The Development of the ICT Cluster in Thailand

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Abstract

In August 2011, Thailand's newly elected first female Prime Minister, Yingluck Shinawatra, announced her new government's intention to pursue a new economic vision – one which called for a shift in focus from the traditional labor-intensive and commodity agricultural industries to more hi-technology-based competition. As she articulated this new vision, she was very much aware that not only was Thailand ranked 38th (out of 134 countries) in the global competitiveness report conducted by the World Economic Forum, it also was ranked well below the world average on all of the factors related to technology, despite the fact that information technology and telecommunications had been a major factor driving the competitiveness of the country. More specifically, as the Prime Minister looked more deeply into the matter, she found that one of the major problems for Thailand concerned the "pillar of technological readiness" – a measured used by the World Economic Forum to assess a nation's capacity to utilize information and communication technologies. Thailand was ranked 86th in number of Internet users, 64th in availability of the latest technologies, 66th in firm-level technological absorption, 88th in broadband Internet subscriptions, and 75th in Internet bandwidth.

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While "technological readiness" was just one metric by which a nation's competitiveness could be assessed, it was an important measure. If Thailand was to succeed in its long-term plan to move into a greater degree of hi-technology-based competition, the poor showing with respect to this metric would have to be improved, along with other key determinants of competitiveness. The question, therefore, in Prime Minister Yingluck's mind was what her government needed to do to realize their vision of moving the country to an altogether different competitive posture – from being mainly a low-valued-added, agriculture-based economy to becoming a high-valued-added, hi-technology one.

Keywords: ICT, ICT Cluster, ICT Competitiveness, ICT and Nation Competitiveness, ICT in Developing Economy

การพัฒนา ICT Cluster ในประเทศไทย

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บทคัดย่อ

ในเดือนสิงหาคม 2554 ประเทศไทยได้นายกรัฐมนตรีหญิงคนแรกจากการเลือกตั้งใหม่ คือนางสาวยิ่งลักษณ์ ชินวัตร ซึ่งได้แถลงเป้าหมายของรัฐบาลว่าจะใช้นโยบายในการยกระดับความสามารถการแข่งขันของประเทศโดยยกระดับคุณภาพแรงงาน และปรับทิศทางการพัฒนาของประเทศจากการพึ่งพาการเกษตรกรรมและดึงดูดการลงทุนด้วยแรงงานราคาถูก มาสู่การใช้เทคโนโลยีสารสนเทศและโทรคมนาคมในการสร้างความสามารถการแข่งขันของประเทศ จากรายงาน Global Competitiveness Ranking ซึ่งจัดทำโดย The World Economic Forum ประเทศไทยอยู่ลำดับ 38 จาก 134 ประเทศในการจัดลำดับความสามารถการแข่งขันของประเทศประจำปี 2554 ลำดับความสามารถการแข่งขันของประเทศไทยจัดอยู่ในระดับที่ต่ำกว่าค่าเฉลี่ยของโลกในทุกปัจจัยที่เกี่ยวข้องกับเทคโนโลยีสารสนเทศ ทั้ง ๆ ที่เทคโนโลยีสารสนเทศ และโทรคมนาคม เป็นส่วนสำคัญในการขับเคลื่อนความสามารถการแข่งขันของประเทศ ตัวอย่างเช่น จำนวนผู้ใช้อินเทอร์เน็ตในประเทศไทย ลำดับที่ 86 ความพร้อมในการใช้เทคโนโลยีที่ทันสมัยติดลำดับที่ 64 การประยุกต์ใช้เทคโนโลยีในองค์กร ลำดับที่ 66 จำนวนผู้ใช้อินเทอร์เน็ตความเร็วสูง ลำดับที่ 88 และความเร็วในการรับส่งข้อมูลอินเทอร์เน็ต (Internet Bandwidth) ลำดับที่ 75

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นายกรัฐมนตรียิ่งลักษณ์ได้เล็งเห็นถึงความสำคัญของเทคโนโลยีสารสนเทศและโทรคมนาคมต่อความสามารถการแข่งขันของประเทศ โดยเธอต้องการสร้างแผนระยะยาวเพื่อให้ประเทศไทยพัฒนาความสามารถการแข่งขันที่เคยอาศัยจากค่าแรงราคาถูกและภาคเกษตรกรรมไปสู่การยกระดับความสามารถการแข่งขันในด้านเทคโนโลยีสารสนเทศและโทรคมนาคม เธอคาดหวังว่าผลของการวัดระดับความสามารถการแข่งขันของประเทศในครั้งต่อไป ประเทศไทยจะมีระดับความสามารถการแข่งขันที่ดีขึ้น

คำสำคัญ: เทคโนโลยีสารสนเทศ โทรคมนาคม ความสามารถการแข่งขัน เครือข่ายวิสาหกิจ

In August 2011, Thailand's newly elected first female Prime Minister, Yingluck Shinawatra, announced her new government's intention to pursue a new economic vision – one which called for a shift in focus from the traditional labor-intensive and commodity agricultural industries to more hi-technology-based competition. As she articulated this new vision, she was very much aware that not only was Thailand ranked 38th (out of 134 countries) in the global competitiveness report conducted by the World Economic Forum, it also was ranked well below the world average on all of the factors related to technology, despite the fact that information technology and telecommunications had been a major factor driving the competitiveness of the country. More specifically, as the Prime Minister looked more deeply into the matter, she found that one of the major problems for Thailand concerned the "pillar of technological readiness" – a measured used by the World Economic Forum to assess a nation's capacity to utilize information and communication technologies. Thailand was ranked 86th in number of Internet users, 64th in availability of the latest technologies, 66th in firm-level technological absorption, 88th in broadband Internet subscriptions, and 75th in Internet bandwidth.

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Overview of Thailand

Located in the strategic centre of the South-East Asian peninsula and bordered by the Gulf of Thailand, Myanmar, Laos, Cambodia, and Malaysia, the Kingdom of Thailand was the world's 50th largest nation in land mass (513,115 square kilometers, or 198,120 sq mi) and the 20th largest country in population (estimated in 2010 as slightly more than 67 million people). (See Appendix 1) The country was divided into six regions (North, Northeast, East, South, West, and Central) plus the administrative

region comprising the capital, Bangkok ("*Krung Thep*"), which was by far the most significant urban area in the country.

Demographically, the country was comprised of a majority of ethnic Thais, but also had a substantial population of persons of Chinese descent (14%), as well as a scattering of other distinct ethnic groups (e.g., the peoples of the several so-called "Hill Tribes"). Approximately 71% of the population fell into the 15-64 age group, although a significant portion (nearly 20%) were in the 0-14 age group and slightly more than 9% were in the 65 years and older group. A 50:50 ratio of males to females pertained in each age group. The population growth was 0.566% as of 2011, which represented a decline from the previous year. While the culture of Thailand had been shaped by many influences, including the ancient civilizations of India, China, and Cambodia, Buddhism -- the state religion, as well as the religious preference of nearly 95% of the population -- had exerted the most profound influence on the ethos and mores of Thai society. The country was also alone among its Southeast Asia neighbors in the distinction of never having been a colony at any point in its long history.

Thailand enjoyed a high level of literacy, with nearly 93% of the population who were 15 years old and over able to read and write. Education was provided mainly by the Thai government through the Ministry of Education and was free through the twelve years of school, but was compulsory only through the first nine years.

Economically, Thailand was an emerging economy and was considered a "newly-industrialized country," with the main industries being electronics, automobile manufacturing, and agro-industry. Although most of the country's labor force worked in the agriculture sector, manufacturing nonetheless accounted for 40% of the GDP, as shown in the following table.

The Structure of Thai Economy [1]

Sector	% of GDP by Sector	% of Labor Force by Sector
Agriculture	8.3	43.3
Manufacturing	40	13
Wholesale and Retail Trades	13.3	15.1
Construction and Mining	4.4	4.8
Other Services (financial, educational, hotels & restaurants, etc.)	33.2	23.9

Thailand's was a heavily export-dependent economy, with exports accounting for more than two thirds of the gross domestic product. In descending order of export value, computers and parts, vehicles and parts, and electrical appliances were the country's major export items, while crude oil and electrical machinery and parts were the main import items (see the table below).

Major Export and Import Items [1]

Major Export Items		Major Import Items	
Computers and parts	8.5%	Crude oil	12.5%
Vehicles and parts	9.6%	Electrical machinery & parts	8.9%
Electrical appliances	7.1%	Industrial machinery & part	7.5%
Base metal products	4.1%	Iron and Steel	6.1%
Plastic products	4.8%	Integrated circuits	3.6%
Petroleum products	4.5%	Computer parts	2.2%

Since the reform of the absolute monarchy in 1932, politics and government were conducted within the framework of a constitutional monarchy, with a prime minister as the head of government and a hereditary monarch as the head of state. In concert with the traditional structure of parliamentary systems of governance, the Thai executive branch was also an active participant in the legislative branch of government. An independent judiciary with a supreme court of final authority comprised the third branch. Since the reformation, Thailand had undergone 18 military coups d'etat and 17 constitutions and charters, reflecting a high degree of political instability. Moreover, throughout the reform period, Thailand had experienced many political crises, such as Black May in 1992 and the recent Yellow Shirt and Red Shirt protests, which again demonstrated the pronounced fragility and instability of the Thai polity.

The electoral victory of the Pheu Thai Party in the 2011 elections not only brought to the premiership the first female prime minister, but also the first head of government with extensive experience in the telecommunications industry. Khun Yingluck, had earlier served as president of the Advanced Information Service, a major Internet service provider founded by her elder brother, deposed Prime Minister Thaksin Shinawatra. Not only had her party campaigned on a pledge of free public

WiFi, broadband Internet, and One Tablet (computer) per Child, the new Prime Minister had disseminated her vision and determination to build ICT as the foundation for the country's competitiveness. In so doing, she had not been oblivious to the fact that several problems in the ICT cluster needed to solved, and new policies implemented, if her vision of enhancing the effectiveness of ICT to drive Thailand's competitive was to be realized. The young Prime Minister was fully aware that much had to be bone before her government would see a report on country competitiveness that ranked Thailand appreciably higher on the global competitiveness scale.

Why Information and Communications Technology (ICT) Mattered

ICT comprises of information and communication technology such as computing devices, software, technical skills, programming tools, web applications, network, Internet, mobile phone, broadband, etc that had the capability to improve or optimize the performance and value creation of people, organizations, and nations. National competitiveness increasingly depended upon the "technological readiness" factor because technology had become a critical driving factor for social and economic development. ICT development in any nation could create spillover effects to other economic sectors, therefore contributing to economic growth and prosperity. In general, the role of ICT for competitiveness of a nation included the following:

1. Enabling a government to efficiently provide services to citizen and businesses. For example, e-government could be used to provide efficient, fast delivery and high quality goods and services to citizens, businesses, government employees and government agencies by transforming existing processes more effectively and productively. It also motivated democracy, transparency, and citizen participation in the decision-making process, policy defining, and political activities as a result of available details on public sector activities and increasing inputs of citizens into the activities of government. For example, e-auctions encouraged transparent procurement processes. Citizen participation included online voting and opportunity to reach elected politicians online.

2. Providing an information infrastructure that enabled citizens and businesses to communicate and exchange information efficiently. As such, ICT had the potential to reduce transaction costs by enabling organizations to exchange information easily and cheaply regardless of time and location.

3. Upgrading existing businesses either by creating value to products and services or by reducing the cost of doing business. ICT enabled digitization of products such as e-books, music, movies, and software. It also enabled digitization of services such as e-transaction, e-payment, e-banking, e-logistic, and customer relationship management.

4. Creating new business models such as e-commerce, social media, mobile applications, etc. ICT also enabled the creation of digital firms in which core business processes were accomplished through digital networks, thus creating greater flexibility in organization and management.

5. Creating quality in educational standards, thereby upgrading the labor skills of the workforce. In the past, teachers were often burdened with outdated teaching tools and had difficulty reaching students. ICT could be used to facilitate digital teaching and learning skills through the use of e-learning and computer-based learning. Several studies showed that students who had access to ICT have higher academic achievement than those without such access. For example, one such study by the Organization for Economic Cooperation and Development ("OECD") found that there was a strong correlation between the use of PCs at home and higher test scores [2].

A 2009 World Bank [3] report stated that ICT has an impact on social and economic development in many ways. For example, Internet and mobile networks increased a nation's ability to reach remote locations and a much wider population base, including persons with low income and literacy levels, enhancing their opportunities to acquire knowledge, share information, transact business, and receive services. In addition, ICT also created digital goods and services such as e-commerce and e-government that had sparked new business models and new job creation. The *2001 Human Development Report* of the United Nations Development Program

("UNDP") [3] indicated that technological innovation could enhance human capabilities in the realms of health, knowledge, creativity, and participation in the social, economic, and political life of a community. Moreover, it proposed that ICT can have an impact on economic growth through productivity gains. In other words, the lack of ICT could be an important factor contributing to the widening of the gap between "developed" and "developing" countries.

In general, ICT had the potential to have both an economic and a social impact on a nation. In terms of economic impact, the World Bank [3] found that in low- and middle-income countries for 10 percentage point increase in broadband penetration could accelerate economic growth by 1.38 percentage points. In a similar study, McKinsey & Company[4] estimated that for every 10 percent increase in broadband penetration in household could boost a country's GDP anywhere from 0.1 percent to 1.4 percent. In addition, Booz & Company [5] found that a ten percent increase in broadband Internet penetration in a specific year is associated with 1.5 percent greater labor productivity growth over the following five years. Furthermore, the growth of Internet and mobile applications had created jobs and led to the creation of new businesses such as e-business, e-commerce, mobile applications, and social media. ICT also had impact on entrepreneurship because it provided opportunities to create new types of business models, as well as reduce the cost of doing business. To summarize, there is a direct link between ICT and economic development. Several finding from both The aforementioned World Bank and UN reports concluded that the more successful economies had more technologies and were better prepared for using them to enhance their competitiveness.

With respect to social impact, several studies indicated that ICT technologies generated social benefits by connecting consumers, businesses, and governments, as well as facilitating social interaction. ICT had the capability to deliver information to individual and business, sustain good governance, and reinforce social capital. Moreover, ICT also conferred opportunities for democracy because it enabled an information-rich society in which citizens had access to a broad range of information from multiple sources. It also provided several channels for citizens to participate in the political process, as well as obtain information about the performance of governments and politicians that could become the basis for making governments and politicians more accountable. Finally, ICT

supported the creation of social community and social ties among individuals. For example, social media like Facebook, Twitter, and LinkedIn, enabled people to form their own communities regardless of time and space. A 2004 Pew study [3] found that Internet users were more likely to receive help on a range of key issues (such as medical condition, financial decision, and seeking a new job), with eighty-five percent of users receiving help compared with seventy-two percent of non-Internet users.

Current Status of the Thai ICT Industry

The information and communication technology (ICT) business was comprised of four main segments: computer hardware, computer software, computer services, and communication (wired and wireless). Driven by the increasing use of technology in all aspects of society, the industry had been growing rapidly in Thailand as in other countries around the globe, as an ever-expanding diversity of products, lower prices, and wider access to knowledge about how to utilize the various technologies bolstered demand in the public, private, and civil society sectors. In consequence, by 2010, the Thai ICT market, accounting for 11% of GDP, had risen to become one of the largest in the South East Asian region and was projected to grow at a compound annual growth rate of 12% over the 2010-2014 period [6]. The total value of Thai domestic spending on IT products and services, which had been in vicinity of US$5.4bn in 2010, was expected to reach US$8.7bn by 2014 [6].

Increased usage of the internet and software application [7] had steadily pushed upward the overall market value of the industry, as can be seen in Appendix 2. Total ICT market value increased every year from 2009 to 2011, when it reached a value of $22,621 million, with a solid 11.7% growth from the previous year. By far the largest contributor to the market value was the communication segment, which accounted for 61.7% (or $13,945 million) of the total ICT market. The remaining segments, in declining order of the magnitude of contributions to the overall market value were computer hardware shares (at 14.8%, for a market value of $3,350 million), software shares (at 12.4%, for a market worth of $2,807 million), and services (at 11.1% shares, for a market value of $2,519 million [6-7].

However, despite the annual increases in the market value for the entire sector, not every segment of the industry increased on annual basis. For example, as seen in Appendix 3, the communication segment did not increase every year during this time period. Further, the smallest segment, computer services, was doing exceptionally well, with a 25% growth rate since 2009. The market values of the computer hardware and software were also increasing, albeit more moderately.

The Public's "Consumption" of Information and Communications Technology

Underlying the above-cited market values and growth rates of the several industry segments lay distinct behaviors concerning the use of ICT technology. For example, *on the institutional side*, while every business trade and service could increase its efficiency in lowering production costs and creating new markets for products and services, the hospital business in Thailand was the one in which the proportion of employees using computers and the Internet at work was the highest (100% and 90%, respectively), as shown in Appendix 4. The next highest manufacturing, travel agencies, construction, and business trade and services, respectively. However, SMEs had been slow to adopt ICT, despite the fact that research had indicated the positive effect of ICT on firm performance in terms of creating productivity, profitability, market value, and market share. Further, the *size* of the particular establishment impacted the usage of ICT. As shown in Appendix 5, establishments with fewer than 16 persons used ICT to a slight degree: computer usage - 21.9%; Internet usage - 14.2%; and, websites - 6.2%. By contrast, establishments with 16 persons or more used ICT at a high proportion, e.g., with more than 81.1% of establishments using computers [8].

Among educational institutions, 99.7% of primary educational institutions had computers, while other levels of educational institutions had computers in every institution. Further, the overwhelming major of educational institutions had Internet access. For instance, as can be seen in Appendix 6, Internet access for primary educational institutions, vocational and non-formal education levels, and the higher education institutions was 97.2%, 99.0%, and 100.0%, respectively.

At the level of the *individual person* and *individual households, per* Appendix 7, mobile phone popularity had rapidly increased from 28.2% in 2004 to 56.8% in 2009. However, the proportion of the population using computers and the Internet increased only less robustly, going from 21.4% to 29.3% for computers during the 2004-2009 period, and from 11.9% to 20.1% for the Internet. Moreover, the Internet access of households increased very modestly, from 5.7% in 2004 to 9.5% in 2009; and, broadband Internet access increased from 52.8% in 2006 to 55.1, while fixed-line telephone decreased from 23.4% in 2004 to 21.4% in 2009 [8].

The proportion of students per computer at the primary education level in Thailand was 14:1 persons per computer, 8:1 at the vocational level, 11:1 at the higher education level, and 109:1 at the non-formal education level (see Appendix 6). The proportion of teachers per computer at the higher education level was 3 instructors per computer, 5 instructors per computer at the vocational level, 10 instructors per computer at the primary education level, and 12 instructors per computer at the non-formal education level.

Governmental Support Policies and Key Organizational Players

A large measure of the credit for the growth and market performance of the ICT business could be attributed to policies of the Thai government, which having long recognized the critical role of ICT in strengthening the nation's competitiveness and in enhancing the quality of life of its citizens, actively supported and promoted the usage of ICT to strengthen businesses. Although Thailand's main industries had long been the electronic, automobile manufacturing, and agro-business industries (the country was largest rice exporter in Asia), Thailand had entered the ICT field in the early 1980s, with an initial resource basis of Thai professionals who had computer and IT experience from either their involvement with the U.S. military during the Vietnam War era or their exposure during studies at U.S. universities. From that time forward, the Thai government, convinced of the importance of ICT in strengthening the nation's competitiveness and in enhancing quality of the life of its citizens, worked to build and develop a nation-wide IT infrastructure (see Appendix 8).

Indeed, the government believed that ICT was destined to have an increasingly important role to play in the enhancement of economic productivity, as well as in the transformation of Thai society into a knowledge-based society [8]. Accordingly, in 2010, the government implemented a framework and policies to support this development and ensure that country was moving forward. The ICT development in Thailand has been guided by the 2010 policy framework, which rested on 3 principles: building human capital, investing in information infrastructure, and promoting a good governance in the ICT industry [9].

Several organizations were assigned key roles and responsibilities for the development of ICT. They were the Ministry of Information and Communication Technology (MICT), the Software Industry Promotion Agency (SIPA), The National Broadcasting and Telecommunication Commissions (NBTC), and the National Electronic and Computer Technology Center (NECTEC). The MICT, as the head of ICT development, had the responsibility for developing the second ICT Master Plan (2009-2013), preparing the 2020 policy framework for the next decade, and coordinating all ICT development according to the ICT Master Plan and the 2010 IT framework [10]. The SIPA supported the development of the software industry by promoting and developing software and other digital content entrepreneurs, improving human resource, boosting investments and market opportunities, supporting research activities and training as well as supporting developing tools and measures to protect the intellectual property rights of software. The NBTC's role was that of communication regulator, with concomitant responsibilities to undertake, support, and promote the development of telecommunications technologies through research and development activities. The NECTEC shared responsibility with the MICT for developing the second ICT Master Plan. Collectively, these organizations were charged with ensuring continuing progress in the implementation of the ICT Master Plan.

In conjunction with research and academic institutes, government played a major role in supporting the entire cycle of the ICT industry by setting up policies, constructing innovations, and developing human skills that matched the growth of the ICT market. The country's strategy for becoming a knowledge- and innovation-based society was set forth in the IT 2010 policy framework and in the first Information and Communication Technology Master Plan (2002-2006) [11]. A strategy was set forth in

five areas – specifically, e-Industry, e-Commerce, e-Government, e-Education and e-Society. The second Information and Communication Technology Master Plan (2009-2013) – which represented a continuation of the policies set forth in the IT 2010 framework – also sought to accelerate accomplishment of targets contained in the first plan, as well as fix the drawbacks that caused the first Information and Communication Technology Master Plan to less successful than had been hoped. The strategies and the weaknesses that they were devised to overcome could be described as Appendix 9 [8, 12].

Imperatives and Advantages of the Cluster Strategy

Professor Michael Porter of the Harvard Business School, the internationally renowned expert on competitiveness, defined a "cluster" as "a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities"[13]. Clusters, he argued, are a crucial enabler of competitiveness. That is, Porter posited that modern competition relied largely on productivity, not on access to inputs or the scale of individual firms [13]. The productivity of companies depended on how they compete in a particular location which was strongly affected by the quality of the local business environment. Companies could not compete effectively without a high quality infrastructure and suppliers. They also could not compete without well educated employees and highly skill labor. In addition, companies would not have pressure to create innovations if the operating environment did not have strong rivalry. Companies also could not operate efficiently under political conflicts or instability in the legal system.

In Porter's view, cluster affected competition in three basic ways: 1) cluster increased the productivity of companies in the area 2) cluster drove the direction and pace of innovation and 3) cluster stimulated the formation of new business and collaboration among firms. In sum, by being part of a cluster, "companies [could] operate more productively in sourcing specialized inputs (services, employees, etc.); foster internal innovation, as well as have ready access to innovations and best practices among firms; easily and efficiently coordinate and transact across firms in the cluster; access information, technology, and needed institutions (governmental, standard-setting agencies, think tanks, specialized research, etc.); pursue new business formation (because of the easy availability of skills, suppliers,

infrastructure, etc.); and measure and motivate improvement"[13].

One of example of cluster was the California wine cluster, which included 680 commercial wineries and thousands of independent wine grape growers. In addition, there was a vast complement of industries supporting both wine making and grape growing. There were also suppliers of grape stock, irrigation, harvesting equipment, and a specialized public relations and advertising firm. The main research institutions were the University of California at Davis which had a world-renowned viticulture and enology program and the Wine Institute. The cluster also had a close collaboration with other California clusters such as ones in agriculture, food and restaurant, and tourism [14].

One of the most successful Information and Communication Technology clusters in the world was Silicon Valley, the southern part of the San Francisco Bay Area in Northern California, with heavy concentration of high-tech companies. The Silicon Valley IT cluster consisted of thousands of world-class software, hardware, network, Internet, and service companies. There were many research and educational institutions such as Bell Labs, Stanford University and the University of California at Berkeley. There was also strong venture capital support for anyone with a promising business plan who wished to start up a business in the area. The Silicon Valley IT cluster had the highest concentration of high-tech workers of any metropolitan area in the world [15]. The concentration of companies, institutions, and technically skilled people in the cluster enabled companies and startups in Silicon Valley to easily find highly skilled job candidates, as well as collaborate with other firms in the cluster. The success of Silicon Valley IT cluster had a spillover effect on other areas in the United States (e.g., Route 128 - Massachusetts, Austin - Texas, and the Research Triangle - North Carolina, to name just a few), as well as elsewhere in the world (e.g., the digital media city (DMC) in the Sangam-dong district in South Korea) [16].

The ICT Cluster in Thailand

To gain maximum synergy, as well as maximum impact from the expenditure of resources, the Thai government had also opted to pursue ICT development through the "cluster approach." At its core, this entailed promoting collaboration among several different types of industry sectors (e.g., manufacturing, trading, service, human resources, and the education)

pursuant to integrating research into a high-value industry like hard disk drive production and other high value-added products [17]. The Thai ICT Cluster consisted of core businesses, including hardware, software, services, and communications companies, located mostly in Bangkok and the central part of Thailand. These core businesses had a strong relationship with supporting industries, including electronic parts, system integrators, content providers, vendors, and brand owners. Related industries were comprised of enterprise, manufacturing, healthcare, banking, consumer, and energy providers. Educational institutions included universities, the National Electronics and Computer Technology Center (NECTC), the Telecommunications Research and Industrial Development Institute (TRIDI), and the Software Industry Promotion Agency (SIPA). Supporting associations consisted of telecom associations, the e-Commerce Association, the Institute of Electrical and Electronics Engineers (IEEE), the International Telecommunication Union (ITU), and the Telecommunications Consumer Protection Institute (TCI). Finally, regulation and policy organizations included the Ministry of Finance, the National Broadcasting and Telecommunication Commission (NBTC), the Ministry of Information and Communication Technology (MICT), the Off•ice of National Economic and Social Development Board, and various legislative agencies.

Despite these structural arrangements and high expectations, to date, the Thai ICT cluster had not yielded the expected results. There were a number of reasons for this. First, not only did the government not have a clear direction for cluster policy, there was also no other institution that served as the central hub to drive policy or manage the cluster. Second, and largely in consequence of the first issue, the cluster was shallow, with weak collaboration among the member organizations. Indeed, there was more conflict than collaboration, more inter-organizational competition than cooperation. Third, occasional legal battles among institutions in the cluster and with the government agencies, along with the instability of the political and legal systems and government corruption, were also serious and ongoing obstacles to cluster development and success. Fourth, government interference with competition – e.g., through the granting of monopoly concessions, largely in the communication sector – further impeded the normal functioning of the cluster.

On the more positive side of the ledger, the cluster had been successful to date in attracting foreign direct investment (especially in the hardware

and communication segments of the industry). However, heavy reliance on cheap and unskilled labor set in motion price-based, as opposed to quality-based, competition among products and services. This was aided by the fact that most consumers were lower-income and had little information about products and services *other than price* on which to base their consumption choices. Further those cluster products and services that were not licensed from abroad tended to be illegally copied, due to the lax enforcement of intellectual property laws.

Hence, to date, it could not be said that the Thai ICT cluster experience had yielded the results that had been anticipated. Indeed, how to invigorate the cluster was one of the main challenges confronting the new prime minister as she embarked on the quest to transform the competitive foundation of the Thai economy.

Structure and Status of Individual Segments of the ICT Industry

The four segments of the overall ICT industry in Thailand were by no means identical in their characteristics. To the contrary, structural, market, and competitive conditions varied considerably.

The Hardware Segment of the Industry

The Thai hardware market of the ICT consisted of three segments: computers, peripherals and devices, and storage devices (see Appendix 10). As shown in Appendix 10, the personal computers and peripherals segment could be further be divided into the following five different groups:

- The computer segment, comprised of desktops and laptops (notebooks and netbooks).
- The monitor segment, consisting of different types of computer monitors, such as LCD and LED monitors.
- The printer market, made up of various types of printers, such as Dot Matrix, Inkjet, and laser printers.
- The peripherals and devices segment, including computer peripherals, personal data assistants, organizers, calculators, printers, monitors, projectors, Uninterruptable Power Supply (UPS), and satellite navigation systems.
- The storage device segment, comprised of memory sticks, CD packs, hard disks, and other data storage devices.

Attracted by both cheap labor and the generous investment incentives of the Thai Board of Investment [18], the majority of the manufacturers of computers and parts were foreign multinational corporations. The usual agreement typically stated that 80% of their production must be exported, facilitating the companies' use of Thailand as an export base for finished computer parts and their components. In this connection, the largest constituent of the computer and parts segment of the ICT industry was the manufacturing of hard disk drives (HDD) and related components – produced mainly for Seagate, IBM, and Fujitsu -- and related components. Together they accounted for over 68% of computer and parts production value. The major export market destinations were the US, Singapore, and the EU.

In terms of the domestic market, the Computer Hardware Market for the year 2009 had a total market worth of 80,869 million Baht, which represented a growth rate of 2.5% from the previous year. In 2010, the hardware market grew by a healthy 13.3% or to 91,596 million baht [7]. The majority of computer hardware sales -- approximately 64% of the total (slightly more than 51.8 million Baht) -- came from the sale of personal computers (PC), which included desktops, notebooks, and netbooks [7].

A number of factors had contributed to the growth of the computer hardware industry, mainly --

- The increased use of ICT for everyday life, including Internet, e-mails, and social networks. [From the Appendix 11 listing of popular websites visited by web surfers, it was evident that entertainment websites were most popular types (accounting for 40.48% of the market), followed by games, Internet, and personal/ social websites at 9.85%, 6.50%, and 6.34%, respectively.]
- Cheaper and more convenient access to the Internet
- Increased PC ownership, which had risen from 20.4 PC per 100 families in 2007 to 24.8 PC per 100 families in 2008
- The ongoing price war among hardware dealers, shops and manufacturers, which resulted in intense competition and lower prices for the consumer
- Technology development suitable for the lifestyle of consumers, for example, environment friendly, energy efficient, PC portability, etc.
- Government purchases of computer hardware for use in the education sector and local government offices

In consequence of these positive factors and conditions in the computer hardware market, this segment of the Thai ICT industry had been doing quite well, although some product areas were experiencing more robust sales and growth rates than others. More specifically, as shown in Appendix 12, sales of Inter Brand PCs, Notebooks, and Netbooks had been increasing impressively, especially sales of Notebooks which had experienced a 27.1% increase in sales from 2009 to 2010 [7]. By contrast, Local PCs and Do-It-Yourself (DIYs) PCs had experienced sales declines during the same period. Further, sales of LCD and LED monitors (CRT monitors were no longer produced), and data storage devices also experienced impressive sales increases, particularly monitors where sales nearly quadrupled from 2009 to 2010 [7]. However, printers, at an increase of a meager 0.9%, were struggling to keep up, partly in consequence of a trend toward all-in-one printers (scanner, printer, photocopier). A lot of experts speculated that in 2012 and thereafter the sales of PCs, Notebooks and Netbooks would decline as a result of the strong growth in all-in-one (convergence) devices such as Tablet PCs, Smart Phones, and other Internet mobile devices [7].

In brief, then, it was believed that the fundamentals of growing affordability and low PC penetration, supported by government ICT initiatives (e.g., the recent program to provide PCs for school children nationwide), would continue to drive healthy growth in the computer hardware market. In addition, the eventual (and long-planned) roll out of 3G mobile and WiMAX broadband service, combined with aggressive vendor and channel promotions, were deemed likely to stimulate strong demand, given that technology adoption in the country had been growing unsteadily.

But, the future of the hardware segment of the industry could not be said to be completely worry-free. Arrayed against these positive drivers of continued growth and development of the computer hardware market in Thailand were a number of potential threats. First was the fact that the country was heavily reliant on the investments of global computer hardware companies, most of whose investments in the country were drive by the quest for abundant sources of cheap labor. As Thailand's economic advancement widened the income gap with other nearby countries (e.g., Vietnam), there was the possibility that these companies might decide to decamp for even cheaper labor in other ASEAN nations. Moreover, contributing a negative tint to the relatively strong and growing domestic consumption was the

fact that competition in the hardware market was based on price rather than innovation. Although the government had invested in several education and research programs, there were still no Thai companies creating any innovative products, a fact vividly illustrated by the fact that there were few patents for computer hardware generated by Thai individuals or companies. Most hardware products had to be imported.

On the demand side, the reality was that although the price of the hardware had been steadily declining, it remained almost prohibitively expensive for the majority of people. This problem, in conjunction with the fact that many people -- especially in the rural areas -- did not see the benefits of using computer or ICT related devices, suggested that the "low hanging fruit" in market penetration may have already been picked. If so, then a continuation of the industry's growth and development at the pace set to date might be more challenging.

The Software Segment of the Industry

Although there had been software companies in Thailand for 35 years (with approximately 1,300 local and international software companies to date) [19], the number remained insufficient to support domestic demand. This insufficiency had been made worse by the fact that many multinational IT companies that had entered the market had failed due to their inability to collaborate within the industry. This situation had highlighted the need for local collaborators with sufficient skills to coordinate the technology with conditions in Thailand. Therefore, Software Park[1] Thailand was created by the Thai government in 1997, and later the Software Industry Promotion Agency (SIPA) in 2002, with the aim of their becoming top-rated learning organizations that could support local entrepreneurs in creating

[1] The mission of Software Park consisted of several different aspirational endeavors and commitments, as follows:
- Infrastructure & Facility Support – provide for office rentals, training & meeting room rentals, park clustering
- Technology Enabling Services – provide technology platforms, collaborate with stakeholders to provide latest technology to alliances
- Software Business Enabling – promote use of IT in all sectors of the economy to help increase productivity and competitiveness, collaboration with the industry, and create environment conducive for the software business
- Technology Transfer – promote transfer of relevant technologies for the software industry at the professional and management levels
- IT Advisory – improve standards of local software companies to international level

a strong world-class software industry capable of enabling the enhanced competitiveness of the Thai economy [19].

The Thai software market could be categorized into four different segments:

- Enterprise Software
- Mobile Application Software
- Embedded System Software, and
- Multimedia Software and other Customized Software

More than 95 percent of the 1300 software development companies in Thailand were classified as "small- and medium-size enterprises" (SMEs), with a registered capital of less than US$ 2 million. The industry employed more than 50,000 professionals across the country. Seventy percent of industry sales were derived from imported, while the monetary value of the country's software exports reached US$139 million in 2010. Two major multinational software developers -- Reuters Software (Thailand) Co., Ltd. (Reuter's largest branch worldwide) and DST International (Bangkok) Co., Ltd. (a subsidiary of U.S.-based DST International – had a commanding presence in the Thai market. They also played active roles in supporting the development of Thailand's software industry by cooperating with the Thai government's various software-related bodies.

During the period, 2006-2010, the industry had registered an impressive growth, averaging annual growth rate of 10.6%. However, as shown in Appendix 13, despite the overall annual increases in terms of monetary value, the growth rate during the year 2009 was only 2.3%, which was quite low compared to the previous years. Further, the industry continued to be dominated by enterprise software products, which accumulated 84% of the market, equivalent to 56,062 million Baht. The next largest segments of the sector were mobile applications and embedded software, comprising 3,069 million Baht and 2,760 million Baht, respectively (see Appendix 14). At slightly more than 45% of total software purchases, the private sector (i.e., corporations and enterprises) was by far the largest customer in 2009, followed closely by government/state enterprises at 43.5%.

In the view of some industry observers, the relatively recent advent of cloud computing[2] had the potential to affect many different sub-categories in the computer industry, such as software companies, Internet service providers (ISPs), and hardware manufacturers (especially those who included software with the hardware) [7]. The ability to rent software over the Internet, as opposed to owning it and having to bear the considerable expense of maintenance and upgrades, was becoming increasingly attractive to companies looking for ways to cut costs. Hence, cloud computing had the potential to alter the business model of the software industry in Thailand and the rest of the world.

As regards threats and similar issues confronting the industry, two stood out in bold relief. The main problem by far was the prevalence of software piracy, an ongoing issue in the Thai IT industry, which had earned the dubious distinction of holding the top rank in the world in terms of software piracy. The lack of enforcement of copyright laws led knowledgeable industry observers to conclude that most software installed on personal computers in the country had been obtained illegally. The consequences of this situation were several: legitimate purveyors of software were deprived of revenues that would have been realized from legitimate sales; the country sustained the tax revenues that would have been realized from legitimate software sales; and programmers, knowing that their software would most likely be pirated, were bereft of the motivation to create software or other intellectual properties.

In conjunction with the country's shortage of the highly skilled labor needed to support the development of software, the entry of new host countries for software developers was a growing threat. More specifically, as Thailand's economic developed accelerated at a faster pace than that of other competitors and potential competitors, the country's longstanding status as the investment destination of choice for software developers was at risk of being lost to venues such as China, India, and Vietnam could, in some instances, offer even lower-costs software production, along with a higher level of software development skills.

[2] Cloud computing is a technology that uses the internet and central remote servers to maintain data and applications. Cloud computing allows consumers and businesses to use applications without installation and they can access their personal files at any computer with Internet access. This technology allows for much more efficient computing by centralizing storage, memory, processing and bandwidth.

The Computer Services Segment of the Industry

Thailand's computer service industry was comprised of different services, including system integration, network services, software maintenance services, hardware maintenance services, data center and disaster recovery services, IT related training and education, IT consulting, and IT outsourcing.

In 2009, the total market worth of the computer services was 48,372 Million Baht (see Appendix 15) and grew by 2.9% in 2010. IT consulting, at 19% of the total value of the segment (2,179 million Baht), had the highest growth rate. Much of this growth could be attributed to the recognition in both the government and corporate sectors of the importance of the stability, reliability, and security of the IT systems. Moreover, robust demand for IT consulting was propelled by financial sector firms, who in their never-ending quest to remain competitive and perhaps build a competitive advantage over their rivals, were investing vast sums on improvements in their banking operations and in the development of new products and services (e.g., Internet banking services, mobile banking services, and other systems related to customer relationship management, "CRM.")

IT outsourcing was also a significantly growing market. Its status as a low-cost and high-skilled labor market, along with government support via several stimulus programs, had placed Thailand among a handful of countries where outsourcing had become a thriving business. In 2009, the market expanded by 16.7% and was expected to grow gradually each year as more organizations began viewing outsourcing as a means of improving productivity (specialized skills), boosting efficiency, reducing costs, and enhancing competitiveness.

With respect to strengths and weaknesses, the computer services segment had some of each. The main strength of the segment lay in its support by the government, e.g., the government's various stimulus programs. Additionally, many organizations were active promoters, e.g., the MICT, SIPA, NECTEC, and Software Park. There were also governmental stimulus programs, such as Thai Khem Kaeng and the Smart Card Project. There was also steady growth in both the computer and mobile markets. Not be overlooked, also, was the not inconsiderable fact that many of the world's top computer companies, such as IBM, HP,

and Accenture had major operations in Thailand. Finally, there were laws and regulations concerning ICT -- such as the Computer Crime Act of 2007 and the electronic tractions law – that offered some protection against illegal activities that could harm the industry.

Offsetting these strengths were a couple of serious weaknesses. First and foremost was the previously mentioned dearth of highly-skilled labor (the country was simply not producing the quantity and quality of software engineers, analysts, programmers, etc. that the industry required). Additionally, there was the weakness of inadequate education, particularly with respect to computer literacy and English language skills -- which resulted in a low level of skilled IT professionals (see Appendix 16).

With respect to potential threats to the segment, there was the earlier-mentioned threat of increased competition from lower-cost, higher-skill outsourcing venues such as Vietnam, India, and China who were positioning themselves to be the IT service countries, as well as the also earlier- mentioned lack of rigorous enforcement of the copyright laws already on the books. Then, at an entirely different level, there were the emerging technologies, such as cloud computing and software as a service (SAAS), that had the potential to completely obsolesce the existing business model in the software services segment of the ICT industry. The concepts underlying these two new technologies would boost such computer services as Web Hosting and Service and Application Hosting. Additionally, the demand for broadband technology would benefit the network services. Cloud computing and SAAS offered the considerable advantage of freeing computing services from the constraints of time and space. Computer services could be provided anywhere and anytime. The service provider and the clients did not have to be co-located.

The Communication Segment of the Industry

The ICT market in Thailand had long been dominated by communication equipment and services, followed by computer hardware, and software and services, as can be seen in the pie chart in Appendix 2. As of 2011, communication accounted for just short of two-thirds (i.e., 61.7%) of the overall ICT market in 2011.

The communication industry consisted of two main segments: communication equipment and communication services, as illustrated in Appendix 17. The communication equipment market consisted of voice and data equipment (such as fixed line and mobile handsets), network equipment (e.g., core equipment and infra cabling), wire line (i.e., PBX/PABX, LAN Cabling), and wireless (access equipment). Communications services involved fixed (voice and value added) and mobile voice services (voice & non-voice), conventional data, IP services, internet access, and mobile non-voice services (see Appendix 17).

Communication equipment contributed 35% of the total communication market, while the communication services contributed 65% of the total market (see Appendix 18). As further shown in Appendix 18, the total communication market had experienced constant growing each year, e.g., increasing from a rate of 5.6% in 2009 to 9.2% in 2010.

There was a negative perspective regarding growth for communication services, especially fixed-line services, the increasing demand for mobile services. Mobile services had grown in popularity because of their perceived ease of use, convenience, and price, which are much cheaper than in earlier years. However, although not growing as fast, fixed line services remained in the race due primarily to the popularity of the subscriber trunk dialing (STD) and international calling (see Appendix 19).

In the mobile services arena, there were two different types of services, i.e., mobile voice service (prepaid, postpaid) and mobile non-voice service (GPRS, SMS, MMS). The market growth for the mobile voice service declined 1% in 2009 due to a combination of factors, including the economic recession and market saturation.

By contrast, the non-voice services -- such as SMS, MMS, Mobile Internet, and mobile entertainment service -- showed significant growth for 2010, totaling 24,598 million baht. This phenomenally high growth was the result of the popularity of the social media, such as Facebook, Twitter, YouTube, Foursquare, mobile internet, and mobile entertainment applications (See Appendix 20).

Internet Access Service of Thailand consisted of the International Internet Gateway (IIG) and (National Internet Exchange), which included the narrowband, broadband service, and wireless Internet. In 2009, there was a positive growth of 8.8% for the market, equivalent to a monetary

value of 20,840 million Baht (see Appendix 21). For the Voice Over the Internet Protocol or VOIP market, there was also a positive growth of 3.9%. The force behind the growth of this sector was the increasing speed of the connection at lower prices.

Technology advancement continued to play a significant role in the communications sector. Innovations such as 3G technology and mobile application technologies were driving the communications sector. Additionally, the 802.11 N or Wireless N Technology and WIMAX for wireless Internet broadband ensured the continued expansion of the market. Further, the use of devices such as smart phones, PDAs and other mobile computing accessories was growing rapidly which would further bolster the growth of the segment[3].

Apart from the wireless technology, Fiber Optic High-Speed Internet played a vital role in boosting the internet sector. Furthermore, the technology that enables workers to communicate and collaborate with other parties is emerging to be an important tool for business to improve employees' productivity, while reducing business costs, such as travelling and real estate costs.

Other than the continuous improvement of innovation, support from the government is considered to be one of the most important aspects in improving the efficiency and effectiveness of the communication industry of Thailand. The government had launched various ICT programs to improve the availability of the communication for the country as a whole, most recently the "National Broadband Policy." In 2010, the Ministry of Information and Communication Technology (MICT), in consultation with the National Telecommunications Commission (NTC), set up a task force to prepare a framework for the national broadband policy for Thailand with the aim of providing broadband internet access at an affordable price to all areas. The policy was expected to cover at least 80 percent of the population by 2015 and at least 95% by 2020 [21].

[3] The process of 3G roll out had begun in 2010. Unfortunately, however, by the end of 2011, the spectrums for 3G (1.9 GHz to 2.1 GHz radio frequency band) and other broadband wireless services (WiMax and 4G) had not been awarded to any operators, except TOT and CAT -- which greatly limited the availability of service. Since only state-owned TOT and CAT could use 3G spectrum, the price for 3G service was high and the service area limited [20]. The other players (AIS, True, Dtac) had to wait for the NBTC to announce the spectrum management master plan, at which time the 3G roll out was to commence in earnest. The 3G and other broadband wireless services were expected to be licensed by auction late 2012.

Structure of the Communication Market. Two state-owned monopolies delivered communication services to the Thai market – i.e., the Telephone Organization of Thailand (TOT), the provider of domestic services, and the Communications Authority of Thailand (CAT), which provided international service. Prior to the restoration of democracy in 1992, both organizations had been under the control of the Thai military, with serving and retired army officers managing the TOT and air force officers managing the CAT. Subsequent to the restoration of democracy, both organizations came under the Ministry of Information and Communication Technology (MICT), as can be seen in Appendix 22.

Concession Systems. Because Thai telecom market was dominated and regulated by TOT and CAT, any private companies who wanted to do telecom business needed to have a concession contract with either TOT or CAT. (The major players in the Thai telecommunication industry are described in Appendix 23.) However, the dispensing of different concession contracts with different conditions made the Thai telecom structure very unique and complex. For example, operators paid different concession fees; and, some operators had to pay a concurrent access charge, while some did not. Further, TOT concessionaires were obliged to share revenue with TOT, while CAT concessionaires shared revenue with CAT, but paid an access charge to TOT. (See Appendix 24 for the concession systems in Thai telecom market.)

Oversight Bodies. Because of the government's later realization that the telecom monopoly and concession systems could hurt competition, two independent regulatory bodies -- the National Telecommunications Commission (NTC) and the National Broadcasting Commission (NBC) were established, pursuant to the Constitution of 1997, to supervise the telecom and broadcast industries, respectively. The law provided that thereafter any (government) agency that owned a radio frequency in telecommunication or broadcasting need to return the frequency to either NTC or NBC to be reallocated. The law also provided that upon establishment of NTC and NBC, the concession systems would end. The NTC commissioners were appointed in December 2004, while the NBC never became an operating entity due to political conflict that eventually resulted in a new oversight arrangement.

More specifically, the Constitution of 2007 ended the separation between NTC and NBC by stipulating the establishment of a unitary oversight authority, the National Broadcasting and Telecommunications Commission (NBTC). While waiting for NBTC to be founded, NTC sought to act on behalf of NBTC to supervise the telecom industry. Since Thailand still did not have 3G (third generation) cell phone network, in September 2010, NTC made arrangements to hold a 3G licenses auction (IMT 2100). But, before the auction could be held, the CAT sued the NTC in the Administrative Court, claiming that NTC did not have the authority to hold the auction. CAT claimed that NBTC had to be founded before the 3G license auction could be held. The outcome was the September 23, 2010 issuance of an injunction order by the High Administrative Court that stopped the 3G auction. By the Court's order, only government-owned operators (i.e., TOT and CAT) were allowed to roll out 3G. As a result, the subsequent 3G service from TOT's and CAT's rollout proved to be very limited and poorly distributed. It was not until November 2010 that NBTC commissioners were appointed. Once the NBTC entered operating status, the telecom structure was to be changed from concession systems to license-based systems (see Appendix 25). In such license-based systems, NBTC was to function as an independent regulatory agency to supervise the policy, regulation and development of the industry, with TOT and CAT to be treated on the same ground as the licensees.

Despite the strength of a high user-adoption rate for the mobile market, the telecom segment of the ICT industry continued to confront the threat represented by governmental interference in the market *via* concession agreements controlled by the two state-owned companies, TOT and CAT – which resulted in unfair competition in the industry. The continuing delay in implementing a 3G network due to politics and politicking by various entities constituted another ongoing threat — a threat that, in turn, made universal access to ICT impossible in that people in some remote areas still could not access the Internet or telecommunication technology.

Ongoing Challenges and Dilemmas Confronting the Thai ICT Industry

Going forward, the country faced a number of challenges and dilemmas in further developing the Thai ICT industry and bringing it

on *par* with the advanced economies that Thailand aspired to be. These challenges included, among others, the disparity of information access among different segments of Thai society (i.e., the "digital divide"), increased public dissatisfaction with the quality and prices of the various types of telecommunications services, the ongoing lagging behavior of Thai companies with respect to the adoption of ICT innovations, and the continued impasse over the development of a commercial 3G network.

Disparity of Information Access

The country continued to have a wide disparity of information access, with access for some segments of the ICT sector greater for some than for others. Indeed, this "*digital divide*" was quite large compared to that in other developing countries. For example, in broadcasting, uniformly across all regions of the country, nearly all Thai households (i.e., over 96%) had access to public television and more than half (i.e., 58.0%) had access to radio. In the fixed-line telephones, a technology that was continuing to lose consumer favor to mobile phones, the Bangkok metropolitan area had the highest proportion of households with such devices (i.e., 56 telephones per 100 households), while the proportion in the provinces ranged from 6 to 40 per 100 households. (See Appendix 26) On the mobile phones front, the gap between urban and rural areas was considerably smaller – an approximately 76% usage rate in Bangkok and environs versus a range of between 50% and 62% in the regions, with an overall country rate of nearly 57%. (See Appendix 26)

However, the situation was appreciably less rosy in the area of information technology, where the gap between people who were able to access information technology and people who could not use ICT continued to be quite wide. For example, in 2009, with only about 29.3% of the population using the computer and only about 20.1% using the Internet [8], the proportion of people using information technology in Thailand was much lower than that of other developing countries (such as Vietnam, Philippines, Malaysia and China), particularly with respect to the Internet usage proportion [22]. In addition, the disparity of ICT use between the Bangkok metropolitan area and the regional areas was quite high.

Government Efforts to Narrow the Digital Divide

Although helping people at every level and in every region of the country to have a computer and access to the Internet in a short period of time was difficult, the government had tried to fix the disparity of computer and Internet use by conducting projects and creating strategies to support educational units, as well as helping community and district units obtain computers and Internet access. However, they still lacked enhancement for effective accessibility to information and communication in remote areas However, with only 10% of rural households having computers (despite nearly 100% rural electrification), it was likely that the prices of computers still placed them beyond the pocketbook of most of the farming population who constituted the majority of rural denizens. Further, a lack of education or instruction on how to utilize computers was believed to further contribute to the urban-rural gap in usage of information technology. (See Appendix 26)

A particularly difficult challenge to overcome was the big gap between rich and poor people, especially in urban and rural areas, which had mainly impacted human development in terms of intellectual property, as well as social and economic status. This was a main challenge for Thailand—to reduce the gaps between the rich and poor, and between the educated and uneducated related to accessibility to information technology, by providing Internet and mobile networks for everyone in all areas in order to disseminate information, news and education to them at the same level. This would lead to developing the country's sustainably through ICT development, which was an important and basic factor for improving the quality of people's lives in the long run.

Increasing Public Dissatisfaction with Certain Telecommunication Services

With the use of ICT having become such an integral part of people's lives, particularly in the urban areas, it was not surprising that complaints about services would increase in proportion to the spreading usage of the services. According to the Telecommunications Consumer Protection Institute, problems related to telecommunication services had become the highest among all complaints. In the first quarter of 2011, there were 1,382 complaints related to telecommunication services, categorized as shown in Appendix 27.

Regarding mobile service, the top complaints included SMS spam and highly expensive charges for data roaming services, as well as prepaid services. Regarding Internet services, the top complaints were that the actual speed of the Internet did not correspond to high speed that Internet operators had advertised and that the bills were often incorrect. In fixed-phone services, the top complaint was incorrect billing charges. These complaints had been increasing as the adoption rate increased due to these services having become necessary for people's daily lives and business.

Government Efforts to Remove the Causes of the Complaints

In the effort to remediate these problems, in 2007, the government established the Telecommunications Consumer Protection Institute (TCI) under the supervision of the NBTC to protect consumers who experienced telecommunication problems, whether with a home phone, mobile phone, public telephone, or the Internet. The TCI was empowered to investigate any dispute between telecom providers and consumers and to render legally binding decisions, accompanied by the requirement that the telecommunications provider resolve the consumer complaint within 30 days. However, a subsequent focus group comprised of telecom providers revealed that telecommunication companies were very dissatisfied due to the perception that the TCI took was biased in favor of consumers. Also, apart from the telecommunications sector, there was no evidence of any consumer protection bodies on the hardware, software, and services side. For example, it was not clear who would be legally responsible for a software or hardware failure -- the producer organization or the user organization. If it were treated in the same fashion as a machine that harms or injures, the software or hardware producer would be held liable. However, the laws to protect software and hardware users did not exist as of 2011.

Lagging Adoption of the Latest ICT Technological Innovations

Thailand had fallen behind many developing countries with respect to both readiness for new technologies and the adoption of innovations. The country's continued status as a laggard in terms of adoption of new technologies greatly contributed to Thailand's ranking by the World Economic Forum as being 82nd (out of 142 countries) on availability of the latest technology in 2010. Indeed, Thailand ranked below other

neighboring countries such as Malaysia, Singapore, Indonesia, and The Philippines (see Appendix 28). In terms of Firm Technology Absorption, Thailand was ranked 75th, which was also below the world average.

On a more positive side, Thailand was ranked 32nd in terms of Foreign Direct Investment (FDI) and Technology Transfer. Thailand had long been an attractive destination for ICT investment. A lot of world class companies in ICT had invested both production facilities and research centers in Thailand. However, despite this investment, Thai companies, as a whole, had failed to adopt the latest technologies and innovations from the world class companies.

Government Efforts to Increase Rate of Both Local Innovation and Adoption of Innovations

First, recognizing that the lack of research and development (R & D) could put the country in danger of losing out to global competition as it pursued economic growth via innovations, the government's response to this situation had been multi-faceted. First, it established research and development institutions – e.g., the National Electronics and Computer Technology Center (NECTC), the Telecommunications Research and Industrial Development Institute (TRIDI), and the Software Industry Promotion Agency (SIPA) – in the attempt to boost local innovation and quicken the adoption of innovations in general. A major drawback to this initiative, however, was the fact that the R&D budget was both limited and under-invested. That is, at 0.25% of the GDP (with a 60%:40% spit between government and the private sector), the Thai R&D budget paled in comparison to the budgets of other Asia countries such as China (1.4%), South Korea (3%), Singapore (2.2%) and Malaysia (0.63) [23-24].

Second, in the quest to attract R&D investment, the government provided tax incentives for ICT and electronics companies that promoted advanced skills, technology and innovation through minimum expenditures on R&D in Thailand, provided that such endeavors met at least one of the following conditions [25]:

1) Average R&D or design expenses for the first 3 years of operations were not less than 1-2% of annual sales.
2) Employees with at least a Bachelor's degree in science, R&D, design, or other technology-related field made up not less than 1-5% of the project's total workforce for the first 3 years of operations.

3) Average training expenses for the first 3 years of operations were not less than 1% of payroll costs.
4) Average expenses for developing Thai vendors or subcontractors or for supporting related educational institutes were not less than 1% of annual sales for the first 3 years of operations."

The tax incentives included exemption from import duties on machinery and an 8-year income-tax holiday. There was no limit on the amount of investment [25]. By attracting R&D investment from the world-class companies, the government hoped to accelerate the upgrading of labor skills and industry competitiveness.

Continued Impasse over the Development of a Commercial 3G Network

Beginning in 2001, third-generation cellular network technology ("3G") had played an increasingly important role in developing the ICT cluster both in developed and in developing countries. However, Thailand was among a very few countries in Southeast Asia that did not have a 3G (third generation) network as of 2010, despite the fact that, with 69 million users, its mobile phone usage rate was *beyond* 100%, its 24 million Internet users represented a penetration rate of 35%, its 12 million mobile Internet users represented a 17% penetration rate, and its 1.2 million smart phone purchases in 2010 suggested a rapidly growing market.

The continued lack of a 3G operation in Thailand was deemed to have contributed to the relatively slow improvement of ICT in the country, compared to neighboring countries. Until 2011, Thailand was still among a very few countries in the world that still operated under the 2G network (second generation cellular network). In the view of some experts, the lack of a commercially available 3G network would generate THB 50 billion loss in investment during 2010-2011, and also cause the country's banking sector to lose the income that would have resulted from lending capital to the would-be operators of a 3G network [26].

The lack of a commercially available 3G as of 2011 could be traced, broadly to the inter-agency politics, and narrowly, to August 2010 court decisions that ruled the would-be regulator of the network, the NTC, did not have the power to issue a new spectrum which would support 3G. The country would have to wait, the court essentially said, for the

operationalization of the newly-established National Broadcasting and Telecommunication (NBTC) that had been recently formed from a merging of the roles of the NTC and NBC, before 3G licenses could be issued. These judicial developments had prompted numerous expects to speculate that the telecommunications market in Thailand was a widely-orchestrated conspiracy because the emergence of NBTC would mean the end of concession systems. That is, ownership of the frequency spectrums presently owned by many government organizations (e.g., CAT and TOT) would have to be transferred to the NBTC for re-allocation (see Appendix 24 and 25). As a result, these organizations would lose the majority of the revenues generated by granting concessions of the current 2G networks to mobile network businesses such as AIS, DTAC, and Truemove. Indeed, some experts pointed out that without concession systems, TOT and CAT would not be able to survive financially because 60-70% of their revenue came from concession fees. Therefore, in the view of many industry observers, government organizations involved in telecommunications in the country were attempting to prevent the emergence of a new broadband such as 3G in order to preserve the concession benefits as long as they could.

Numerous experts speculated that the longer that Thailand must wait for 3G and other mobile broadband technologies, the slower would be the improvement in the ICT cluster. This, in turn, would likely lead to Thailand falling behind others in terms of information and telecommunication technology, as the country could not upgrade new technologies to the extent that its neighboring countries could. Among other unfortunate outcomes would be potentially adverse impact on the educational development of the country, in that people in rural areas would still lack access to technology and information, a principal cause of the digital divide in the country.

Future Challenges

As the Prime Minister and her ICT ministerial team looked toward the desired ICT future and the steps needed to get there, certain "imperatives" were at the forefront of their minds.

First, given the importance of ICT to the country's competitiveness, and given Thailand's low -- worsening -- ranking in most of the factors related to technology (e.g., ranked 26th in 2009, but 39th in 2011) a concerted initiative needed to be undertaken to implement advanced and new

technologies, such as 3G, WiMAX, etc. With respect to mobile broadband technologies, the nearly 100% mobile phone penetration rate suggested that technologies such as 3G would be an efficacious way to push access to the vast majority in the rural areas. Hence, some way had to be found to deal with the conflicts of interest and political instability that they holding back the introduction of 3G.

Similarly, WiMAX was another good candidate for improvement initiatives. The wireless aspect of the technology was very attractive to the investor since no cable needed to be installed, thus making it much easier to expand in comparison to the wired network. However, a major impediment to the widespread dissemination of this technology was the fact that most of the Thai Internet service providers, being traditional telephone operators, had expanded their business from *land lines*. Hence, they viewed improvement in their wired networks as more logical option, given that it would represent an *addition* to their existing service, rather than a completely new one that would necessitate the granting of a new government license from the government. Especially in the aftermath of the 3G fiasco, Internet service providers did not relish the prospect of falling under even greater governmental control. Hence, the Prime Minister and her team had to ponder the feasibility and advisability of having the government itself become the WiMAX provider, as had been mentioned recently by some of the candidates for election to the post of Bangkok governor.

One ongoing trend that gave team members pause was the fact that although land line technology was slower to deploy and more costly to expand, an increasing number of operators were entering the business, precipitating nearly continuous price wars fought with price cuts and greater bandwidths. With the Bangkok market being near saturation, Internet service providers were finding it necessary to extend their reach into more rural areas, thus brining high-speed connections to an increasing number of people on the disadvantaged side of the digital divide. Thus, a key issue for the Prime Minister and her ICT team was whether this trend alone, if left alone, might in time be sufficient to raise Thailand's competitiveness ranking.

Along with the question of how to best expand Internet access was the key issue how to educate people in the use of the technology. Giving technology to students without teaching them about its potential was likely

to be in vain. At present, the majority of youth used the Internet as another means of entertainment. The challenge would be to integrate the technology to be a part of the required education. Teaching the new generation the potential of the vast information and the self-reliance of learning through Internet could be a key improvement for the country, especially where locations are difficult to reach and few teachers are willing to go there.

Other trends of which the Prime Minister and her ICT team had to take into consideration were continuous declines in hardware prices, accompanied by increased performance. Even more important was the accelerating trend toward technology convergence is another trend – i.e., a phenomenon in which one device combined several functions from other devices. For example, iPhone combined computer, phone, television, radio, and camera in one device. Technology convergence allowed consumers the convenience of having one instead of many devices, saving both size and cost. It also introduced cross-industry competition because products could be easily substituted. For example, a computer producer, like Apple, competed with a phone company, like Nokia. The implications of these trends in terms of opportunities that should be seized in order to increase Thailand's competitiveness were something that the Prime Minister and her ministers had to sort out.

On the software side, by far the biggest "elephant in the room," as the saying goes, was the ongoing and *huge* piracy problem in the country. Despite being illegal, major stores purveying purloined software (e.g., at Pantip plaza and Fortune Town) continued to operate in plain sight. Whether the problem came from ignorance, corruption, or simply completes unconcern with the intellectual property rights of the software developers, the fact was that this practice prevented the industry from growing. No company would be willing to fund a project and see the profits on their expensively and hard-developed accrue to people with zero investment in the product selling their intellectual property for a few satang on each baht of investment. The Prime Minister and her team were well aware that improvement in the country's ICT competitiveness score would gain a minimal boost, if any at all, from the software side of the industry until such time as the Thai government found a way to arrest this trend. The question, as always, was how to do this.

Meanwhile, on a more auspicious note, the rise of cloud computing and software as a service, offered developers an alternative business model with greater prospects for protection of their intellectual property. With these technologies, the users had to, one way or another, connect to the server of the provider regularly in order to use the software. This new innovation held out the promise of making it much more difficult for hackers to crack and "liberate" the software for free public access because authorization and authentication had to be performed each time the user required the service.

Where to from Here?

Overall, then, while the development of ICT in Thailand had been growing moderately, many challenges had arisen in all segments of the market. The young prime minister needed to decide what her government should do to address these issues and problems and to provide solutions to enhance the competitiveness of the ICT cluster, given the criticality of the ICT cluster to the continued competitiveness of the nation.

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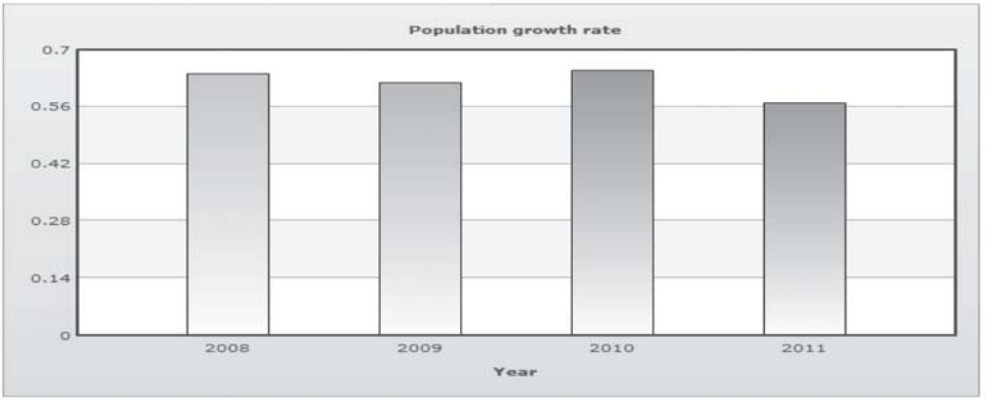
Appendix 1: Thailand's Population

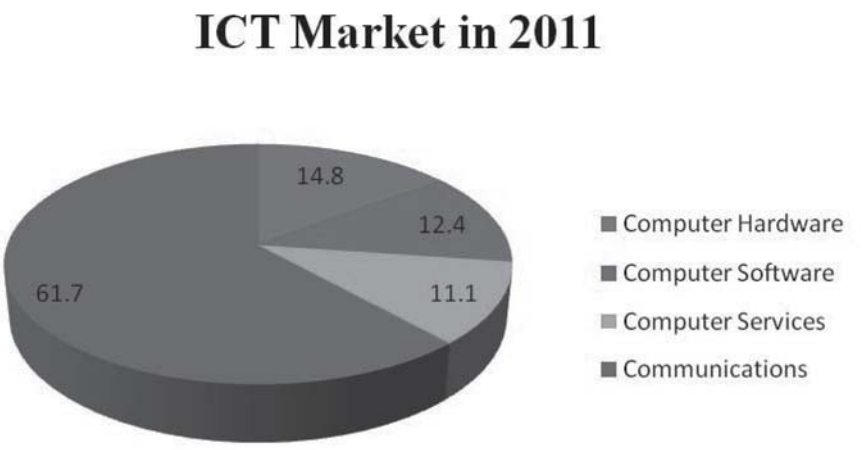


Year	Population growth rate	Rank	Percent Change	Date of Information
2008	0.64	149		2008 est.
2009	0.62	147	-3.13 %	2009 est.
2010	0.65	144	4.84 %	2010 est.
2011	0.57	147	-12.31 %	2011 est.

Source: http://www.indexmundi.com/thailand/population_growth_rate.html

Thailand's Map

Appendix 2



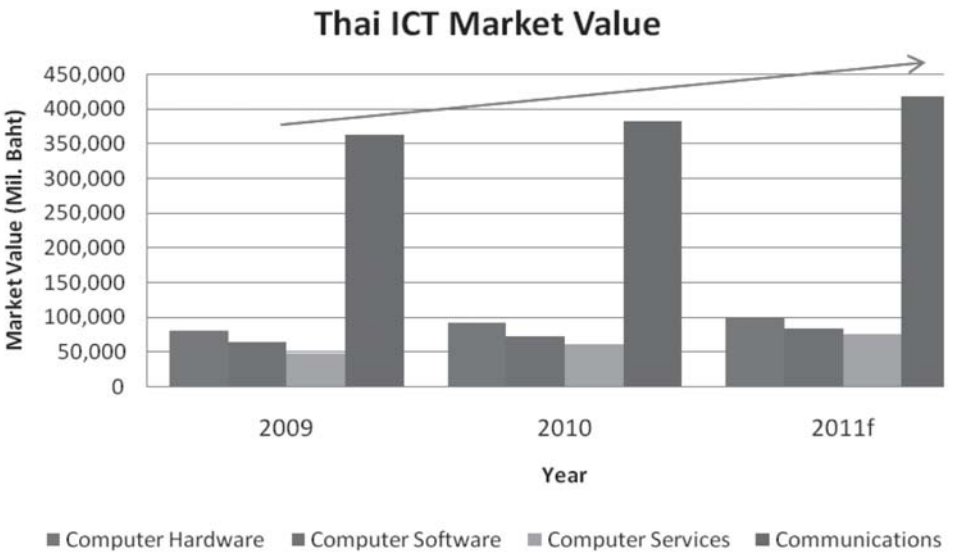
Source: Thailand ICT market 2010 and outlook 2011 (NSTDA, 2011)

ICT Market Share in Thailand Year 2009-2010 and Estimation for Year 2011

Market	Value (Mil $US Dollar)			Market Size (%)			Market Growth (%)	
	2009	2010	2011e	2009	2010	2011	09/10	09/11e
Computer Hardware	2,696	3,053	3,350	14.5	15.1	14.8	13.3	9.7
Computer Software	2,145	2,413	2,807	11.6	11.9	12.4	12.5	16.3
Computer Services	1,612	2,013	2,519	8.7	9.9	11.1	24.8	25.1
Communications	12,090	12,766	13,945	65.2	63.1	61.7	5.6	9.2
Total ICT Market	**18,543**	**20,245**	**22,621**	**100**	**100**	**100**	**9.2**	**11.7**

Source: Thailand ICT market 2010 and outlook 2011 (NSTDA, 2011)

Appendix 3: Thai ICT Market Value (NSTDA, 2011)



Appendix 4: Number of Employees Using Computers and the Internet in Establishments, 2010 (NSO, 2010)

Economic Activity	Number of establishment using computer	Employees using computer		Number of establishment using Internet	Employees using Internet	
		Number	Average per Establishment		Number	Average per Establishment
Total	507,447	2,664,335	(5.25)	339,452	1,421,779	(4.19)
Business Trade and Services	417,350	1,740,720	(4.17)	276,192	910,059	(3.30)
Manufacturing	63,311	632,220	(9.99)	41,952	321,542	(7.66)
Construction	11,178	51,649	(4.62)	9,047	36,614	(4.05)
Other Land Transport and Activities of Travel Agencies	14,419	67,918	(4.71)	11,082	45,863	(4.14)
Hospital	1,234	171,827	(139.24)	1,179	107,701	(91.35)

Source: ICT Business Survey, National Statistical Office

Appendix 5: Indicator on ICT Usage of Establishment by Size of Persons (Santipaporn, 2010)

Indicator[1/]	Total	Size of Establishment (No. of persons)	
		Less than 16 persons	16 persons or more
Proportion of establishments using computers	23.5	21.9	81.1
Proportion of employees using computers	22.9	23.4	22.5
Proportion of establishments using the Internet	15.7	14.2	68.5
Proportion of employees using the Internet	12.2	13.1	11.4
Proportion of establishments with a web site	7.0	6.2	37.9
Proportion of establishments placing orders over the Internet	2.7	2.5	11.1
Proportion of establishments receiving orders over the Internet	1.8	1.6	9.6

Source: ICT Business Survey, National Statistical Office

Appendix 6: Usage of ICT in Educational Institutions (Santipaporn, 2010)

Indicators	Total	Primary	Vocational	Higher	Non formal
Infrastructure					
Student to computer ratio [1/]	14	14	8	11	109
Teacher to computer ratio	8	10	5	3	12
Proportion of schools with computer	99.7	99.7	100.0	100.0	100.0
Proportion of schools with wireless internet access	97.3	97.2	99.6	100.0	98.7
Proportion of school computers used for instructional purposes [2/]	69.6	72.6	77.0	55.0	43.9
The usage of ICT for instruction					
Proportion of teachers who develop electronic media for instructional purposes	26.9	22.8	45.8	53.6	27.6
Average number of IT courses offered per school	3	2	17		2
Training					
Average number of teachers with a computer science or IT degree	1	1	5	23	1
Proportion of teachers with IT training	66.3	65.9	71.0	76.1	80.4

Source: ICT in Educational Institution Survey, National Statistical Office (See Annex 2)
Note: 1/ Total number of students / Total number of computers
2/ Computers for instructional purposes refers to computers in computer tabs and lecture room

Appendix 7: Penetration and Usage on ICT Devices; 2004-2009 (Population Age 6 Years and Over) (Santipaporn, 2010)

Using ICT	2004	2005	2006	2007	2008	2009
Proportion of individuals who used a mobile phone	28.2	36.7	41.6	47.3	52.8	56.8
Proportion of individuals who used a computer	21.4	24.5	25.9	26.8	28.2	29.3
Proportion of individuals who used the Internet	11.9	12.0	14.2	15.5	18.2	20.1
Proportion of households with Internet access	5.7	6.2	7.2	7.6	8.6	9.5
Proportion of households with access to the Internet by type of access						
Narrowband	-	-	26.3	21.7	22.8	24.0
Fixed broadband	-	-	52.8	58.0	48.7	55.8
Mobile broadband	-	-	-	-	4.6	7.7
Proportion of fixed line telephone per 100 households	-	26.8	24.8	24.3	23.5	22.1

Source: ICT Household Survey, National Statistical Office

Appendix 8: The Timeline of Thailand ICT Industry (Runckel, 2005)

1986 – Thailand establishes the National Electronic and Computer Technology Center (NECTEC). NECTEC is given the mission of transferring technology to Thai's countrywide.

1987 – NECTEC initiates the Interuniversity Network Project. At the same year, the beginning of the Internet started when two faculty members at the Asian Institute of Technology's (AIT) computer science department made some lest UUCP connections to the University of Melbourne, University of Tokyo, and UUNET via x.25.

1988 – The Australian International Development Plan (IDP) assisted Prince of Songkla University (PSU) in the South of Thailand in setting up email connectivity.

1989 – The Thai government initiates the SchoolNet project to provide Internet access to every school in the country. In 1995, 4758 schools around Thailand success the Internet through SchoolNet.

1991 – A Unix-to-Unix Copy or UUCP network was established to five universities in Thailand.

1992 – Chulalongkorn University acquired the first 9.6 Kbps leased line to UUNET, the network was transformed to TCP/IP

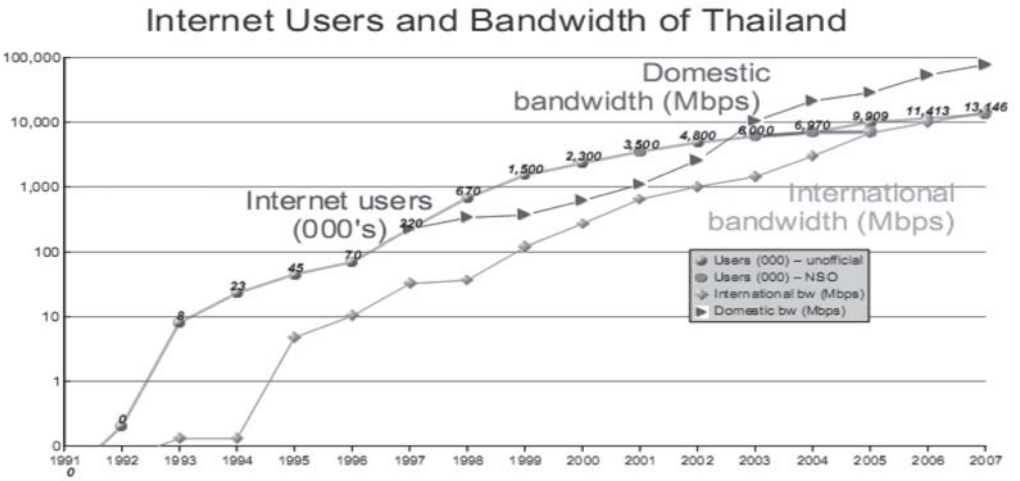
1993 - Thailand-based Shinawatra Computer and Communications Co. Ltd. signed a US$ 100 million contract with Hughes Space and Communications Company Ltd. in 1991 to launch Thailand's first satellite communications project in this year.

1994 – Thaicom de-orbited their 2nd Thaicom (HS-376) and was running actively for 15 years. Same year, CAT set up Thailand's first commercial ISP, Internet Thailand Company, and established a legal formula for creating an ISP

1995 – The usage of the Internet started to grow extensively; the Internet became commercialized and expanded outside the academic realm to the general population.

CAT, TOT and NSTDA established the Internet Thailand Company, a state enterprise Internet Service Provider. See the following diagram for the growing internet users and bandwidth in Thailand.

Internet Users and Bandwidth of Thailand



Source: Adapted from NECTEC (www.nectec.or.th/internet/) and NSO

The above diagram represents the growing numbers of the Internet users and bandwidths of Thailand. It is evidenced that there is a big increased in 1994 with 23,000 users to 45,000 users in 1995 and that is the big turning point in increasing number of the Internet users and bandwidths in Thailand as we can see the increasing trends in each year.

1996 – The Thai government had approved 14.2 billion Baht budget for the national IT infrastructure and human resource development, which is part of the telecommunication master plan aims at developing a national IT infrastructure, human resource, and enhancing government service using the computer network.

1997 – Cabinet approved plan for NECTTEC to start Software Park Thailand. Princess Maha Chakri Sirindhorn opens the Knowledge Distribution Network portion of the Kanchanapisek Network Project. People from all of Thailand's 20 area codes can dial in access number 1509 and use PPP (point-to-point protocol) handshake for free access to the network.

The Software Park Thailand was also established by the Thai government in this year.

1999 – NECTEC Software Park Commences operation with three thousand squares meters at the Software Park Building. By 2003, Software Park Thailand houses 50 companies with 17 companies having international business links, employs over 560 workers and generates around US$10 million per year income for the domestic company. At this stage there are big IT Company like IBM, Sun, HP and Oracle operating in Thailand. The Internet in Thailand grows to more than 100 Mbps of bandwidth, with KSC as the first ISP in Thailand providing 34-Mbs link.

2001 – The United Nations Development Program (UNDP) reported that Thailand's development of Human IT resources in 2001 was 66th out of 162 countries.

2002 – Thailand established the Ministry of Information and Communication Technology (ICT). The Thai government announces the ICT Policies (Fundamental Plan for Information and Communication Technology of Thailand). This new plan sets out for the ICT Ministry five keys development goals; government, e-commerce, e-industry, e-education, and society.

At the same year, The Telephone Organization of Thailand (TOT) and the Communications Authority of Thailand (CAT) both registered as private companies.

2003- First EDGE trial by DTAC enable the company to be the first wave to move towards advanced mobile service.

Software Industry Promotion Agency (SIPA) was also established in this year by the Thai government to improve the effectiveness of the software industry and increase the competitiveness of the country.

2004 – The National Telecommunications Commission (NTC) was established as the first independent state telecommunications regulator under the Telecommunication Business Act. The organization established with its duties is to regulate all telecommunications services in the country.

2005 – Thailand became the world's largest exporter of hard disk drives in 2005 as the industry generated more than US$263 billion in exports equal to 9.4% of total Thai exports and 42% of the worldwide HDD market.

Broadband users in 2005 were about 570,000 subscribers. The size of ICT market in Thailand in 2005 was approximately US$ 11.09 billion, with majority of the market being telecommunications. The software market valued at $1.09 billion.

2006 – 14 universities were funded by NECTEC to run research projects that respond to the needs of the industry.

Appendix 9: The Second Information and Communication Technology Master Plan (2009-2013)

Strategy 1: Develop ICT professionals and the general population to be information-literate

The aim of this strategy was to accelerate the development of personnel of adequate quantity and quality to support the development of Thailand into a knowledge- and innovation-based society. Both ICT professionals and personnel in other fields -- along with youth, the disadvantaged, the disabled, and citizens at all levels – were to be encouraged and supported to acquire the knowledge and skills to create, produce, and use ICT in an efficient, effective, ethical, and considerate manner.

Strategy 2: Strengthen national ICT governance

This strategy aimed to improve the mechanisms and processes of ICT management and monitoring to achieve a good governance framework by emphasizing operational unity, efficient use of resources, and participation from all sectors.

Strategy 3: Develop ICT infrastructure

The purpose of this strategy was to develop and manage ICT infrastructure in order to provide universal access to businesses and citizens around the country, including the disadvantaged and people with disabilities. It was to encourage businesses to put in place infrastructure that could keep up with technological evolution in order to meet increasing consumer demand.

Strategy 4: Use of ICT to support good governance in public administration and services

The objective was to encourage government agencies to use ICT to improve governance in administration and services. A citizen-centric approach should be adopted to provide services in an efficient, effective, transparent, and just manner. Participation from all relevant sectors was to be encouraged.

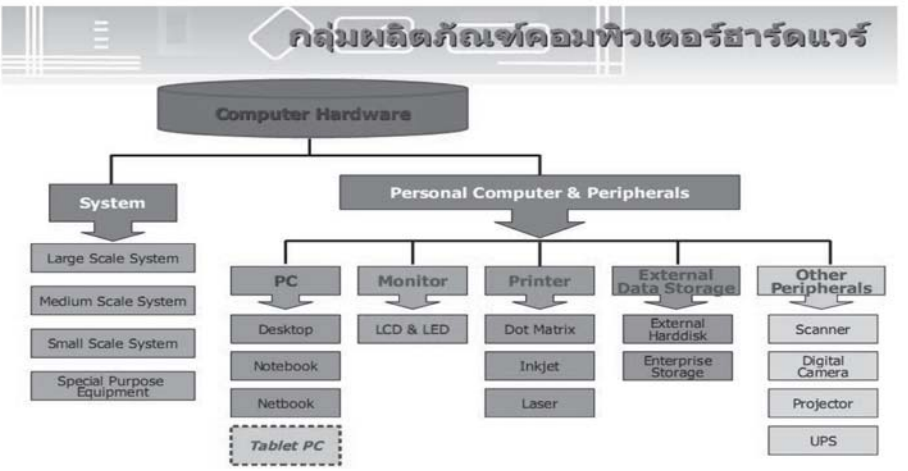
Strategy 5: Upgrade competitive capacity of the ICT industry to add value and increase earnings

This strategy sought to upgrade the competitiveness of Thai ICT businesses by promoting research, development, and innovation by the public sector, as well as the academic and private sectors, to upgrade the technological capability of the Thai ICT businesses to a more upstream technology. Technology transfer of research outputs to businesses was to be encouraged. The business environment should also be improved. The priority sectors are the software industry and the digital content production industry, with the aim to increase the sector's contribution to the national economy and earnings.

Strategy 6: Use ICT to build sustainable competitiveness for Thai industries

This strategy aimed at promoting access and use of ICT in the production of goods and services in all sectors to enhance competitiveness by increasing domestic value-added and at the same time being environmentally friendly. This purpose here was to help prepare businesses to compete under global free trade regimes in the future. Special emphasis was given to sectors in which Thailand had a comparative advantage and potential to compete, such as agriculture, health services, and tourism. Small and medium enterprises (SMEs) as well as community enterprises were also targeted for development.

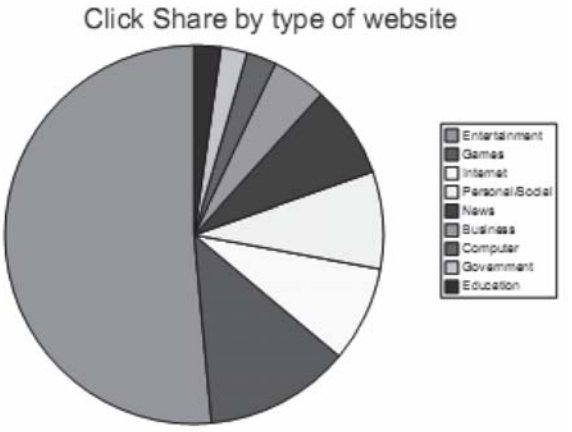
Appendix 10: Hardware Market Structure (NSTDA, 2011)



Source: National Electronics and Computer Technology Centre (NECTEC), Thailand ICT Market 2010& Outlook 2011 Press Conference, Hardware" 11 March 2011

Appendix 11: Web Behaviors in Thailand

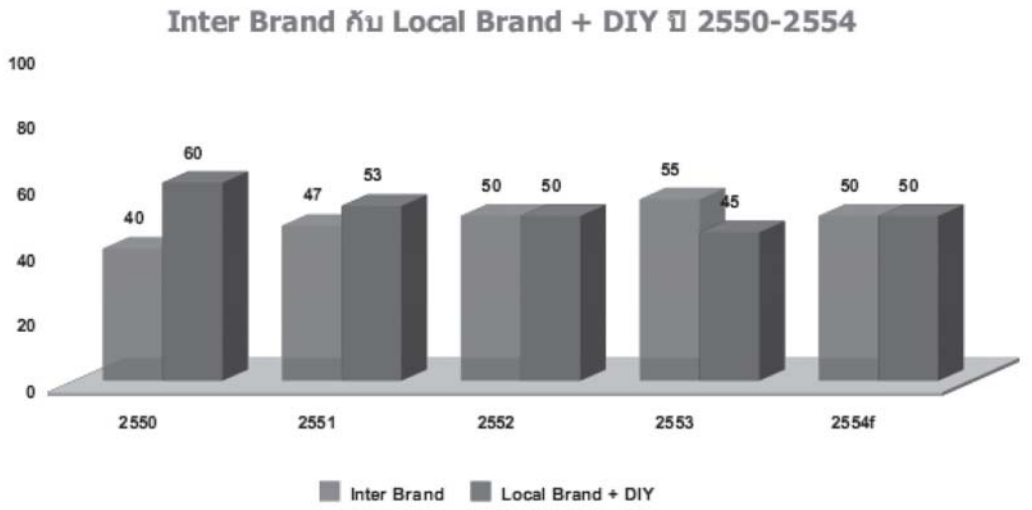
Type of website	Click Share
Entertainment	40.48%
Games	9.85%
Internet	6.50%
Personal/Social	6.34%
News	6.33%
Business	3.72%
Computer	2.01%
Government	1.75%
Education	1.71%



Source: NECTEC, 2007, Important Internet Statistics for Thailand

Appendix 12: PC Market in Thailand

Inter Brand vs. Local Brand



Source: National Electronics and Computer Technology Centre (NECTEC), Thailand ICT Market 2010 & Outlook 2011 Press Conference, "Hardware," 11 March 2011

Appendix 13: Market Growth of Software Industry

Source: SIPA & NECTEC, Thailand ICT Market 2009 and Outlook 2010, Software Market Worth

Appendix 14: Software Market

ตารางที่ 2-1: มูลค่าตลาดคอมพิวเตอร์ซอฟต์แวร์ ปี 2551 – 2552 และประมาณการปี 2553

ประเภทซอฟต์แวร์	มูลค่า (ล้านบาท)			อัตราการเติบโต (%)		
	2551	2552	2553f	50/51	51/52	52/53f
1. Enterprise Software	55,547	56,062	58,071	10.1	0.9	3.6
2. Mobile Application	2,640	3,069	3,720	23.8	16.3	21.2
3. Embedded Software	2,359	2,760	3,423	21.8	17.0	24.0
4. Others	2,391	2,474	2,670	15.2	3.5	7.9
รวม	62,937	64,365	67,884	11.2	2.3	5.5

Source: SIPA & NECTEC, Thailand ICT Market 2009 and Outlook 2010, Different types of Software Market

Appendix 15: Computer Services Market

จำแนกตามประเภทบริการปี 2551 – 2552 และประมาณการปี 2553

ประเภท	มูลค่า (ล้านบาท)			อัตราการเติบโต (%)	
	2551	2552	2553f	51/52	52/53f
1. System Integration[1/]	12,901	13,520	15,830	NA	17.1
2. Network Services		17,724[2/]	21,486	NA	21.2
3. Software Maintenance Services[3/]	865	1,027	1,276	18.7	24.2
4. Hardware Maintenance Services	2,612	2,862	3,367	9.6	17.6
5. Data Center and Disaster Recovery Services	1,199	4,779[4/]	5,677	NA	18.8
6. IT Related Training & Education	1,501	1,529	1,529	1.9	0.0
7. IT Consulting	1,823	2,170	2,548	19.0	17.4
8. IT Outsourcing	4,080	4,761	5,679	16.7	19.3
รวม	24,981	48,372	57,392	NA	18.6

Source: SIPA & NECTEC, Thailand ICT Market 2009 and Outlook 2010, Different types of Computer Services

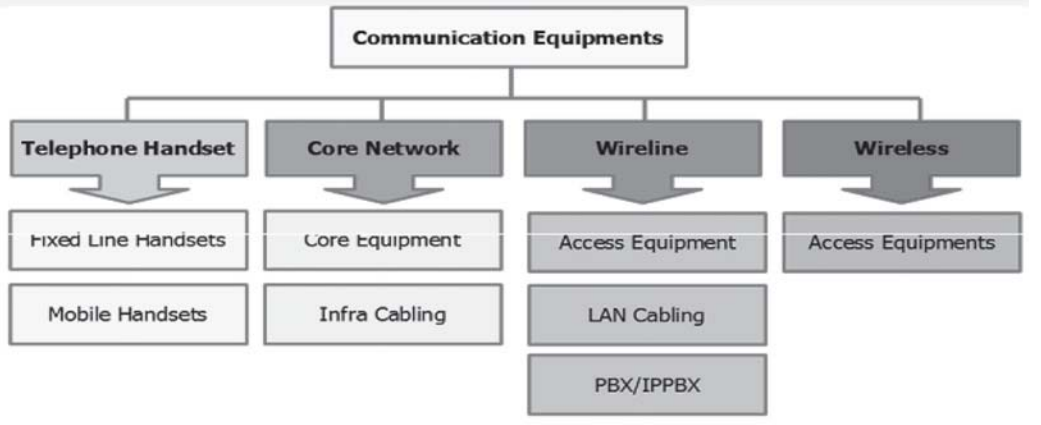
Appendix 16: IT Labor Skill in Thailand

Career Profession/Position	Number	Percentage
System operator	95,199	45.83
Others	44,278	21.32
System technician	17,219	8.29
Programmer	13,993	6.74
Computer trainer	3,634	1.75
System manager	3,595	1.73
Data communication specialist	3,296	1.59
Database specialist	3,263	1.57
Application software specialist	2,962	1.43
System analyst and designer	2,873	1.38
IT security specialist	2,871	1.38
CAD & CAM specialist	2,865	1.38
Software engineer	2,721	1.31
CIO	2,473	1.19
Project manager	2,121	1.02
Webmaster	1,723	0.83
IT quality assurance specialist	1,622	0.78
Multimedia software specialist	993	0.48

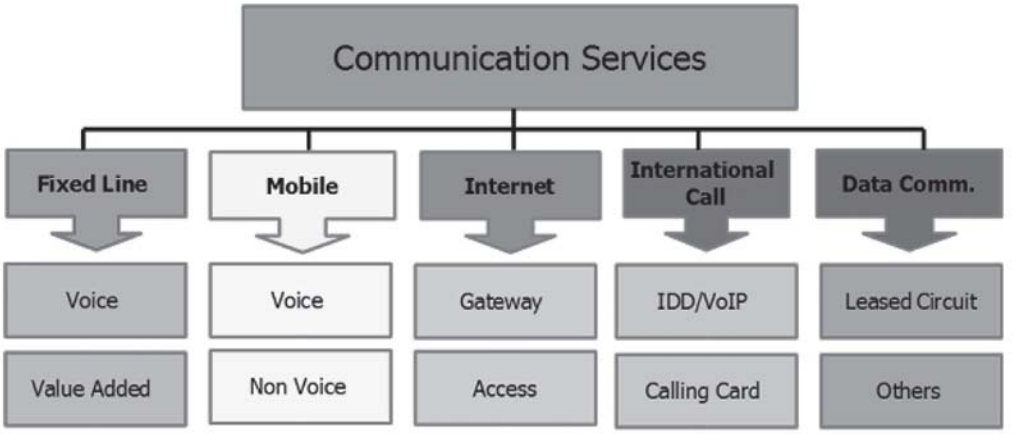
Source: Ministry of ICT, 2007

The above table represents the IT workforce in Thailand; it can be seen from the above table that the majority of the IT professionals in Thailand are in the low skilled group. Almost 70% of the personnel are the system operators, technicians and programmers, while the specialized experts are in a smaller groups comprising between 0.48% to 1.59%.

Appendix 17: The Structure of Communication Market Communication Equipment

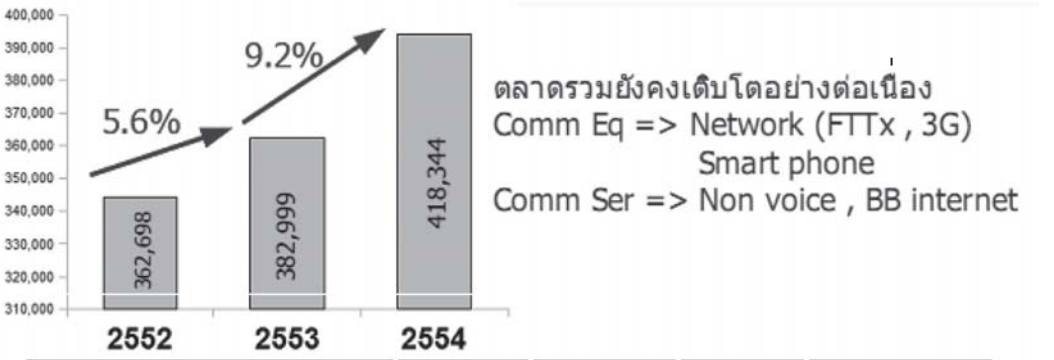


Communication Services



Source: National Electronics and Computer Technology Centre (NECTEC), Thailand ICT Market 2010 & Outlook 2011 Press Conference

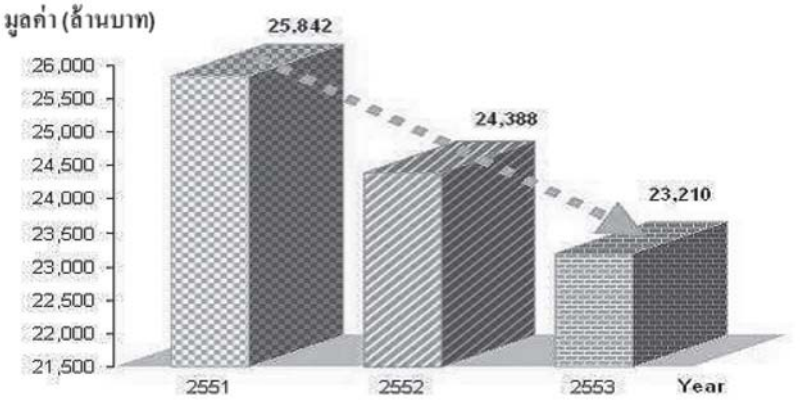
Appendix 18: Thailand's Total Communication Market (NSTDA, 2011)



Categories	2552	2553	2554	Growth (%)	
				YTY (52-53)	YTY (53-54)
Communication Equipments	126,530	133,780	149,452	5.7	11.7
Communication Services	236,168	249,219	268,892	5.5	7.9

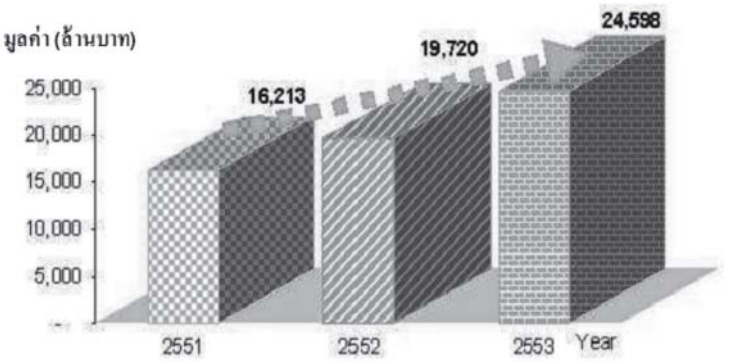
Appendix 19: Fixed-Line Trend (NSTDA, 2011)

แผนภาพที่ 4-5 มูลค่าตลาดบริการโทรศัพท์ประจำที่ปี 2551 – 2552
และประมาณการปี 2553



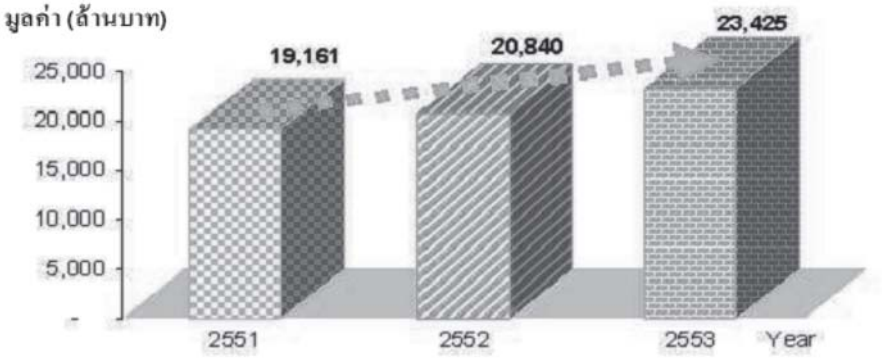
Appendix 20: Mobile Non-Voice Services (NSTDA, 2011)

แผนภาพที่ 4-6 มูลค่าตลาดบริการเสริมไร้สายปี 2551 – 2552
และประมาณการปี 2553

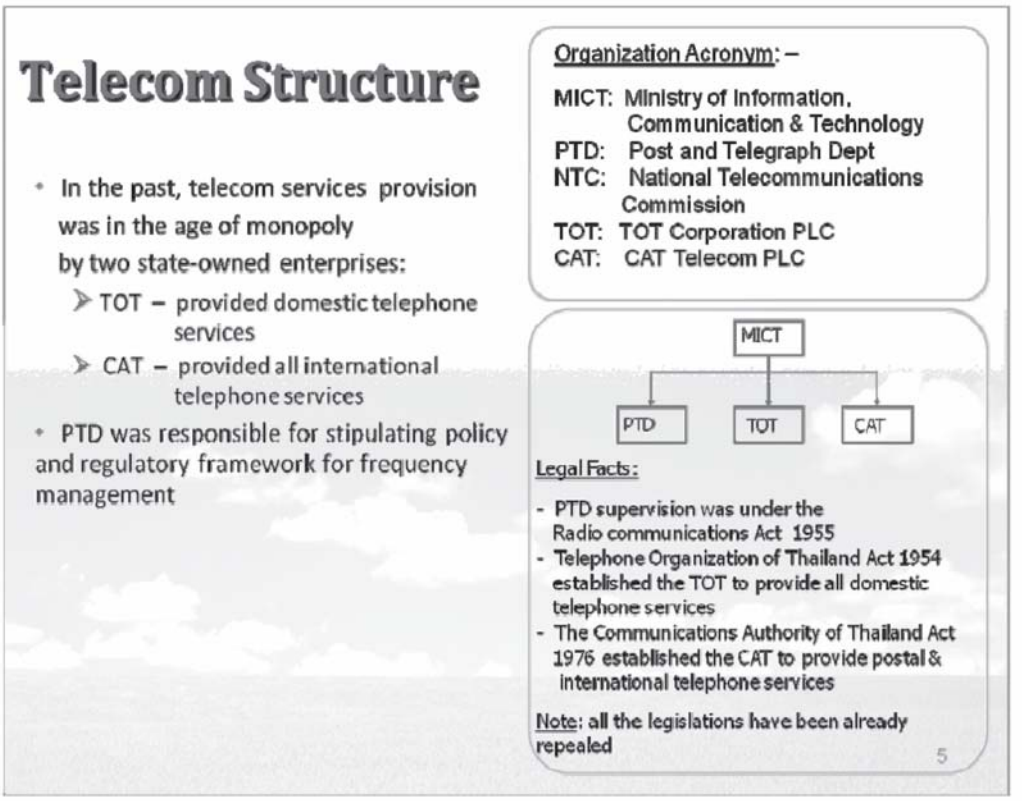


Appendix 21: The Value of ISP Market between 2008-2009 (NSTDA, 2011)

แผนภาพที่ 4-7 มูลค่าตลาดบริการเชื่อมต่ออินเทอร์เน็ตปี 2551-2552 และประมาณการปี 2553



Appendix 22: Telecom Structure



Source: NTBC

Appendix 23: Major Players in Thai Telecom Industry

Ministry of Information and Communication Technology (MICT)

Since technology and communication around the world have been developed and changed sharply, the Thai government is concerned about this issue and has tried to develop country standards to be comparable to worldwide standards. One major tool is Thailand's strategic plan 2008-2011. MICT is the major organization for developing and integrating information technology and communication systems in Thailand to be efficient and effective.

The major roles of the MICT are the following:

- Suggest and govern government policy according to technology and communication systems
- Promote Thailand as a hub in Asian region in technology and communication systems
- Support, encourage, and improve technology and communication to increase potential and capability of Thailand's industry competition
- Encourage human resources in technology and communication to be more efficient
- Monitor and evaluate performance results according to technology and communication development policy

The MICT is a government department that governs technology and communication systems in Thailand but does not operate itself. Instead, there are major two state enterprises for this: Cat telecom and TOT, which support the MICT in providing telecommunication systems in Thailand by granting concession contracts to private operators, details of which are provided below.

TOT

TOT was privatized as a public company limited in 2002. Their main operation can be divided into 5 main areas.

1. Voice
2. Internet and data
3. Multimedia and content
4. Related business

5. Other services

For voice services, there are 4 types: fixed-line, public, mobile, and international calls. Fixed-line services are a major source of revenue, accounting for 57% of the total market.

In terms of the Internet and data, TOT provides many types of Internet services, such as ADSL, IIG, TOT online, Wi-Fi hot spot, and satellite. TOT has many data services such as 3G, (Third Generation Network), Metro LAN, VPN, leased line, ATM, and ISDN.

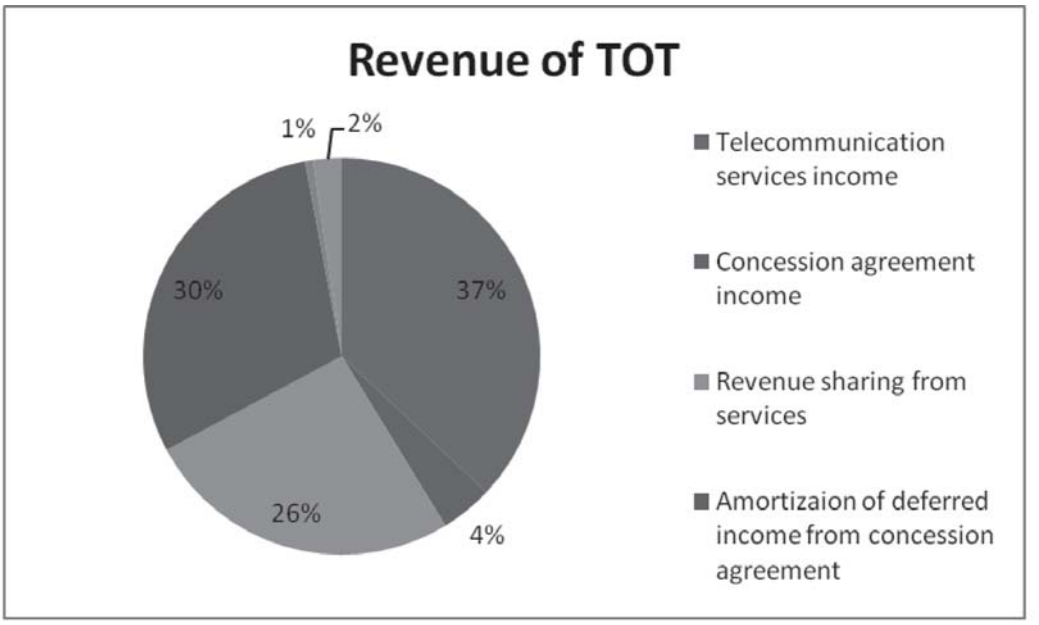
Regarding multimedia and content services, TOT promotes e-Learning system for education and institutes. Games online such as "Tales Runner" and "We Do" were created in 2009 to promote these online services from TOT. Net calls and e-conferences are also new services that TOT promotes for online users that prefer to chat or connect online.

Regarding related business, TOT has developed new services to increase revenue such as the TOT call center, TOT phone cards, both postpaid and prepaid, the Internet Data Center, a Certificate Authority service, a network system and equipment checking, and research and training services.

For other services, TOT provides numerous services for customers such as a sport complex, seminar and conference organizers, etc. TOT also has private contracts with many private companies in Thailand to promote more efficient communication services such as a 2.6 Million fixed-line with True Corp., a 1.5 Million fixed-line for TT&T, 900Mhz mobile system for AIS and so forth. Also, TOT has invested and acquired stocks of these companies to maintain the control rights and to promote collaboration between companies.

TOT is the biggest fixed-line telephone provider in Thailand. They have tried to change their operation using new hi-speed connections and communication systems such as ADSL and 3G. The strong point or core competency of TOT is its fundamental network that spreads all over the countries area for ages and long royalty of customers.

With reference to revenue structure, TOT obtains its main revenue from concession agreements with private companies, as shown in the following graph.



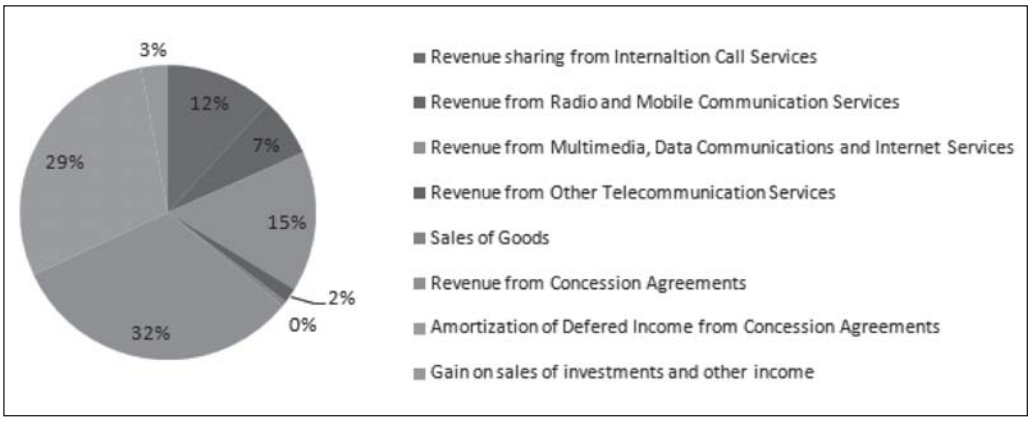
Source: Annual report TOT, 2009

According to notes to financial statements, TOT has a BTO (Built-Transfer-Operate) contract with many private operators. Since 2009, NTC has approved ownership transfer of the 1900 MHz frequency and 3G mobile system from CAT telecom to be solely operated by TOT.

CAT Telecom Public Company Limited

CAT Telecom Public Company Limited was privatized as a public company limited in 2003 like TOT.

The company basically operates in domestic and international telecommunication activities, including providing international call services, radio and mobile communication services, multimedia services, data communication services, wireless communication services, Internet and network system services, IT security services, E-Auction services, and other related services. According to the financial statement for 2009, the revenue structure of CAT telecom can be presented in the following graph.



Source: Annual report CAT, 2009

As with TOT, CAT telecom receives its main revenue stream from concession agreements, accounting for 32% of total revenue, and amortization of deferred income from concession agreements, accounting for 29% of total revenue. Thus, more than half of the total revenue of CAT is from concession deals (61%). The second largest revenue is from multimedia and Internet services at about 15%, followed by revenue sharing from International call services from private operators at about 12%.

On August 4, 2005, the company was granted a telecommunication business license from the NTC (National Telecommunication Commission) as shown below.

1. Internet License
2. Telecommunication Business License (international calling card services)
3. Telecommunication Business License (networks or facilities provider, service provider using its own telecommunication network

According to notes to financial statements, CAT has a BTO contract with many private operators, such as True and Dtac. Five main concessions have been granted: cellular mobile system services, Internet services, satellite network services, mobile radio system, and domestic high-speed leased circuit services. For the cellular mobile system services, the operators must pay annual fees based on certain percentages of service income as specified in the individual agreements.

On January 24, 2008, the company was granted permission to provide international Internet services and telephone exchange services. Regarding

International call service agreements, the company has entered into an agreement with certain mobile operators, such as AIS, True Move, Dtac, to provide international call services to customers through mobile phone numbers and networks.

AIS

Advanced Info Service (AIS) is a leading Thai mobile telecommunication company with the largest share of both market revenue and subscriptions in Thailand. According to investor relation information posted on company websites, AIS has been in operation for more than 19 years with a network covering more than 97% of the total area and supporting more than 28 million mobile subscribers. Regarding the revenue stream, there are six business sectors that create revenue for AIS, as the graph below indicates.

Source: Annual report AIS, 2009

Mobile GSM Network Operator

AIS provides mobile telephone services on 900 MHz and 1800 MHz based on the BTO (Build-Transfer-Operate) contrac. For 900 MHz, AIS was granted the 25-year BTO contract from TOT in 1990. AIS also entered into an Interconnection (IC) Agreement with Total Access Communication Public Company Limited (DTAC) and also with True Move Company Limited (True Move) in 2006 and 2007 respectively. For 1800 MHz, Digital Phone Co., Ltd. (DPC), which is a subsidiary of AIS (98.55% owned by AIS), was granted a 16-year BTO contract from CAT Telecom Public Company Limited (CAT) in 1997. Furthermore, DPC also has a network roaming agreement with AIS to enable nationwide service to both

the GSM 1800 and GSM 900 customers to provide better network service quality for both networks.

International Direct Dialing Service

AIN GlobalComm Co., Ltd. (AIN), which is one of AIS's subsidiaries, has a 20-year license concession from the National Telecommunications Commission (NTC) that began in 2006. This license allows the service to operate its own international gateway facility.

Data Communications Service

Super Broadband Network Co., Ltd. (SBN), which is one of AIS's affiliate company (99.99% owned by AIS), provides data service on a fixed-line facility. In 2007, SBN acquired a license from NTC to be a network operator and a telecom service operator. Regarding company websites and financial reports, SBN has offered various services that include Internet (ISP), international & national Internet gateway, International Private Leased Circuit (IPLC), Internet Protocol Virtual Private Network (IP VPN), a voice over IP, and an IP television.

Also, AIS still has the Advanced Data network Communications Co., Ltd. (ADC), which is a joint venture between DPC and TOT Corporation Public Company Limited (TOT), providing data communication via a telephone line network and an optical fiber service. The services offered include web hosting, data back up, and integrated Internet services.

Call Center Service

For the call center, AIS has another affiliate: the Advanced Contact Center Co., Ltd. (ACC) (99.99% owned by AIS), to provide services. This service focuses on customer care, after-sales and customer service maintenance, promoting new marketing campaigns, and suggesting new products and services to both existing and new customers.

Sales and Distribution of Handsets, SIM cards, and Refill cards

AIS assigned the Wireless Device Supply Co., Ltd. (WDS) (99.99% owned by AIS) to be the main distributor of handsets, SIM cards, and refill cards. From the annual report for 2009, SIM cards and refill cards were distributed at 350 authorized Telewiz shops, 280 Telewiz Express outlets, and more than 10,000 general and sub-dealers nationwide.

Mobile Payment Service

The Advanced MPAY Co., Ltd. (AMP), which is one of AIS's affiliates, received a grant from the Bank of Thailand (BOT) to offer electronic payment transactions based on the electronic cash cards under the brand "mPAY." The services include mobile transactions, sucha as online shopping, bill payments, payments for goods and services, etc.

Others

Except for the first six above services, AIS also provides network and computer system services. The Advanced Wireless Network Co., Ltd. (AWN) received a license of type-I to be an Internet service provider (ISP) and a license of type-III to be a network provider from the NTC. According to recent statistics, AIS has gained the largest share as a wireless operator in Thailand, at about 52% of the total market.

DTAC

The company was founded in August 1989 to provide wireless telecommunication service in Thailand under a concession agreement with CAT Telecom Public Company Limited. DTAC provides many telecommunication services, such as voices services, value-added services, smart phones, network development, etc. The revenue of Dtac can be devided into 4 main categories—service revenue, IC revenue, telephone and starter kits, and other income. From notes to the financial statement of DTAC in 2010, the revenue for each segment is as presented in the table below.

	2010
Service revenues	54,659
Interconnection revenue	14,091
Telephone sets and starter kits sale	3,082
Other operating income	520
Total revenues	72,351

Source: Annual report DTAC, 2010 (unit in Baht)

We can see that the main revenue of DTAC comes from service revenue, accounting for 76% of the total revenue. The table below describes the revenue component of service revenue, which can separated into voice services (both prepaid and postpaid subscribers), value-added services (multimedia and Internet usage), revenue from International Roaming (IR) service, and other services. According to these statistics, we can see that voice service is the major source of income for DTAC.

Notes: On 14 November 1990, DTAC was granted by CAT telecom permission to provide cellular telephone services under the concession. The concession covered a 27-year period. The service rates and fees charged to subscribers have to be approved by the NTC (the National Telecommunications Commission). Additionally, the company is obliged to comply with various conditions and to pay fees in accordance with the concession.

	2010	
	Amt	%
Voice	42,427	77.6%
- postpaid	11,199	20.5%
- prepaid	31,228	57.1%
VAS	7,574	13.9%
IR	2,509	4.6%
Others	2,149	3.9%
Service revenues ex. IC	54,659	100.0%
IC	13,242	
Service revenues	67,900	

Source: Annual report DTAC, 2010

For IC revenue, which is the second largest portion of the DTAC revenue structure, DTAC received approval from the National Telecommunications Commission (NTC) for the Reference of Interconnect Offer (RIO) on 29 August 2006. The company has entered into interconnection charge agreements with many operators, as listed below.

Operators	Effective period
a) True Move Co., Ltd.	17 November 2006 onwards
b) Advance Info Service Plc.	30 November 2006 onwards
c) Triple T Broadband Co., Ltd.	22 December 2006 onwards
d) DTAC Network Co., Ltd.	9 July 2007 onwards
e) Digital Phone Co., Ltd.	16 July 2007 onwards
f) CAT Telecom Plc.	6 July 2010 onwards

Source: Annual report DTAC, 2010

According to the notes to the financial statement of DTAC, the company has stated that they shall pay revenue sharing to CAT every year based on a percentage of revenue from services provided under the agreement, but not less than a minimum annual revenue sharing payment as specified in the Concession Agreement. In addition, in July 2010, the company has new IC (Interconnection Charge) settlement with CAT/HUTCH. It is expected that this service segment will grow gradually.

For telephone sets and starter kit sales, the major increase in revenue recently was from the successful launch of the iPhone in Mar-10 and the sale of Blackberry handsets for the full year. Since the smartphone is very famous and popular among business people and other groups of people in the society, Dtac decided to take part in this market by selling the iPhone in March 2010 after the introduction of Blackberry service in December 2009. Furthermore, Dtac also partnered with key handset manufacturers such as Samsung, Nokia, and HTC to offer bundled data and handset packages. All of these strategies implemented by Dtac has driven them to be very successful in the smartphone and starter kit business.

Lastly is other service revenue, which is mainly revenue from International Direct Dialing Service (IDD services) and other fees, such as Mobile Number Portability (MNP), which has increased its total revenue for mobile service operators in the market recently. MNP service has enabled mobile phone customers to retain their numbers when switching operators. This service focuses on giving both outgoing and incoming subscribers a good experience with and impression of DTAC.

True

True Corporation is one of the largest fully-integrated telecommunication, mobile phone, and Internet service providers in Thailand. The company initially registered as TelecomAsia in 1993 to provide fixed-line phone service and has been listed on the Stock Exchange since the same year under the symbol 'TA.' However, TelecomAsia was heavily in debt due to capital investment in network, which is a characteristic of the network company and it changed its name to 'True' and changed the security symbol to 'True' in April 2004 in order to change its image and to improve its operation.

The company has five major brands and business segments: 'Truemove', the number three mobile phone operator in Thailand with 3G capability; 'TrueOnline', the largest broadband and fixed-line phone provider in the Bangkok Metropolitan Area (BMA), as well as the leading data communication service provider and 'TrueVisions,' the only nationwide cable TV operator in Thailand. The company also has extended service in the financial area under the brand 'TrueMoney' and digital content provider under the brand 'TrueLife.' The company has recently started its own coffee shop as a diversified business called 'TrueCoffee' as well; however, the primary businesses are still the first five segments. A revenue breakdown for each business sector is as below.

Business Group	2009	
	Baht Million	%
1. TrueOnline Revenues	21,784	34.9%
2. TrueMove Revenues	31,312	50.1%
3. TrueVisions Revenues	9,378	15.0%
Total Revenues	62,474	100%

Source: True annual report, 2009

Please note that True Money and True Life are included in True Move sector.

Under the BTO agreement, the Build Transfer Operate ("BTO") agreement, with TOT, True received the right to operate, maintain a network, and provide the services below:

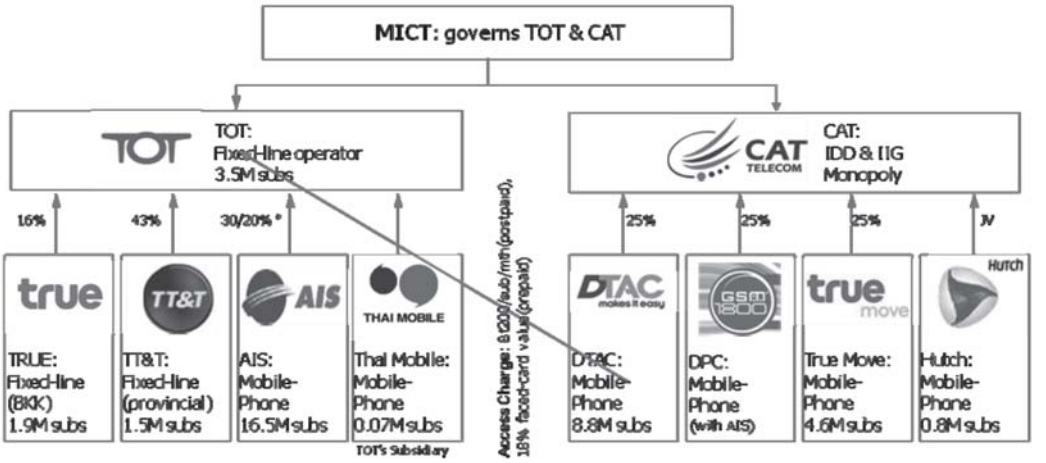
- Fixed-line telephone
- Personal Communication Telephone
- public telephone (Build Operate Transfer)
- Digital Data Network
- acceptance of fault notification and drop wire maintenance
- customer service centre

For Internet services, True was granted Internet Type I and II licenses from the NTC to operate Internet services in Thailand. Regarding cellular telephone services, True was granted from CAT telecom a 17-year concession agreement beginning in 2001 to provide nationwide cellular telephone services.

True has two large competitors, AIS (together with its majority-owned subsidiary, DPC) and DTAC, holding a 44.8 percent and 30.6 percent subscriber market share, respectively, at the end of 2009. True were third, with a market share of 24.6 percent.

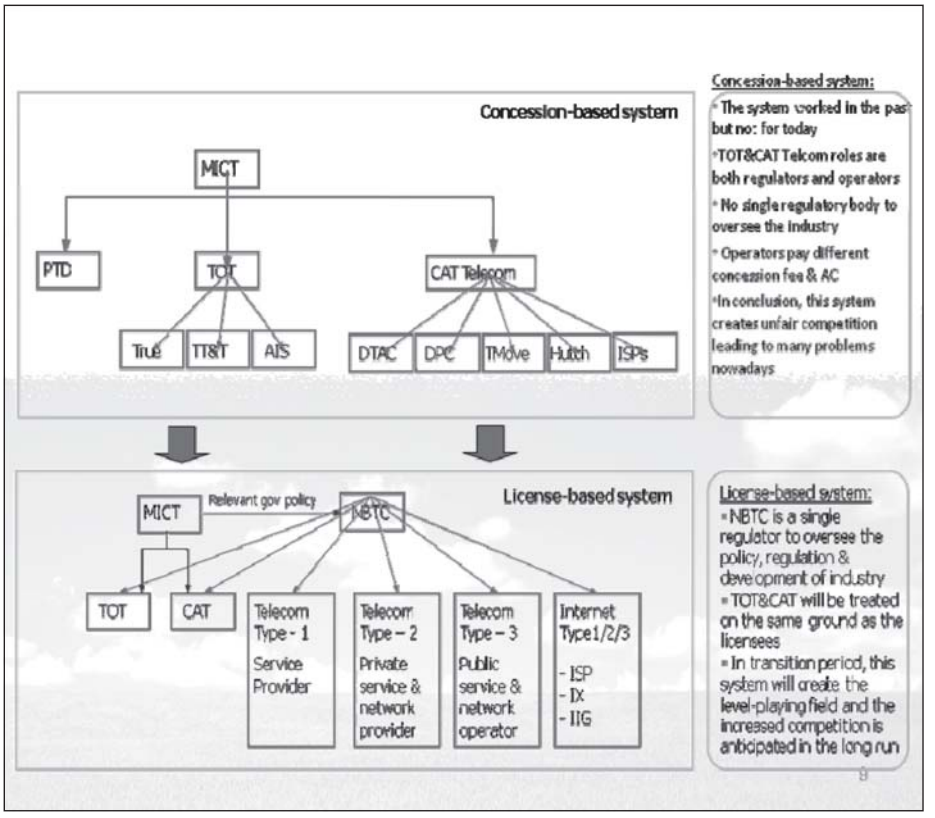
At the beginning of 2009, the True Group raised six billion bath, which was supported by the CP Group. The right offering was comprised of ten billion shares priced at Baht 1.95 per share. The purpose of this raise was to assist its with its operation and to pursue further business growth, e.g. 3G network investment. True Group has issued a five yearsdebenture with an nterest rate of 6.5%pa. to rate its capital and to finance its operation which, as of August, raisedg a total of Baht 7 billion. During the year, True Group has improved its services with higher Internet speed, an increase in Wifi hotspots in Bangkok and other major cities, international call promotion for TrueMove, the launching of iPhones in Thailand, new bundling packages between TrueVisions and TrueMove, PayTV advertisements available on TrueVisions, which is a new source of income for the group, a mortgage payment service launch between TrueMoney and Government Housing Bank, a 10-year license for electronic payments granted for TrueMoney, and several other changes across its business segments.

Appendix 24: The Concession Systems in Thai Telecom Industry



Source: NBTC

Appendix 25: The Comparison between Concession Based and License Based Systems



Source: NBTC

Appendix 26: Proportion of Households with Television, Radio, and Proportion of Individuals that used Computers, the Internet and Mobile Phones, 2009 (Santipaporn, 2010)

Region	Proportion of households with[1/]		proportion of individuals who used[2/]		
	television	radio	computer	internet	mobile phone
Whole Kingdom	96.3	58.0	29.3	20.1	56.8
Bangkok	97.8	67.3	45.8	38.0	75.5
Central	96.5	54.3	29.8	19.3	62.3
Northern	95.7	64.4	27.8	19.5	54.8
Northeastern	96.2	56.6	25.3	16.7	50.2
Southern	95.5	47.2	27.6	17.5	52.6

Source: 1/ Household Socio-Economic Survey, National Statistical Office.

2/ ICT Household Survey, National Statistical Office..(see Annex 1)

Proportion of Households in Rural Areas with Electricity, Computers, and Internet Connection, 2008

Region	Proportion of households in rural area		
	With Electricity	With Computer	Connect Internet
Whole Kingdom	**98.1**	**9.2**	**30.3**
Central	98.7	12.7	40.7
Northern	96.6	10.2	29.2
Northeastern	98.8	6.4	18.4
Southern	97.5	8.5	29.8

Source: Fundamental Telecommunication Services in Local Area Survey, National Statistical Office

Appendix 27: Top Complaints in Telecommunication Services

Types of Complaints	Number of Complaints	Percentage
Mobile Phone	1,019	73.73
Internet	311	22.50
Fixed-phone	52	3.76
Total	**1382**	**100**

Source: http://www.tci.or.th/complain_stat.php#complain_stat

Appendix 28: The Technology's Factor related to the Global Competitiveness Report (2011) Availability of Latest Technologies (Forum, 2011)

To what extent are the latest technologies available in your country? [1 = not available; 7 = widely available] | 2010–11 weighted average

RANK	COUNTRY/ECONOMY	VALUE
1	Sweden	6.9
2	Switzerland	6.7
3	Norway	6.6
4	Iceland	6.6
5	Finland	6.6
6	Netherlands	6.5
7	United Kingdom	6.5
8	Belgium	6.5
9	Denmark	6.5
10	Austria	6.4
11	France	6.4
12	Hong Kong SAR	6.4
13	Israel	6.3
14	Canada	6.3
15	Japan	6.3
16	Portugal	6.3
17	Singapore	6.3
18	United States	6.3
19	Luxembourg	6.3
20	Germany	6.2
21	Malta	6.2
22	Bahrain	6.1
23	Australia	6.1
24	Korea, Rep.	6.1
25	United Arab Emirates	6.1
26	Puerto Rico	6.1
27	Barbados	6.1
28	Panama	6.0
29	New Zealand	6.0
30	Chile	6.0
31	Qatar	6.0
32	Ireland	5.9
33	Spain	5.9
34	Estonia	5.9
35	Malaysia	5.8
36	Saudi Arabia	5.8
37	Taiwan, China	5.7
38	Lithuania	5.7
39	South Africa	5.7
40	Czech Republic	5.6
41	Cyprus	5.6
42	Jordan	5.6
43	Hungary	5.5
44	Jamaica	5.5
45	Oman	5.5
46	Slovenia	5.5
47	India	5.5
48	Guatemala	5.5
49	Slovak Republic	5.5
50	Senegal	5.4
51	Croatia	5.4
52	Turkey	5.4
53	Brazil	5.4
54	Namibia	5.4
55	Mauritius	5.4
56	Greece	5.3
57	Tunisia	5.3
58	Kuwait	5.2
59	Dominican Republic	5.2
60	Trinidad and Tobago	5.2
61	Mexico	5.2
62	Philippines	5.2
63	Sri Lanka	5.1
64	Peru	5.1
65	Morocco	5.1
66	Uruguay	5.1
67	Cape Verde	5.1
68	Costa Rica	5.0
69	Latvia	5.0
70	Brunei Darussalam	5.0
71	Italy	5.0
72	Kenya	4.9
73	El Salvador	4.9
74	Indonesia	4.9
75	Albania	4.9
76	Rwanda	4.8
77	Gambia, The	4.8
78	Colombia	4.8
79	Lebanon	4.8
80	Côte d'Ivoire	4.8
81	Honduras	4.8
82	Thailand	4.8
83	Argentina	4.8
84	Botswana	4.7
85	Guyana	4.7
86	Zambia	4.6
87	Azerbaijan	4.6
88	Poland	4.6
89	Macedonia, FYR	4.6
90	Montenegro	4.6
91	Uganda	4.6
92	Belize	4.6
93	Pakistan	4.6
94	Ghana	4.6
95	Bangladesh	4.6
96	Ukraine	4.6
97	Venezuela	4.5
98	Cambodia	4.5
99	Georgia	4.5
100	China	4.5
101	Suriname	4.4
102	Tajikistan	4.4
103	Kazakhstan	4.4
104	Ecuador	4.4
105	Bosnia and Herzegovina	4.4
106	Bulgaria	4.4
107	Nigeria	4.4
108	Benin	4.4
109	Paraguay	4.3
110	Egypt	4.3
111	Malawi	4.3
112	Moldova	4.3
113	Mozambique	4.3
114	Nepal	4.2
115	Romania	4.2
116	Armenia	4.2
117	Iran, Islamic Rep.	4.2
118	Mali	4.1
119	Syria	4.1
120	Mongolia	4.1
121	Russian Federation	4.1
122	Algeria	4.0
123	Serbia	4.0
124	Mauritania	4.0
125	Cameroon	3.9
126	Lesotho	3.9
127	Nicaragua	3.9
128	Tanzania	3.9
129	Zimbabwe	3.9
130	Madagascar	3.9
131	Ethiopia	3.8
132	Burkina Faso	3.8
133	Vietnam	3.8
134	Timor-Leste	3.7
135	Haiti	3.7
136	Bolivia	3.7
137	Swaziland	3.6
138	Kyrgyz Republic	3.5
139	Yemen	3.5
140	Angola	3.4
141	Chad	3.2
142	Burundi	3.1

Source: World Economic Forum, Executive Opinion Survey

FDI and Technology Transfer (Forum, 2011)

To what extent does foreign direct investment (FDI) bring new technology into your country? [1 = not at all; 7 = FDI is a key source of new technology] | 2010–11 weighted average

RANK	COUNTRY/ECONOMY	VALUE
1	Ireland	6.4
2	Qatar	6.1
3	Singapore	6.0
4	Panama	5.8
5	Costa Rica	5.8
6	Slovak Republic	5.5
7	Hong Kong SAR	5.5
8	Saudi Arabia	5.5
9	Uruguay	5.5
10	United Arab Emirates	5.5
11	Hungary	5.4
12	Malaysia	5.3
13	Luxembourg	5.3
14	Israel	5.3
15	Czech Republic	5.3
16	Portugal	5.3
17	Belgium	5.3
18	Bahrain	5.3
19	Sweden	5.3
20	Malta	5.2
21	Canada	5.2
22	Chile	5.2
23	United Kingdom	5.2
24	Mexico	5.2
25	Tunisia	5.2
26	Estonia	5.1
27	Switzerland	5.1
28	Brazil	5.1
29	Denmark	5.1
30	Australia	5.1
31	Netherlands	5.0
32	Thailand	5.0
33	Lithuania	5.0
34	Cambodia	5.0
35	Peru	5.0
36	Barbados	5.0
37	Poland	5.0
38	India	5.0
39	Taiwan, China	5.0
40	Honduras	5.0
41	South Africa	5.0
42	Albania	5.0
43	France	4.9
44	Austria	4.9
45	Sri Lanka	4.9
46	Oman	4.9
47	New Zealand	4.9
48	Uganda	4.9
49	United States	4.9
50	Mozambique	4.9
51	Jordan	4.9
52	Spain	4.9
53	Rwanda	4.9
54	Morocco	4.9
55	Senegal	4.9
56	Montenegro	4.9
57	Norway	4.8
58	Puerto Rico	4.8
59	Colombia	4.8
60	Kenya	4.8
61	Dominican Republic	4.8
62	Vietnam	4.8
63	Mauritius	4.8
64	Indonesia	4.7
65	Japan	4.7
66	Philippines	4.7
67	Egypt	4.7
68	Zambia	4.7
69	Azerbaijan	4.7
70	Jamaica	4.7
71	Turkey	4.7
72	Trinidad and Tobago	4.7
73	Ghana	4.6
74	Angola	4.6
75	Cape Verde	4.6
76	Cyprus	4.6
77	Armenia	4.6
78	Guatemala	4.6
79	Iceland	4.6
80	China	4.6
81	Côte d'Ivoire	4.6
82	Namibia	4.6
83	Romania	4.5
84	Brunei Darussalam	4.5
85	Mongolia	4.5
86	Korea, Rep.	4.5
87	Cameroon	4.4
88	Gambia, The	4.4
89	El Salvador	4.4
90	Botswana	4.3
91	Nigeria	4.3
92	Germany	4.3
93	Latvia	4.3
94	Nicaragua	4.3
95	Malawi	4.3
96	Tanzania	4.3
97	Finland	4.2
98	Georgia	4.2
99	Croatia	4.2
100	Kazakhstan	4.1
101	Bangladesh	4.1
102	Benin	4.1
103	Moldova	4.1
104	Mali	4.1
105	Bulgaria	4.1
106	Syria	4.1
107	Tajikistan	4.1
108	Greece	4.0
109	Guyana	4.0
110	Serbia	4.0
111	Iran, Islamic Rep.	4.0
112	Lebanon	4.0
113	Macedonia, FYR	3.9
114	Argentina	3.9
115	Haiti	3.9
116	Italy	3.9
117	Bosnia and Herzegovina	3.9
118	Burkina Faso	3.9
119	Madagascar	3.9
120	Ethiopia	3.9
121	Pakistan	3.9
122	Slovenia	3.9
123	Algeria	3.8
124	Ukraine	3.8
125	Paraguay	3.8
126	Lesotho	3.8
127	Venezuela	3.7
128	Nepal	3.7
129	Russian Federation	3.7
130	Ecuador	3.6
131	Suriname	3.6
132	Zimbabwe	3.6
133	Bolivia	3.6
134	Chad	3.5
135	Kuwait	3.4
136	Belize	3.4
137	Swaziland	3.4
138	Timor-Leste	3.4
139	Burundi	3.3
140	Mauritania	3.2
141	Kyrgyz Republic	3.0
142	Yemen	2.7

Source: World Economic Forum, Executive Opinion Survey

Firm Technology Absorption (Forum, 2011)

To what extent do businesses in your country absorb new technology? [1 = not at all; 7 = aggressively absorb] | 2010–11 weighted average

RANK	COUNTRY/ECONOMY	VALUE
1	Sweden	6.5
2	Iceland	6.3
3	Japan	6.3
4	Switzerland	6.2
5	Norway	6.1
6	Israel	6.1
7	Qatar	6.0
8	Korea, Rep.	6.0
9	Denmark	6.0
10	Singapore	6.0
11	Finland	6.0
12	Austria	5.9
13	Taiwan, China	5.9
14	Germany	5.9
15	Hong Kong SAR	5.9
16	United Arab Emirates	5.9
17	New Zealand	5.9
18	United States	5.9
19	Australia	5.8
20	Bahrain	5.7
21	Netherlands	5.7
22	United Kingdom	5.7
23	Saudi Arabia	5.7
24	Luxembourg	5.7
25	France	5.6
26	Belgium	5.6
27	Portugal	5.6
28	Malaysia	5.6
29	Canada	5.6
30	South Africa	5.5
31	Senegal	5.5
32	Panama	5.5
33	Puerto Rico	5.5
34	Malta	5.5
35	Ireland	5.5
36	Estonia	5.5
37	Jordan	5.4
38	Barbados	5.4
39	Kuwait	5.4
40	Chile	5.4
41	India	5.3
42	Sri Lanka	5.2
43	Cyprus	5.2
44	Turkey	5.2
45	Czech Republic	5.2
46	Spain	5.2
47	Guatemala	5.2
48	Brazil	5.2
49	Oman	5.2
50	Tunisia	5.1
51	Namibia	5.1
52	Philippines	5.1
53	Lithuania	5.0
54	Indonesia	5.0
55	Costa Rica	5.0
56	Mauritius	5.0
57	Dominican Republic	5.0
58	Slovak Republic	5.0
59	Hungary	4.9
60	Kenya	4.9
61	China	4.9
62	Peru	4.9
63	Brunei Darussalam	4.9
64	Cape Verde	4.8
65	Côte d'Ivoire	4.8
66	Azerbaijan	4.8
67	Honduras	4.8
68	Lebanon	4.8
69	Rwanda	4.8
70	Syria	4.8
71	Trinidad and Tobago	4.8
72	Jamaica	4.7
73	Albania	4.7
74	Morocco	4.7
75	Thailand	4.7
76	Uruguay	4.7
77	Cambodia	4.7
78	Egypt	4.7
79	Nigeria	4.7
80	Croatia	4.7
81	Mexico	4.6
82	Ukraine	4.6
83	Colombia	4.6
84	Slovenia	4.6
85	El Salvador	4.6
86	Zambia	4.6
87	Gambia, The	4.6
88	Vietnam	4.6
89	Greece	4.6
90	Mongolia	4.5
91	Botswana	4.5
92	Pakistan	4.5
93	Argentina	4.5
94	Latvia	4.5
95	Bangladesh	4.4
96	Guyana	4.4
97	Uganda	4.4
98	Mozambique	4.4
99	Montenegro	4.4
100	Poland	4.3
101	Benin	4.3
102	Italy	4.3
103	Ecuador	4.3
104	Malawi	4.2
105	Venezuela	4.2
106	Burkina Faso	4.2
107	Bosnia and Herzegovina	4.2
108	Cameroon	4.2
109	Ghana	4.2
110	Paraguay	4.2
111	Zimbabwe	4.2
112	Mali	4.2
113	Kazakhstan	4.1
114	Armenia	4.1
115	Georgia	4.1
116	Nepal	4.1
117	Romania	4.1
118	Nicaragua	4.0
119	Tajikistan	4.0
120	Iran, Islamic Rep.	4.0
121	Macedonia, FYR	4.0
122	Lesotho	4.0
123	Yemen	4.0
124	Suriname	3.9
125	Tanzania	3.9
126	Moldova	3.9
127	Bulgaria	3.9
128	Swaziland	3.9
129	Belize	3.9
130	Russian Federation	3.8
131	Madagascar	3.8
132	Haiti	3.8
133	Angola	3.7
134	Algeria	3.7
135	Ethiopia	3.7
136	Serbia	3.7
137	Timor-Leste	3.6
138	Kyrgyz Republic	3.6
139	Bolivia	3.6
140	Mauritania	3.6
141	Chad	3.6
142	Burundi	3.2

Source: World Economic Forum, Executive Opinion Survey