



Final Report

Application of Information Technology to Improve
Productivity in Thai Service Corporations

by

Dr. Watana Patanapongse

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ชื่อโครงการ: การประยุกต์ใช้เทคโนโลยีสารสนเทศเพื่อเพิ่มผลผลิตในบริษัทภาคบริการของไทย

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วัตถุประสงค์ของการศึกษาคือ เพื่อต้องการทราบว่าบริษัทภาคบริการของไทยมีอัตราการเพิ่มผลผลิตสูงขึ้นหรือไม่ ภายหลังจากที่ได้นำเทคโนโลยีสารสนเทศ (IT) ระดับสูงมาใช้ และเพื่อเสนอแนวทางในการนำเทคโนโลยีสารสนเทศระดับสูงมาใช้เพิ่มผลผลิตสำหรับบริษัทภาคบริการของไทย และเพื่อเสนอแนวทางในการกำหนดนโยบายของรัฐเพื่อช่วยเหลือบริษัทภาคเอกชนในการรับเทคโนโลยีสารสนเทศมาใช้ให้เกิดประโยชน์สูงสุด ประชากรเป้าหมายของการศึกษาประกอบด้วย (ก) ธนาคาร (ข) โรงแรม และ (ค) ธุรกิจค้าปลีก ในการศึกษาครั้งนี้ ได้สำรวจรูปแบบของระบบ IT ที่ติดตั้งในบริษัทต่าง ๆ เพื่อต้องการทราบว่าบริษัทที่ได้ติดตั้งและได้ใช้ระบบสารสนเทศเพื่อการจัดการ (MIS) มีอัตราการเพิ่มผลผลิตสูงขึ้นหรือไม่ โดยกำหนดอัตราการเพิ่มผลผลิตโดยเฉลี่ยรายปีของบริษัทต่าง ๆ ไว้สองช่วง คือ (ก) สามปีก่อนใช้ระบบ IT ซึ่งนับรวมปีที่ปรับปรุงระบบ IT ไว้ด้วย และ (ข) สามปีภายหลังจากการปรับปรุงระบบ IT ว่ามีอัตราการเพิ่มผลผลิตซึ่งวัดโดยใช้อัตราส่วนของรายรับรายปีทั้งหมดต่ออัตราส่วนของรายจ่ายรายปีทั้งหมดกรณีศึกษามีสามคู่ในสามกลุ่มธุรกิจภาคบริการระหว่างบริษัทของไทยและของญี่ปุ่น จากการศึกษาพบว่า อัตราการเติบโตของการเพิ่มผลผลิตได้เพิ่มขึ้นในระดับมีนัยสำคัญทางสถิติ ภายหลังจากการติดตั้งหรือปรับปรุงระบบ IT ในระดับ MIS ขึ้นไป บริษัทที่ใช้ MIS แสดงให้เห็นถึงอัตราส่วนการเพิ่มผลผลิตที่สูงกว่ากลุ่มบริษัทที่ใช้ IT ในระดับที่ต่ำกว่า บริษัทที่ปรับปรุงระบบ IT ของตนไม่ถึงระดับ MIS ปรากฏเห็นได้ชัดว่า อัตราการเพิ่มผลผลิตกลับลดลงภายหลังจากที่ได้ปรับปรุงระบบ IT ของตน ผู้ให้สัมภาษณ์ส่วนใหญ่เชื่อว่า IT มีส่วนช่วยสนับสนุนการเพิ่มผลผลิตของบริษัทของตน ข้อค้นพบจากกรณีศึกษาแสดงให้เห็นว่าความสำเร็จที่เกิดขึ้นมีผลเนื่องมาจากการใช้ IT ระบบเครือข่าย การพัฒนาทรัพยากรมนุษย์ และการยกเครื่องระบบบริหารของบริษัท (Reengineering) และการวางแผนด้านการจัดการที่มีประสิทธิภาพ IT จะไม่มีผลต่อการเพิ่มผลผลิตจนกว่าจะมีการใช้งานในระดับ MIS ขึ้นไป ทั้งนี้เพราะผู้ที่ใช้ IT ในระดับต่ำ คือในระดับที่ใช้ระบบการบันทึกข้อมูลธุรกิจ (TPS) และระบบสำนักงานอัตโนมัติ (OAS) นอกจากอัตราการเพิ่มผลผลิตภายหลังจากการปรับปรุงระบบ IT ไม่เพิ่มขึ้นแล้ว ยังกลับลดลงอีกด้วย ข้อเสนอแนะในที่นี้คือบริษัทควรลงทุนในระบบ IT ใหม่ ๆ ที่ช่วยสนับสนุนการตัดสินใจของฝ่ายบริหารและเทคโนโลยีการสื่อสารแบบเครือข่าย

Keywords: Information Technology, Productivity improvement, Thai Service Corporations, Japanese Service Corporations.

Abstract

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Project Title: Application of Information Technology to Improve Productivity in Thai Service Corporations

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Project Period: August 1, 1998 to July 31, 1999

The objectives of the study were to determine, for Thai service corporations, whether any increase in productivity followed introduction of advanced information technology (IT); and to provide some guidelines to companies on the introduction of advanced IT to increase productivity, and towards government policy in assisting firms to adopt IT. The target population comprised (a) banks, (b) hotels, and (c) retail sales businesses. The types of IT systems installed were surveyed, to determine whether a company had installed and used a management information system (MIS). The average annual productivity increase of the sample companies was determined over two periods of time: three years before and including, and three years following, the year of installation or upgrading of the IT system, where productivity was measured as the ratio of total annual revenue to total annual costs. Case studies comprised three pairs of companies, Thai and Japanese, in the same above three fields. It was found that the rate of growth of productivity increased to a statistically significant degree following the installation of, or upgrading of, the IT system to the level of a MIS. Companies that had introduced a MIS showed a higher rate of increase of productivity than those that made more elementary use of IT. Companies that upgraded their IT systems, but not to the level of a MIS, apparently experienced a decrease in rate of growth of productivity following upgrading. The majority of company informants believed that IT had enhanced their companies' productivity. Case studies indicated that much success could be attributed to innovative networked IT, human resource development, reengineering, and effective managerial planning. Information technology did not begin to affect productivity growth until it reached at least the level of sophistication of a MIS. The reason for this effect is believed to be that many companies that install IT only at the level of transaction processing systems (TPS) and office automation systems (OAS) are making only elementary use of this technology; that is, merely to automate routine office work, performed by nonmanagerial personnel. Companies are recommended to invest in innovative IT systems that support managerial decision making and in networked communications technology.

Keywords: Information Technology, Productivity improvement, Thai Service sector, Thai management style, Japanese service sector.

Executive Summary

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Project Title: Application of Information Technology to Improve Productivity in Thai Service Corporations

Investigators: Dr. Watana Patanapongse, Principal Investigator, Research Center, National Institute of Development Administration (NIDA); Dr. Veeraphol Suvannunt, Mentor, Associate Professor, Graduate Program of Technology Administration, National Institute of Development Administration (NIDA) Committee (alphabetical list): Dr. Lawrence DAVIDSON, Professor and Head, Center of Global Business, Kelly School of Business, Indiana University, Bloomington; Dr. William STEEVES, Professor, School of Applied Management and Decision Sciences, Walden University; and Dr. T.K. Tanahashi, Professor, School of Management Science, Tokyo Keizai University

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Project Period: August 1, 1998 to July 31, 1999

Objectives:

The objectives of the research project were, firstly, to investigate how, in contemporary Thai service corporations, the introduction of modern computerized information technology (IT) has affected productivity. Specifically, it tested the author's hypotheses: (a) The rate of increase of productivity in Thai companies significantly applying information technology is greater than in those companies not significantly applying information technology (H_1), and (b) the rate of increase of productivity at a time after introduction of information technology is greater than at a time before introduction of information technology (H_2). It thus extended to the service industries the author's previous work on the relationship of IT to improved productivity in Thai manufacturing organizations. Secondly, on the basis of the findings, it was hoped to provide some guidelines to individual companies on the introduction of advanced IT to enhance organizational efficiency and hence increase productivity; and towards government policy in assisting firms to adopt IT.

Methodology

Case studies were carried out of three pairs of companies, in the fields of (a) banking, (b) hotel business, and (c) retail sales. Each pair compared a Thai company with a Japanese company of similar status. Data for the studies were obtained from documentary materials by or on the respective company and by in-depth interview of knowledgeable persons at the company. The objective in each case was to obtain a history of the organization's use of IT, and of financial and business performance, to see what light this could throw on the relationship of IT to productivity; and to observe how the organization used other managerial techniques to improve productivity.

For the purpose of the survey, the investigator:

1. Selected as the target population Thai service companies, established before 1990, in the fields of (a) banking, (b) hotel business, and (c) retail sales.

2. Adopted the definition of a company as a "significant" user of IT if it had installed and actively used a management information system (MIS) and employed personnel responsible for the system. A company that had installed a transaction processing system (TPS) or office automation system (OAS) or both, but not MIS, was designated as a "less than significant" user.

3. Adopted as a measure of annual productivity the ratio of total annual revenue to total annual costs.

4. Specified two periods of time: (a) from three years before and including, and (b) three years following, the date of installation or last major upgrading of the IT system.

5. Distributed to the target companies questionnaire-cum-interview schedules, in order to (a) survey the types of IT systems installed and dates of installation, and so determine whether or not a recipient company was a "significant" user of IT as above defined; (b) request data on total annual revenue and total annual costs over the periods above specified; (c) survey the opinions of employees responsible for IT, as to the consequences for productivity of the introduction of IT in their respective companies; and (d) elicit opinions of respondents as to recent and future trends in their companies' productivity.

6. Selected from the target population a sample of companies able to supply adequate and sufficient data for the purpose of calculation, comprising two subsamples of (a) "significant" users, and (b) "less than significant" users, of IT.

7. Determined the average annual rate of productivity increase for the sample companies over the two periods of time above specified.

8. Employed the Mann-Whitney U test to compare rates of productivity increase between "significant" and "less than significant" users of IT, and so test Hypothesis H_1 .

9. Employed the Wilcoxon Matched-pairs Signed Ranks test to compare sample companies before and after installation or upgrading of their IT systems, and so test Hypothesis H_2 .

Results:

Case studies of highly successful companies indicated that much of this success could be attributed to innovative networked IT. However personnel were agreed that introduction of IT alone was not sufficient to ensure increased productivity. Information technology must be supported by training and human resource development, business process reengineering, and skilled management. Assessment of productivity is complicated by the occurrence of the current economic crisis, which has caused a severe loss of productivity and profitability for many companies. However, it is noteworthy that the companies of this study are continuing to prosper while many others are failing.

The survey data confirmed the research hypotheses. It was found that the rate of growth of productivity increased to a statistically significant

degree following the installation of, or upgrading of the IT system to the level of, a MIS. Companies that had introduced a MIS showed a higher rate of increase of productivity than those that made more elementary use of IT. An unexpected result was that companies that upgraded their IT systems, but not to the level of a MIS, apparently experienced a decrease in productivity growth following upgrading. The finding was in agreement with the view of company informants, the majority of whom believed that the introduction of IT had enhanced their companies' productivity.

Among the surveyed companies, banks were the most advanced in the use of IT and likely to face the most severe problems related to IT. Budgets for investment and training in IT were rather small. Hotels placed the most emphasis on training of personnel. Among techniques, other than IT, intended to enhance productivity, there was most interest in reengineering, benchmarking and TQM. The Internet was becoming fairly widely used.

Discussion Conclusion

It was concluded that the installation and active use of a MIS has a statistically significant positive effect on the rate of increase of productivity. For this sample of service industries, as for the manufacturing industries of the author's previous study, IT did not begin to have an appreciable effect on productivity until it reached at least the level of sophistication of a MIS. The reason for this effect is believed to be that many companies that install IT at the level of TPS and OAS are making only elementary use of this technology, that is: merely to automate existing office practice. If the result is to reinforce out-of-date procedures, the negative effect would be explained. The use of IT must be innovative to be effective; and must support and be supported by employees and management at all levels.

Firstly, it is suggested that a company investing in IT must not limit itself to TPS and OAS. From the very beginning it must invest at least at the level of MIS, and possibly more advanced systems: decision support systems (DSS) and executive support systems (ESS). In short, it should endeavor from the start to apply the full potential of modern computerized IT to managerial decision making and enhanced business performance. If its personnel are inexperienced, they may well take expert advice from a reputable consultant organization.

Management must maintain awareness of advances in technology as they appear. They must consider the relevance of each new development to their own business objectives. They must ask "How can we use this to improve our business performance?" and "Can this enable us to do something we have never done before?"

Secondly, when an organization invests in IT, it must be in networked IT. It must use IT to bring it into contact with its customers, suppliers, associates, and sources of information worldwide. A company that does not now go on-line may not survive.

A company must recognize that it must reorganize itself to take advantage of the new technology. It must give attention to education of personnel to make optimum use of the new technology. And it must recognize that IT can support, but cannot replace, managerial planning and decision making.

For a government department concerned with application of IT to national development, promotion of human resource development and education for IT is the first priority.

Further research into the relationship of IT to productivity is required. Case studies should reveal new insights into the meaning and measurement of productivity for the service industries, which can then be subjected to survey research. Organizations such as the Thailand Productivity Institute (TPI) and Asian Productivity Organization (APO) are in a strong position to conduct such research.

In the meantime, a new management style based on global communication and access to information is likely to emerge, and managers are urged to adopt it.

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First, I would like to express my sincere appreciation to the Thailand Research Fund (TRF) who awarded the post doctoral research scholarship to me, especially Profesor Dr. Vicharn Panit M.D., the Director of the TRF. I still remember his speech on the orientation day for the TRF post doctoral scholarship recipients. He said: "If we would like to be a good research scholar or a good academic, we should try to be accustomed to a plain or simple life style. To live a simple life, we have to train ourselves. At the beginning, we might feel it hard to live a simple life but if we further keep training ourselves we would be accustomed to it. Once I tried myself and now I am accustomed to this kind of life style. The greedy cannot be a good research scholar." Without the scholarship, this work may not have appeared in the research world. In addition, I would like to thank Associate Professor Dr. Veraphol Suvannunt of the Graduate Program of Technology Administration, National Institute of Development Administration (NIDA), who was willing to work as my mentor. Without him, the procedure for this post doctoral research awardee would not be complete.

My sincere appreciation again goes to Associate Professor Dr. Kanikar Sookasame, at the School of Applied Statistics, NIDA, for the time being working as Director, Research Center, NIDA, who supported me to further my study as a doctoral research worker. In addition, I would like to thank Associate Professor Dr. Anumongkol Sirivedhin, President of the National Institute of Development Administration at the time, who supported me to do this research and signed the contract on behalf of NIDA when receiving this scholarship from TRF. Without his signature at that time, my status as a TRF scholarship recipient would have automatically ended.

In academic work, I would like to express my sincere thanks to Professor Dr. William D. Steeves Jr., School of Applied Management and Decision Sciences, Walden University, Professor Dr. Lawrence Davidson, Head of Global Business, Kelly School of Business, Indiana University at Bloomington, and Professor Dr. T.K. Tanahashi, School of Management Science, Tokyo Keizai University who agreed to work as my committee members. Dr. Tanahashi also signed to work with me as host scientist under the scholarship granted to me by the Japan Society for the Promotion of Science (JSPS) and the Thailand Research Council (TRC) to go to do one month's research in Japan during September 8 to October 11, 1998. Again it was he who contacted Tokyo Keizai University for me to attend as a research scholar and stay at the Varsity Guest House for about a month.

From the beginning, I would like to thank once again Professor Dr. Steeves who gave me critical notes and comments on my work. My appreciation also goes to Professor Dr. Davidson who sent me a long critique

and comments which were very useful for me when taking care in undertaking this research. My thanks should go once again to Professor Dr. Tanahashi who gave me useful comments and suggestions. Without this committee, my work would not have the quality it has.

For the period of collecting data for case studies, that is, at the Thai Farmers Bank and at the Central Plaza Hotel: My thanks should go to my MBA students at Southeast Asia University and Saint John's University, who helped me to interview personnel at the Thai Farmers Bank and at the Central Plaza Hotel. I can say that it was my good opportunity to work as visiting lecturer at the two universities, because I had a chance to train these MBA students in how to collect data. It could be said of these students that, after intensive training in how to interview and collect data, the data collected appears of high quality.

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Having completed one case study, a case study of the Central Plaza Hotel, I had an opportunity to present my work at an international symposium.

sium on Information Technology and Industrial Renovation which was organized by the Asian Productivity Organization (APO) and hosted by the Indonesian Productivity Institute (IPI) in Yogyakarta, Indonesia, from 31 August to 5 September 1998. I would like to thank many people concerned in giving me the opportunity to take part in this symposium. First, my thanks should go to the Thailand Productivity Institute (TPI) who informed me of the news; and then to APO and IPI who sponsored and hosted me for this symposium. Again, many experts and IT practitioners, as representatives from Asian countries, gave me new insight on IT which could not be gained from reading but directly from their experiences. The symposium helped me to learn more paradigms of IT. The most important thing is that I had an opportunity to present my model of productivity measurement in the service sector. After presenting the article, I was happy that my model, as used in this research, was well accepted by most of the participants.

Fortunately, after returning from Indonesia, I had a chance to mark up some new ideas and new knowledge obtained from the symposium to refine my case study questionnaire outline, before going to Japan to undertake three case studies in parallel as a comparison with the Thai case studies on (a) banks, (b) hotels, and (c) retail sales businesses.

For my research work in Japan, once again, I would like to thank Professor Dr. Tanahashi for his accepting me as a Japanese host scientist. Without his acceptance, the procedure for receiving a scholarship from the Japan Society for the Promotion of Science (JSPS) would not have been successful. There were many people and many organizations who helped me in going to work in Japan on an exchange scientist program during September 8 to October 10, 1998.

On the Thai side, I would like to thank the Thailand Research Council (TRC) who sent me the news and awarded me this joint project between Thailand and Japan as an exchange scientist. Once again, I would like to thank Dr. Kanikar Sookasame, NIDA Research Center Director; and Dr. Anumongkol Sirivedhin, NIDA President at the time, who approved my leave for research in Japan for one month. On the Japanese side, I would like to thank Mr. Kenji Nakashima, Head, Asian Program Division, JSPS, who coordinated my visit well and gave me the opportunity to arrive in Japan and return to Thailand with safety and with a memory of good impressions. He also arranged for a person to meet me at the Narita Airport on the day I arrived in Tokyo. Without such service I might have faced many problems.

From the first day of my stay at the Tokyo Keizai University's Apartment till the day I departed from the Apartment, I was staying there in a comfortable and colorful atmosphere. This is because of the hospitality given to me by all people at the International Exchange Office, Tokyo Keizai University, especially Miho Obinata San, Manami Tachikawa San, and Hideo Kuwahara San. Without their help, I might have faced many difficulties.

During my stay in Tokyo, Professor Dr. Tanahashi worked hard with me, because the target companies we had planned before my visiting Tokyo were not ready to allow us to use them as case studies. To contact new companies for case studies was a very hard job. In addition to the worry about the confidentiality of company data, private companies are usually careful about facts and figures going to the public. To contact the companies for my case studies at the time was a very serious matter because we had to fight with the time being limited and drawing shorter. To solve this problem, I planned as follows:

(1) I requested the Thailand Research Council (TRC) to contact relevant companies directly. The problem is: TRC could not approach JSPS on this matter because JSPS itself does not have any formal relationship with the private sector in Japan. Therefore what TRC could do was to issue a formal letter of recommendation for me to show to whom it may concern. May I take this opportunity to thank people at TRC who coordinated and helped me for this purpose.

(2) I requested the Thailand Productivity Institute (TPI) to contact the Asian Productivity Organization (APO) and request APO to contact the Japan Productivity Center (JPC) to contact the target companies. Before TPI would officially work on this, they required a letter of official request from the NIDA President. I immediately faxed a letter to the NIDA Research Center to prepare and process the letter for the NIDA President's signature. After receiving a letter of official request from us, Khun Masussawee Dhadasih, working as APO Liaison Officer for Thailand, formally contacted APO, but due to the time limitation, APO could not help on this matter. However, APO, especially Mr. Kenneth Mok, Dr. A.K.P. Mochtan, and Mr. Choi helped me find some useful documents relevant to the project. In fact, I personally contacted and discussed this matter with Mr. Choi, who represented APO at the symposium in Indonesia, during the time we were at the symposium.

(3) I approached the Thai Embassy to Japan in Tokyo by contacting Minister Krawee Synthuchao, Office of Commercial Affairs, Royal Thai Embassy. It was very kind of him and his staff, Khun Somsri Ngaotheppithak, Khun Phansak Musikarat, and Khun Sirirat Wongpairote, that they helped to successfully contact two companies, that is, the Bank of Tokyo-Mitsubishi and the New Otani Hotel.

(4) Dr. Tanahashi and his colleagues at Tokyo Keizai University especially Professor Dr. Kazuo Takeuchi, contacted their alumni working at various businesses in Tokyo. The outcome was that they successfully contacted the New Otani Hotel and 7-Eleven Japan. It is noticeable that the New Otani Hotel was also contacted by the Thai Embassy. It could be said that to contact companies for indepth interview for case studies is very tough. One agency alone sometimes cannot attract their interest. However, when two or three agencies approach them and request them for the same purpose, they pay more attention to our request. May I once again thank all people concerned for their success in contacting companies for case studies.

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CHAPTER 1: INTRODUCTION

1. Introduction to the Study

Recently, as has happened in most developing as well as developed countries, the service sector has come to play an increasingly important role in the Thai economy.

A service industry may be defined as one that produces and deals in "an intangible good that consists primarily of human skill in the form of advice, labor, management or ideas" (Gipson, 1994). These industries may be further classified as providing

1. Consumer services, e.g. retailers, caterers, etc.
2. Professional services, e.g. accountants, doctors, lawyers, etc.
3. Trade services, e.g. banks, insurance companies, etc.

Three features are commonly said to distinguish service industries from manufacturing industries:

1. Intangibility: A service is a process, not a physical object. In consequence, they are not always easy to understand or define.

2. Inseparability: Services cannot be stored or inventoried. In general, the service is consumed as it is supplied. Both the supplier and the customer are directly involved in the service process. The appropriateness of viewing the service organization as an "open system" is apparent.

3. Heterogeneity: Since there is a more personal interaction between the customer and supplier, different customers may judge the same supplier differently. This creates difficulties in defining the quality of a service (Watkins, 1996).

Too much must not be made of these differences. For instance, a retailer or non-manufacturing exporter deals in tangible products, which can be and commonly are inventoried. However, the service, that of mediating between manufacturer and consumer, remains intangible.

Data quoted by Tinakorn and Sussangkarn (1996) illustrate that, by 1990, the service industries accounted for almost 50% of gross domestic product, and constituted the fastest growing sector of the economy.

Table 1.1
Gross Domestic Product by Industrial Origin and Percentage Distribution

(Millions of Baht and Percentage)

	At 1962 prices		At 1972 prices		
	1960	1969	1970	1980	1990p
Agriculture ¹	21,399.5	25,257.0	42,064.0	61,770.0	90,711.0
of which	(38.2)	(31.3)	(27.0)	(20.6)	(14.4)
- Crops	15,874.0	24,542.0	26,723.0	39,783.0	56,070.0
	(28.3)	(21.8)	(17.2)	(13.3)	(8.9)
Industry ²	10,896.5	29,233.0	39,201.0	92,287.0	226,402.0
of which	(19.4)	(26.0)	(25.2)	(30.8)	(35.8)
- Manufacturing	7,320.0	18,821.0	24,893.0	64,494.0	156,043.0
	(13.1)	(16.7)	(16.0)	(21.7)	(24.7)
Service ³	23,773.4	48,056.0	74,429.0	145,415.0	314,497.0
of which	(42.4)	(42.7)	(47.8)	(48.6)	(49.8)
- Banking, insurance, and real estate	1,088.6	4,104.0	3,846.0	8,286.0	33,656.0
	(1.9)	(3.6)	(2.5)	(2.8)	(5.3)
GDP	56,069.4	112,546.0	155,694.0	299,472.0	631,610.0
	(100)	(100)	(100)	(100)	(100)

- Notes: ¹ Agriculture includes crops, livestock, fisheries and forestry.
² Industry includes mining and quarrying, manufacturing, construction, and electricity and water supply.
³ Services includes transportation and communication, wholesale and retail trade, banking, insurance and real estate, ownership of dwellings, public administration and defence and other services.

The 1990 data are preliminary.

Source: NESDB. The series of GDP at 1972 prices was revised down to only 1970. Therefore, the 1962 price series cannot be connected with the 1972 price series.

Table 1.2
Growth Rates of GDP by Industrial Origin

	(Percentage)		
	At 1962 prices	At 1972 prices	
	1960-1969	1970-1980	1980-1990
Agriculture	5.7	3.9	3.9
of which			
- Crops	4.9	4.0	3.5
Industry	11.6	8.9	9.4
of which			
- Manufacturing	11.1	10.1	9.2
Service	8.1	6.9	8.0
of which			
- Banking, insurance, and real estate	15.9	8.0	15.0
GDP	8.0	6.7	7.8

Note: Growth rates are calculated approximately as an average compound rate over the specific period.

See other notes and source in Table 1.1.

Indeed, up to the date of publication of this study, few would have doubted that the story of Thailand's economic development was one of success. Geographically and economically, Thailand lies within the Asia-Pacific region, which has often been regarded as a model of economic and industrial development (Sun, 1995). Thailand and several of its neighbours in the area of South East Asia were attaining the status of newly industrialized countries (NICs) and were leaders in global economic and industrial growth. Between 1980 and 1994, per capita GNP in Thailand grew at an average annual rate of 7.8% (Pongpaichit & Baker, 1996, p. 3), far in excess of most developing regions of the world.

It was generally agreed that this remarkable economic performance was a consequence of long term macroeconomic stability and an emphasis on export-oriented industrialization, private sector involvement, a favourable attitude towards foreign investment, a relatively open market economy and industrial human resources development (Bank of Thailand, 1994).

At the same time the fact cannot be ignored that this economic development was being achieved at the cost of increasing disparity of income and wealth distribution both between and within countries of the region, increasingly uncontrolled and poorly planned urbanization, environmental degradation, and strain on the physical infrastructure, which led some critics (Pongpaichit & Baker, 1996; Rigg, 1995, pp. 3-24) to question how long such development could be sustainable. The current economic crisis clearly indicates that such fears were not unfounded.

Already, in the early part of 1996, there were signs of a slowdown in the rate of growth (Advanced Research Group Co., Ltd., 1997, pp. 2-44). In the first half of 1996, exports grew at a rate of only 3.5%. The decline was especially noticeable in traditional labor intensive manufactures and seafood products. Rising costs of production, shortage of raw materials and trade barriers were cited as explanations. Imports fell in all major categories of non-oil products, but less so than exports, a situation that represented a deteriorating balance of trade. Inflation rose at a decreasing rate, but was still appreciably greater than in the preceding year. In the wake of these changes, private consumption and investment fell. Only public investment, mainly on basic infrastructure projects, expanded appreciably. Nonetheless, at this time, the outlook for 1997 was still optimistic.

Siamwalla (1997) attributes the subsequent crisis to excessive borrowing by the private sector, mainly to finance investment in land and real estate, coupled with short-sighted policies by the Bank of Thailand, which was eventually unable to prevent a catastrophic fall in the baht exchange rate.

Be that as it may, some new development is required if economic progress is to be resumed and maintained in a sustainable fashion. The problem is complex, but the solution is in part at least a matter of the more efficient use of resources, that is of productivity.

Information technology (IT) now plays a very important role in the Thai business corporation. Information is a prerequisite for effective corporate planning for organizational and financial goals. In principle, management can apply computerized IT to achieve greater productivity in the organization. Many Thai corporations have already taken this step.

In a preceding study, the author (Patanapongse, 1996) investigated the relationship of IT to improved productivity for a sample of Thai manufacturing organizations. The study adopted the classification (Loudon & Loudon, 1991) of computer-based information systems (CBIS) into (a) Transaction Processing Systems (TPS), (b) Office Automation Systems (OAS), (c) Management Information Systems (MIS), (d) Decision Support Systems (DSS), and (e) Executive Support Systems (ESS). A company was defined as "significantly" applying IT if it had installed and actively used a MIS - irrespective of whether or not any more advanced system (DSS or ESS) was also employed. Productivity was measured as the ratio of total annual revenue to total annual costs.

It was found that the introduction of a MIS was associated with a positive and statistically significant increase in productivity. However, in the course of this study, certain other questions arose which require further research to answer. Though the study showed a correlation between "significant" use of IT, as here defined, and enhanced productivity, it was still not clear exactly how IT use was related to productivity.

Moreover it is desirable that studies on the relationship of IT to productivity be extended to the service industries. In recent publications, Drucker (1992, 1993, 1995) has argued that the most urgent challenge confronting management at the present time is that of improving the productivity, often absurdly low, of the service industries. Drucker is writing with developed countries in mind; but, as the statistics quoted above clearly show, the argument is equally well applicable to Thailand. It follows that more research is needed to answer unanswered questions on the adoption and optimal application of IT by management with a view to the improvement of corporate productivity, more especially in the service industries.

2. Statement of the Problem

Has the introduction of IT improved productivity in those Thai service organizations that have adopted it? There is certainly a widespread subjective impression among management who have introduced computerized IT systems that productivity has improved in consequence (Choi, Subramanian, Lee & Kim, 1989; Patanapongse, 1996), but quantitative data in support of this assertion are rarely given. The adoption of IT is one among many factors that could affect productivity. It is possible, for instance, that the best managed firms adopt IT more readily and that improved productivity is a consequence of superior management rather than of IT use in itself; or that productivity improvement is a consequence of increased capital investment in productivity, of which that in IT is only a part.

In addition, the question of just how IT could act to improve productivity - important to a management concerned with how best to introduce IT within its own organization - remains elusive.

3. Background of the Problem

The keyword of the late 20th to early 21st century is "globalization." Computerized telecommunications will soon make it possible for individuals and businesses to communicate with anyone else on the planet, on any subject, in real time (Naisbitt, 1994, chap. 2).

Globalization of business is breaking down traditional national boundaries. Business now depends on accurate and timely information on worldwide marketing conditions. Information technology is advancing to meet this need. Thai corporations, especially medium and small corporations, are facing the problems of adopting and adapting the most appropriate forms of IT. Among these is the shortage of a technologically trained workforce, which is vital for the productivity and competitiveness of both manufacturing and service industries. Facilities for skill upgrading are also inadequate at present (Khoman, 1995; Yuthavong et al., 1985).

Thailand named the year 1995 as the Year of Information Technology, an expression of the awareness of the importance and benefits of IT. It is now a national policy to recruit, educate and train personnel to most effectively apply IT to improve productivity.

In the changing world at the turning point of the 21st century, all countries must adjust themselves to the trend towards globalization. Thailand equally has to be in time with this trend. Organizational management, in both already industrialized and newly industrializing countries, has to accept computerization, and give its attention to IT systems. Business today is facing the Age of Information. Increasingly, strategic planners must recognize that, in the global economy of today, information is the key to growth and competitiveness (Komske, 1990). The sheer volume of information available presents a challenge to management: how to locate, process, report and use the most relevant information in order to make effective managerial decisions.

Organizational success depends on converting data into information. For instance, the vast amount of data that a department store can collect from the scanners used at check-out points must be organized if it is to provide information on sales trends to a store manager. Information, to be of value in managerial decision making, must be timely, relevant, reliable and verifiable, complete, clear and accessible to the people who will use it (Dock & Wetherbe, 1988, p. 36). Computerized IT has made this possible.

Computerized data and information processing has dramatically changed the way in which companies do business. Almost all information is now processed using computers. To serve the needs of management for information in a globalized age, management database systems and management information systems (MIS), decision support system (DSS) and executive support systems (ESS) have evolved (Bartol & Martin, 1994, p. 595; Loudon & Loudon, 1991, p. 44). These systems are computerized for data acquisition, analysis, interpretation, forecasting; and for decision making.

4. Purpose of Study

The purposes of this study are:

1. To investigate how, in contemporary Thai service corporations, the introduction of modern computerized IT has affected productivity. If the findings of the study indicate that the introduction of advanced IT will greatly enhance organizational efficiency and hence increase productivity and concomitant profitability, Thai service organizations would be wise to introduce such technology in order to compete better in the world market, and the Thai government might consider what incentives are possible to promote adoption of advanced IT in Thailand.

2. To determine whether any increase in productivity following introduction of advanced IT is observable. Specifically it will compare (a) the rate of increase of productivity in Thai service corporations significantly applying IT with that in corporations not significantly applying IT, and (b) the rate of increase of productivity after introduction of IT with the rate before introduction of IT.

3. Should the findings of this study indicate a clear connection between the adoption of IT and enhanced productivity in Thai service firms, to provide some guidance towards government policy in assisting and encouraging firms to adopt IT.

4. On the basis of the findings of this study, to provide information of value to firms themselves when faced with decision making as to when and in what form to adopt IT, and thus to ensure the best return on the substantial financial investment involved.

5. Rationale or Theoretical Basis for the Study

Productivity is defined, at its broadest, as the ratio of output to input. Productivity, then, increases when output increases or input decreases, or both. The optimum output is determined by the market (Domingo, 1991). Productivity increase, then, implies minimizing the input: that is, the most efficient use of resources to achieve the desired output. Efficient use of resources implies: Improve the process - the transformation stage between input and output.

This has been the motive behind much of what has come to be known as "organizational theory," as it has developed since the late 19th and early 20th centuries. Each theoretical viewpoint has had its own particular recommendations for improving productivity (Bovee, Thill, Wood & Dovel, 1993, pp 43-61; Sheldrake, 1996). Broadly, these can be classified under three approaches, according to whether the emphasis is on: (a) analysis and improvement of the work process, (b) human relations and the psychology of work, or (c) organizational structure and goals.

Scientific management, as developed by Taylor (George, 1972, chaps 5-7; Taylor, 1911), the Gilbreths (1917), and Gantt (1919) led to "time and motion study" - the identification of, and training of the worker in, the most efficient way of performing a manual task; the endeavour to place the right person in the right job; and, on the assumption that the worker's motivation is mainly economic, to differential piecework pay systems and bonuses to reward workers who performed up to and beyond expectations.

The human relations school, originating from the work of Mayo (1933; see also Roethlisberger & Dickson, 1939) focuses attention on motivations other than pay. The emphasis now is to motivate employees to work productively by providing an environment that satisfies psychological and social needs. Managers must gain cooperation of the group and promote job satisfaction and norms consistent with the goals of the organization. Maslow (1943) argued that managers are to encourage behavior that satisfies people's needs and organizational goals simultaneously. McGregor (1960/1987) advocated that managers should have trust in employees and their

ability to choose the methods they will use to attain organizational goals. Herzberg (1966/1974) recommended "job-enrichment" to make the task more meaningful and satisfying to the worker. One may also cite Chester Barnard's (1938/1968) observation that individuals will not work effectively for an organization that they do not feel satisfies their own personal goals at least part of the time.

Research into human relations has shown, however, that the situation is more complex than was originally thought (Carey, 1967). Satisfied employees are not necessarily more productive and the nature of the work itself is an important element in productivity.

Fundamental to all these approaches to improving productivity is the effort to make optimum use of human resources. The more effective use of human capital is recognized as being a major, possibly the most important, component of productivity change. All of the computerized information systems introduced to date have as their objective the more efficient performance of some human task. They have been introduced in the hope that they will enable more effective use of human resources - and hence increased productivity. Studies of the effect of IT on organizational performance suggest that this can be achieved. However, the introduction of IT must be properly planned - IT has not rendered the insights of the past redundant.

6. Hypotheses

The following hypotheses were proposed:

H_1 Research hypothesis (H_1): The rate of increase of productivity in Thai companies significantly applying information technology is greater than in those companies not significantly applying information technology.

Null hypothesis (H_0): The rate of increase of productivity in Thai companies significantly applying information technology is the same as in those companies not significantly applying information technology.

H_2 Research hypothesis (H_2): The rate of increase of productivity at a time after introduction of information technology is greater than at a time before introduction of information technology.

Null hypothesis (H_0): The rate of increase of productivity at a time after introduction of information technology is the same at a time before introduction of information technology.

7. The Significance of the Study

Already, by the year 1995, which had been officially named the "Year of Information Technology," business organizations in Thailand had moved from doing business only within the country, or with neighbouring countries, to doing business worldwide - the process that is at present called globalization. These organizations are introducing computerized IT that is becoming standard worldwide. Yet, though there is much managerial interest in enhancing productivity, the effect of IT has hardly been considered. The question has not been the subject of any previous quantitative study, on the basis of which a definitive answer could be given. How best to measure productivity of the service industries, and of the information industries themselves, is controversial; and a researcher has scope to propose and test new measures of productivity in this area. This study, by throwing light on the role of IT in enhancing productivity, and hence profitability and competitiveness, in the service industries, may assist management in strategic planning for IT. The organizations under study may serve as examples, or "benchmarks," for others.

Improved productivity is thought to be the key to future prosperity and a higher standard of living for any country. Expanded productivity is desirable for developing countries such as Thailand, but in developed countries also, the problem of lax productivity and its cause have been matters of concern for some time. All will move forward more rapidly if the factors promoting productivity can be identified and encouraged. The study can be expected to impact positively, not only on strategic planning of IT for improved productivity by Thai corporations, but on planning for the future in other developing countries; and may be of service even to organizations in developed countries that have no previous experience in the use of IT.

8. Definition of Terms

Information technology (IT) refers to the application of computer-based systems to the input, storage, processing, retrieval, and transmission of information. Systems currently in use cover the five main types: Transaction Processing Systems (TPS), Office Automation Systems (OAS), Management Information Systems (MIS), Decision Support Systems (DSS), and Executive Support Systems (ESS).

Significant application of IT refers to a company having installed, and employing a person or persons to operate, a management information system (MIS), and actively using the system to support its day-to-day business.

Productivity refers to a measure of efficiency of production, here expressed as:

$$\text{Productivity} = \text{Real Output} / \text{Real Input}$$

where

$$\text{Real Output} = \text{Total revenue for year X} \times 100 / \text{Price index for year X}$$

$$\text{Real Input} = \text{Total costs for year X} \times 100 / \text{Price index for year x.}$$

And price indices are relative to a base year for which the price index is set at 100.

Thai service company refers to any service company doing business in Thailand, whether a wholly Thai-owned corporation, or Thai/foreign joint venture. It does not include contemporary Thai corporations doing business outside Thailand.

Local area network (LAN) refers to personal computers or workstations linked through a communications network, employing a network operating system, and sharing database and processing facilities.

5S refers to a principle of Japanese management to the effect that work should be guided by five general rules, expressed in Japanese as seiri (distinguish what is needed), seiton (neatness), seiso (cleanliness of the workplace), seiketsu (cleanliness of habits), and shitsuke (discipline).

9. Methodology

The purpose of the study was to assess the impact on service sector productivity of the application of IT. Specifically, it compared the productivity of Thai service companies which had, and those which had not, significantly applied IT. Since almost all organizations are now using computerized IT to some extent, it was necessary to define "significant" usage. For the purpose of the study a company was regarded as a "significant" user if it had installed, was actively using, and employed personnel to operate, a MIS.

As a measure of productivity, the ratio of total annual revenue to total annual costs, for a given year, was taken. Money values were adjusted by price index to a base year of 1985.

Case studies were carried out on a series of companies representing various service industries and levels of IT application, in order to elicit data and opinions from company personnel knowledgeable in the application of IT. The objective of the studies was to investigate the consequences for productivity of investment in advanced IT and to refine the questionnaire-cum-interview schedule to be used in the main survey.

For the main survey, a questionnaire was distributed to service sector companies. The questionnaire had three main objectives: (a) to determine whether the company was, or was not, a "significant" user of IT, as defined for the purpose of the study; (b) to determine the dates of "introduction of various IT systems in use, whether or not the company was regarded as a "significant" user; and (c) to request data on total annual revenues and total annual costs over a period of seven years, from three years before to three years after, the year of introduction or upgrading of IT.

The final comparison was carried out on a sample comprising both significant, and less than significant, users of IT. For all cases, the average annual rate of increase in productivity was calculated for the period before, and the period after, the year of introduction or upgrading of IT. The Mann-Whitney and Wilcoxon Matched-pairs Signed Ranks tests were then used, as described in Chapter 3, to compare productivity growth before and after the year of introduction of IT, and as between significant and less than significant users of IT.

10. Organization of the Study

Following the introductory first chapter, the study continues with a review of literature on related management principles. Systems theory, as it applies to organizational behavior, is first considered in Chapter 2. The history of computerized IT is briefly reviewed and the IT systems currently available to support managerial decision making are described. After citing the difficulty in assessing the impact of IT on productivity in the service industries, available evidence, mainly from case studies, on the impact of modern computerized IT on organizational performance and effectiveness is then reviewed, including such studies as are available on adoption of IT by Thai organizations. The present status of strategic planning in Thailand and Thai managerial style are described. Chapter 2 concludes with a more detailed discussion of the concept of productivity and its measurement.

Chapter 3 describes the research methodology in detail; the survey instruments and statistical procedures employed to investigate the impact of the introduction of IT on productivity for the sample of service companies studied.

Chapter 4 presents and analyses data from and reports the results of case studies.

Chapter 5 presents and analyses data from and reports the results of the survey.

Chapter 6 gives conclusions and recommendations for IT application, for productivity improvement for concerned organizations and for future research.

CHAPTER 2: THEORETICAL BACKGROUND AND RELATED LITERATURE

1. Introduction

The theme of this study can be considered as organized around five key words or phrases: (a) Systems theory, (b) Information technology (IT), (c) Strategic planning, (d) Thai management style, and (e) Productivity.

2. Systems Theory

This study takes the open systems viewpoint of the organization, as a background to concepts of IT. A systems model is clearer if it is presented in a figure as follows:

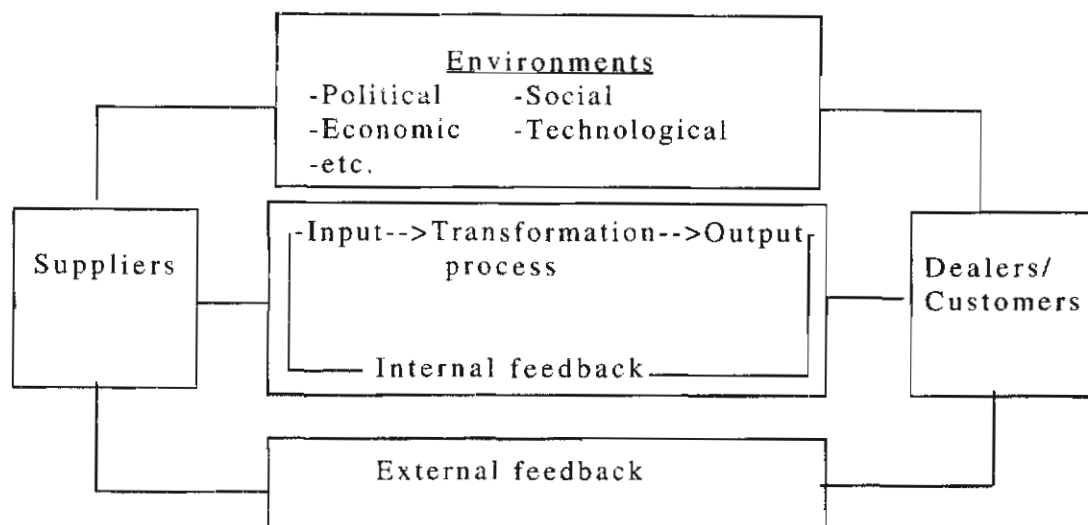


Figure 2.1 Simplified environmental model of the organization as a system.

To analyse an organization, first one must keep in mind the following basic conditions of any business organization:

1. An organization cannot be conceived as a static entity but as a dynamic reality. This is because in real situations, a business organization is both changed by its own intentions and the effects of both its suppliers and

customers, as well as the environment surrounding it. Therefore management must be ready to adopt and adapt new changes not only to survive but also to thrive.

2. An organization cannot be conceived as a mechanistic entity but as an organic reality. This is because an organization is a living being, like a biological organism, not a fixed set of components like a machine. A machine cannot adapt itself to its environment like a living being. To survive in the fast changing environment any organization must learn how the environment changes and must adapt itself to fit the changed situation. One must always keep in mind that the smaller must adapt itself to follow the bigger. An organization is a tiny object in comparison to the environment.

3. An organization cannot be conceived with understanding by using only one theory. Hawking (1988) once said "To try to establish only one theory to be able to describe all things in the universe is very difficult. Therefore scientists prefer to separate problems into smaller parts and try to establish a specific theory for a specific part of problems." In addition, Einstein (Covey, 1989) once said "The significant problems we face cannot be solved at the same level of thinking we were at when we created them." "At the same level of thinking" here is the same as within the same "paradigm" as Kuhn (1962) would have said. In conclusion, according to these thinkers' suggestions on how to tackle problems, one must use differing theories for tackling any one problem, or use different standpoints for observation of the problem. In real natural observation, one cannot completely see the elephant from only one standpoint. In the academic field, one cannot explain any one problem by using only one theory.

As the figure given above suggests, one must conceive organizations as naturally not closed, but open systems. Personnel, resources, and information move across the boundary between the system and its environment. The boundary itself may be ill-defined and largely arbitrary. The influence of external elements may be more significant than that of internal components. A variety of participants will contribute towards the organization, with differing interests and values. Participants do not necessarily have common goals or concern themselves with the long term survival of the organization. They move in or out of the organization, and form temporary coalitions within the organization, on the basis of comparative advantage to themselves. Much of the work of organization involves a process of bargaining, in the attempt to create common norms and objectives.

The open systems perspective views the organization as a system of more or less closely associated independent activities that must be continuously motivated and regenerated if the organization is to survive. Thus, the open system definition as given by Scott (1992), is "Organizations are systems of interdependent activities linking shifting coalitions of participants; the systems are embedded in - dependent on continuing exchange with and constituted by - the environments in which they operate" (p. 25).

Buckley (1967) summarizes the concept of the open systems organization as "a system is open means, not simply that it engages in interchanges with the environment, but that this interchange is an essential factor underlying the system's viability."

Since 1960 onwards, organization theorists have accepted the open systems model (Scott, 1992, p. 100), the reason being that it is recognized that management must accept inputs from outside, while the organization is influenced by, and influences, directly and indirectly, its environment. The environment may be community, town, state, or - increasingly in the age of globalization - the world.

These remarks are especially cogent now, as the evidence is that IT is moving organizations away from the older, hierarchical structure towards a matrix structure of numerous semi-independent, but related, organizations. Large companies are finding it increasingly advantageous to devolve and outsource activities to smaller companies, specializing in the respective activity. Organizational boundaries are becoming diffuse. Organizations are becoming in a very real sense "open systems."

Organizational systems have goals. An organization is purposeful. It has long-range objectives; but, since it must adjust according to changes in its subsystems and in the environment, management must determine middle- and short-range goals as well, to enable the organization to run effectively. All systems theorists are agreed that one principle that determines goal-seeking behavior is feedback. In consequence, organizational systems exhibit feedback, which may be negative or positive (Narayanan & Nath, 1993, pp 65-66).

It is characteristic of the organization as a system that those processes that aim to achieve organizational goals aim at efficient transformation of inputs into outputs that, in the case of service organizations, comprise services to the customers. In the broadest sense, this is the input, transformation, and output of information. Though the original notion of cause and effect is that identical conditions will lead to identical results, organizations are complex, nonlinear, and "chaotic." We should not be surprised that organizational processes exhibit equifinality, that one goal can be reached in many ways; and multifinality, that there can be more than one outcome from organizations sharing a common environment.

The essence of the systems viewpoint is this idea of input converted through the transformation processes into output. Information technology moves through this complex process at every stage.

3. Information Technology

As understood today, IT is computerized information technology, and a brief look at the history of computers in business is in order (Hill & Jones, 1995, pp. C162-C202).

Early vacuum tube-based computers were confined to a few large research institutions. At that time it was fashionable to predict that there would never be a market of any size for computers! Around 1956, the transistor replaced the vacuum tube. Technology moved from vacuum tubes to discrete transistors, to elementary integrated circuits, and to large and very large-scale integrated circuits.

The 1970s were the heyday of the mainframe computer. Users at that time were mainly large business organizations and public corporations. Computers were still expensive. With the rapidly falling price of mass produced integrated circuits, the mainframe began to face competition from the smaller and less expensive minicomputers that brought computer power within the reach of smaller businesses and organizations. However, it was the personal computer (PC), introduced by Apple in 1977, followed by IBM in 1981 and then by a host of successful competitors, that could be said to have brought IT to all.

The availability of computers of ever-increasing power at ever-decreasing cost has been paralleled by developments in telecommunications, in particular in satellite and fibre optic transmission, making possible a worldwide computerized communications network. It is these trends in the processing and transmission of information that have brought about the Age of Information Technology. Globalization of information networks has important implications for exchange of data and information not available through conventional commercial channels; for connecting users internationally for business, research and education; and to enable collaboration within and across geopolitical borders (Huston-Somerville & Kreitz, 1995).

Organizational information processing was formerly the province of mainframe computers operated by a central data processing department. The emergence of PCs (microcomputers) in the 1980s, together with their increasing capacity and decreasing cost, has greatly expanded the information-processing abilities open to organizations. The great processing speed of supercomputers is still being applied to problems involving highly complex and formerly time-consuming calculations, for example aircraft scheduling and optimization. However, the trends towards ever greater computer power at ever decreasing cost, together with the potential for networking, is gradually reducing the difference among various types of computer.

Business organizations have from the start been major users of IT. Technological developments are bringing about vast changes in the way that information is handled and used in organizations. The expected four-fold increase in the number of office PCs, to some 46 million, by the year 2000 (Dreyfuss, 1988), will offer to managers the opportunity to have increasingly more and better information at their fingertips. But to make use of this opportunity requires a clear understanding of computer-based information systems (CBISs) and their characteristics. The technological sophistication notwithstanding, the basic principles are simple and not unfamiliar.

It is helpful first to make a distinction between "data" and "information," a distinction which is as important for managers as it is for computer professionals. From the point of view of the CBIS user, data are unanalysed facts and figures. Information is data that have been analysed, correlated, and processed and presented in a form that is meaningful to the user, the decision maker (Bartol & Martin, 1994, p. 593).

For example, the record of sale of a single item on a supermarket cash register, linked to a central computer system, is a piece of data. On its own it is of little interest to management. But the processing of many such pieces of data by a central computer will produce inventory figures which are of great interest to management in charge of purchase, delivery and stocking. Otherwise processed, the data will yield information on sales, on a day-to-day or week-to-week basis, which will be utilized in managerial decision making at various levels.

Today the processing of data into information is computer-based. It is electronic data processing (EDP); and the major computer-related function of an organization that performs it has been commonly referred to as an EDP department, management information system, or simply information system or information service (Gordon & Olson, 1985).

To obtain the information needed for these various purposes, organizations must not only develop a CBIS, but must redesign themselves to make optimum use of the system. The systems approach to understanding the organization applies likewise to understanding the information system, for the latter can also be thought of as involving input, transformation, and output.

In an information system, data are the inputs, processing comprises the various forms of analysis and manipulation - classification, sorting, calculating, and summarizing - that transform data into information. Typically, at some stage, processing involves storage - some means by which data are held for use at a later stage in processing. The outputs are the reports, documents, displays, and other forms in which information is made available to the decision maker. There will in addition be controls: feedback from the output to input stages, to ensure that the output is appropriate to its intended

purpose. They may also include internal checks to verify, as far as possible, the accuracy of the data and processing, as well as steps to determine the usefulness of the output to the user.

Loudon and Loudon (1991) define a CBIS as "a set of procedures designed to collect (or retrieve), process, store, and disseminate information to support planning, decision making, coordination and control." These authors distinguish five main types of system as follows:

(1) Transaction Processing Systems (TPS) execute and record the routine daily transactions required to conduct an organization's business. They are used in highly structured, repetitive situations, such as retail sales transactions or withdrawals from a bank account. A TPS provides direct assistance at the operational level. Moreover, since the system is directly involved in the interaction with customers and suppliers, it plays a vital role in the interfacing between the organization and its environment.

In electronic data interchange (EDI), for which widely recognized technical standards have been established, specially formulated documents, such as purchase orders and shipping invoices, can be sent directly from the computer of one company to the computer of another.

(2) Office Automation Systems (OAS) facilitate communication and increase productivity of managers and office personnel through document and message processing. The earliest to appear were the word processors which allow rapid creation, editing and printing of text. More recently, electronic mail systems are making possible the high speed exchange of written messages through computerized information networks. There are many variations on these systems.

OAS allow the automation of tasks that have long been recognized as those of the office worker; and, initially, they were seen primarily as a means of increasing the productivity of clerical and secretarial staff. It is now coming to be realized that they equally well facilitate the work of managers and professional workers (Finn, 1983; McLeod, 1986).

(3) Management Information Systems (MIS) typically allow on-line access to current and historical information and summarize information originating from TPS to produce the kind of routine and exception reports required by middle level and first line managers and supervisors. They are aimed at tactical and operational applications, as in planning, decision making and control.

For example, materials requirements planning systems provide information to master schedulers on materials procurement difficulties, to capacity planners on any needed short or long term capacity changes, and to first and middle level managers on costs, quality and supplier activities.

(4) Decision Support Systems (DSS) support the process of managerial decision making in relatively unstructured situations. They provide means for clarifying the analysis of a situation where there may be no one single answer or optimum decision.

As compared with MIS, DSS provide more advanced analysis and greater access to a variety of models that can be applied to a given situation; they make more use of information from external sources, in addition to the internal sources of TPS and MIS; and they are more interactive, allowing direct communication between the manager and the controlling program, allowing results of various analyses to be obtained almost immediately.

(5) Executive Support Systems (ESS) or Executive Information Systems (EIS) are a fairly recent development intended to support decision making at the top levels of organizational management (Watson et al., 1991: 13-30). They differ from the more narrowly focused DSS in using a wider variety of computing facilities, telecommunications and display options - for instance charts and graphs - applicable to many different problems. The ESS makes less use of analytical models, delivers information from a variety of sources on demand and allows highly interactive questioning. An ESS is essentially an information system geared to the needs, and often to the individual work habits, of an executive working in a particular situation.

This classification is well known and widely used. We need only add one general observation on the systems described above. TPS and OAS provide for routine collection of data and the storage, processing, and transmission of information. They allow for the automated, and much more timely and efficient, performance of tasks which have long been accepted as those of the office worker. On the other hand, MIS, DSS, and ESS, in increasing order of sophistication, are designed to apply IT in support of managerial planning and decision making.

There is another division, however, which to some extent cuts across this classification. Tapscott and Caston (1993) distinguish two eras in the use of computerized IT. In Era I, extending well into the 1980s, computers were used as stand-alone, isolated systems, often the province of a specialized data processing department of the organization. With the advent of the personal computer (PC), computers came out of the data processing department and became accessible to everyone in the organization. This certainly enabled individuals to greatly increase their productivity. However computers were still used in isolation.

Era II began when organizations became aware of the need for communication. Local area network (LAN) technology came into being, enabling sharing of information, computer power and resources among many users within the organization. The ability of computers to exchange information over the telecommunications system enabled the development of the wide area network (WAN), linking organization to organization - to customers, suppliers, associates and even competitors. The 1990s have seen the development of a worldwide network by which any user can, in principle, exchange information with any other (Cronin, 1995).

More and more, people in organizations are, for instance, talking of "doing business on the Internet." Over the past few years, this formerly academic network has become one of the fastest growing media through which businesses can share information.

The Trading Process Network (TPN) initiated by General Electric on the World Wide Web in 1996 ("Big, boring, booming," 1997) has cut the process of GE's bidding for supplies from 21 days to 10 days. Many more, including overseas, suppliers can be approached, and the increased competition has cut the cost of goods by 5-20%. Suppliers benefit by receiving speedier information and precise deadlines and have begun to initiate such systems for themselves. The use of EDI, of which General Electric is the world's largest service supplier, is being extended over the Internet. Industry communities of interlinked businesses are being created.

In the view of Tapscott and Caston, these developments are leading to a paradigm shift in the organization. There is a shift from isolated to work group computing; from fragmented IT systems dealing separately, for instance, with production and process control, finances, and human resources, to integrated systems; and from internal to interenterprise computing. A new open, networked organizational design is emerging.

These authors further suggest that the problem for many large organizations at present is that their IT systems are still locked into the stage of Era I computing. It is easier for smaller and new organizations to make the change.

On the basis of these considerations we might ask, of the organization's IT system, the following questions, representing increasing levels of "significance" of IT application:

1. Is IT being used to automate routine office procedure (TPS, OAS)?
2. Is IT being used to supply succinct, summarized information and reports to management (MIS)?
3. Is IT being used to aid managerial decision making by, for instance, computer modelling and simulation, scenario projection, etc. (DSS, ESS)?

4. Is the organization networked: Does it employ IT to communicate (a) within the organization (LAN), (b) interorganizationally (WAN), or (c) worldwide?

Previous research on the theoretical background and practical application of IT will be discussed in two steps: (a) research on the application of IT at the international level, and (b) research on the application of IT in the Thai context.

On international experience in application of IT, Sanders (1973), who studied computer utilization in underdeveloped countries, stated that the public administration network performs two major functions. One is the routine, on-going administrative activity necessary for continued viability. The second is its role as an information system. These two major functions can apply equally to the private sector, especially in developing countries, for example in Thai corporations. According to Sanders, the information system provides data organization, allowing it to make readily available the kind of timely information needed to perform administrative tasks.

Information technology systems, at the first stage, were developed only in the area of data processing, giving rise to TPS, OAS, and MIS. In the second half of the 1980s, DSS and ESS came into existence.

Over the past 30 years, there have been many attempts to develop CBIS to serve management. The management environment is dedicated to information processing and computer systems can be expected to be of considerable benefit to managers. The first attempts, in the 1960s, to create MIS were not successful, leading Ackoff (1967) to christen them "management misinformation systems." The next generation were DSS and were based on a greater attempt than were MIS to understand the decision making character of the manager's task (Eason, 1992).

Because computers can process information very quickly, managers can easily become overloaded with reports that cannot be of any use without further refinement. Executives prefer quality to quantity (Tate, 1988). To be of use to management, information must be:

1. Relevant: Information should be related to the decision in hand; though, the more unstructured the situation, the more difficult it may be to determine exactly what information is relevant.

2. Accurate: Information must be correct and reliable if it is to form the basis of effective decision making. The degree of precision required will depend on the situation.

3. Timely: Information must be there when it is needed.

4. Complete: Information from all relevant sources, and covering all aspects relevant to the decision, must be brought together.

5. Concise: Information must be summarized in a way that provides sufficient detail for the relevant decision to be made (Gremillion & Pyburn, 1988).

The requirement for information will vary as the responsibilities for planning and control vary from level to level of management.

In most companies, especially medium- to large-sized companies, information needs become specialized by area, for example finance or human resources. When computers first began to be used in organizations, from the late 1960s to early 1970s, computer specialists first endeavoured to meet all these varied needs through one central information system. Later, the difficulties of designing and implementing one overall system that will simultaneously meet all the information needs, especially of a large organization and one where organizational departments are dynamic and rapidly changing, came to be realized.

A more modern view is that information systems are more likely to be efficient if they are more specialized, designed to meet the needs of specific areas - with, however, the option of sharing data and information with other systems for specific purposes.

As for the impact of information systems, previous studies have shown that managers who implement new information systems must confront the ways in which these systems can affect the organization. The availability of cost-effective IT has brought about many changes in both organizational structure and organization-to-organization linkages (Morton, 1991, pp. 83-86; Rockart & Short, 1989; Solomon & Hymowitz, 1987). Inside the organization, information systems tend to shorten the chain of command by giving employees more information and therefore more scope to solve problems by themselves; and to improve the organization's responsiveness (Goleman, 1988).

The constant demand for increased power and capability drives advances in IT, as successful organizations are now those that can utilize this technology to achieve greater efficiency and effectiveness. At an early stage "on-line" processing of data replaced "batch" processing, which was the only technique available up to the 1960s (Kroenke, 1992, p. 44).

Data-processing power can be vastly multiplied by linking computers in a network. Personal computers linked in "local area networks" (LANs) are now beginning to solve business problems which formerly required much larger, mainframe computers (Brandt, Depke, Lewis, Hammonds, & Hawkins, 1989). Electronic data interchange (EDI) is greatly cutting down on transaction processing costs and time (Forger, 1989; Senn, 1990, pp. 611-615). With advances in communications technology, trends such as teleconferencing and

telecommuting are changing the ways in which organizations conduct business (Huey, 1989; Rice, 1989), and bringing about an increase in home based employment (Parker, 1989, pp. 516-519; Whittingham-Barnes, 1990).

Research in artificial intelligence has given rise to expert systems, the aspect of this field to be applied most frequently to organizational management (Bradshaw, 1989; Meador & Mahler, 1990; Senn, 1990, pp. 586-589). Such systems may be developed to minimize the risk of error in decision making, or the risk of loss of experienced employees, or to make decisions involving very large quantities of interrelated information (Leonard-Barton & Sviokla, 1988; Lyons & Fabiano, 1990, pp. 589-890; Senn, 1990, pp. 589-590).

Many economists have predicted that, in the global age of information, small- and medium-sized companies would come into their own. This is happening. Smaller companies have the flexibility and freedom from bureaucratic restraint to innovate more rapidly. At the same time, telecommunications and computer networks have given them the same access to the global marketplace as have larger companies. Even large scale industries are profiting by devolution of work in favour of global strategic alliances of small scale, independent entrepreneurs (Thinapong, 1990).

As remarked by Chaiwat Chaiphanth (1991, pp. 56-81), the application of IT differs from country to country and varies between and within economic sectors, depending directly and indirectly on market structure, competition and government involvement. Moreover, diffusion of innovations such as IT is not a simple process. Considerable time may be required for social systems to adopt innovations even when these have obvious economic advantages (Rogers & Shoemaker, 1971, p. 6; Hall, 1981). A common problem for an organization is how to accelerate the adoption of an innovation that would benefit the organization or a subunit (Rogers, 1983, p. 1). For many organizations, how to manage IT effectively, once it has been adopted, is now becoming a primary problem.

The first computers (two sets) were introduced into Thailand in 1963, for use in the census and for educational data (Malaivongs, 1995, pp. 23-24). In 1965, computer technology was introduced for use in statistical analysis of agricultural data at the National Statistical Office, a national organization responsible to the Prime Minister's Office. The first computer purchased to perform this task was an IBM 1401 (Lauhawiriyakramon & Jungsakul, 1983, p. 10). Application was thus first in the public sector. The use of computer technology expanded to other national projects, such as the National Census and the National Business Project. In 1970, the Center for Data Collection by Machine was established at the National Statistical Office and given responsibility for data processing tasks (Lauhawiriyakramon, 1983).

In an early study, Sanders (1973) described the implementation by a foreign contract firm in Thailand of a fairly sophisticated computerized

project, the Village Information System Thailand (VIST). Implementation included four stages, the first of which was the creation of a magnetic tape file of the exact geographic location of all villages in the pilot area. The subsequent stages were the creation of three cross referenced files of specified information at the village level which could be coordinated or abstracted at national, provincial, or local government level, depending on requirements. The initial objective was in the area of counterinsurgency, which was still a problem in Thailand at that time, but the system was in principle capable of extension into a national information database.

Sanders went on to propose how such a system could be applied to the problems of increasing agricultural productivity and diversity. It was felt that agricultural development could be made more effective without any fundamental and traumatic administrative change. Sanders proposed the establishment of a computerized accounting system for agricultural cooperatives, to compensate for the lack of trained managerial personnel; a register of local, offseason job opportunities, which could be linked to the provision of relevant, short term training programs; and the formation of a comprehensive agricultural database.

VIST was far from typical of computer use in Thailand at the time, which was in general randomly scheduled and haphazard. There were then more than 22 computers in the country, of which seven were government owned and operated. However, in the early 1970s, Thai universities began to make use of the effectiveness of the computer in performing complicated and repetitive tasks to handle and support administrative operations such as student registration, grade reports, class scheduling, updating of student files, payrolls and accounting (Raksaksri, 1984, pp. 7-10). Otherwise, these first few years saw only a gradual increase in the number of computers used in the public sector: 5, 12, 18, 30, 46, and 73 sets in 1966, 1969, 1972, 1975, 1978, and 1981 respectively. From 1980, when IBM introduced PCs into Thailand, onwards, both the public and private sectors have made increasing application of PCs (Malaivongs, 1995, pp. 23-24).

In 1988-1989, The Thailand Development Research Institute Foundation investigated the feasibility of developing a digital system for the storage, retrieval and analysis of national resource and environmental information for the Songkhla Lake Basin in Southern Thailand (Phantumvanit et al., 1989). The survey indicated that there was a large potential user community, both among government agencies and industry, that would benefit from the service, and that much relevant data existed in scattered form. Case studies were undertaken on application to land use planning (including aquaculture), rubber cultivation, and urban planning. The final recommendation was for a Geographic Information System (GIS), based on Intel 80386 microcomputers.

Boonmark (1990) surveyed the use in 1990 of microcomputers among 200 small trading and service corporations. "Small" was here defined as having registered capital of less than or equal to 1 million baht (US\$ 40,000), annual sales less than or equal to 5 million baht (US\$ 200,000), and employing 10 or less persons. The major applications were in accounts and finance and in database management. The main problems encountered were lack of suitable software, including software adapted to the Thai language; and lack of appropriate knowledge and training among personnel. There was a projected need for personnel familiar with popular programming languages, systems analysts, and software specialists. Management information systems (MIS) were coming into use quite widely. The applications were again most commonly in accounts and finance, and in marketing. The advantages claimed for MIS were increased speed of data access, and data more appropriate to the user's requirements.

With the advent of MIS and their successful application in the business sector, their extension to the public sector in Thailand is a natural development. In particular, Satyarakwit (1990) has proposed a framework for a national management information system and reviewed information systems for use in the area of rural development administration.

Overall, the development of IT in Thailand in 1990, especially in the public sector, was budgeted at 3 billion baht (US\$ 120 million).

In the course of research on IT application, Chaiwut Chaipanth (1991, p. 59) interviewed heads of the computer sections of production and export corporations, over March to September 1990. Data on the development of IT systems for management were collected from 277 companies.

The study revealed that significant computer use by the private sector in Thailand began only in 1980. Most alpha group enterprises that applied computer technology were in the banking and financial business. The systems in use at that time were cumbersome and expensive. However, within the preceding four to five years, as advances in technology made computers smaller and cheaper, they became popular among medium and small size companies. At that time the application of PCs by private enterprise was growing at the rate of 20-30% per year.

The responses indicated that progress in management by application of IT took place in four distinct stages: (a) loosely structured management (62%), (b) management for increase in recorded sales (21%), (c) management by control (11%), and (d) management by planning and control for efficient use of resources (6%).

The analysis showed that 62% of respondents were still at the first stage, that of loosely structured management. Such a company had a computer section, but without any control, budgeting, or development plan. Only 11% of

respondents had developed a computer system to promote marketing as an objective. These companies had clear job specifications and software for each application area, but control was still loose and there was no overall program or budget plan.

Since external factors have a significant influence on internal management, companies have to design and plan their computer and IT system to accord with these external factors: (a) market conditions, risk, and competitiveness; (b) technology developments, such as in system design, bringing increased efficiency at decreased price; (c) government policies and activities; and (d) other economic factors and figures.

It was evident that at that time Thailand had not yet fully taken advantage of IT. Transaction processing, office automation, and management information systems were in use - decision support and executive support systems were still uncommon. It is perhaps because of this need that Thailand named 1995 the Year of Information Technology - evidence of an awareness of the importance and benefits to be gained from IT.

Guideline policies for the development of the information industry were set out in the 7th National Economic and Social Development Plan (1992-1996), which comprised (a) promotion and support of government and private sector joint venture cooperation over IT, by reducing import tax on machinery and equipment from 30-60% to 5%; (b) planning an information system for all government agencies; (c) emphasis on intellectual property rights, in order to promote an industry in computer software and hardware; (d) an increased budget for research and development in IT; and (e) the establishment of computer-related courses as core subjects for the high school student.

The first organizations to have adopted advanced computerized technology have so far been mainly foreign investment companies. By now, every year, hundreds of employees from mostly American-Thai and Japanese-Thai joint ventures, are sent to attend computer training courses at government institutes and private schools, both inside and outside the country. At the same time, over the past 10 years, Thai universities have contributed a great deal to the growth and development of computer use in Thailand. Many now offer courses in computer literacy or programming languages (Raksaksri, 1984, p. 56).

Computer use among a sample of firms was surveyed in 1994 by the National Electronics and Computer Technology Center (NECTEC) (Malaivongs, 1995, pp. 23-24). The data are shown in Table 3.

Table 2.1
Types of Computers Used in Different Sectors

Type	Government Number	State enterprises Number	Private Number
PC	95	100	100
Mini	52	63	50
Workstation	19	75	25
Mainframe	14	63	33
LAN	29	75	50
Others	-	38	-

Note: Adapted from National Electronics and Computer Technology Centre [NECTEC] (1994, July), *Guidelines to develop IT human resources in Thailand*. Referenced in Malaivongs (1995, p. 24).

The data show that PCs were, by 1994, extensively used in all sectors. It may be fairly assumed that, by then, all large companies used PCs; but it is not quite certain whether small companies all did so. Minicomputers seem to have been very well accepted in all sectors and about half of the surveyed organizations had installed and used them. Workstations, mainframes, and LANs were used in a similar proportion among the three sectors. However, it seemed that mainframes would play a lesser role in the future, while more organizations move towards LANs and client-server systems. It should be noted that state enterprises used more specialized computer systems, such as workstations and process control machines, than did the other two sectors.

The state of the PC market in Thailand in 1995 was surveyed by Kananurak (1993). Total sales in 1995 were 269,994 units, valued at US\$ 568.14 million. These comprised 90.27% desktop PCs, 7.30% portables and 2.4% classified as PC servers, designed to meet the needs of more than one user. This represented an increase over the previous year of 42.33% in unit sales and 62.66% in value. Prices had fallen, including those of Pentium-based PCs, which have now become standard.

Kananurak's forecast for PC sales up to the year 2000 is given in Table 2.2.

Table 2.2
Thailand Desktop PC Units and Values Shipments Market Forecast,
1995-2000.

Year	Unit Shipments		Value Shipments (US\$M)	
	Units	% change	Value	% change
1995	243,712		486,95	
1996	317,169	30.14	631,17	29.62
1997	408,000	28.64	795,60	26.05
1998	514,000	26.09	977,46	22.86
1999	634,200	23.28	1,166,93	19.38
2000	759,980	19.83	1,367,96	17.23
CAGR	25.54%		22.95%	

Note. CAGR = Calculated average growth rate. From Kananurak (1993).

The maximum growth rate was forecast for PC servers, sought by companies that see data collection as the key to competitiveness in a globalized age; and for the increasingly lighter and more versatile portables.

The assembly of PCs and computer peripherals has been a significant part of Thailand's growing consumer electronics industry since the early 1980s, after 1985 showing the highest growth rate within this sector (Wiboonchutikula, 1993). A growing domestic demand coming with rising income and the substitution of automation for labor to reduce costs and increase productivity has provided an opportunity for small local firms that can specialize in areas that have local advantages, such as Thai language word processing. On a much larger scale, the production of computer peripherals and computers for export is the province almost entirely of wholly foreign-owned companies and joint ventures. In either case, the industry is heavily dependent on imports of raw materials and parts. Wiboonchutikula favours more foreign investment in this high-growth industry; and, at the same time, government support of local private firms to use their own initiative and capability, and of education to produce more skilled and technologically competent labor.

It is generally believed that growth in productivity is one factor on which future development and a higher standard of living depend. For this reason, in the developed economies of the world, an apparently slackened rate of productivity over at least the past two decades has become a matter of concern (Baumol & McLennan, 1985, pp. 3-57; Holzer & Nagel, 1984, pp. 45-68). To what extent, for instance US productivity and competitiveness, have in fact fallen off is itself a matter of controversy. However, in so far as the change is real, slowness in adopting advanced technology, especially computerized IT, has been put forward as a reason (Davis and associates, 1986, p. 2).

The fact is that the effect of IT on productivity, especially in the service industries, has proved peculiarly difficult to assess. Despite the manifest advantages offered by computerized IT and the experience of individual users, many investigators have failed to find a significant increase in productivity, especially within the service sector, following the widespread introduction of IT since the beginning of the 1970s. Brynjolfson (1993) considers four explanations which have been offered for this "productivity paradox":

1. Mismeasurement of output and input.

The benefits most managers attribute to IT - improved quality, variety, customer service, speed and responsiveness - are difficult to represent in productivity statistics or accounting figures. Input costs, including expense on software and training, are equally ambiguous.

2. Time lag

The benefits from investment in IT may take several years to appear. If only short-term costs and benefits are considered, it may appear that investment has been inefficient.

3. Redistribution of profits

Information technology benefits individual firms, but is unproductive from the point of view of the industry or economy as a whole. For instance a firm with advanced information on market conditions may make profits, at the expense of reduced profits to its competitors.

4. Mismanagement

The most interesting version of this argument is that management decisions on investment in IT are based on out-of-date principles, formulated in a time when little IT existed, rather than on strict cost/benefit accounting. The economy has not yet caught up with the Age of Information.

For many companies, IT constitutes one of the single largest capital investments. For these companies there seems no way out of the dilemma of trying to contain costs while remaining ahead in efficiency and competitiveness. For assessing IT investments, it is recommended that

1. The cost of finance as a percentage of sales is not necessarily a fair benchmark of efficiency for IT. An example is Wal-Mart's willingness to spend on innovative distribution and inventory management systems that have brought it to the top of the retail world.

2. Return on investment (ROI) is not a reliable measure for assessing IT investments. It is a more accurate measure of cost-cutting than of revenue-

generating projects, whereas it is the latter that are likely to be of more value to the firm. Where distributed computing results in distributed costs, the investment itself is getting more difficult to measure.

3. Technology is not a substitute for good management. Inefficient work processes should be eliminated before beginning to automate.

4. The measures that will be used to evaluate the project must be clearly specified. Work must be reengineered in advance of a new IT application - it must be clear exactly what new value-added work employees will do. Thirdly, business sponsors must follow through on the project-users, and project champions should be asked what gains were made and what problems were encountered.

5. There are a number of practices which will reduce complexity and reduce infrastructure costs: (a) benchmarking, to determine the true costs of IT; (b) observance of technology standards; (c) centralized procurement, to control purchases and manage suppliers; (d) use of asset management software and services to depreciate hardware and monitor software licences; and (e) outsourcing of functions that external vendors can handle more efficiently.

6. Chargebacks should be assessed only for services that employees actually use.

7. The Chief Information Officer (CIO) and Chief Finance Officer (CFO) should work together to promote sound IT management practices and ensure that IT supports strategic aims.

Brynjolfsson (1993) is inclined to consider measurement difficulties as the principle cause of the gap between expectations and apparent performance. With better measures of IT productivity the gap may not be so great after all. Moreover, it has often been argued that the aim of IT is not to produce more of the same things, but to do new things in new and better ways. Intangibles such as better customer responsiveness are difficult to quantify.

Hitt and Brynjolfsson (1966) studied the effect of IT on productivity, profitability and consumer surplus for a sample of 370 large firms. Information technology input was measured as a combination of capital expenditure on computer hardware and the labor portion of the total IT budget. It was found that IT investment had a significant impact on output, and therefore on productivity; and a substantial effect on consumer surplus, a measure of value of the output to the customer. At the same time, the effect on profitability and hence competitive advantage was minimal. These authors suggest that the increased efficiency afforded by IT intensifies competition and lowers prices - IT may create value without increasing profits to the firm. Managers should look beyond productivity to how IT can enhance strategic factors such as product position, quality and customer service. There is much that is still unknown about how best to exploit the value of IT.

In an opinion survey among individual users ("Has technology changed," 1995), 96% of respondents asserted that IT had increased their productivity; and moreover that IT enabled small firms to compete better against large businesses. The move towards home-based work was evident.

Metheny (1994) reporting a National Research Council study "Information Technology in the Service Society: A Twenty-First Century Lever," points out that the 0.7% average annual growth of the US service sector during a period of massive investment in IT does not reflect aspects of service quality such as increased speed, responsiveness, convenience, safety and reliability. There are now entire enterprises and new services which could not exist without IT. Traditional measures of productivity ignore service quality and do not consider benefits to customers and suppliers. There is no doubt as to the value of IT - the problem is how best to apply it. Businesses need to develop an IT strategy based on customer and user needs, and to establish benchmarks for service performance. Peterson (1994) further quotes the same study as noting that failure to achieve returns from IT investments has arisen from inadequate planning and implementation, including inadequate training for workers, attention to customer needs or rethinking on how the business should operate.

For developing countries such as Thailand, the problem is to enhance productivity in order to gain competitive advantage in world markets and speed the progression towards a universally high standard of living. To this end, the Thailand Management Development and Productivity Center (TMDPC) was established, as a unit of the Department of Industrial Promotion, Ministry of Industry, on January 18, 1963, under a cooperation scheme between the Thai government, which undertakes all financing of the Center, and the United Nations (Asian Productivity Organization [APO], 1993. pp. 118-120). The International Labor Organization provided experts to assist in developing the skills and experience of staff up to 1970.

The Center provides training in relevant management areas, consultancy and information services, and programs in productivity promotion, including such productivity improvement techniques as KAIZEN and quality control circles. Its activities are best summed up in its own statement of objectives:

- I. To promote productivity and management development by raising the level of productivity in terms of both quality and quantity by:
 - assisting in increasing the standard of living through increased productivity and raise the skills of management techniques, thereby enabling better use of materials, plant and equipment, with results to be reflected in higher output, lower costs, and higher wages,
 - providing trained management and supervisory personnel for success of present plans for industrial development and,
 - developing human resources by improving work efficiency and product and service quality.

2. To provide consulting services in both functional management and productivity promotion to industries and business enterprises.

The Center's first survey (Thailand Management Development and Productivity Center [TMDPC], 1992), in 1991, among 93 owners and top management, and 529 supervisors and workers, of a random sample of companies, revealed a widespread, though rather superficial, awareness of the importance of productivity: 73.1% of owners/top management and 61.1% of supervisors, stated that they understood the concept. Respondents' associations of various factors with productivity are summarized in Table 2.3.

Table 2.3
Factors Associated with Productivity

Factor	Percentage of Respondents	
	Owners/ Managers (%)	Supervisors/ Workers (%)
Quality of products/ services	68.8	55.9
Increased production/ sales	65.6	64.5
Cost reduction	58.1	46.5
Work attitudes	45.2	35.9
Team work	40.9	35.5
Wage increase	22.6	30.1

Note. From TMDPC (1992).

Thus, 91.4% of owners/ managers considered productivity increase to be the most important of managerial functions. However, 39.0% had only started this activity after 1986 (designated "Productivity Year" by the government) and 18.3% had not yet started.

Percentages of firms citing productivity programs, including various practices from Japanese management, were: meetings, 63.5%; training, 37.9%; suggestion schemes, 29.3%; 5S, 26.4%; safety programs, 24.4%; small group activities, 15.1%.

Percentages of owners/ managers reporting benefits from productivity programs cited: cost reduction, 72.0%; increased quality, 59.1%; increased profit, 48.4%; better worker relations, 46.2%; better labor-management relations, 45.2%; increase in value added by employees, 34.4%; better awareness of productivity, 33.3%; other benefits 31.2%. Percentages of supervisors/ workers citing benefits were: work improvement, 48.3%; team work development, 37.6%; better job relations, 30.0%; more work, 27.9%.

The survey team emphasized the importance of gain sharing as a means to motivate employees.

Information Technology and Organizational Performance

Contemporary textbooks citing case studies are full of glowing tales of the successful application of IT (Senn, 1995, pp. 123-124, 512-513), as well as some that are less successful (Hill & Jones, 1995, pp. C265-C287).

Many of these numerous studies, from the 1990s onwards, are of IT related to production, rather than management, administration and services. However, they do make it clear that the introduction of IT is not a simple matter. Thus, Buchanan and Boddy (1983) reported seven case studies of applications of computerized technology among Scottish firms. The results were not easy to evaluate. In all cases work performance was enhanced, but productivity as a whole was only marginally improved. Work was more intensely paced and more stressful.

Strassman (1985, pp. 29-40) cites studies, admittedly of experimental situations, in which the results of introduction of office automation were evaluated by comparison with already existing good, but nonautomated, office practice. Output could be more than doubled, with substantial savings in costs and time.

These benefits, however, may fail to be realized if the introduction of IT is not carefully planned. A series of brief case studies published by Legge, Clegg, and Kemp (1991) reveal much about the problems that can arise if advanced IT is adopted without consideration of the human and organizational factors involved. The system may simply fail to do what it was intended to do, if there is a lack of coordination between the users and suppliers of the system. Otherwise, cases analysed by these authors illustrate poor reception of the system due to lack of contact between branch employees and head office systems staff; ergonomics problems associated with the rapidity of organizational change, out-of-date office design, and conflict between safety and productivity goals, when a rapidly growing computer system was introduced amidst office premises never designed for it; and problems of human relations.

Human relations constitute the most important factor that must be considered in any effort to introduced advanced technology, if the human tendency towards resistance to change is to be minimized. Butler (1986, pp. 54-56) cites as an extreme case the resistance faced by the London "Times" newspaper to the introduction of modern printing technology. By contrast, Locke (1991) is enthusiastic in reporting the successful computerization of the newsroom at the "Los Angeles Times," and the resultant reduction in costs, improved communications, and greater flexibility.

Most studies undertaken to date have been of the introduction of IT in Western countries. With the publication by Choi, Subramanian, Lee, and Kim (1989) of the results of a survey undertaken by the Asian Productivity Organization under the project title "Productivity Through People in an Age of Changing Technology" we come to a study of the effects of technological innovation in, mostly developing, Asian countries. Of the authors' case studies, six were in Thailand.

The study found Thailand receptive to change and innovation. In the case of Thai enterprises, factors motivating the choice of technology were found to be (a) a move towards greater capital investment and automation, in response to increased labor unrest following the uprising of 1973; (b) a need to conserve energy - energy consumption being a major factor in production costs; (c) the hope - often realized in practice - that advanced technology will enhance efficiency and productivity; and (d) especially in the case of service industries, the enhancement of company image in the eyes of customers - from the marketing point of view, enhanced competitive effectiveness.

Computerized information systems play a major part in modern banking. The Bangkok Bank Ltd. (BBL) was the first commercial bank in Southeast Asia to computerize, starting with an IBM system 360 Model 30 mainframe for head office operations in June 1969. From there on, computerization proceeded apace. A major step forward was the installation in 1987 of 250 sets of on-line Philips terminal computers in various branches. Computerization transformed BBL into a completely electronic bank, enabling increased customer service efficiency and supplying management with timely, accurate information for decision making. The expansion and improvement of BBL's services through the use of the latest technology has been a continuing process. The most complete automatic teller machine service in Thailand was launched in 1984, on-line computerized withdrawal and deposit services had been steadily extended up to 1982, and BBL executives now used microcomputers to obtain bank operation information both from the mainframe computer and local area network.

Computerization did not take place without some unease among employees. Failure of supervisors at the branch level to inform employees of impending changes in the work process caused confusion. However, those employees who became idle were transferred to new branches, and those detailed to operate the machines were retrained and promoted.

The Bank of Asia Ltd. (BAL) introduced computerization in 1981, utilizing a distributed data processing (DDP) system based around minicomputers installed in each branch office. Only four years were required from conceptualization to commencement of operations. There were no changes in workforce and existing branch staff were easily trained to operate the software used. Management received reports faster, customers received better and faster service, daily accounts were closed faster - and staff got

home earlier. Employees gained in morale and learning - if not in financial rewards - and felt that their value was enhanced. In 1984, a major reorganization of BAL was required in order to increase responsiveness to customer needs and technological change.

In summary, the authors concluded that Thai cultural values tend to aid the first phases of technological change. Employees generally accept directives from top management without comment, and feel secure in their jobs so long as they perform satisfactorily. Employees at BBL who became idle were willing to be patient until they could be relocated. Each firm investigated took pains to train and develop personnel, who thus perceived that they had gained in the way of new skills. None of the firms laid off employees during the process of change. Changes in organizational structure occurred, but did not seem to have any direct relationship to technological change.

All firms investigated gained economically, in quality of customer services, and in productivity. All showed a trend from labor intensive to professional and technological personnel intensive, if not to fully capital intensive. Employees, especially at lower levels, came to feel that they were more valuable. One of the most satisfying aspects of technological development appears to be the opportunity it can offer to continuously learn something new.

The once commonly held view that the world, more especially the developed world, is moving towards a postindustrial, "service economy" (Forester, 1987, pp. 247-249), is regarded by Davidow and Malone (1992, pp. 10-15) as an intellectual myth. It is the increasing productivity and complexity of the manufacturing industries that have fueled the growth of service industries - an economy of any size cannot exist without a manufacturing base. Nonetheless, service industries now occupy an increasing proportion of the work force; and many service jobs are notoriously less well paid than manufacturing jobs. But it is generally recognized that, if wages and salaries are going to increase, then productivity must increase as well.

In two recent works, Peter Drucker (1992, pp. 79-95; 1993, pp. 83-96; see also Drucker, 1995), argues that the greatest challenge facing management in developed countries today is to increase the productivity, at present absurdly low, of the newly dominant workforce groups of knowledge workers and service workers. New technology in itself does not automatically generate high productivity. Increase must come from "working smarter," but this may have a rather different meaning from what it did for the kind of manual labor first studied by Taylor.

In traditional manufacturing, the job was taken for granted. The question was to find the "one best way" of doing it. For information work we must first ask: "What is the task?," "What are we trying to accomplish?," "Why must we do it at all?" Increased productivity comes from redefining the task, and especially from eliminating what does not need to be done. The focus in increasing productivity must be on performance.

Drucker (1995) distinguishes three categories of knowledge and service jobs:

1. Performance means quality: Examples are research, strategic decision making, or packaging design. We do not yet know how to analyse the work process in such jobs. We can only ask "What works?"

2. Performance means quality plus quantity: the sales representative, medical technician, and branch manager - productivity requires work on both aspects.

3. Performance means quantity, quality has been built into the output: filing, processing insurance claims, and similar clerical jobs. These are in effect production jobs, though the product is not tangible, and the approach of Taylor still applies.

Only when we have decided to which category a job belongs can we decide what needs to be analysed, improved, or changed.

Drucker further points out that the work of increasing productivity must be done in partnership with the people who actually carry out the jobs. It is now generally accepted, at least in theory, that the worker's knowledge of the job is the starting point for improving productivity, quality, and performance. Moreover, increased productivity requires continuous learning. Equally important, it has been found in recent years that knowledge and service workers learn best when they teach others. In the information age the organization will become not only a learning, but also a teaching institution.

Drucker is writing with developed countries in mind, but his observations are scarcely less relevant to developing countries. Developing countries will not simply repeat the Industrial Revolution. Service industries are already contributing about half Thailand's gross domestic product. Moreover, managers in Asia as a whole are under pressure to increase productivity ("How high is high?", 1996). The demand accompanies the trend in the region towards more high technology, higher value-added industries. As labor costs increase, it is coming to be realized that in future competitiveness will come to depend on quality rather than on price.

Assavasena (1986) drew attention to the low level, at that time, of labor productivity in the small and medium scale industries that play a major role in Thailand's industrial and economic development - in contrast to Japan, where there was little difference in productivity between these and large scale industry. Lack of access to information on technology and management, leading to inability to innovate and poor competitiveness, was singled out as one contributing cause. The Technological Promotion Association (Thai-Japanese), established in 1973, was proposed as the organization best suited to be in charge of a technological information center for small and medium scale industry development, operating through the creation of a network linking databases already existing in Japan and Thailand.

In an address presented at the same workshop, Adulbhan (1986) remarked that competitiveness must now be based on quality. Referring to the value-added concept of productivity, Adulbhan stated that productivity improvement must now be a matter of cost minimization. Productivity can be improved in two ways: (a) human resource development to achieve greater work efficiency, and (b) acquisition of new technology which will lower costs or improve quality. Faster service to the customer through computerized communications technology is one aspect of competitive advantage. What industry most needs is up-to-date information on new technology.

Laohavanich (1986) considers that the problems facing newly developing countries in the commercialization of innovative R&D comprise (a) lack of knowledge and information about science and technology, the nature of R&D, technology development, and the transfer process in less developed countries; (b) lack of understanding of their proper roles in technology transfer and development among policy makers, high ranking officials, and mass media; and (c) lack of national information systems on science and technology development and technology transfer. A united information network system, linking all available sources, is required.

4. Strategic Planning in Thai Management

In Thailand, planning at the national level has been implemented against a background of repeated economic and political crises, throughout which however Thailand's overall economy has remained strong, and against an increasing movement towards globalization and internationalization. It exhibits a trend from purely economic concerns to those of human resource development, from which a company planning for optimally effective performance and high productivity in a future of computerized organization may well have something to learn.

Awareness of human resources development in strategic planning is not new (Hongladarom, 1992). Its importance has only become more urgent at the present day, as the traditional development strategies of capital accumulation and export promotion can no longer guarantee long-term prosperity for Thailand. If properly implemented, human resource development can lead to increased labor productivity, increased comparative advantage and international competitiveness, and improved overall economic activity and quality of life.

Most organizations are no doubt in principle capable of proactive planning for the future, in the sense described by Ackoff (1981; see also Hamel & Prahalad, 1989). However, successfully envisioning and planning for a future that necessarily involves discontinuity and change challenges the prevailing paradigm (Barker, 1989), and commonly meets with resistance - the familiar resistance to change.

In the strategic planning process, envisioning the future enables the leaders of an organization to make a paradigm shift where necessary, to become receptive to new ideas, and to understand and accept the need and opportunity for change.

This has never been more necessary than now. Information technology is one of those technological developments that will profoundly affect life and business in the next few decades of the coming century. Very probably it is because, as Magnet (1995) suggests, of the need to recognize that organizational restructuring must come with technological change that, though computers have been in existence for some 40 years, IT is only now beginning to pay.

An opinion survey on organizational culture carried out by Swierczek (1989) among mostly Thai managers is instructive. Only 1.8% attached even minimal importance to technology. Participants had little experience of choosing technology and tended to accept uncritically whatever was at hand.

In the second part of Swierczek's study, participants were asked to review a case study of a company, Thai Telemarketing, providing an innovative service in response to customers' orders by telephone. The company was burdened by a laborious work flow procedure, resulting in delayed orders and high error rates. Participants were requested to suggest redesigns for the organization. In reality the case calls for both a technical and a social solution: the introduction of a computerized telecommunications system, and at the same time the redesign and enrichment of jobs, to give each employee more autonomy, significance, and responsibility. In fact, though participants did not ignore office technology, they proposed to use it very passively, as an advanced typewriter or filing system. Emphasis was rather on redesigning the work flow. Participants in the study did, however, show a very high concern for issues of human resource management, that Strassmann (1985, pp. 181-219) considers essential if computerized IT is to be developed to the maximum advantage.

There can be no doubt that, since the time of Swierczek's study, there has been widespread adoption of computerized IT by organizations in Thailand. But the consequences of introducing such technology, how successful it has been and the consequences for productivity and development, remain a wide open field for research. There have been only a few recent case studies of adoption of IT by Thai corporations, and of the results, which can form a basis for further research.

5. Thai Management Style

Thailand has been described as having a "loosely structured" social system (Embree, 1950). It is a society that emphasizes individualism. Compared for instance with that of Japan, it may appear to lack discipline. But such

a society possesses values that are able to maintain continuity while, at the same time, adjusting itself to changing circumstances. This is significant, since Thailand has changed from the style of an agriculturally based to that of a semi-industrially based society, and must now adjust further to a service based economy. Part of the problem of the executive is that of adjusting to this change and gearing the corporation into the modern business environment, while not losing many valuable traditions preserved from the past.

Today the world is becoming globalized, and Thai executives are having to adjust to this trend, to adopt and adapt new ways of behavior in the organization, especially in the area of information, resource, and process management, and performance evaluation.

In the past, Thai executives did not think it necessary to pay much attention to up-to-date information in relation to their decision making, a consequence of the fact that they did not have to fight any strong competition. Now, however, the influence of globalization is forcing executives to invest in their own primary information sources and to give more importance to information management. The more the world becomes globalized, the more the business organization's decision making needs up-to-date, accurate, and sufficient information. Otherwise, new competitors, far stronger than any in the past, will take over its stake in the business arena.

Thai executives are facing the problem of adjusting their organizations to a world that is becoming globalized. The rigidly hierarchical system of command is no longer adequate, and is giving place to more flexible, organic and matrix systems of organization (Thinaphong, 1990). To an extent which has never been so in the past, managers are having to give attention to questions of resource management and cost minimization, process management and quality control, performance evaluation and above all to up-to-date, accurate, and sufficient information.

6. Productivity

Productivity and profitability are the factors that decide the survival and growth of an organization or an economy. The improvement of productivity and profitability must be in the minds of management contemplating the introduction of advanced IT. Is this hope justified?

The author's hypothesis is that productivity is directly related to the level of technology employed, a supposition that receives support from previous studies (Arndt & Bouton, 1987; Lawrence, 1984; Leamer, 1984; Maskus, 1983). The rate of growth in productivity will be greater in those organizations that make greater use of advanced IT than in those that make lesser use of such technology.

However, the question is not easy to answer quantitatively. For instance, in all the cases studied by Buchanan and Body (1983), some aspect of organizational performance was improved. It was not so obvious whether performance as a whole was any better. Thus, with the introduction of word processing, the daily output per typist rose six times, but neither the cost of the typing service, nor the time taken to deliver a finished document, decreased appreciably.

The difficulty lies partly in how one defines the term "productivity." Buchanan and Boddy avoided the term, and preferred to look at the criteria individual organizations used to measure performance. These included, for instance, sales and profits per employee, typist output per day, and measures of consistency and capacity. Schermerhorn (1993, p. 8) states simply that productivity is a function of quantity, quality and resources: Productivity rises when quantity or quality of product increases, or cost of resources decreases.

Basic definitions of productivity, as used by various authors, have been reviewed by Edomsomwan (1995, pp. 2-5). In common to all these definitions, where they are precise, is the idea of productivity as a ratio of output over a given period to input of resources over the same period. This is a measure of how efficiently resources are utilized to produce output: Measures of output and input appropriate to the situation under study must be decided.

Three different forms of productivity measure have been distinguished by most researchers and practitioners:

1. Partial productivity: the ratio of total output to one class of input.

Thus, in labor productivity, one of the most commonly used measures, input is worker-hours (Alexander Hamilton Institute, 1977, pp. 1-5).

$$\text{Labor productivity} = \text{Output/worker-hours}$$

Worker-hours may be replaced by its equivalent in real wages.

Other inputs could be, for instance, raw materials or investment in equipment. Thus Dewitt (1970) defines

Personal productivity = revenues per employee

Capital productivity = revenues per stockholders' equity dollar

Facilities productivity = revenues per plant and equipment dollar.

2. Total factor productivity: the ratio of total output to the sum of associated labor and capital (factor) inputs (Kendrick & Creamer, 1965; Taylor & Davis, 1977; Wiboonchutikula, 1987).

3. Total productivity: the ratio of total output to all input factors.

Thus, a comprehensive measure of productivity would be

$$\text{Productivity} = \text{Output} / (\text{Labor} + \text{Capital} + \text{Raw materials/ parts} + \text{Miscellaneous})$$

To use this formula, dollar values are assigned to each component. These must be adjusted to a base year, to compensate for inflation and make the figures comparable from year to year.

In more detail

Output: If there is more than one product, these must be weighted before they can be added together. For instance, the sales price per unit may be multiplied by the number of units.

Labor: Worker-hours are multiplied by hourly wage rates, using average rates for job classes.

Capital: The value may be calculated by treating the assets as if they were being leased, and using the rental value.

Raw materials/ Purchased parts: Purchased units multiplied by unit prices.

Miscellaneous: This includes all other input costs - utilities, taxes, advertising, and supplies not used in production.

Mundel (1983, pp. 10-14; 1986) defines the Productivity Index as "the ratio of the outputs produced for use outside an organization, with due allowance for the different kinds of products, divided by the resources used, all divided by a similar ratio from a base period."

The index so defined is a dimensionless number. It compares current productivity with productivity over a base period. In our case the base period would be a period before the innovative technology was introduced.

Thus if:

$$\begin{aligned} O_C &= \text{Aggregate output for current period} \\ I_C &= \text{Resource input for current period} \\ O_B &= \text{Aggregate output for base period} \\ I_B &= \text{Resource input for base period} \end{aligned}$$

Then, Productivity Index

$$P = (O_C / I_C) / (O_B / I_B) \times 100 \quad (A)$$

Or, rearranging

$$P = (O_C / O_B) / (I_C / I_B) \times 100 \quad (B)$$

The subsidiary ratios are termed as follows:

1. O_C / I_C = current performance index
2. O_B / I_B = base performance index
3. O_C / O_B = outputs index
4. I_C / I_B = inputs index

Formulation (A) may be easier to use, as the ratios (1) and (2) may be computed from periods of different lengths, whereas in (B) the ratios require that all data be from periods of equal length.

A case where productivity measurement became relevant in Thailand arose when the Ministry of Finance, as recommended by the World Bank, issued a ruling that Thai state enterprises must so manage their businesses to allow productivity to increase by at least a factor of two per year. The formula that the Ministry prescribed for these enterprises is

Productivity Increase = (% Change in output) / (% Change in input)

Percentage change in output = $[(O_t - O_{t-1}) / O_{t-1}] \times 100$

where O_t = Output in the current year,
 O_{t-1} = Output in the preceding year,

Percentage change in input = $[(I_t - I_{t-1}) / I_{t-1}] \times 100$

where I_t = Input in the current year,
 I_{t-1} = Input in the preceding year,

By way of example, the Rayong station of the Electricity Generating Authority of Thailand (EGAT) could, in 1994, generate electricity at the rate of 1500 MW. In 1993 its rate of production was 1250 MW. Over this period, wages for labor increased from 150 million baht in 1993 to 160 million baht in 1994. In terms of the above formulae

Percentage change in output = 20%
Percentage change in input = 6.67%
and hence, Productivity Increase = 3.00

Prokopenko (1987, pp. 24-59) though preferring total productivity, considers output per worker-hour to be a good measure of productivity in most industries, except those that are very highly capital intensive.

Total factor productivity was applied to a study of industrial growth in Thailand by Wiboonchutikula (1987). This author gives formulae incorporating labor, physical capital, and real intermediates into the input factor.

Productivity indices were applied to measurement of overall national productivity for a variety of Asian countries in papers presented at an APO symposium in 1979 (Asian Productivity Organization, 1979).

Productivity measurements are discussed by Baumol, Blackman, and Wolff (1992, pp. 225-250). These authors point out that each measure of productivity, labor, total factor, or other, has its legitimate uses - each offers vital information that would not be available without it.

Lichtenberg (1992, pp. 17-23) emphasizes the importance of labor productivity as being closely related to per capita income and hence to the standard of living, but regards total factor productivity as a better measure of producer efficiency.

Strassmann (1985, pp. 100-115, 259-265) refers to the measurement of productivity by a simple output/ input ratio, for instance output divided by the number of worker-hours, as the "efficiency" approach to productivity. He gives as an example the number of invoices generated by an office against the number of worker-hours: A 6.9% increase from 1979 to 1980 was recorded. However, when the input is taken, not as worker-hours, but as direct dollar costs in salaries plus technology, the result is a loss of 0.7%! Strassmann prefers to consider the productivity of the invoicing department in terms of its value to the business. The output is now aggregate dollar value of receivables, debt write-offs, sales time, and lost business; input comprises salaries, technology, and training. Productivity gain is now 77%, achieved as a result of a modest investment on training of the sales force in 1980.

Strassmann considers the efficiency approach to productivity to be unreliable when applied to information handling work. He proposes instead an "effectiveness" approach to productivity (Strassmann, 1985, pp. 116-150, 265-269). Effectiveness is concerned with the quality and usefulness of the output to the customer. He proposes further a value-added measure of productivity as a practical method of assessing the contribution of computerized technology to organizational performance.

In this procedure, the details of which are elaborated by Strassmann, the total value added by a business unit is computed by subtracting total costs from gross revenue. The contribution of capital to the value added must then be subtracted. The next step is to separate the contributions of direct labor and of management. Labor productivity is then determined by dividing by the costs of labor. Strassmann gives as an example the following, from an office automation program:

Output (thousands of dollars):

Revenue	US\$ 9,411
Less purchases	6,961
Value added	2,450
Less cost of capital	472
Labor value added	1,978

Input (thousands of dollars):

Labor costs	US\$ 1,499
Labor productivity:	1.32

In this calculation it is essential to include, among labor costs, nonwage costs such as holidays, social insurance, and other benefits. Strassmann gives an alternative procedure for calculating labor productivity, and year-to-year productivity changes. It is of interest that, in this particular case, labor productivity was actually falling while heavy investments in office automation were being made.

When costs of operating labor have been deducted, what remains is management value added. When divided by the cost of management, the result is management productivity. Management costs include directly related office expenses, but exclude product-related IT expenses.

Management value added divided by the costs of technology gives IT productivity. Strassman, however, considers productivity indices, when used alone, as unsatisfactory. The strategic aspects of IT are best assessed by their effect on business results, such as changes in market share and market penetration, profit margins, and quality of product and customer service.

The results of a 1981 study of department stores, using these methods, are somewhat sobering. In heavily automated departments, after 4 years of computer operation, productivity had actually declined by 0.17%, in data-processing departments it had increased by only 0.07% - though labor costs in nonautomated departments were four times greater than in automated departments. In this case management had concentrated entirely on automating routine administrative tasks - but some development, other than in IT, was acting to depress performance.

It is possible to consider productivity from two points of view: that of the owners or shareholders of the company, and that of the customer. From the point of view of the former, what the company must "produce" is profit; and, for this purpose, the ratio of annual revenue to annual costs is a logical measure of performance. In the case of a non-profit making organization this view of productivity is hardly applicable. Nonetheless, even here, financial ratios are still meaningful as a measure of organizational efficiency.

From the point of view of the customer the output of interest is goods or services. While it is not particularly difficult to measure tangible goods, and the inputs required to produce them, how best to quantify outputs and inputs of the service industries is still controversial.

Mark (1988) considers first some of the simpler cases. Output units for the transportation industries have two dimensions: amount and distance, reflecting how much has been transported how far, for instance as ton-miles or passenger-miles. Output for communications industries, for instance telephone and television services, are best measured by revenues generated, deflated by appropriate price indices. Electric utility output has a clearly defined unit of kilowatt-hours. Retail and wholesale trade output can be measured by volume or value of transactions. Measures can be developed for government and hospital services. However, for many areas in the service sector, such as education, entertainment, legal, social and some medical services, severe conceptual and data problems of measurement remain. A currently rapidly growing area that presents great difficulties in measurement is the generation of computer software.

McNair and Leibfried (1992, pp. 141-147) consider productivity of "white collar" workers, its measurement, and improvement. They point out that, in areas such as IT, it is particularly difficult to define the outputs created or to measure their effectiveness. They suggest four elements to administrative worker productivity:

1. Effectiveness: the relationship between strategy and work activities. Employees' time should be directed to more productive tasks that directly support company strategy.
2. Organization: the structure of business functions, work activities, operations and reporting relationships. Productivity should aim at eliminating (a) overlap/duplication, (b) fragmentation, (c) inappropriate groupings of functions or alignment of functions, (d) inefficient reporting relationships, (e) excessive management layers, (f) lack of clarity of mission, and (g) inappropriate job design.
3. Motivation: the extent to which employees are committed to achieving business objectives. If turnover is high and motivation weak, the reasons should be determined and resolved.
4. Process: work flow, methods and technologies. Value-added activities, scheduling and control, use of automation and situations causing bottlenecks, should be reviewed.

The goal is continuous improvement and elimination of waste. Productivity measures, as before, include ratios:

1. Units of output/ number of employees,
2. Units of output/ cost of production,
3. Value-added operations/ non-value-added operations,
4. Cost of management/ number of subordinates.

Other factors indicative of productivity are throughput time, incidence of errors, deadline accomplishment, customer satisfaction, and degree of employee commitment. Administrative productivity can also be measured by organizational profitability and methods that allocate costs between service providers and users.

As far as the organization is concerned then, the purpose of IT is to increase productivity. Productivity is defined, at its broadest, as the ratio of output to input. Productivity, then, increases when output increases or input decreases, or both. However, this simple formula hides a wealth of details.

We may well begin by considering the concept of "true productivity" as discussed in an article by Rene T. Domingo (1991). This author first points out that there are two views on improving productivity. In conventional companies, management thinks in terms of getting the maximum output - irrespective of whether the market can absorb it - from the available input. In what Domingo calls "world class companies," management thinks in terms of the required output from the minimum input.

Domingo's steps to increased productivity, which must be continuously applied, are then as follows:

1. Determine the required output. The required output is user-defined. It is what the external customer wishes to buy; or the internal customer, the next worker in a production process, needs to use. This latter is the basis of the just-in-time approach to manufacturing. In terms of the external customer this means that the output is determined by the market. The right output means goods or services of the right quality, delivered in the right quantity, at the right time. If necessary, it is better to have idle input rather than idle output. In the worst case, it would be better to pay workers to do nothing, rather than to accumulate an inventory of high value-added products that will not sell.

This goes in two stages:

- 1.1 Eliminate unsatisfactory quality.
 - 1.2 Avoid too early or too late delivery. For Domingo, wrong delivery time is equivalent to wrong quantity.

2. Eliminate waste: any unnecessary input or output that entails cost or investment. This again goes in two stages, which should be in this order:

- 2.1 Stop making unnecessary output. We may add a corollary that a world class company does not pollute: A pollutant is a useless output.

- 2.2 Improve the process, to eliminate unnecessary input.

3. Resource abundance is not an excuse for waste. A world class company makes the most effective use of resources: It minimizes the use of an input, rather than trying to minimize its unit price - it does not exploit cheap labor, nor deplete natural resources.

On this view, productivity improvement depends on improving the process, the transformation stage between input and output.

As far as the organization is concerned then, the purpose of IT is to increase productivity. We may next turn to how Thai executives and technocrats conceive of productivity and its measurement.

To this end, Chumpol Phornprapha, Chairman of the Board of S.P. International Group of Companies, and previously of the Council of the National Institute of Development Administration (NIDA), and currently Chairman of the Council of Silpakorn University, considers productivity as "Continuous interaction among three basic factors which are human resources, system of work, and facilities." Elaborating on human resources, he defines three types of organizational leaders: advanced, conservative, and indifferent - among which he upholds the advanced leader, the one who learns to clearly understand the real importance of productivity to the organization. The advanced leader follows changing environmental factors and tries to develop the organization in appropriate ways, either by changing the organizational structure or by bringing in more capable staff or new technology, so that the organization will be able to sustain competition and gain more advantage in planning and executing business strategy. These leaders tend in general to be found among the well educated, younger generation, who are considered aggressive in the business field. They will try to improve the organization in all three factors of productivity (Phornprapha, 1992).

In considering one example of productivity in the organization, he looks at the internal information system of the company. He proposes that the availability of and speed with which the management finds information can indicate the level of office productivity. This is apart from the relevance and quality of the work. Good information can only come from a good work system, good personnel, and good facilities. If the company can handle an information enquiry at a satisfactory level, we can be confident, up to a point, that it does not have any serious productivity problems.

As business becomes global, Thailand has adopted new technological equipment that speeds up work and contributes significantly to productivity. It is important to management to understand this technology and select what is appropriate to the organization; since, not only will it change the system of work, but it will challenge personnel to learn how to use it to its maximum potential.

Phornprapha stresses the importance of human resources in improving productivity. Management and staff educated in skills from many fields of business are required if the company is to expand and diversify successfully.

Manaswee Thadasi (1988, pp. 10-22) considers increase in productivity to involve three factors: technology, human resource development, and improved management. Technology is classified as hardware, or software. Personnel must be trained to use appropriate technology and management style enhanced to achieve higher productivity. Executives must adopt innovative and up-to-date management techniques.

"Belief in the value of the individual" is cited by Tansuvan and Saeng-Xuto (1992) as a guiding principle of human resource management at Siam Cement Co., Ltd. At the firm's "Abridged Business Concept" (ABC) training program, graduate employees asked for the reasons motivating them to stay on at the company most frequently reply: appropriate salary, appropriate benefits, challenging work, room for advancement, good environment, good boss, good colleagues, fun, fairness, good teamwork, recognition, and the opportunity to learn new things. Much care is taken over selection of new recruits, in the hope of gaining lifetime commitment. Salaries and benefits are at the forefront of the labor market, and take into consideration individual, team, and company performance. The effort is made to promote fairly; and there is much emphasis on wellbeing and safety in the workplace - the Japanese 5S concept is considered a core foundation of quality, productivity, and profitability. Training has emphasized rotation of job functions and overseas experience for QC circle teams - though the authors thought that there was now a need to give more attention to comprehensive, in-depth, technical training.

The Petroleum Authority of Thailand (PTT), a public enterprise aiming to improve productivity in order to achieve competitiveness against major multinational oil corporations, held an executive workshop to investigate difficulties in promoting productivity improvement in the organization (Watakeekul, 1992). PTT identified two main constraints:

1. Productivity is achieved through people. It is wholly dependent on optimum human resource (HR) utilization. If employees are unmotivated, as a result of inadequate or unfair compensation or promotion systems, lack of recognition, ineffective HR programs, or a poor workplace, this constitutes a major constraint on productivity.

2. An inflexible, overly bureaucratic system, overburdened with rules and regulations - as is commonly the case with public organizations - creates inefficiency and leaves individuals no freedom to act to increase productivity.

PTT took steps to remedy these problems, including a move towards a more decentralized organizational management system and employee participation on the Japanese model.

In Thailand, industry is still labor intensive (Khunponkaew, 1996), a situation which differs from that of a developed country such as members of the OECD like the United States, Japan, Singapore, or of Europe. Industry in developed countries is capital intensive. Overall productivity in developed countries can be expected to be higher than that of Thailand. This can be observed from per capita GNP, which is in fact higher than that of Thailand.

Labor productivity in Thailand, defined as annual gross domestic product per worker, is higher than that of the United States, Japan or Singapore (Tables 2.4 and 2.5).

Table 2.4
Thailand: Labor Productivity and Productivity Index

Year	1988	1989	1990	1991	1992	1993
GDP (million million baht)	1.56	1.75	1.95	2.12	2.28	2.47
Employed workforce (millions)	28.10	29.32	29.98	30.79	31.38	31.91
Labor productivity (baht)	55,516	59,686	65,043	68,853	72,657	77,405
Labor productivity index	100.00	107.51	117.16	124.04	130.88	139.43
Minimum wage (baht per day)	73	78	90	100	115	125
Wage increase (%)	-	6.85	15.38	11.11	15.00	8.70

Note. From Khunphonkaew (1996, p. 13). One US\$ equivalent to 25 baht.

Table 2.5
National Labor Productivity

Unit: US\$ and percentage

Year	Country		
	Japan	Singapore	Thailand
1985	22,917 100.00	14,325 100.00	1,505 100.00
1986	23,057 100.65	14,829 103.52	1,542 102.46
1987	24,074 105.05	15,559 108.61	1,635 108.64
1988	25,186 109.90	16,436 114.74	1,741 115.68
1989	26,114 113.95	17,169 119.85	1,868 124.12
1990	26,938 117.55	17,517 122.28	2,068 137.41
1991	27,277 119.03	18,216 127.16	2,214 147.11
1992	27,088 118.20	18,679 130.39	2,286 151.89

Note. From Khunphonkaew (1996, p. 13).

Thailand's productivity situation is thus favorable, as it started from a low base. However as the country moves towards further development, industry will become less labor intensive and more capital intensive.

The studies of Tinakorn and Sussangkarn (1996) indicated that Thailand's rapid growth over the preceding two decades was the result of adding more labor, capital and land to the production process rather than to increased productivity as such. Over the period 1987-1990, total factor productivity increase averaged 1.2% per year, only a 15.8% contribution to total growth. Such productivity improvements as were achieved were attributed to importing more efficient and modern machinery, and to an improved or more productive workforce.

There is a lively awareness of the importance of promoting productivity, but the focus to date has been mainly on such measures as total quality control, 5S, worker participation, and improvement of labor-management relations (TMDPC, 1992). So far little attention has been given to the effect of IT, despite the widespread adoption of computerized information processing

systems. It is only evident that investment in IT does not automatically result in improved organizational performance. Much depends on how work is organized round the new technology, on strategic decisions by management, and hence on the assumptions and values of those who make the decisions.

7. Summary

A review of the literature suggests that the organization can be regarded, from the systems viewpoint, as an open system, of which the managerial function and the IT system are interacting parts. Managers must face the effect the introduction of IT has on the way the organization does business and the organizational restructuring it may require.

Applications of IT in Thailand are now getting beyond the elementary level: MIS, and more advanced systems, are in use. Thai cultural values appear to minimize resistance to innovation and there are reports of successful applications of IT, though in this rapidly changing field it is difficult to determine the best way of using the new technology.

There is concern for improved productivity in Thailand, but the effects on service sector productivity of introducing advanced IT have so far hardly been considered. Data up to date, derived mostly from developed countries, are difficult to interpret. The uncertainty arises in part from difficulties in how productivity of the service industries, the effectiveness with which these organizations use their resources, should be defined and measured.

The author adopts the hypothesis that productivity is related to the level of IT employed. The research methodology, as set out in the following chapter, is designed to address this hypothesis.

CHAPTER 3: RESEARCH METHODOLOGY

1. Introduction

The purpose of the study was to assess the impact on productivity, within the Thai service sector, of the application of information technology (IT). It was to compare the productivity of Thai service companies which had, and those which had not, significantly applied IT. It further investigated the current extent of use of computer-based information systems (CBIS) among these companies, and the opinions of respondents towards the consequences of such use. It could thus assess the impact of adopting IT on productivity; and test the hypotheses that (a) the rate of increase of productivity is greater in those service companies significantly applying IT, and (b) the rate of increase of productivity after introduction of IT is greater than before introduction.

The objective was to investigate a possible causal connection between two variables: a company's use of IT, and its measured rate of increase in productivity. The appropriate design technique to obtain the required factual data was that of a survey (Fowler, 1993; Ghauri, Gronhaug & Kristianslund, 1995; Zikmund, 1994), following case studies.

For the purpose of the survey the investigator

1. Selected as the target population Thai service companies established before 1990.

2. Adopted the definition of a company as a "significant" user of IT if it had installed and actively used a management information system (MIS) and employed personnel responsible for the system. A company that had installed TPS or OAS, or both, but not MIS, was regarded as a "less than significant" user.

3. Surveyed the types of IT systems installed by companies and the dates of installation; and so determined whether or not a company was a "significant" or "less than significant" user of IT, as here defined.

4. Requested data on total annual revenue and total annual costs, over a period extending from three years before to three years after, the year of introduction of IT.

5. Surveyed the opinions of employees responsible for IT, as to the consequences for productivity of the introduction of IT in their respective companies.

6. Elicited opinions of respondents as to recent trends in their companies' productivity, including companies not yet "significant" users of IT.

7. Selected, from the target population able to supply adequate and sufficient data for the purpose of calculation, two subsamples, comprising (a) "significant" users, and (b) "less than significant" users, of IT.

8. Specified two periods of time, of three years before and including (that is, four years in all), and three years after, the year of introduction of IT.

9. Determined the average annual productivity increase of the sample companies over those two periods of time.

10. Tested the hypothesis that the rate of increase of productivity of those companies "significantly" applying IT is greater than in those not "significantly" applying IT.

11. Tested the hypothesis that the rate of increase of productivity is greater at a time after introducing IT than at a time before introducing IT.

A parallel survey was carried out of the opinions of informants, as to the application of IT and its effects on the growth of productivity in their respective companies.

2. Population and Sample for the Survey

The companies were limited to (a) banking institutions (b) hotels, and (c) retail sales businesses.

The sample was collected from those companies which were established before 1990. The reason for this choice of date is that the sample should be of companies which can provide at least three years' record of total revenue and total costs before IT introduction, one year at commencement of IT use, and at least three years of experience after introducing IT. Here the term "introduction" may refer to a company's first installation of an IT system, or to a major upgrading of an existing system. There were some companies that, even though in existence since 1990, had only recently introduced IT, for example some not before 1997. So only a limited number of companies had characteristics that exactly fitted the researcher's requirements.

The researcher aimed for as large a sample as possible. Some companies approached were reluctant to supply the required financial data; and not all that were cooperative supplied sufficient data for the purpose of the analysis. In particular some failed to provide revenue and cost data over the full 7-year period specified by the study.

Those companies which were able to supply clear and unambiguous data, meeting the requirements of the study, were accepted for the sample. All these companies had introduced active use of IT, of which those that had introduced MIS were designated significant users of IT. Those companies that had introduced IT, but only at the level of OAS and TPS, were designated as less than significant users of IT. For all companies, data for total revenue and total costs were available for the two periods of three years before and including, and three years after, the year of introduction of IT; hence productivity and the rate of increase of productivity, as defined previously, could be calculated for each of the two periods, before and after IT introduction, for all companies.

It was thus possible to compare rates of increase of productivity as between

1. The sets of significant and less than significant users of IT, before either set of companies had introduced IT.
2. The sets of significant and less than significant users of IT, after both set of companies had introduced IT.
3. The set of significant users of IT, before and after the year of introduction of IT.
4. The set of less than significant users of IT, before and after the year of introduction of IT.

3. Instrumentation

The instruments used for this study comprised

In-depth interview

The in-depth interview enabled the investigator to elicit data from informants regarded as knowledgeable in the application of IT, representing their respective companies. Case studies were carried out on a series of companies, chosen to represent differing service industries and differing levels of IT application. The data and opinions obtained were used by the investigator to refine the questionnaire-cum-interview schedule.

Questionnaire-cum-interview schedules

The schedules were developed in several stages, after obtaining expert opinion as well as feedback from case study data obtained by in-depth interviews. Productivity measurement was based on total annual revenue and costs. This information would be readily available to companies from accounting records.

The final schedules were considered to be reliable, and valid for the intended purpose, since questions on which the statistical comparison between significant and less than significant users of IT was based, requested only factual data. Questions which requested opinions, and were therefore more liable to subjective interpretation, were not used for statistical comparison.

4. Data Collection Procedures and Techniques

Data collection procedures for the study were as follows:

Secondary data were obtained from relevant documentary sources: books, and other published sources. The libraries of NIDA, Indiana University, Tokyo Keisai University, and of other universities and institutions in Bangkok, in Indianapolis, and in Tokyo were used, as well as current data obtained via Internet. Secondary data were also obtained from published information on the companies studied. Secondary data were collected before primary data, because information obtained from the secondary data would assist the investigator to construct reliable and valid instruments for primary data collection.

Primary data from the case studies were obtained by in-depth interviews and a questionnaire-cum-interview schedule. Primary data from the survey were obtained by a questionnaire-cum-interview schedule.

1. In-depth interviews were used to question responsible personnel in companies selected for case study, representing differing service industries and differing levels of IT application.

The objective of the case studies was to investigate the consequences for productivity of investment in advanced IT. Such a study should consider productivity and profitability of the company before and after introduction of IT. The guidelines of Hill and Jones (1995) may be adopted with advantage:

1. The history, development and growth of the company over time, with particular reference to critical incidents in the company's history.
2. Identification of the company's internal strengths and weaknesses, with a view to a SWOT analysis.
3. Analysis of the external environment: opportunities and threats.
4. Evaluation of the SWOT analysis.
5. Analysis of corporate level strategy: the company's mission and goals.
6. Analysis of business level strategy: How does the company aim to compete?
7. Analysis of organizational structure and control systems.

The "critical" event here is the introduction and implementation of IT. The questions of interest are:

1. What were the reasons for adopting IT? What advantages were expected?
2. How was the decision to install IT arrived at?
3. What systems were installed: TPS, OAS, MIS, DSS, ESS, or other?

4. How was installation implemented? What types of computers were installed? What were the sources of hardware and software? Who carried out the installation?

5. What problems, if any, arose? How were they solved? Problems which have been reported include:

- 5.1 Failure of the system to work as intended.
- 5.2 Lack of training of personnel.
- 5.3 Difficulties of interfacing with existing business practices.
- 5.4 Ergonomic problems.
- 5.5 Reduced job satisfaction.
- 5.6 Employee resistance, individual or organized.

6. What advantages are claimed for IT by management and employees?

7. What were the consequences of adopting IT?

- 7.1 For productivity and profitability.
- 7.2 For organizational structure.
- 7.3 For management style.
- 7.4 For personnel.

The novel feature of these case studies was their focus on the effects of IT on productivity. With this objective, wherever possible, detailed financial and accounting data were obtained over the period covered by the study. Various measures for assessing productivity were evaluated.

In view of the fact that many of the effects reported for IT are intangible, an effort was made to ascertain the effect of introduction of IT on profit margin, market share and penetration, throughput time and deadline accomplishment, incidence of errors, quality of service and customer satisfaction, and employee commitment.

The investigation into the way in which a company uses IT to improve productivity is not unlike the initial phases of a benchmarking study (Camp, 1995) and guidelines to benchmarking practice were also born in mind when conducting the case studies. The question here is: How does the organization employ IT to improve productivity? Benchmarking places the emphasis on basic business processes: How is IT used to make these processes more efficient?

Camp (1995) introduces a concept of "Step Zero." Before anything else is undertaken, the investigator should consider (a) the output of the study, (b) the customer for the study, (c) the customer's requirements, and (d) the specifications to meet these requirements. As stated in Chapter 1 of this study, the "customers" for an investigation into the consequences of IT for productivity are all those service organizations faced with decision making as to how best to install computerized IT within their own organizations. What

the managements of these organizations will want to know is: How should IT be applied to improve productivity? The case studies were conducted with this question in mind.

2. Questionnaire-cum-interview schedules were used to obtain data from personnel in the two groups of companies. The objectives of the questionnaires were:

(a) To determine the types of IT systems installed and the dates of introduction; and whether the company was a significant user of IT as defined for the purpose of this study.

(b) To request data, where available, on total annual revenue and total annual costs over a period extending from three years before to three years after the year of introduction of significant use of IT as defined for the purpose of this study.

(c) To obtain the personal opinion of the respondent as to the effect of the introduction of IT on productivity; and, including in the cases where the company was not a significant user of IT, of recent trends in productivity.

The questionnaire-cum-interview schedule was distributed initially by mail. In order to ensure collection of sufficient data within reasonable time, the mailed questionnaire was followed up by a telephone interview. Some company representatives were interviewed by the investigator in person. The sample finally accepted comprised companies able to supply clear and unambiguous data meeting the requirements of the study.

5. Data Analysis

The purpose of analysis is to extract from the data a response to the research hypotheses. Hence the data needed to test any specific hypothesis must be made available in a form that permits the use of the intended statistical procedures. The plan of analysis follows from the problem statement, the purpose of the study and the hypotheses.

On the basis of an interdisciplinary approach that stressed mainly systems theory, CBIS theory, and a conceptual framework for strategic implications of information systems, the investigator first overviewed closely related previous research findings and literature on application of IT in strategic planning for improved productivity in contemporary business organizations. Close attention was given to the policies of companies towards application of IT. The opinions of personnel towards CBIS systems in their respective companies, as well as opinions on the adoption of innovative technologies, especially personal computers, were noted.

The data analysis plan is set out in the discussion of the statistical procedures used in the study.

6. Statistical Procedures

For the purpose of this study, productivity growth rates, as between companies significantly and not significantly using IT, and as between the periods before and after introduction of IT, were compared and contrasted. The objective was to test the proposed hypotheses:

H_1 Research hypothesis (H_1): The rate of increase of productivity in Thai companies significantly applying information technology is greater than in those companies not significantly applying information technology.

Null hypothesis (H_0): The rate of increase of productivity in Thai companies significantly applying information technology is the same as in those companies not significantly applying information technology.

H_2 Research hypothesis (H_2): The rate of increase of productivity at a time after introduction of information technology is greater than at a time before introduction of information technology.

Null hypothesis (H_0): The rate of increase of productivity at a time after introduction of information technology is the same as at a time before introduction of information technology.

A company was regarded as "significantly" applying, or as a "significant" user of IT if it had installed and was actively using a management information system (MIS) and employed personnel responsible for the system. The year in which this system was installed was taken as the base year. Data on total annual revenue and total annual costs were available for the three years before the base year, the base year itself, and for three years following the base year (a 7-year period in all).

All companies in the sample were users of IT, at least at the levels of transaction processing (TPS) and office automation (OAS) systems. A company employing TPS or OAS or both, but not MIS, was regarded as a "less than significant" user of IT. In this case, the year of installation or upgrading of the existing IT system was taken as the base year for calculation.

Figures for total annual revenue and total annual costs were adjusted to 1985 values, using the published wholesale price index for the respective year.

That is

$$\begin{aligned}\text{Real Output} &= \frac{(\text{Total revenue for year X} \times 100)}{\text{Price Index for year X}} \\ \text{Real Input} &= \frac{(\text{Total costs for year X} \times 100)}{\text{Price Index for year X}}.\end{aligned}$$

Then

Productivity = Real Output/ Real Input

and Annual productivity increase

$$= \frac{(P_x - P_{x-1})}{P_{x-1}} \times 100$$

where P_x = Productivity for year X

and P_{x-1} = Productivity for year X-1.

The average annual productivity increases, over each three-year period, before and after IT introduction, for each company, were taken as the figures for statistical analysis.

In making the comparison between significant and less than significant users of IT, the question of the test to be employed now arises. The actual statistical distribution followed by observed values of annual productivity increase is unknown. There are certainly no grounds for assuming, a priori, that these figures are normally distributed. Nonparametric tests are therefore in order, and moreover would be preferred in view of the small sample size (Mendenhall & Reinmuth, 1982, chap. 17; Watson, Billingsley, Croft, & Huntsberger, 1993, chap. 18).

The Mann-Whitney U test is the test of choice when comparing two independent sets of data, as in this case between two independent groups of companies, significant and less than significant users of IT. The Wilcoxon Matched-pairs Signed Ranks test is designed to compare paired sets of data, as in this case productivity data for the same company before and after introducing IT. Thus, the Mann-Whitney U test was used to test Hypothesis H_1 . The Wilcoxon Matched-pairs Signed Ranks test was used to test Hypothesis H_2 .

Otherwise, statistical analysis was in part descriptive, especially where employed to report and compare opinions as to productivity trends, and IT usage, by company personnel. The chi-square test was used to compare IT hardware usage among personnel at various management levels.

For correlation purposes, a significance level of 0.05 was accepted, as is the general practice in social science research.

To calculate and analyse data, the investigator used the Statistical Package Program for Social Science (SPSS/PC+). The Excel spreadsheet was employed to tabulate financial data and calculate annual percentage productivity increase.

CHAPTER 4: PRESENTATION AND ANALYSIS OF DATA FROM CASE STUDIES

1. Introduction

Case studies were first used by Harvard Business School in order to go more deeply into questions of interest and to gain access to detailed information which could not be obtained by using the survey technique alone. The purpose of a case study is to gain information from a situation which is similar to those which will later be the subject of specific quantitative research, to assist the formulation of research approaches and techniques, and reveal problems that may arise. It may also reveal unexpected insights and directions for new research (Zikmund, 1994). Used in this way it is a guide to research design (Merriam, 1988). Yin (1994) further suggests that, where we have a theory that specifies a particular outcome for a firm in a particular situation, we may use a case study to test the theory and its applicability to the organization, especially where the situation is one on which there has been little or no previous study.

Thus, though it has become a strategic necessity for companies to invest in information technology (IT), the results of large scale surveys to detect the expected increase in productivity have been ambiguous. In the case of service industries, the situation is complicated by the fact that it is not entirely clear how best to define and measure productivity in these industries. In-depth case studies of a number of selected service organizations would be expected to throw light on these questions and to provide guidelines towards conducting a wider survey of IT and productivity in Thai service organizations.

This section presents results of such case studies of three pairs of organizations in the fields of (a) banking, (b) hotel, and (c) retail sales business. In each case the investigator's objectives were to determine the status and history of IT use by the organization and whether the findings supported the hypothesis that the rate of increase of productivity was greater after a significant innovation in the organization's use of IT than before. For full details of the respective case studies the reader is referred to Appendix 13-18.

The banking industry is central to the economic system and at the forefront in the application of IT. The hotel business plays an essential role in the tourism industry, which is listed among the top ten income earners for Thailand. Retail marketing is a leading representative of the small and medium scale enterprises (SMEs) which account for 90% of business in the country and are thus most influential on national economic development. How the industries under study employ IT may serve as a model for application by other service organizations. Their successes, and at the same time the problems encountered, can be instructive to managers concerned with how to apply IT to enhance productivity and efficiency.

Since many of the Thai organizations which form the subject of the main study are subsidiaries of, or joint ventures with, Japanese companies, it was felt that a number of comparative studies on selected Japanese service industries would be of value. Such companies generally tend to transfer managerial techniques, including those related to IT, from the parent company to Thailand. How far such transfer is successful is itself a matter of interest. These comparative studies were made possible by the award to the author of a scholarship by the Japan Society for the Promotion of Science (JSPS) to go to conduct research in Japan over a period of 31 days in September, 1998.

Japanese companies have often been regarded as a model of effective and efficient management; and Japanese productivity management has achieved a world competitive edge. Comparison with others may help to reveal the strengths and weaknesses in one's own organization. Thus, this study compares (a) the Thai Farmers Bank with the Bank of Tokyo-Mitsubishi, (b) the Central Plaza Hotel with the New Otani Hotel, and (c) C.P. 7-Eleven Co., Ltd. with 7-Eleven Japan Co., Ltd. - the latter being a benchmarking case.

Since many factors other than IT may affect productivity, it was of interest to observe how these organizations used other managerial approaches to improve productivity.

2. Research Method for Case Studies

Data collection methods for case study research have been reviewed by Merriam (1988), Eisenhardt (1989), Ihde (1977), Yin (1994), and Hellriegel, Slocum and Woodman (1992). They include documents, interviews, questionnaires, and direct and participant observation. To these, Sekaran (1992) adds physical measurement and unobtrusive sources of data. The researcher will use more than one method of data collection to converge on the topic of interest. Bogdan and Taylor (1984) advise the researcher to allow information to emerge from the participants before pursuing any specific line of enquiry.

Interviews with knowledgeable persons are a major source of case study information. They may range from entirely unstructured, informal conversations around the topic of interest to highly structured questionnaires. Generally, the number of persons interviewed will not be large - the art is in deciding who to interview.

Documentary materials will in general have been produced independently of the study. An organization will have large amounts of such documentary materials, some of it publicly available, others in the form of internal records of the organization, which may however be made available to the researcher.

Hill and Jones (1995) present guidelines for the analysis of case studies in strategic management which are of value to the researcher preparing to conduct such a study. They stress the importance of a careful

analysis of a company's financial position. Financial performance ratios, calculated from the balance sheet and income statement, comparing the company's performance over a period of years, present one measure of the concrete profitability and productivity outcomes of a company's strategy and structure.

Data were obtained (a) from published sources of information by or on the respective organization, including annual reports and financial statements; (b) by indepth interview of knowledgeable personnel at the organization; and (c) by responses to a questionnaire schedule from persons at managerial level or responsible for the IT system.

A questionnaire-cum-interview schedule was designed specifically for the case studies (see Appendix 19). Since this could not be completed immediately, it was left with the informant; but questions from the schedule, especially on general facts and information, opinions and attitudes, were used in the interview. Facts and figures were checked where possible against other sources, for example company annual reports and published materials relating to the company. Financial data on revenues and costs could be checked, for instance, in Thailand, with the Department of Commercial Registration (DCR) under the Ministry of Commerce, the Ministry of Finance, the Bangkok Bank, Thai Farmers Bank and so forth. In Japan, the financial data on revenues and costs could be checked with the Tokyo Stock Exchange and libraries such as of the Center for International Cooperation for Computerization (CICC), Tokyo Keizai University and so forth.

3. Findings from Case Studies

3.1 The Banking Industry

The Thai Farmers Bank

The Thai Farmers Bank (TFB) is a major banking organization considered successful in applying IT, being in 1991 the recipient of a World Executive's Digest award as one of "Asia's Outstanding Companies" in the field of IT Management.

Computerization commenced in 1975 with the installation of the first mainframe. According to informants, transaction processing systems (TPS) were first introduced in 1976, office automation systems (OAS) in 1980, a management information system (MIS) in 1983 and a decision support system (DSS) in 1990. Investment in mainframe computers continued, and, in 1984, the IT system was greatly expanded, projects that included on-line information systems, ATMs, telephone banking and automatic payment, credit authorization and executive data services, being completed in a little over a year.

In 1985 the computer system was reorganized for greater efficiency in operation. The IBM deposit/withdrawal software SAFE II was introduced, and advanced high speed laser printers brought into use. In 1986 the communications system was upgraded to increase capacity, efficiency and speed, and reduce costs; and the printing capacity expanded.

Further investment in high capacity, state-of-the-art mainframe computers continued through 1987-1989, and in 1990 the single carrier per channel (SCPC) satellite communications system was introduced. The on-line communication and customer service system was now very efficient, encompassing the Bank's business centers throughout the country and abroad.

New software was adopted in 1992 to make credit card service faster, more convenient and more secure; and in 1994 SAFE II was replaced by RELIANCE 2000 to support financial services worldwide.

In summary, the Bank's IT development is characterized by a willingness to invest in the most advanced hardware and software systems currently available, satellite communication, and high speed printing facilities. On at least three occasions it has made major investments in mainframe computers; and it was one of the first banks to introduce automatic teller machines (ATMs) to Thailand. Additional IT resources include minicomputers, client servers, and PCs used both individually and networked. Data and private networks, ISDN, e-mail, videoconferencing and electronic data interchange (EDI) are in use.

Informants were of the opinion that the introduction of IT accounted for an approximately 20% increase in productivity per year. Productivity improvement appears as reduced cost and personnel requirements and increased revenue, and increased speed of transaction processing. The rate of return on investment in equipment over 1989-1991 was high, the rate of growth in 1988 being 105% greater than in 1982.

The first significant point in the Bank's development of IT was the introduction of a MIS in 1983. The productivity figures, calculated by the author's standard procedure, show that the three years average productivity increase for TFB, before introduction of the MIS, that is over the three years 1980 to 1983, was -0.83. However, following introduction of this system, that is over the years 1984 to 1986, it was -0.21, an increase of 0.62. A marked increase in productivity from 1983 to 1984, at a time when productivity was generally tending to fall, is mainly responsible for this result.

There was general agreement among informants that IT alone is not sufficient to ensure increased productivity. In the case of TFB we can recognize three major contributing factors: (a) education of personnel, (b) business process reengineering, and (c) efficient management.

Investment in training of personnel has been extensive. Both in-house training and study abroad were being promoted from as early as 1966. In 1993 the Bank opened its Training Center, one of the largest and most modern of such institutes in existence, to conduct in-house learning programs, while continuing to fund scholarships for study abroad.

A major reengineering program was instituted in 1992 and first fully implemented in 1993, since when it has been on-going. This program has itself required formidable investment in computerized IT, so the two aspects cannot be separated. During the two years following implementation of the program, the Bank's total assets and net income increased by 32.6% and 45.7% respectively, while number of employees decreased from 16,330 to 16,086 at the end of 1995. In 1993, net profit margin (NPM), return on assets (ROA), and return on equity (ROE), increased by 30.0%, 37.8% and 31.3% respectively. In 1994, NPM increased by 19.5% and ROA by 11.2%; but ROE showed a slight fall, of -0.2%. The effects of economic recession were beginning to be felt.

The study of productivity in Thailand is complicated by the occurrence of the economic crisis, which in 1997 caused a severe loss in profitability for many organizations, including TFB. Nonetheless, the Bank has remained financially strong. This is at least in part to be attributed to farsighted management.

The Bank of Tokyo-Mitsubishi

The Bank of Tokyo-Mitsubishi (BTM) emerged from a merger of Mitsubishi Bank and Tokyo Bank on April 1, 1996. The major centers in Tokyo and Osaka preside over a very large number of networked subsidiary branches and ATM units. As of June 1998, there were 350 branch offices in Japan's major cities, as well as a worldwide network of overseas branches.

Though computerization commenced earlier, the first significant point for this study was the establishment of a Systems Division in 1974-1975. Beginning as a small subdivision of the Operations Division, the Systems Division grew rapidly and became independent.

It appears probable that networking represents the most significant development in IT from the point of view of this study. The case of BTM should be viewed against the background of networked on-line banking in Japan:

1. Inter-branch networking (1967-1974): Networking between separate branches of an individual bank. Deposits, domestic money orders, and automatic transfer between accounts became available on-line; and cash dispenser (CD) machines were introduced.

2. Inter-bank networking (1975-1986): Networking between separate banks, though a Center for Japanese Banks. Loans and foreign exchange became available on-line.

3. Social networking (1981 onwards): Networking with the bank's customers, individual and corporate. Automatic teller machines were introduced and inter-bank networking extended to CD and ATM. Banking facilities and communication lines were liberalized and internationalized. Home banking, through telephone and PC, became possible. The Automatic Answer Network System for Electrical Request (ANSER) and the Credit and Finance Information Switching System (CAFIS) were introduced.

Banks such as BTM are now regularly linked with other financial institutes, business corporations and retail point of sale (POS) units; provide stock exchange and international MIS services; and are becoming linked worldwide into a global integrated financial service system. Each is the center of an extensive computerized network, in which fund transfers, financial transactions, cash and credit card withdrawals and futures transactions are now performed by direct computer to computer connection. In Japan, all banks including the Bank of Japan (BOJ), together with the Tokyo Clearing House, savings and credit cooperatives and other financial facilities, CD and ATM services, are integrated into an inter-bank network.

At BTM the Systems Division now maintains Computer Centers at the bank headquarters, at neighbouring Tama - which is also the Information Center - and at Ikejiri, Aobadai and Osaka. Current IT resources are extensive. They include 18 IBM mainframe computers, as well as Fujitsu, Hitachi and Compaq units; IBM 400 minicomputers, and 300-400 workstations, among all branches taken together. There are estimated to be, in all, more than 10,000 PCs in use. Computers in use and their applications, as of March 1998, are listed in detail in Appendix 14.

As is commonly the case, software for mainframe applications has been custom made; but Microsoft software packages are also extensively used. Efforts are being made to ensure uninterrupted service through the entry into the year 2000, and testing of domestic and international systems was scheduled to be completed by December 1998.

Communications are maintained mainly by rented fiber optic lines, including undersea cable for branches abroad. E-mail and teleconferencing are in use. The Electronic Commerce Banking Division was established in 1997; and, in the same year, Internet banking using smart card technology, and telephone banking were successfully tested. These services, together with electronic cash services, are being expanded throughout the network.

The Bank aims to increase productivity by approximately 10% per year. Informants agreed that IT helps towards this endeavour.

The most recent significant event in the Bank's history is the merger of the two banks in 1996, which would require pooling of IT resources of the two parent organizations. Quantitative data, based on financial statements, are available for the period around the merger. Calculation shows that the

three years average productivity increase before the merger, that is over the years 1994 to 1995 was positive, that is 0.15, whereas three years following the merger, that is over the years 1996 to 1998 it was negative, that is -0.4. This result, however, obscures the fact that there was a very large increase in productivity in the year of the merger, 1996, and that productivity was substantially the same in the following year. Unfortunately for BTM, the merger took place on the eve of an economic recession that rendered the increase in productivity, for the time being at least, unsustainable.

There was general agreement among informants that IT alone is not sufficient to ensure increased productivity. Business process reengineering and education of personnel have been undertaken concomitantly with continuous upgrading of technology. An emphasis is placed on training of personnel responsible for IT systems. A budget of 30 million yen per year is allocated to the training department for the Systems Division, employing 10 persons at a salary of about 500,000 yen per month each.

The economic recession has affected business in Japan, including that of the Mitsubishi group of which BTM is a key member, and it is now recognized that recovery from the crisis will require drastic restructuring. The Bank has an impressive record of success as Japan's foremost city bank and source of finance to Japan's largest industrial group. We may be confident that IT has played a part in this success. The current problems of the Japanese banking industry serve to emphasize that IT is not the only factor affecting productivity.

3.2 The Hotel Industry

The Central Plaza Hotel

The Central Plaza Hotel, Bangkok, is a major hotel established in 1983 and listed on the Stock Exchange of Thailand (SET), and owns numerous subsidiary companies. Information technology management centers round the Computer Information System (CIS). For the purpose of this study, the most significant development in IT application was the establishment of the CIS in 1993.

The CIS Department is headed by the CIS and Planning Director, who is assisted by two Assistant CIS Managers, responsible for planning and operations and related to the front office and back office respectively. Each Assistant CIS manager has two CIS support persons under his supervision, and there is one Secretary. Broadly the CIS Department is responsible for ensuring as near as possible uninterrupted computer services to all other departments and to provide technical assistance and advice to the hotel management.

The Hotel employs the following hardware: (1) Minicomputers, (a) an IBM AS/400 Model 5000, and (b) IBM AS/400 Mid-Range Model 200. There is one IBM workstation; PCs based on 486 and Pentium processors; and a Compaq Prosignia client server using Novell 3.12. Peripherals include an HP Scan Jet SL Scanner; Micros 4700 and Micros 2700 point of sale (POS) units; and a Casio digital camera. Laser, inkjet and dot matrix printers are used, as well as terminal transfer IBM 5250. Network products are LAN Cards, that is 3COM, and Racal; and HUB.

For communication: LANs are Novell; mobile telephones are Nokia; PABX is NEC and ALCATEL. Both FAX/ modems and FAX machines are used. Terminals are IBM 5250 and IBM Emulation Card. The Internet services of Samart, KSC and Asia Access are used.

The CIS Department uses Hotel Information System (HIS) software for two main functions: (a) for the front office, ASVN such as for check-in (C/I); and (b) for the back office, which is mainly concerned with accounting. In addition, ACOM was installed for accounting purposes.

The HIS software is extensively used. Its many functions include check-in (C/I), check-out (C/O) and cashier functions in the front office. All business transactions are recorded, whether in real time or by batch processing, in a folio system. There is an interface system which comprises three subsystems: telephone, POS, and pay per view (PPV). In addition, there are functions for housekeeping, a night auditor, accounts receivable (A/C) and batch processing to prepare reports.

The main functions of the ACOM software, in the front office are general ledger (G/L), accounts payable (A/P), inventory, and fixed assets.

The CIS Department receives and organizes data from five subsidiary hotels in addition to the Central Plaza itself. Data are updated daily, and backed up daily and monthly. There is a maintenance agreement with IBM, which undertakes to replace malfunctioning computers within one hour. IBM has also undertaken to upgrade software with a view to avoiding the "Y2K problem."

The Hotel leases copper wire lines from the Telephone Organization of Thailand (TOT); and uses satellite communication via the Parappa satellite of Indonesia. Bookings may be made through the Hotel's website.

It is widely recognized that personnel management makes a major contribution to productivity. A hotel depends on the quality of its service, and great effort is spent on the training of staff. In the field of IT, the CIS Director and Assistant Managers all agreed that the principle problem lay in training users, especially in the subsidiary provincial hotels, to use the IT system efficiently; and that personnel problems, training, salaries of users, and lost time due to inability to use the hardware and software, are the main source

of increased costs. The techniques for increasing productivity to which the Hotel gives prominence are those of human resource development.

The establishment of the CIS Department in 1993 was taken as a point of significant introduction of IT. This occurred at a time when productivity was generally tending to fall. However, the average rate of productivity increase over the years 1991-1993 was -6.78. After the establishment of the CIS Department, over the years 1994-1996, the figure was -5.07. This represents an increase of 1.71.

Though the Hotel made a notable loss at the time of the economic crisis in 1997, it is equally notable that a rapid recovery commenced in 1998. Hotels, whose business depends much on tourists from overseas, are perhaps less vulnerable to local economic changes.

The case of the Central Plaza Hotel illustrates the point that much depends on human resource development and training of personnel to handle the new technology.

The New Otani Hotel

The New Otani, Hotel, Tokyo was established in 1964 and is the center of a network of foremost hotels in Japan and internationally. Information technology management commenced with the establishment of a Computer Development Department in 1970, initially at the planning stage. The first mainframe was installed in 1974. Computerization was in-house until 1987, when a network was established to exchange reservation information among the various branches. For the purpose of this study, the establishment of networking was regarded as the most significant development in IT application.

The IT management organization is now known as the Information System Department. The Fujitsu mainframe installed in 1974 was used for check-in, check-out, bidding and accounts. An IBM unit was installed in 1978. Recent acquisitions are two IBM 9221 units and four IBM AS/400 minicomputers, all installed in 1998. IBM, Hitachi and Macintosh PCs, about 250 units, as well as laptop and IBM notebook PCs, are in use.

Input devices include Epson image scanners, a Canon digital camera; and 28 Unisys POS cash registers, installed in 1990. Laser, inkjet and dot matrix printers are in use.

Network devices include 10 DEC LAN cards and two DEC HUB acquired in 1998. Two Hitachi PABX were installed in 1995. A client server network system is used.

All member hotels of the New Otani Group are linked, primarily by fiber optic cable, for exchange of reservation data. Reservations can be made via the Hotel's website, www.newotani.co.jp, maintained since 1996.

At an early stage, custom made software was developed in-house. Currently, commercially available software is used for accounting, database management and word processing; and Microsoft and IBM applications, utilities and operating systems.

As a whole, software can be classified as (a) front office, reservations and customer services; and (b) back office, accounting and human resource development. Databases are maintained on (a) client information, individual and corporate; (b) room reservation; and (c) staying guest information.

The principle problems reported by information system personnel were (a) insufficient budget, (b) excessive time spent on maintenance, (c) slowness of the networking and communications system, (d) insufficient knowledge of IT systems, and (e) the rapid rate of development of computer systems rendering equipment out of date.

Informants agreed that IT helped to increase productivity, and that it did so by enabling more efficient use of time, making accurate information available in a timely manner. In order to achieve high productivity, it was considered that information must be uniformly available throughout the company, for instance by having information stored in central servers, to which users are linked by a LAN system. Technology must be appropriate to the task in hand.

There was also agreement that IT is not sufficient on its own. Productivity also requires (a) education of employees; (b) market planning, strategically linked throughout the hotel chain; and (c) consideration for cost performance.

Employees at all levels must be continually educated in the latest technology and must be accustomed to using the computer system as a source of information. Training of employees is coordinated through a Manpower Development Department.

Plans for future productivity increase develop these ideas. E-mail has already been introduced among top and middle management. Paper work is to be reduced; and speed, volume and accuracy of information for decision making emphasized, to increase sales. The system should be simple to use, empowering individuals to get information and act on it quickly.

A significant development in IT use at the New Otani Hotel occurred with the introduction of the networking system in 1989, following which the various member hotels could communicate and share reservation data and information over a large area. The three years average productivity increase,

before introduction of the system, that is over 1986-1989 was 0.24. Following introduction over 1990 to 1992, it was 1.75, an increment of 1.51. This is an impressive increase, more than sevenfold.

The New Otani Hotel presents a striking case of improvement in productivity following the change from stand alone to networked computing, allowing sharing of information over a wide area. The optimum use of computer technology implies entering the global network. The first objective of the system is service to the customer.

3.3 The Retail Sales Business

C.P. 7-Eleven Co., Ltd.

C.P. 7-Eleven Co., Ltd. is a franchised chain store business which has grown very rapidly, from its first branch in 1989 until, after 10 years, there are now more than 1,000 branches. This type of business involves major problems of inventory control, to solve which IT is becoming a strategic necessity. Customers are expecting rapid response, in addition to quality assurance. Competition based on time to respond requires an effective information system to maintain awareness of customer requirements, to link suppliers with distributors, and make possible a short cycle, just-in-time inventory system.

The Information Technology Division forms a subdivision of the company's organizational structure. At present, computerization is widely used throughout stores and offices to facilitate communication and provide accurate up-to-date information and services for managerial decision making.

Computer resources include minicomputers, workstations, PCs used both stand-alone and networked, laptops, notebooks and subnotebooks. Input devices include scanners and digital cameras. POS units are coming into use. Communications facilities include mobile phones, radio transceivers, PABX and FAX/modems. Satellite communication, ISDN, data and private networks, LAN and WAN, videoconferencing and EDI are in use. Multimedia communication is possible. The company maintains a website at www.7eleven.co.th.

Transaction processing systems (TPS) and office automation systems (OAS) were first installed in 1991. In 1995 the system was upgraded with a view to installing a MIS - though the MIS development was not commenced until 1998. Care is taken to maintain the security of data.

The budget allotted to IT purchases in 1997 was stated to be 23 million baht, of which 5 million baht was on software. Telephone communications are one of the largest sources of expense.

At the time of the study, 76 persons were specifically employed on IT-related tasks. In-house training and maintenance is preferred to contracting out. The principal problems encountered are a need for better trained personnel and improved communications technology - and for more budget.

The IT system is still under development. An important aspect of future development will be upgrading to a fully operative bar-coded POS system, at present under pilot study. Inventory management will then become fully on-line.

Informants themselves were in no doubt that IT enhanced productivity, by an estimated 20-30%. However, it is again evident that there are many factors that contribute to the success of C.P. 7-Eleven:

Firstly, there is the emphasis on training of personnel, not only in the use of IT, but in customer service.

Secondly, very careful managerial planning accompanied the decision of the Charoen Pokphand management to purchase the 7-Eleven franchise from Southland Corporation. This careful managerial planning is also evident in its expansion and marketing strategy.

The upgrading of the computer system in 1995 may be taken as the first significant point in the development of the IT system. The average productivity increase over the years 1992-1994 was 1.90. Following upgrading, that is over the years 1995-1997, it was 0.23, a decrease of 1.67. Thus, overall productivity for the three year period is actually higher before upgrading than after. However, the average result hides the fact that, immediately following upgrading, the rate of productivity increase rose, from -0.43 in 1994 to -0.05 in 1995, and then to 0.94 in 1996. Thereafter, in 1997, when the economic crisis would have been taking effect, it fell again to -0.21.

Profitability has been consistently positive since 1993, again with a marked rise in 1996, followed by a slight fall off.

The C.P. Group has felt the effect of the economic recession since 1995. Nonetheless, C.P. 7-Eleven remains one of the most successful of the C.P. Group's businesses, as well as the most successful retail store chain in Thailand. Awareness of the need to develop an advanced, networked IT system is one of several factors that support this success.

7-Eleven Japan Co., Ltd.

7-Eleven Japan Co., Ltd. operates Japan's largest convenience store chain, consisting of over 7,300 stores in 25 of the nation's prefectures; and is the first among Japanese retailers in terms of ordinary profit. Together with Ito-Yokada Co., Ltd., it is the largest shareholder in the Southland Corporation, the leading convenience store operator in the US.

7-Eleven Japan has built up an information infrastructure that enables sales information to be used to ensure that orders and deliveries are quick, timely and continuous, supporting a just-in-time inventory system. Since the establishment, there has been continuous innovation in the IT system.

Electronic ordering was commenced in 1977. A point of sale (POS) system was introduced in 1982, followed by electronic ordering booths (EOB) in 1983; and interactive POS registers were installed in 1986. Graphic order terminals (GOT) were installed, and satellite transmission (ST) of information was commenced, in 1990. New POS registers were installed in 1992, shortly after the Integrated Services Digital Network (ISDN) system, allowing multimedia transmission over the telephone line, was put into operation.

A POS records detailed data on each sale, which collectively will be taken into account when reordering. The system is estimated to earn 7-Eleven 9% more than the outlets of its closest competitor. From 1996 onwards, shops have provided information on local weather information, which is critical when reordering products whose sales are influenced by the weather.

Satellite communication became fully operational in 1997; and in 1998, the Fifth Generation Total Information System, linking approximately 53,000 computer terminals, was completed, at an investment of ¥ 60 billion. This system is one of the largest existing networks comprising satellite communications and ISDN, linking stores, head office, suppliers and distributors. Employees at each store are provided with multimedia product information. A database of sales performance figures can be constructed. Voice and handwritten memoranda can be used for intrastore communication. Product ordering is simplified and time required for processing orders reduced. Store order deadlines have been extended by one hour. Store advisers receive sales and order data for all stores under their supervision through mobile computers. Stores, head office and suppliers share information on the same level and can adapt quickly and efficiently to changes in consumer preferences.

Main computers operate in tandem at Yokohama and Osaka, to ensure that, if an element malfunctions, there will be an alternative channel to perform the same function. Each computer processes sales and ordering information in real time, continuously preparing what would be the optimum

decision at the moment, until the deadline for taking orders arrives, when the final decision is reached in 40 minutes and instructions for delivery are sent out to suppliers and distribution centers.

It is expected that the system will minimize lost sales opportunities and inefficiencies in all processes, help to achieve growth and develop higher value products, and enhance competitiveness.

From financial data, available since the foundation of the company in 1977, it is evident that productivity has increased continuously. Informants considered that, since competitors could achieve only about two thirds of the sales of 7-Eleven, about one third of sales could be attributed to the advanced information, and associated distribution, systems. The system has been continuously reformed and upgraded, while profitability and efficiency have risen.

The development of this sophisticated ordering and distribution system has taken place in more than one phase. It is noteworthy that a sharp rise in average daily sales per store followed the introduction of GOT and satellite transmission of data in 1990 and the establishment of ISDN in the succeeding year.

The objective of the networking system is to provide detailed, accurate, and real time information to management - it is a MIS. It derives much of its data from transaction processing. Each day, approximately 100 million POS data items, and their totals and analyses, are made available to stores and suppliers by the following day at the latest. The management themselves have no doubt that the selling power of 7-Eleven is derived from the integration of all stages from production to delivery to sale.

Calculation shows that the three years average productivity increase over the years 1992-1994, before introduction of the network system, was -2.81. However, following introduction of this system, that is over the years 1995-1998, it was 3.93, an impressive increase of 6.74.

Since the beginning, profit margin has steadily increased, and stock turnover time steadily decreased over this period. The most striking feature is a sharp rise in sales over the years 1990-1993, at the time of the introduction of an advanced data transmission system, including GOT, ST and ISDN. All three measures tend to level out from about 1996 to 1998. This is a period in which businesses have faced severe financial stress. However, it is noteworthy that 7-Eleven Japan has continued to expand while many other businesses are failing. Total sales, revenue from operations, ordinary profit, net income, income per share and number of stores all increase over this period. Return on equity (ROE) and return on revenue (ROR) show a rise over the period 1990-1992. Since listing on the Tokyo Stock Exchange, 7-Eleven has shown a steady increase in profits and dividends over 18 consecutive years, and has executed 15 free share distributions and stock splits. As of February

28, 1998, the payout ratio was 30.0%, return on shareholders' equity was 13.9%, and the ratio of cash dividends to shareholders' equity was 4.2%.

Factors contributing to the success of 7-Eleven Japan Co., Ltd. are (a) an advanced highly networked IT system; (b) continuous reform and rationalization of the distribution system, itself supported by the IT system; (c) attention to training and human resource development; and (d) effective strategic management, especially as regards expansion.

Company personnel interviewed were themselves in no doubt that it is to the IT system that 7-Eleven Japan owes its success.

4. Conclusion and Recommendations

From the above case studies we may attempt to derive some guidelines for a management concerned with how best to introduce IT in order to enhance productivity and efficiency.

We note first that all these organizations have made major commitments to the use of IT in support of the company's business. All go far beyond the stage of office automation alone. Each continuously upgrades its computer system, aiming to be at the forefront of modern technology. Each endeavours to choose technology appropriate to its own tasks, while at the same time being aware of the innovative possibilities of advanced IT. Each makes use of networking, not only within the country but worldwide.

Informants recognized that IT was not the only factor contributing to improved productivity:

1. Two organizations, TFB and BTM, had undertaken major reengineering programs: The organization must be adapted to make maximum use of IT.

2. All stressed personnel training and human resources development. Personnel must be educated to use the IT system effectively - and to give optimum customer service.

3. All companies show evidence of careful managerial planning and strategy. Where problems have arisen, they are to be attributed, not to failure of the IT system, but to mistakes in managerial decision making in the past.

The Japanese organizations under study were in general larger, and more globalized, than the corresponding Thai organizations. However, this does not necessarily confer a competitive advantage. The Thai Farmers Bank appears to have an advantage, as compared with BTM, in not being part of a major industrial conglomerate, whose fortunes it may be too dependant upon. In general one can say that

1. Banks in Thailand need to expand on-line, real time customer services: deposits, withdrawals and transfer of value. And these services need to be globalized: One need not be afraid of a "flight of capital" abroad, if investors can be confident that capital can be successfully managed at home. Electronic transfer - with adequate security measures - will be increasingly recognized as the fastest and most convenient way of making payment. At the same time, one should resist any attempts to impose a "cashless society." There is an anonymity about payment in cash that can be called on when one is not quite sure how much credence to give to even a bank's guarantees of security.

2. Foremost hotels in Thailand appear to be not appreciably behind those in Japan. A hotel is a business that can easily advertise and allow on-line booking through a website, and thus take advantage of the increasing public familiarity with, and access to, the Internet.

3. For retail sales business, a comparison is made of 7-Eleven in Japan with 7-Eleven in Thailand. 7-Eleven Japan Co., Ltd. may be studied as a benchmarking case in the application of networked IT to achieve high efficiency and productivity. C.P. 7-Eleven in Thailand, though very successful, has still to catch up with this level of performance. Retail businesses need to make maximum use of innovative IT, such as the installation of real-time POS systems at every sales outlet; and online advertising and sales.

Case study research into the use of innovative IT needs to be extended to other types of service industry, such as transportation, catering and health care. However, at present we can say that the techniques observed and described here can be seriously considered by service company managers and adapted to their own particular lines of business. One can say that innovative IT becomes effective at two stages:

1. When IT goes beyond office automation, to support managerial decision making.

2. When IT becomes networked, allowing real time communication between an organization's members, and its actual and potential suppliers and customers worldwide. A company which does not now go on-line may not survive.

CHAPTER 5: PRESENTATION AND ANALYSIS OF DATA FROM SURVEY STUDIES

1. Introduction

The study presented here was designed to determine the effects of application of information technology (IT) on the productivity of contemporary Thai service organizations.

The presentation and analysis of survey data are organized under two headings as follows:

1. Presentation and analysis of factual data from the survey. This part of the presentation falls under two subheadings:

1.1 Comparison and contrast between significant and less than significant use of IT, testing of hypotheses as originally formulated.

1.2 Comparison and contrast between periods before and after use of IT, testing of hypotheses as originally formulated.

2. Presentation and analysis of opinion data from the survey. This part of the presentation falls under two subheadings:

2.1 Comparison and contrast among three groups of service companies on IT application, analysing and synthesizing the findings on opinions of the company representatives.

2.2 Comparison and contrast among opinions of informants on IT application, analysing and synthesizing the findings on opinions of the informants.

2. Research Method for Survey Studies

How to collect data is the first question of the investigator. In this case, survey data were collected by questionnaire, supplemented by interviews. Survey questionnaires may be (a) descriptive, identifying the phenomena whose variance is to be described, or (b) analytical, identifying the independent, dependent and extraneous variables of the problem (Ghuri, Gronhaug & Kristianslund, 1995).

Descriptive surveys are often used to obtain views and opinions of employees in an organization. In the current research opinions of informants on IT use and productivity in their respective companies were sought. On the other hand, analytic surveys can be used to test a hypothesis, for instance one

relating level of IT use to productivity increase. In this type of survey the variables of interest must be carefully specified. In this case, these variables were derived from financial data on company performance, and dates of introduction of innovative IT systems. These are the data which will be subject to statistical analysis.

Both types of survey are concerned with identifying the population for study, and drawing from the population a representative sample. The research objectives will determine how data are to be collected. Typically data are collected by a questionnaire, which may be mailed to the potential respondent, or administered in a telephone or personal interview. In postal surveys there tends to be a high rate of failure to respond; while in interviews the interviewer must avoid biasing the response.

Guidelines to construction of the questionnaire are derived from secondary data and case studies (Ghuri, Gronhaug & Kristianslund, 1995; Jankowicz, 1991). In comparative case studies, the questions of interest are studied in a number of organizations and the observations compared to draw conclusions which may be of use in designing the subsequent survey.

To collect data for the present survey, several approaches were used:

1. The author compiled a list of companies as the population for this project which comprised three types of service company: (a) banking industry, 16 Thai banks and eight foreign banks (Department of Commercial Registration (DCR), Ministry of Commerce, reported on June 24, 1999); (b) hotel industry, 1,478 hotels in the Bangkok Metropolitan area and 3,213 hotels throughout the country (DCR, reported on July 31, 1997); and (c) retail sales business, 156 department stores in the Bangkok Metropolitan area and 354 department stores throughout the country (DCR, reported on June 10, 1999). These were obtained from the DCR. Due to the nature of this project, that is, a project aimed to study IT application, for the banking industry there was no problem in selecting the target sample, though this was a smaller population than that of the other two types of service companies. However, for hotels and retail sales business there were some limitations. That is, some of these businesses were very small and the respondents replied that they did not have nor use computers, so they did not have any ideas about IT application. Hence, the author omitted hotels and retail sales businesses which were small and not computerized. Therefore, the actual population for this research project consisted of (1) all sizes of banking industry, which comprised about 30 companies; (2) only medium and large hotels, which comprised approximately 400 companies; and (3) only medium and large retail sales businesses which comprised approximately 200 companies.

2. Having obtained a target list, that is of those banks, hotels and retail sales businesses which used computers, the author contacted these selected companies and asked them for an appointment to visit and interview them. There were only six companies which invited the interviewer to visit and interview them at their premises.

3. To those companies which did not invite the author to interview them was sent a mailed questionnaire. In fact the author sent the questionnaire to all the target sample listed above. But at the first round there were only about five banks, six hotels and four retail sales businesses that returned the filled out questionnaire. Some companies returned the questionnaire without filling it out. Also the author had to interview those companies who returned the filled out questionnaire over uncompleted questions; and some companies to fill out the questionnaire again.

4. To those who had not yet returned the mailed questionnaire, the author sent the questionnaire at a second round; and, this time, contacted them over appointment for interview or on the questionnaire. All companies expressed willingness to answer the questionnaire. After waiting for about two weeks, the author received filled out questionnaires for four more banks, nine more hotels, and six more retail sales businesses.

5. At this time the author tried to contact directly the Managing Director of each individual company which had not yet returned the questionnaire, in order to request their cooperation. The author requested the Managing Director's secretary of each company to collect the filled out questionnaire from each informant within their company. This time, the author received filled out questionnaires from 10 banks, six hotels and 12 retail sales businesses.

6. The author requested those companies which had not yet returned the questionnaire to answer the questions by telephone. It was hard work to get them to cooperate. The author had to train and hire two research assistants to interview informants from only eight banks, 10 hotels and 14 retail sales businesses. Normally it seems not so difficult to interview informants by telephone. However in this case, it was difficult because some informants did not want to give their names. The author gave instructions to the interviewers to ask the name of the informant who gave information by telephone. This is because in this way we can trust the data and information received; and also, in case the questionnaire is not complete, we can contact the right informant to answer the questions again.

3. Findings from Company Factual Data

A survey of company factual data on total revenue and total costs as well as other interesting financial data of the companies was undertaken separately from that of informants' opinions which were collected by questionnaire schedule. The survey period for factual data was between August 1998, the beginning of the project, to June, 1999. The population comprised

Thai service companies in the banking, hotel and retail sales businesses. The sample was selected from the abovementioned three types of service companies for which data could be successfully obtained.

The processes for collecting factual data were as follows:

1. Ask the Director or personnel in the IT department of the company whether or not the company could be regarded as at the Management Information System (MIS) level of IT application. For this purpose, the author gave close attention to whether or not the informants understood the question clearly. In practice, the author sometimes had to explain by telephone for more than half an hour the definitions of five levels of IT systems, that is Transaction Processing System (TPS), Office Automation System (OAS), Management Information System (MIS), Decision Support System (DSS) and Executive Support System (ESS).

2. After finding when the individual company started to use TPS, OAS, MIS, DSS, or ESS, the author collected the company data on total revenue and total costs and sent on the questionnaire. Only one company cooperated by sending back to the author the filled out questionnaire.

3. Having learnt that a mailed questionnaire could not be successful, the author compiled factual data from directories, such as Thailand Company Information, published by Advanced Research Group Co., Ltd. and so forth. But these do not give data on all companies. Actually, financial data on total revenue and total cost could be obtained only for some years, especially for the contemporary year.

4. For those companies which answered that they first used MIS in an earlier year, such as in 1980, the author had to collect data from the DCR. At the DCR, the author found that it is from this source that the Advanced Research Group Co., Ltd. obtained the data for their directories. Therefore the author compared the data at DCR with the data of the directories. However, it was found that data for before 1980 could not be obtained from the DCR.

5. For some companies which answered that they first used MIS before 1980, the author had to collect financial data from their annual reports over the relevant years at the libraries of private companies, such as the libraries at the Bangkok Bank, the Thai Farmers Bank, the Siam Commercial Bank, and others. The author has found that, comparing between libraries of universities, government offices and private companies such as banks, some banks preserve many more valuable documents on financial data than the libraries at various public offices.

To successfully obtain factual data on total revenue and total cost of the sample companies was very difficult. For some companies which answered that they first used MIS in 1996, the author had to wait for data

for the year 1998, which could be obtained in June 1999. For this reason collection of data consumed a long time, from August 1998 until June 1999. Those companies answering that they first used a MIS in 1997 could not be used for the purpose of testing the hypothesis, because the data were not sufficient for analysis. For this reason the author had to select more companies to compensate for those which answered that they first used MIS in 1997 or later.

4. Comparison and Contrast Between Significant and Less than Significant Users of IT

The Mann-Whitney U test was used to test the first hypothesis pair under study. The procedure for the Mann-Whitney U test is given in Appendix 8.1.

In order to test the hypothesis as to whether or not the rate of increase of productivity in Thai service corporations significantly applying IT was greater than in those corporations not significantly applying IT, the comparison and contrast between the significant and less than significant users of IT is presented in Table 5.1.

Table 5.1

Rate of Increase of Productivity: Comparison Between Significant and less than Significant Users of IT.

Type of Company	Mean Productivity (3 years)	
	Before MIS	After MIS
Significant users (MIS used) [40 companies]	-0.00343	0.01435
Less than significant users (MIS not used) [27 companies]	0.09931	-0.02780
Mann-Whitney U test	218.00	319.00
Z_{cal}	-4.116	-2.825
One-Tailed P	0.0000 ($P^* < .05$)	0.0025 ($P^* < .05$)

Note: For details of calculation see Appendix 8.1.

Testing the Hypothesis

Scores reflecting the rates of increase of productivity, as between the two types of company, that is, significant users of IT (MIS used), and less than significant users of IT (MIS not used) were calculated according to the Mann-Whitney U test.

Hypothesis 1.

H_1 Research hypothesis (H_1): The rate of increase of productivity in Thai companies significantly applying information technology is greater than in those companies not significantly applying information technology.

Null hypothesis (H_0): The rate of increase of productivity in Thai companies significantly applying information technology is the same as in those companies not significantly applying information technology.

Table 5.1 presents data showing the rate of increase of productivity for the two types of company, that is, significant users of IT (MIS used), and less than significant users of IT (MIS not used), compared according to the Mann-Whitney U test. Surprisingly, before installation of MIS and setting up of an IT department among significant users of IT (MIS used), or before upgrading of an IT system among less than significant users of IT (MIS not used), a significant difference between the two sets of companies was found. That is to say, significant users of IT (MIS used) had an average productivity before installation of MIS lower than after commencing use of MIS by -0.00343 for a three year average; while less than significant users of IT (MIS not used) had an average productivity higher than before upgrading the IT system by 0.09931 for a three year average. When using the Mann-Whitney U test to test for a statistically significant difference between these two types of companies at a .05 level of significance, it was found that less than significant users of IT (MIS not used) showed productivity increase at the time before upgrading of the IT system higher than that of significant users of IT (MIS used) at a statistical significance level of .05 ($P^* < .05$).

After installation of MIS and setting up of an IT department among significant users of IT (MIS used), or after upgrading the IT system among less than significant users of IT (MIS not used), surprisingly a significant difference between the two types of companies was found. That is to say, significant users of IT (MIS used) had an average productivity higher than before commencing use of a MIS by 0.01435 for a three year average; while less than significant users of IT (MIS not used) had an average productivity lower than before upgrading the IT system by -0.02780 for a three year average. When using the Mann-Whitney U test to test for a statistically significant difference at the .05 level between these two types of companies, it was found that the significant users of IT (MIS used) showed a productivity increase at the time after installation of MIS and setting up of an IT department, or upgrading of the IT system, higher than that of less than significant users of IT (MIS not used) at a statistical significance level of .05 ($P^* < .05$). Thus, H_0 was rejected while H_1 was accepted.

In summary, before using MIS or before upgrading the IT system, the rates of increase of productivity for the companies using MIS and the companies not using MIS were significantly different ($P^* < .05$). However, after introducing MIS or upgrading the IT system, the rates of increase of productivity, as between the companies using MIS and the companies not using MIS, were also significantly different ($P^* < .05$). It can be seen that the companies using MIS had increased their productivity more so than companies not using MIS.

5. Comparison and Contrast Between Periods Before and After Use of MIS or upgrading of IT System

The Wilcoxon Matched-pairs Signed Ranks test was used to test the second hypothesis pair under study. The procedure for this test is given in Appendix 8.2. In order to test the hypothesis as to whether or not the rate of increase of productivity over a period after introduction of MIS or after upgrading of the IT system was greater than that over a period before introduction of advanced IT, the comparison and contrast between periods before and after introduction of MIS, or before and after upgrading of the IT system, is presented in Table 5.2.

Table 5.2

Rate of Increase of Productivity: Comparison Between Periods Before and After Upgrading of IT System

Type of Company	Mean Productivity (3 Years)	
	Before MIS	After MIS
Significant Users (MIS used) [40 Companies]	-0.00343 Ranks - = 29 cases, Sum of Ranks = 547, Z = -1.841, One-Tailed P = 0.033 ($P^* < .05$)	0.01435 Ranks + = 11 cases Sum of Ranks = 273
Less than significant (MIS not used) [27 Companies]	0.09931 Ranks - = 0 cases, Sum of Ranks = 0, Z = -4.541, One-Tailed P = .000 ($P^* < .05$)	-0.0278 Ranks + = 27 cases Sum of Ranks = 378

Note. For details of calculation see Appendix 8.3.

Testing the Hypothesis

Scores reflecting the rates of increase of productivity, as between the two periods of use, that is, before introduction of MIS or before IT upgrading, and after introduction of MIS or IT upgrading, were calculated according to the Wilcoxon Matched-pairs Signed Ranks test.

Hypothesis 2.

H_2 Research hypothesis (H_2): The rate of increase of productivity at a time after introduction of MIS or after upgrading of the IT system is greater than at a time before introduction of MIS or before upgrading of the IT system.

Null hypothesis (H_0): The rate of increase of productivity at a time after introduction of MIS or after upgrading of the IT system is the same as at a time before introduction of MIS or before upgrading of the IT system.

Table 5.2 presents data showing the rates of increase of productivity for the two types of company, in each case, before use of MIS or before upgrading of the IT system, and after use of MIS or after upgrading of the IT system, compared according to the Wilcoxon Matched-pairs Signed Ranks test.

It was found that, for those companies that were significant users of IT (MIS users), that is had installed MIS and had set up an IT department, the rate of increase of productivity after introduction of MIS was greater than that before introducing MIS, at a significance level of .05 ($P^* < .05$). For companies employing only TPS and OAS, which had upgraded their IT systems but not to the MIS level, the rate of increase of productivity, for three years before upgrading of the IT system was greater than after upgrading the IT system at a .05 level ($P^* < .05$). Thus H_0 was rejected while H_2 was accepted.

In summary, it was concluded that

1. The use of IT at the MIS level has a statistically significant positive effect on the rate of increase of productivity. In this case, the rate of productivity increase among the companies using MIS at the time before installation of MIS is lower than the rate of productivity increase after installation of MIS.

2. The use of IT at lower than MIS level, that is at TPS or OAS but not at MIS, DSS or ESS levels, has no statistically significant positive effect on the rate of increase of productivity. In this case, the rate of productivity increase among the companies not using MIS at the time before IT upgrading is, surprisingly, higher than after upgrading the IT system.

The findings from this study lead to the recommendation that all companies should invest in IT and should organize their IT systems at a MIS

level or above. Otherwise, the investment in IT may result in a reverse effect, as in this case, where those companies which were less than significant users of IT (no MIS used) have productivity increase at the time before IT upgrading higher than after IT upgrading.

6. Comparison and Contrast among Opinions of Company Representatives on IT Application

The questionnaire on company data was sent to the Managing Director's secretary and requested her/him to contact relevant persons for filling out the questionnaire and also to collect and return the questionnaire to the author. The questionnaire for company data was designed with the purpose of checking whether the year of first using MIS was the same as previously stated. If it was the same there was no problem. The author used this filled out questionnaire to confirm the correctness of the previous data. If the reply was not the same as with the previous data obtained by telephone, the author discussed this question again with the relevant persons at the company. If their answers were different and they could not agree with one another, the author decided not to use that company's financial data for analysis. Therefore, in this research project, the number of sample companies for financial analysis and the number of sample companies for representative's opinion analysis are different.

6.1 Types of IT System Installed Classified According to Company Group

There were 126 sample companies for company data. The informants who answered this kind of questionnaire did not represent only one personnel group. For some companies, the informant may be the head or director of an IT department, and/or head or director of a training department, and/or head or director of an accounting department. This is because one person cannot answer all questions in the questionnaire. It needs relevant persons from relevant departments to answer the questions.

Responses to the question "Please state types(s) of IT system(s) installed and first year of active use," were as in Table 5.3.

Table 5.3

Type of IT System Installed Classified According to Company Group

Type of IT System Installed	Banks % (n)	Hotels % (n)	Retail Sales % (n)	Total % (n)
1. TPS	22.2 (28)	38.9 (49)	38.9 (49)	100.0 (126)
2. OAS	22.2 (28)	38.9 (49)	38.9 (49)	100.0 (126)
3. MIS	23.7 (18)	38.2 (29)	38.2 (29)	100.0 (76)
4. DSS	25.0 (4)	18.8 (3)	56.3 (9)	100.0 (16)
5. ESS	38.5 (5)	7.7 (1)	7.7 (7)	100.0 (13)

Note: The total number of the sample (n) in this table is 126 which is the overall sample of companies used for analysis of the opinions of representatives of the companies. However, the total number of companies giving factual data (total revenue and total costs), which were used for testing the hypotheses, is 67, which are included in Table 5.3.

Table 5.3 presents the number and percentage of respondents reporting use of various IT systems in the Thai service companies under the survey. All companies used TPS and OAS: That is, hotels and retail sales businesses (38.9%), followed by banks (22.2%) respectively, answered that they had installed and used TPS and OAS. However, for MIS: Hotels (38.2% and retail sales businesses (38.2%), followed by banks (23.7%) respectively, answered that they had installed and used MIS, and thus were regarded as significant users of IT. For DSS: Retail sales businesses (56.3%), followed by banks (25.0%) and hotels (18.8%) respectively, answered that they had installed and used DSS. For ESS: Banks (38.5%), followed by hotels (7.7%) and retail sales businesses (7.7%) respectively, answered that they had installed and used ESS, which is regarded as the most advanced level of IT applied to managerial decision making.

6.2 Employment of IT Personnel and Setting Up of IT Department Classified According to Company Group

Table 5.4

Employment of IT Personnel and IT Department Classified According to Company Group

Employing IT Personnel and IT Department	Banks % (n)	Hotels % (n)	Retail Sales % (n)	Statistical Value
1. Yes	70.4 (19)	53.1 (26)	53.2 (25)	LR $\chi^2=11.728$ d.f.= 4 P= .019 (P* < .05)
2. No, but have plan for future	18.5 (5)	4.1 (2)	8.5 (4)	
3. No, and no plan for future	11.1 (3)	42.9 (21)	38.3 (18)	
Total	100.0 (27)	100.0 (49)	100.0 (47)	

Note: 1. LR stands for Likelihood Ratio. It is suggested that LR be used when figures in some cells are of too small value.

2. There were three respondents who did not answer this question. Among these, one was from a bank and two were from retail sales.

There were statistically significant differences among answers of representatives of the three types of company towards employing IT personnel and setting up an IT department.

Comparing the three groups of companies:

(1) The answer "Yes, they had employed IT personnel and set up IT department": Banks (70.4%), had employed IT personnel and set up an IT department, followed by retail sales businesses (53.2%) and hotels (53.1%).

(2) The answer "No, but they had a plan for the future": Banks (18.5%) answered thus, followed by retail sales businesses (8.5%) and hotels (4.1%) respectively.

(3) The answer "No, and no plan for the future": Hotels (42.9%) answered thus, followed by retail sales businesses (38.3%) and banks (11.1%) respectively.

6.3 Opinions of Company Representatives towards Productivity Increase

Table 5.5

Opinions of Company Representatives towards Productivity Increase After MIS Installation or After Upgrading

Productivity Increase After MIS Installation	Banks % (n)	Hotels % (n)	Retail Sales % (n)	Statistical Value
1. Increase	96.2 (25)	75.6 (34)	100.0 (43)	LR $\chi^2 = 18.190$ d.f. = 2 P = 0.000 (P* < .05)
2. No change	3.8 (1)	24.4 (11)	- (-)	
Total	100.0 (26)	100.0 (45)	100.0 (43)	

Note: There were twelve respondents who did not answer this question. Among these, two were from banks, four were from hotels and six were from retail sales.

The findings in Table 5.5 indicate that (a) for banks, 25, or 96.2%, of respondents answered that productivity in their organization had increased following the introduction of more advanced IT, while only one, or 3.8% reported no effect; (b) for hotels, 34, or 75.6% reported increased productivity, while 11, or 24.4% reported no change; while (c) for retail sales businesses, all 43 informants, or 100%, reported enhanced productivity. None reported a decrease in productivity.

6.4 Opinions of Company Representatives towards Budget for IT Investment

Table 5.6

Opinions of Company Representatives towards Budget for IT Investment
Classified According to Company Group

Budget for IT Investment	Banks % (n)	Hotels % (n)	Retail Sales % (n)	Total % (n)
1. Lower than or at 1.00%	11.1 (2)	8.3 (2)	20.0 (6)	13.9 (10)
2. Between 1.01-5.00%	11.1 (2)	29.2 (7)	36.7 (11)	27.8 (20)
3. Between 5.01-10.00%	38.9 (7)	29.2 (7)	23.3 (7)	29.2 (21)
4. Between 10.01-20.00%	16.7 (3)	8.3 (2)	10.0 (3)	11.1 (8)
5. Between 20.01-30.00%	11.1 (2)	12.5 (3)	3.3 (1)	8.3 (6)
6. At 30.01 and above	11.1 (2)	12.5 (3)	6.7 (2)	9.7 (7)
Total	100.0 (18)	100.0 (24)	100.0 (30)	100.0 (72)

The findings in Table 5.6 indicate that the budget for investment in IT in all company groups was small, that is (a) 13.9% answered that they had a budget for investment in IT lower than or at 1.00%; (b) 27.8% answered that they had a budget for investment in IT between 1.01 and 5.00%; and (c) 29.2% answered that they had a budget for investment in IT between 5.01 and 10.00%. In conclusion, 70.9% answered that they had a budget for investment in IT lower than or at 10.00%.

Among these, the company which had the minimum budget for investment in IT stated that they had only 0.10% and the company which had the maximum budget for investment in IT stated that they had 60.00%.

6.5 Opinions of Company Representatives towards IT Problem Solution

Table 5.7

Opinions of Company Representatives towards Solution of IT Problems
Classified According to Company Group

IT Problem Solution	Banks % (n)	Hotels % (n)	Retail Sales % (n)	
1. Solve problems by themselves	32.1 (9)	36.2 (17)	16.3 (8)	$\chi^2 = 7.578$ d.f. = 4 P = 0.108 (P > .05)
2. Hire outside persons	10.7 (3)	14.9 (7)	8.2 (4)	
3. Both solve problems by themselves and hire outsiders	57.1 (16)	48.9 (23)	75.5 (37)	
Total	100.0 (28)	100.0 (47)	100.0 (49)	

Note: There were two respondents from hotels that did not answer this question.

There was no statistically significant difference among opinions of representatives of the three types of company towards solution of IT problems.

Comparing the three groups of companies:

(1) Solve problems by themselves: Hotels (36.2%) preferred to solve problems themselves, followed by banks (32.1%) and retail sales businesses (16.3%).

(2) Hire outside persons: Hotels (14.9%) were more inclined to hire outside assistance than were banks (10.7%) or retail sales businesses (8.2%).

(3) Both solve problems by themselves and hire outsiders: Retail sales business (75.5%) mostly used both approaches, followed by banks (57.1%) and hotels (48.9%).

6.6 Opinions of Company Representatives towards Budget for Training

Table 5.8

Opinions of Company Representatives towards Budget for Training
Classified According to Company Group

Budget for Training	Banks % (n)	Hotels % (n)	Retail Sales % (n)	Total % (n)
1. Lower than or at 1.000%	46.7 (7)	50.0 (7)	31.3 (5)	42.2 (19)
2. Between 1.001-5.000%	33.3 (5)	28.6 (4)	50.0 (8)	37.8 (17)
3. Between 5.001-10.000%	13.3 (2)	14.3 (2)	12.5 (2)	13.3 (6)
4. Between 10.001-20.000%	6.7 (1)	- (-)	- (-)	2.2 (1)
5. On 20.001% and above	- (-)	7.1 (1)	6.3 (1)	4.4 (2)
Total	100.0 (15)	100.0 (14)	100.0 (16)	100.0 (45)

The findings in Table 5.8 indicate that the budget for training in all company groups was not so large; that is (a) 42.2% answered that they had a budget for training lower than or at 1.000%; and (b) 37.8% answered that they had a budget for training between 1.001 and 5.000%. In conclusion, 80.0% answered that they had a budget for training lower than or at 5.00%.

Among these, the company which had the minimum budget for training stated that they had only 0.005% and the company which had the maximum budget for training stated that they had a budget for training at 40.000%.

6.7 Opinions of Company Representatives Towards Training

Table 5.9

Opinions of Company Representatives towards Training Classified According to Company Group

Training	Banks % (n)	Hotels % (n)	Retail Sales % (n)	Statistical Value
1. In-house training	3.6 (1)	16.3 (8)	10.2 (5)	$\chi^2 = 26.706$ d.f. = 6 P = .000 (P* < .05)
2. Outside training	14.3 (4)	26.5 (13)	14.3 (7)	
3. Both in-house and outside training	71.4 (20)	16.3 (8)	32.7 (16)	
4. No training	10.7 (3)	40.8 (20)	42.9 (21)	
Total	100.0 (28)	100.0 (49)	100.0 (49)	

There was a statistically significant difference among opinions of representatives of the three types of company towards training of personnel in IT.

Comparing the three groups of companies

(1) In-house training: Hotels (16.3%) had the greatest tendency towards use of in-house training alone, followed by retail sales businesses (10.2%) and banks (3.6%).

(2) Outside training: Hotels (26.5%) also showed the greatest propensity for outside training alone, followed equally by banks (14.3%) and retail sales businesses (14.3%).

(3) Both in-house and outside training: Banks (71.4%) preferred to use both approaches to training, followed by retail sales businesses (32.7%), and hotels (16.3%).

(4) No training: Retail sales businesses (42.9%) were most likely to have no provision for training, followed by hotels (40.8%) and banks (10.7%).

6.8 Opinions of Company Representatives Towards Management Techniques Intended to Improve Productivity

Table 5.10

Opinions of Company Representatives towards Management Techniques Intended to Improve Productivity

Management Techniques Used	Banks % (n = 28)	Hotels % (n = 49)	Retail Sales % (n = 49)	Statistical Value
1. TQM				$\chi^2 = 1.118$
- Yes	25.0 (7)	26.5 (13)	34.7 (17)	d.f. = 2 P = .572
- No	75.0 (21)	73.5 (36)	65.3 (32)	(P > .05)
2. Benchmarking				LR $\chi^2 = 15.209$
- Yes	21.4 (6)	2.0 (1)	- (-)	d.f. = 2 P = .000
- No	78.6 (22)	98.0 (48)	100.0 (49)	(P* < .05)
3. Baldrige Award				LR $\chi^2 = 1.902$
- Yes	- (-)	2.0 (1)	- (-)	d.f. = 2 P = .386
- No	100.0 (28)	98.0 (48)	100.0 (49)	(P > .05)
4. Reengineering				$\chi^2 = 12.748$
- Yes	57.1 (16)	18.4 (9)	28.6 (14)	d.f. = 2 P = .002
- No	42.9 (12)	81.6 (40)	71.4 (35)	(P* < .05)
5. ISO 9000				LR $\chi^2 = 3.968$
- Yes	17.9 (5)	4.1 (2)	10.2 (5)	d.f. = 2 P = .137
- No	82.1 (23)	95.9 (47)	89.8 (44)	(P > .05)

Table 5.10

Opinions of Company Representatives towards Management Techniques Used to Help Improve Productivity (Cont.)

Management Techniques Used	Banks % (n = 28)	Hotels % (n = 49)	Retail Sales % (n = 49)	Statistical Value
6. KAIZEN				LR $\chi^2 = 3.036$
- Yes	3.6 (1)	- (-)	- (-)	d.f. = 2 P = .171
- No	96.4 (27)	100.0 (49)	100.0 (49)	(P > .05)
7. Others				LR $\chi^2 = .375$
- Yes	7.1 (2)	4.1 (2)	6.1 (3)	d.f. = 2 P = .829
- No	92.9 (26)	95.9 (47)	93.9 (46)	(P > .05)

There were statistically significant differences among company representatives' opinions towards use of benchmarking and reengineering for the improvement of productivity. There were no significant differences in opinions towards use of TQM, Baldrige Award criteria, ISO 9000 standards, KAIZEN, or other techniques to improve productivity.

Comparing the three groups of companies:

(1) TQM: Retail sales businesses were most likely to favor TQM (34.7%), followed by hotels (26.5%) and banks (25.0%).

(2) Benchmarking: Banks (21.4%) were most interested in benchmarking, followed by one hotel (2%). No retail sales business representatives expressed interest in benchmarking.

(3) Baldrige Award: Only one company, a hotel (2.0%) expressed interest in Baldrige Award criteria.

(4) Reengineering: Banks (57.1%) were most interested in reengineering, followed by retail sales businesses (28.6%), and hotels (18.4%).

(5) ISO 9000: Banks (17.9%) expressed some interest in ISO 9000 for improving productivity, followed by retail sales businesses (10.2%) and hotels (4.1%).

(6) KAIZEN: Only one company, a bank (3.6%) expressed interest in KAIZEN.

(7) Others: Banks (7.1%) expressed some interest in other techniques for improving productivity, followed by retail sales businesses (6.1%) and hotels (4.1%).

In reply to the question "During the preceding three years up to now, on what topics have your company personnel attended for training?" topics of training were as in the following list:

1. Topics for in-house training were:

1.1 Banks

- Branch school 1-2-3.
- COBOL and MS advanced programming, computer programming.
- Computer systems and computer techniques.
- Concepts of LAN, MVS, VSE/VSAM.
- Database programming languages.
- Development and training of personnel at every level.
- Debt management systems, marketing management.
- Drawing with graphics programs.
- Effects of Y2K problem.
- English language.
- Financial analysis.
- General skills, such as use of Word, Internet, general management.
- Human performance management, new leadership management, office management, foreign exchange.
- In-house and new products.
- JAVA, HTML, assembly language, VSAM, CICS, mainframe tools.
- Lotus Notes, Microsoft Office, MIS training, CA-View; performance, teaching and evaluation, orientation, exceptional management practices.
- MS Windows 95, MS Office
- Operating systems; development of work systems.
- Power Designer, Power Builder v. 6, SQL Workshop, DB/2, advanced SQ, DB/2 concept, introduction and advanced.

- Quality service management.
- Skills in exchange business and debtor management.
- Wings, Storage, Lotus Notes.
- Training technique etc,
- Training in software and hardware.
- Training course for branch personnel.
- Training of personnel in debt management.
- Use of AMS, CM/2, TSO, CICS programming.
- Use of LAN systems, purchased packaged software.
- Use of system development programs for the IBM mainframe, such as VM, VSE, EASYTREV, VSAM, CMS and CICS.
- Visual BASIC, Microsoft Access 95.
- Windows 95 packages: Word, Excel, Power Point.

1.2. Hotels

- Energy conservation.
- E-mail and Internet.
- FIDELIO Front Office, Sales and Marketing and EMS System.
- Front Office training.
- Notes Mail.
- Microsoft Office 97, Excel, Word, accounting programs.
- Office information training.
- Problem solving (basic computer techniques)
- Product knowledge.
- Reservation system programs.
- Sales and catering training.
- Tips to please customers.
- Up-selling techniques.
- Use of software: Introduction to Windows etc.
- Windows 95, Word processing, spreadsheets.

1.3 Retail Sales Business

- Accounting systems.
- Coaching and on-the-job training.
- E-mail, applications, communication.
- IBM AS/400, Corocal, Insormix, RPG, CTT, Solaris, Y2K problems.
- Introduction to computers, Windows 95, Lotus Notes, Office suite, Windows, DOS, Winword, Excel.

- JDA system.
- LAN, Netware, Windows NT, office automation.
- Operations system for Sales Department.
- PC programs, accounting programs, Polido.
- POS system.
- Purchasing software and training at the company.
- Work system, goods ordering, goods receipt, methods of report reading.

2. Topics for outside training were:

2.1 Banks

- AIX System Administration I & II.
- AIX/600 v.4.1 Advanced Administration.
- ALX/6000 for User (v.3.2).
- Alternate channel delivery for bank.
- Application development.
- AS/400 basic CL programming work: concepts and program fundamentals, introduction to communication, CL commands, interactive program design, performance analysis and cap., recovery and availability management, RPG batch programming WS, RPG IV programming WS, security concepts and planning, system operator training
- Basic administration.
- Building client/server applications.
- CICS command level coding, CICS fundamentals.
- Client/server architecture and technique, Client Access/400 (DOS), client/server technology and management.
- Crisco Rotor.
- Customer service.
- Cute PTP.
- Data warehousing, seminar, data modeling and database design, distributed database systems, database design and SQL.
- Debt restructuring.
- Delphi Training 96.
- Development of operating systems, development of programs for client/servers, development tools.

- DB2/400 relational database coding; DB2 fundamentals and application programming work, DB2 for OS/2 database administration, and for OS/2 performance tuning, tips on DB2, DB2 planning guide for administrators.

- English courses.

- FoxPro 2.6 for Windows, fundamentals of SNA, FX Option.

- Help desk support center.

- IBM PC server technical training: server installation, Netware installation, Windows NT, advanced IBM Net/Finity Implementation WS, IBM technology update.

- Information system analysis and design.

- Internet packages: IE-NC, Cute, PTP, UNIX, data communication, Windows NT, Internet for beginners, Internet Day 98, data communication and Internet; Intranet technology, Homepage, HTML authoring course, Intranetware administration training.

- Introduction to ATM and high-speed systems, data communication, computers and DOS, computer networks, Lotus Notes.

- Java programming, Korn Shell programming.

- JCL (Job Control Language).

- LAN Server 4.0 implementation for the administrator, local area network concepts, local area networks (LAN).

- Law relating to reconstruction of Thai economy following economic crisis.

- Lotus Notes, managing projects with Microsoft Project.

- Mini MBA.

- MS programs such as Windows, Excel, MS Office 2000, MS Windows v. 3.1, MS Word for Windows, MS Excel v. 5.01., MS Word 6.0 for Windows, MS Excel 5.0 for Windows, Windows NT 4.0, workstations and servers, Windows NT 4.0 advanced administration, MS Conference 97, Microsoft Year 2000.

- Modern office management, office automation packages.

- Networking concepts, Novell Netware v. 4.10.

- NT administration.

- Open client/server application analysis.

- Operating systems, database programming, communication.

- SQL administration.

- OS/2 Warp v.3 installing and support, using and customizing, OS/2 Warp Server and IBM software, OS/2 LAN Server 4.0 tuning and cap., basic administration.

- O/S, database, Y2K project, OS/2 LAN Server 4.0 basic administration, OS/2 Warp v. 4 using and customizing.

- Outbound, PC trouble shooting.

- PowerBuilder 5.0 features preview, advanced PowerBuilder and Object O.

- Project control, programming, software packages.

- Risk management, RPG/400 interactive program W.

- S/390 Open for Business.

- Security training, security management.

- SELC, S/A, SQL/400 programming workshop.

- S-Designer.

- System Administrator for Microsoft, System Administrator I.

- TCP/IP architecture.

- Techniques for preparing executive reports.

- Telecommunications.

- Thai economy and IT in 1998, Thailand Training Seminar on data, law for business reconstruction and fighting the Thai economic crisis.

- The people side of project management.

- Transaction server overview, CICS.

- Training course in specific techniques such as IT.

- Training in banking, mini-MBA, E-business, computer techniques.

- Training in programming, networks.

- Turning data into knowledge.

- UNIX for end users, UNIX for system administration, use of and systemization of UNIX, UNIX operating system.

- Visual Warehouse, Visual Age Workshop.

- Windows NT, NT servers, Internet, databases.

- Windows 95 networking training.

2.2 Hotels

- AS/400

- Computer networks.

- E-commerce.

- Energy conservation.

- English courses.

- Information technology
- Internet Administrator 4.11, Netware Advance 4.11, HTML, introduction to Internet
- Microsoft Technet
- MS Windows 95, Windows NT, MS Excel advanced.
- Netware Administrator 4.11, Netware Advanced 4.11.
- Novel Netware 4.1.
- Operating systems.
- Safety management.
- Service management.
- Training courses on how to use packaged programs.
- Training courses on labor law.
- Training courses on social security.
- Training courses based on software purchased from vendors.
- Tax
- Upgrading of software.
- Y2K problems

3. Retail Sales Businesses

- Accounting systems.
- Application development tools
- AS/400 introduction, AS/400 display station operation.
- Computer-based project management
- Concepts and program fundamentals WS.
- Corocal.
- CTT.
- FoxPro programming.
- Informix-SQL, Informix system administration, developing application using Informix-4GL.
- Introduction to computers.
- LAN, Netware, Windows NT, office automation, RPG.
- SAS application.
- Security concepts.
- Solaris.
- UNIX, UNIX for end users, UNIX for system administration, VNIIX
- Word for Windows, Excel, Windows NT.
- Y2K problems.