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Efficiency in utilizing ICT infrastructure in developing countries: a case study of the Royal Thai Police's attitudes to the adoption of an image retrieval application for eyewitness identification

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EFFICIENCY IN UTILIZING ICT INFRASTRUCTURE IN DEVELOPING COUNTRIES:
A Case Study of the Royal Thai Police's Attitudes to the Adoption of an Image Retrieval Application for Eyewitness Identification

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DECLARATION

This thesis is submitted in accordance with the regulations of the University of Wollongong, in fulfillment of the requirements for the award of a Doctor of Philosophy, in the School of Information Technology and Computer Science, Faculty of Informatics. It does not incorporate any material previously published or written by another person unless otherwise referenced or acknowledged. The work presented in this thesis is the author's work that has not been submitted for qualification at any other academic institution.

Vilasinee Srisarkun

April 2004

ABSTRACT

One of the most important aspects of decision and policy making is the timely access to accurately and relevant information. At present the situation in some developing countries is that communication and exchange of information between the government agencies are still paper-based. It can often take weeks or months for one government agency to obtain the records it requires from another agency. The lack of communication between these agencies often results in duplication of efforts and inefficiencies. This lack of communication also means that agencies often produce more of the irrelevant albeit sophisticated information (such as the Statistics Division) than the essential information that is critical and actually needed by other agency for decision-making. *(World Bank report, 1998)*

In order to bring people into information society, to have access to information, it is crucial to have appropriate technology and applications that compatible with both old and new technologies—given that majority can not afford to keep up with new technologies being introduced everyday--as well as quality programming in indigenous languages, To create an information society in developing countries, we must first have knowledge of their past, understand their present. Only then participating in their future can be more probable and possible *(Matsepe-Casaburri 1996)*

The overall aim of this study is to add value to the process of information sharing among the government departments in Thailand. It does this by analyzing the

opportunity to integrate existing technology with the data available in existing databases and make it more valuable for future use. A case study of the Department of Local Administration, under the Ministry of Interior, and the Royal Thai Police Department is used to develop an understanding of how the utilization of data to a full extent can be beneficial in the government service.

In Thailand, every Thai citizen is required to carry a national identity card. Personal data of each person such as date of birth, height, blood type, religion and occupation, including registered address and individual photograph image, are kept in the Central Registration Database Systems (CRDS). The CRDS is operated by the Department of Local Administration under the supervision of the Ministry of Interior.

In order to maximize the benefits from this database, the CRDS is shared by other authorized government agencies. The Royal Thai Police Department is one of the government agencies that also share the information from the CRDS. Frequently, the individual registration database and photographs from CRDS are needed to support crime investigation.

This research therefore, investigates how the Thai government could utilize the existing database system to aid in the crime investigation process. It then suggests an effective method of image retrieval to support police officers when searching criminal records from a Central Registration Database Systems.

The research begins with an exploratory study of the use and sharing of information amongst the government agencies in developing countries. It examines the use of existing technology and how the Government uses technology to access information.

There are two major objectives in this research. The first one addresses how value can be added to the present data in the existing system. The author chooses to focus on the area of crime investigation and evaluate two existing image retrieval methods, in order to determine the most suited one from crime investigation process in Thailand. The second objective is to examine and evaluate the attitudes and perceptions of the Thai police towards acceptance of IT usage in the crime investigation process. The results are then was compared with the literature on barriers to the adoption of IT and some of the more recently developed Technology Acceptance Models, which is also used to explain the findings.

AUTHOR'S PUBLICATIONS

1. Srisarkun, V and Cooper, J. "Face Recognition Using a Similarity-based Distance Measure for Image Database", *the Proceeding of the VIPromCom-2002-4^{th} EURASIP-IEEE Region 8 International Symposium on Video Processing and Multimedia Communications*, June 16-19, 2002, Zadar, Croatia.

2. Srisarkun, V, Jittawiriyanukoon, C and Cooper, J "A Model for Self-Similarity Search in Image Database with Scar" *the Proceeding of the ECIS 2002-10^{th} European Conference on Information Systems*, June 6-8, 2002, Gdansk, Poland.

3. Srisarkun, V and Cooper, J. "Self-Similar Searching in Image Database for Crime Investigation," *the Proceeding of twentieth IASTED International Conference on Applied Informatics*, February 2002, Innsbruck, Austria.

4. Srisarkun, V and Jittawiriyanukoon, C. "A Model for Self-Similar Searching in Face Image Data Processing," *the Electronic Proceeding of the Sixth INFORMS Conference on Information Systems & Technology*, November 3-4, 2001, Miami, Florida, U.S.A.

5. Srisarkun, V and Jittawiriyanukoon, C "Traffic Shaping for Frame Relay over ATM Network," *Proceeding of the 13^{th} IASTED International conference on Parallel and Distributed Computing and Systems*, pp. 469-473, August 21-24, 2001, Anaheim, U.S.A.

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LIST OF ACRONYMS

ARS	Automated Registration Services
B2B	Business-to-Business
B2C	Business-to-Consumer
B2G	Business-to-Government
BPP	Border Patrol Police
C2G	Citizen-to-Government
CIS	Crime Information System
CRDS	Central Registration Database System
DOLA	Department of Local Administration
e-ASEAN	Electronic Association of Southeast Asian Nations
e-Commerce	Electronic Commerce
e-Government	Electronic Government
e-Investment	Electronic Investment
e-Service	Electronic Service
e-Society	Electronic Society
e-Thailand	Electronic Thailand
e-Trade	Electronic Trade
G2B	Government-to-Business
G2C	Government-to-Citizen
G2G	Government-to-Government
GUI	Graphic User Interface

I2	Information-to-Image
ICT	Information and Communication Technology
IDT	Innovation Diffusion Theory
IT	Information Technology
IS	Information System
MIS	Management Information System
MOI	Ministry of Interior
MPCU	Model of PC Utilization
NAMIS	National Administration for Management Information System
NGO	Non-Governmental Organizations Associated with United Nations
PC	Personal Computer
PID	Photograph Image Database
PISC	Police Information System Center
POLIS	Police Information System
PSIS	Police Station Information System
RTP	Royal Thai Police
SCIS	Support Criminal Investigation System
SIS	Security Information System
SPSS	Statistical Package for the Social Sciences
SQS	Sequential Search
SSIS	Social Services Information System
SSS	Self-Similarity Search

TAM	Technology Acceptance Model
TAT	Tourism Authority of Thailand
TNPD	The National Police Department
TPB	Theory of Planned Behavior
TTF	Task Technology Fit
UN	United Nations
US	United States
UTAUT	Unified Theory of Acceptance and Use of Technology

CHAPTER ONE
INTRODUCTION

1.1 INTRODUCTION

The need for developing countries to expand an Information and Communication Technology (ICT) policy in order to bridge the gap between industrialized and developing countries are crucial. Walbeck (1999, p.18) suggested that the local government, post and telecom organizations, user groups from industries and social institutions, international organizations and donor agencies should liaise in development activities and supporting projects, in order to bridge the information technology gap.

The problem of the digital divide described by Bataller (2001, p.4) is the gap between the rich and the poor, which includes communities and nations who can and cannot access and take advantage of information and communication technologies. The consequences of what could be called digital poverty are not just technological. Those unable to use information and communication technologies to their advantage lag behind in economic and educational development. Opportunities for trade and investment are held back, access to international research and technology is hampered, and productivity and efficiency gains are all but denied.

Bataller (2001, p.29) believes that with the right attention from the government and private sectors, these same technologies can bring opportunities for real advancement in the social, economic and environmental conditions of developing countries. Dramatic improvements in communication and information exchange can strengthen existing economic and social networks, as well as create new ones. The ability to create global knowledge networks that are pervasive and low cost can provide gain in efficiency, and foster new industries and business models. Bataller strongly believes that information and communication technologies offer the potential to respond to real problems facing significant portions of humanity today.

1.2 ICT AND E-GOVERNACE IN DEVELOPING COUNTRIES

Rao (2003, p.274) defined Electronic Governance (e-Governance) as the use of Information and Communication Technologies (ICT) for the planning, implementation, and monitoring of government programs, projects and activities. According to Ahmedabad (2003), e-Governance is expected to help deliver cost-effective and easy-to-access service to citizens, and improve processing of transactions both within the government, and between the government and other agencies. The stakeholders in e-Governance include government officials, legislators, regulatory agencies, citizens, voluntary organizations, technology consultants and vendors, academics, researchers, funding agencies, and the media. In other words, it involves anybody who is interested in the application of ICT for governance.

There are three main domains of e-governance that are: 1) improving government process (e-administration), 2) connecting citizens (e-citizens and e-services), 3) building external interactions (e-society) (Ntiro, 2000). This research investigates the first domain of e-governance that is, improving government process or e-administration. Such initiatives deal particularly with improving the internal workings of the public sector, they include; cutting process costs, managing process performance, making strategic connections in government and creating empowerment (Heeks, 2001).

Heeks (2001, p.4) believes that new information and communication technologies can make a significant contribution to the achievement of good governance goals as e-governance can make governance more efficient and more effective and also bring other benefits. Government can improve the input/ out put ratio by cutting financial costs and / or time cost. Automation can replace higher human costs with lower ICT costs to support efficiency/ productivity improvements. Informatisation can support decisions and implementation in downsizing or rightsizing exercises. The rationale is to address the large size of public sector expenditure and/ or the inefficiency of many of its processes (Heeks, 2001). The Thailand case below is an example.

In Thailand, the Department of Local Administration has created a comprehensive Central Registration Database Systems (CRDS) that contains millions of birth and death records, marriage and divorce records, registration of address records and many more. *(See Appendix B, page 248 about CRDS)*. This system has also provided the basis for a national identity number and hence, a secure and accurate national ID card. Automation of previously manual process has saved considerable sums of money. The information base and ID numbers have also been an essential building block in the creation of other public sector planning and service delivery applications.

The overall aim of this study is to explore the value added to the information shared among the government departments in developing countries. It does this by analyzing the opportunity to use the existing technology to add value to the existing data and improve it for future use. A case study of the Department of Local Administration and the Royal Thai Police Department is discussed in order to develop an understanding of the utilization of data to the full extent, so that it will be beneficial to the government service.

In Thailand, all Thai citizens are issued a (light-blue) colored national identity card when they turn fifteen years old and they get renew it every six years. The information it contains includes details such as the name of the ID card holder, date of birth, height, blood type, religion, and registered address. In addition to a photograph and the holder's fingerprints, this information on each Thai individual is stored in the Central Registration Database Systems (CRDS) operated by the Department of Local Administration under the supervision of the Ministry of the Interior. Figure 1.1 is a representation of the Thai National Identity Card. The format of the card has been maintained, however, the content has been translated from Thai to English for the purpose of this thesis.

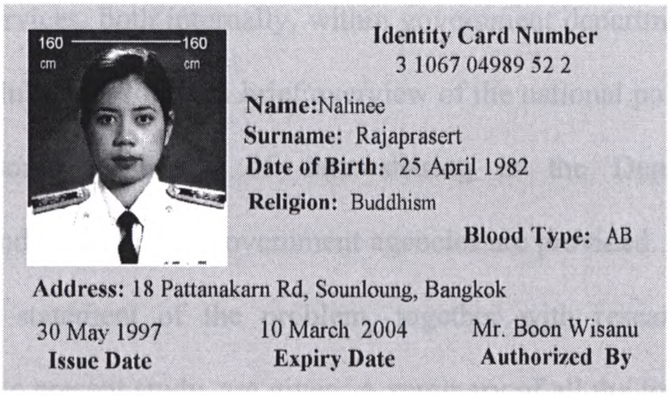

Figure 1.1: Example of the Thai National Identity card

In order to increase the efficiency of internal administration, these Central Registration Database Systems (CRDS) can be utilized and shared by other authorized government agencies such as the Passport Division and the Immigration Office. The Royal Thai Police Department and the Crime Combat Section are also two other government agencies that share the information from the CRDS. Frequently, the individual registration database and photographs are needed for a crime investigation.

This research, therefore, investigates the Thai government's utilization of the existing system and database, to serve the purpose of crime investigation, by suggesting an effective method for image retrieval. A Self-Similarity Searching method, which is to be discussed later in Chapter Four, is introduced, together with a series of experiments that prove the effectiveness and the suitability of the method.

This first chapter provides a brief background into how the implementation of Information and Communication Technologies (ICT) Policies and the adoption of ICT by developing countries can benefit these countries in several areas, including administration services, both internally, within government departments and externally to the citizens (Mubashir, 2000). A brief overview of the national policy regarding IT in Thailand and some discussion of data sharing at the Department of Local Administration and among other government agencies are provided. A discussion of the background and statement of the problem, together with research objectives and expectations of the present study, are given. A summary of all the following chapters of the thesis is also included at the end of this chapter.

1.3 CONTEXT OF THE PROBLEM

This thesis focuses on how the Thai Government (the Royal Thai Police) can make optimum use of the image database from the Central Registration Database and which theory and methods are best suited to image retrieval for the benefit of crime investigation.

In this research, a proposed image retrieval method called the Self-Similarity Searching method, allows a police officer to search for a photographic image from a large image file faster if attributes like Scars, birthmarks or moles were are specified before performing image retrieval. So, it can be said that the value of the original image is increased for the purpose of crime investigation. Senior bureaucrats in Thailand identified the field of crime investigation to be an area of particular concern particularly due to the existence of a high number of unsolved crimes. This is the reason why this thesis chose to focus on the utilization of IT in the field of criminal investigation in order to increase the efficiency of the crime investigation process.

1.4 OBJECTIVES OF THIS STUDY

The thesis begins with an explanatory study of the use and sharing of information among the government departments in developing countries. It examines the methods by which technology and how technology is currently used to again access to information.

There are two major objectives in this research. The first objective of the research addresses how value can be added to the data present in the existing system .The author chose to focus on the area of crime investigation and evaluate two existing image retrieval methods in order to determine the one that was most suited to the crime investigation process in Thailand.

The second objective was to examine the attitudes and perceptions of the Thai police towards the acceptance of Information Technology usage in the crime investigation process. These attributes and perceptions were then evaluated and compared with both the literature on barriers to the adoption of IT and also to some of the more recently developed technology acceptance models.

1.4.1 Aims of this Thesis

1) Investigate the effective use of the ICT including the use of information sharing by government departments that have been provided with it under the national ICT Policies.

2) Examine the use of image retrieval for crime investigation and test Self-Similarity Search as a suitable application of image retrievals and to add value to the use of ICT infrastructure implemented by the Thai government.

3) Determine the attitude and perception of the Thai police towards the adoption of IT and the proposed image retrieval to enhance crime investigation using a framework based on current Technology Acceptance Models

1.4.2 Research Objectives Outline

The following table outlines the research objectives and methods used in this thesis.

Table 1.1: Research Objective Outline

Study	Methods	Objectives
1	Interview	- To examine the use of Information Technology in Thai government agencies. - To examine the possibility of the use of the image database by the crime investigation unit. - To review the crime investigation processes and determine the use of the image database to facilitate the investigation processes.
2	Experiment	- To introduce the method of image retrieval together with a series of experiments to prove the effectiveness of the application. - To compare the performance of the Self-Similarity Searching and the Sequential Searching method. - To add value to the existing image data for better sharing and more useful utilization among the government agencies, particularly the Thai police.

3	Interview And Questionnaires	- To determine the attitudes and perceptions of the Thai police officers towards the use of IT and proposed image retrieval for crime investigation. - To gain an in-dept understanding of the working of the Thai police's perception and acceptation of IT for crime investigation

1.5 THE EXPECTED CONTRIBUTION OF THE STUDY

The contribution of this research is to raise the awareness of information sharing possibility amongst the government agencies in developing countries. Thailand is taken as an example of a developing country in this research. The research will evaluate the effectiveness of the image retrieval methods that can be used to make the search time for the police investigation process faster when looking for criminal photograph records. This method can also be applied to larger image database searches like the Central Registration Database.

This research also seeks to promote and encourage the uptake and use of IT in developing countries, where ICT policies and implementation of systems have taken place, by adding value to the ICT policies of such countries.

1.6 RESEARCH METHODOLOGY

Information for this research has been obtained from two sources. The first source was personal interviews. The second source included academic journals, articles, newspapers, books and material available on the Internet. The research method consists of two phases. Phase one describes the experimental design used to test the Self-

Similarity Searching method that was suggested by Satini and Jain (1996) and Porntrakoon and J.Nukoon (1999) as suitable methods for photographic image retrieval.

The theory behind the Technology Acceptance Models Davis (1989), Thomson et al. (1991), Goodhue (1995), Harrison et al. (1997), and Venkatesh et al. (2003) form a framework for the second phase of this study. Perceptions and attitudes of IT are measured in second phase and the resulting analysis compared with the TAM models.

An alternative use of the image data and a method of retrieval are introduced as an example of adding value to the Central Registration Database System. The Self-Similarity Searching method for crime investigation was then introduced to the Thai police together with the survey and questionnaires in order to determine their attitude and perception towards the use of IT in police work, especially image retrieval techniques for crime investigation. Follow up interviews were conducted when they were considered to be necessary. User acceptances of information technology models were used to help design the questionnaires and interpret the results.

1.7 ORGANIZATION OF THE STUDY

This section of the thesis describes the context, statement of the problem, research aims and objectives. The rest of the research is organized as follows:

Chapter Two provides background information and an overview of the use of information and communication technology (ICT) in developing countries. Models of Technology Acceptance are discussed.

Chapter Three discusses the prevailing use of IT in the Thai government administration system. It summarizes the use of IT and uptake of ICT by the Thai Government according to the national IT strategic plan with particular reference to the Royal Thai Police and the Department of Local Administration. The chapter discusses the possibility of data sharing and image retrieval between these two government agencies in Thailand and proposes image database sharing and retrieval for improved crime investigation.

Chapter Four discusses the image retrieval methodology alternatives that can be used to look for the image effectively. Relevant literature discussing previous research is reviewed and then the appropriate image retrieving methods for the experiment was selected. Finally, several experiments using the Self-Similarity Searching method were designed.

Chapter Five discusses design methods, methods of collection and the methods of processing of data employed in this research.

Chapter Six focuses on the result and discussions obtained by using methods described in Chapter Four. The Self-Similarity Searching and the Sequential Searching method were compared to establish the most effective one. This chapter also discusses how an improvement was made in the Self-Similarity Searching method by adding an additional attribute.

Chapter Seven provides findings and analysis of the questionnaire and interviews. It investigates the attitudes and perception of the Thai police toward the use of IT in police work and their acceptance of the Self-Similarity Searching method for crime investigation.

Chapter Eight provides the summary and conclusions derived from this research. This chapter includes discussion on image data sharing amongst the Thai Government Agencies and the effectiveness of the retrieval method that can be used to ease the crime investigation process. Finally, recommendations for the use of the research results and for possible future research are discussed. Figure1.2 details the structure of the whole research.

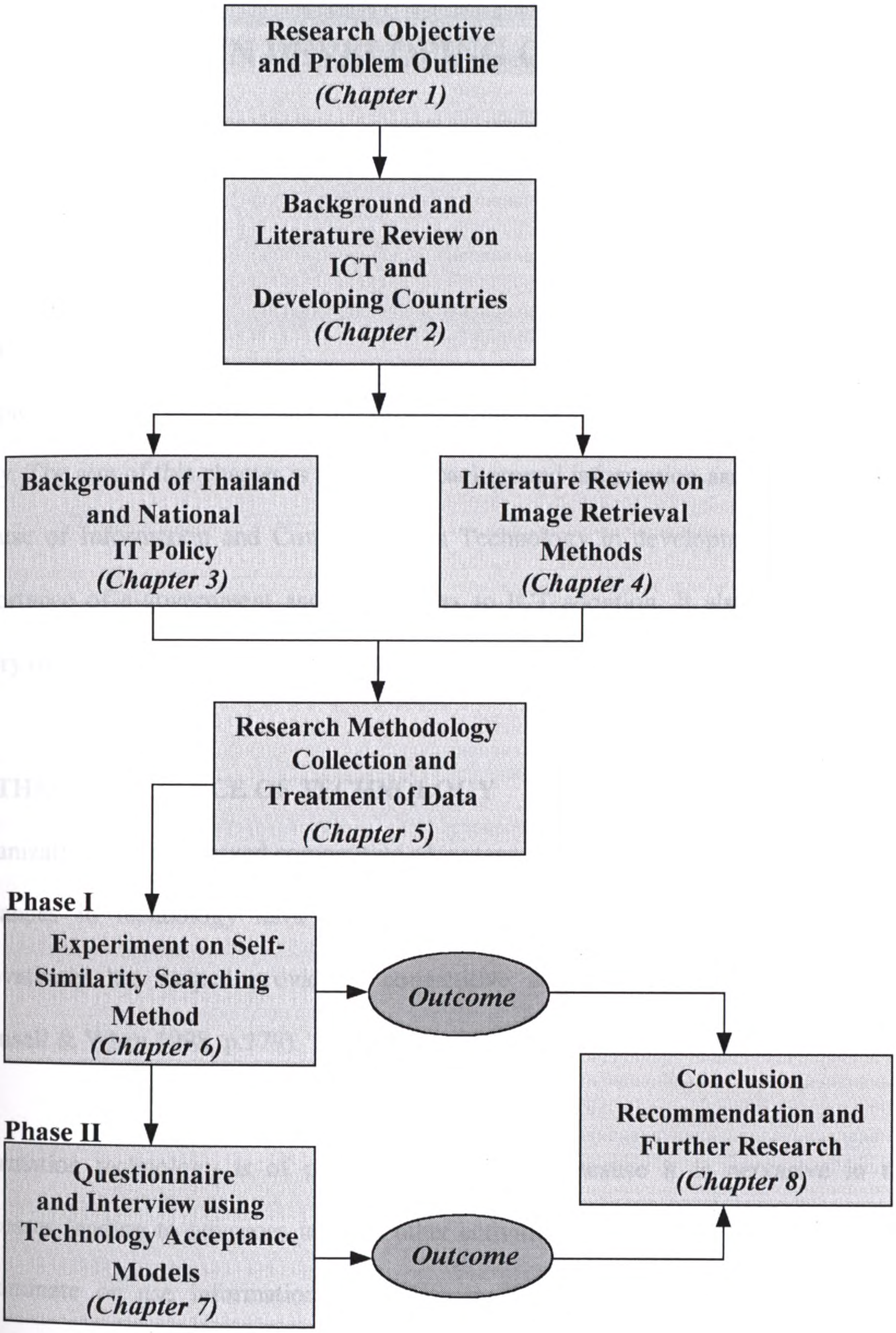

Figure 1.2: Structure of the research

CHAPTER TWO
ICT IN DEVELOPING COUNTRIES

2.1 INTRODUCTION

Chapter One describes the main objectives of the research and its contribution to the study. The aim of this chapter is to provide background information and an overview of the use of Information and Communication Technology in developing countries, the importance of e-government and the barriers to ICT adoption. It also introduces the theory of Technology Acceptance models.

2.2 THE IMPORTANCE OF TECHNOLOGY

Organizations have achieved competitive advantage by implementing new technologies. Advances in technology have helped shape new products and services. It also innovatively has helped provide a competitive edge for innovative organization (Mansell & When 1998, p.179).

Information technology is of particular importance because it is pervasive in the processes leading to advances in most other activities. All activities create, transport, disseminate or use information. Advances in IT have a compounding effect on technological advances everywhere. Accordingly, information technology is exerting a remarkable and profound effect on worldwide competition (Lubbe 1998, p.39).

ICT is a general-purpose technology, and thus has wide applicability in various manufacturing and services sectors. It has a widespread effect and extensive linkages with the rest of the economy (Brahm 2001, p. 94). Boer and Walbeck (1999, p. 210) commented that: Advancing technology is important because it favorably alters industry structure, shapes and moulds competitive forces within and between companies and industries thereby changing forever the behavior patterns of billions of individuals. Technology for its own sake is not important. What is important is its dramatic net impact on society as a whole.

Information and communication technologies offer the potential to respond to real problems facing significant portions of humanity today. The question is which technologies and what kinds of applications? According to Bataller (2003, p. 4) the selected technologies fall into two general categories. The first category consist of technologies that are typically one to five years away from widespread adoption in developed countries and the second category consists of technologies like the Internet, that are now mature and widely used in developed countries but are still in the early stages of adoption or are nonexistent in developing countries.

According to Backus (2001) the following technologies hold the great promise of making positive differences in economic and educational conditions worldwide:

- **Communications and networking technologies** including wireless networks, power line communications, FM data radio channels, ad-hoc networking, infrared, voice over Internet protocol.

- **Computing devices** including mobile phones, handheld computers, sensors, smart cards, storage media, global positioning system receivers and touch screens.
- **New power sources** including portable solar chargers, wind-up batteries and fuel cells.
- **Language technologies** including text to speech, speech recognition, handwriting recognition, translation, e-mail and instant messaging.
- **Business applications** including content management, personalization and key public infrastructures.

These technologies can provide a number of advantages to developing countries. New communication technologies such as wireless do not depend on an installed infrastructure. Alternative energy sources can supply power to areas without access to a power grid. Language technologies ensure that those without formal education can use the applications most beneficial to them. Backus (2001, p.44) suggests that "in each case, care must be given to select the right combination of technologies and to help countries leapfrog to the technologies most likely to have an immediate impact on their populations".

How might these information and communications technologies work together to provide important solutions in developing countries? Accenture research (2003) recommends applications in the following areas as an illustration.

In the health area, a mobile health assistant using handheld computers equipped with various sensors could provide remote consultation, diagnosis and treatment, assisting rural health workers in diagnosing conditions, or in capturing data enabling a remote diagnosis (Accenture, 2003).

In the field of education, education in remote areas could be supported by a number of technology-enabled applications, including a mobile teaching assistant to provide teachers with curriculum information, as well as class materials. Virtual universities and education portals could also be supported with the proper application of information and communication technologies (Accenture, 2003).

In government, empowerment and participation in government could be enabled by such applications as a mobile "e-Government" assistant, a mobile terminal that a rural government employee could use to provide government information and services in remote areas. Initial success stories already exist for the innovative use of information and communications technologies to provide educational and economic support in developing countries. In addition to that, these technologies and business models can have a high social impact and be profitable at the same time. For example, Grameen Telecom and Grameen Bank have initiated a Village Pay Phone program to provide phone access to communities in rural India. Local entrepreneurs, often women, lease a mobile phone through micro-finance provided by the Grameen Bank and resell telephone services to people in their village (Accenture, 2003).

Improving healthcare has, of course, a significant impact on people's lives. For example, local hospitals in Banjul, Gambia, provide remote consultation, diagnosis and treatment to residents in Ginnack, a remote island village. Nurses visit the island twice a week and take digital pictures of the patients' visible symptoms. These are taken to a local hospital where physicians examine the pictures. If further consultation is required, the physician can send the pictures over the Internet to a medical institute in the United Kingdom (Accenture, 2003).

Success stories such as these show that it is possible to apply information communication technologies in innovative ways to begin to solve problems and to offer new kinds of opportunities to people in developing countries. Such solutions (Bataller 2003, p.10) can be both sustainable and profitable. However, if initial successes are to continue, both private and public sources must focus attention on a number of key areas.

For example (Bataller 2003, p.2) alternative power sources should be considered when power infrastructure is limited. Wireless technologies should be considered when the Internet connectivity is expensive and the bandwidth is limited because wireless technologies higher bandwidth at lower cost and wireless infrastructure assets can be better protected against theft and vandalism. The need to build up the human capacity, both to use and to develop technological applications, is the most challenging part of a technology solution deployment. However experience shows people, especially youngsters, are eager to use innovative technologies and quick to learn.

Government policy (Stephen 2003, p.3) is also one of the key areas that need to be mentioned. Many government regulations in developing countries are not supportive of advancing access in rural areas. Involving the community at an early stage in the planning and implementation of an e-Government project enables faster adoption.

One of the main challenges, beyond the lack of supportive policies and appropriate human capacity, is funding. However, with four billion people living in developing countries, and because the population in the current 49 Least Developed Countries (as defined by the United Nations) is expected to triple over the next fifty years, a case could be made for a vast long-term potential (Bataller 2003, p.4).

It is estimated that the population in Thailand will increase by an additional 41% between 1995 and 2020. This increase in population will create an increasing need for basic services and social development. People will have a higher standard of living and will be better educated. News and information will be readily accessible. As a result, people will expect more from government services both in terms of quality and quantity (The Fifth Decade, 2000).

Information and technology (McPherson 2003) has an impact on the basic daily life of any particular place. The people in that particular place or community have lifestyles that are deeply influenced by its technological status. For example, governments, education systems, transportation services, and other miscellaneous services essentially owe their efficacy to their respective technological background and back up.

Nevertheless in developing countries, technological advancement has its pros and cons. In countries where issues such as poverty, lack of basic infrastructure including water and electricity, and the low level of literacy exist, raising the standard of living of its people is more crucial than consideration of ICT adoption. It has, however, been demonstrated that developing countries can take advantages of the lesson learnt by developed countries in the adoption of ICT. Developing countries have been able to leapfrog generations of technology to take advantage of the latest technology. The adoption of mobile phones in China is a good example. China's fixedline telephone system has never been sufficient for effective modern day communication. The Chinese have partially overcome this barrier with the adoption of the mobile system (Bataller, 2003)

2.3 IT AND DEVELOPING COUNTRIES

In 1982 a number of governments in developed countries including Britain and Japan realized the importance of IT and formulated national plans for education, research and development (Kantrowitz 1982, p.175). One of the most important aspects of decision and policy making is access to timely, accurate, relevant information. The current situation in most of the developing countries is the complete opposite. All communication and exchange of information is paper-based. It can often take weeks or months for one government department to gain the substantial records it requires from another department. The lack of communications between departments results in duplication of effort and other inefficiencies. The lack of communication means that although departments often produce sophisticated information that is relevant for many other departments (such as the Statistics Division), this information, which is critical for decision-making by these government departments, is not made available (Branscomb 1993, p.140)

The implementation of IT by a Government (McLellan 2001, p.308) can facilitate information exchange and improve interdepartmental communication. Moreover, information based on the World Wide Web technology using browsers can facilitate ease of access and ease of use. For example, the Gyandoot Project of India demonstrated a successful implementation of ICT in developing countries that later failed.

The Gyandoot Project was supported by Global Knowledge Partnership (GKP). The GPC was a consultation organization committed to the sharing of information, experiences and resources through information and communication technology and to promote the effective use of knowledge and information especially in developing countries (Sharma & Yurick 2001).

Gyandoot or ("messenger of knowledge") was a digital library in the Dhar district of the state of Madhya Predesh in India. This Gyandoot project was established on January 1, 2000. An official website gave citizens global access via a portal. Gyandoot provided farmers with access to the latest market quotes, product exchanges, and other information crucial to farming. With all these facilities, farmers could find the highest prices for their products without relying on traders or the wholesale market. Furthermore, the villagers used Gyandoot to keep track of the cost of their products in the wholesale market. They could make informed buying and selling decisions concerning raw materials and products. The system's functions primarily supported information management, but also enabled users to apply this information to create decision rules which lead to improved transaction processing efficiency, and decision making effectiveness.

Gyandoot was a community-owned and financially self-reliant project. The technology used to accomplish it included an intranet covering 20 village information kiosks and connecting to rural public cyber cafes. In addition, a portal was used to support all online activities. The setup cost of Gyandoot amounted to no more than US$57,000. The project was considered so successful that the Legislature decided to replicate information kiosks similar to those of the Gyandoot project throughout the entire state. The library provided an example of an on-line economic community, which helped an entire group of merchants with similar interests (Sharma & Yurick 2001).

However follow up literature reviews of the Gyandoot project discovered that in 2003 the Gyandoot Project, a "unique government-to-citizen Intranet" which provided computer kiosks in a disadvantaged district of Madhya Pradesh (and received the Stockholm Challenge Award in 2000), failed to sustain itself. The project was subverted by the local leadership and the bureaucracy. After implementation the system was never updated and the commissioner who originally implemented the project was transferred. This left no committed leadership to manage the project (Bonham & Seifert 2003, p.19).

Bonham and Seifert (2003, p.21) further commented that the failure of the Gyandoot project could be linked to where there is weak leadership, implementation of e-government solutions will be slow and the maintenance of systems, once in place, can become problematic. "Bureaucracy (Bonham & Seifert 2003, p.22) derives its power from holding on to information, which is then utilized to bargain a premium from the citizen depending upon the citizen's need and urgency".

Thus, the commitment of management to any project is an important factor in terms of a project's success or failure. A particular system does not essentially have to be highly innovative to be successful, but definitely needs to be the one that is functional, foolproof, easily implemented and supported by management. The current Thai government is very committed to its IT policy and ensuring that it is implemented. This is discussed fully in Chapter Three.

An example of the successful use of ICT (EJISD 2003, p.21) is the Beijing City Government Website in China. The Beijing City Government Website provides citizens with facilities such as government services, information on laws and regulations, a news center, links to other government departments and email. The email section invites citizens to make suggestions about government development, to complain about government services, or to report unsatisfactory government work. The email section enables knowledge sharing and knowledge management, as citizens are able to offer their "know how" on areas to improve. The website further provides an electronic forum for enquirees to obtain answers to questions such as how to move one's official residence to Beijing. The forum responds by listing specific regulations and procedure, thus enabling additional knowledge sharing. While it is simply a website with email communication and electronic forum functions, it facilitates two-way communication between the government and the public, which in turn opens up the possibility for knowledge exchange and management (EJISDC, 2003).

According to the 1998 World Bank report (1998, p.95) on the opportunities of IT in developing countries, up to 80% of medium to large corporations throughout the developed nations have deployed Intranet technology. It is these types of technology adoption from developed countries that developing countries can benefit from by leapfrogging the usual start-up problems.

The concept that the technology appropriate to poor countries like most developing nations differs from that technology which is appropriate to advanced societies is, however, not a new one. Stewart (1978b, p.47) stated that: A country which cannot hope to reach within a foreseeable time a capital supply equal per head to that of the United States will not use its limited resources best by imitating American production techniques but ought to develop production techniques appropriate to thinner and wider spreading of the available capital.

While there are no solutions that can be cut and simply pasted onto another nation's situation, the innovative ways in which some countries have addressed these challenges offer inspiration to other countries (Stewart 1978a). One good practice that was shared was to focus on sustainable development to tackle the lack of infrastructure and to get the most ICT impact. For example, Egypt, which has an illiteracy rate of 34% and only 1% Internet penetration, is using call centers and kiosks to make services more available to its citizens. Any citizen with a phone can access most government forms and information by calling their new call centers and getting a fax response back from what would otherwise be a very unresponsive bureaucracy. Those without a phone can go to a local kiosk and get personal assistance using the same online system designed to override the currently paper intensive process (Winograd & Flores 2000, p.987).

An interesting comment by Nuntra and March (2000, p.123) was that developing countries have a great deal of manpower and that it is mostly illiterate. While technology implementation can gain efficiency and replaces manpower, developing countries such as India, Indonesia and Thailand have large populations that are basically uneducated and employed in manual labour. Statistically, one computer takes away the job from approximately 10 people and hence shows up on the unemployment rate of such countries. Introducing technology in such circumstances is not always the best solution (Nuntra & March 2000, p.124).

The World Bank Report (1998, p.77) recommends that IT implementation by governments be taken in conjunction with an IT Strategic Plan. Without correct planing, history has demonstrated IT implementation often fail. In most developing countries, IT strategic plan suggested that the deployment of IT within the government and then the gradual introduction of controlled access to the wider community would be a step towards over come this barrier. This would be a major step forward in the sharing and communication of information within the government departments in any country. A lack of timely, relevant and accurate information was identified as a major barrier to development in developing countries. The whole concept is commonly referred to as e-government.

2.4 E-GOVERNMENT

According to GIPI (2000, p.51), "E-government is the use of information and communication technology (ICT) to transform government by making it more accessible, effective, accountable and more responsible to the needs of their citizen"

E-government includes: providing greater access to government information; promoting civic engagement by enabling the public to interact with government officials; making government more accountable by making its operations more transparent and thus reducing the opportunities for corruption; delivering services online, saving time and money and especially benefiting rural and traditionally undeserved communities (GIPI 2003, p.68).

E-government (Utta 2003, p.343) is about transforming the way government interacts with governed or exercises sovereign authority. It requires a coherent strategy, beginning with an examination of the nation's political will, resources regulatory environment and ability of population to make use of planned technologies and then it paves them a strategy that is well planned. According to GIPI (2001, p.169), the successful e-government transformation includes five elements; these are process reform, leadership, strategic investment, collaboration, and civic engagement

It is quite a complex task to create and maintain e-government capability particularly for a developing country, as it requires considerable resources. Most developing countries are still at the initial stages of e-government e.g., setup the static website (UN/ASPA

2001). Awareness of the Internet is not yet universal as persons in urban areas in the developing world have yet to hear of the Internet (Michael 2001).

According to Global E-Government Report 2003 (Darrell 2003, p.34), of 2,166 government websites in 198 different nations, there are major differences in e-government performance based on region of the world. In general, countries in North America (including United States, Cannada, and Mexico) are the area offering the highest percentage of online services. Forty-five percent had fully executable online services; this was followed by Asia (26%), the Middle East (24%), the Pacific Ocean Islands (17%), and Western Europe (17%). Only 1% in Russia/Central Asia, 5% in Africa, and 6% of websites in Eastern Europe offer online government services

Table 2.1: Percentage of Government Websites offering Online Services by Region of the World

Region	2001	2002	2003
North America	28%	41%	45%
Pacific Ocean Islands	19%	14%	17%
Asia	12%	26%	26%
Middle East	10%	15%	24%
Western Europe	9%	10%	17%
Eastern Europe	-	2%	6%
Central America	4%	4%	9%
South America	3%	7%	14%
Russia/ Central Asia	2%	1%	1%
Africa	2%	2%	5%

Source: (Darrel 2003, p.36)

Example of the Buffalo-Niagara government in the US demonstrated the initial stage of e-government in developed countries. According to government indicator (Cooper 2002, p.28) there has been a slight increase in the number of Buffalo-Niagara municipalities reporting a website. A majority of municipalities reporting no website, however, have no future plans for creating one due most commonly to lack of money, interest, staff, or time. Municipalities may remain unaware or unconvinced of the benefits offered by the World Wide Web to enhance public access and engagement, increase government efficiency, and promote the community.

This indicator (Cooper 2002, p.31) is based on the combined responses of two surveys of municipal governments in the binational Buffalo-Niagara region conducted by the Institute for Local Governance and Regional Growth. The survey of 270 municipal governments was conducted in summer 2000. Surveys submitted full or partial responses describing their government's web presence. It was noted that training and equipment are serious hurdles to website creation as of 31% cite lack of training and 19% lack of equipment.

The nature of information (SOTR 2002, p.59) provided by municipal websites vary, with most of the 55 municipalities that maintain a website providing tourism, meeting, and contact information, but very few offering interactive services, such as bill payment. For example, every responding local government with a website provides basic municipal information, including the names, titles, and phone numbers of staff or officials. Most, or about 80%, supply citizens with council or board meeting information as well as tourism and events promotion. E-mail contact information, links, and municipal maps are also common features found on more than half of these websites. Interactive content and more technical information, such as property assessment or building permit data, remain relatively less common on municipal websites.

According to the above example, it illustrates an interesting opportunity for developing countries with limited technology to support advanced forms of e-government with interaction and knowledge exchange. This analysis is consistent with Barlas (2002) who recommended that developing countries should begin the process of e-government by publishing government information online that of value to their citizen daily lives, such as documents and forms, rules and regulation.

In Thailand, most of the government departments and ministries already established organization homepage that provided online information and knowledge exchange either for internal, inter-departmental, or government-to-citizen communication. Although, Karnjanatawe (2003, p.14) survey indicated that almost 70% of the Thai Internet users are not satisfied with the government website and the main causes of dissatisfaction includes out-of-date information, difficult-to-locate websites, difficult-to-find information, lack of needs orientation, and dead links. Still there are some remarkable government websites that provide electronic service delivery to the Thai citizen. Such websites are the Department of Local Administration website and the Department of Public Works and Town and Country Planning.

The Department of Public Works and Town and Country Planning website provides citizen with facilities such as free housing blueprints up to 30 models for user to download, information about rules, regulation and law of building, electronic forum for enquirees to obtain answers to questions such as "what needs to be done if the factory is located in the area that is now declared to be a living area?" (DPT 2004).

Another example is the Department of Local Administration website that provides following facilities to the citizen; free email accounts for every individual Thai citizen at (Khonthai.com), links to other government websites and email, news center, government database, individual database (registration and password required for some sensitive data). In addition, this particular website is multilingual, meaning that it offers information in both Thai and English version (DOLA 2004).

Though these two websites are just a simple website with email communication and electronic forum functions, they facilitate two-way communication between the government and the public, government-to-government, which in turn opens up the possibility for knowledge exchange and management. Barlas (2002b) recommended that the government should post information that relevant to their people, and the design of their website should be easy to maintain. Good information should be accurate, complete, economical, flexible, reliable, relevant, simple, timely and verifiable (Stairs 2000). It is noticed that these two government departments have their own IT sub-division that specifically responsible for the website and online services. In order to maintain and to keep the website up to date, available human resources together with IT is a crucial input.

2.5 BARRIERS TO ADOPTION OF IT

Many developing and developed countries found that they had much in common when it came to challenges on the way to achieving e-government (Winograd & Flores 2000, p.27). For example:

- Lack of infrastructure in developing countries
- Finding the necessary talent and skills required for adapting to an IT based system
- Educating citizens to use and like technology
- Meeting citizens' expectations for privacy and security
- Leadership
- Collaboration

The major cause of the digital divide in developing countries is the uneven development of information technology infrastructures between urban and rural areas. The example of the ICT situation in six developing countries is shown in table 2.1.

Table 2.1: ICT Situation in Six Developing Countries

	India	Bangladesh	Thailand	Malaysia	China	Philippines
Fixed lines & mobile telephones (per 1,000 people)	35.5	5.0	142.6	412.3	177.6	124.4
PCs (per 1,000 people)	4.5	1.5	24.3	103.1	15.9	19.3
Internet Users	5.0 million	100,000	2.3 million	3.7 million	22.5 million	2.0 million

Source: (EJISDC 2003)

As can be seen in Table 2.1 in comparison to Malaysia, Thailand is relatively behind in developing its ICT sector. This is especially so outside the urban metropolis of Bangkok. With 24 PCs per 1,000 persons and about 266 Internet users per 10,000 persons, the use of PCs and Internet access are restricted only to a small segment of society.

This is one of the most difficult obstacles to overcome as it entails having to engage in an intense and comprehensive effort to increase computer literacy, provide universal Internet access, and enhance the ability to innovate in the Internet economy. Governments should take the lead in guarantee affordable Internet access to remote areas and offer training programs at local community centers (E-Readiness, 2002).

The Thai economy is still to recover fully from the 1997 Asian economic crisis, and that to some extent is also constraining the further development of ICT. The country is also hampered by the lack of high-level science and technical personnel. However, aspirations for ICT development are high, and this may be supported by the fact that the country produces PC components. The Thai government has also launched the development of Phuket as the cyber city of the country (Prakash, 2001).

Charmonman (1998, p.373) commented that rapid computerization in developing countries has made it necessary for them to study computer-related human resources requirements as without proper planing, the undesirable problems associated with either shortage or oversupply of computer professionals would probably occur.

Winograd (2001, p.15) contented that countries are not only implementing programs to try and close the digital divide but they are also trying to use ICT to bridge the divide between citizens and bureaucrats, thereby increasing trust in democracy. This also requires educating both citizens and civil servants on how to use the new technologies and benefit from them.

Another barrier to the adoption of IT in developing countries (UN Report 2001) is lack of education and lack of sufficient use of English, which is their second language. In developing countries, the rift between the ratios of educated to under-educated people is large. In developing countries quite often the educated populations already have access to the same level of ICT as in developed countries. For example, professionals working in large cities in India and China have access to similar technology as their counterparts in UK or USA. This is not the case for the majority of the population of developing countries that live in rural areas.

Another barrier in most of the developing countries is the lack of English as a second language (Winograd & Flores 2000, p.27). Seventy-three percent of the websites have material predominantly written in the English language (OCLC, 2001), a language that is native to only 8% of the world's population (Boer & Walbeck 1999, p.209). According to the Internet World Stats (2004), top ten languages used in the Internet still remains an English speaking continent with 35.9% of the total Internet users. Chinese comes in the second place with 13.2% of the total users, Japanese (8.3%), German (6.8%), Spanish (6.7%), French (4.4%), Korean (3.8%), Italian (3.6%), Portuguese

(2.9%), Dutch (1.7%), and the rest of the languages (12.7%) (Internet World Stats 2004).

There are several reasons for the English dominance. The main one is American usage as 47% of all public websites are found in the US. Moreover, several of the most Internet intensive countries have English as their mother tongue, including Canada, UK, Ireland, Australia and New Zealand (OCLC 2001). However, this does not mean that webmasters should underestimate the power of having a non-English version of their website. The fact that there are fewer German or Spanish websites, mean that the chances of getting a good position in the search engines for pages written in these languages increases significantly (Gefen & Riding 2003, p. 27). Additionally, in every region where English is not the main language spoken, nine in ten Internet users prefer to get local information in their own language (Michael 2001).

The idea is to change that by using software technology and human translators to make a Web page written in any major language, readable in any other (Boer & Walbeck 1999, p.211). The market for intelligent multilingual content is booming as the Web becomes the international medium it was intended to be, some companies offer applications like Desktop Translator, that will rewrite HTML automatically into a preferred language as a page is downloaded (Orlowski, 2004). Though major software industries are now working toward the language barrier in Internet, still there is a long way to complete all the 6,500 languages in the world as right now there are only 415 languages available on the website (Wikipedia, 2004).

One of the other barriers that need to be mentioned in this research apart from the ICT infrastructure, education and language, is the knowledge management issue. Generally, the need for knowledge management arises in three areas that are in relationship to the public, within government departments and in the coordination between government departments (Wagner 2003, p.11). This research focuses on the relationship within government departments and between government departments

In the relationship within government departments, knowledge management can potentially improve the efficiency of operations that might otherwise require considerable knowledge. For example, in Hong Kong's Civil Service, staff applications for "leave" (e.g., for vacation) are guided by more than 200 rules. These rules regulate the type of leave that applies (e.g., annual, staff development), length of leave, timing of the leave, and so on. According to all these rules, a knowledge management system can significantly lighten the leave administration's burden, and increase speed and accuracy of applications (PANTLEG, 1999).

Between government departments, the give and take of knowledge generally revolves around the reuse of existing knowledge in the light of new information and to the promotion of the best solution taking into consideration the avoidance of duplication of effort. For example, (Odendall 2003, p. 589) in the Government of Victoria (Australia), a knowledge management effort was started when seven individuals in different departments realized they were working on the same problem. They decided to build a virtual community to share experiences. The same sharing principle also underlies the Canadian government's new "Leadership Network".

Hence to avoid such circumstances, Heeks (2001, p. 17) suggested that: it is feasible that the process of e-government should be initiated in a gradual way and in a medium or form accessible to and by all. This throws light upon the fact that this process needs to be rendered to people in a well-channelised way, so that people are able to reap its benefits in a uniform manner.

Developing countries should start the process of e-government by managing knowledge by publishing government information online, beginning with rules and regulations, documents and forms. It is recommended that the publishing begin with a strategy with appropriate milestones. It should post information of value to people in their daily lives, and the design of the web site should be easy to maintain and sustain funding to ensure that information is updated regularly (Barlas 2002a).

Winograd (2002) suggested that while the solutions for each country are very different, we could also draw some general idea from lessons learned. In order to fully benefit from the availability of new ICT tools, governments need to undertake a simultaneous cultural change process in their public service. For example, ICT's can increase equal opportunity by helping to balance home and work using telecommuting and new productivity tools.

Citizens need to be educated about the potential of new technologies. Government has a role to play in achieving a cultural shift that increases a society's willingness to use new technologies, given proper legal and consumer protections. And we need to use the impact of ICT on organizational structures to create an administration that is less hierarchical and empowers civil servants to better serve citizens and be more responsive to their needs (Utta 2003, p.333).

Winograd (2002) further commented that e-government is primarily about people, not about technology. ICT provides the tools, but it is people that make them work. Human resource management is a major tool for attracting new skills, making civil services more receptive to change, and empowering civil servants to innovate by using the new technology. But to make this change happen and to fully realize the benefits of ICT we must return to the human dimension and focus as much research and investment in our people as we do in the technology.

Venkatesh et al. (2003) strongly believe that for technologies to improve productivity, they must be accepted and used by employees in organization. This issue adds complexity to the adoption of ICT in developing countries. As Thailand is a developing country and part of this study looks at the perceptions and attitudes of the Thai police to the acceptance of IT, therefore, it is important that both barriers to the adoption of IT by developing countries and technology acceptance models are mentioned.

2.6 TECHNOLOGY ACCEPTANCE MODELS

Explaining user acceptances of new technology is frequently cited as one of the most researched areas in the contemporary information system literature (Hu et al. 1999). According to Venkatesh et al. (2003) research in this area has resulted in several theoretical models, with essential core from information systems, psychology, and sociology that regularly explain over 40 percents of the variance in individual intention to use technology (e.g., Davis, Bagozzi & Warshaw 1989; Taylor & Todd 1995b).

2.6.1 Technology Acceptance Models (TAMs)

The Technology Acceptance Model represents an important theoretical contribution towards understanding information systems usage and acceptance behaviors (Davis, Bagozzi & Warshaw 1989). The Technology Acceptance Model (TAM) was developed by Davis, F.D (1986) to provide an explanation of the determinants of computer acceptance or computer-usage behavior across a broad range of end-user computing technologies. TAM focused on attitudes toward using a particular IT which users develop based on perceived usefulness and ease of use of the IT. According to Bagozzi and Edwards (1998), TAM has very strong behavioral elements, assume that when someone forms an intention to act, that they will be free to act without limitation. In the real world there will be many constraints, such as limited ability, time constraints, environmental or organizational limits, or unconscious habits which will limit the freedom to act.

In the second phase of this research the Thai police are presented with a new image retrieval method for crime investigation, a number of factors influence their decision about how and when they will use it needs to be determined. The author then uses TAMs to gain an in-dept understanding of how the Thai police come to accept and use the proposed image retrieval for crime investigation. However, this model with its original emphasis on the design of system characteristics does not account for social influence in the adoption and utilization of new information systems (Davis, Bagozzi &

Warshaw 1989). Furthermore, the original TAM as tested by Hubona and Kennick (1996) indicated poor predictive value for a certain technology adoption.

In this particular research, a need to combine TAM with other models such as Task-Technology Fit model (TTF), Model of PC Utilization (MPCU), Theory of Planned Behavior (TPB), and Innovation Diffusion Theory (IDT) is necessary to better understand how the Royal Thai Police Department can facilitate greater commitment of users or individual Thai police to effective use of new information technologies introduced, particularly a proposed image retrieval method to assist in crime investigation.

2.6.2 Task-Technology Fit Model (TTF)

Task-Technology Fit Model or TTF focuses on the match between user tasks need and the available functionality of the IT component (Goodhue 1995, p.1829). TTF models have two key elements, Task Characteristics, Technology Characteristics, which together affect Task Technology Fit, which in turn affects the outcome variable, either performance or utilization. TTF model postulate that information technology will be used if and only if the functions available to the user support (Fit) the activities of the user. Consequently, experienced users will choose only tools and methods that enable them to complete the task with the greatest net benefit and information technology that does not offer adequate advantage will not be used (Goodhue & Thomson 1995, p. 214)

In this research TTF is used to determine an appropriateness of the proposed image retrieval method introduced to the Thai police as a tool to assist them in crime investigation.

2.6.3 Model of PC Utilization (MPCU)

MPCU was adapted and refined from Trandis's (1997) theory of human behavior by Thomson et al. (1991) for information system contexts and used the model to predict PC utilization. The nature of the model makes it particularly suited to predict individual acceptance and use of range of information technologies, the core construct of the model also include Job-Fit, Social Factors, Complexity, Long-term Consequences, Affect towards Use, and Facilitating Condition (Thomson, Higgins & Howell 1991, p.141).

In the second phase of this research, MPCU and its core constructs are used to explain how the Thai police officers come to accept and use computer and information technology in their line of work For example, Job-fit is used to justify the extent to which an individual police believes that using a technology can enhance the performance of his or her job (Thomson, Higgins & Howell 1991, p.142). Complexity is used to rationalize the degree to which an innovation is perceived as relatively difficult to understand and use (Rogers & Shoemaker 1997).

The Social Factors core constructs of MPCU in this research are used to clarify "the individual's internalization of the reference group's subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations" (Thomson, Higgins & Howell 1991, p.143). Facilitating Conditions can also be used to outline objective factors in the environment that observers agree make an act easy to accomplish. In this particular research, "provision of support for users of PCs may be one types of facilitating condition that can influence system utilization" (Thomson, Higgins & Howell 1991, p.129).

Once the author introduces proposed image retrieval method for crime investigation to the Thai police. It is imperative to comprehend individual feelings towards this technology. Based on Triandis (1977), Affect toward Use is described as "feelings of joy, elation, or pleasure, or depression, disgust, displeasure, or hate associated by an individual with a particular act" (Thomson, Higgins & Howell 1991, p.126).

2.6.4 Innovation Diffusion Theory (IDT)

Similar to MPCU, IDT is also can be used to study individual Thai police technology acceptance. Grounded in sociology, IDT (Rogers, 1995) has been used since the 1960s to study a variety of innovations, ranging from agricultural tools to organizational innovation (Tornatzky & Klien, 1982). In the information system context, Moore and Benbasat (1991) adapted the characteristics of innovations presented in Rogers and refined a set of constructs that could be used to study individual technology acceptance. It was found (Moore & Benbasat, 1996) to support for the predictive validity of innovation characteristics, it core constructs involve the following issues: Relative Advantage, Ease of Use, Image, Compatibility, Voluntaries of use.

In IDT, Moore and Benbasat define Relative Advantage as "the degree to which an innovation is perceived as being better than its precursor" (Moore & Benbasat 1991, p.195). Ease of Use core construct (Moore & Benbasat, 1991) is employed in this research to determine the degree to which a proposed image retrieval method introduced to the Thai police is perceived as being difficult to use or not.

Image is one of the core construct that is mentioned in the IDT, Moore and Benbasat 1991, p.195) define Image as "the degree to which use of an innovation is perceived to enhance one's image or status in one's social system". This individual essential detail is verified in Chapter Seven. Compatibility or "the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters" described by (Moore & Benbasat 1991, p.195) is also used to determine the Thai police perception and acceptance towards the use of computer and proposed image retrieval for crime investigation.

Voluntariness of Use is another core construct of IDT that is use in this research to discover "the degree to which use of the innovation is perceived as being voluntary or free will" (Moore & Benbasat 1991, p. 195).

2.6.5 Theory of Planned Behavior (TPB)

Another model that has been successfully applied to the understanding of individual acceptance and usage of many different technologies is the Theory of Planned Behavior or TPB. The core construct of the TPB model consist of 'attitude toward behavior' and 'perceived behavioral control' (Harrison et al. 1997; Mathiesone 19911; Taylor and Todd 1995b).

In the original TPB, while 'experience' was not explicitly included, it has been incorporated into TPB through follow on studies of Morris and Venketesh (2000). Empirical evidence has demonstrated that experience moderates the relationship between subjective norm and behavioral intention, such as that subjective norm becomes less important with increasing level of experience (Venkatesh et al. 2003). This is similar to the suggestion of Karahanna & Straub (1999) in the context of TRA or Theory of Reasoned Action.

Ajzen (1991) presented a critical evaluation of respective studies that successfully used TPB to predict intention and behavior in a spacious diversity of settings. TBS is addressed in this research to determine individual Thai police perception toward the use of information technology and proposed image retrieval method regardless of their experience.

While each of these models mentioned above offers significant explanatory power, a model that integrates constructs from these models may offer a significant improvement over either model alone (Dishaw & Strong 1999). Therefore the general argument for combining the Technology Acceptance Models and variety of Theories of individual technology acceptance is that they capture different aspects of user's preference to utilize information technology. For example, TAM alone based on the attitude and behavior models on which it assume that user' beliefs and attitudes toward a particular information technology largely determine whether users exhibit the behavior of using the information technology. On the other hand, TTF models take a decidedly rational approach by assuming that users choose to use information technology that provides benefits such as improved job performance, regardless of their attitudes towards the information technology (Goodhue, 1995)

In order to gain a better understanding of individual Thai police perception towards the use of information technology and proposed image retrieval method for crime investigation introduced in this research, it is essential to combined Technology Acceptance Models and theories of individual technology acceptance mentioned in this section together and apply their core constructs to each study as appropriate. Figure 2.1 shows the basic concept-underlying User Acceptance Models.

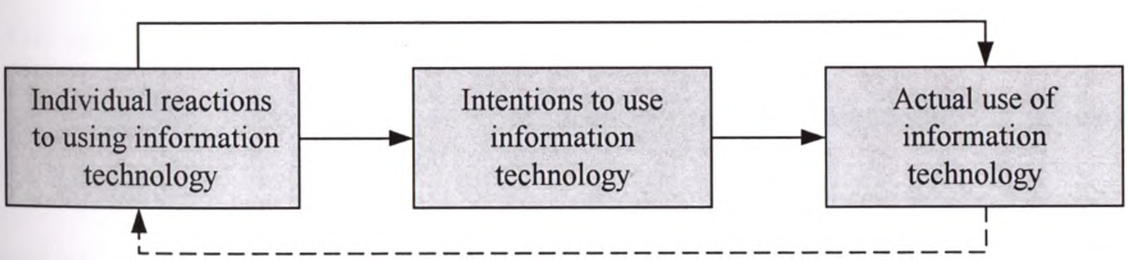

Figure 2.1: Basic concept underlying user acceptance models

Source: (Venkatesh et al. 2003)

2.7 CONCLUSION

Chapter Two summarized the use of information and communication technology in developing countries especially within and between government sectors. The adoption and barriers to ICT in developing countries was also included. Some examples of how the implementation of ICT by a government can facilitate information exchange and improve interdepartmental communication and the service to the citizens were given.

The current literature and recent developments of theoretical models on user acceptance of new technology was outlined. This is used in Chapter Five as a framework for determining the attitudes and perceptions of the Thai police towards the acceptance of IT. However as Thailand is a developing nation we have the added complexity of the barriers to the adoption of IT to be considered when analyzing the results of the Thai police's attitudes and perception. Both these factors are taken into consideration in the discussion of the results in Chapter Seven.

CHAPTER THREE
THAILAND IT STRATEGIC PLANNING

3.1 INTRODUCTION

Chapter 3 discusses a case study of Thailand. It outlines the use and uptake of ICT in the Thai Government and its strategic IT planning with particular reference to the Royal Thai Police (RTP), the Department of Local Administration (DOLA), and the opportunity to use and share the image database from the Central Registration Database (CRDS) to enhance the government services among other authorized agencies.

3.2 THAILAND CASE STUDY

The case study of Thailand and the Thai Government in this research is aimed at improving the utilization of existing information and technology for modern administration and management in order to respond to the needs of national economic and social development according to the Thai National Policy. This research focuses on making technology more user-friendly and replacing data processing by using IT for knowledge processing.

3.2.1 Thailand as a Developing Country

To put the IT strategic plan and policy of Thailand in perspective, it is important that we first describe and analyze the geographical, political, social and economic aspect of the country. Thailand is a developing country that is located in the heart of Southeast Asia. Thailand shares its land borders with Laos in the north, Cambodia in the northeast, Burma in the southwest and Malaysia in the extreme south. The size of the country, approximately 514,000 square kilometers, is about the same as France, or slightly more than twice the size of Wyoming (Thailand Geography 2003). A unified Thai kingdom was established in the mid-14th century. Known as Siam until 1939, Thailand is the only Southeast Asian country never to have been colonized by a Western power (Janyawadee 2001). On May 11, 1949, an official proclamation changed the name of the country to "Thailand", by which it has since been known. The word "Thai" means "free", and therefore "Thailand" means "Land of the Free." (Wanta 1998)

Figure 3.1: Map of Thailand

Source: (TAT 2000)

The population in Thailand was approximately 63 million in 2001, according to the Thai Department of Statistic (2002); 75% of the population are Thai and 4% Chinese, and the rest are from minority groups. The majority of people are Buddhist. Thai is the official language taught in schools and used by the government. Other languages spoken by members of ethnic minorities include Chinese (chiefly Teochiu), Malay, Karen and Khmer. Smaller groups speak Tai languages such as Shan, Lua and Phutai. Many minority groups, especially Chinese, also speak Thai (Papart 2002).

The constitution mandates 12 years of free education, however, this is not provided universally. Most children attend school for at least 6 years and more than 85 percent of the population is literate. However, fewer than three out of ten children continue beyond elementary school level. More than a dozen universities and specialized post-secondary institutions provide higher education for about 3 percent of the adolescents (Education in Thailand 2001).

Thailand's mixed economy includes both a strong private sector and state enterprises while the government assumes responsibility for general infrastructure development. The economy is basically capitalist and the government is committed to free trade. The rapid economic development of the 1960s and the 1970s was slowed by the worldwide recession of the early 1980s. There was a strong recovery by 1987 (ARR 2002).

During the decade of 1985-1995 Thailand experienced the world's highest growth rate, achieving an annual average of almost 9%. This increased speculative pressure on

Thailand's currency and in 1997 it led to a crisis that uncovered serious flaws in the financial system. The Thai Baht long pegged at 25 to the US dollar reached its lowest point of 56 to the US dollar (World 66Beta 2002), in January 1998 causing the country's economy to contract by 10.2% that same year. Thailand only began to recover from the crisis in 1999 with the economy expanding from 4.2% that year to 4.4 in 2000. This can largely be attributed to the 20% increase in exports that occurred in 2000. An ailing financial sector and the slow pace of corporate debt restructuring, combined with a softening of global demand, however, slowed growth in 2001 to 1.4% (MapZone, 2002).

The Thai economy is export-dependent, with exports accounting for 60% of GDP. Thailand's recovery from the 1997-98 Asian financial crisis relied largely on external demand from the United States and other foreign markets (Papart 2002). The Thaksin government took office in February 2001 with the intention of stimulating domestic demand and reducing Thailand's reliance on foreign trade and investment (Junichi 2001). Since then, the Thaksin administration has refined its economic message, embracing a "dual track" economic policy that combines domestic stimulus with Thailand's traditional promotion of open markets and foreign investment. Weak export demand held 2001 GDP growth to 2.1%. Beginning in 2002, however, domestic stimulus and export revival fueled a better performance, with real GDP growth at 6.8% in 2003 (Suvicha 2003).

Modern enterprises are concentrated mainly in Bangkok and its surrounding provinces. The majority of these enterprises are Thai owned but there are numerous joint foreign ventures (Chittratanawat, 2002). Beside these, state enterprises form an important segment of the markets. In the late 1980s, the agriculture sector accounted for roughly 20 % of gross domestic product (GDP) and 30 % of total exports. The main categories of manufacturing include food and beverages, textiles and apparel, and wood and mineral products. Mineral resources contributed about 2 % to the gross national product (GNP) and include tin, tungsten, fluorite, antimony and precious stones, which are all significant foreign exchange earners (Yamado, 2003).

3.3 THAI GOVERNMENT AND POLITICS

Thailand's political system has transformed from an absolute to a constitutional monarchy through a bloodless revolution in 1932. Since then the kings of Thailand have exercised their constitutional legislative powers through a bicameral National Assembly comprised of a House of Representatives elected by popular vote, and a Senate appointed by the King upon recommendation of the Prime Minister. Thai kings exercise executive powers through the cabinet headed by a prime minister, and judicial powers through the law courts. While not directly involved in Thailand's political life, the King exerts a strong moral influence on carefully selected (Janyawadee 2001).

King Bhumibol Adulyadej (1946-present) formally reigns over a highly centralized unitary state but the power to make decisions concerning the affairs of the state rests with the Prime Minister (Nareemal, 2002). A multiparty system exists with sixteen parties participating in the 1986 election. Partisan politics is gradually gaining in importance but the election is still largely a function of personalities. Practical politics does exist but remains mainly confined to members of military-bureaucratic elites and their supporters (AsianINFO, 2000).

The monarchy is hereditary; the Prime Minister is designated from among the members of the House of Representatives. Following national elections for the House of Representatives, the leader of the party that can organize a majority coalition is usually appointed Prime Minister, by the King (Nareemal 2002). In Thailand each government is named after the first name of that current Prime Minister. For example, during the period 1997-2000 it was the Chuan Government as it was led by the Prime Minister Chuan Likphai. The government from 2001 to the present is called the Thaksin Government as it is led by the Police Lieutenant Colonel Thaksin Shinawatra, leader of the Thai Rak Thai Party (Quick Reference Guide on Thailand, 2003). *(Political Parties and leaders lists can be found in Appendix A, on page 266).*

3.3.1 Administrative Divisions

The country is divided into seventy-six provinces (*changwat*). Each province is further divided into subdivision of districts (*amphoe*), which are then divided into subdistricts (*king amphoe*), communes (*tambon*), villages (*muban*), and municipalities (*tesaban*). Refer to Figure 3.1 for the map of Thailand. Except Bangkok, four-year terms provincial governors are appointed by the Ministry of Interior. While Bangkokians have been electing their own governor and provincial assembly since 1985 (Saranjis 2003).

3.3.2 Thai Government Policies

In the past although the adoption and implementation of ICT was identified in the Thai government strategies plan, and it had been given a high priority. The current Thaksin government has also identified the importance of ICT to the country's future development and has taken immediate action to ensure its ICT policies are implemented. "In order to achieve the e-government transformation, elected officials and administrators are needed at all levels of government who understand the technology and the policy goals and who will push reform" (GIPI, 2001). One way of demonstrating his commitment to the adoption of ICT is that he has provided all members of the parliament with a laptop and 100,000 computers desktop have been given to schools throughout Thailand. (OTOP, 2003)

A further example of Thaksin government's commitment to the adoption of ICT is that prior to his becoming Prime Minister, he initiates an IT project called One Tambon One Product (Small villages in Thailand are called Tambon). In 1999 the Thai Rak Thai Party initiates the development of a portal for Tambon in Thailand. Each Tambon has its own homepage, which features local products and tourist information. The project aims at encouraging the rural people to use and understand the Internet and to promote the local products of the Tambon (Thaitambon, 2002).

In 2000 the Prime Minister Thanksin realized the need to upgrade this initial project, resulting into the development of the website Tambon.com, which includes the original project specifications but added additional features such as the highlights of the best product from each Tambon. It contains a database of the essential information from each Tambon in Thailand. This database includes such information as transportation, administration, professional groups, tourism and hotels. The website facilitates buying and selling products between Tambons (Otop-Thailand, 2002).

The intention is to encourage the villagers to improve their local products and help to expand their markets. In addition, the project aims at exposing and encouraging villagers to take advantage of the Internet and to promote tourism. This initial project is the forerunner to Prime Minister Thaksin's e-government policies that were developed and implemented as soon as he took up office in 2000.

In the field of science and technology, Thaksin Government states that it is mindful of the fact that in order to achieve an economic recovery it is necessary to rely on appropriate science and technology to develop the production and services sectors (MOI, 2002). Towards this end, the following policies will be pursued. Firstly, the issue of the development of personnel in the areas of science and technology needs to be specified at every level so that there is a sufficient number in terms of both quantity and quality. This will help support sustainable national development and prepare the country for entry into the New Economy.

Second objective is to promote science and technology in the area of research and development by providing support to agencies in both the public and private sectors to benefit the management and production of small and medium-sized enterprises.

Additionally, Science and technology should also used to help resolve economic, social and environmental problems as should the selection of appropriate skills suitable to improve the potential, expertise and proficiency of Thais. This will help increase the capacity for production for export and domestic consumption, both in the industrial and agricultural areas (MOI 2002)

The third objective is to promote the use of technology, particularly information technology, for modern administration and management in order to respond to the needs of national economic and social development. The technology chosen should be appropriate, inexpensive and able to be developed and expanded in a sustainable manner. The forth objective is the need to revise and amendment of the laws dealing with science and technology so that they may benefit scientific and technological development as well as protect intellectual property rights (MOI 2002).

3.3.3 e-Government Projects in Thailand

The World Bank defines e-government as "the use of information and communications technologies to improve the efficiency, effectiveness, transparency and accountability of government" (World Bank, 2000). Previous section indicates that the Thai government does recognize that IT is an aspect of life that no modern country can ignore.

The objectives of developing e-government in Thailand are numerous. They aim to promote and build confidence in creating e-government in every government level, to improve service delivery to citizens, to improve services for business, to promote transparency and anticorruption in the government sector, to provide efficient government purchasing and most of all to empower through information (Supawat 2003).

In order to establish the Thai e-government, the ICT policies have initiated several projects. The first project is the *'Multi-Application Smart ID Card'* project that provides all Thai citizens with smart ID cards that they can use for government identification and many other activities, such as opening bank accounts, applying for credit cards, and many more. Second project is called the *'e-Procurement'* Project. E-procurement project is an effort to develop an electronic process for all government procurements, increasing their efficiency and ensuring their certification (Thaweesak 2002).

The third e-government project is the *'Government Data Exchange'* which will improve management within the government based on the idea that an organization's effective management depends on effective data exchange. The forth project is the *'National Spatial Data Infrastructure'* that focuses on applying the Geographic Information System to the government's strategic management of domestic resources. The fifth project is the *'Software for Back Office'*; the project addresses the interoperation of software applications that support different government processes under the same government license. This project will make applications such as office automation software and accounting software compatible (Thaweesak 2002).

Another e-government project is the 'e-government Institute', which is still in its initial state of development. Aims of the e-government Institute are to provide training and continuing education for all government officers, so that they can work efficiently in the e-government environment (Taweesak 2002).

In 2001 there were eighteen Thai government organizations, which claimed they were successful in adopting IT as their work tool. These are listed in Table 3.1

Table 3.1: List of Thai Government Organizations that have adopted IT

	List of Thai Government Organizations that have adopted IT in their workplace
1.	The Customs Department
2.	The Public Relations Department
3.	The Telephone Organization of Thailand
4.	The Department of Agriculture Extension
5.	The Ministry of Agriculture and cooperative
6.	The Communication Authority of Thailand
7.	Registration Processing Center
8.	The Revenue Department
9.	The National Electronics and Computer Technology Center
10.	The Ministry of Science and Technology and Environment
11.	The Electricity Denigrating Authority of Thailand and the PTT Public Co., Ltd.
12.	The Government Information Technology Services
13.	The Budget Bureau
14.	The Ministry of Interior
15.	The Ministry of University Affairs
16.	The Metropolitan Electric Authority
17.	The Ministry of Education
18.	The Tourism Authority of Thailand

Source: (Tradex 2001)

The use of IT among the above-mentioned government organizations can be illustrated by the following examples. The Tourism Authority of Thailand (TAT) has developed a travel portal site (WWW) under the “Project of e-Commerce for the Tourism Industry”. This web site allows the Thai travel tourism businesses (accommodation and tour operators) to utilize e-Commerce and the real-time hotel reservation and tourism service reservations in Thailand. Tourists from around the world can quickly access online tourism services by clicking the “Online Booking” icon on the homepage. This leads them to the real-time hotel reservation and tour booking systems, which can give details and information of tourist attractions of specific destinations. The complete loop of travel information and real-time reservations is likely to catch the tourists’ attention and attract online orders from them.

3.4 NATIONAL IT STRATEGY

"The development and adoption of a comprehensive National IT Strategy is vital for the growth of the Knowledge Economy in developing countries, including an interactive approach to the computerization of government ministries, the introduction of regulations supporting adoption of IT, the development of relevant, accessible knowledge databases and the promotion of IT at all levels of society" (World Bank Report, 1998, p.4).

3.4.1 Thai National Policy Regarding IT

For decades, advances in information technology have enhanced lives and economies around the world. On 11 December 1996, the government of Thailand, under the direction of the Prime Minister General Chavalit Yongjaiyuth, announces to the parliament eleven new policies, of which policy number 9 focuses mainly on "Science and Technology". The Thai government has a strong desire to upgrade proficiency in science and technology to serve as tools for the development of the country's economy (MOI, 2001).

The aim is to efficiently boost production capacity so as to compete in the global market, as well as to reinforce the long-term strategy for the development of science and technology. The goals include the following; to develop the quality and quantity of manpower in science and technology in order to accommodate the great demand for labour in this field; to establish joint-efforts with foreign countries in the development of technology and to encourage foreign investment in the production of high-level technology, as well as to conduct research and development related to technology, and to set up training institutions for the transfer of technology to the Thai people (MOI 2001).

Further aims is to encourage the development of the technology necessary for the potential growth in all production sectors of the country; to encourage technology transfer that will be of significant support for targeted industries established by foreign investors, and in the agriculture industry, which is wholly dependent on the Thai, as well as to encourage the transfer of technology to different regions of the country; to encourage joint efforts and mutual cooperation in science and technology research and development between the government and private sectors; to create an awareness and special interest in science and technology, as well as to promote scientific creativity among Thai youth; to develop and adapt IT systems for human development and economic expansion (MOI 2002).

In 1986, Thailand establishes the National Electronics and Computer Technology Center or Nectec. The primary vision of this organization is to transfer technology to the Thai citizen. However, due to the government operations that were slow and inefficient, the early Nectec operation required many long processes to perform only one task. (Chadamas 2002)

In order to improve the Nectec processes, in 1991 the Thai government reorganized the center under the supervision of the National Science and Technology Development Agency or NSTDA. It reinvented the NSTDA and Nectec management system as a collection of private enterprise sections that made cooperation between the government and private organizations easier and more effective. (Thaweesak 2003)

After its inception, NSTDA's first activity in 1992 was to establish National IT policies namely IT2000, a short term policy for 1997 through 2009. Following this plans, the first target group for training was government staff. The Thai government later created the Chief Information Officer or CIO position organizations in all government organizations and established IT education and training for government officers and management. The next step is to transfer IT to the people, therefore, in 1996, Princess Maha Chakri Sirindhorn assigned Nectec the task of implementing the Kanchanapisek Network Project to distribute technologies to the Thai citizen. The project focused on students in rural areas, the disabled, and children in hospitals. (Chadamas 2002)

By 1999, the Thai government and private sectors were cooperating to develop the IT infrastructure, however, the improvement rate was still not meeting the government expectations. Hence, in 2002, the Thai government announced new ICT policies namely 'Fundamental Plan for Information and communication Technology of Thailand. A crucial element of these new policies was the creation of the ICT Ministry with the five development goals that are 1) e-government, 2) e-commerce, 3) e-industry, 4) e-education, and 5) e-society. By pursuing these five goals, the government believes it will provide a framework in which Thai organizations can develop their own systems for the front end and back office by using exclusive domestic resources. (Thaweesak 2002)

The review of the National Policy regarding IT identifies the strategic importance of the implementation of IT in the Department of Local Administration (DOLA), which is under the supervision of the Ministry of the Interior. The author selects DOLA for the case study because the Department has been using and developing IT that best meets the mandates from the National Policy. Moreover, the most important data for each individual registration is recorded here for future use and sharing among other authorized government agencies in Thailand. This is the vision of the Ministry of Interior for the next decade and the background of the Department of Local Administration.

3.4.2 Ministry of the Interior

An examination of the changes in the economy and society, which will make up the working era of the Ministry of Interior over the next ten years (from 1997-2006), reveals a trend towards substantial changes in a number of different areas.

First of all, decentralization will be tangible, and the growth of local areas will increase, both in terms of the quantity and the types of work, which will require control and supervision by government representatives. Second of all, considering the growth in numbers of urban dwellers, it is foreseeable that the ratio of people in the cities will increase from 35% in 1995 to 43% in 2005 (MOI 2001). As a result, the need for basic services, community and social development will increase accordingly. On the other hand, crime and public disorder will also see an increase as a consequence of the growth in the number of urban dwellers and in consumerism. People will have higher standards of living and be better educated. News and information will be more readily accessible. As a result, people will expect more from government services, both in terms of quality and quantity (MOI 2000).

It is also seen that the bureaucratic systems will be overhauled, as well as becoming smaller and more efficient. Political reforms will be tangible and people will be more enthusiastic in participating in state administration. Bureaucratic systems will be competently monitored to measure achievements and transparency. Moreover, trends in globalization and advancement in technology will result in a wider dissemination of news and information. This in turn will lead to a free market economy and more consumerism. People will expect more from governments. NGOs will become stronger and play more active roles (MOI 2000)

Another substantial changes is the guidelines used to solve the problem of poverty will emphasize major city developments and special economic zones rather than relying on the development of infrastructure in rural areas (MOI 2001).

In order to adjust the direction and performance of the Ministry of the Interior to suit the conditions mentioned previously and to enable the whole community to gain maximum benefit from the Ministry of Interior, the following ten-year vision has been put forward:

> *"The Ministry of the Interior will be the main organization supporting local administrations in their development of efficient and sufficient administration resources to provide public services efficiently, according to the wishes of the people. This will be achieved by providing a provincial administration system, which is ready to assist local administrations. It should inspire the people to have confidence in the system of law, the services it provides and the open and clear manner in which the system operates. It will be a supporting organization for rural development by developing cities in accordance with environmental quality standards.*
>
> *This will be done through efficient use of land and the development of high quality infrastructure, which will be able to support ongoing economic development and the growth of society. It will add to and increase the quality of life.*
>
> *To achieve these goals, the Ministry of the Interior will exploit modern information technology to enhance performance by undertaking on schemes and projects that can be monitored and evaluated in a tangible way. Personal development, with an aim to having good morale and confidence in a morally principled system, will be exploited as a means for management administration." (MOI: 1996, p.6)*

3.4.3 Main Functions for the Ten Years Period (1997-2006)

In order to achieve the aforesaid vision, the Ministry of the Interior has defined two main functions and eleven aspects for the ten year period. The main functions are the administrative and the development functions. Administrative functions are concerned with the administration of personnel, working administration and information technology. The goal in this area is to have a modern information technology system, which enhances the capacity for development over a range of areas, including the efficient provision of services to the public (MOI 1996).

The development goal is concerned with the preservation of peace and the safeguarding of life and property and to instill faith in this system. The primary measures are to genuinely and continuously decrease or eliminate factors which are the major causes of crimes or the instigation of crimes, especially with regard to crimes involving drugs, and the exploitation of women, children and minors; crimes using technology as a tool, economic crime and household crime (MOI 2000).

The development of an interconnected information system for the Royal Thai Police Department, the Department of Correction, and the Department of Local Administration has been implemented by employing modern technology to enhance the capacity of the police in carrying out investigations, inquiries and inspections of criminal information and personal verification, as with the working conditions under the new constitution (MOI 2000).

This research seeks to further enhance this system by adding value to its capacity. It investigates the utilization of information and technology by the Royal Thai Police and the Department of Local Administration for crime investigation purpose. Thai police will be introduced to an effective image retrieval method to search for criminals that will help them do their job faster.

3.5 BACKGROUND OF THE DEPARTMENT OF LOCAL ADMINISTRATION (DOLA)

The Department of Local Administration, or DOLA, is one of the most important departments of the Ministry of the Interior in Thailand. The main objectives of the department are to provide a one-stop and immediate electronic civil registration service and issuing of ID card at the local registrar offices and to build a database and computer system for civil registration and ID cards. This system is designed so that it can later be utilized by other authorized government agencies all over the country, thus increasing efficiency in internal administration.

For its ten years' effort in the preparation of the project, the Central Population Database was announced winner in the government category of the annual Computer World Smithsonian Awards, on June 25, 1990 in Washington D.C. (WS, 2000). The project has been recognized as the world's first population database capable of transforming information technology to benefit people.

Services offered by the Local Administration Department include the Registration and Issue of Birth Certificates; Death Certificates; National Identity Cards; Marriage

Certificates; Divorce Certificates; home addresses and Relocation Certificates; Change of Forename or Last name Certificates; Register Shared Last Name and Issue Certificates; Firearms Register and Issue Certification of the Owner and Beast and Burden Registration (MOI, 2000).

IT application objectives for the Department of Local Administration are to organize a database system for the central registration database (CRD), a database and card registration service for the public (ARS), an information database for the Department of Local Administration (MIS), and an information database for public services by way of the internet (DWS).

3.5.1 The Central Registration Database (CRD)

The objectives of the Central Registration Database are; to develop measures to efficiently control and administer the Registration Database System all over the kingdom, as well as to protect the primary rights of Thai citizens and the security of the Registration Database System and to prevent document forgery that might pose a serious threat to national peace and security. Second objective is to develop a system that will effectively provide a document inspection and certification service for the public through the use of computers (DOLA 2001).

The third objective of the CRD is to maintain a Central Population Database for general use and for joint-planning efforts by various sections of Thai society, also to maintain a Central Registration Database that will be linked to and used by government agencies and to improve efficiency in public services under the responsibility of each government agency. The forth objective is to develop standard Personal Identification Numbers to be jointly used by various government agencies (DOLA 2001).

In addition, the Central Registration Database System itself also provides the following databases that can be used and shared among other government agencies when needed. Those basic additional registration databases are Military Registration Database, Land and Property Registration Database, Car Registration Database, Business License Registration Database, Social Welfare Registration Database, Labor Welfare Registration Database, Tax Registration Database, Registration of Passport Database, Government Officer Database, Prime Producer Database, Bankruptcy Database and Criminal Database (ROT 2000). *See Appendix B, page 228 for all the databases contained in the National Registration and Identification Card Systems.*

These databases provided by the Department of Local Administration (DOLA) can be used to benefit police work as this information (CRD) can assist crime investigation. Therefore, this research promotes two fundamental types of change in the traditional use of the DOLA databases. First it adds value to the existing data in DOLA database by using existing ICT infrastructure in the Royal Thai Police and implementing and introducing image retrieval application that enhances criminal investigation. The research also investigates areas of improvement in the use of IT by the Thai police and makes recommendations to the Thai police.

After extensive study of the Thai Government's policy and the objectives of the Department of Local Administration, and observing the use and sharing of information among other government agencies, the main areas that the author would like to address and conduct further research in are how the existing Central Registration Population Database can be used and shared in order to enhance the work at the Royal Thai Police Department.

From the interview with a visionary senior government officer at the preliminary stage of this research, it seems clear that the government is seeking to fulfill these needs, but the approaches taken should not be defined and driven by software vendors. Although it is normal that any company marketing hardware and software would take the development and dissemination of its own products as its primary objective, the Police Department needs a broader perspective on these issues than any single vendor can provide. The government can avoid any dependence upon, or even association with, particular products or vendors by using information provided by the academic researcher.

3.6 BACKGROUND OF THE ROYAL THAI POLICE (RTP)

Major operational components of Thailand's National Police Department include Provincial Police, Metropolitan Police, Border Patrol Police (BPP), and Central Investigation Bureau. Paramilitary forces included BPP and civilian militia-like Volunteer Defense Corps, both of which were used in suppressing armed insurgency supported by the Communist Party of Thailand (TNPD 2000).

Primary responsibility for the maintenance of public order through enforcement of the kingdom's laws is exercised by the National Police Department (TNPD), a subdivision of the Ministry of the Interior. Charged with performing police functions throughout the entire country, the TNPD was a unitary agency whose power and influence on Thai national's life had at times rivaled that of the army.

The formal functions of the TNPD cover more than the enforcement of laws and apprehension of offenders. The department also plays an important role in the government's efforts to suppress the remnants of the insurgency. In the event of an invasion by external forces, much of the police force would come under the control of the Ministry of Defense to serve with, but not incorporated into, the military forces (TNPD 2000).

Originally modeled on the pre-World War II national police force of Japan, the TNPD was reorganized several times to meet changing the situation and internal security needs. American advice, training and equipment, which were provided from 1951 through the early 1970s, did much to introduce new law enforcement concepts and practices and to aid in the modernization of the TNPD. During this era the strength and effectiveness of the police grew steadily (Saran 2000).

All components of the police system were administered by the TNPD headquarters in Bangkok, which also provided technical support for law enforcement activities throughout the kingdom. The major operational units of the force were the Provincial Police, the Border Patrol Police (BPP), the Metropolitan Police and smaller specialized units supervised by the Central Investigation Bureau (TNDP 2000).

In mid-1987 the total strength of the TNPD, including administrative and support personnel, was estimated at roughly 110,000. Of this number, over one-half were assigned to the Provincial Police and some 40,000 to the BPP. More than 10,000 served in the Metropolitan Police. Quasi-military in character, the TNPD was headed by a Director General, who held the rank of police general. He was assisted by three Deputy Directors General and five Assistant Directors General, all of whom held the rank of police lieutenant general. Throughout the TNPD system, all ranks except the lowest (constable) corresponded to those of the army. The proliferation of high ranks in the TNPD organizational structure, as in the military, indicated the political impact of the police on national life (Jompa 2000).

In 2000, the Thai National Police Department (TNPD) became an independent unit that was no longer a sub-division of the Ministry of the Interior. Moreover, the unit is now renamed as the Royal Thai Police (RTP), with 210,052 police officers in 2003 (Boonjatorn 2003).

3.6.1 Central Investigation Bureau

Having jurisdiction over the entire country, the Central Investigation Bureau is organized to assist both provincial and metropolitan components of the RTP in preventing and suppressing criminal activity and in minimizing threats to national security. The specialized units of the bureau, including the railroad, marine, highway, and forestry police, employs up-to-date technical equipment, law enforcement techniques and training (RTP 2001).

In addition to the specialized units, five other divisions and offices employ modern procedures to assist crime investigation and prevention. The Crime Suppression Division is one of the bureau's largest components that responsible for conducting most of the technical investigations of criminal offenses throughout the kingdom. Its emergency unit copes with riots and other public disorders, sabotage, counterfeiting, fraud, illegal gambling operations, narcotics trafficking and the activities of secret societies and organized criminal associations (Sathapana 2002).

The Special Branch, sometimes referred to by critics as the "political police" (ROT, 2003) is responsible for controlling subversive activities and serves as the RTP's chief intelligence organization. The Criminal Records Office collects and maintains the records required in the conduct of police work, including dossiers and fingerprints of known criminals and persons suspected of wrongdoing. At the well-equipped Scientific Crime Detection Laboratory, technicians perform the required chemical and physical analyses. The Licenses Division registers and licenses firearms, vehicles, gambling establishments, and various other items and enterprises as required by law (ROT 2003). The current research is entirely concentrated on the internal administration of the Central Investigation Bureau.

3.6.2 Procedures in Criminal Law

Responsibility for the administration of criminal law is shared by the Ministry of the Interior and the Ministry of Justice. Appropriate branches of the RTP are charged with detecting and investigating crimes, collecting evidence, and bringing the accused before the court. The Public Prosecution Department of the Ministry of the Interior represents the state in criminal proceedings and prosecutes the case while the Ministry of Justice supervises the operation of the courts (MOJ 1998).

The first step in a criminal case is a preliminary investigation, which is carried out by a police officer. The investigation might include searches of suspects, their homes and any others thought to be implicated. The required warrants for these searches indicate the reason for the search, the identity of the person or place to be searched, the name and official position of the officer making the search and the nature of the offence charged or alleged. The police generally adhere to this requirement except in instances covered by the Anti-Communist Activities Act of 1979 (MOJ 1997).

Similar procedures applied for arrest warrants, but a senior police officer is permitted to make an arrest without a warrant when the offence is of a serious nature, or when someone is apprehended in the commission for a crime, or in possession of a weapon or instrument commonly used for criminal purposes. Private citizens are permitted to arrest without warrant anyone caught in the act of committing a serious crime. Arrested suspects are required to be taken promptly to a police station, where the arrest warrant must be read and explained to them. They are then held or released on bail. The provisions for bail and security are defined by law (Ranaka 1999).

After an arrest, a further and more detailed investigation of the case is made but not until the complainant—the state or a private individual—has submitted and signed a full bill of particulars. At the beginning of this phase, accused person is warned that any statement they make might be used against them in court. The investigator is not permitted to use threats, promises or coercion to induce the accused to make self-incriminating statements (Ranaka 1999).

When the investigation is completed, a report is filed with the public prosecutor, who then prepares an indictment and gives a copy to the accused or his counsel, who enters a plea of guilty or not guilty. Based on the plea and the evidence gathered, the judge either accepts a case for trial or dismisses all charges. Trials are normally held in open court and the accused is presumed to be innocent until proven guilty. If the defendant has no counsel and wishes to be represented, the court appoints a defence attorney (RTP 2000).

During trials, accused person or his counsel can cross-examine prosecution witnesses and re-examine defence witnesses. They can also refuse to answer questions or to give evidence that might be self-incriminating. At the conclusion of the argument, the court usually recesses while the judge reachess a decision. The court is required, however, to reconvene within three days and the judgment be read to the accused in open court. The presiding judge, after pronouncing a sentence, frequently cancels half of the term of the sentence if the accused confesses to his crime or has no previous criminal record. A convicted person wishing to appeal is required to do so within fifteen days. The case then is transferred to the Court of Appeal, which can reverse or reduce, but not increase, the sentence imposed by the Court of First Instance (RTP 2000).

Although periodic revisions of the Criminal Code improve the quality of the criminal justice, the system still suffers from disparity in verdicts. In many cases, the court experiences difficulty in determining appropriate verdict because the minimum punishment specified by the Criminal Code is often quite severe. To avoid verdict inconsistency in similar offence, judges are provided with a list of standard verdict and points for consideration from past practices as guidelines. These guidelines are not compulsory, therefore court's discretion is honored (TCJ 2000).

To permit judges to exercise informed discretion, the Ministry of Justice stresses the importance of accurate information about the causes of the crime, the nature of the accused and other circumstances pertinent to judicial decisions. Even so, the criminal courts show some difficulty in overcoming the historical tendency to regard punishment solely as retribution for past misdeeds and deterrence of future antisocial behavior (MOJ 2000).

3.6.3 Police Information System (POLIS)

The Royal Thai Police (RTP) is in the final stages of implementing a nationwide database network system to aid in the operations of police officers from the police headquarters to the local police station level. This project, supervised by the police Information System Center (PISC), will establish a network to support all division, metropolitan police stations, provincial headquarters, division, sub-division and provincial police stations. This involves installation of 640 desktop computers, a budget of Baht 331 million, and was expected to be completed by March 27th, 1998. The completion date was later extended by 120 days (RTP 2001).

POLIS is a central database system with the database stored at PISC. PISC is linked to other divisions within the compounds of the police headquarters via fibre optic cables and to other divisions in Bangkok, such as the Metropolitan Traffic Division and the Police Registration Division, via lease lines (64 Kbps). Provincial area headquarters, linked to PISC via lease lines (64 Kbps), will serve as distribution nodes for sites within each provincial area via dial line. Each of the provincial area headquarters is also linked to the headquarters of the neighboring provincial area, to create alternative communication routes (RTP 2001).

For example, Chiangrai would normally link with Provincial Area 5 headquarters in Chiangmai to communicate with PISC. If the link between Chiangrai and Chiangmai is disrupted, Chiangrai may choose to link with Provincial Area 6 headquarters in Pitsanulok or Provincial Area 1 headquarters in Ayudhya. Details of Systems in POLIS can be found in Appendix B, on page 230.

POLIS consists of six main database systems and twenty-six sub-minor databases. The six main database systems are Crime Information System (CIS), Management Information System (MIS), Security Information System (SIS), Social Services Information System (SSIS), Support Criminal Investigation System (SCIS), and Police Station Information System (PSIS). Of these systems SCIS relates most to this research.

The Support Criminal Investigation System (SCIS) consists of the Investigative System and Photograph Database. The Investigative System is used to assist the investigating officers in their search for relevant information such as persons, activities and property, by automatically linking with related databases. For example, a search for "Mr.X" will invoke automatic searches in the Criminal Database, Firearms Database, Missing Persons Database, Arrest Warrant Database and Exconvict Database. Other than this, Information to Image (I2) software is also used to provide graphical images of relationships between persons and events, where events may be telephone numbers, vehicle registration or location. This will lead investigators to the networking of gang operations. The Photograph Database contains all graphical images related to other databases (RTP, 2001).

3.6.3.1 IT distribution throughout police divisions

In 2000 the government rolled out IT to the police; most divisions and sub-divisions received between one to three computers. Major data entry divisions received more computers. For example, the Traffic Endorsement Control Center of the Traffic Division and the Criminal Records Division received fifteen and thirty computers respectively. The Metropolitan Police Stations received two or three computers, the Provincial Area Headquarters received one, the Provincial Area Administrative Division received four, the Investigation Sub-Division received one, Provincial Headquarters one and Provincial City Police Stations received one. In all, there are 640 computers, 457 dot matrix printers and 23 laser printers distributed. Desks and chairs are also provided, so the only thing the recipient has to do is specify the location. Although the number of computers is not sufficient to serve the needs, it must be noted that this is only the first phase. It is the establishment of main pipelines to major parts of the country. Further phases will see links to every provincial police station throughout the country (RTP, 2001)

3.6.3.3 POLIS operation

Computer applications in POLIS are developed in a Windows environment using Visual Basic and presented in the form of Graphic User Interface (GUI). Every screen is presented in Thai and is very user-friendly, so users do not have to be computer experts. Even though POLIS consists of six database systems with twenty-six centralized databases, access to each of these databases would be restricted to users on a need-to-know basis. For example, a personnel officer in Chiangmai will be able to access only personnel records of police officers in Chiangmai, and will not be able to access Vehicle Registration Database, Arrest Warrants Database etc (RTP, 2001).

POLIS has merely just been implemented and used at the Royal Thai Police Headquarter in 2004. The successful completion of POLIS will depend solely on the collaboration of the sources of the data. PISC merely acts as a go-between for users to access data in an efficient manner. The uses of the acquired data through this system will be governed by the database owners. The owners will specify which data may be updated or deleted and by whom.

POLIS will effectively change the old vertical procedure of operations to a much more efficient horizontal procedure of operations (flat organization). In the past, for section 1 division 1 bureau 1 to obtain data from section 2 division 2 bureau 2, requests needed to be made through channels of command from section 1 to division 1 to bureau 1 to bureau 2 to division 2 to section 2 and back again. This is vastly time consuming. The new procedure will enable section 1 to request data directly from section 2 if the data is classified as distributable (RTP, 2001).

Thus, POLIS is not just an information system, which involves twenty-six databases and reduces redundancy in operations, it also serves to modify police operations in order to gain an advantage over criminals, increase effectiveness and efficiency, and strive towards new and better ways of police management. At times when jurisdictional areas are being reduced to better serve the public, criminals are taking advantage of the country's growth and commit a wider range of crimes throughout the country. Therefore, the police must use information systems to rapidly extend the arm of the law to every corner of the country.

3.6.4 The Opportunity use of Image Database for Crime Investigation

In general the image database contains pictorial, graphical, pattern or photographic images that can be electronically captured or retrieved by using computer-based technology when needed (Riseman, 1998). Normally, image processing makes heavy use of optical scanning and optical disk technologies (Chuck, 1999).

The analysis of a picture using techniques that can identify shades, colours and relationships that cannot be perceived by the human eye is called image processing (Lyons, 1995). It is used to solve identification problems, such as those faced in forensic medicine or in creating weather maps from satellite pictures (Fischler & Elschlager 1973). Image retrieval deals with images in bitmapped graphics format that have been scanned in or captured by digital cameras. It can also be used for any image improvement, such as refining a picture in a paint program that has been scanned or entered from a video source (Riseman, 1998).

At present the Support Criminal Investigation System (SCIS) uses Information to Image (I2) software to provide graphical images of relationships between persons and events, where events may be telephone numbers, vehicle registration or location that could lead investigators to the networking of gang operations. The Photograph Database contains all graphical images related to other databases (RTP, 2000).

Since SCIS is linked to the Central Registration Database System (CRDS) for information on individual Thai, an image retrieval application would add value by utilizing the existing photographic image to further aid in criminal investigation by matching witness descriptions of suspects to the image in the database, using an image retrieval method.

3.7 CONCLUSION

Thailand, a developing country with a population of 63 million people has a mixed economy that includes a strong private sector as well as state enterprise. Currently the country is governed by the Thaksin government who is acutely aware of the importance of focusing on science and technology to develop the production sector in order to get over the economy crisis in 1997.

Thailand has adopted the system of e-Governance with a focus on four main areas of e-Service; online information service, simple transaction services, electronic funds transfers and e-Procurement. Presently, 18 organizations are using IT systems. The Thai government also recognizes the demand for science and technology personnel and through the Thai national policy has implemented the use of IT system for economic expansion. They also strive to implement IT systems in a range of other areas like preservation of peace by decreasing or eliminating crime-causing factors.

The Department of Local Administration, which is in charge of all civil registration related services, maintains a Central Record Database that is linked to government agencies all over the country. Information contains in this database can be used to help in crime investigation. This thesis proves that the value of information stored in the database can be maximized by using existing ICT infrastructure.

The Royal Thai Police (RTP), formally known as Thailand National Police Department, is responsible for the maintenance of public order and law enforcement of the country. The Central Investigation Bureau is also created to assist the RTP in suppressing criminal activity. The Central Investigation Bureau consists of specialized units like the Crime Suppression Division Unit that uses modern procedures whilst conducting technical investigations of crime offences throughout the kingdom.

In addition, the Police Information Center has developed a database system known as Police Information Systems (POLIS). POLIS is user-friendly, that has a graphical user interface presented in Thai language and offers police officers a greater degree of flexibility in accessing information shared between government agencies.

Thus, the Central Registration Database Systems containing individual photographic images of Thai Citizens who have registered for the National Identity Card can be used to provide a more efficient crime investigation search in the future, in conjunction with the retrieval method proposed in the next chapter.

CHAPTER FOUR
IMAGE RETRIEVAL

4.1 INTRODUCTION

Chapter Four reviews different image retrieval methods that can be used to utilize the image database effectively, particularly for the purpose of crime investigation. The literature on image retrieval methods was reviewed, and then a suitable image retrieval method was selected for the case study. Finally, several experiments using the selected method were designed with the aim of determining the most suitable method to use for the case study on the Thai Royal Police. Two possible methods, the Sequential Searching method and the Self-Similarity Searching method, were selected to conduct further experiments on the collection of image databases.

4.2 AN OVERVIEW OF IMAGE RETRIEVAL

An image is a visual representation of an object. In information technology, the term has several meanings. The first usage is an image, which is a picture that has been created or copied and stored in electronic form. The image can be described in terms of either vector graphic or raster graphic attributes. An image stored in raster form is sometimes called a bitmap. An image bitmap is a file containing information that associates different locations on a specified image with hypertext links. Secondly, an image can be a section of random access memory (RAM) that has been copied to another memory or storage location (Mustile 2000, p.237).

Imaging is the capture, storage, manipulation, and display of images (Chang & Hu 1992, p.432). In document imaging, the emphasis is on capturing, storing, and retrieving information from the images (which are often mainly images of text). In graphical imaging, the emphasis is on the manipulation of created images in order to achieve special effects through rotating, stretching, blurring, resizing, twirling, and other changes to the original image (Bach, Paul & Jain 1993, p.621).

In image processing, an essential issue is how to understand a particular given scene (Castleman 1996). Representing an image by its pixels requires significant memory storage. For example, if the image consists of 1,000 x 1,000 pixels, then the memory required to store it is 1 MB. This is assuming that it is a black and white image, i.e., it has 2 levels of gray only. The amount of memory will increase significantly if the image is a colored one (Pitas 1993, p. 40). Representing images using pixels does not take into account any possible relationships between the objects in the image, assuming that the image contains a number of objects.

On the other hand, if we pre-process the image so as to extract some primitives (objects), the image could be represented using a much smaller amount of memory (Shepards 1962). This fact is self-evident in that if an image is represented using pixels, no relationship is assumed among any pixels or groups of pixels within the image. On the other hand, if a number of pixels are grouped together to form a primitive (in the form of an object), then we can reduce memory storage as it can depict the relationships among these objects. In addition, the relationships among the objects become more transparent (Bachan 2001).

4.3 METHOD OF IMAGE RETRIEVAL

Important elements to be considered in the design and implementation of an Image Database Systems supporting queries by image content are: image feature extraction, image content representation and organization of stored information, search and retrieval strategies, and user interface design (Tamura & Yokoya 1984, p.31). Addressing such issues has become the object of intensive research activities in many areas of computer science over the past few years (Chang & Hsu 1992, p.433)

Advances, mainly in the areas of databases and computer vision research, have resulted in methods, which can be used for image archiving, retrieval, and IDB design work (Petrakis & Foloutsos 1997, p.436). However, as observed in Jain and Niblack (1992) work, there is a need for increased communication between the vision and the database communities to deal with the above issues. Combining results from both areas is an important next step.

In the area of face recognition, objects such as face, eyes, nose, and mouth are produced as representations for each face image, they are used to support decision making in criminal record search. The capabilities of the image recognition application field can be extended to provide valuable teaching, training, and enhancing image interpretation support by developing techniques supporting the automated archiving and the retrieval of images by content (Petrakis & Falostsos 1997, p.438).

4.3.1 Image Retrieval by Content

Image content can be described indirectly through attribute (e.g., subject, speaker, etc.) or text (e.g., captions) (Chritodoulakis et al. 1986, p.347). Queries by image content require that prior to storage images are processed, and appropriate descriptions of their content are extracted and stored in the database. Retrieval by image content is not an exact process, two images are rarely identical. Instead, all images with up to a specified degree of similarity have to be retrieved. The design of appropriate image similarity/distance functions is a key issue and is application-dependent. An almost orthogonal issue is the speed of search (Petrakis & Faloutsos 1994).

4.3.2 Exact Match Searching in Image Database

One method of the exact match searching developed by Chang, Shi and Yan (1987, p.414) is 2D-strings. This system involves constituting an efficient image content representation and providing low complexity (i.e., polynomial) matching in image databases. A unique name or class is assigned to each object. Two one-dimensional strings then represent the relative positions between all objects. The problem of image retrieval is transformed into one of string matching: all 2D-strings containing the 2D-strings of the query as a substring are retrieved. To speed up retrievals, methods for indexing 2D-strings in a database have been proposed in Petrakis and Orpahnoudakis's (1993: 1996) work. Lee and Hou (1990, p.62) comment that 2D-C strings deal with situations of overlapping objects with complex shapes.

In other words, 2D-strings represent symbolically the image contents and may be used as iconic indexes of images in the database; they are obtained by projecting image objects on the two coordinate axes of the image and considering precedence relationships between the projections. A pictorial query can be also expressed as a 2D-string and the problem of pictorial information retrieval is reduced to a pattern-matching problem (Leland 1994). Many researchers (Lee et al 2000; Chang et al. 1992; Petrakis et al 1996) have carried out developments of the early 2D-strings approach. Among these, 2DG-strings with the cutting mechanism overcome limitations of 2D-strings due to the inability to give a complete description of spatial relationships that occur in complex images. Lee and Hsu (1990, p.1,079) defined 2D-Bstrings, which preserve all spatial relations between objects with efficient segmentation.

Petrakis and Orphanoudakis (1993, p.520) contends that 2D-strings may yield "false alarms" (non-qualifying images) and "false dismissals" (qualifying but not retrieved images). Techniques for inexact match retrievals based on 2D-strings have also been proposed in Ramakrisna (1999) "Self-Similar traffic model" and Ishikawa (2001) "Query processing in Image Database", but they require exponential time for matching.

4.3.3 Approximate Searching in Image Databases with No Indexing

Approximate search systems described in the machine vision literature (Bach, Paul & Jain 1993, p.624) typically focus on the quality of the features and the matching function, with little or no emphasis on the speed of the retrieval. Thus, each image is described by a set of features; to respond to a query, the system searches the features of all the images sequentially. A typical, recent system along these lines is described in Petrakis and Faloutsos (1997, p.437). The system described supports the segmentation and interactive retrieval of facial images from an image database (IDB). A prior knowledge regarding the kind and the positioning of expected image objects (e.g., face outline, nose, eyes, etc.) is employed and used to guide the segmentation of face images into disjoint regions corresponding to the above objects. The database search is exhaustive using sequential scanning.

4.3.4 Approximate Searching in Image Database with Indexing

An attempt to combine indexing and an appropriate database search is proposed in Jagadish's (1991) research. The main idea is to extract n features from each image, thus mapping images into points in an n-dimensional space. Any spatial access method can then be used to handle range and nearest-neighbor queries efficiently. The original paper did not address the issue of false dismissals, and also it failed to address the problem of retrieving images by specifying properties of objects and relationships between objects. However, this research had a significant impact as later on most of the following image retrieval research was either directly influenced by Jagadish or discovered the Jagadish's approach independently.

The works of Hou et al (1992) and Petrakis and Faloutsos (1994) continue along similar lines to that of Jagadish (1991) but Petrakis and Faloutsos (1994) research was focusing on medical images. Given a picture, the four "most important" objects are taken, and their centers of mass are used to represent their spatial relationships. However, this approach seems to allow for false dismissals. Refer to Figure 4.2, if an X-ray has five objects, one of them will be ignored. Thus, queries on this fifth object of X-ray will not be retrieved (Petrakis & Faloutsos 1997).

4.4 SIMILARITY SEARCHING METHOD

One of the image retrieval methods that use the approximate searching by image content approach is called a Similarity Search or a Self-Similarity Searching method (Srisarkun, Jittawiriyanukoon & Cooper 2002). Similarity searching is the algorithm for when each object and object correlation of each image in the database is compared to each object and object correlation of the key image attribute by attribute. Not every object needs to be well matched. Instead, the image with an attribute value falling in the range of the specified degree of similarity is retrieved. For a key image, one or more images with up to a specific degree of similarity will be retrieved (Porntrakoon & J.Nukoon 1999)

Matching and dissimilarity measurements are seldom based on the same techniques, but they differ in emphasis and applications. Matching techniques are developed mostly for recognition of objects under several conditions of distortion (Lee 1992). Similarity measures, on the other hand, are used in applications like image databases, in which the query image is just a very partial model of the user's desires and the user looks for similar images, according to some defined criterion, to it (Shi 1987). In query by *example,* the users select an image, or draw a sketch, that reminds them in some way of the image that they want to retrieve. Images similar to the example according to the given criteria are retrieved and presented (Saniti & Jain 1999). Figure 4.1 illustrates the query image or the key image, which can be either sketch image or photographic image.

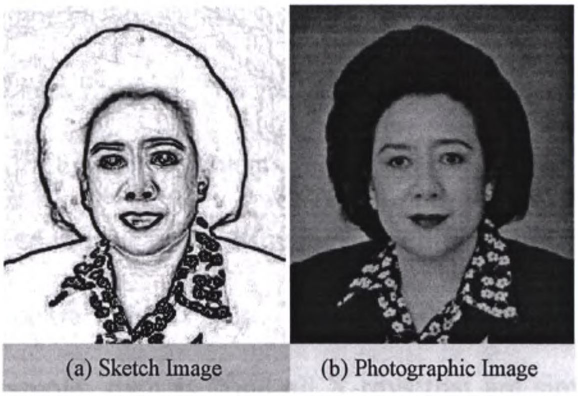

Figure 4.1: Query Image or Key Image

In a typical matching application, a comparison is expected to be successful for images very close to the model, and unsuccessful for images different from the query. The degree of similarity of images different from the model is of no interest as long as it remains below a suitable acceptance threshold. On the other hand, database applications require a similarity measure that will accurately predict perceptual similarity for all images "reasonably" similar to the query (Satini & Jain 1999, p.872).

Similarity selections of objects in a very large database can be executed by an incremental search on the basis of their distance from a given point. To cope with this problem, however, indexing support and retrieval strategies, which are able to ensure good performance for different kinds of queries, need to be developed (Lumini & Maio 1999).

Petrakis and Faloutsos (1994) first introduced similarity searching in Medical Image Databases. Their research is very useful for medical image retrieval. The purpose of their method is to handle approximate searching by image content in medical image databases. Image content is represented by attribute relational graphs holding features and relationships between objects. The method relies on the assumption that a fixed number of "labeled" or "expected" objects (e.g., "heart", "lungs", etc.) are common in all images of a given application domain in addition to a variable number of "unexpected" or "unlabeled" objects (e.g., "tumors", "hematoma", etc.). The method can answer queries by example, such as "find all X-rays that are similar to Smith's X-ray" (Petrakis & Faloutsos 1997, p.439).

Individual objects are describes by properties corresponding to characteristics of their position, size and shape (Orphanoudakis et al. 1989, p.617). The description used in Petrakis and Faloutsos (1997) in terms of properties of objects contained in images, and in terms of relationships between such objects. An object has a number of attributes including size (s), roundness (r), and orientation (o). These attributes are used to store the content of an object in a medical image. Spatial relationship is the relationship between two objects in an image. The attributes of a relationship are Distance (d), and Relative Position (p). Petrakis and Faloutsos (1997) method uses the mesh correlation, which means all objects have relationships between each other. Figure 4.2 shows the attributed graph representing the content of the example image of a medical image.

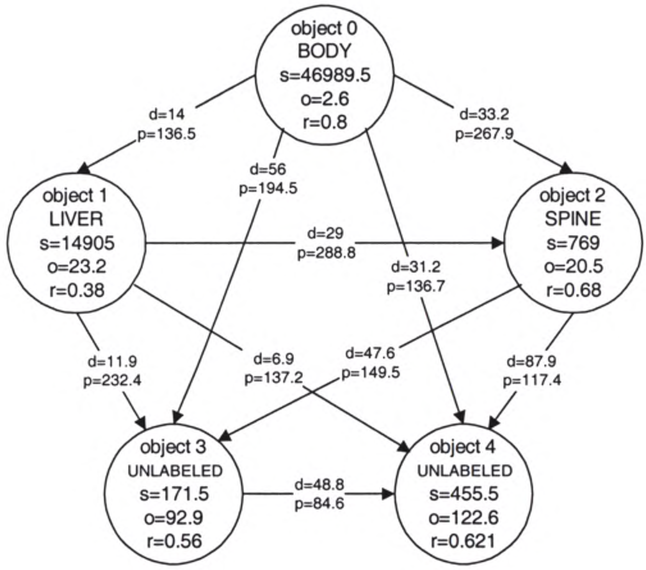

Figure 4.2: Objects, Spatial Relationships, and Attributes of a Medical Image

Source: (Petrakis & Faloutsos 1997)

Although Similarity Searching in Medical Image Databases provides the ability to search for similar images in the database very quickly, there are still some drawbacks of the method which include:

1) The file size of an image is unpredictable because of the unlabeled objects. Meaning that medical images already have a number of labeled or expected objects, which are common in all images, plus the number of unlabeled or unexpected objects, which can be varied.
2) The file size is larger because all objects are attached to their names. For example, an object with a name with 10 characters will require more space than an object with a name of only 5 characters long.
3) The image is difficult to identify because there is no reference object in an image. Refer to Figure 4.2 if object number "0" is not "BODY", a different set of similar images may be retrieved from the database.

Porntrakoon and J.Nukoon (1999) proposed Self-Similarity Searching method that solves the drawback issues in Petrakis and Faloutsos (1997) research. However, in his research the application and solution is applicable for the 2-dimension face image retrieval only.

Unlike the Medical image, there is no unexpected object on the normal face image, apart from such things as scars, birthmarks, or moles (Srisarkun, Jittawiriyanukoon & Cooper 2002). Therefore the file size of an image is predictable because of the labeled objects. In the medical image database, all objects are attached to their names, in consequence, the file size is larger. The object with name 10 characters long will require more space than the object with name only 5 characters long. To solve this problem, Porntrakoon and J.Nukoon (1999) references each object on the face with numbers to reduce the space requirement. *(See Table 4.1 and Table 4.2)*

Another problem of the medical image database is that there is no reference object in an image, hence, the image is difficult to identify. It is shown in Figure 4.2 that a different set of similar images may be retrieved from the database if object number "0" is not "BODY". As mentioned earlier that the Self-Similarity Searching method of Porntrakoon and J.Nukoon (1999) gives reference to each object on the face image, (e.g., Object number "0" must be the center of the face and Object number "2" must be the left eyebrow, etc), this way a different set of similar images will not be retrieved as the reference was clearly specified at the beginning.

4.4.1 Similarity Searching for Face Image

The face image is two-dimensional (2D) that is it has vertical and horizontal dimensions. A photographic image consists of objects and object correlations, which are identified prior to their storage. Each object has the object number starting from zero (e.g., "0" is face object, "1" is right eyebrow object) and each object correlation has the fixed number starting from zero (e.g., 0 is the relation between face and the right eyebrow) as shown in Table 4.1 and 4.2, the numbers of objects and object correlation are fixed. Each object and object correlation include the number of attributes (e.g., size at 0 degree, reference angle and distance between those two reference objects) (Kapouleas 1990, p.587).

Each object and object correlation of each face image in the database will be compared to each object and object correlation of the key image attribute by attribute. The comparison may or may not eventuate in a perfect match, instead the image with atribute value falling in the range of specify degree of similarity is retrieved (Dellepiane et al 1992). In other words, for a key image, one or more images with up to the degree of similarity will be retrieved. Similarity searching provides the faster search time and retrieves the similar images from ones stored in the database comparing to sequential searching (Santi & Jain 1996 ; Porntrakoon & J.Nukoon 1999).

4.4.1.1 Conversion of face image

The face image is segmented into closed contours corresponding to dominant image objects. Each object contains its object correlation and attributes (Raman, Sarkar & Boyer 1993, p.89). The face image comprised of ten objects and each object is attached by the number. The objects and object numbers of a face image are shown in Table 4.1 (Porntrakoon & J.Nukoon 1999).

Table 4.1: Face Image Objects and Its Object Numbers

Object Number	Objects (Reference from Center of the Photograph Image)
0	Center of the face
1	Right eyebrow
2	Left eyebrow
3	Right eye
4	Left eye
5	Right ear
6	Left ear
7	Nose
8	Mouth
9	Scar, moles, birthmarks or tattoos

Source: (Adapted from Porntrakoon & J.Nukoon 1999)

Figure 4.3 illustrates the following: object number 0 represents the center of the face, number 1 represents the right eyebrow, number 2 the left eyebrow, number 3 the right eye, number 4 the left eye, number 5 the right ear, number 6 the left ear, number 7 the nose, number 8 the mouth and number 9 represents scars, moles, birthmarks or tattoos.

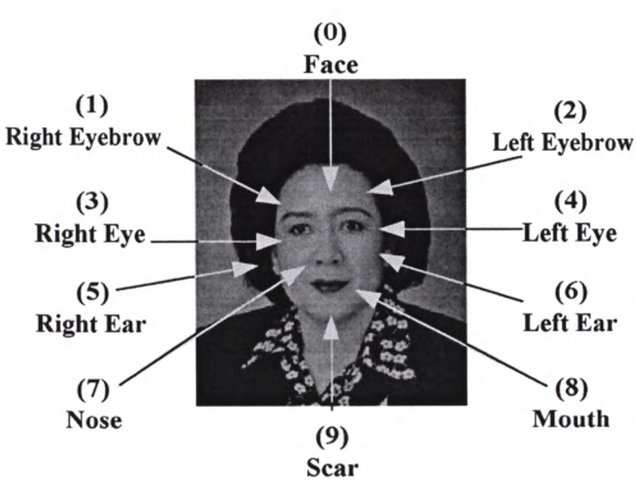

Figure 4.2: The face objects may or may not show the presence of a scar

Since each object in the photograph image is a non-roundness object, each object includes a number of attributes as follows: 1) Size at 0 degrees, 2) Size at 90 degrees, 3) Size at 180 degrees and 4) Size at 270 degrees. These attributes are measured in millimeters.

In order to reduce the number of objects and calculation complexity, the research refers to a center point for all objects as shown in Table 4.2. For example, let *n* be the number of objects of an image. If the center point is the reference point, then the object number is (*n*-1). If no reference point is applicable then the number of the object will be $\sum_{i=1}^{n-1} n-i$.

There are nine-object correlations in a face image, each correlation has it own number as shown in Table 4.2. Each relation contains 3 attributes, which are relation number, distance, and angular direction to the reference point, which is the face object. The distance is measured in millimeters while the direction is measured in degrees (Portrakoon & J.Nukoon 1999)

Table 4.2: Object Correlation Number

Correlation No.	Object Correlation
0	**Right eyebrow in relation to face**
1	Left eyebrow in relation to face
2	Right eye in relation to face
3	Left eye in relation to face
4	Right ear in relation to face
5	Left ear in relation to face
6	Nose in relation to face
7	Mouth in relation to face
8	Scar in relation to face

Source: (Adapted from Porntrakoon & J.Nukoon 1999)

In this research, the objects and object correlation are estimated prior to the storing. The amount includes size, distance, and angle. Searching for stored images in the database requires that all images with a positive correlation will be retrieved. The alikeness of the output images depends on the degree of Self-Similarity (Srisarkun, Jittawiriyanukoon & Cooper 2002).

4.4.1.2 Self-similar parameter

The single Hurst (H) parameter is designed to capture the degree of self-similarity in a given empirical record. The comparison is said to be self-similar when the value of H is between 0 and 0.5. It has a high degree of self-similarity if the H-value is closer to 0 (Srisarkun & Jittawiriyanukoon 2002). There are a number of methods used to estimate the H-parameter. The first three of these listed here are described in detail by Ramakrishna (1999).

1) Whittle Estimator:

The Whittle Estimator method is not a graphical method and provides a confidence interval. It assumes that any long-range dependence dataset approaches the random center point displacement when aggregated to a certain level. It follows other methods like the R/S statistic or variance time plot (Ramakrishna 1999).

2) Local Whittle Estimator:

The Local Whittle Estimator technique only assumes that the dataset trace is a long-range dependent, it does not care whether it is the random center-point displacement model or not. However for certain cases, it gives an incorrect estimation (Ramakrishna 1999).

3) Wavelet Method:

The Wavelet technique is used to estimate the H-parameter in a multi-fractal dataset over small time scales. The differences in an aggregated series are analyzed compared to the variance plot method where the aggregated series within a fixed interval was looked into. The Hurst parameter is then calculated from the slope of the line of the plot (Ramakrishna 1999).

4) The variance-time plot:

The variance-time plot technique is based on a graphical method by indicating that there is a slowly decaying variance of self-similar series. The variance of $X^{(m)}$ is plotted against m on a log-log plot (Ennis, Normal & Thurstone-Shepsrd 1993, p 143).

5) Analysis of R/S plot:

The analysis of R/S plot is (Ashby & Perrin 1988, p. 128), purely graphical technique. It plots the re-scaled range or R/S against a time interval N on a log-log plot. The result should fit a straight line with slope H.

6) The Periodogram method:

The Periodogram method uses the slope of the spectral density of the dataset as approaching the origin (centerpoint). According to Jacobs, Finkelstien and Salesin

(1995, p.578) on the log-log plot, the periodogram slope is a straight line with slope β-1 = 1 –2H close to the origin.

Methods 4-6 may be biased for a large H measure, since they do not provide a confidence interval. However they are useful in detecting faulty assumptions e.g. non-stationary characteristics in a dataset (Srisarkun & Jittawiriyanukoon 2002).

If the correlation parameter H is 0<H<0.5 then the data has a positive correlation, if H=0.5 then the data has zero correlation, and if 0.5<H<1 then the data has a negative correlation. In comparison between each image in the database and key image, the degree of self-similarity H between these two objects will be computed. Let *k* be the number of attributes of an object; let *q* be an attribute value of the object of the key image and *r* be an attribute value of the object of stored image. The correlation of each attribute between 2 objects is defined as:

$$\text{corr} = q_i - r_I \qquad (1)$$

where i = 0, 1, 2, …, k-1

Then, H parameter is defined as:

$$H = \frac{|q_i - r_i|}{\max(q, r)} * 100 \qquad (2)$$

For example, the self-similarity H between two objects shown in Figure 4.4(b), is computed as follows:

Size at 0 degree $H = \frac{|51-52|}{52} * 100$

$= 0.0192$

Similarly, size at 90 degrees = 0.0123

Size at 180 degrees = 0.0096

Size at 270 degrees = 0.0122

Distance = 0.0484

Angle = 0.006

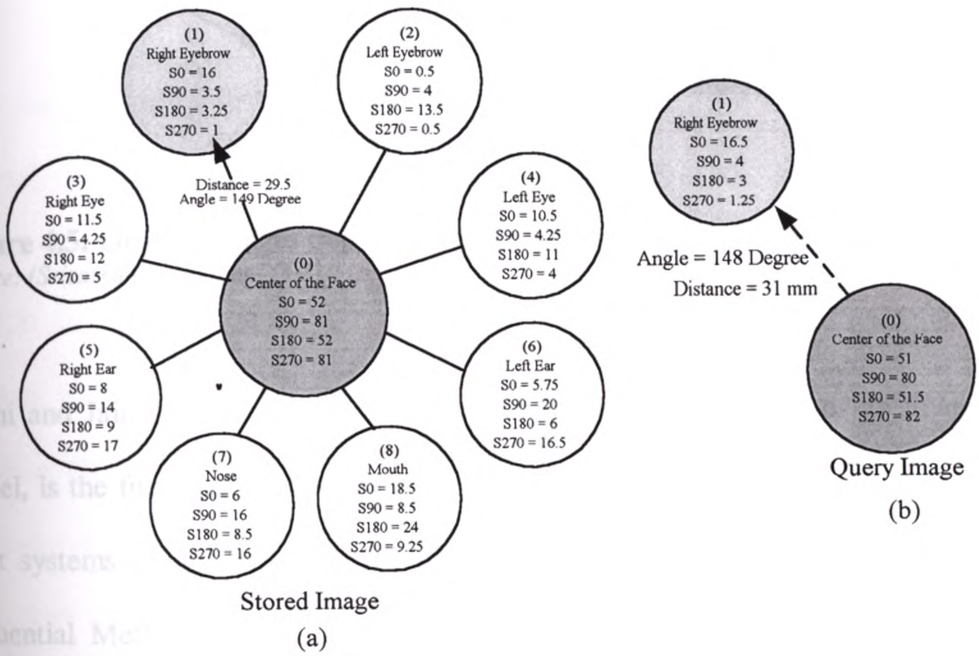

Figure 4.4: (a) Data contents of a stored image
(b) Example of data contents of a query image

Source: (Adapted from Porntrakoon & J.Nukoon 1999)

By using the Self-Similarity Searching method searching for stored images in the database requires that all images with a positive correlation will be retrieved. The alikeness or a similarity of the output images depends on the degree of self-similarity; the lower that H is, the closer the image will be. Figure 4.5 illustrate the output images after the degree of self-similarity was specified.

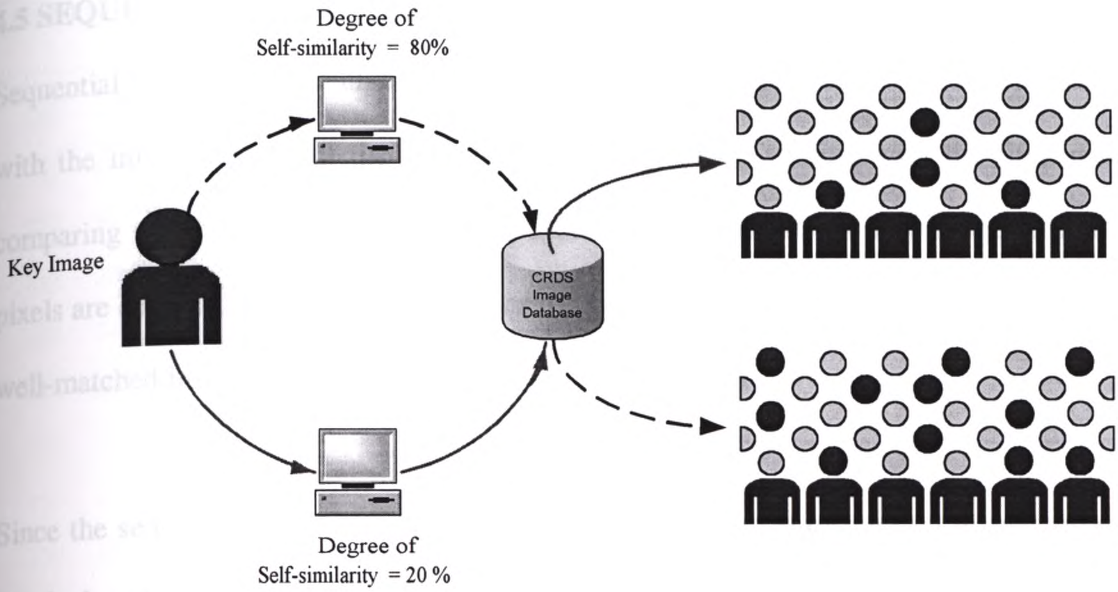

Figure 4.5: Output images depend on the degree of self-similarity specified by user
Source: (Srisarkun & Cooper 2002)

Satini and Jain (1999, p.877) stated that: comparing two images, or an image and a model, is the fundamental operation of many Visual Information Retrieval systems. In most systems of interest, a simple pixel-by-pixel comparison using for instance the Sequential Method will not do. The difference that we determine must bear some correlation to the perceptual difference of the two images or with the difference between two adequate semantics associated to the two images.

In relation to the above statement, Porntrakoon and J. Nukoon (1999) also agreed that compared with Sequential Searching, Self-Similarity Searching will retrieve the self-similar images from the database more quickly. Sequential Searching method is detailed in the next section.

4.5 SEQUENTIAL SEARCHING

Sequential Searching is the algorithm that compares the image content of a stored image with the image content of the key image pixel by pixel, starting with the first, and comparing whether the pixel value of the stored image matches the key image until all pixels are covered. Only if all pixel values of the stored image match the key image, the well-matched image will be retrieved.

Since the sequential search compares the values of each pixel of the two images pixel by pixel, and also an image comprises of great number of pixel, the sequential searching time of an image depends on the size of image. In this research, an image with the size 90*120 and 256 monochrome scale will be examined. Therefore, one image will produce a total of 10,800 pixels for comparison. If there are 10,000 images in the database, there will be 108,000,000 comparisons. If the size of the image is larger and the color range is wider, the sequential search time will be considerably longer (Srisarkun & Cooper 2002). Moreover, representing an image by its pixels requires significant memory storage.

The following Figure 4.6 shows the example of cost computation between a key image and a stored image. The first column is a part of the key image data, the second column is part of the stored image data. The first pixel of the key image and stored image are compared. The third column in Figure 4.6 is the cost computation between a key image and a stored image. The cost is the difference between these pixel values.

Example of Key Image Data					Example of Stored Image Data					Cost between Key Image and Stored Image				
251	249	253	253	251	249	249	253	249	251	2	0	0	4	0
251	247	250	251	251	250	248	250	249	252	1	1	0	2	1
251	248	252	250	251	248	235	252	250	253	3	7	0	0	2
248	250	252	251	253	250	250	252	250	253	2	0	0	1	0
249	248	252	251	252	251	248	252	233	253	2	0	0	18	1
251	250	252	251	252	251	250	253	210	250	0	0	1	41	2
251	249	250	251	254	251	249	253	248	250	0	0	3	3	4
251	250	252	251	254	251	250	250	249	251	0	0	2	2	3
250	250	250	249	253	250	250	250	249	252	0	0	0	0	1
250	248	247	253	253	249	248	251	250	252	1	0	4	3	1
250	250	251	252	253	249	250	251	250	252	1	0	0	2	1
250	252	251	249	252	250	255	251	251	253	0	3	0	2	1

Figure 4.6: Example of Cost Computation between a Key Image and a Stored Image

The advantages of Self-Similarity Searching over Sequential Searching methods can be summarized as follows (Porntrakoon & J.Nukoon 1999):

1) Compared to Sequential Searching, file size of the Self-Similarity is much smaller because fewer values are stored in an image. In other words, Self-Similarity Searching needs to compare fewer values between key image and store image because the number of objects and objects correlation are fixed.
2) The Self-Similarity searching time is faster than the Sequential searching time both in the main memory and on the disk.
3) Similar images are retrieved for further comparison and decision-making.

One of the main objectives in this research is to find a suitable image retrieval method that can be used to search images with a faster search time when retrieving a Criminal Record for the purpose of investigation. Moreover, the storage space required for this kind of search should be less as in the future it should be possible to retrieve all the images from the Central Registration Database which is a very large image database of the 64 million Thai citizens.

Portrakoon and J.Nukoon (1999) research suggest that the Self-Similarity Searching methods can be applied to increase the speeds of the crime records search and provide the similar faces for subsequent decision-making processes. However, their research was tested on a database containing 100 images, which is not enough to be able to be reach, a substantive conclusion. Therefore, an experiment that is more rigorous and robust is to be conducted in order to prove Porntrakoon and J.Nukoon's claim before introducing the Self-Similarity Searching method to the Thai police Series of experiments are carried out, results and analysis are presented in Chapter Six.

4.6 CONCLUSION

There has been a considerable amount of research carried out on the image retrieval methods (Flickner et al, 1995) and their use in the different situations and areas of work. Some of the image retrieval methods are used in the medical image database (Petrakis & Faloutsos 1997), some are used in the texture pattern image database (Ma & Manjunath 1996). Older methods such as 2D string (Chang, Shi & Yan 1987, p.414) giving binary answer like "yes or no" is slow and not scaleable. Furthermore, image content representation methods based on strings have been proven to be ineffective in capturing image content and may yield inaccurate retrieval (Petrakis & Faloutsos 1997). The needs to find the methods that allow querying particularly the face image database with the degree of similarity are considered.

After reviewing most of image retrieval methods available the two methods the Self-Similarity Searching and the Sequential Searching methods were to be tested. This decision was made based on the work conducted by Satini and Jain (1996); Porntrakoon and J.Nukoon (1999) who stated that the Self-Similarity Searching method is more effective when using it to retrieve 2-dimension face images.

Testing a method for its effectiveness when applied to large image databases is a time consuming process. Therefore, the author was able to test only two of these methods (the Self-Similarity and the Sequential Searching methods) within the time frame and the resources available. In order to determine which of the two methods selected was the best one, further work was conducted and this is presented in Chapter Six.

CHAPTER FIVE
METHODOLOGY

5.1 INTRODUCTION

Chapter 3 details the Thai government's IT strategic plans and outlines the use and uptake of IT by the government. This thesis aims to promote the use of IT between the government departments and presents an opportunity to add value to information sharing among them. Thus Chapter Four explains image retrieval methods and concentrates on the Self-Similarity Searching method that was suggested by Porntrakoon and J.Nukoon (1999) as a suitable method for photographic image retrieval.

This chapter outlines the methods undertaken in order to achieve the aims of the thesis. The research method involves two phases. Phase one describes the experimental design used to test the Self-Similarity Searching method as a suitable method for photographic image retrieval. Phase two describes the methods used to obtain the attitudes and perceptions of the Thai police to the proposed IT application for identifying suspects.

In this research both qualitative and quantitative methods are combined and applied throughout the research. Each phase of the research required different methods that will be discussed in detail in the next section. Figure 5.1 illustrates the structure of the research methodology and techniques used in this thesis.

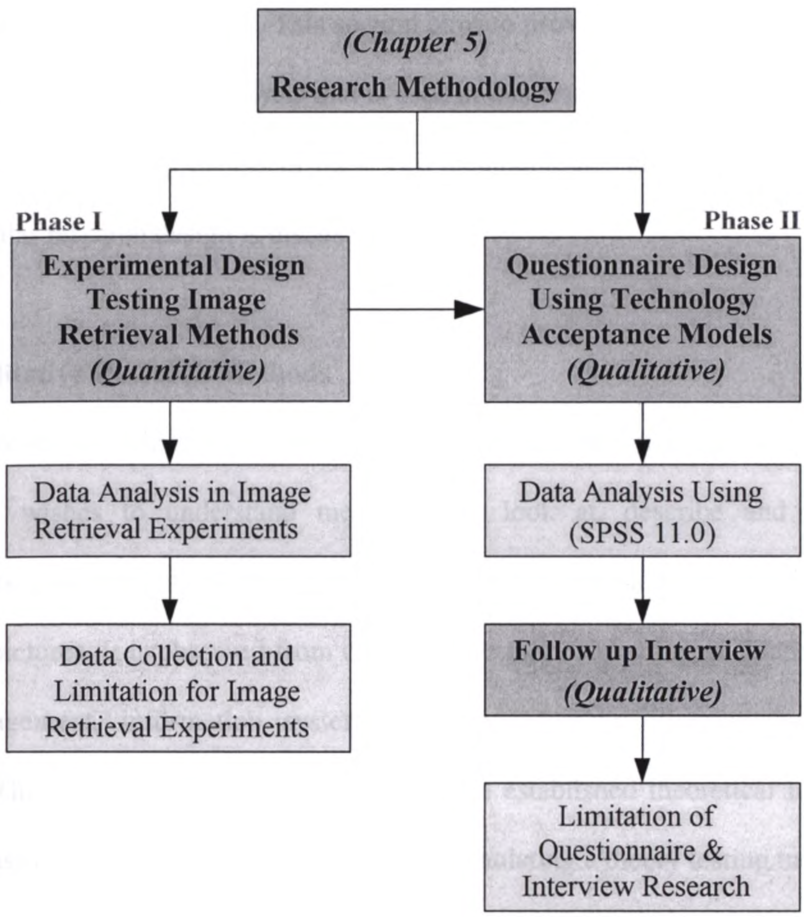

Figure 5.1: Structure of the Research Methodology

5.2 RESEARCH METHOD

A method described by Leedy and Jeannie (1993) is a way of accomplishing an end result, it is how one operates, a way to get the job done. Methodology (Leedy & Jeannie 1993, p.101) is merely the study of a particular method, or methods, for reaching a desired end. Research methodology is therefore a continuing process; it is a continuum that is ever changing, ever developing.

Leedy and Jeannie (1993, p.139) believe that the nature of the data dictates the methodology; if the data is verbal, the methodology is qualitative, if data are numerical, the methodology is quantitative. This section aims to provide a critical view of both the qualitative and quantitative analysis that is used in this research. A brief overview of the nature and distinguishing factors of these two methodologies and their applicability for this particular research design is discussed.

5.2.1 Qualitative Research Methods

"Qualitative research has always been a viable mode of investigation. It is carried out when one wishes to understand meanings, or look at, describe and understand experiences, ideas, beliefs and values. The research deals with the data in the form of words or pictures. It is observed from the literature that conducting qualitative research into management, information systems, and management information systems is growing. This is necessary, due to the lack of an established theoretical basis on the above areas, which could guide researchers in formulating a theory testing method, such as that described later on in the next section. In qualitative research, the researcher does not begin with a theory to test or verify certain phenomenon. Contrary to quantitative research, qualitative research is a process of inductive thinking and a theory may emerge during the data collection and analysis phase of the research". (Creswell 1994, p.94)

Qualitative research largely relies on the interpretive and critical approach to social science (Neuman, 1991, p. 322). It is also observed from the inquiry into management literature that the current research of a qualitative method in management and or organizations has significant implications for practicing managers (Hitt 1995, p.178). This technique gives great freedom to practicing managers to comment on their management practices. The methods include interviews, focus groups, participant observation, and personal learning logs.

5.2.2 Quantitative Research Methods

Quantitative research methods include questionnaires, surveys, experiments and content analysis. A study deals with the collection of data in a numerical form. Theories are used deductively and placed towards the beginning of the plan for the quantitative research (Creswell 1994, p.87). The objective of quantitative research is to test a theory, rather than take steps towards the development of theory. The existing theory then becomes a framework for the study and extending or advancement of the theory is achieved by collecting data to test it.

5.2.3 Appropriate Research Methods

Appropriate methods for this research were selected on the basis of the types of data required for the research (Yin, 1994). Wisker (2001, p.138) comments that using qualitative and quantitative research methods together is a common approach. Subjectivity exists in both kinds of research methods, as it does also in what could be termed 'pure', scientific research where scientists carry out well-managed and well-documented experiments. Their choice of experiments and, to some extent, the questions they ask of the data in order to interpret it is based on essentially subjective research questions, a need to know some things rather than others. This can be determined by different times and places, different needs and abilities, the opportunities for different kinds of study, and different subjects (Wisker 2001, p.138).

In this particular research both qualitative and quantitative methods were employed. Phase One of the research employed the quantitative method approach as it dealt with the scientific experiment testing a suitable image retrieval method for crime investigation. A qualitative method approach was used in Phase Two of the research, questionnaire and interview techniques were adopted to determine the attitudes and perception of the Thai police officers to the acceptance of this new technology.

5.3 RESEARCH STRUCTURE

The aim of this research was to respond to the research objectives outlined in Chapter One. The research examined the effectiveness of the Self-Similarity Searching method and the possibility of using it to enhance criminal investigation. The research also aimed to gain an understanding of the real user's perceptions and attitudes to accepting of the system if it was to be put into use in their unit. The users in this particular case study are the Thai police.

5.3.1 Phase I: SSS Application

The research questions that are addressed in Phase I of this research are:

- Is the Self-Similarity Searching method more effective as suggested by Santini and Jain (1996), Porntrakoon and J.Nukoon (1999) when using it to retrieve a 2-dimension image database as compared with the Sequential Searching method?

- Could the Self-Similarity Searching method be improved? If so, how could it be improved?

These questions are answered by conducting a series of experiments.

5.3.2 Phase II: Questionnaire and Interviews

The research questions that are addressed in Phase II of this research are:

- Is the Self-Similarity Searching method suitable for use in crime investigation as suggested by Porntrakoon and J.Nukoon (1999)?
- What is the attitude and perception of the Thai police towards the use of ICT and the Self-Similarity Search for criminal investigation?

These questions are addressed by conducting a questionnaire analysis focusing on the Thai police officer's attitude, perception and acceptance of information technology, particularly the Self-Similarity Search technique for criminal investigation. A number of underlying models on technology acceptance, helped guide the design of the questions in the questionnaire and the resulting analysis of the data.

5.4 EXPERIMENTAL DESIGN

Experiments are conducted in an attempt to answer certain questions as pointed out by Cresswell (1994). Experiments represent attempts to identify why something happens, what causes some event, or under what conditions an event does occur (Burns 1995, p.245). This research is interested in identifying retrieval methods that use less computer storage space and the least time (Santini & Jain 1996) to retrieve images in order to find an optimum image retrieval method for the purpose of crime investigation. The experiment is divided into two series: Experiment I where the research experiment to test the effectiveness of the Self-Similarity Searching method over the Sequential Searching method is carried out; and Experiment II which aims to improve the Self-Similarity Searching method and make it suitable for crime investigation purposes (Porntrakoon & J.Nukoon, 1999).

Experiment I: The comparative experiment of the Self-Similarity Searching method and Sequential method.

This experiment was designed to compare the effectiveness of the two searching methods. The objectives of this experiment were to:

(a) test the effectiveness of the Self-Similarity Search and Sequential Search method;

(b) identify preliminary recommendations to improve the Self-Similarity algorithm.

Experiment II: The comparative experiment of the Self-Similarity Searching with and without the scar specification.

This experiment was designed to determine the performance search of the Self-Similarity algorithm alone, as well as when an attribute or object likes a scar is added and specified.

5.4.1 Self-Similarity Searching Method (SSS)

This stage of the study took place after an extensive literature of image retrievals had been reviewed. The Self-Similarity Searching method was put to test in comparison with the Sequential Searching method in order to prove the effectiveness of the method that Porntrakoon and J.Nukoon (1999) claimed could be used to improve crime investigation. The original idea from Porntrakoon and J.Nukoon (1999) was only tested on database contains 100 images, which was not enough to be able to be reach, a substantive conclusion. Thus an experiment that was more rigorous and robust was required to actually prove Porntrakoon's claim. As stated by Cresswell (1994, p.94) "to test a theory", the theory that was tested in this case was that of Satini and Jain (1996) and Porntrakoon and J.Nukoon (1999).

After this set of experiments proved successful (Chapter Six) a further set of experiments was designed. The purpose of the second set of experiments was to determine the impact on the Self-Similarity algorithm of adding an extra attribute (such as a scar) to the key image (image being search for). The reason for the additional attribute is based on research by Roger (1997) who has shown that when witnesses are describing suspects they often first identify a defining feature such as a scar, birthmark or tattoo. The results of this experiment are discussed in Chapter Six.

5.4.2 Collection and Sources of Data for the SSS Experiment

The databases used for testing both the Self-Similarity and Sequential searching methods consisted of 10,000 photograph images obtained from several different sources. First 3,500 photograph images were taken from volunteers who came to apply for civil registration or for the issue of birth and marriage certificates, at six different local administrations. The second batch of 2,750 photograph images was obtained from the Chachengsao Registration Database, courtesy of Chachengsao District Administration Office. In addition 2,450 photograph images were obtained from the Samutprakarn Registration Database, courtesy of Samutprakarn District Administration Office. A further 1,300 photograph images were taken from volunteer students from three different high schools and the university. These images were then compiled into one database.

In order to perform the Self-Similarity Search, the large data sets of photographic images collected earlier were measured prior to their storage. This procedure is called the object correlation estimation or face image conversion (Porntrakoon & J.Nukoon 1999). Firstly, each photograph image is scanned by an 8 bit-monochrome-scale with 90*120 pixels, and then enlarged 6 times. Next the photograph image is converted into objects and object correlation. The attribute values of each object and object correlation are then identified. Once identified, all data is stored in the database. Procedures for identifying the objects, object correlation, and attribute values are described in detail in Chapter Six.

To check the efficiency of the Self-Similarity Searching method, the Query program written in C language was implemented. Samples of the 10,000 photographic images previously converted and installed in the hard disk were used. A PentiumIII 450MHz PC was used for this experiment. The photographic images were organized into 10 databases with a different number of images stored in each database; 1,000, 2,000, 3,000, 4,000, 5,000, 6,000, 7,000, 8,000, 9,000 and 10,000. For each category, five images in the database with cost = 0% or with positive correlation ($0<H<0.5$) were randomly used for computing the average search time of both the Self-Similarity Search and Sequential Search method (Srisarkun & Cooper 2002). The algorithms of SSS and SQS methods can be found in Appendix D on page 283. The experiment is divided into 2 series, and these are outlined earlier in section 5.3.

Design of Experiment I: In order to test Porntrakoon and J.Nukoon's (1999) theory the experiment to compare SSS and SQS methods was undertaken in the following way:

Step 1: Begin with a database of 100 images

Step 2: Five trials of each algorithm recording response time, number of images identified as "similar"

Step 3: Calculate average of response time of the five trials for each searching method

Step 4: Increase size of database by 100

Step 5: Repeat steps 2 to 4 until database reaches 10,000 images *(Results of all of these trials can be found in Appendix D, on page 258)*

Step 6:Compare and analyze average response times of the two searching methods as the databases increase in size *(Results of analysis discussed in Chapter Six)*

Step 7: Compare space requirements of both SSS and SQS algorithms during the searching performance (*Also discussed in Chapter Six)*

Design of Experiment II: Once the SSS was proved to be effective for image retrieval, the author then sought to improve the original SSS algorithm of Porntrakoon and J.Nukoon (1999) by adding the scar attribute to the algorithm. This experiment was carried out to see whether the response time decreased and space requirement increased when an additional attribute was specified, and to see whether the number of images found as "similar" decreased with the increased specification. The following steps were undertaken in Experiment II:

Step 1: Begin with the database of 100 images

Step 2: Five trials of each SSS algorithm (one with the scar specification and one without the scar specification) recording response time and number of images found that were "similar"

Step 3: Calculate the average response time of the five trials for SSS method both with and without the scar specification

Step 4: Increase the size of the database by 100

Step 5: Repeat steps 2 to 4 until the database reaches 10,000 images *(Results of all of these trials can be found in Appendix D, on page 270)*

Step 6: Compare and analyze average response times of the SSS method with and without the scar specification as the database increases in size *(Results of analysis are discussed in Chapter Six)*

Step 7: Compare the storage requirements of both SSS algorithms with and without the scar specification during the searching performance and also compare number of images found as "similar" *(Results of analysis are discussed in Chapter Six)*

5.4.3 Limitations of Data Collection for the SSS Experiment

The photograph database is limited to 10,000 images but is repeatedly used in the experiment. It is time consuming to pre-measure each photographic image prior to the storage and retrieval, however, the author has improved the measuring time by using the Photoshop 6.0 software program as described in Chapter Four and Six.

5.4.4 Data Analysis in the SSS Experiment

The Self-Similarity Search was performed in order to analyze the image data that was collected from the field research. The permission to use some of the photographs that were used in this experiment was kindly granted by the Governor of Chachaengsao, and the Governor of Samutprakarn, but there was a need for confidentially and thus the photographs are not displayed in this thesis. The only photographs displayed in this thesis are those of the author's mother who consented to have her photograph used for this research.

5.4.5 Limitation of SSS Experiment

Some limitations need to be mentioned at this point of the study as these limitations help to understand and locate some of the experimental results in a more meaningful context as well as to help other researchers with the design of future diffusion experiments.

The face image is two dimensional as it has a vertical and horizontal dimension. All objects, and the object's correlations, have to be identified prior to their storage and retrieval. All 10,000 photographic images were measured using the software program Photoshop6.0 as detailed in Chapter Four. This process can be done much faster if the automatic conversion of face image, such as face pattern conversion software, is available. At the time of the experiment a PC PentiumIII 450MHz was used. All databases had been stored on the hard disk.

Another fact that needs to be mentioned is the conceptual limitation of the Self-Similarity Search experiment. It is time consuming to test the effectiveness of every retrieval method described in Chapter Four. Since the previous work of Satini and Jain (1996) and Porntrakoon and J.Nukoon (1999) suggested that the Self-Similarity Searching method could be used to retrieve a 2-dimension face, the author selected the Self-Similarity Searching method together with the Sequential Searching method, which is the commonly used image retrieving method in order to make an effective comparison.

5.5 QUESTIONNAIRE DESIGN

Phase two of this research is to determine the perception and attitudes of the Thai police to the use of information technology specifically the Self-Similarity Searching technique for criminal investigation. A questionnaire was designed and distributed to the police after the presentation of the image retrieval system for crime investigation. The purpose of the questionnaire was to determine the attitude and perception of the police inspectors towards the retrieval method as an effective tool for helping in suspect identification.

5.5.1 Technology Acceptance Models

A number of models were used as background information in designing the questionnaire are the Technology Acceptance Model (TAM), the Task-Technology Fit model (TTF), Model of PC Utilization (MPCU) and the Theory of Planned Behavior (TPB). TAM, TTF, MPCU and TPB provide a much needed theoretical basis for exploring the factors that explain software utilization and its link with user performance. These models offer a different, though, overlapping perspective on utilization behavior.

TAM focuses on attitudes toward using a particular IT component which users develop based on perceived usefulness and ease of use of the IT component (Davis et al. 1989, p.317). TTF focuses on the match between user tasks need and the available functionality of the IT component (Goodhue 1995, p.214). MPCU was adapted and refined from Trandis's model (1977) for IS contexts and used the model to predict PC utilization, however, the nature of the model makes it particularly suited to predict individual acceptance and use of range of information technologies (Thomson, Higgins & Howell 1991). TPB has been successfully applied to the understanding of individual acceptance and usage of many different technologies (Harrison et al. 1997; Mathiesone 1991; Taylor and Todd 1995b).

While each of these models offers significant explanatory power, a model that integrates constructs from these models may offer a significant improvement over either model alone (Dishaw et al. 1999, p.9). One such model is the Unified Theory of Acceptance and Use of Technology (UTAUT), which integrates information from several previously, established models (Venkatesh et al. 2003).

5.5.2 Arrangement of Questionnaires

The layout of the questionnaire was arranged with 1.5 line spacing between each question, so that it is easier for the participants to read. Sufficient space is provided for the respondents to write when an open-ended question is asked. There were 47 questions in the survey. The survey consists of four parts; a cover letter, a fact sheet about SSS, the main body of the questionnaire with questions 1-45 and space for comments at questions 46 and 47. Each question was carefully designed after consultation with the advisor and the statistics instructor to make sure that the questionnaire would gather the correct data and be able to answer the research questions.

The cover letter and instruction:

The cover letter is attached to the front of every questionnaire. The cover letter describes the purpose of the questionnaire to the participants and also assures the participants that their details will be kept confidential. Clear instructions on filling in each section of questionnaire are provided to the participants. They were also asked to answer every question by relying on their own knowledge and/or experience.

Fact sheet:

Since the subject of Self-Similarity Searching is totally new to the participants in this research, information sheets containing a brief summary about image retrieval and the Self-Similarity Searching for crime investigation were provided to participants to assist them in answering some of the question concerning the method.

Main body of the questionnaires:

The main body of the questionnaire was divided into four sections:

(1) Computer literacy, knowledge and skills of the participants

(2) Eyewitness identification methods and the use of IT in criminal investigation

(3) Attitudes and perceptions towards the use of IT, particularly the Self-Similarity Search method for crime investigation

(4) General comments

Section 1: Computer literacy, knowledge and skills (Questions 1-8)

The questions in this section were to provide background information on the level of computer usage, literacy and skills of the participants.

Section 2: Eyewitness identification and the use of IT in crime investigation (Questions 9-32)

The questions developed in this section were based on the various constructs depicted in the Task-Technology Fit model (TTF). For example in question 28, the participants were asked if they were comfortable with the idea of using an artist's sketch to locate a similar photograph from criminal databases. Model of PC Utilization (MPCU) with the emphasis on 'affect towards use' was used to guide and support the analysis of question 28.

Section 3: Attitudes and perceptions towards the use of IT and the Self-Similarity Search for crime investigation (Questions 33-45)

In this section the questions were guided by the Extended Technology Acceptance Model (TAM2), the Model of PC Utilization (MPCU), the Theory of Planned Behavior (TPB), the Task-Technology Fit (TTF) model and the Innovation Diffusion Theory (IDT). For example in question 43, the participants were asked if they would be willing to use a computer for image searching if the technology was provided to them. TAM2 was used to guide and support the analysis of this question.

Section 4: General Comments

The last section of the questionnaires contains two discussion questions that invite recommendations and comments on the general use of IT in police investigation for future research. It is in this part of the questionnaire that participants were encouraged to express their ideas regarding the research freely.

Measurement Scales:

Various formats of scaling are used to present items in this questionnaire. The first one is the forced choice format; it is used when responses can be easily categorized. "A forced choice format is a response format in which respondents must choose between discrete and mutually exclusive options" (Dane 1990, p.266). The following is an example of a question in this survey that used the forced choice scale format: Have you ever used a computer for crime investigation purposes? The answers provided for this question are:

[ ] Yes

[ ] No

The second format for scale items that is used in this questionnaire is the itemized format. The itemized format involves presenting a continuum of statements representing various choice options (Dane 1990, p.266). An example of a question in this questionnaire that used the itemized format is: How often do you use the computer at the police station? The answers provided are:

[ ] everyday

[ ] only when needed

[ ] never.

The last format scale item used in this questionnaire is the Likert scale or summative scale. Likert scales consist of items reflecting extreme positions on a continuum, items with which people are likely either to agree or disagree. The items are typically presented in a graphic format that includes endpoints labeled "agree" and "disagree". Dane (1990, p.272) suggested that for any one of the items, agree might be scored a "1" and disagree scored an "8". In this questionnaire, "Strongly agree" is score 1 and "Strongly disagree" is scored 5. The following question illustrates an example of the Likert scale format in this questionnaire: Self-Similarity Searching method is useful for crime investigation. The answers provided are:

(1) Strongly agree

(2) Agree

(3) Neutral

(4) Disagree

(5) Strongly disagree.

5.5.3 Pilot Test

A pilot test with two senior police officers was conducted after the questionnaire was translated from English to the Thai language. The reason translation was needed is because the focus participants are Thai and the Thai language is their official language. Conducting the survey in English would have caused confusion and misinterpretation. The pilot test was carried out to ensure that there were no inconsistencies or ambiguities in the questions. Feedback from the two senior police officers helped clarify some questions. The questionnaire was revised to incorporate the suggestions made by these senior police officials.

5.5.4 Participants

Participants in this research are purposive participants. They are Thai police officers from ten different police stations and are directly involved with crime investigation. For the purpose of comparative study the participants were classified into two groups; one group contains those who are computer literate and the other group is made up of those with no, or low computer literacy. *(Classification of participants is detailed in Chapter Seven)*

5.5.5 Collection and Sources of Data

This study uses multiple sources of data collection methods for the purpose of exploring the use and uptake of IT by the Thai government and how the proposed image retrieval method could enhance the police investigation when searching criminal records.

5.5.6 Limitations of the Questionnaires and Interview Technique

It is important that the use of a questionnaires and interview technique as a research methodology in this research is mentioned as a limitation to help fellow researchers understand and locate some of the survey findings in a more meaningful context. There are three categories of the limitations to this research: they are conceptual, methodological and data collection limitations.

5.5.6.1 Conceptual Limitations

There are two conceptual limitations in this study. First, the validity of the Self-Similarity Search presentation was assessed in only three provinces plus the capital city Bangkok, as a pilot study; however, the same method can be used in other police stations that have access to computers. Second, the current experiment and presentation does not include the graphical user interface (GUI) in Self-Similarity Searching, so the additional GUI to SSS would improve effectiveness in the real work.

5.5.6.2 Methodological Limitations

There are two main methodological limitations related to this study; the data collection techniques, and the image retrieval methods. First, the sources of data are very limited, because some of the data is in the Thai language and also reserved for the Thai government use only. There is very limited literature on police investigation research in Thailand, however, an in depth interview method was conducted in order to bridge the gap between the theory and the practice.

5.5.6.3 *Data Collection Limitations*

There are two main areas of data collection limitations. First, the data collected from the questionnaires was compiled and later follow up meetings were held with a limited number of the interviewees.The meetings were scheduled to suit the time preferences of individual police officers and hence not all officers were available for this follow up session. Nevertheless, care was taken to see that the key people who were directly involved in the decision making process were interviewed.

Taking into consideration the fact that the power point presentations and the distribution of questionnaires is a time consuming process, as well as the fact that the police stations were located far apart from each other, it was only possible to cover 10 police stations within the given time frame of the project. The choice of police stations was further limited because numerous police stations had no access to a computer and hence had no computerized records.

The second limitation of the data collection was the photographic images used in this project had to be obtained from two different sources. However, most of the photographic images of the citizens in Sumutprakarn and Chachengsao province were by courtesy of the governor with the condition that the images must not be displayed in the thesis. The other photographs were obtained from volunteers during the image collection visits to the Office of District Administration.

5.5.7 Data Analysis

Mendenhall (1999, p.701) stated that how we analyze our data depends on our research hypotheses and the types of measurement scales we use. He recommended three general types of analyses appropriate for survey or questionnaires data; description, association and elaboration. Data analyses used for surveys depend on the purpose of the research and the type of data collected. Mendenhall further recommended that summary statistics are the most appropriated for descriptive purposes.

The data from the questionnaires can be analyzed in many different ways by classifying the participants into different groups based on their answers to section 1 of the questionnaire. For example, different groupings may include the police stations they are based at, computer skills, years of using a computer and rank in the police force. However, for the purpose of this research, the analysis was based on the participants' computer literacy. The reason computer literacy was chosen is because it is a major variable in both Technology Acceptance Model (TAM) and Task-Technology Fit (TTF) model.

5.5.7.1 Statistic Analysis (SPSS)

The data from the questionnaire was analyzed using the SPSS software program version 11.0. SPSS (Statistical Package for the Social Sciences) is one of the most widely available and powerful statistical software packages. It covers a broad range of statistical procedures that allow researcher to summarize data (e.g., compute means and standard deviations), determine whether there are significant differences between groups (e.g., t-tests, analysis of variance), examine relationships among variables (e.g., correlation, multiple regression), and graph results (e.g., bar charts, line graphs) (Einstein 2000)

According to Gillham (2000, p.27) "by using a statistical test to check impressions (whichever way it goes) we can extract more meaning from what we have found". It may be that we have uncovered a difference that requires further research, discussion or analysis, in particular the reason why this difference exists. Table 5.1 outlines the analytical plan for the questionnaires collected.

Table 5.1: Analytical Plan

Question #	Statistics Analyses	Purposes
All Questions	Descriptive analysis Frequency analysis	Summarizing information about the distribution, variable, and central tendency of variable
Q1,6,7,38, 39,40,41,43	T-test analysis	Testing a hypothesis about a single mean and two independent means
Q1, 2, 6, 7	Crosstab	Comparing cases
Q1, 2, 6, 7	Chi-Square tests	Comparing observed and expected counts

5.6 INTERVIEW DESIGN

Interviewing as a research method can be seen from two perspectives, conducting the interview, and interpreting the interview (Scheurich 1995, p. 239). Gillham (2000, p.1) described the interview as a conversation, usually between two people. But it is a conversation where one person--the interviewer--is seeking responses for a particular purpose from the other person: the interviewee. He also stated that the form and style of an interview is determined by its purpose. Therefore, in this study, the research interview is conducted to obtain information and understanding of issues relevant to the general aims and specific questions of a research project. Interview approaches were used in the preliminary stage of this research and at the end of Phase II.

5.6.1 Preliminary Interview

The preliminary interviews for this research were conducted early in this study in order to evaluate the potential of the research direction and also to ensure that resources could be accessed throughout the study. Support as well as future assistance and cooperation from the Thai government was crucial for this particular research.

Semi-structured, open-ended interviews were conducted with senior government officers. One of the main preliminary interviews was with the Director of Registration Administration Bureau, Department of Local Administration who leads the largest national level project 'Population Registration' (PPR) in Thailand. He is a man with a vision who received the 'Government and Non-Profit Organization Computer World Smithsonian Award, 1990' for 'the Visionary use of Information Technology'.

Other interviewees include the Governor and the Head District Officer of Chachoengsao Province, a Director of Management Information Technology at Mahidol University and a Senior IT Consultant of Sun Microsystems Ltd., Thailand who is closely involved with most of the Thai Government Projects. They identified that while the government had a strong IT strategy that it was committed to, there was still reluctance in many of the government departments to fully utilize the technological infrastructure that had been provided for them. These interviews also highlighted the current problem of many crimes in Thailand going unsolved because of the current methods of witness identification. Based on this information it was decided that the Royal Thai Police would greatly benefit from an image retrieval system that improved their current method of witness identification.

5.6.2 Phase II Follow up Interviews

After the presentation on the Self-Similarity Search and the completion of the questionnaire by the participating police, follow up interviews were conducted. The purpose of these interviews was to gain clarification and add richer meaning to the result of the questionnaires.

5.7 CONCLUSION

This chapter has described the overall research methodologies used in this study. Numerous activities such as the sources of data collection, research techniques, development of the interview instrument, the treatment of data and the limitations of the research were outlined. Furthermore, this study emphasized the use of primary sources of data obtained through both personal and group interviews together with the document analysis. The interview technique was used twice in this particular research.

First it was used at the beginning of the research as a guideline for the study direction and to establish a connection between the source and the author for future cooperation, after an extensive literature review had been performed. The second time, it was used to evaluate the effectiveness of the image retrieval method that was proposed in Chapter Four.

The treatment for the image data collected was also briefly described as full details have already been discussed in Chapter Six. The results of the interview research and the experiment research, which is the implementation of the Self-Similarity Search, are assessed both analytically and synergistically in Chapter Seven. The comparisons of the

Self-Similarity Searching method and Sequential Searching method in the image search for crime investigation is provided in the synthesis of the study findings, which is presented in Chapter Eight.

CHAPTER SIX
EXPERIMENTAL RESULTS AND DISCUSSION

6.1 INTRODUCTION

In this chapter the results of the two sets of experiments based on the models introduced, developed and discussed in Chapter Four are presented. This allows an evaluation and comparison of the system in a controlled environment. The first set of experiments is a comparison of the effectiveness between Sequential Search and Self-Similarity Search methods based on the parameters described in Chapter Four. A second set of experiments is based on the algorithm that was developed by the author from the previous research (Srisarkun & Jittawiriyanukoon 2002). It is a comparison of the effectiveness of the Self-Similarity method with scar specification and the Self-Similarity method without the scar specification.

Porntrakoon and J.Nukoon (1999); Satini and Jain (1996) believed that the Self-Similarity Searching method is more effective than the Sequential Searching method when used to retrieve an image from the database. Therefore the first series of the experiment is designed to prove that statement. The second series is conducted in order to prove the effectiveness of the Self-Similarity Searching method as claimed by Portrakoon and J.Nukoon (1999). However, in this particular research the original algorithm was developed further with the addition of the scar attribute. Results and analysis are discussed at the end of the chapter. Figure 6.1 outlines the series of experiments.

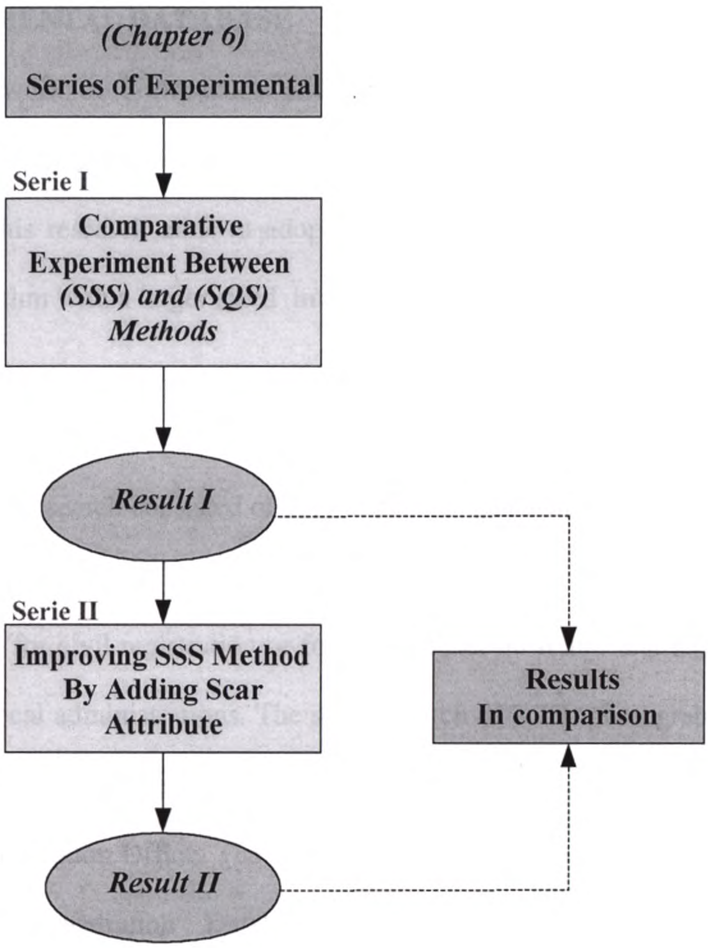

Figure 6.1: Outline of Experimental Series

A part of this chapter appeared in the Proceedings of the sixth INFORMS Conference on Information Systems and Technology 2001, the Proceedings of the twentieth IASTED International Conference on Applied Informatics 2001, the Proceedings of the tenth European Conference on Information Systems (ECIS'02), the Proceedings of fourth EURASIP-IEEE Region 8 International Symposium on Video Processing and Multimedia Communications (VIPromCom-2002).

6.2 EXPERIMENTAL DATABASE

The original work of Porntrakoon and J.Nukoon (1999) was tested on a database consisting of 100 images only, which is not enough to arrive at a substantive conclusion. This research aims to adopt and test Porntrakoon and J.Nukoon's (1999) original algorithm with a larger sized image database of 10,000 images.

The databases used for testing both the Self-Similarity and Sequential Searching methods in this research consisted of 10,000 photographic images obtained from several different sources. The first 3, 500 photographic images were taken from volunteers who came to apply for civil registration or for the issue of birth and marriage certificates at six different local administrations. The second batch of 2,750 photographic images was obtained from the Chachoengsao Registration Database, courtesy of the Chachengsao District Administration Office. The third batch of 2,450 images was obtained from the Samutprakarn Registration Database, courtesy of the Samutprakarn District Administration Office. In addition 1,300 photograph images were taken of student volunteers from three different high schools and universities in Chachoengsao Province.

6.2.1 Treatment of Image Data

Following the protocol given by Porntrakoon and J.Nukoon (1999); prior to the experiment each of the 10,000 photographic images are scanned by selecting 8 bit-monochrome-scale (e.g., 256 monochrome scale levels) with 90*120 pixels. They are then enlarged to six times their original size and converted into objects and object numbers. The attribute values of each object and object number are then identified and stored in the database. The following steps are used to identify the objects, object numbers, and attribute values:

1) There are ten objects in each face image; Face Center, Right Eyebrow, Left Eyebrow, Right Eye, Left Eye, Right Ear, Left Ear, Nose, Mouth, and Birthmark or Scar as illustrated in Figure 6.2.

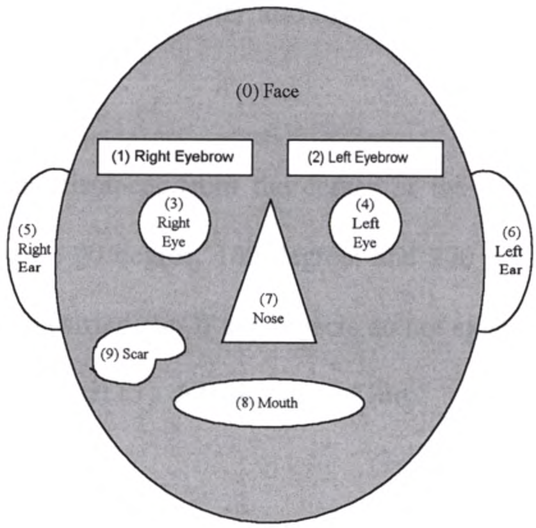

Figure 6.2: The face objects

2) The center of each object is then identified as shown in Figure 6.3

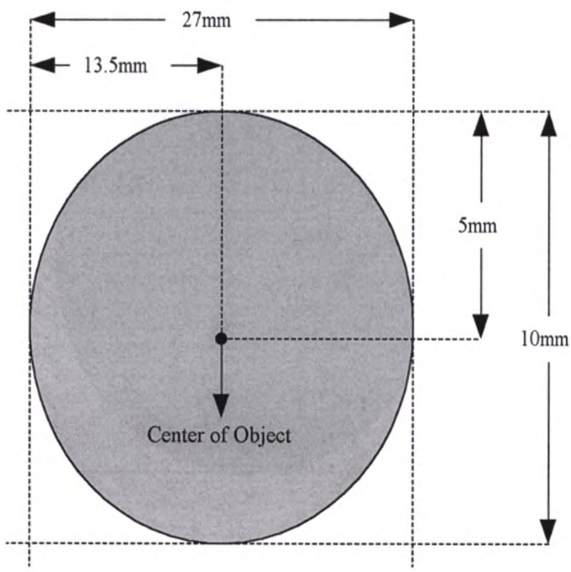

Figure 6.3: The location of object center and distance measurement in millimeter

3) For each object, the distances from the center of the object to the object were measured at 0 degree; 90 degree, 180 degree; and 270 degree angles. Figure 6.4 illustrates how this is carried out. If any objects do not exist in the face image, these attribute values are then set to a default value of zero.

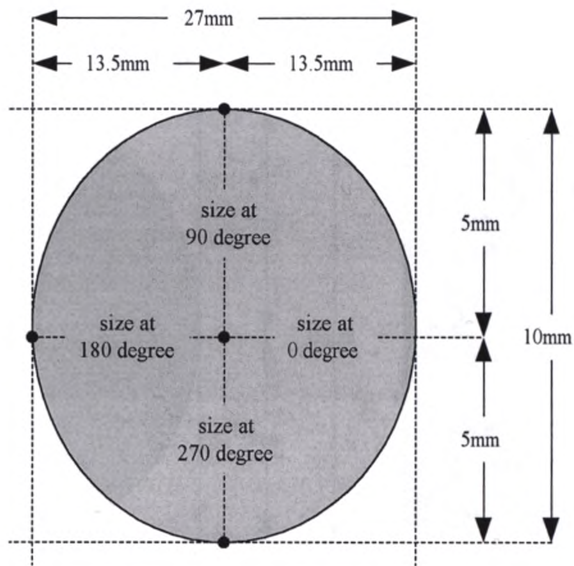

Figure 6.4 : Measurement of distance at different angles

Source: (Adapted from Porntrakoon & J.Nukoon 1999)

4) There are 9 object numbers in each face image, each of which has a reference object: face Center towards right eyebrow; face center towards left eyebrow; face center towards right eye; face center towards left eye; face center towards right ear; face center towards left ear; face center towards nose; face center towards mouth; and face center towards scar. Figure 6.5 shows how the photograph of the face is linked to the measures of object distances.

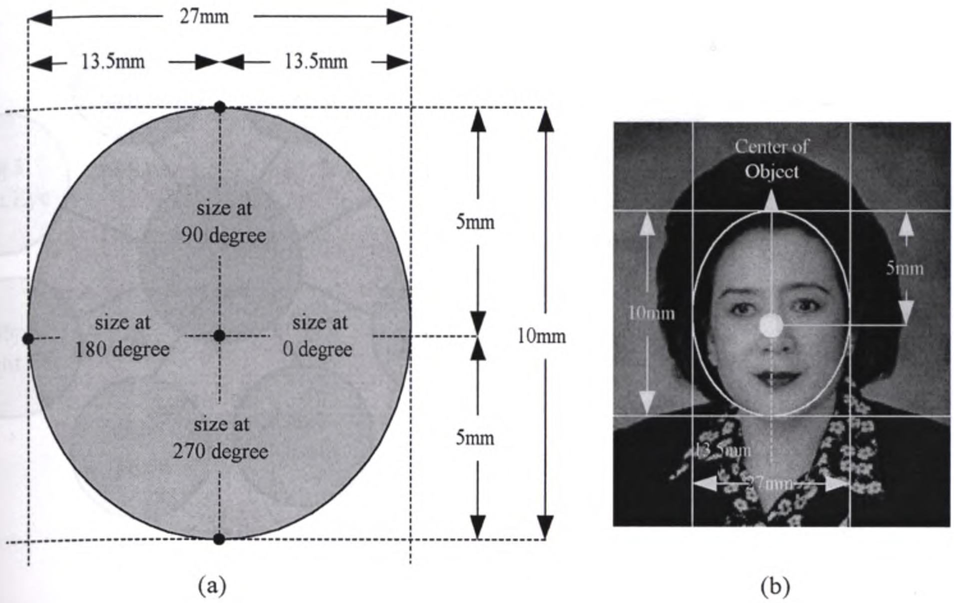

Figure 6.5: (a) Measurement of distances of object from center of face to object center at different angles (b) Example of face measurement

Source: (Srisarkun, Cooper & Jittawiriyanukoon 2002)

5) After each attribute of each object is identified, the distance between two objects is measured in millimeters from the centers of these two objects. The angles between the two objects are measured in the horizontal direction of the line connecting these two object centers as shown in Figure 6.6. If any object does not exist in the face image, these attribute values are set to zero e.g., scar.

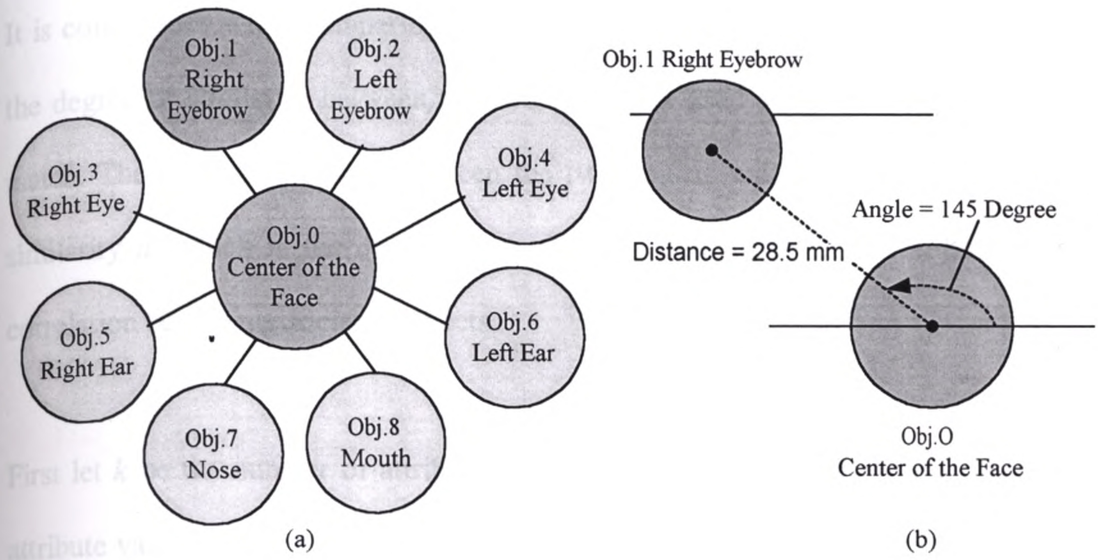

Figure 6.6: (a) Object correlation (b) Object correlation measurement
Source: (Adapted from Porntrakoon & J.Nukoon 1999)

6) All contents of the image are then stored in the database, as shown in Figure 6.7

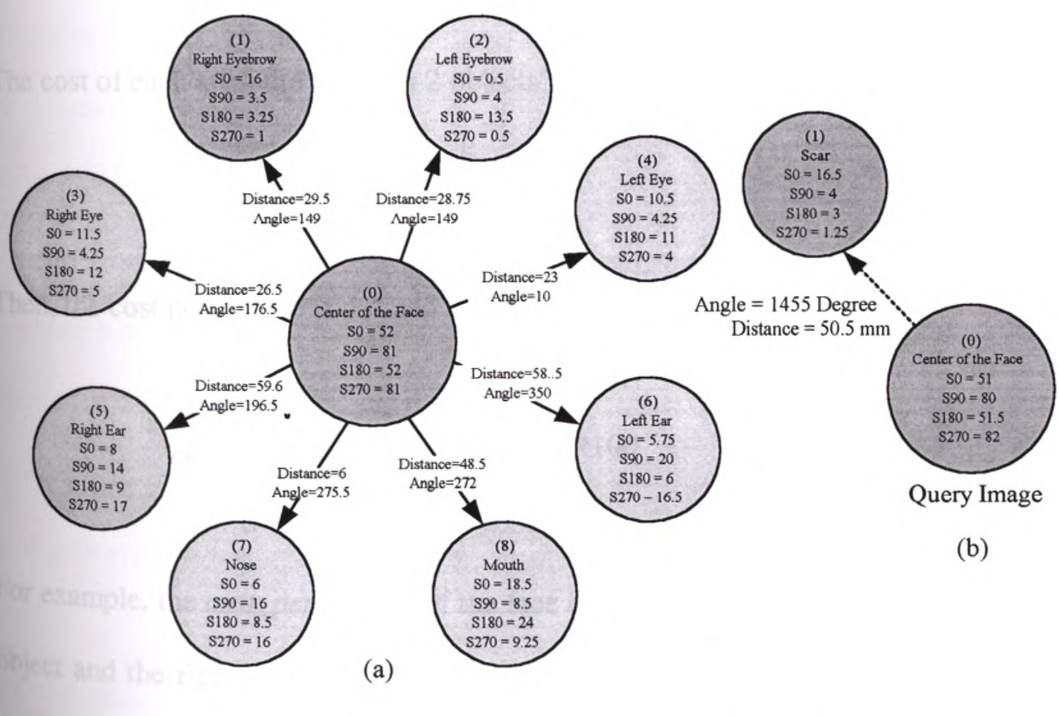

Figure 6.7: (a) Data contents of a stored image
(b) Example of data contents of a key image
Source: (Adapted from Portrakoon & J.Nukoon 1999)

It is compulsory when comparing the key image with each image in the database, that the degree of similarity between the two images is used as a measurement of a good match. The cost of matching between the two objects will be defined as a degree of similarity *d*, which is the cost percentage of a good match of the objects or object correlation between associated objects.

First let ***k*** be the number of attributes of an object or object correlation. Then ***q*** is an attribute value of the object of the key image and ***r*** is an attribute value of the object of the stored image. The absolute values of ***q*** and ***r*** are computed as follows:

$$q_i = |q_i| \text{ and} \tag{1}$$

$$r_i = |r_i| \tag{2}$$

where $i = 0, 1, 2, \dots, k\text{-}1$

The cost of each attribute between 2 objects is defined as:

$$cost = |q_i - r_i| \tag{3}$$

where $i = 0, 1, 2, \dots, k\text{-}1$

Then, the cost percentage is defined as:

$$cost\_percentage = \frac{|q_i - r_i|}{\max(q, r)} * 100 \tag{4}$$

For example, the *cost_percentage* of the face object and object correlation between face object and the right eyebrow of an image, as shown in Figure 6.7 (b), is computed as follows:

❖ Size at 0 degree :

$$\frac{|51-52|}{52} * 100$$

$cost\_percentage$ = (5)

Therefore, Similarity size at 0 degree = 1.92 %

- Size at 90 degree:

$$\text{cost\_percentage} = \frac{[80-81]*100}{81}$$

Therefore, Similarly size at 90 degree = 1.23 %

- Size at 180 degree :

$$\text{cost\_percentage} = \frac{[51.5-52]*100}{52}$$

Therefore, Similarity size at 180 degree = 0.96 %

- Size at 270 degree:

$$\text{cost\_percentage} = \frac{[82-81]*100}{81}$$

Therefore, Similarity size at 270 degree = 1.22 %

- Distance = 4.84 %
- Angle = 0.67 %

Similarity searching in the database of stored images requires that all images within the pre-specified degree of similarity d must be retrieved. That is, all the images with the following condition are retrieved.

$$cost\_percentage \leq d \qquad (6)$$

In comparison with Sequential Searching, Similarity Searching will retrieve similar images from the database with a faster search time. The similarity of the output images depends on the degree of similarity. The lower the degree of similarity specified, the more the output image would resemble the key image. However, in Sequential Searching, it takes a longer time to find the similar images in the database.

6.2.2 Query By Example

In query by example, users select an image, or draw a sketch, that reminds them in some way of the image they want to retrieve. Images, which show similar attribute to the key image example with respect to the criteria, mentioned in section 6.2.1 are retrieved and presented. In a typical matching application, we expect a comparison to be successful for images very close to the query and unsuccessful for images, which are different from the query. The degree of similarity of images different from the query is of no interest to us as long as it remains below a suitable acceptance threshold. On the other hand, database applications require a similarity measure that will accurately predict perceptual similarity for all images 'reasonably' similar to the query. Figure 6.8 demonstrate matching operation, stored images are compared with the query or key image, and then only images that show similar attribute to the key image with respect to the criteria specified by the user are retrieved and presented.

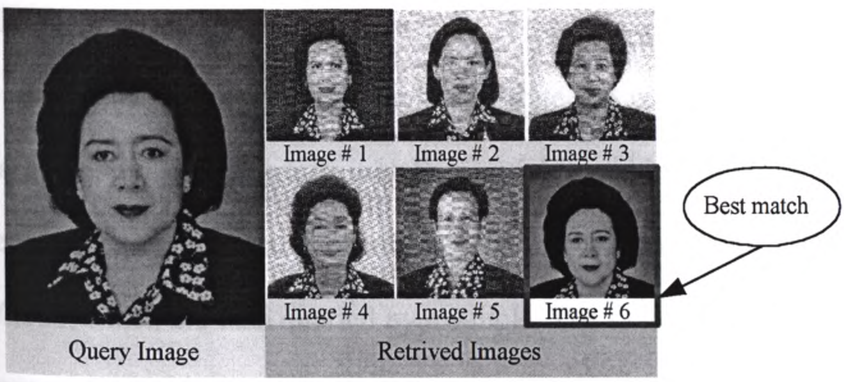

Figure 6.8: Demonstration of query by example

In this research, a query program written in C language is implemented in order to check the efficiency of the proposed method. A sample of up to 10,000 face images from different sources was obtained as explained at section 6.2. However, large databases of face images are too complicated to identify attributes, object correlation and so on. The software that automatically converts the face image into the data is currently being developed.

In this particular research, a PentiumIII 450MHz PC is used for the experiment. All databases are stored on the hard disk. The experiments were divided into several groups with a different number of images stored in the database; 1,000, 2,000, 3,000, 4,000, 5,000, 6,000, 7,000, 8,000, 9,000 and 10,000. For each group of comparisons five images in the database with cost = 0% or with a positive correlation ($0<H<0.5$) are randomly used for computing the average time of Sequential Searching and Similarity Searching. The algorithms of both searching methods used in this experiment are shown in Appendix D.

6.3 EXPERIMENT I

The main goal of the first experiment is to illustrate the performance gains by using Self-Similarity Search in comparison with Sequential Searching methods. In this set, we use different databases consisting of varying number of stored images ranging from 1,000 to 10,000, which are then queried by example. The search is performed five times and an average search time in each group is calculated as shown in Table 6.2. The following steps are undertaken in Experiment I:

Step 1: Begin the search with a database of 100 images

Step 2: Five trials of each algorithm recording response time by system clock are conducted

Step 3: Calculate the average of the response time of five trials for each searching method

Step 4: Increase size of database by 100

Step 5: Repeat steps 2 to 4 until database reaches 10,000 images *(Result of all of these trials can be found in Appendix D)*

Step 6: Compare and analyze average response times of the two searching methods as the database increased in size

Step 7: Compare space requirements of both SSS and SQS algorithms during the searching performance

6.3.1 Result and Analysis of Experiment I

The results of experiment I endorse the work of Porntrakoon (1999). It is proven that the Self-Similarity Searching method is faster than the Sequential Searching method as claimed by Santini (1996) and Porntrakoon (1999). The following table 6.1 summarizes average search times from each category in experiment I. *(A full trial record of Experiment I can be found in Appendix D, on page 258)*

Table 6.1: Average Search Time of the SSS in comparison with the SQS

Images = 100

TRIAL	1st	2nd	3rd	4th	5th	Average
Sequential Search	4.20	4.21	4.21	4.19	4.21	4.20
Self-Similarity Search	0.63	0.61	0.62	0.62	0.62	0.62

Images = 1,000

TRIAL	1st	2nd	3rd	4th	5th	Average
Sequential Search	41.65	41.63	41.63	41.59	41.60	41.62
Self-Similarity Search	6.09	6.11	6.09	6.06	6.06	6.08

Images = 2,000

TRIAL	1st	2^{nd}	3^{rd}	4^{th}	5th	Average
Sequential Search	83.62	83.64	83.62	83.58	83.59	83.61
Self-Similarity Search	12.33	12.35	12.37	12.35	12.40	12.36

Images = 3,000

TRIAL	1st	2^{nd}	3^{rd}	4^{th}	5th	Average
Sequential Search	125.61	125.59	125.63	125.63	125.64	125.62
Self-Similarity Search	18.49	18.51	18.50	18.51	18.54	18.51

Images = 4,000

TRIAL	1st	2^{nd}	3^{rd}	4^{th}	5th	Average
Sequential Search	167.52	167.56	167.59	167.64	167.59	167.58
Self-Similarity Search	24.77	24.79	24.75	24.72	24.69	24.74

Images = 5,000

TRIAL	1^{st}	2^{nd}	3^{rd}	4^{th}	5th	Average
Sequential Search	209	211.5	208	210	209	209.5
Self-Similarity Search	30.92	30.89	30.85	30.85	30.89	30.88

Images = 6,000

TRIAL	1st	2^{nd}	3^{rd}	4^{th}	5th	Average
Sequential Search	251.62	251.60	251.58	251.57	251.58	251.59
Self-Similarity Search	37.11	37.13	37.10	37.11	37.15	37.12

Images = 7,000

TRIAL	1st	2^{nd}	3^{rd}	4^{th}	5th	Average
Sequential Search	293.64	293.61	293.63	293.60	293.63	293.62
Self-Similarity Search	43.31	43.31	43.35	43.37	43.33	43.33

Images = 8,000

TRIAL	1st	2^{nd}	3^{rd}	4^{th}	5th	Average
Sequential Search	335.61	335.61	335.63	335.65	335.65	335.63
Self-Similarity Search	49.55	49.55	49.56	49.55	49.55	49.55

Images = 9,000

TRIAL	1st	2^{nd}	3^{rd}	4^{th}	5th	Average
Sequential Search	377.60	377.59	377.60	377.60	377.61	377.60
Self-Similarity Search	55.72	55.71	55.71	55.71	55.71	55.71

Image = 10,000

TRIAL	1^{st}	2^{nd}	3^{rd}	4^{th}	5th	Average
Sequential Search	423	416	412	418	423	419
Similarity Search	58	61	64	66	61	62

Figure 6.9 indicates the average response time using both Sequential Search and Self-Similarity Search with a different number of face images in the database. As can be seen, the response time for both the Sequential Search and Self-Similarity Search depends on the total number of images. However with the Self-Similarity Search, the

response time gradually increases compared with the values for the Sequential Search. The response time gain of Self-Similarity Search over Sequential Search with images from 100 up to 10,000 can be defined as follow:

$$y_{seq} = 4.20x \quad (8)$$

$$y_{sim} = 0.62x \quad (9)$$

$$\text{Gain} = 4.20/\ 0.62 = 6.8 \quad (10)$$

It can be said that the gain of Self-Similarity Search time is almost seven times that of Sequential Search time.

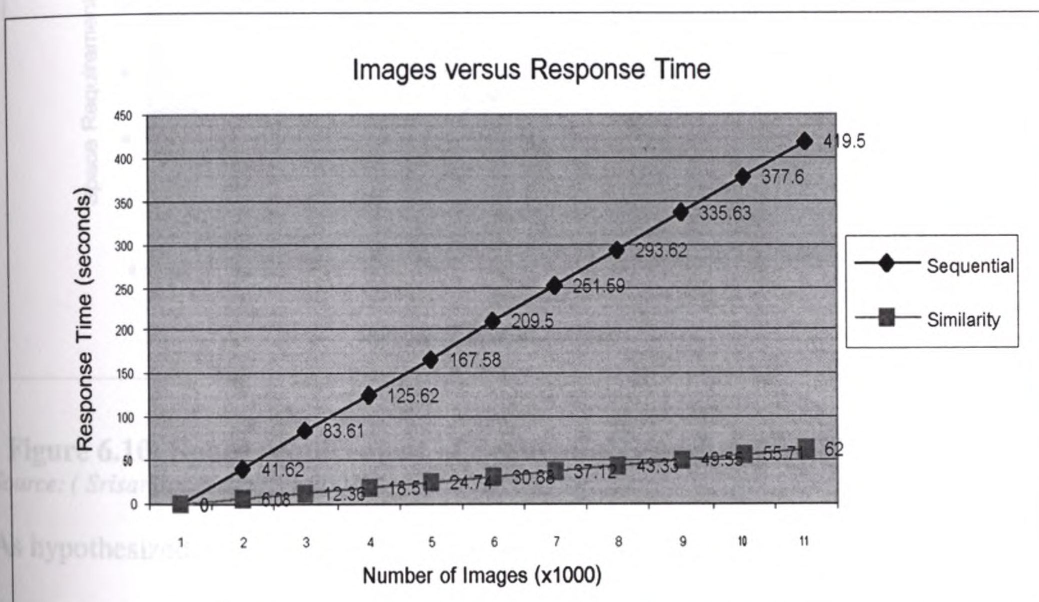

Figure 6.9: Response time of Sequential Search versus Similarity Search
Source: (Srisarkun & Cooper 2002)

Figure 6.10 indicates the space required for the Sequential Search and Self-Similarity Search with 100 different images in the database. It shows that the Sequential Search requires much larger space to store those images while the Self-Similarity Search requires less space. The space gain of Self-Similarity Search over Sequential Search with images from 100 up to 10,000 can be defined as follow:

$$y_{seq} = 105.5x \tag{11}$$

$$y_{sim} = 2.6x \tag{12}$$

$$\text{Gain} = 105.5/\ 2.6 = 40.6 \tag{13}$$

It can be said that the space gain by performing the Self-Similarity Search is forty-one times that of the Sequential Search

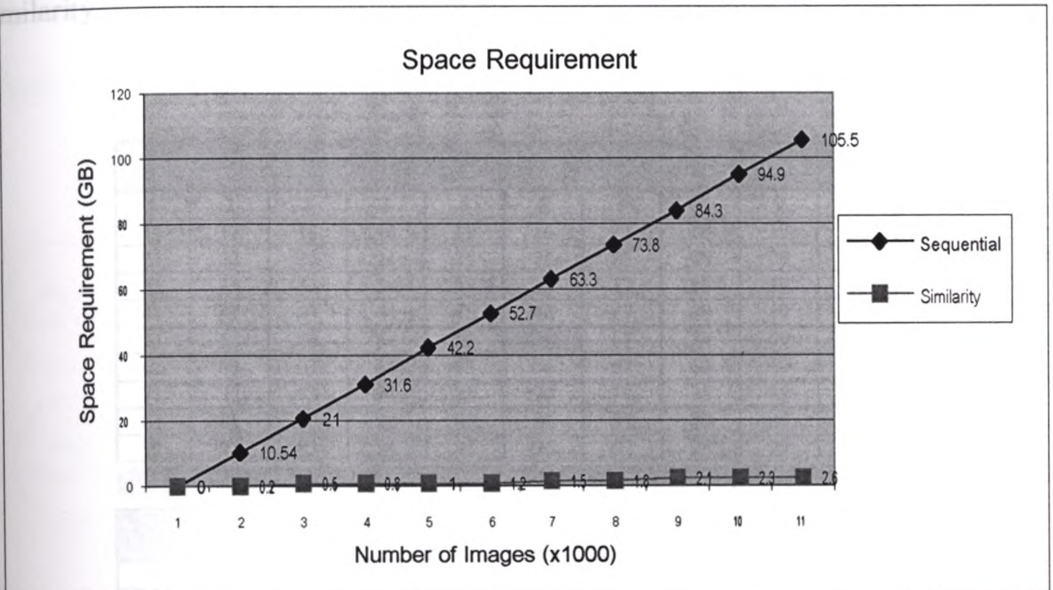

Figure 6.10: Space requirement of Sequential Search versus Similarity Search
Source: (Srisarkun & Cooper 2002)

As hypothesized, the results from the first set of experiments showed that the Similarity Searching method is faster than Sequential Searching and requires less storage space. The next set of experiments is then performed using the same procedures and methods as the first set, only this time the refinements of attributes for some objects is focused in order to find images in the database bearing a greater degree of similarity to the key image. Moreover, we need to know how much storage space and time gain is achieved when the given attribute is defined.

6.3.1.1 Effectiveness Analysis

The effectiveness of the Self-Similarity Searching method is analyzed by query the face image database using the same key image for both Sequential Searching and Similarity Searching. Ten thousand face images are stored into the database. A random image is selected to be the key image and query the database with zero percent of the degree of similarity.

Sequential Searching : Image 56.SQS									
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
Number of Image = 1					Searching Time = 4.20 Seconds				

Similarity Searching : Image 56.SSS									
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
Number of Image = 1					Searching Time = 0.62 Seconds				

Figure 6.11: Effective Analysis of SQS and SSS

With reference to the results illustrated in figures 6.11, it can be seen that when the degree of similarity is 0%, the Self-Similarity Searching method provides the same results as the Sequential Searching method. However, it is almost 7 times faster than the Sequential Searching method. These experiment results prove the effectiveness of the Self-Similarity Searching method when applied to the face image database.

6.4 EXPERIMENT II

The second set of the experiments focuses particularly on cases with scars, this experiment is carried out to see whether the response time decreases and the space requirement increases when an additional attribute is specified. To do this the SSS algorithm was adapted to improve the search. If no scar is matched then the rest of object matching will be skipped. However, if the presence of the scar is detected then Figure 6.10 illustrates the way this attribute is introduced.

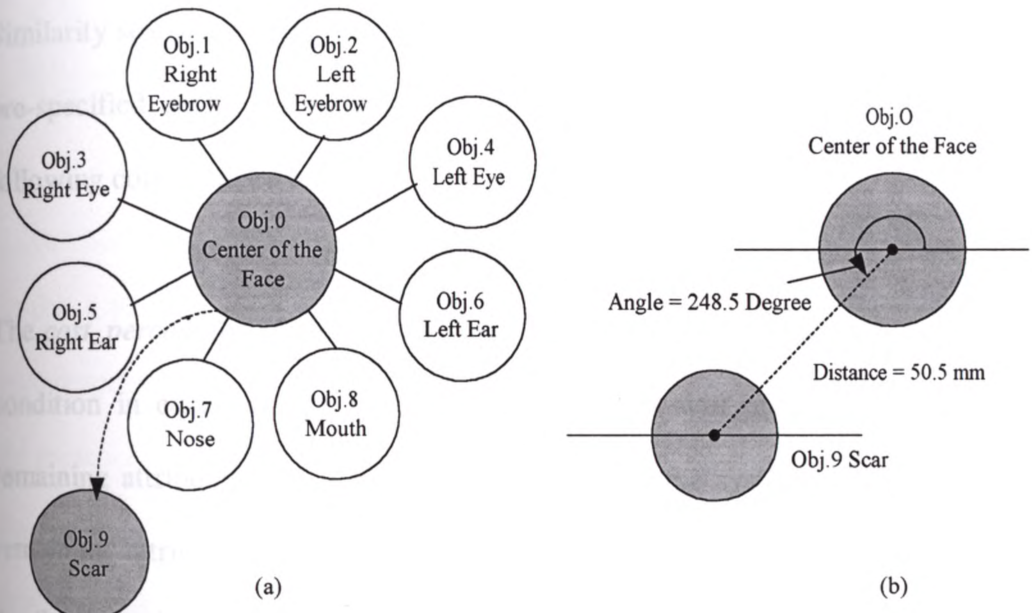

Figure 6.12: (a) Object angle
(b) Object angles measurement with a scar specification
Source: (Srisarkun & Cooper 2002)

In this case let k be the number of attributes (in case of scar k = 9) of an object or object correlation. Let q be an attribute value of the object of the key image and r is an attribute value of the object of stored images as shown in Figure 6.11 (b). The absolute values of q and r are computed as follows:

$$q_i = |q_i| \text{ and} \quad (1)$$

$$r_i = |r_i| \quad (2)$$

where $i = 0, 1, 2, \ldots, k\text{-}1$

The cost of each attribute between 2 objects is defined as:

$$cost = | q_i - r_i | \tag{3}$$

where $i = 0, 1, 2, \ldots, k\text{-}1$

Then, the cost percentage is defined as:

$$cost\_percentage = \frac{|q_i - r_i|}{\max(q, r)} * 100 \tag{4}$$

Similarity searching in the database of stored images requires that all images within the pre-specified degree of similarity d must be retrieved. That is, all images with the following condition are retrieved.

$$cost\_percentage \leq d \tag{5}$$

The *cost_percentage* of the scar attribute ($k = 9$) will be the first to be computed. If the condition in equation.5 is **TRUE** then the system will proceed to check the other remaining attributes. But if it is **NEGATIVE** then the system will skip checking the remaining attributes, marking "**NO MATCH**" and immediately move on to check another stored image. Figure 6.12 illustrates the data contents of a stored image and a query image where both show the presence of scars.

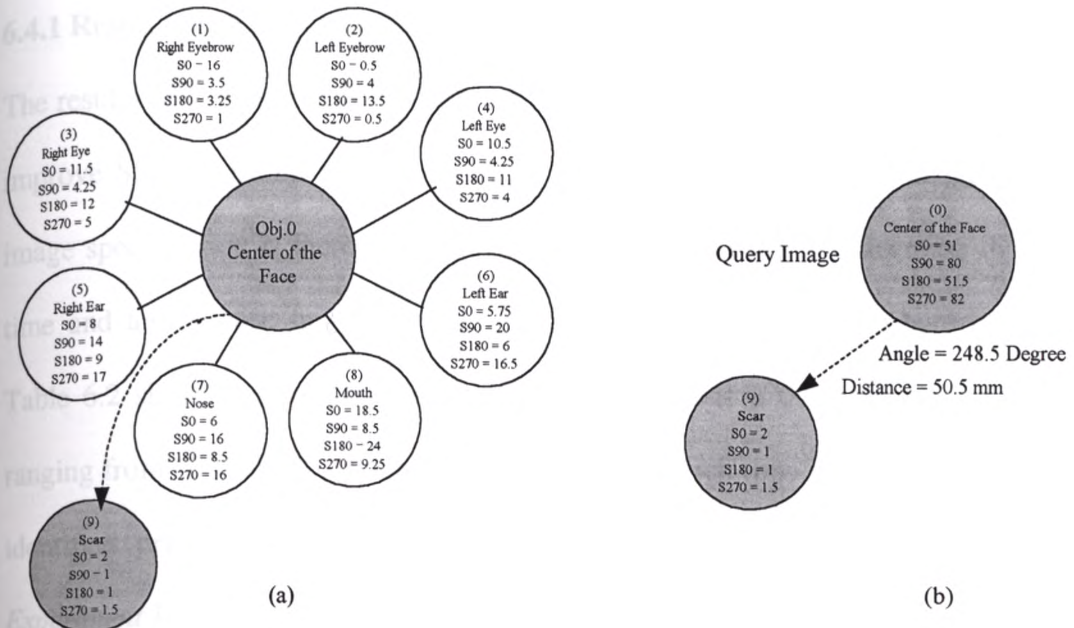

Figure 6.13: (a) Data contents of a stored image with scar
(b) Example of data content of a query image with scar

Source: (Srisarkun & Cooper 2002)

To check the efficiency of the proposed method, the sample of 10,000 face images that were scanned in experiment I are employed again. This time only face images that show the presence of the scar are considered. The attribute value of the scar and scar number are identified and entered into the database (refer to section 6.2.1 for object conversion procedure. As in experiment I this experiment is divided into several groups with a different number of images stored in the database; 1,000, 2,000, 3,000, 4,000, 5,000, 6,000, 7,000, 8,000, 9,000 and 10,000.

For each category, as specified in the next section, five images from the database with cost ranging from 0% to 10% are randomly used for computing the average search time of Similarity Searching with and without a scar specification.

6.4.1 Result and Analysis of Experiment II

The results of experiment II confirm the author's original hypothesis that the use of the improve SSS algorithm would produce a smaller number of output images when the image specification is increased. They also proved that there is a decrease in response time and an increase in space requirement when an additional attribute is specified. Table 6.2 shows average search time when tolerance is = 0% and image database is ranging from 100-10,000; it demonstrates how the search time is improved when scar is identified prior to the retrieval. *(Full record of trial from 100-10,000 images in Experiment II can be seen in Appendix D, on page270)*

Table 6.2: Average Search Time of SSS with and without Scar in Comparison

Images = 100

TRIAL	1st	2nd	3rd	4th	5th	Average
Self-Similarity Search	0.63	0.61	0.62	0.62	0.62	0.62
SSS with SCAR	0.066	0.065	0.064	0.065	0.065	0.065

Images = 1,000

TRIAL	1st	2nd	3rd	4th	5th	Average
Self-Similarity Search	6.09	6.11	6.09	6.06	6.06	6.08
SSS with SCAR	0.07	0.08	0.07	0.04	0.04	0.06

Images = 2,000

TRIAL	1st	2nd	3rd	4th	5th	Average
Self-Similarity Search	12.33	12.35	12.37	12.35	12.40	12.36
SSS with SCAR	0.128	0.126	0.12	0.112	0.114	0.12

Images = 3,000

TRIAL	1st	2nd	3rd	4th	5th	Average
Self-Similarity Search	18.49	18.51	18.50	18.51	18.54	18.51
SSS with SCAR	0.184	0.185	0.185	0.185	0.184	0.185

Images = 4,000

TRIAL	1st	2nd	3rd	4th	5th	Average
Self-Similarity Search	24.77	24.79	24.75	24.72	24.69	24.74
SSS with SCAR	0.247	0.247	0.247	0.246	0.246	0.246

Image = 5,000

TRIAL	1st	2nd	3rd	4th	5th	Average
Self-Similarity Search	30.92	30.89	30.85	30.85	30.89	30.88
SSS with SCAR	0.3	0.3	0.3	0.3	0.3	0.3

Images = 6,000

TRIAL	1st	2nd	3rd	4th	5th	Average
Self-Similarity Search	37.11	37.13	37.10	37.11	37.15	37.12
SSS with SCAR	0.37	0.37	0.37	0.37	0.37	0.37

Images = 7,000

TRIAL	1st	2nd	3rd	4^{th}	5th	Average
Self-Similarity Search	43.31	43.31	43.35	43.37	43.33	43.33
SSS with SCAR	0.43	0.43	0.43	0.43	0.43	0.43

Images = 8,000

TRIAL	1st	2nd	3rd	4^{th}	5th	Average
Self-Similarity Search	49.55	49.55	49.56	49.55	49.55	49.55
SSS with SCAR	0.495	0.495	0.495	0.495	0.495	0.495

Images = 9,000

TRIAL	1st	2nd	3rd	4^{th}	5th	Average
Self-Similarity Search	55.72	55.71	55.71	55.71	55.71	55.71
SSS with SCAR	0.557	0.556	0.555	0.555	0.553	0.555

Images = 10,000

TRIAL	1st	2nd	3rd	4^{th}	5th	Average
Self-Similarity Search	62.02	62.01	62	62	62	62
SSS with SCAR	0.62	0.63	0.63	0.62	0.62	0.62

Figure 6.14 indicates the average response time between Self-Similarity Search with and without scar specification with a different number of face images in the database by using the query samples. As depicted in figure 6.14, the response time for both the Self-Similarity Searches with and without scar specifications depends on the total number of images involved. Results indicate that Self-Similarity Search with a scar definition will dramatically improve the performance of the search as compared to the Self-Similarity Search without the scar specification. The response time gain of Self-Similarity Search with additional scar attribute over Self-Similarity Search without scar attribute when performed on databases with images ranging from 100 to 10,000 can be defined as follows:

$$y_{sim} = 0.62x \tag{14}$$

$$y_{scar} = 0.065x \tag{15}$$

$$\text{Gain} = 0.62/\ 0.065 = 9.5 \quad (16)$$

It can be said that the time gain of Self-Similarity Searching with scar specification is approximately ten times that of the one without the additional attribute.

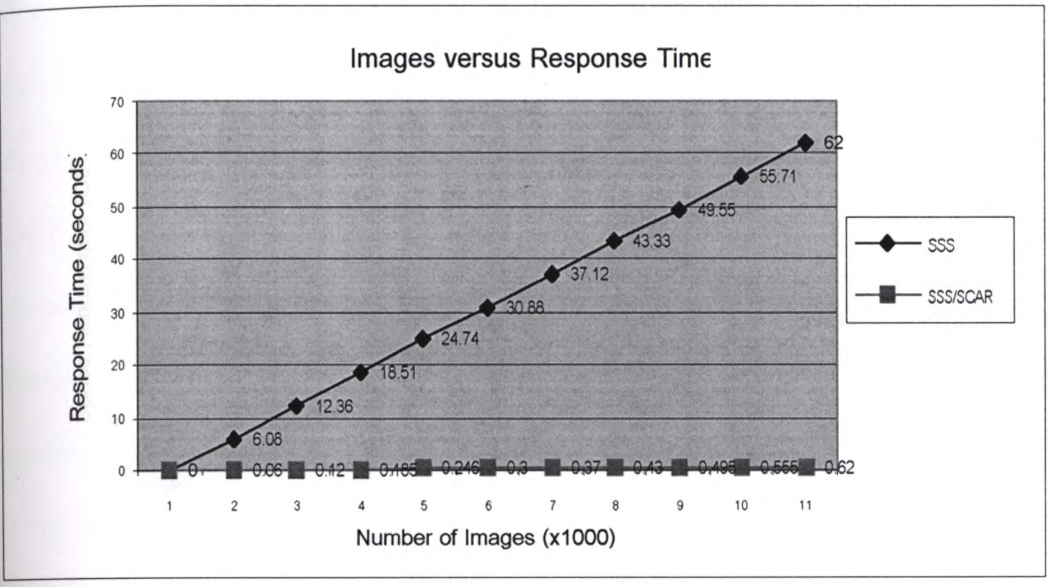

Figure 6.14: Response time of Self-Similarity Search with and without scar specification

Source: (Srisarkun & Cooper 2002)

Figure 6.15 indicates the space required for the Self-Similarity Search with and without scar specification in a database consisting of 100 different images. It shows that the Self-Similarity Search without a scar specification requires much larger space to store those images while the Self-Similarity Search with additional scar attribute requires less space. The space gain of Self-Similarity Search with a scar specification over the one without scar when performed on databases that contained from 1,000 to 10,000 images can be defined as follows:

$$y_{sim} = 10.54x \quad (17)$$

$$y_{scar} = 0.2x \quad (18)$$

$$\text{Gain} = 10.54/\ 0.2 = 52.7 \quad (19)$$

It can be said that the space gain by performing the Self-Similarity Search with scar specification is approximately fifty three times that of the Self-Similarity Search without scar specification.

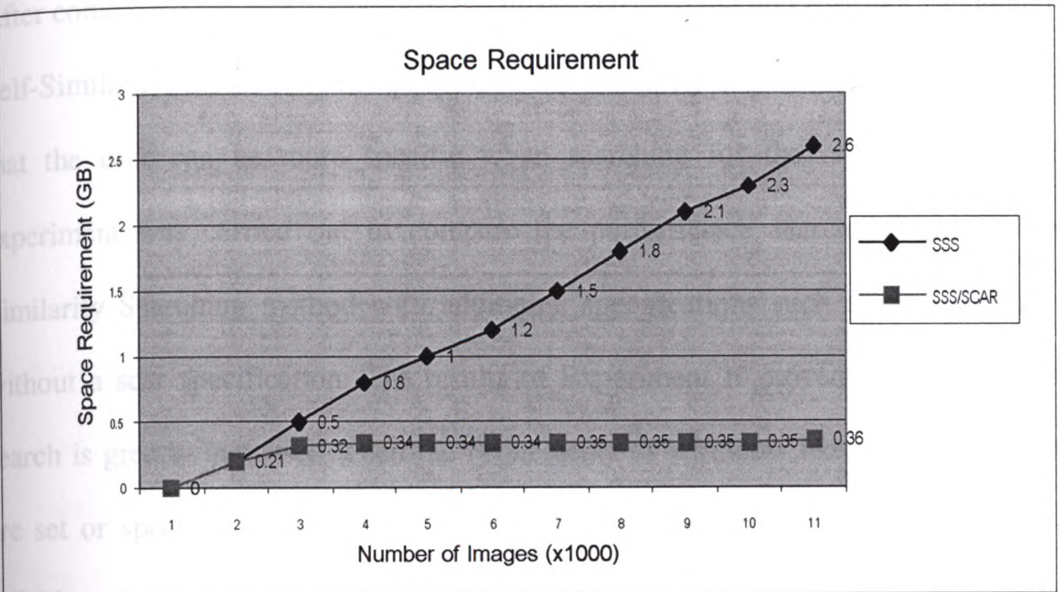

Figure 6.15: Space requirement for Self-Similarity Search with and without scar specification
Source: Srisarkun & Cooper 2002)

6.5 CONCLUSION

In order to find the most efficient image retrieval methods that can be used to assist and enhance the crime investigation in Thailand, experiments were conducted. The first experiment was carried out to compare the performance search of the Self-Similarity Searching method over the Sequential Searching method, to determine whether the Self-Similarity Searching method is more effective than the sequential searching method as claimed by Satini and Jain (1996) and Porntrakoon and J.Nukoon (1999). Reasonable results were derived from the experiments. Results of Experiment I clearly demonstrated that the Self-Similarity Searching method scored over the Sequential

Searching method in terms of an increase in search time and a decrease in storage space requirements, thus scaling up well for large image database.

After comparing the effectiveness of the image retrieval method between Sequential and Self-Similarity, the author then developed the similarity search with scar algorithm, so that the user can be more specific when searching for the criminal. The second experiment was carried out to compare the performance search between the Self-Similarity Searching method with additional specifications such as scar and the one without a scar specification. The results of Experiment II proved that the speed of a search is greatly increased when the refinements of attributes like scars or birthmarks are set or specified. Thus it can be seen that the Self-Similarity Search method is a reliable and effective means of image retrieval.

However, we still need to determine whether or not the image retrieval method is suitable for crime investigation purposes as suggested by Porntrakoon and J.Nukoon (1999). The next chapter investigates the attitudes and perceptions of the Thai police toward the use of IT and image retrieval for crime investigation, with particular emphasis on the use of the Self-Similarity Searching method.

CHAPTER SEVEN
QUESTIONNAIRE RESULT AND DISCUSSION

7.1 INTRODUCTION

Chapter six presented the results of the experiments, which tested the Self-Similarity Search algorithm on face recognition. This chapter presents the results of a study of the Thai police inspectors' attitudes and their perception of the use of Information Technology in police work, particularly their attitude to the use of a Self-Similarity Search algorithm for image retrieval.

In-dept interviews were conducted with senior government officers and senior police inspectors at the beginning of the research in order to discuss the research, as well as to establish the connection and collaboration that would be needed in the later stages of the research. A questionnaire was distributed to 149 police inspectors from ten selected police stations. The participants' responses were analyzed and in cases where the responses were not clear further interviews were conducted and issues were clarified and resolved.

The purpose of the interviews and questionnaire was to investigate if the image retrieval method could enhance police work, and also to determine the attitudes and perceptions of the police towards the integration of computer technology into their crime investigation. The results of this research provided valuable insights into what the Thai police thought should be implemented, for the adoption of information technology as a successful part of community policing in Thailand. The police who participated in this research were those police involved in crime investigation and interrogation such as murder, kidnapping, robbery and assault. (The statistics of reported crimes of Thailand during January 2000-December 2000 can be viewed in Appendix C, on page 257)

Appointments were made with the police officers at ten police stations, four stations are located in Bangkok, the capital of Thailand; and the other six stations are located in Samutprakan Province, Chonburi Province, and Chachoengsao Province which are located in the suburbs of Bangkok; see Figure 7.1 for the Map of Thailand. A presentation outlining the advantages of using the Self-Similarity Searching method to aid police work in investigations that require image identification was made to each of the ten police stations. A total of 149 police officers from the ten stations participated in this research.

These police officers, who were directly involved in criminal investigation, were given a 35-40 minute presentation on the Self-Similarity Search for image retrieval method. This was followed by the distribution of the questionnaire *(Full questionnaires details is presented in Appendix F, on page 320).*

After the questionnaire was completed and collected from the participants, there was some informal follow up interviews with a number of the police inspectors. These occurred outside the police station because the police officers were often on duty and requested that the meetings be scheduled at lunchtime or after duty. The interviews helped the researcher gain a deeper understanding of the investigation process and also helped clarify some of the responses to the questions in the questionnaire.

7.2 OVERVIEW OF QUESTIONNAIRE AND INTERVIEW PROCEDURE

Interviews were conducted with senior government officials and senior police inspectors at the beginning of the research in order to evaluate the potential of the research direction and also to ensure that the resources could be accessed throughout the study. This group of officials holds a high degree of influence in deciding government policies and possesses a great amount of experience in the area of research. The author communicated frequently with this group of officials throughout the study whenever doubts arose. Their assistance during these times proved to be vital to the progress of the thesis.

7.2.1 Geographical Distribution of Police Stations

Of the ten police stations used in this research, the first four, Thongmahamake, Thonglor, Muggasan and Pravate are located in Bangkok, which is the capital city of Thailand. Samlongneur and Amphoe MuangI (Amphoe = District) are located in the Samutprakan Province.

The Samutprakan Province (Titida 2002, p.47) is also known as Pak Nam and is situated at the mouth of the Chao Phraya River. It is popularly known as 'Muang Pak Nam' (the river city). It occupies an area of 1,004 square kilometers and is located 25 kilometers from Bangkok. Currently, the Samutprakan Province is administratively divided into five Amphoes: Muang, Phra Pradaeng, Bang Phli, Bang Bo, and Phra Samut Chedi, for administration purposes.

The Bangpakong and Amphoe MuangII stations are located in the Chachoengsao Province. The Chachoengsao Province is situated on the out skirts of Bangkok, and is an hours drive by car. The last two participating police stations, which are Banglamoong and Amphoe MuangIII, are located in the Chonburi Province (Siam 2000).

The Chonburi Province is around one hundred kilometers from Bangkok, on the Bang Na-Trat Highway. Chonburi is a well-known seaside destination and a major agricultural and industrial producer, with extensive sugar cane, tapioca and coconut plantations, shallow and deep-water fisheries, as well as manufacturing plants (TOT 2001). For a map showing the locations of the various police stations described above, refer to figure 7.1.

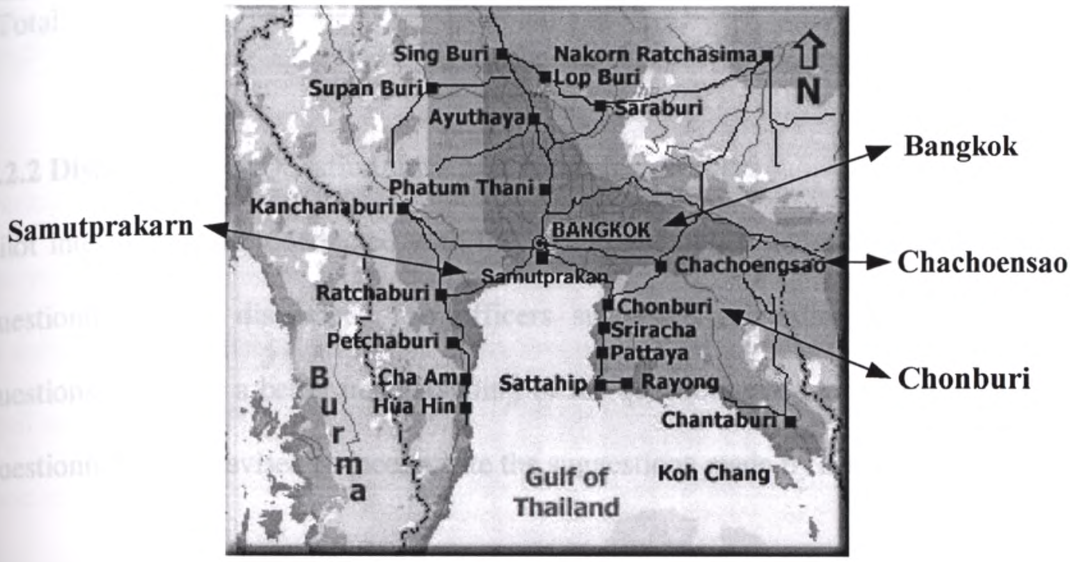

Figure 7.1: Partial map of Thailand showing the location of Bangkok, Samutprakan, Chachoengsao and Chonburi Provinces
Source: (Adapted from TOT 2000)

Table 7.1 shows the location and the number of police officers that participated from each of the ten police stations. The results and analysis of the data are discussed throughout the rest of this chapter.

Table 7.1: Percentage Distribution of Police Participants

Station	Participating Police Stations	Capital City/ Province	Number of Participating Police Inspectors	Percentage %
1	Thongmahamake	Bangkok	16	10.7
2	Thonglor	Bangkok	14	9.4
3	Muggasan	Bangkok	12	8.1
4	Pravate	Bangkok	15	10.1
5	Sumlongneur	Samutprakan	15	10.1
6	Amphoe Muang	Samutprakan	21	14.0
7	Bangpakong	Chachoengsao	14	9.4
8	Amphoe Muang	Chachoengsao	16	10.7
9	Banglamoong	Chonburi	14	9.4

10	Amphoe Muang	Chonburi	12	8.1
Total	10	1 Capital and 3 Provinces	149	100.0

7.2.2 Distribution of Questionnaire and Interview Process

Pilot interviews were conducted with the two senior police officers, during which the questionnaire was discussed. The officers suggested rewording the text in some questions to ensure a better understanding of the questionnaire by the participants. The questionnaire was revised to incorporate the suggestions made by senior police officials.

Telephone calls were made to the ten selected police stations and permission to conduct this research was requested. After permission was granted an official letter detailing the purpose of the research was faxed to each station. Further telephone calls were made to arrange a date and time for the presentations.

A 45 minute presentation on the Self-Similarity Searching algorithm was given and this was followed by an informal discussion which gave the participating police the opportunity to answer and comment on each question (For a full outline of the questions see Appendix F, on page 320). Some ideas led to valuable discussions and recommendations, which are described in Chapter Eight.

7.2.3 Direct Observation

Police officers with advance and intermediate computer skills responded to some of the questions differently from the police who had never used a computer. Observations made during the presentation showed that computer literate police officers were more confident and eager to learn about the subject presented.

During the many discussions the author had with the officers, it became clear that only the younger generation of the police officers were comfortable with using a computer, as subjects such as basic computer skills were not taught at the Thai Police Academy until recently. Of the older generation of officers who use the computer in their work, most were trained only in a specific software package that was used in their local station after they were assigned to their jobs.

7.3 RESULT AND ANALYSIS

In this section, data from the questionnaire responses and the subsequent interviews that were conducted is analyzed and the findings are discussed in relation to relevant journal articles e.g., Porntrakoon & J.Nukoon 1999; Srisarkun & Cooper 2001; Davis 1993; Dishaw & Strong 1999.

Several articles (Wells et al. 2003; Srisarkun., Jittawiriyanukoon & Cooper 2002; Tversky 1977;) were reviewed for this chapter including the documents and reports from National Institute of Justice (NIJ) and a guideline for eyewitness evidence under Thai constitutional law. SPSS version 11.0 was used to analyze the result of the questionnaires.

Results and analysis of the questionnaire are divided into three parts. Part one discusses the results and analysis of questions 1-8 in section one of the questionnaire. Part two discusses results and analysis of question 9-33 in section two of the questionnaire. And part three discusses results and analysis of question 34-45 in section three of the questionnaire. Please note that information obtained from the follow up interviews has been added to the analysis of some questions to gain a better understanding of the participant's response.

7.3.1 Result and Analysis of the Questionnaire Part I

Part one deals with the results and analysis of the background to the level of computer usage, literacy and skills of the participants.

Table 7.2 : Computer Skills of Participants

Computer Skills	Number of Participants	Percentage
Very Good	4	2.7
Good	25	16.8
Medium	45	30.2
Poor	49	32.9
Never Use Computer	26	17.4
Total	149	100

Computer literacy of participants

Luehrmann and Peckham (1987) described computer literacy as "being able to tell a computer to do what one wants it to do and in order to tell a computer to do anything, one must first understand exactly what one wants done". Of the one hundred and forty-nine police officers who completed the questionnaires and participated in the interviews as outlined earlier in section 7.1, only 49.7% could be described to be computer literate as defined by Luehrmann and Peckham (1987)

Referring table 7.2 to There were only four police officers (2.7%), who rated their computer skills as “very good”, 25 police officers (16.8%) rated their computer skill as “good”, 45 (30.2%) rated their computer skills as “medium”, while 49 (32.9%) rated their computer skills as “poor” or "beginners". The remaining 26 (17.4%) police officers stated that they had never used the computer before.

The police officers who rated themselves as "poor" were generally beginners. These officers can use basic tools like word processing, they can save and retrieve data and undertake a small amount of Internet search. The police, who rated their skills to be at an intermediate level, make more use of the computer features for their work. Those with advanced computer skills are usually the ones who have a personal interest in computing and had taken classes at the local college or university.

For further analysis discussed throughout this chapter, the police officers (participants) were then regrouped into 2 categories; category one is "computer literacy" category two is "less-non computer literacy". Participants who rated their computer skill as very good, good and medium are grouped in "computer literacy" (49.7%), and those with very little or no computer literacy (50.3%) are grouped as "less-non computer literacy.

Table 7.3: Frequency use of Computer at the Police Station

Frequency Use of Computer	Number of Participants	Percentage
Everyday	52	34.9
Only when needed	65	43.6
Never	32	21.5
Total	149	100

Frequency and purpose of computer usage at the police station

Adam, Nelson and Todd (1992, p.241) suggests that if the reasons behind the individual's choices of software are understood and the frequency with which they use the software is known, then this information could be used to make improvements in the way the software is utilized and this could lead to an increase in the overall efficiency in an organization. Thus, it can be seen that the frequency and purpose of computer usage are two very significant variables. It is important that the Thai government takes these variables into account when planning an IT policy. If the IT policies are not compatible with the degrees of proficiency and levels of acceptances of the individual they are aimed at, then the policies are not bound to succeed.

Referring to table 7.3, it was seen that 34.9% of participants used the computer at their police station everyday, whereas 43.6% used the computer only when needed, and the remainder 21.5% never used it at all. The police used the computer in their work for diverse purposes. Table 7.4 indicates that the computer was utilized most frequently for database management with two thirds (66.4%) of the participants using this facility. More than half, 59.7%, of the participants used the computer at their station for retrieval and sharing of information from the internal database using an Intranet.

Less than 40% of the participants (35.6%) used the Internet when information from a web site is needed. Email is rarely used as a means of communication. A printed letterhead with the official seal is the official form of communication. Those on mobile duty prefer the use of walkie-talkies as a means of a communication. The results also show that computers are used as a replacement for the typewriter in word processing in at least 32.2% of the cases.

Table 7.4: Type of Computer use at the Police Station

Purpose of Computer	Number of Participants	Percentage
Database Application	99	66.4
Intranet	89	59.7
Internet	53	35.6
Word Processing	48	32.2

Level of awareness of the nationwide database network system

When asked about their awareness of the implementation of a nationwide database network system to aid in the operation of police officers from the police headquarters to the police station level by the Royal Thai Police, the questionnaire results show that three quarters (74.5%) of the participants are aware of the implementation and 25.5% of the participants do not know about this project. This should be brought to the attention of the Police Headquarters who need to increase publicity of this project and thus increase awareness amongst the police force throughout the nation.

Knowledge of Police Information System (POLIS)

The Police Information System (POLIS) is a central database system with the database stored at Police Information System Center (PISC), (a full detail of POLIS can be seen in Appendix C, page 250) 76.5% of the participants stated that they knew what the Police Information System is about, 22.1% of the participants said that they did not know what it is all about and 1.3% were unsure. These participants then further explained that they had heard of the POLIS project but had no idea what is it about, or they were uncertain about what they think they had heard. Again this uncertainty indicates the need for the Royal Thai Police to promote the POLIS project.

Participants' knowledge of the use of the computer for crime investigation

The participants were asked if they have any idea how the computer could be used to assist with and enhance criminal investigations. The results show that around one fifth (20.1%) of participants do not know how the computer can be used in criminal investigation but the remainder (79.9%) know how it can be used. Some of them also gave relevant examples, at the same time stating that these technologies were not yet in use in Thailand.

Examples of technologies and computer use in crime investigation given by the participants include In-Car Video Systems, Computer-Assisted Fingerprint Identification and the use of forensic technology for crime scene investigation was also mentioned.

Experience in using the computer for crime investigation purposes

The questionnaire results show that 47.7% of the participants had never used the computer for a crime investigation purpose and the 52.3% of the participants who claimed that they had, stated their purpose of use were mainly for searching available databases.

The investigation officers had used both internal databases and some external databases. The internal databases that the police officers often used are the Arrest Warrant

Database, the Missing Person Database and the Firearms Registration Database. The last of these contains data listing all firearms registered in Bangkok. The external database that is most frequently used by the participating police officers, is a database linked to the Central Registration Data Center of the Ministry of Interior, which contains data on the firearms registered in the provinces.

This link also provides information on the 60 million registered citizens of Thailand and includes individual registrations of address, religion, marital status, birth certificate etc. Other external databases that are often used by the police officers are the Driver License Database and the Motor Vehicle Registration Database that are linked with the Land and Transportation Department.

Police officers also commented that using the computer to search a database could decrease the time needed for the search and thus increase the effectiveness of performing their job assignment. This outcome is consistent with the MPCU, TAM and TTF model. MPCU is employed to predict individual acceptance and use of range of information technologies. One of the MPCU core construct is 'Job-Fit'; it can be described as how the capabilities of a system enhance an individual's job performance (Thompson, Higgins & Howell 1991, p.125). This study indicates that the Thai police found computers to be very useful and practical for database search task. Similar to TTF core construct, which is the matching of the capabilities of the technology to the demands of the task, which is the ability of IT to support a task (Goodhue 1995).

TAM and TTF further assist this study in determining the aspects of users' choices to utilize IT. TAM and the attitude / behavior models on which it is based, assume that users' beliefs and attitudes toward a particular IT largely determine whether users exhibit the behavior of using the IT. In TTF model assuming that users choose to use IT that provides benefits, such as improved job performance, regardless of their attitude towards the IT (Goodhue 1995). Both aspects, attitude towards the IT and rationally determined expected consequences from using the IT, are likely to affect users' choice to use IT (Dishaw & Strong 1999). The author believes that a further in-dept study of TAM combined with TTF regarding the users' choices to utilize IT would certainly helps the Thai government understand how to provide software tools or IT that the Thai police perceived to be useful and easy to use in the future.

Willingness to learn more about IT in crime investigation

Participants were asked if they would be willing to learn more about the use of IT in crime investigation, if they were provided with the resources to do so. The questionnaire results confirmed that 97.3% of the participants were interested in learning more about IT. Of this group some participants believed that using the computer would increase their effectiveness on the job, whilst some of them believed that using the computer would make it easier to do their job.

On the other hand, 2.7% of the participants were not interested in learning about IT for crime investigation and stated that they would only learn if they were compelled to do so. Otherwise, they have no personal interest in the subject of computers or an appreciation for Information Technology whatsoever. This outcome is similar to the research finding of Dishaw and Strong (1999) that users regularly use IT that they do not like because it improves their job performance. And according to Davis, Bagozzi & Warshaw (1989, p.988) this outcome also indicates the degree to which a person believes that using a particular system or technology would enhance his or her job performance. It is also indicated that facilitating conditions will not have a significant influence on behavioral intention (Thomson, Higgins & Howell 1991). However, this should not stop the government from investing in Information Technology, as the percentage of participants unwilling to use computers is very low.

In summary, although the results show that 79.9 % of the police officers know how the computer can be used to assist the police officers in criminal investigation, only 52.3% actually use it. Most of the time the computer is used only to search for an individuals' information from the Central Registration Database System (CRDS) that contains information of registration databases e.g., firearm registration database, address registration etc.

7.3.2 Result and Analysis of Questionnaire Part II

Part two of the questionnaires provides results and analysis of the current methods used for eyewitness identification. Since there is no statistical research available regarding the subject of eyewitness identification in Thailand, some of the answers in this part of the questionnaire reflected the individual police officer's experience and perceptions.

Methods of keeping criminal records

The results show that 13.4% of the police stations maintain their criminal records in a paper-based system that involved the use of mug books. A mug book is a file of mug shots, and it contains pictures of criminals that are kept on file by the police (Wells 2003). Only 4% of the participating stations had computerized their criminal records and 79.2% were in the process of converting their records from the paper-based system to a computer-based system.

Interviewees commented that establishing a computer-based system was particularly difficult, as the police officers simply did not possess the time or the skills for such data entry work. They highlighted the need for hiring computer personnel skilled in data entry to do this kind of job. Until this need is met some police stations will continue to have paper-based systems.

Witness identification techniques

A Line up can be described as a line of persons arranged by police for inspection or identification (Wells 2003). In a line up, a suspect is placed amongst people, called 'fillers' who are known to be innocent of the offense and who are there simply to help make the process fair to the suspect. The eyewitness is then asked if one of the people in the lineup is the perpetrator. A typical police lineup is composed of six people, one of whom is a suspect and the remaining are fillers (Tversky 1977). Lineup procedures or methods vary, sometimes the lineup is a set of photographs and this is called a 'Photo-lineup' and sometimes the lineup is live and is referred to as a 'Live-lineup' (Well & Lindsay 1998, p.322).

Different methods of eyewitness identification were listed in the questionnaire and participants were asked to indicate the methods that they had used during the course of their police work. A Photo-lineup is used by 74.5% of the participants and 17.4% of them had used the Live-lineup procedure for eyewitness identification. However, the Live-lineup procedure can only be used when a suspect has been apprehended. A large proportion (92.6%) stated that they had made use of the computer database representation of the criminal records, which contains individual criminal profiles.

According to their experience participants were asked to state the amount of time it usually took them to arrange a Live-lineup. Over two thirds, 67.8%, of the participants said that it usually takes a day to arrange a Live-lineup, 9.4% said it could take up to one week, and 0.7% said it could some times take a month. When answering this question 22.1% marked their answer as "other" and further explained that the procedure and their involvement depends on the case concerned. In some cases the person does not show up, or a suspect runs away and sometimes the eyewitness or the victim are hospitalized, and therefore fail to report to the police immediately after the criminal event.

There were cases that required the lineup to be repeated. Based on the participants experience 63.1% said that the Live-lineup procedure is regularly repeated and the reason behind this is the eyewitness or the victims' uncertainty about the suspect identification at the initial lineup. Despite the repeated lineup cases, the frequency of getting a successful result from a Live-lineup or Photo-lineup procedure was quite high, as 94.6% of the participants said that they get a result from these methods; and up to

70.5% of the participants agree that the Live-lineup and Photo-lineup procedures give them effective results.

Regarding the costs involved in live-lineup arrangement, 30.9% of participants said that there are some costs involved. Those costs include the transportation given to the eyewitnesses or the victims who are unable to pay their fare and that cost can be estimated to be around 500-1000 Thai Baht (AU$20-40), depending on the distance the person involved needs to travel. Sometimes the police have to pick up the victim or witness and bring them to the station. Such cases usually arise in rural areas.

At present most of the criminal databases available at each of the participating police stations are a 'Known Criminal Database' where records of every convicted person are maintained. However, there would always be the case that involves a suspect who had never been convicted of a crime before. This would give rise to the need to search the Central Registration Database, which contains information on every Thai citizen.

In the questionnaire, participants were asked if the use of the computer to display images of Thai citizens at the police station could cut down the cost of a repeat Live-lineup. More than three quarters, 78.5% of the participants believe that in the long term it would be cheaper to use the computer to repeat the Photo-lineup or sometimes the Live-lineup process. However, 11.4% of the participants were not of the opinion that the computer would reduce the cost of the lineup procedure. This minority, who disagreed, were those who had a low degree of computer literacy or were not computer literate. This outcome is in agreement with the definition of a "performance expectancy" given by Davis, Bagozzi and Warshaw (1989, p.1001) who define it as the degree to which an individual believes that using a particular system would enhance him or her to attain gain in job performance.

Condition of the eyewitness or victim and its effects on the results of the line up procedure

Based on their experience, 79.9% of the participants said that the eyewitnesses were usually nervous about the lineup procedure and only 6% disagreed. However, up to 91.9% agreed that the mental condition of the eyewitness or the victim had an effect on the identification process.

During further discussions about using a computer to assist in the Live-lineup procedure, more than three quarters (76.34%) of the participants believed that an eyewitness or victim would feel more comfortable selecting the photograph of a suspect from a computer containing the criminal database, instead of having to face the person who might have previously hurt them. Conversely, 12.1% of the participants did not believe that using a computer to make identifications would make the victim or the eyewitness feel more comfortable in identifying the suspect. The perception held by 76% of the police officers interviewed, about the eyewitness being more comfortable making an identification from a photograph rather than having to make a face to face encounter is supported by Thomson, Higgins & Howell (1991, p.183) who explained 'affect toward use' as "feeling of joy, elation, or pleasure; or depression, disgust, displeasure, or hate associated by an individual with a particular act".

Accuracy and confidence in eyewitness identification

There is increasing evidence that false eyewitness identification is the primary cause of the conviction of innocent people (Wells & Lindsay 1998). In the current research, it is shown that 82.6% of the Thai police agreed with the statement that eyewitnesses tend to identify the person from the lineup who, in their opinion, looks most like the culprit relative to the other members of the lineup, however, 17.4% disagree with this statement.

Wells (2001) mentioned in his research that "a suggestive interview procedure, before or after an identification is made, can dramatically weaken the accuracy and confidence relationship." Based on the participants' experience, they were asked if there is any relatedness between eyewitness 'identification confidence' and eyewitness 'identification accuracy'. Results show that 94% of the participants agreed that there is a strong relationship between eyewitnesses 'identification confidence' and eyewitness 'identification accuracy', however, 6% of the participants disagreed with the above statement.

Read, Lindsay and Nicholls (1997) research indicates confidence is a poor indicator of accuracy. In his study, some participants were very confident in false identifications and others were very non-confident in accurate identifications. In relation to Read's research, the Thai police were then asked *if the eyewitness who was 'completely certain' about the accuracy of the identification is more likely to identify the right culprit*. The questionnaire responses show that 81.2% of the participants agree that the eyewitness who was 'completely certain' about the accuracy of the identification is more likely to identify the right culprit. A minority (18.8%) of the participants disagrees with the above statement and further comments that it is possible for a person to be certain about the wrong thing.

The Thai police officers were asked whether the eyewitness who was *'somewhat uncertain' about the accuracy of the identification would be more likely to give a 'false identification' of a suspect.* Around one third, 31.5% of the participants disagreed with the above statement, whereas, 68.5% of the participants agreed that the eyewitness who was 'somewhat uncertain' about the accuracy of the identification is more likely to give a 'false identification' of a suspect. Those who agree further commented that they had come in contact with 'false identification' cases where the suspect is let off because the eyewitness was uncertain about the accuracy of the suspect identification. This proves that some identification of alleged criminals will be false and lead to the mistaken arrests and even imprisonment.

Factors that influence the 'false identification'

Memon and Hope (2000) believe that an eyewitness is vulnerable to information encountered prior to a lineup. In this part of the questionnaire, the Thai police were asked about the factors that influence a 'false identification'. Results show that 77.2% of the participants believe that an individual's capability of memorizing an event is the first factor that influences the false identification. The second factor (49%) is based on the time of the day when the crime occurred, as visibility can be affected negatively after sunset. The third factor (48.3%) is the long time gap that occurs between the actual occurrence of the crime and it being reported to the police. Personal bias, e.g., racism could also be one of the factors influencing false identification, however, according to 6% of the participants such cases rarely occur in Thailand.

In addition to the Thai police responses to this question, Luss and Wells (1994) research dealing with real world cases also mentioned similar factors. His research indicates that "some witnesses have only a fleeting incidental glimpse of the perpetrator whereas other spend considerable time in intense face-to-face interactions; some witnesses make an identification within an hour of witnessing the culprit, and others only after weeks; some perpetrators have strikingly memorable faces and other do not; in some cases the appearance of the perpetrator as witnessed and the line up are very similar and in others they are very dissimilar." These considerations suggest that the ability to identify the perpetrator varies greatly from one witness to another.

Further analysis also indicates that nearly all of the participants (91.9%) agreed that false identification could lead to mistaken arrest or imprisonment of a suspect. These responses from the Thai police officers were found to be relevant to an analysis of actual cases in the U.S., which reveals that mistaken identification, of the wrong person by victims and witnesses to a crime, is the single most common error leading to the arrest and conviction of innocent people. Several cases in Canada also suggest a similar problem (U.S. National Institute of Justice 1996).

Results show that 61.1% of the Thai police in this study had experienced 'false identification' cases but 23.5% had not come across these kinds of cases yet. Participants were then asked *if they had come across cases where the suspect was let off* *because the eyewitness was 'uncertain' about the accuracy of the suspect identification.* A large proportion of the participants, 83.9% had experienced a case where the suspect was let off because the eyewitness was 'uncertain' about the accuracy of the identification involved and 12.8% of the participants had not yet experienced such a case. This lack of certainty emphasizes the need for more accurate identification methods.

Presence of a scar or other distinctive marks increases success of witness identification

With regards to composing a photo lineup, a trainer's Manual for Law Enforcement (Bradfield & Wells 2000, p.589) suggests that "the investigator or the police officer should consider creating a consistent appearance between the suspect and fillers with respect to any unique or unusual feature (e.g., scars or tattoos) used to describe the perpetrator by artificially adding or concealing that feature". This means that if there is a unique feature or characteristic described by the witness, such as a scar, the preferred procedure is to leave the unique feature visible and select fillers with a similar feature or characteristic.

All most all, 98.7%, of the participants said that the identification of a scar, birthmark or tattoo would be a great help for the police in narrowing down the range of suspects. And similarly almost all 97.3% of the participants agreed that it is very useful if the eyewitness could define any scars or birthmarks, which a suspect might have, only 2.7% of the participant disagree with the above statement. This outcome is in agreement with a Trail Proceeding (Wells 2000, p.646) which states that a "facial scar would be 'an important factor' to use in identifying a suspect, it also helps the police to eliminate other suspects if eyewitnesses can identify distinctive marks or scars".

An overwhelming majority (98%) of the Thai police officers in this study agreed that an obvious scar or birthmark of a suspect that was easy to remember could help the police in solving crime. According to the concept of competency and credibility in eyewitness identification issues, primarily in criminal investigations, credibility is the weight given to testimony: past history, motive, ability to know information, condition at time of event. It stated that "eyewitness identification is most credible if witnesses remember a particular unique feature such as tattoo, scar, and bad teeth" (Wells & Olson 2002, p.278).

Participant's opinion on the use of computers in the field of crime investigation

Participants were asked about their ideas regarding the use of an artist's sketch to locate a similar photograph from the computer database. More than four fifths of the participants (81.2%) liked the idea of using the sketch to find a similar photo in the computer database but 12.1% stated that they did not like the idea. This outcome confirms the relationship between attitude towards behavior and completing a task as stated by Davis, Bagozzi and Warshaw (1989, p.981) as an individual's positive or negative feelings about performing a task.

Participants were asked whether a display of a few similar photographs could affect the decision of the victim or the eyewitness. The result shows that only 4.7% of the participants disagree with the fact that a few similar photographs would affect the decision of the police or eyewitness. The rest of the participants agreed that a few similar photographs affect the decision of the police or eyewitness, but it depends largely on each individual's perception. This will be discussed later on in Chapter Eight.

In contrast to the comments made in response to the previous question, 17.4% of the participants disagree that looking at a few similar photographs would make it easier to identify a culprit. The rest of the participants, 78.8% believed that looking at a few similar photographs makes it easier to identify the suspect.

A Trainer's Manual for Law Enforcement (Bradfield & Wells 2000, p.590) recommends that the police can sometimes choose to enhance the fillers with a similar feature; however, they still need to ensure that the suspect does not unduly stand out. If the suspect has a unique feature not described by the witness, the police should not alter the suspect's photograph. Rather, the police should select fillers that have a similar, but not identical, feature or enhance the fillers with similar features.

In summary, the results from the analysis of the questionnaires applied were based mostly on the participating police officers individual experience and perception towards the suspect of eyewitness identification, as there is no rigorous statistical evidence on this particular subject available as yet.

7.3.3 Result and Analysis of Questionnaire Part III

As it was imperative that the police officers in this study understood the concept of IT and the use of image retrieval in criminal investigation; presentations were given to the participants in each police station. The presentations dealt with topics such as data sharing amongst the Thai government departments, specifically data sharing between the Royal Thai Police and the Department of Local Administration; the utilization of image databases for crime investigation and it also emphasized the use of the Self-Similarity Search and its benefits based on the result in Chapter Six. Part III provides results and analysis of the participants' opinion towards the topics discussed during presentation.

It is shown that more than 50% of the police inspectors who completed the questionnaire had a good understanding of the use of Information Technology for police work. Most of them agreed that photographic images play an important role in crime investigation, especially when a scar, birthmark or tattoo is specified on the suspect, this makes it easier for the police to search the criminal records.

When it came to the question regarding the use of a Self-Similarity Search for crime investigation, it was seen that only 47% of the participants truly understood how the searching tools work. This is acceptable as more than 21% of the participants had never used the computer before, therefore, the subject was very unfamiliar to them. However, more than 90% agree that Image retrieval should be used in the crime investigation process.

This outcome is consistent with both the TAM and TTF model. Davis (1989, p.318) explained that when a user perceives ease of use of a technology, it influences their view of its usefulness. Also Dishaw and Strong (1999) found that for his TTF model was statistically significant relationship between perceived ease of use, and through perceived ease of use to perceived usefulness. However in the follow up interviews a small percentage (0.7%) varied from this relationship. The interviews indicated that while some police inspectors did not perceive that Self-Similarity Search was easy to use they still agreed that the system was very useful and should be adopted.

The ability of software to support a task is expressed by the formal construct known as Task-Technology Fit (TTF), which is concerned with the matching of the capabilities of the technology to the demands of the task. TFF assumes that software will be used if and only if, the functions available to the use support (fit) the activities of the user. Relating to reason, experienced users will choose those tools and methods that enable them to complete the task with the greatest net benefit. Software, which does not offer sufficient advantage, will not be used. Higher degrees of "Fit" lead to higher performance (Goodhue & Thomson 1995, p.218).

The results of the questionnaires show that 52.4% of the participants think that the Self-Similarity Searching method is practical for image retrieval whilst 29% are neutral. The rest, who disagree, said that the multiple similar image result that derived from the search could confuse the eyewitnesses when they have to identify the suspect. Nevertheless the majority agree that the Self-Similarity Searching method is useful for crime investigation. These results are further analyzed in section 7.5.

The result of the questionnaire also shows that 93% of the police inspectors agree that the crime investigation unit should adopt the Self-Similarity Searching method for criminal image retrieval and it is worthwhile for the government to invest in Information Technology to improve the government service. Most of the participants are willing to use the computer for performing image searches if their stations adopt the method and the required facilities and training are provided.

This outcome is consistent with the MPCU and IDT model. Venkatesh (2003, p.427) commented that facilitating condition do have a direct influence on usage beyond that explained by behavior intention alone. He defined facilitating condition as " the degree to which an individual believes that organizational and technical infrastructure exist to support the use of the system, this definition captured concept and embodied by three difference constructs: perceived behavior control, facilitating conditions and compatibility. Each of these constructs is operationalzed to include aspects of the technological and/ or organizational environment that are designed to remove barriers to use". In MPCU, facilitating conditions can also be used to outline objective factors in the environment that observed agree make an act easy to accomplish (Thomson, Higgins & Howell 1991).

Similar to MPCU, IDT can also be applied to further explain this outcome. In information system context IDT was found (Moore & Benbasat 1991) to support for the validity of innovation characteristics by refined a set of constructs that could be used to study individual technology acceptance. In this study, the majority of Thai police agreed that the Self-Similarity Searching Method is very practical to be used for crime investigation and further demonstrated their willingness to use the proposed image retrieval if the Royal Thai Police Department adopts this technology. These result indicate 'Compatibility' or the degree to which an innovation is perceived as being consistent with the existing values and needs, and 'Voluntariness of use' or the degree to which use of the innovation is perceived as being voluntary or free will (Moore & Benbasat, 1991, p.195)

From the author's observations, it was noticed that of the participants (17.4%) who had the least understanding of the Self-Similarity Searching method (18.8%) did not agree that the method was practical for image retrievals and (11.8%) of these 18.8% were the ones that had a prejudice against computer technology. Further analysis of this issue is discussed in section 7.4.

In the end, almost all of the participants agreed that there should be more research into the use of Information Technology for the Thai Police. However, the research should involve the police (the real users) at all levels, as they will be the ones to use such a system.

The police inspectors recommended that the image-searching tool was best used at the witness identification procedure after the victim has reported to the police. Using the image-searching tool that contains the images of the entire Thai population will help solve crimes even more quickly as there will always be a case of an "unknown criminal" or a missing person case to search for. From the author's observation during the interviews, most of the participating police inspectors were quite excited about the use of IT for crime investigation and they wished that the system could be put into practice soon.

For a Crime Information System, an external database linked to the Central Population Data Center of the Ministry of Interior, which contains data on firearms registered in the provinces and also provides information on the 60 million registered citizens of Thailand, is considered to be one of the most important databases required for a crime investigation.

Most of the time, the individual's image is acquired to further the investigation process or to find suspects. Therefore, the current research has been done in the area of utilizing the image database to its fullest extent, so that it can be shared in order to improve government services.

Given there were different attitudes to the adoption of image retrieval of the two groups (police officers with computer literacy and police officers with very little to no computer literacy) further statistical analysis of the data was undertaken. This analysis investigated whether there were statistically significant differences in the attitudes and perceptions of these two groups toward the use of the computer for crime investigation.

7.4 CROSSTAB & CHI SQUARE TEST

Crosstab and Chi-Square tests were used to determine independence or relatedness between two items in the following categories:

- Computer literacy and frequency of computer usage
- Computer literacy and the use of computer for crime investigation
- Knowledge of computer and use of computer for crime investigation
- Frequency of computer usage and use of computer for crime investigation

The resulting Crosstabs are shown in Table 7.5, 7.7, 7.9, and 7.11. Chi-Square results are shown in Table 7.6, 7.8, 7.10 and 7.12. (See Appendix E, on page 285 for a full Statistical Analysis of the questionnaire)

a) Computer literacy and frequency of computer usage

The objective of this analysis is to determine whether there is any relationship between participant with computer literacy and the frequency of their computer usage. The crosstabulation in Table 7.5 shows that 52 of the participants with either computer literacy or with a lower degree of computer literacy use the computer everyday (34.9%). There are 65 participants from the same group who use the computer when their job requires them to do so (43.6%) and 32 (21.5%) participants never use the computer at the police station. A Chi-Square test for independence or relatedness determined that the Pearson Chi-Square statistic was significant (44.572, df 2, $p<0.1$). It can be concluded that there is a relationship between participants with computer literacy and the frequency of use of the computer at work (Refer to Table 7.6).

Table 7.5: Computer literacy and frequency of computer usage

TIME * COMSKILL Crosstabulation

Count

		COMSKILL		Total
		1	2	
TIME	1	42	10	52
	2	30	35	65
	3	2	30	32
Total		74	75	149

Table 7.6: Chi-square Test: Computer literacy and frequency of computer usage

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	44.572[a]	2	.000
Likelihood Ratio	50.951	2	.000
Linear-by-Linear Association	44.174	1	.000
N of Valid Cases	149		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 15.89.

b) Computer literacy and the use of computer for crime investigation

The objective of this analysis is to determine whether there is any relationship between participants with computer literacy and the use of computer for crime investigation purpose. With reference to Table 7.8 the chi-square test determines that there is a significant relationship between participants with computer literacy and those who actually use the computer for crime investigation. It was expected that participants with computer literacy would be more likely to use the computer for crime investigation than those with little or no computer literacy.

The crosstabulation below (Table 7.7) shows the total number of participants with computer literacy that are 74 (49.7%) out of 149 (100%), only 47 participants (31.5%) with computer literacy use the computer for crime investigation and 27 participants (18.1%) do not use the computer do not do so. There are 44 respondents (29.5%) with little or no computer literacy, who do not use the computer for crime investigation and 31 participants (20.8%) who use the computer for crime investigation. It is noticed that participants with a lower degree of computer literacy make up 1/3 of the group that uses the computer for crime investigation purposes.

It was surprising to note that people with a lower degree of computer literacy use the computer more frequently in the area of crime investigation than those with a higher degree of computer literacy. Follow up interviews with the police officers helped to clarify this scenario. Police officers who consider themselves to have a lower degree of computer literacy had no knowledge of software packages other that the one that was required in their job and in which they had been trained in. Although their knowledge of such a package was limited their job involved its use extensively and they thus ended up spending more time on the computer as compared to their more computer literate colleagues.

The second reason is that some police officers with computer literacy were assigned to use the computer in other areas other than crime investigation, such as "Control Command Communication and Information" or what they called C3I. Another reason why police with computer literacy use the computer in crime investigation less than those with little computer literacy is because some of them were assigned to outside tasks such as crime scene investigation where face-to-face investigation is conducted.

Table 7.7: Computer Literacy and the use of computer for crime investigation

COMSKILL * USINGCOM Crosstabulation

Count

		USINGCOM		
		1	2	Total
COMSKILL	1	27	47	74
	2	44	31	75
Total		71	78	149

Table 7.8: Chi-Square Tests:
Computer Literacy and the use of computer for crime investigation

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.346[b]	1	.007		
Continuity Correction [a]	6.484	1	.011		
Likelihood Ratio	7.409	1	.006		
Fisher's Exact Test				.009	.005
Linear-by-Linear Association	7.297	1	.007		
N of Valid Cases	149				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 35.26.

c) Knowledge of Computers and use of computer for crime investigation

The objective of this analysis is to determine whether there is any relationship between the participants who knew how the computer could be used to enhance the criminal investigation and the participants who actually use computers for crime investigation purposes. Looking at the crosstabulation of the two categories in Table 7.9, it can be seen that there are 76 participants who know how the computer can be used to enhance the criminal investigation and actually use it.

However, it is noticed that 2 out of 28 participants, who indicated that they had no idea how the computer can be used to enhance the criminal investigation, indicated that they had used the computer for crime investigation purpose. This could mean that there are some errors in the data entry level or it is possible that some participants marked the wrong answer. However, a chi-square test (table 7.10) determined that there was statistical significance between participants who have knowledge of how the computer can be used in crime investigation and those who actually use it for this purpose.

Table 7.9: Knowledge of Computers and use of computer for crime investigation

Q6 * USINGCOM Crosstabulation

Count

		USINGCOM		Total
		1	2	
Q6	1	28	2	30
	2	43	76	119
Total		71	78	149

Table 7.10: Chi-Square Tests:
Knowledge of Computers and use of computer for crime investigation

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	31.425[b]	1	.000		
Continuity Correction [a]	29.174	1	.000		
Likelihood Ratio	35.836	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	31.214	1	.000		
N of Valid Cases	149				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 14.30.

d) Frequency of computer usage and use of computer for crime investigation

The objective of this analysis is to determine whether there is any relationship between the frequency of computer usage and use of computer for crime investigation. The Chi-Square test (table 7.12) determined that the relationship between participants with computer literacy and participants who use computers for crime investigation was significant. Table 7.11 shows that there are 75 participants (50.34%) who use the computer for crime investigation everyday and 35 (23.49%) who use the computer for investigations only when needed. However, there are 8 participants (5.37%) who indicated that they use the computer for crime investigation but also said that they never use the computer at their police station.

Follow up interviews with police officers explained this conflicting outcome. A police officer (interviewee) explained that some participants stated that they use the computer for crime investigation but also stated that they never used it at their police station because they used it elsewhere, for instant, at the Royal Thai Police (Headquarter Office) where there are more computer facilities provided. In addition some of them used it at home. Moreover, it is because the question was "How often do you use the computer at the police station?"

Table 7.11: Frequency of computer usage and use of computer for crime investigation

TIME * USINGCOM Crosstabulation

Count

		USINGCOM		
		1	2	Total
TIME	1	17	35	52
	2	30	35	65
	3	24	8	32
Total		71	78	149

Table 7.12: Chi-Square Test:
Frequency of computer usage and use of computer for crime investigation

Chi-Square Tests

	Value	df	ymp. Sig. (2-side
Pearson Chi-Square	14.318[a]	2	.001
Likelihood Ratio	14.790	2	.001
Linear-by-Linear Ass	13.381	1	.000
N of Valid Cases	149		

a. 0 cells (.0%) have expected count less than 5. The minim

In summary, these results show that there is an inverse relationship between participants with a higher degree of computer literacy and a frequency of use of the computer at work. Officers with a lower degree of computer literacy made greater use of the computer than their more computer literate colleagues. This can be explained by the fact that the more computer literate officers tended to be involved in areas other than crime investigation.

It has also been shown that an increase in awareness amongst the participants, about the application of the computer in the field of crime investigation, results in an increase in computer usage in this field. Further it was seen that the more computer literate officers tended to make a greater use of the computer whilst away from their offices rather than use the computers at their respective police stations.

7.5 T-TEST ANALYSIS

T-test is used to examine the effects of one independent variable on one or more dependent variables and is restricted to comparisons of two conditions or groups (two le vels of the independent variable). The results of this test enable the researcher to determine if two means differ significantly (Einstein & Abernethy 2000).

Policemen were grouped into five categories on the basis of their computer skills. Their answers are ranked from 1-5 with 1=Very good, 2=Good, 3=Meduim, 4=Poor and 5=Never use it, but because there were small numbers of interviewees, the responses were then regrouped into the following order: participants who marked their answer 1, 2 and 3 are placed in group one (Computer literacy) and whoever marked their answer 4 or 5 are placed in group two (Less-non computer literacy).

The purpose of the t-test analysis was to further understand the attitude of the police officers towards the use of IT, image retrieval, and the Self-Similarity Searching method for crime investigation. Moreover, the test is used to further investigate whether responses to the questionnaire differed between police officers with computer literacy, police officers who know how the computer can be used to enhance criminal investigations and those who actually used the computer for this purpose.

Use of image retrieval in the crime investigation process (Overall Mean 1.58)

a) With regards to whether an image retrieval system should be used in crime investigation, it is seen that there is no significant difference between participants with computer literacy and participants with very little or no computer literacy. However, a significant difference was found between participants who actually use the computer for crime investigation (Mean 1.36) and those who do not use the computer for crime investigation (Mean 1.83).

T-test analysis ($t = 4.233$, $p<0.1$) indicated that police who use the computer for crime investigation agree to a greater extent that image retrievals should be used for crime investigation than those police who do not use the computer for crime investigation.

b) Based on the T-test result ($t=5.817$, $p<0.1$), the difference between participants who have knowledge of how the computer can be used to enhance the criminal investigation (Mean 1.43) and those that do not know how the computer can be used to enhance criminal investigation (Mean 2.20) was also found to be significant (Overall Mean 1.82). The test results indicate that participants who have some knowledge of how computers can be used in criminal investigation agree more that image retrievals should be included in their procedures than those police who lack such knowledge.

The practicality of using the Self-Similarity Searching Method for image retrieval (Overall Mean 2.46)

There was no significant difference between participants with computer literacy and participants with very little or no computer literacy with regards to their opinions concerning the use of the Self-Similarity Searching method. Although there was no significant difference between the participants who actually use a computer in their crime investigation and those that do not use the computer at the 0.05 levels, the significance was 0.89. While not statistically significant, this does show that there appears to be some difference between the views of the two groups of participants (Mean 2.31) and (Mean 2.62) in terms of the practicality of using Self-Similarity Search for crime investigation.

Additionally, there appears to be some difference between participants (Mean 2.36) who know how the computer can be used to enhance the criminal investigation and those (Mean 2.83) who do not know based on the t-test result. Even though there was no significant difference at 0.05 level, the significance was 0.38. (Overall Mean 2.59)

The use of the Self-Similarity Searching method in crime investigation

a) When asked if they considered the Self-Similarity Searching method useful for crime investigation, there is no significant difference between participants with computer literacy and participants with very little or no computer literacy. The difference between participants who actually use the computer for crime investigation (Mean 1.42) and those that do not (2.04) was found to be significant (Overall Mean 3.46). The T-test analysis ($t = 6.014$, $p<0.1$) indicated that a greater number of police officers who actually use the computer for crime investigation agree that the Self-Similarity Searching Method is useful for crime investigation than those respondents who do not use the computer for crime investigation.

b) The difference between participants who know how the computer can be used to harness in the criminal investigation (Mean 1.63) and those who do not know (Mean 2.07) was also found to be significant based on the t-test result ($t=3.150$, $p<0.1$), overall Mean 3.150. This result indicated that police with knowledge of computer usage for crime investigation agree more strongly than those who do not posses the knowledge that the Self-Similarity Searching method is useful for crime investigation.

Adoption of the Self-Similarity Searching method by the crime investigation unit

a) When participants were questioned about whether the crime investigation unit should adopt the Self-Similarity Searching method, no significant difference was observed between participants with computer literacy and participants with very little or no computer literacy. The difference between participants who actually use the computer for crime investigation (Mean 1.26) and those that do not (Mean 1.82) was found to be significant (Overall Mean 1.54). The T-test analysis ($t = 6.143$, $p<0.1$) indicated that police who use the computer for crime investigation agree more than those respondents who do not that the crime investigation unit should adopt the Self-Similarity Searching Method for criminal image retrieval.

b) The difference between participants who know how the computer can enhance the criminal investigation (Mean 1.42) and those who do not (1.93) was also found to be significant according to the t-test results ($t=4.270$, $p<0.1$) with an overall Mean of 1.67. It is indicated that the police who know how the computer can be used to enhance the criminal investigation agree more than those who do not that the crime investigation unit should adopt the Self-Similarity Searching Method for criminal image retrieval.

Individual willingness to use the computer for the image search (Overall Mean 1.55)

There is no significant difference between participants with computer literacy and participants with very little or no computer literacy with regard to the individual's willingness to use a computer in crime investigation when such facilities are made available at the police station. Although there was no significant difference between the participants who actually use computer for crime investigation and those that do not at the 0.05 level, the significance was 0.84. While not statistically significant this does show that there appears to be some difference between the views of participants who have used a computer for criminal investigation (Mean 1.45) and those who have not (Mean 1.65) in terms of their willingness to use the computer for the image search if the police stations have a computer installed.

Prejudice against computer technology

a) There is no significant difference in the prejudice levels between participants with computer literacy and participants with very little or no computer literacy, while the difference between participants who actually use computers for crime investigation (Mean 4.37) and those who do not (Mean 3.83) was found to be significant (Overall

Mean 4.1). The T-test analysis (t =-3.503, p<0.1) indicated that the police who have used the computer in crime investigation agree more than those who do not use the computer that they have a lower degree of prejudice against computer technology.

b) Based on the T-test result (t=-3.105, p<0.1), the difference between participants who know how the computer can be used to enhance criminal investigation (Mean 4.24) and those who do not know (Mean 3.63) was also found to be significant (Overall Mean 3.93). It is indicated that the police who have knowledge of how computers can be used to enhance a criminal investigation considered themselves to have less prejudice or absolutely no prejudice against the use of computer technology.

In summary, it could be concluded that neither participants with computer literacy nor those with very little or no computer literacy, influence the way they accept the use of IT or the Self-Similarity Search for crime investigation. However, the participants' awareness of how a computer can be used to enhance criminal investigation and how they put this knowledge to use strongly influences the acceptation of the use of IT or the Self-Similarity Search for crime investigation.

These results are in accordance with Dishaw and Strong (2003, p.13) who stated that with an increase in knowledge through experience a tool will be perceived to be easier to use. He also stated that the experienced users would see more potential use of the tools, as they became more experienced and thus would also perceive the software tools to be more useful.

In other words it means that the policemen who know how the computer can assist in criminal investigation or those who actually use the computer for such purposes see the potential of using the computer technology for crime investigation. The questionnaire results confirm that this group of participants strongly agreed that the Self-Similarity Searching method should be used for criminal image retrieval. These outcomes are also supported by Goodhue (1995) views in regards to experienced users and their choice of tools and methods used to accomplish a task effectively.

Whilst trying to determine the extent to which the concept of social influence determines a police officers acceptance towards IT, the author discovered that all police officers would be willing to accept such technology if they were compelled to do so by their supervisor. This is in accordance with Davis, Bagozzi & Warshaw (1989, p.1001) definition of subjective norm "the person perception that most people who are important to him think he should or should not perform the behavior in question".

The author also found that contrary to the findings of Moore and Benbasat (1991) the police officer's level of acceptance of IT is not due to a belief that using a computer would increase their status in the social system. Unlike personnel in the business field, police officers were more concerned about increasing the efficiency of crime solving methods rather than acquiring a high profile image.

7.6 CONCLUSION

This study incorporates the use of the technology acceptance models namely IDT, MPCU, TTF, TPB and TAM. The result of combining these models provide a better understanding of users' choices of IT utilization. For instance, TAM is made up of two core constructs, which are perceived usefulness and perceived ease of use. Perceived usefulness can be defined as "the degree to which a person believes that using a particular systems would enhance his or her job performance" (Davis 1989, p.333) whereas, perceived ease of use can be defined as "the degree to which a person believes that using a particular system would be free effort" (Davis, 1989, p.331). It is seen that in the case of the Thai police perceived usefulness does not influence perceived ease of use unless facilitating conditions such as appropriate training and computer equipment are made available at the police stations. These outcomes agree with the findings of Venkatesh et al (2003) and Thompson et al. (1991) MPCU that facilitating conditions are not fully mediated by intention or social influences but are a direct antecedent of usage.

Some of the findings presented here point to several issues that need to be considered by the Thai Royal Police Department and the Thai Police Academy. These issues include a review and update of the curriculum at the Police Academy. Courses such as Information Technology and basic computer courses should be added to the curriculum.

In addition to that, a comparison of the findings with Technology Acceptance models show that they are more complex when applied to a developing nation. IT adoption is also influenced by the barriers that exhibits in many developing countries, such barriers are lack of infrastructure, leadership, collaboration, education, privacy, security, necessary talent and skills required for adapting to an IT based system (Winograd & Flores 2000). One of the most significant barriers for this study is "education" and also the lack of technology infrastructure in some of the police stations that did not have access to the computer.

CHAPTER EIGHT
CONCLUSION

8.1 INTRODUCTION

This thesis focuses on the adoption and implementation of Information and Communication Technology (ICT) in developing countries. It investigates introducing an application that would add value to the ICT infrastructure that the Thai government has implemented under its National IT Strategic Policy. In doing so this may increase the use of ICT in Thailand and that could contribute to bridging the gap between Thailand and the developed nations.

Battaller (2001) determined that a lack of development in the information and communication technology field causes the developing countries to lag behind developed nations in areas such as education and economic development. Bataller also believes that the government can play a crucial role in the improvement of social and economic conditions of such developing countries by investing in information technology.

One way of making this improvement is by adapting a system of e-Governance with the use of ICT for the planing, implementation and monitoring of the government progress, projects and activities. Of the three main areas of e-Governance, which are e-Administration, e-Services and e-Society, this research focuses on e-Administration. It mainly aims at determining how value can be added to the information already existing in a countries official databases and how this information can be integrated with existing technology to enable it to be shared amongst various administrative departments.

Consultation with senior bureaucrats in Thailand established the field of crime investigation, to be an area of particular concern in government administration, due to the existence of a high number of unsolved crimes. This thesis is concerned with the use of the Central Registration Database Systems (CRDS) which is operated by the department of Local Administration.

The Department of Local Administration is in charge of all civil registration related procedures and comes under the supervision of the Ministry of Interiors. The CRDS is linked to authorized government agencies all over the country and contains information as well as photographic images of every Thai citizen over the age of fifteen. The Royal Thai Police is one of the government agencies that also have access to the CRDS for crime investigation purposes. Individual photographic images play an important role in witness identification procedures.

The thesis has investigated the use and uptake of ICT as a part of e-government in developing countries. It presents a case study of the Thai government, the police force and explores approaches of value adding to their existing information and technology by investigating the use of image data sharing within and between Thai government departments.

This study sought to further enhance data sharing between the Royal Thai Police and the Department of Local Administration by demonstrating an application that would support criminal investigation and improve the utilization of the IT infrastructure implemented under the Thai government IT policy. It does this by introducing a new IT application (image retrieval) that facilitates and enhances the use of the central registration image database. Two image retrieval methods were tested for comparison. The more efficient method, the Self-Similarity Search was then further tested for its effectiveness with additional attributes such as facial scars, birthmarks or tattoos.

The study then went on to investigate the perceptions and attitudes of the Thai police towards the use of ICT in police work, particularly their attitudes to the new image retrieval method, the Self-Similarity Search and its use in retrieval of images for crime investigation. Presentations were conducted and questionnaires were distributed to ten selected police stations. Follow up interviews were conducted to gain a richer meaning to the findings.

In the concluding chapter a summary of key findings, contribution, recommendation and future research are presented. Recommendations on ICT training, education and technology infrastructure are outlined for the Thai police and the Thai government. Based on the research results, areas of further research in Self-Similarity Search are also suggested. The thesis has three main objectives that are outlined in the next section together with the key findings.

8.2 SUMMARY OF RESEARCH FINDINGS

The overall aim of the thesis is to demonstrate the need for developing nations to adopt ICT as a key policy issue in order to bridge the gap between developed and developing nations and try to overcome the widening digital divide by implementing ICT policies and adopting e-governance (Heeks, 2001).

The first main objective of the thesis was to investigate the effective use of the ICT and sharing of information by government departments. Chapter One briefly outlined the background of the research, how Information Technology could be used to advance developing countries, especially in the government sector. The intention of the research was to investigate ways of improving government by sharing the innovations in e-government that have taken place at the community to country level with particular regard to the perspectives of an e-government project, which explores how governments can best exploit information and communication technologies (ICT) to enhance good governance principles and achieve public policy goals.

To achieve the aim of the this study, the literature on the use of information and communication technology in developing countries especially within and between government sectors and the adoption and barriers to ICT in developing countries was reviewed. It also includes examples of how the implementation of ICT by a government can facilitate information exchange and improve interdepartmental communication and the service to the citizens. Thailand as a developing country was selected for study in this research as an example of a nation that is trying to adopt ICT policy to bridge the gap between itself and developed nations.

8.2.1 Effective use of ICT by the Thai Government

Adoption of ICT is a key policy issue for many developing countries throughout the world. In order to bridge the gap between developed and developing nations and to try to overcome the widening digital divide developing nations are implementing ICT policies and adopting e-governance (Heek 2001, p.7)

From the literature and a thorough analysis of the Thai Government's Strategic Plans and Policies it is clear that the Thai Government is committed to improving the economic and social well being of its citizens by adopting an aggressive approach to the adoption and implementation of ICT. By the development of its policies and the establishment of Portals such as Thailandportal.com, it is setting an excellent example for Thai industry to follow. The Thailand Portal provides comprehensive Thai products and supplier information for global trade. Practical information such as export services, trade events, exchange rate, tourism, country profile, law and regulation are also included.

One of the Thai Government's National policies on Science and Technology is to promote the use of technology, particularly information technology for modern administration and management in the government sector. It was mentioned that the technology chosen should be appropriate, inexpensive and can be developed and expanded in a sustainable manner (ICT Policy, 1998).

The Thai government policy encourages the joint efforts and mutual cooperation in science and technology research and development between the government and private sectors. This includes conducting research and development in relevant technologies that may help Thailand leapfrog some of the earlier technologies that have been adopted by developed nations and bring them more into alignment with the latest technologies being used by developed nations. The joint efforts with private industry also include setting up training institutions for the transfer of technology to the Thai people (MOI, 2001). The Thai government is keen to promote and co-ordinate their efforts, by promoting the relevant use of technologies and applications, as well as disseminating best practice.

This research focused on contributing to this philosophy by investigating an application that could potential adds value to the Thai Central Registration Database System (CRDS). The idea of extending the use of the Thai citizen's photograph image to assist in crime investigation, which is an issue identified by senior bureaucrats because of the escalating number of unsolved crimes in Thailand, is a way of promoting relevant applications of IT while contributing to society and demonstrating the Governments commitment to its IT policy and e-government initiatives.

8.2.2 Results of Experiment for SSS and SQS

Having established the commitment of the Thai Government to its ICT policies and identifying the possibility of utilizing CRDS to assist in addressing the unsolved crime issue, the second main objective of the thesis was to examine the use of image retrieval for crime investigation and to test and select a suitable retrieval method.

To achieve this aim of the study a thorough literature review of image retrieval methods and techniques that could be adopted by the crime investigation unit were reviewed in Chapter Four. The main idea was to find a suitable image retrieval method that can be used to search images with a faster search time when retrieving a Criminal Record for the purpose of investigation. Moreover, the storage space required for this kind of search should be less as in the future it should be possible to retrieve all the images from the Central Registration Database which is a very large image database of the 64 million Thai citizens.

There has been a considerable amount of research carried out on the image retrieval methods and their use in the different situations and areas of work. Some of the image retrieval methods are used in the medical image database (Petrakis & Faloutsos 1997), some are used in the texture pattern image database (Ma & Manjunath 1996). Older methods such as 2D string (Chang, Shi & Yan 1987, p.414) giving binary answer like "yes or no" is slow and not scaleable. Furthermore, image content representation methods based on strings have been proven to be ineffective in capturing image content and may yield inaccurate retrieval (Petrakis & Faloutsos 1997). The needs to find the methods that allow querying particularly the face image database with the degree of similarity are considered.

After reviewing numbers of image retrieval methods, the two methods namely; the Self-Similarity Searching and the Sequential Searching methods were selected. This decision was made based on the following accounts; first of all, Satini and Jain (1996) research indicate that the Self-Similarity Searching method is more effective than the Sequential

Searching method when using it to retrieve 2-dimension face images. Second of all, Porntrakoon and J.Nukoon (1999) research suggest that the Self-Similarity Searching method could be applied to increase the speeds of the criminal records search. However, Porntrakoon and J.Nukoon research was tested on a database containing only 100 images, which is not enough to be able to be reach a substantive conclusion. An experiment that is more rigorous and robust is conducted in order to determine the best retrieval method to be used in crime investigation, and also to prove Porntrakoon and J.Nukoon's claim before introducing the Self-Similarity Searching method to the Thai police. Additional factors to be considered when conducting series of experiments are the timing issue and the availability of resources.

In order to test Satini and Jain (1996); Portrakoon and J.Nukkon (1999) theory, comparative effectiveness experiment of the Self-Similarity Search and the Sequential Search method was conducted by utilizing a large database consisting of 10,000 images obtained from different sources as detailed in Chapter Five.

Result of the 1st experiment clearly demonstrated that when performing image database search, the Self-Similarity Searching method was more efficient than the Sequential Searching both in search time and in storage space requirements, thus scaling up well for large image database. Compared to Sequential Searching, file size of the Self-Similarity is much smaller because fewer values are stored in an image. In other words, Self-Similarity Searching needs to compare fewer values between key image and store image because the number of objects and objects correlation are fixed. Thus, the Self-

Similarity searching time is faster than the Sequential searching time both in the main memory and on the disk. For example, when the degree of similarity is specified as 0%, the Self-Similarity Searching method provides the same results as the Sequential Searching method, however, the result shows that when performing the image database search the Self-Similarity technique is much faster than the Sequential Method almost seven times. This outcome is inconsistent with Satini and Jain (1999), Portrakoon and J.Nukoon (1999) research about the effectiveness of the Self-Similarity Searching method over the traditional Sequential search.

In order to improve the Self-Similarity Searching performance before the second experiment was carried out, numerous journals and articles about witness identification were reviewed. In one of the proceeding of a murder trial report in the USA (Trail Proceeding of Witness Identification Issue, 2000) it was noted that a "facial scar" is an important factor to use in identifying a suspect, it also helps the police to eliminate other suspect if eyewitness can identify distinctive marks or scars. Credibility in eyewitness identification is often an issue, however an "eyewitness identification is most credible if witness remember particular unique feature such as tattoo, scar, bad teeth etc" (Review Issue of Eyewitness Identification, 2002).

Thus based on the idea that a distinctive facial feature such as a scar is useful in eyewitness identification a second set of experiments was then performed. By using the same procedures and methods as the first experiment this time the attribute refinements were to include a "Scar". This attribute was added to the algorithm in order to find a closer likeness to the images from the database and to determine how much storage space was needed and how much time was gained when a new attribute like a "Scar" was specified. Results show that the search time is greatly decreased when the refinements of attributes like scars or birthmarks are set or specified. The results of the experiment presented in Chapter Six clearly demonstrate that the Self-Similarity Search method is a reliable and effective means of image retrieval and proves Porntrakoon and J.Nukoon (1999) conjecture with respect to Self-Similarity Search effectiveness for retrieving face images.

After the experiments, the Self-Similarity Searching method was selected as an application that could possibly be a useful application for adding value to the use of the criminal database and the Central Registration Database (CRDS) by the Thai police. This application was then demonstrated to the Thai police as outlined in Chapter Five.

8.2.3 Results of Thai Police Attitude

The third main objective of this thesis was to determine the attitudes and perceptions of the Thai police towards the adoption of IT and the Self-Similarity Searching application for crime investigation. Venkatesh et al. (2003) stated that for technologies to improve the productivity of an organization they must be accepted and used by employees in that organization. The results of the analysis of the data from the questionnaire were compared with some of the well known technology acceptance models, identified in the literature.

To achieve this aim of the study, questionnaires were distributed to the ten selected police stations in addition to the prior presentation given. Furthermore, the author uses several Technology Acceptance Models, such as TAM, TTF, MPCU, to explain results of the questionnaire in order to gain a better understanding of how the Thai police come to accept and use the proposed image retrieval for crime investigation. There were total of 149 police inspectors who participated in this study, 49.7% of the participants are classified with 'computer literacy' according to Luehrmann and Peckman (1987) and the rest of the participant are those with a lower degree of computer literacy and no computer literate.

In summary, results show that there is an inverse relationship between participants with a higher degree of computer literacy and time spent at the computer at work. Officers with a lower degree of computer literacy spend more time using the computer to conduct simple tasks, than those colleagues with more computer literacy. This can be explained by the fact that the more computer literate officers tended to be involved in more complex tasks that did not always involve the computer.

It has also been shown that an increase in awareness amongst the participants, about the application of the computer in the field of crime investigation, results in an increase in computer usage in this field. Further it was seen that the more computer literate officers tended to make a greater use of the computer whilst away from their offices rather than use the computers at their respective police stations.

Information obtained from the questionnaire and interviews with the police concluded that there are the two main eyewitness identification techniques in use in Thailand, these are Live-line up and Photo-lineup. The Photo-lineup proved to be the more popular of the two. However, 79.9% of the police officers stated that the accuracy of these procedures was based on a number of variable factors such as: confidence of eyewitness or victim, time of day or night the event took place, time lag between the occurrence of the event and it being reported to the police, and an individual's capacity of memorization. In addition a Live-lineup procedure can only be carried out once the suspect has been apprehended. A large number of the police officers felt that using the computer in the identification process would not only increase accuracy but also result in better eyewitness confidence as it avoid face-to-face contact with the perpetrator. Moreover, using a computer for witness identification would eliminate the cost associated with the lineup procedure.

An outcome of this study shows an overwhelming majority (90%) of the participants agreed that the crime investigation unit should adopt the Self-Similarity Searching method for image retrieval and that the government should invest in IT to improve its services. Most of the participants were willing to use the computer for performing image searches if their station adopted the method; and the required facilities and training were provided.

It could be concluded that neither participants with computer literacy nor those with very little or no computer literacy influence the way they accept the use of IT or the Self-Similarity Search for crime investigation. However, the participant's awareness of how a computer can be used to enhance criminal investigation and how they put this knowledge to use strongly influences the acceptation of the use of IT or the Self-Similarity Search for crime investigation.

These results are in accordance with Dishaw (2003) that by increasing knowledge through experience a tool will be perceived to be easier to use. One can also say that the experienced users would see more potential use of the tools, as they became more experience and thus would also perceive the software tools to be more useful.

In other words it means that the policemen who know how the computer can assist in criminal investigation or those who actually use the computer for such purposes see the potential of using the computer technology for crime investigation. The questionnaire results confirm that this group of participants strongly agreed that the Self-Similarity Searching method should be used for criminal image retrieval. These outcomes are also supported by Goodhue (1998) views in regards to experienced users and their choice of tools and methods used to accomplish task effectively.

Whilst trying to determine the extend to which the concept of social influence determines of police officer acceptance towards IT, the author discovered that all police officers would be willing to accept such technology if they were compelled to do so by their supervisor. This is in accordance with Davis et al. (1998) definition of subjective norm "the person perception that most people who are important to him think he should or should not perform the behavior in question".

The author also found that contrary to the findings of Moore and Benbasat (1991) the police officer's level of acceptance of IT is not due to a belief that using a computer would increase their status in the social system. Unlike personnel in the business field, police officers were more concerned about increasing the efficiency of crime solving methods rather than acquiring a high profile image.

This study incorporates the use of the technology acceptance models, which is made up of two core constructs, which are perceived usefulness and perceive ease of use. Perceived usefulness can be defined as "the degree to which a person believes that using a particular systems would enhance his or her job performance" (Davis, 1989) whereas, perceived ease of use can be defined as "the degree to which a person believes that using a particular system would be free effort" (Davis, 1989).

It is seen that in the case of the Thai police perceived usefulness does not influence perceived ease of use unless facilitating conditions such as appropriate training and computer equipment are made available at the police stations. These outcomes agree with the findings of Venkatesh (2003) that facilitating conditions are not fully mediated by intention or social influences but are a direct antecedent of usage.

Although the findings are supported by recent developments in technology acceptance models the findings are made more complex because as a developing nation IT adoption is also influenced by the barriers outlined in Chapter Two. Two of the most significant barriers for this study are "education" (Wingrad, 2000) and the lack of technology infrastructure in some of the police stations that did not have access to computers. Some of the findings presented here point to several issues that need to be considered by the Thai Royal Police Department and the Thai Police Academy. These issues are addressed in the recommendation section in this chapter.

8.3 FUTURE RESEARCH

In this research, two main issues are recommended for further study. The first issue is a development of the Self-Similarity Searching method, second is further research on the Technology Acceptance Models with an emphasis on the developing countries issue.

8.3.1 The Self-Similarity Search (SSS)

The study shows that SSS is very useful for image retrieval. Not only does it reduce the search time, the storage space requirement is also reduced. However, after introducing the Self-Similarity Search to the Thai Police, some disadvantage of the searching result was identified by some of the police officers. Sometimes the Self-Similarity Searching distributes similar searching results that may cause confusion to the eyewitness especially if they were uncertain about the suspect image at the time the crime was first reported.

However, as described in A Trainer's Manual for Law Enforcement (2000) to ensure a fair trial and the witness accuracy of identification, police are recommended to enhance the fillers with similar features in the line up as they need to ensure that the suspect does not unduly stand out. If the suspect has a unique feature not described by the witness, the police should not alter the suspect photograph. Rather the police should select fillers that have a similar, but not identical features or enhance the fillers with similar features. The demonstration of the Self-Similarity Searching method indicates that the method is suitable for the image searching. However, the technique is suitable for the eyewitness identification process only not other types of criminal investigation. It is quite useful for the police in the way that they can retrieve a set of images based on the degree of similarity. Unlike the exact match search, only a small difference in pixels could end with no match at all. In other words, police might spend a longer time searching for images using traditional image retrieval such as Sequential Searching.

Many interesting issues and problems arose during the experiment of a Self-Similarity Searching method and the development of this thesis that are challenging and could be put to further study. The possible directions for further work on the Self-Similarity Searching method is outlined as followed:

- ***Image automatic conversion:*** The automatic conversion of face image, such as face pattern conversion software, which will provide more accurate measurement of face image, would reduce the time spent on face measurement prior to the storage and retrieval.

- ***Refinement of attribute:*** The refinement of attributes, such as increasing the number of attribute for each objects e.g., eye, mouth, which will retrieve the closer likeness images from the image database.

- ***Functionality:*** enabling efficient image capture, indexing, access, and delivery in a networked environment.
- ***Interface:*** further work should provide simple, intuitive entry points into diverse collections, since most of the Thai police are not familiar with the computer programming or non computer literacy. A visual interface that uses pictures, or

icons, on the screen, menus, and short-cut keys to send commands to the computer system might be easy for them to use, in other words, it provides a user friendly for their ease of use.

8.3.2 Future Research on Technology Acceptance Model in Developing Countries

Two of the findings from the analysis of the attitudes of Thai police to the acceptance of the Self-Similarity Search for crime investigation were not supported by the literature on current Technology Acceptance Models. The first was the findings of Moore and Benbasat (1991) that states the level of IT acceptance could be influenced by perceived increase in social status. The second was that more experienced computer users would have a higher level of perceived usefulness (Dishaw, 2003). For developing countries there may be other factors, linked to barriers to adoption of ICT that influence technology acceptance. Further research needs to be undertaken to determine if developing countries need additional variables to be considered when studying Technology Acceptance Models

Previous research of Venkatesh et al. (2003) contented that little to no research has addressed the link between user acceptance and individual or organizational usage outcomes. Hence, while it is often assumed that usage will result in positive outcomes, this remains to be tested. Various Technology Acceptance Models outlined in Chapter Two were used to explain the attitude and perception of the Thai police towards the use of IT in crime investigation area that might inform further inquiry into a long term or short term effects of information technology implementation on job related outcomes, such as productivity, job satisfaction, organizational commitment, and other performance oriented constructs. Therefore, future research should also study the degree to which systems perceived as successful from an IT adoption perspective. For instance, those that are linked and highly used by users, are considered a success from an organizational perspective (Venkatesh 2003).

8.4 RECOMMENDATION

This research provides recommendation to the Thai Government in regards to the implementation of ICT plan and policy. Some findings in this research also provide recommendations for the consideration of the Royal Thai Police.

8.4.1 Recommendation for the Thai Government

E-government is the use of information and communication technology (ICT) to transform government by making it more accessible, effective, accountable and more responsible to the needs of their citizen or among the government themselves. Many countries both developing and developed countries found that they had much in common when it came to challenge on the way to achieving e-government (Wingrad, 2000).

It is recommended that the Thai government should continue to champion the adoption and implementation of ICT. However, they need to ensure that education and training are provided. In addition they need to guarantee technology infrastructure, which is one of the main indicators that Thailand is lagging in the ICT sector. This is especially so outside the urban metropolis of Bangkok, with 24 PCs per 1,000 persons and about 266

Internet users per 10,000 persons, the use of PCs and Internet access are restricted only to a small segment of society (EJISD, 2003).

Barlas (2003) suggested that developing countries should start the process of e-government by publishing government information online, beginning with rules and regulations, documents, forms. It is recommended that the publishing begin with a strategy with appropriate milestones. The government should post information of value to people in their daily lives, and the design of their web site should be easy to maintain.

Many Thai portals have already been set up as a focal point for information and knowledge exchange either for internal, inter-departmental, or government-to-citizen communication. The Thai government has provided individual portal solutions for almost every government department, as well as a portal for electronic service delivery to citizens.

Governments that engage in portal development learn that development costs and effort are considerable, but further that on-going maintenance is even more resource intensive. Without frequent updates, the portal quickly becomes outdated and loses its visitors. According to a survey by the National Electronics and Computer Technology Center in Thailand, almost 70% of Thai Internet users are not satisfied with their governmental web sites (Karnjanatawe, 2003). The main causes of dissatisfaction are out-of-date information, difficult-to-locate web sites, difficult-to-find information, lack of needs orientation, and dead links.

The Thai government should continue with the portal/ website projects as part of achieving the e-government, however, they need to monitor and ensure that funding is sustained to guarantee that information provided is relevant and current.

8.4.2 Recommendations for the Thai Police

It is my intent here to set forth a small and practical set of important recommendations along with a detailed rationale for each. The author believes that by doing this, we will maximize the chances that these recommendations will be adopted and thus lead to real change. Most of the recommendation arose from the open questionnaire, as outlined in Chapter Seven.

There are still many barriers to overcome in the rapid adoption and implementation of ICT in developing nations. Heeks (2001) identify such a barriers include lack of computer knowledge and skills by many of the government employees. In regard to the finding in this study, it has been shown that the percentage of police with computer literacy and IT knowledge is still very few in Thailand. This is also supported by the survey of Chamonman (1998), the conclusion supports the hypothesis that education is one of the barriers in the adoption of IT in developing countries. The literature review indicated that as the economy and technology are growing, there has been an increased demand for skilled knowledge workers and professionals. Skill labor is still in short supply, especially in the ICT sector (UNE, 2002). To address this issue the Thai government should invest in a high quality, comprehensive education system designed to meet the demands of the evolving workplace inline with the IT policy.

Many criminals that commit crimes these days use technology. Hi-tech crime involves networked computers and Internet technology. It falls broadly into three areas, which are attacks on technology (e.g. viruses), use of technology to commit crime (e.g. hacking, online pornography) and use of technology as a supporting activity (e.g. communication). The police should have some updated training in order to handle the situation if encountered. The Thai Police Academy should consider adding IT or computer for crime related courses in order to increase the ICT literacy in police officers.

Recommendation I: The Thai Police Cadet Academy should review the IT program curriculum and a basic computer skills course should be added to the principle program. Moreover, the Thai government should review the ICT policy in policing in specific. In addition, the Criminal Justice course, each lecture should focus on a timely issue in crime and criminal justice intended to bring new perspectives to the classroom. It should provide information on various forms of available technologies used to solve, control, and prevent crime.

Recommendation II: Given that the Thai government has been rolling out IT systems for the Royal Thai Polices such as the POLIS project the government needs to ensure that the IT infrastructure is in place for the police to access these new systems. It is recommended that the Thai government should review the ICT infrastructure plan for the Royal Thai Police to ensure that relevant computer facilities are available as well as necessary training to assist them in the crime investigation.

8.5 CONCLUSION

The main aim of this thesis was to add value to the existing data for further use and sharing amongst the Thai government department. This has been achieved by first investigating and demonstrating the use of efficient IT application for searching for similar images from an extremely large database. Secondly, it is clearly demonstrated that the Thai police were very receptive to the adoption of this IT application to aid in crime investigation. These findings are consistent with Dishaw et al (1999) TTF model. Thus, by implementation of such IT application value is added to the existing CRDS and information that is shared between Thai government departments. This research has demonstrated that the utilization of information stored in the CRDS can be improved using existing ICT infrastructure and the implementation of a relevant IT application. This improvement can be used to aid in crime investigation especially in the area of witness identification.

Over the past several years the Thai government has been promoting the development of the quality and quantity of human resources in science and technology to accommodate the great demand for labor in this field. They also wanted to create awareness and special interest in science and technology, as well as to promote scientific creativity among Thai youth. The author is committed to conduct information technology related research in order to help the Thai government develop their administration services by making them more accessible, effective, accountable, and more responsive among the government sectors and to the needs of the Thai citizen.

The research undertaken in this thesis has demonstrated that it is possible to increase the utilization of ICT infrastructure that developing nations implement by the development of simple applications, in this case an image retrieval system. Such applications will enhance the adoption of ICT citizen, in this case government departments, particularly when the users (Thai police) can see the technology fits the task (Dishaw et al. 1999).

The author strongly believes that the mutual cooperation between the government, public sector and the research scholar in conjunction with the availability of the ICT will make it possible for the developing nations to address the gap between themselves and the developed nations.

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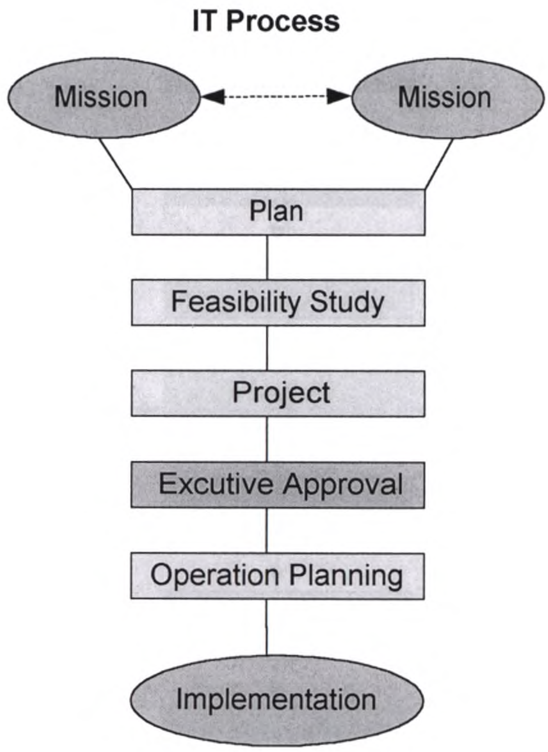
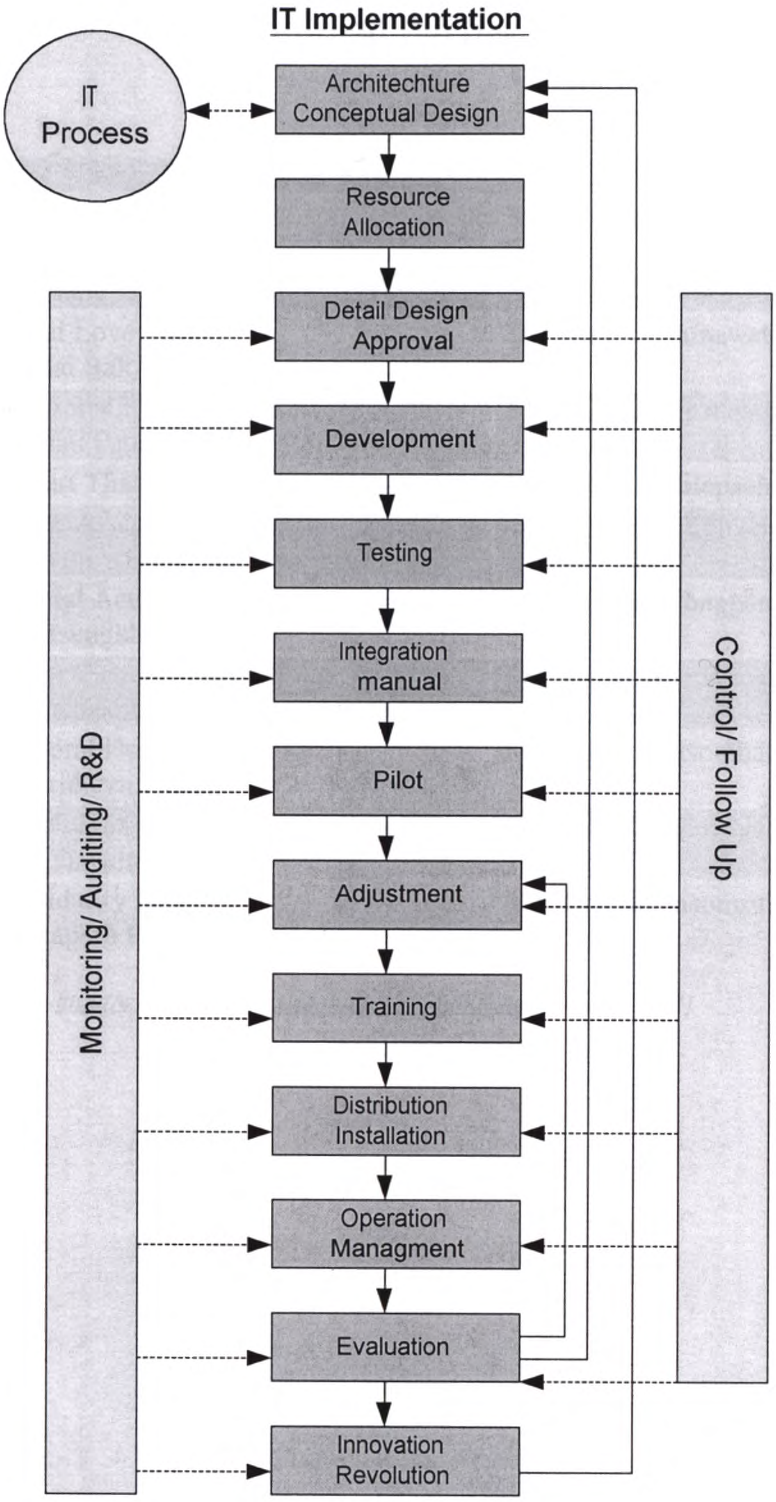
Appendix A



General IT Process for Government Approval

Source:(MOI 2002)



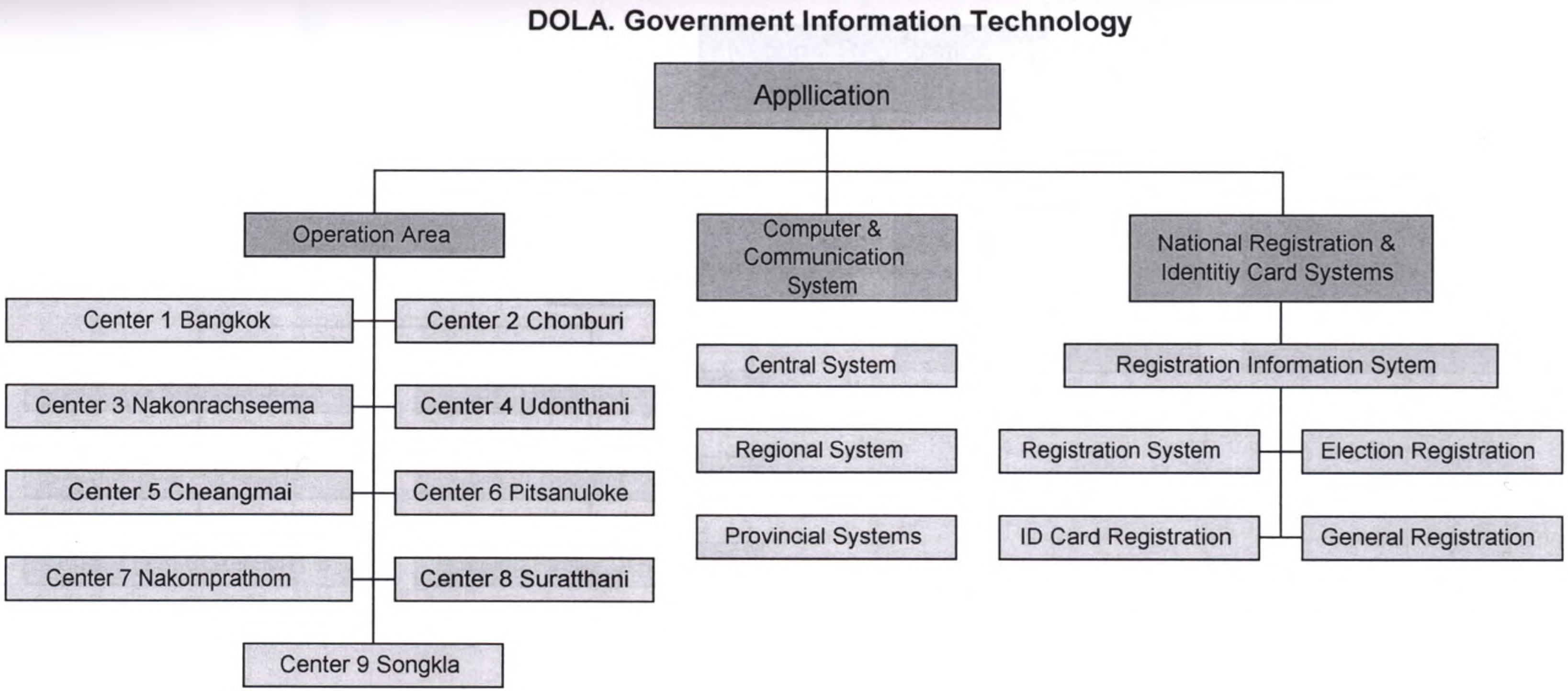
General IT Implementation Cycle in Government Project

Source:(MOI 2002)

Thai Political Parties

No.	List of Thai Political Parties	Leader
1.	Thai Democrat Party (Prachatipat)	Mr. Chuan Leekpai
2.	Phalang Dhama Party	Mr. Chaiwat Sinsuwong
3.	Thai Love Thai (Thai Rak Thai Party)	Dr. Thaksin Shinawatra
4.	National Development Party (Chatt Pattana Party)	Mr Suwat Limpatapanlop
5.	Chart Thai Party	Mr. Banharn Silapaahcha
6.	New Aspiration Party (Khamwongmai Party)	Gen. Chavalit Yongchaiyudh
7.	Social Action Party (Kitsungkhom Party	Mr. Montree Pongpanit
8.	Thai Citizen Party (Prachakorn Thai Party)	Mr. Samak Sundaravej
9.	Liberal Democratic Party (Seridham Party)	Mr. Phinij Jarusombat
10.	Mass Party (Mounchon Party)	Pol. Capt. Chalerm Ubumrung
11.	Solidarity Party (Ekaparb Party)	Mr. Chaiyot Sasomsub

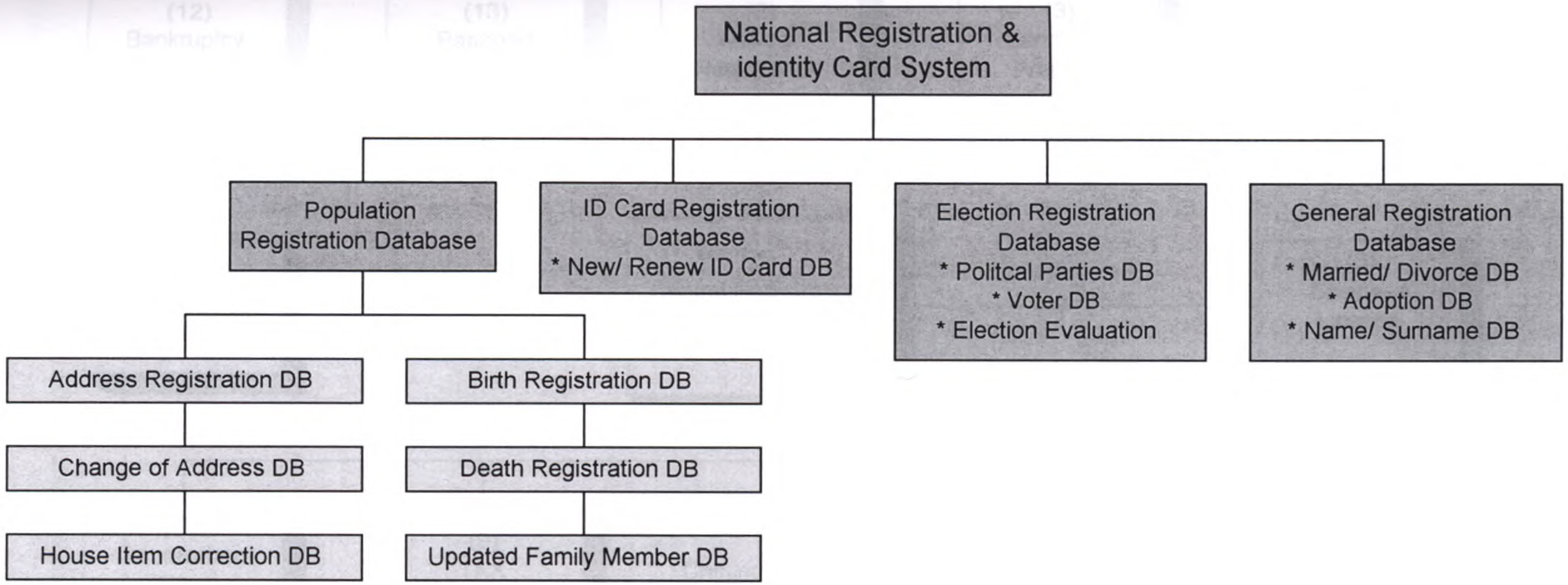
Source: http://www.parliament.go.th/files/politi/d02.htm [March, 2003]



Department of Local Administration (DOLA) : Government IT Organization Structure

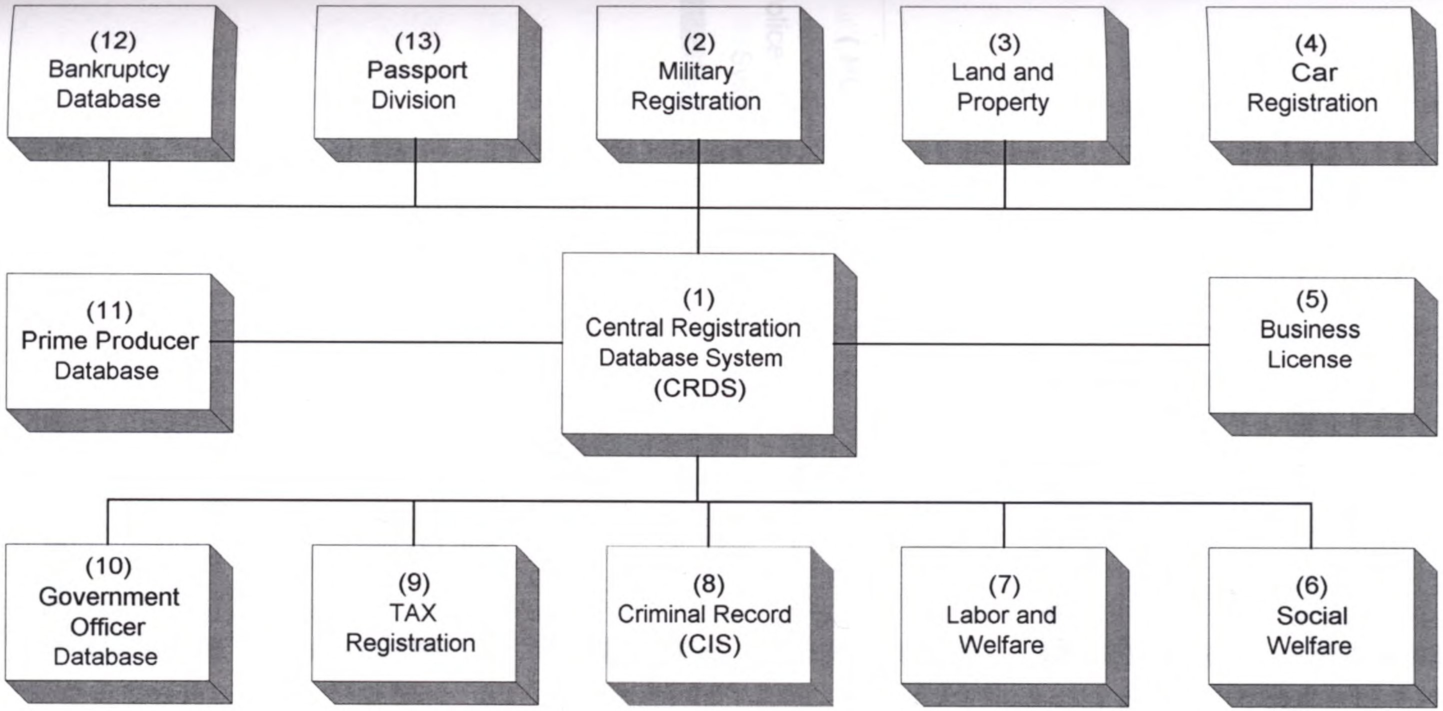
Source:(Adapted from DOLA 2002)

Appendix B



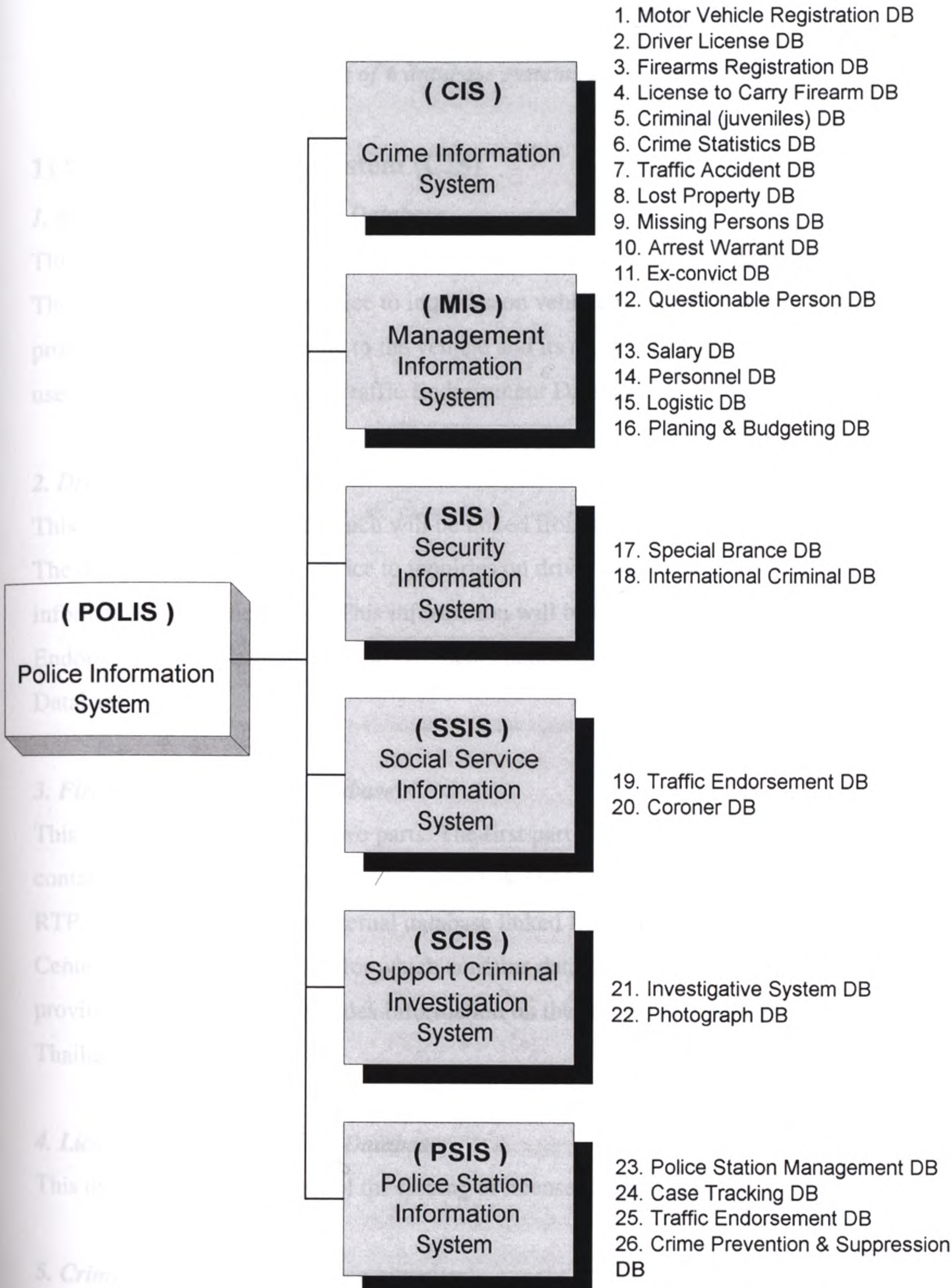
Structure of National Registration and Identity Card System

Source: (Adapted from DOLA 2002)



CRDS contains valuable information that can be shared by other authorized government agencies

Source: (Adapted from DOLA 2002)



Police Information Systems (POLIS)

Source: (Adapted from RTP 2002)

Appendix C

Police Information System (POLIS)

POLIS consists of 6 database systems and 26 databases.

1) Crime Information System (CIS)

1. Motor Vehicle Registration Database

This is an external database which will be linked from the Land Transport Department. The database will provide service to inquiries on vehicle registration which would provide information pertaining to the vehicle and its owner. This information will be used by investigators and the Traffic Endorsement Database.

2. Drivers License Database

This is an external database which will be linked from the Land Transport Department. The database will provide service to inquiries on drivers license which would provide information about the holder. This information will be used by investigators, the Traffic Endorsement Database, the Traffic Accident Database and the Penalty Scoring Database.

3. Firearms Registration Database

This database is divided into two parts. The first part is the internal database which contains data of firearms registered in Bangkok and is under the responsibility of the RTP. The second part is an external database linked from the Central Population Data Center of the Ministry of Interior which contains data of firearms registered in the provinces. This link also provides information on the 60 million registered citizen of Thailand.

4. License to Carry Firearms Database

This database is used to control the issuing of license to carry firearms.

5. Criminal Database (including juveniles)

This database contains records of all criminals.

6. Crime Statistics Database

This database is a collection of data of all criminal cases throughout the country for use in statistical analysis, investigation and evaluation of efficiency in police operations.

7.Traffic Accident Database

This database is a collection of data of all reported traffic accidents throughout the country for use in statistical analysis in efforts to minimize the number of traffic accidents.

8. Lost Property Database

This database is used to collect information on all reported lost items ranging from motor vehicles to household items.

9. Missing Persons Database

This database contains details of missing persons and will be linked to information relating to unidentified bodies (John Doe) in the Coroner Database.

10. Arrest Warrant Database

This database contains details of issued arrest warrants and will be automatically linked to other related databases.

11.Exconvict Database

This database contains details of criminals who have been released from prison. The information will provided to the respective jurisdiction of residence.

12.Questionable Persons Database

This database contains secret data on persons suspected of criminal acts such as being involved in organized crime, being hired assassins and drug dealers.

2) Management Information System (MIS)

1. Salary Database

This database contains salary records of every police officer and is linked to the Personnel Database.

2. Personnel Database

This database contains records of police officers and provides services to inquiries on personnel records such as position appointments, movements, disciplinary actions, royal decorations, education, etc.

3. Planning and Budgeting Database

This database is used to provide trial balance sheet, check use of budget, control use of budget, used for setting up budget for the following year and to manage an efficient use of the budget.

4. Logistic Database

This database is used to collect data relating to all equipment and supplies from the acquisition stage to their registration, distribution, maintenance and withdrawal from registration. Such as office equipment, motor vehicle, communication equipment, firearms, land property and construction.

3) Security Information System (SIS)

1. Special Branch Database

This database contains secret data on persons suspected of breach of national security such as terrorism and espionage.

2. International Criminal Database

This database contains data on foreigners who may commit crimes in Thailand or may be wanted by other countries. This data is obtained from INTERPOL, ASEANAPOL and direct requests from other countries.

4) Social Services Information System (SSIS)

1. Traffic Endorsement Database

This is a central database for traffic endorsements and for penalty scoring.

2. Coroner Database

This database contains data on the unidentified bodies and records of autopsies.

5) Support Criminal Investigation System (SCIS)

1. Investigative System (I2)

This system will assist the investigating officers in their search for relevant information such as persons, activities and property, by automatically linking with related databases. For example, a search for "Mr.X" will invoke automatic searches in Criminal Database, Firearms Database, Missing Persons Database, Arrest Warrant Database, Exconvict Database . Other than this, Information to Image (I2) software is also used to provide graphical images of relationships between persons and events, where events may be telephone numbers, vehicle registration or location. This will lead investigators to the networking of gang operations.

2. Photograph Database

This database contains all graphical images related to other databases.

6. Police Station Information System (PSIS)

1. Police Station Management Database

This database contains all information needed to manage a police station, such as personnel, finance and logistics. The information is used to prepare schedule of operations, control the use of budget and control the use of police equipment.

2. Case Tracking Database

This database contains all the details of cases that occur in each police station's jurisdiction, such as case number, date/time, type of offense, details of the injured party, investigating officer and outcome of the case, and is linked to the Arrest Warrant Database, Stolen Property Database etc. This is used for keeping track of cases through their judicial processes upto the final verdict.

3. Traffic Endorsement Database

This database contains on traffic endorsements issued by each police station and details of receipts issued for fine payments. This is used for local management and for evaluating performance of each traffic police officer.

4. Crime Prevention and Suppression Database

This database contains details of local suspected persons or persons with tendency towards mischief, such as motorcycle taxi operators, local influential persons and local bullies.

7) Equipment Distribution

Most divisions and sub-division will receive between 1 to 3 computers. Major data entry divisions would receive more computer, such as Traffic Endorsement Control Center of the Traffic Division and the Criminal Records Division would receive 15 and 30 computers respectively. Metropolitan Police Stations would receive between 2 to 3 computers, Provincial Area Headquarters - 1, Provincial Area Administrative Division - 4, Investigation Sub-Division - 1, Provincial Headquarters - 1 and Provincial City Police Stations - 1. In all, there are 640 computers, 457 dot matrix printers and 23 laser printers. Desks and chairs would also be provided, so the only thing the recipient has to do is specify the location.

Although the number of computers are not sufficient to serve the needs, it must be noted that this is only the first phase. It is the establishment of main pipelines to major parts of he country. Further phases will see links to every provincial police stations throughout the country.

8) Operation

Applications in POLIS are developed on the Windows environment using Visual Basic and presented in the form of Graphic User Interface (GUI). Every screen is presented in Thai and very user friendly, so users do not have to be computer experts.

Eventhough POLIS consists of 6 database systems with 26 centralized databases, access to each of the databases would be restricted to users need to know. For example, personnel officers in Chiengmai will only be able to access personnel records of police officers in Chiengmai and will not be able to access Vehicle Registration Database, Arrest Warrants Database etc.

The successful completion of POLIS will solely depend on the collaboration of the sources of the data. PISC merely acts as a go-between for users to access data in an efficient manner. The uses of acquired data through this system will be governed by the database owners. The owners will specify as to which data may be updated or deleted and by whom.

POLIS will effectively change the old vertical procedure of operations to a much more efficient horizontal procedure of operations (flat organization). In the past, for sect-1 div-1 bur-1 to obtain data from sect-2 div-2 bur-2 requests must be made through channels of command from section 1 to division 1 to bureau 1 to bureau 2 to division 2 to section 2 and back again. This is vastly time consuming. The new procedure will enable section 1 to directly request data from section 2, if the data is classified as distributable.

Thus, POLIS is not just an information system which involves 26 databases and reduces redundancy in operations but also serves to modify police operations to gain an advantage on criminals, increase effectiveness and efficiency, and strive towards new and better ways of police management. At times where jurisdictional areas are being decreased to better serve the public, criminals are taking advantage of the country's growth to commit wider range of crimes throughout the country. Therefore, the police must use information systems to rapidly extend the arms of the law to every corner of the country.

The Statistics of Reported Crimes of Thailand during January – December 2000

Type of Crime	Reported	Arrested
1. Violent Crime	**8258**	**3763**
1.1 Murder	5135	2043
1.2 Gang Robbery	790	427
1.3 Robbery (total)	2032	1100
1.4 Kidnapping	15	11
1.5 Arson	286	182
2. Crimes against Person	**34787**	**22099**
2.1 Murder	5135	2043
2.2 Non-Negligent Manslaughter	230	151
2.3 Negligent Manslaughter	290	211
2.4 Attempted Murder	4735	2429
2.5 Assault	20360	14640
2.6 Rape	4037	2625
3. Property of Crimes	**68334**	**35377**
3.1 Theft	58435	29024
3.2 Snatching	1979	1309
3.3 Blackmail	10	6
3.4 Extortion	308	217
3.5 Robbery (total)	2032	1100
- Injury to victim	612	334
- No injury to victim	1420	766
3.6 Gang Robbery	790	427
3.7 Possession of Stolen Good	300	274
3.8 Vandalism	4480	3020
4. Interesting Crimes	**43450**	**12269**
4.1 Motorcycle Theft	19011	4583
4.2 Car Theft	3322	417
4.3 Cattle Theft	462	130
4.4 Agricultural Instruments Theft	546	118
4.5 Bus Robbery	1	0
4.6 Taxi Robbery	35	20
4.7 Rape and Murder	16	15
4.8 Kidnapping	15	11
4.9 Cheating and Fraud	6922	3099
4.10 Misappropriation	13120	3876
	Cases	**Defendants**
5. Victimless Crimes	**380306**	**550458**
5.1 Offensive Weapon	20001	20486
- General Weapon	19404	19926
- War Weapon	597	560
5.2 Gambling	83862	241033
- General Gambling	56090	212764
- Illegal Shares	27772	28269
5.3 Narcotics	263324	275551
5.4 Prostitution	11345	11591
5.5 Pornography	1774	1797

Note: Populations = 61,661,701

Source : Royal Thai Police (Last update : 12 Feb 01)

Appendix D

EXPERIMENT I:

TOLERANCE versus RESPONSE TIME

Experimental result of the average search time in (second) of Sequential Search vs. Self-Similarity Search when tolerance is = 0% or when positive correlation (0<H<0.5) with Image database up to 10,000.

Images = 100

TRIAL	1st	2nd	3rd	4^{th}	5th	AVG
Sequential Search	4.20	4.21	4.21	4.19	4.21	4.20
Self-Similarity Search	0.63	0.61	0.62	0.62	0.62	0.62

Images = 200

TRIAL	1st	2nd	3rd	4^{th}	5th	AVG
Sequential Search	7.98	7.98	7.98	8.01	8.01	7.99
Self-Similarity Search	1.18	1.16	1.20	1.19	1.18	1.18

Images = 300

TRIAL	1st	2nd	3rd	4^{th}	5th	AVG
Sequential Search	12.19	12.25	12.23	12.23	12.25	12.22
Self-Similarity Search	1.74	1.76	1.76	1.78	1.76	1.76

Images = 400

TRIAL	1st	2nd	3rd	4^{th}	5^{th}	AVG
Sequential Search	16.46	16.44	16.39	16.39	16.37	16.41
Self-Similarity Search	2.39	2.41	2.41	2.39	2.41	2.40

Image = 500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	20.58	20.59	20.58	20.57	20.58	20.58
Self-Similarity Search	3.06	3.08	3.06	3.02	3.00	3.04

Images = 600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	24.79	24.76	24.76	24.74	24.79	24.76
Self-Similarity Search	3.63	3.65	3.67	3.65	3.65	3.65

Images = 700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	29.03	28.98	28.99	28.99	29.07	29.01
Self-Similarity Search	4.27	4.27	4.25	4.23	4.23	4.25

Images = 800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	33.21	33.19	33.22	33.19	33.19	33.19
Self-Similarity Search	4.82	4.84	4.88	4.86	4.86	4.85

Images = 900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	37.39	37.40	37.42	37.43	37.43	37.41
Self-Similarity Search	5.51	5.52	5.47	5.48	5.47	5.49

Images = 1000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	41.65	41.63	41.63	41.59	41.60	41.62
Self-Similarity Search	6.09	6.11	6.09	6.06	6.06	6.08

Images = 1100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	45.81	45.84	45.81	45.79	45.85	45.82
Self-Similarity Search	6.74	6.69	6.74	6.72	6.73	6.72

Images = 1200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	50.01	50.03	50.01	49.99	50.01	50.01
Self-Similarity Search	7.35	7.35	7.37	7.37	7.37	7.36

Images = 1300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	54.14	54.16	54.14	54.22	54.24	54.18
Self-Similarity Search	8.00	8.01	8.00	7.99	8.00	8.00

Images = 1400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	58.38	58.38	58.35	58.32	58.35	58.35
Self-Similarity Search	8.62	8.62	8.59	8.58	8.61	8.60

Images = 1500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	62.57	62.57	62.57	62.57	62.57	62.57
Self-Similarity Search	9.23	9.25	9.25	9.27	9.25	9.25

Images = 1600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	66.73	66.75	66.75	66.69	66.79	66.74
Self-Similarity Search	9.89	9.87	9.87	9.83	9.84	9.86

Images = 1700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	70.95	71.00	70.98	70.89	70.97	70.95
Self-Similarity Search	10.49	10.51	10.49	10.51	10.51	10.50

Images = 1800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	75.21	75.19	75.15	75.13	75.19	75.17
Self-Similarity Search	11.09	11.11	11.11	11.07	11.09	11.09

Images = 1900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	79.40	79.43	79.39	79.39	79.44	79.41
Self-Similarity Search	11.71	11.72	11.74	11.75	11.74	11.73

Images = 2000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	83.62	83.64	83.62	83.58	83.59	83.61
Self-Similarity Search	12.33	12.35	12.37	12.35	12.40	12.36

Images = 2100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	87.84	87.81	87.84	87.85	87.81	87.83
Self-Similarity Search	12.93	12.89	12.95	12.95	12.90	12.92

Images = 2200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	92.01	91.99	92.01	92	92	92
Self-Similarity Search	13.52	13.54	13.54	13.58	13.59	13.55

Images = 2300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	96.21	96.20	96.18	96.18	96.15	96.18
Self-Similarity Search	14.18	14.18	14.16	14.14	14.11	14.15

Images = 2400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	100.41	100.38	100.38	100.37	100.42	100.39
Self-Similarity Search	14.82	14.86	14.84	14.86	14.82	14.84

Images = 2500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	104.57	104.59	104.61	104.57	104.53	104.57

Self-Similarity Search	15.44	15.45	15.44	15.49	15.49	15.46

Images = 2600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	108.77	108.78	108.75	108.72	108.73	108.75
Self-Similarity Search	16.06	16.07	16.06	16.06	16.06	16.06

Images = 2700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	112.99	113.00	112.99	112.98	112.95	112.98
Self-Similarity Search	16.64	16.67	16.65	16.66	16.65	16.65

Images = 2800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	117.19	117.24	117.19	117.24	117.19	117.21
Self-Similarity Search	17.29	17.31	17.29	17.27	17.25	17.28

Images = 2900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	121.45	121.41	121.38	121.38	121.45	121.41
Self-Similarity Search	17.88	17.84	17.88	17.86	17.86	17.86

Images = 3000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	125.61	125.59	125.63	125.63	125.64	125.62
Self-Similarity Search	18.49	18.51	18.50	18.51	18.54	18.51

Images = 3100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	129.82	129.81	129.78	129.76	129.74	129.78
Self-Similarity Search	19.19	19.21	19.18	19.16	19.13	19.17

Images = 3200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	133.97	133.97	134.01	133.85	133.93	133.95
Self-Similarity Search	19.77	19.74	19.72	19.74	19.80	19.75

Images = 3300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	138.11	138.16	138.17	138.16	138.12	138.14
Self-Similarity Search	20.41	20.39	20.41	20.43	20.48	20.42

Images = 3400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	142.38	142.39	142.35	142.35	142.38	142.37

Self-Similarity Search	21.03	21.01	21.01	20.98	21.03	21.01

Images = 3500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	146.59	146.57	146.60	146.64	146.65	146.61
Self-Similarity Search	21.62	21.65	21.67	21.65	21.67	21.65

Images = 3600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	150.83	150.83	150.79	150.79	150.82	150.81
Self-Similarity Search	22.18	22.21	22.23	22.27	22.31	22.24

Images = 3700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	155.03	155.05	154.98	154.99	155.05	155.02
Self-Similarity Search	22.92	22.90	22.89	22.88	22.92	22.90

Images = 3800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	159.24	159.22	159.22	159.18	159.21	159.21
Self-Similarity Search	23.50	23.49	23.50	23.55	23.57	23.52

Images = 3900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	163.41	163.39	163.37	163.39	163.41	163.39
Self-Similarity Search	24.11	24.13	24.11	24.13	24.13	24.12

Images = 4000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	167.52	167.56	167.59	167.64	167.59	167.58
Self-Similarity Search	24.77	24.79	24.75	24.72	24.69	24.74

Images = 4100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	171.78	171.75	171.77	171.75	171.75	171.76
Self-Similarity Search	25.34	25.32	25.36	25.36	25.43	25.36

Images = 4200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	176.01	176.05	176.05	176.03	175.98	176.02
Self-Similarity Search	25.97	25.95	25.93	25.95	25.97	25.95

Images = 4300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	180.26	180.26	180.24	180.20	180.20	180.23
Self-Similarity Search	26.52	26.51	26.52	26.56	26.59	26.54

Images = 4400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	184.47	184.45	184.47	184.39	184.39	184.43
Self-Similarity Search	27.23	27.21	27.21	27.18	27.23	27.21

Images = 4500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	188.61	188.59	188.59	188.67	188.65	188.62
Self-Similarity Search	27.81	27.78	27.80	27.78	27.78	27.79

Images = 4600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	192.79	192.79	192.78	192.81	192.78	192.79
Self-Similarity Search	28.43	28.41	28.46	28.44	28.46	28.44

Images = 4700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	196.97	196.99	196.98	196.95	196.95	196.97
Self-Similarity Search	29.09	29.11	29.11	29.07	29.02	29.08

Images = 4800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	201.21	201.23	201.21	201.19	201.21	201.21
Self-Similarity Search	29.71	29.73	29.68	29.74	29.71	29.71

Images = 4900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	205.34	205.38	205.37	205.36	205.37	205.36
Self-Similarity Search	30.29	30.33	30.36	30.33	30.39	30.34

Images = 5000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	209	211.5	208	210	209	209.5
Self-Similarity Search	30.92	30.89	30.85	30.85	30.89	30.88

Images = 5100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	213.77	213.76	213.79	213.79	213.81	213.78
Self-Similarity Search	31.49	31.52	31.54	31.52	31.54	31.52

Images = 5200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	218.01	218	217.99	218	218	218

Self-Similarity Search	32.15	32.15	32.12	32.11	32.12	32.13

Images = 5300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	222.22	222.23	222.22	222.21	222.22	222.22
Self-Similarity Search	32.81	32.79	32.77	32.75	32.79	32.78

Images = 5400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	226.43	226.40	226.37	226.43	226.44	226.41
Self-Similarity Search	33.41	33.39	33.39	33.44	33.52	33.43

Images = 5500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	230.61	230.64	230.65	230.61	230.64	230.63
Self-Similarity Search	34.03	34.06	34.09	34.06	34.03	34.05

Images = 5600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	234.81	234.85	234.82	234.81	234.86	234.83
Self-Similarity Search	34.66	34.69	34.67	34.66	34.72	34.68

Images = 5700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	238.98	238.99	239.03	239.01	239.04	239.01
Self-Similarity Search	35.27	35.31	35.29	35.29	35.26	35.28

Images = 5800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	243.20	243.18	243.21	243.23	243.24	243.21
Self-Similarity Search	35.89	35.89	35.91	35.95	35.96	35.92

Images = 5900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	247.39	247.41	247.41	247.40	247.39	247.4
Self-Similarity Search	36.57	36.55	36.55	36.51	36.53	36.54

Images = 6000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	251.62	251.60	251.58	251.57	251.58	251.59
Self-Similarity Search	37.11	37.13	37.10	37.11	37.15	37.12

Images = 6100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	255.80	255.79	255.83	255.80	255.77	255.79

Self-Similarity Search	37.76	37.74	37.72	37.70	37.74	37.73

Images = 6200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	260.03	260.01	260.03	260.01	260.03	260.02
Self-Similarity Search	38.37	38.35	38.32	38.35	38.37	38.35

Images = 6300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	264.24	264.22	264.23	264.24	264.22	264.23
Self-Similarity Search	38.94	38.96	38.98	38.97	38.96	38.96

Images = 6400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	268.38	268.35	268.36	268.34	268.37	268.36
Self-Similarity Search	39.54	39.57	39.59	39.55	39.57	39.56

Images = 6500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	272.61	272.59	272.57	272.57	272.57	272.58
Self-Similarity Search	40.21	40.21	40.18	40.18	40.18	40.19

Images = 6600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	276.77	276.77	276.77	276.77	276.77	276.77
Self-Similarity Search	40.84	40.85	40.83	40.81	40.83	40.83

Images = 6700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	281.01	281.01	281.02	281.01	281.01	281.01
Self-Similarity Search	41.43	41.48	41.48	41.46	41.46	41.46

Images = 6800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	285.17	285.18	285.21	285.18	285.21	285.19
Self-Similarity Search	42.06	42.07	42.06	42.06	42.06	42.06

Images = 6900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	289.35	289.39	289.41	289.39	289.37	289.38
Self-Similarity Search	42.47	42.46	42.45	42.44	42.43	42.45

Images = 7000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	293.64	293.61	293.63	293.60	293.63	293.62

Self-Similarity Search	43.31	43.31	43.35	43.37	43.33	43.33

Images = 7100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	297.78	297.75	297.72	297.72	297.78	297.75
Self-Similarity Search	43.97	43.95	43.95	43.93	43.93	43.95

Images = 7200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	301.96	301.93	301.91	301.96	301.96	301.94
Self-Similarity Search	44.57	44.57	44.59	44.57	44.60	44.58

Images = 7300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	306.11	306.15	306.17	306.17	306.13	306.14
Self-Similarity Search	45.19	45.20	45.23	45.21	45.23	45.21

Images = 7400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	310.43	310.40	310.39	310.40	310.43	310.41
Self-Similarity Search	45.84	45.83	45.81	45.81	45.81	45.82

Images = 7500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	314.61	314.63	314.61	314.59	314.61	314.61
Self-Similarity Search	46.44	46.44	46.44	46.45	46.44	46.44

Images = 7600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	318.77	318.77	318.75	318.77	318.74	318.76
Self-Similarity Search	47.03	47.04	47.02	47.06	47.06	47.04

Images = 7700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	323.04	323.03	323.03	323.02	323.03	323.03
Self-Similarity Search	47.66	47.65	47.66	47.64	47.65	47.65

Images = 7800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	327.12	327.14	327.14	327.18	327.17	327.15
Self-Similarity Search	48.27	48.29	48.30	48.29	48.27	48.28

Images = 7900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	331.36	331.34	331.32	331.32	331.36	331.34
Self-Similarity Search	48.92	48.93	48.92	48.90	48.89	48.91

Images = 8000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	335.61	335.61	335.63	335.65	335.65	335.63
Self-Similarity Search	49.55	49.55	49.56	49.55	49.55	49.55

Images = 8100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	339.85	339.84	339.84	339.82	339.81	339.83
Self-Similarity Search	50.19	50.17	50.21	50.19	50.15	50.18

Images = 8200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	343.99	343	343.99	343	343.99	343.99
Self-Similarity Search	50.78	50.77	50.78	50.81	50.81	50.79

Images = 8300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	348.17	348.16	348.19	348.20	348.19	348.18
Self-Similarity Search	51.39	51.40	51.40	51.39	51.37	51.39

Images = 8400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	352.40	352.39	352.39	352.40	352.39	352.39
Self-Similarity Search	52.01	52.01	52.01	52	52.01	52.01

Images = 8500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	356.59	356.57	356.55	356.55	356.59	356.57
Self-Similarity Search	52.60	52.59	52.62	52.60	52.64	52.61

Images = 8600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	360.82	360.81	360.82	360.83	360.79	360.81
Self-Similarity Search	53.25	53.24	53.22	53.25	53.22	53.23

Images = 8700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	365	365.01	365.01	365.01	365.01	365.01
Self-Similarity Search	53.86	53.87	53.85	53.86	53.86	53.86

Images = 8800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	369.19	369.23	369.21	369.23	369.24	369.22
Self-Similarity Search	54.48	54.49	54.48	54.47	54.48	54.48

Images = 8900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	373.44	373.46	373.44	373.41	373.41	373.43
Self-Similarity Search	55.09	55.11	55.09	55.08	55.08	55.09

Images = 9000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	377.60	377.59	377.60	377.60	377.61	377.60
Self-Similarity Search	55.72	55.71	55.71	55.71	55.71	55.71

Images = 9100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	381.80	381.80	381.80	381.81	381.80	381.80
Self-Similarity Search	56.33	56.31	56.33	56.31	56.33	56.32

Images = 9200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	386	386	386	386	386	386
Self-Similarity Search	56.99	56.97	56.96	56.96	56.99	56.97

Images = 9300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	390.19	390.21	390.18	390.17	390.17	390.18
Self-Similarity Search	57.60	57.60	57.60	57.61	57.60	57.60

Images = 9400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	394.35	394.35	394.36	394.37	394.37	394.36
Self-Similarity Search	58.23	58.21	58.22	58.22	58.22	58.22

Images = 9500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	398.64	398.62	398.62	398.60	398.59	398.61
Self-Similarity Search	58.85	58.85	58.86	58.88	58.86	58.86

Images = 9600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	402.84	402.82	402.84	402.84	402.82	402.83
Self-Similarity Search	59.45	59.45	59.45	59.45	59.45	59.45

Images = 9700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	407.04	407.02	407.03	407.02	407.01	407.02
Self-Similarity Search	60.07	60.05	60.03	60.05	60.05	60.05

Images = 9800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	411.22	411.22	411.22	411.22	411.23	411.22
Self-Similarity Search	60.72	60.71	60.69	60.71	60.72	60.71

Images = 9900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	415.41	415.39	415.40	415.38	415.38	415.39
Self-Similarity Search	61.33	61.32	61.33	61.30	61.33	61.32

Images = 10000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Sequential Search	419.50	419.51	419.50	419.50	419.50	419.5
Self-Similarity Search	62.02	62.01	62	62	62	62

EXPERIMENT II

TOLERANCE versus RESPONSE TIME

Experimental result of the average search time in (second) of the Self-Similarity Search with and without Scar specification when tolerance is = 0% or when positive correlation (0<H<0.5) with Image database up to 10,000.

Images = 100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	0.63	0.61	0.62	0.62	0.62	0.62
SSS with SCAR	0.066	0.065	0.064	0.065	0.065	0.065

Images = 200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	1.18	1.16	1.20	1.19	1.18	1.18
SSS with SCAR	0.02	0.02	0.01	0.01	0.01	0.01

Images = 300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	1.74	1.76	1.76	1.78	1.76	1.76
SSS with SCAR	0.016	0.017	0.017	0.017	0.018	0.017

Images = 400

TRIAL	1st	2nd	3rd	4th	5^{th}	AVG
Self-Similarity Search	2.39	2.41	2.41	2.39	2.41	2.40
SSS with SCAR	0.02	0.02	0.02	0.02	0.019	0.02

Image = 500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	3.06	3.08	3.06	3.02	3.00	3.04
SSS with SCAR	0.03	0.03	0.03	0.28	0.29	0.03

Images = 600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	3.63	3.65	3.67	3.65	3.65	3.65
SSS with SCAR	0.03	0.034	0.038	0.038	0.038	0.036

Images = 700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	4.27	4.27	4.25	4.23	4.23	4.25
SSS with SCAR	0.04	0.044	0.042	0.041	0.043	0.042

Images = 800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	4.82	4.84	4.88	4.86	4.86	4.85
SSS with SCAR	0.045	0.047	0.05	0.049	0.048	0.048

Images = 900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	5.51	5.52	5.47	5.48	5.47	5.49
SSS with SCAR	0.057	0.058	0.052	0.055	0.053	0.055

Images = 1000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	6.09	6.11	6.09	6.06	6.06	6.08
SSS with SCAR	0.07	0.08	0.07	0.04	0.04	0.06

Images = 1100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	6.74	6.69	6.74	6.72	6.73	6.72
SSS with SCAR	0.068	0.065	0.068	0.066	0.067	0.067

Images = 1200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	7.35	7.35	7.37	7.37	7.37	7.36
SSS with SCAR	0.072	0.072	0.074	0.074	0.073	0.073

Images = 1300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	8.00	8.01	8.00	7.99	8.00	8.00
SSS with SCAR	0.08	0.09	0.08	0.07	0.08	0.08

Images = 1400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	8.62	8.62	8.59	8.58	8.61	8.60
SSS with SCAR	0.088	0.088	0.085	0.084	0.086	0.086

Images = 1500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	9.23	9.25	9.25	9.27	9.25	9.25
SSS with SCAR	0.09	0.09	0.09	0.092	0.091	0.091

Images = 1600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	9.89	9.87	9.87	9.83	9.84	9.86
SSS with SCAR	0.099	0.1	0.098	0.095	0.096	0.098

Images = 1700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	10.49	10.51	10.49	10.51	10.51	10.50
SSS with SCAR	0.15	0.1	0.95	0.1	0.1	0.1

Images = 1800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	11.09	11.11	11.11	11.07	11.09	11.09
SSS with SCAR	0.115	0.11	0.11	0.11	0.11	0.11

Images = 1900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	11.71	11.72	11.74	11.75	11.74	11.73
SSS with SCAR	0.115	0.119	0.118	0.116	0.117	0.117

Images = 2000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	12.33	12.35	12.37	12.35	12.40	12.36
SSS with SCAR	0.128	0.126	0.12	0.112	0.114	0.12

Images = 2100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	12.93	12.89	12.95	12.95	12.90	12.92
SSS with SCAR	0.13	0.131	0.13	0.13	0.131	0.13

Images = 2200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	13.52	13.54	13.54	13.58	13.59	13.55
SSS with SCAR	0.135	0.135	0.135	0.135	0.135	0.135

Images = 2300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	14.18	14.18	14.16	14.14	14.11	14.15
SSS with SCAR	0.142	0.14	0.138	0.14	0.141	0.14

Images = 2400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	14.82	14.86	14.84	14.86	14.82	14.84
SSS with SCAR	0.146	0.145	0.15	0.148	0.15	0.148

Images = 2500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	15.44	15.45	15.44	15.49	15.49	15.46
SSS with SCAR	0.15	0.151	0.152	0.15	0.15	0.15

Images = 2600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	16.06	16.07	16.06	16.06	16.06	16.06
SSS with SCAR	0.16	0.16	0.16	0.16	0.16	0.16

Images = 2700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	16.64	16.67	16.65	16.66	16.65	16.65
SSS with SCAR	0.164	0.165	0.164	0.165	0.165	0.165

Images = 2800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	17.29	17.31	17.29	17.27	17.25	17.28
SSS with SCAR	0.17	0.17	0.172	0.17	0.17	0.17

Images = 2900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	17.88	17.84	17.88	17.86	17.86	17.86
SSS with SCAR	0.179	0.178	0.178	0.178	0.178	0.178

Images = 3000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	18.49	18.51	18.50	18.51	18.54	18.51
SSS with SCAR	0.184	0.185	0.185	0.185	0.184	0.185

Images = 3100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	19.19	19.21	19.18	19.16	19.13	19.17
SSS with SCAR	0.191	0.192	0.191	0.191	0.191	0.19

Images = 3200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	19.77	19.74	19.72	19.74	19.80	19.75
SSS with SCAR	0.197	0.197	0.197	0.197	0.198	0.197

Images = 3300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	20.41	20.39	20.41	20.43	20.48	20.42
SSS with SCAR	0.2	0.2	0.2	0.2	0.2	0.2

Images = 3400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	21.03	21.01	21.01	20.98	21.03	21.01
SSS with SCAR	0.21	0.21	0.21	0.21	0.21	0.21

Images = 3500

TRIAL	1st	2nd	3^{rd}	4th	5th	AVG
Self-Similarity Search	21.62	21.65	21.67	21.65	21.67	21.65
SSS with SCAR	0.216	0.217	0.217	0.216	0.216	0.216

Images = 3600

TRIAL	1st	2nd	3^{rd}	4th	5th	AVG
Self-Similarity Search	22.18	22.21	22.23	22.27	22.31	22.24
SSS with SCAR	0.22	0.22	0.22	0.22	0.22	0.22

Images = 3700

TRIAL	1st	2nd	3^{rd}	4th	5th	AVG
Self-Similarity Search	22.92	22.90	22.89	22.88	22.92	22.90
SSS with SCAR	0.229	0.229	0.228	0.23	0.23	0.23

Images = 3800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	23.50	23.49	23.50	23.55	23.57	23.52
SSS with SCAR	0.235	0.234	0.235	0.235	0.235	0.235

Images = 3900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	24.11	24.13	24.11	24.13	24.13	24.12
SSS with SCAR	0.24	0.24	0.24	0.24	0.24	0.24

Images = 4000

TRIAL	1st	2^{nd}	3rd	4th	5th	AVG
Self-Similarity Search	24.77	24.79	24.75	24.72	24.69	24.74
SSS with SCAR	0.247	0.247	0.247	0.246	0.246	0.246

Images = 4100

TRIAL	1st	2^{nd}	3rd	4th	5th	AVG
Self-Similarity Search	25.34	25.32	25.36	25.36	25.43	25.36
SSS with SCAR	0.25	0.25	0.25	0.25	0.25	0.25

Images = 4200

TRIAL	1st	2^{nd}	3rd	4th	5th	AVG
Self-Similarity Search	25.97	25.95	25.93	25.95	25.97	25.95
SSS with SCAR	0.25	0.26	0.25	0.25	0.26	0.25

Images = 4300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	26.52	26.51	26.52	26.56	26.59	26.54
SSS with SCAR	0.26	0.26	0.26	0.26	0.26	0.26

Images = 4400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	27.23	27.21	27.21	27.18	27.23	27.21
SSS with SCAR	0.27	0.27	0.27	0.27	0.27	0.27

Images = 4500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	27.81	27.78	27.80	27.78	27.78	27.79
SSS with SCAR	0.278	0.277	0.277	0.278	0.277	0.277

Images = 4600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	28.43	28.41	28.46	28.44	28.46	28.44
SSS with SCAR	0.28	0.28	0.28	0.28	0.28	0.28

Images = 4700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	29.09	29.11	29.11	29.07	29.02	29.08
SSS with SCAR	0.29	0.29	0.29	0.29	0.29	0.29

Images = 4800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	29.71	29.73	29.68	29.74	29.71	29.71
SSS with SCAR	0.297	0.297	0.297	0.297	0.297	0.297

Images = 4900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	30.29	30.33	30.36	30.33	30.39	30.34
SSS with SCAR	0.3	0.3	0.3	0.3	0.3	0.3

Images = 5000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	30.92	30.89	30.85	30.85	30.89	30.88
SSS with SCAR	0.3	0.3	0.3	0.3	0.3	0.3

Images = 5100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	31.49	31.52	31.54	31.52	31.54	31.52
SSS with SCAR	0.31	0.31	0.31	0.31	0.31	0.31

Images = 5200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	32.15	32.15	32.12	32.11	32.12	32.13
SSS with SCAR	0.32	0.32	0.32	0.32	0.32	0.32

Images = 5300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	32.81	32.79	32.77	32.75	32.79	32.78
SSS with SCAR	0.328	0.327	0.327	0.325	0.32	0.32

Images = 5400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	33.41	33.39	33.39	33.44	33.52	33.43
SSS with SCAR	0.33	0.33	0.33	0.33	0.33	0.33

Images = 5500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	34.03	34.06	34.09	34.06	34.03	34.05
SSS with SCAR	0.34	0.34	0.34	0.34	0.34	0.34

Images = 5600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	34.66	34.69	34.67	34.66	34.72	34.68
SSS with SCAR	0.346	0.346	0.345	0.347	0.347	0.345

Images = 5700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	35.27	35.31	35.29	35.29	35.26	35.28
SSS with SCAR	0.35	0.35	0.35	0.35	0.35	0.35

Images = 5800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	35.89	35.89	35.91	35.95	35.96	35.92
SSS with SCAR	0.358	0.358	0.359	0.361	0.361	0.36

Images = 5900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	36.57	36.55	36.55	36.51	36.53	36.54
SSS with SCAR	0.365	0.365	0.3366	0.365	0.365	0.365

Images = 6000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	37.11	37.13	37.10	37.11	37.15	37.12
SSS with SCAR	0.37	0.37	0.37	0.37	0.37	0.37

Images = 6100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	37.76	37.74	37.72	37.70	37.74	37.73
SSS with SCAR	0.377	0.377	0.377	0.377	0.377	0.377

Images = 6200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	38.37	38.35	38.32	38.35	38.37	38.35
SSS with SCAR	0.38	0.38	0.38	0.38	0.38	0.38

Images = 6300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	38.94	38.96	38.98	38.97	38.96	38.96
SSS with SCAR	0.389	0.389	0.389	0.391	0.391	0.39

Images = 6400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	39.54	39.57	39.59	39.55	39.57	39.56
SSS with SCAR	0.4	0.4	0.4	0.4	0.41	0.4

Images = 6500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	40.21	40.21	40.18	40.18	40.18	40.19
SSS with SCAR	0.4	0.4	0.41	0.4	0.41	0.4

Images = 6600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	40.84	40.85	40.83	40.81	40.83	40.83
SSS with SCAR	0.4	0.4	0.4	0.4	0.41	0.4

Images = 6700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	41.43	41.48	41.48	41.46	41.46	41.46
SSS with SCAR	0.41	0.41	0.41	0.42	0.41	0.41

Images = 6800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	42.06	42.07	42.06	42.06	42.06	42.06
SSS with SCAR	0.42	0.42	0.42	0.42	0.42	0.42

Images = 6900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	42.47	42.46	42.45	42.44	42.43	42.45
SSS with SCAR	0.425	0.424	0.425	0.424	0.425	0.425

Images = 7000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	43.31	43.31	43.35	43.37	43.33	43.33
SSS with SCAR	0.43	0.43	0.43	0.43	0.43	0.43

Images = 7100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	43.97	43.95	43.95	43.93	43.93	43.95
SSS with SCAR	0.44	0.44	0.44	0.44	0.44	0.44

Images = 7200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	44.57	44.57	44.59	44.57	44.60	44.58
SSS with SCAR	0.445	0.445	0.446	0.445	0.446	0.445

Images = 7300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	45.19	45.20	45.23	45.21	45.23	45.21
SSS with SCAR	0.45	0.45	0.45	0.45	0.45	0.45

Images = 7400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	45.84	45.83	45.81	45.81	45.81	45.82
SSS with SCAR	0.458	0.458	0.458	0.458	0.458	0.458

Images = 7500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	46.44	46.44	46.44	46.45	46.44	46.44
SSS with SCAR	0.46	0.46	0.46	0.46	0.46	0.46

Images = 7600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	47.03	47.04	47.02	47.06	47.06	47.04
SSS with SCAR	0.47	0.47	0.47	0.47	0.47	0.47

Images = 7700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	47.66	47.65	47.66	47.64	47.65	47.65
SSS with SCAR	0.476	0.476	0.475	0.475	0.474	0.475

Images = 7800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	48.27	48.29	48.30	48.29	48.27	48.28
SSS with SCAR	0.48	0.48	0.48	0.48	0.48	0.48

Images = 7900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	48.92	48.93	48.92	48.90	48.89	48.91
SSS with SCAR	0.49	0.489	0.489	0.489	0.489	0.489

Images = 8000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	49.55	49.55	49.56	49.55	49.55	49.55
SSS with SCAR	0.495	0.495	0.495	0.495	0.495	0.495

Images = 8100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	50.19	50.17	50.21	50.19	50.15	50.18
SSS with SCAR	0.5	0.5	0.5	0.5	0.5	0.5

Images = 8200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	50.78	50.77	50.78	50.81	50.81	50.79
SSS with SCAR	0.5	0.5	0.5	0.5	0.5	0.5

Images = 8300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	51.39	51.40	51.40	51.39	51.37	51.39
SSS with SCAR	0.51	0.51	0.51	0.51	0.51	0.51

Images = 8400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	52.01	52.01	52.01	52	52.01	52.01
SSS with SCAR	0.52	0.52	0.52	0.52	0.52	0.52

Images = 8500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	52.60	52.59	52.62	52.60	52.64	52.61
SSS with SCAR	0.525	0.526	0.526	0.525	0.525	0.525

Images = 8600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	53.25	53.24	53.22	53.25	53.22	53.23
SSS with SCAR	0.53	0.53	0.53	0.53	0.53	0.53

Images = 8700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	53.86	53.87	53.85	53.86	53.86	53.86
SSS with SCAR	0.535	0.535	0.536	0.535	0.535	0.535

Images = 8800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	54.48	54.49	54.48	54.47	54.48	54.48
SSS with SCAR	0.54	0.54	0.54	0.54	0.54	0.54

Images = 8900

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	55.09	55.11	55.09	55.08	55.08	55.09
SSS with SCAR	0.55	0.55	0.55	0.55	0.55	0.55

Images = 9000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	55.72	55.71	55.71	55.71	55.71	55.71
SSS with SCAR	0.557	0.556	0.555	0.555	0.553	0.555

Images = 9100

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	56.33	56.31	56.33	56.31	56.33	56.32
SSS with SCAR	0.56	0.56	0.56	0.56	0.56	0.56

Images = 9200

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	56.99	56.97	56.96	56.96	56.99	56.97
SSS with SCAR	0.569	0.561	0.565	0.565	0.566	0.565

Images = 9300

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	57.60	57.60	57.60	57.61	57.60	57.60
SSS with SCAR	0.57	0.57	0.57	0.57	0.57	0.57

Images = 9400

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	58.23	58.21	58.22	58.22	58.22	58.22
SSS with SCAR	0.58	0.58	0.58	0.58	0.58	0.58

Images = 9500

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	58.85	58.85	58.86	58.88	58.86	58.86
SSS with SCAR	0.588	0.585	0.585	0.581	0.584	0.585

Images = 9600

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	59.45	59.45	59.45	59.45	59.45	59.45
SSS with SCAR	0.594	0.594	0.594	0.594	0.594	0.59

Images = 9700

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	60.07	60.05	60.03	60.05	60.05	60.05
SSS with SCAR	0.6	0.6	0.6	0.6	0.6	0.6

Images = 9800

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	60.72	60.71	60.69	60.71	60.72	60.71
SSS with SCAR	0.6	0.6	0.6	0.6	0.6	0.6

Images = 9900

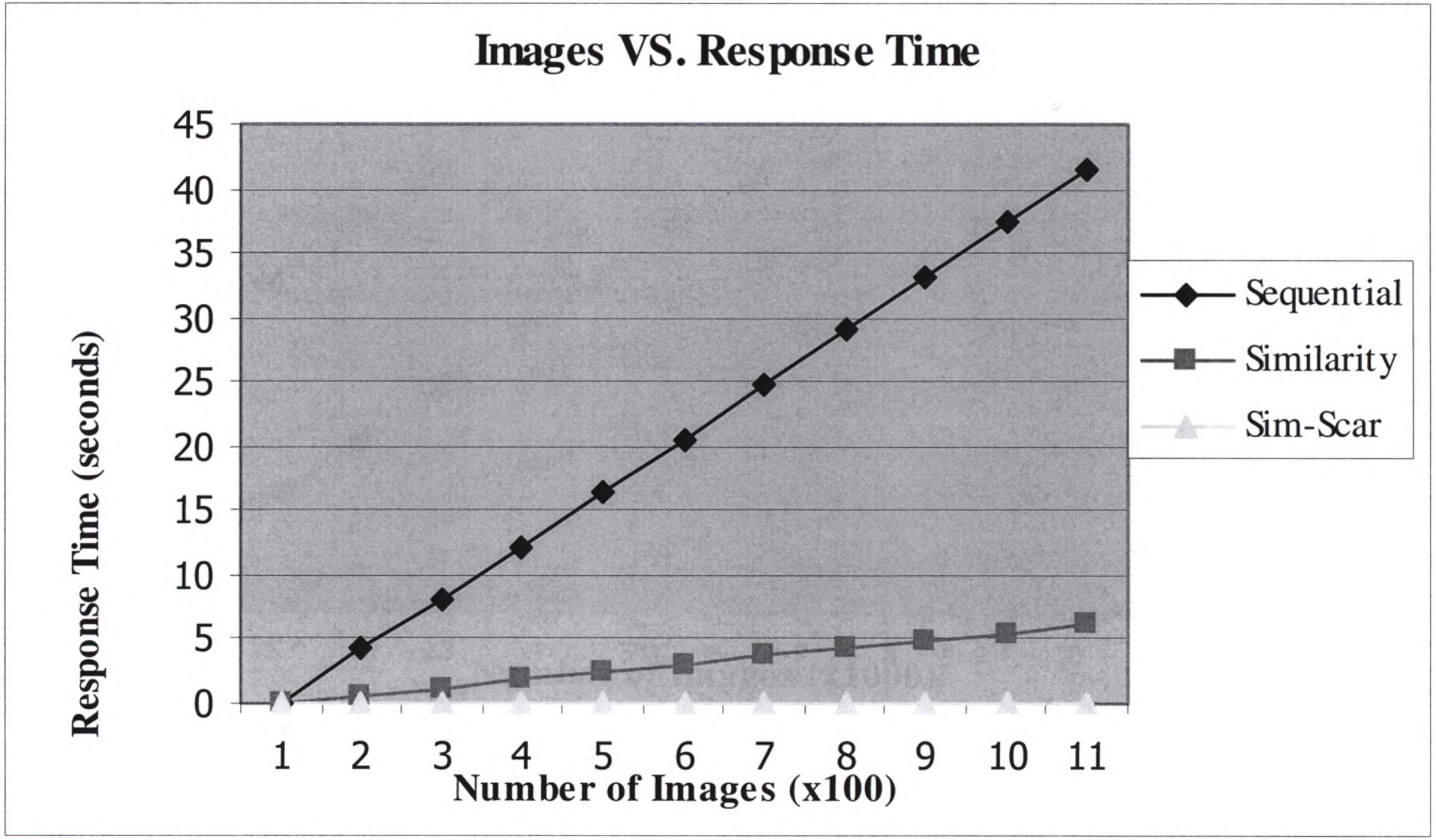
TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	61.33	61.32	61.33	61.30	61.33	61.32
SSS with SCAR	0.60	0.61	0.61	0.62	0.61	0.61

Images = 10000

TRIAL	1st	2nd	3rd	4th	5th	AVG
Self-Similarity Search	62.02	62.01	62	62	62	62
SSS with SCAR	0.62	0.63	0.63	0.62	0.62	0.62

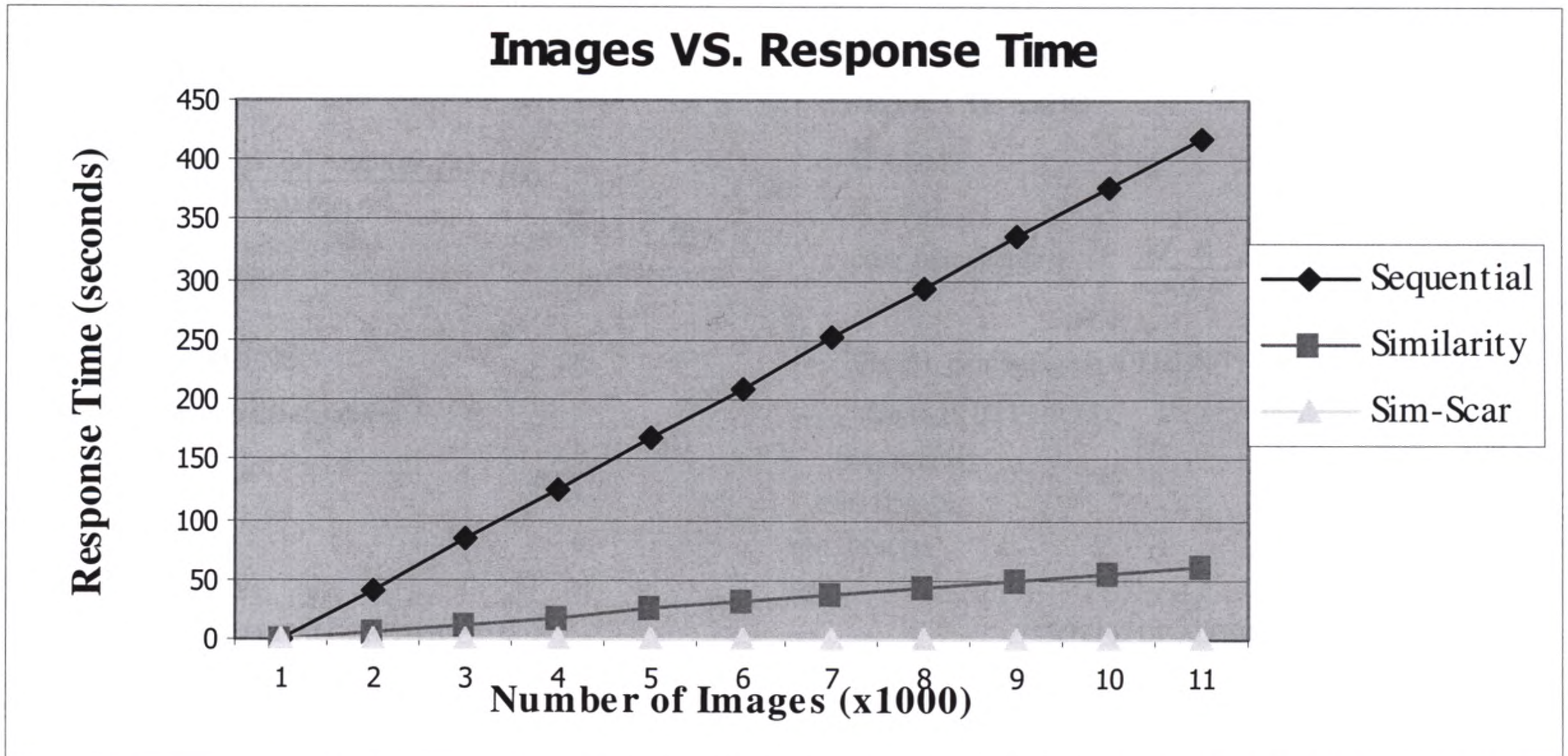
Graph: Images VS. Response Time (seconds) : (100-1000 Images) with Degree of Similarity = 0%

Images	0	100	200	300	400	500	600	700	800	900	1000		
Sequential	0.00	4.20	7.99	12.22	16.41	20.58	24.76	29.01	33.19	37.41	41.62		
Similarity	0.00	0.62	1.18	1.76	2.40	3.04	3.65	4.25	4.85	5.49	6.08		
Sim (SCAR)	0.00	0.065	0.01	0.017	0.02	0.03	0.036	0.042	0.048	0.055	0.06		
Seq Diff	0.00	4.20	3.79	4.23	4.19	4.17	4.18	4.25	4.18	4.22	4.21	**AVG**	4.16
Sim Diff	0.00	0.62	0.56	0.58	0.64	0.64	0.61	0.6	0.6	0.64	0.59	**AVG**	0.60
Scar Diff	0.00	0.065	-0.055	0.007	0.003	0.01	0.006	0.006	0.006	0.007	0.005	**AVG**	0.006



Graph: Images VS. Response Time (second) : (1000-10000 Images) with Degree of Similarity = 0%

Images	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000		
Sequential	0.00	41.62	83.61	125.62	167.58	209.5	251.59	293.62	335.63	377.60	419.5		
Similarity	0.00	6.08	12.36	18.51	24.74	30.88	37.12	43.33	49.55	55.71	62		
Sim (SCAR)	0.00	0.06	0.12	0.185	0.246	0.3	0.37	0.43	0.495	0.555	0.62		
Seq Diff	0.00	41.62	41.99	42.01	41.96	41.92	42.09	42.03	42.01	41.97	41.9	**AVG**	41.95
Sim Diff	0.00	6.08	6.28	6.15	6.23	6.14	6.24	6.21	6.22	6.16	6.29	**AVG**	6.2
Scar Diff	0.00	0.06	0.06	0.065	0.061	0.054	0.07	0.06	0.065	0.06	0.065	**AVG**	0.062



- SEQUENTIAL SEARCH ALGORITM -

```
BEGIN
INPUT
  Parameters   : n (number of images in database)
               : q (key image data)
               : r (existing image data)
               : d (pre-specified degree of similarity)
               : nc (number of columns)
               : nr (number of rows)
FOR i = 1 TO n DO
  FOR j = 1 TO nc DO
    FOR k = 1 TO nr DO
    cost_percentage =
```

$$\frac{\max(q_{jk}, r_{jk}) - \min(q_{jk}, r_{jk})}{\max(q_{jk}, r_{jk})} * 100$$

```
    END FOR (1)
    END FOR (2)
    IF cost_percentage ≤ d THEN
      Retrieve the image from the database
      END IF
    END FOR (3)
    END.
```

/*****END OF ALGORITHM*****/

- SIMILARITY SEARCH ALGORITHM -

```
BEGIN
INPUT
  Parameters   : n (number of images in database)
               : q (key image data)
               : r (existing image data)
               : d (pre-specified degree of similarity)
               : no (number of objects)
               : na (number of attributes)
FOR I = 1 TO n DO
  FOR j = 1 TO no DO
    FOR k = 1 TO na DO
      Q = |qjk|
      R = |rjk|
      cost_percentage =
```

$$\frac{|Q - R|}{\max(Q, R)} * 100$$

```
      IF cost_percentage ≥ d THEN
        Go to END FOR (3)
      END FOR (1)
    END FOR (2)
END FOR (3)
END.
```

/*****END OF ALGORITHM*****/

Sequential Search Algorithm and Self-Similarity Search Algorithm

SIMILARITY SEARCH ALGORITHM

```
BEGIN
INPUT
 Parameters    : n (number of images in database)
               : q (key image data)
               : r (existing image data)
               : d (pre-specified degree of similarity)
               : no (number of objects)
               : na (number of attributes)
FOR I = 1 TO n DO
 FOR j = 1 TO no DO
   FOR k = 1 TO na DO
     Q = |q_jk|
     R = |r_jk|
     cost_percentage = |Q - R| / max(Q, R) * 100

     IF cost_percentage ≥ d THEN
       Go to END FOR (3)
    END FOR (1)
  END FOR (2)
END FOR (3)
END.
```

SIMILARITY SEARCH with SCAR ALGORITHM

```
BEGIN
INPUT
 Parameters    : n (number of images in database)
               : q (key image data)
               : r (existing image data)
               : d (pre-specified degree of similarity)
               : no (number of objects)
               : na (number of attributes including scar attribute)
               : ns (number of scar attribute)
FOR I = 1 TO n DO
 FOR j = 1 TO no DO
  FOR k = 1 TO na DO
     IF ns exists THEN {
       Q = |q_jk|
       R = |r_jk|

       cost_percentage =        |Q - R| / max(Q, R) * 100

     IF cost_percentage ≥ d THEN  Go to END FOR (3)  ELSE }
     ELSE  Go to END FOR (2)
    END FOR (1)
  END FOR (2)
END FOR (3)
END.
```

Self-Similarity Algorithm with and without SCAR specification

Appendix E

STATISTICAL ANALYSIS

The major parts of the statistical analysis is divided into three section

Section 1: Introductory and General Questions

Section 2: Eyewitness Identification

Section 3: Proposed Image Retrieval Method Performance Evaluation

Remarks: *The following questions contain qualitative responses that are not shown in this section; Q3, Q6, Q7, Q8, Q12, Q15 and Q1,Q2 and Q3 from section 4. However, there are discussed in the body of Chapter Seven.*

Section One: Introductory and General Questions (Q1 - Q8)

Statistics

		Q1	Q2	Q4	Q5	Q6	Q7	Q8
N	Valid	149	149	149	149	149	149	149
	Missing	0	0	0	0	0	0	0

1. My computer skills are :

Q1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	4	2.7	2.7	2.7
	2	25	16.8	16.8	19.5
	3	45	30.2	30.2	49.7
	4	49	32.9	32.9	82.6
	5	26	17.4	17.4	100.0
	Total	149	100.0	100.0	

Note : 1=Very good, 2=Good, 3=Medium, 4=Poor, 5=Never use it

Remarks: The following table shows result after regrouping the sample 1,2,3 = 1 (Computer literacy) and 4,5 = 2 (Less-non computer literacy)

COMSKILL

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	74	49.7	49.7	49.7
	2	75	50.3	50.3	100.0
	Total	149	100.0	100.0	

2. How often do you use the computer at the police station?

Q2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	52	34.9	34.9	34.9
	2	65	43.6	43.6	78.5
	3	32	21.5	21.5	100.0
	Total	149	100.0	100.0	

Remark : 1=Everyday, 2=Only when needed, 3=Never, 4=Others

3. What are the purposes of using the computer at your station/ unit? *(You can check more than one)*

Statistics

		STATION#	Q3A	Q3B	Q3C	Q3D
N	Valid	149	149	149	149	149
	Missing	0	0	0	0	0

STATION#

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	16	10.7	10.7	10.7
	2	14	9.4	9.4	20.1
	3	12	8.1	8.1	28.2
	4	15	10.1	10.1	38.3
	5	15	10.1	10.1	48.3
	6	21	14.1	14.1	62.4
	7	14	9.4	9.4	71.8
	8	16	10.7	10.7	82.6
	9	14	9.4	9.4	91.9
	10	12	8.1	8.1	100.0
	Total	149	100.0	100.0	

Q3A

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	50	33.6	33.6	33.6
	1	99	66.4	66.4	100.0
	Total	149	100.0	100.0	

Remark : 1= Database management

Q3B

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	60	40.3	40.3	40.3
	1	89	59.7	59.7	100.0
	Total	149	100.0	100.0	

Remark : 1 = Intranet

Q3C

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	96	64.4	64.4	64.4
	1	53	35.6	35.6	100.0
	Total	149	100.0	100.0	

Remark : 1=Internet

Q3D

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	101	67.8	67.8	67.8
	1	48	32.2	32.2	100.0
	Total	149	100.0	100.0	

Remark : 1= Reason of using computer at the police station other than for (Database management, Intranet and Internet connection)

4. Do you know that the Royal Thai Police (RTP) are implementing a nationwide database network system to aid in the operations of police offices from the police headquarters to the police station level?

Q4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	111	74.5	74.5	74.5
	2	38	25.5	25.5	100.0
	Total	149	100.0	100.0	

Remark :1=Yes and 2=No

5. Do you have any idea what Police Information System (POLIS) is about?

Q5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	114	76.5	76.5	76.5
	2	33	22.1	22.1	98.7
	3	2	1.3	1.3	100.0
	Total	149	100.0	100.0	

Remark: 1=Yes, 2=No and 3=Others

6. Do you have any idea how the computer can be used to assist and enhance the criminal investigation? *If the answer is Yes. In what area is the computer used most for the police work in Thailand?*

Q6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	30	20.1	20.1	20.1
	2	119	79.9	79.9	100.0
	Total	149	100.0	100.0	

Remark: 1=No and 2=Yes

7. Have you ever use computer for crime investigation purpose? *If the answer is Yes. How did you use it?*

Q7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	71	47.7	47.7	47.7
	2	78	52.3	52.3	100.0
	Total	149	100.0	100.0	

Remark: 1=No and 2=Yes

8. If provided with computers and IT resources, will you be interested in learning more about IT for crime investigation? *If the answer is No, please explain why?*

Q8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	145	97.3	97.3	97.3
	2	4	2.7	2.7	100.0
	Total	149	100.0	100.0	

Remark: 1=Yes and 2=No

Section Two: Criminal Record Keeping and Procedures for Eyewitness Identification of Suspects Questions (9 – 33)

9. How do you keep the record of the criminal?

Statistics

Q9

N	Valid	149
	Missing	0

Q9

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	20	13.4	13.4	13.4
	2	6	4.0	4.0	17.4
	3	118	79.2	79.2	96.6
	4	5	3.4	3.4	100.0
	Total	149	100.0	100.0	

Remark: 1=Manually by the book of record (a mug books), 2= The criminal record are kept in the computer, 3=Some are kept in the book and some are kept in the computer database and 4=Others?

10. What is an approaches used at your unit when it comes to the witness identification of suspects procedure? *(You can check more than one answer)*

Statistics

		Q10A	Q10B	Q10C	Q10D
N	Valid	149	149	149	149
	Missing	0	0	0	0

Q10A

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	38	25.5	25.5	25.5
	1	111	74.5	74.5	100.0
	Total	149	100.0	100.0	

Remark: 1=Photospreads Procedure

Q10B

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	123	82.6	82.6	82.6
	1	26	17.4	17.4	100.0
	Total	149	100.0	100.0	

Remark: 1=Lineups Procedure

Q10C

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	11	7.4	7.4	7.4
	1	138	92.6	92.6	100.0
	Total	149	100.0	100.0	

Remark: 1=Computer database representation of the Criminal Record

Q10D

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	149	100.0	100.0	100.0

Remark: 1= Others

11. How long does it take for arranging a lineup?

Q11

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	101	67.8	67.8	67.8
	2	14	9.4	9.4	77.2
	3	1	.7	.7	77.9
	4	33	22.1	22.1	100.0
	Total	149	100.0	100.0	

Remark: 1=One day, 2=One Week, 3=One Month, 4=Others

12. Is the lineup repeated? *If the answer is Yes, please explain the reason*

Q12

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	55	36.9	36.9	36.9
	2	94	63.1	63.1	100.0
	Total	149	100.0	100.0	

Remark: 1=No, 2=Yes,

13. How often do you get the result from a lineup or photospreads procedure?

Q13

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	3	2.0	2.0	2.0
	2	141	94.6	94.6	96.6
	3	5	3.4	3.4	100.0
	Total	149	100.0	100.0	

Remark: 1=Every time, 2=Sometimes and 3=Others?

14. The lineup and photospreads procedures give you an effective result.

Q14

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	36	24.2	24.2	24.2
	2	105	70.5	70.5	94.6
	3	8	5.4	5.4	100.0
	Total	149	100.0	100.0	

Remark: 1=No, 2=Yes and 3=Others

15. Is there a cost involved with the lineup procedure? *If the answer is Yes, how much does it cost by estimation for each lineup procedure*

Q15

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	91	61.1	61.1	61.1
	2	46	30.9	30.9	91.9
	3	12	8.1	8.1	100.0
	Total	149	100.0	100.0	

Remark: 1= No, 2=Yes and 3=Others

16. Do you think it cost would be cheaper to use the computer?

Q16

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	17	11.4	11.4	11.4
	2	117	78.5	78.5	89.9
	3	15	10.1	10.1	100.0
	Total	149	100.0	100.0	

Remark: 1=No, 2=Yes and 3=Others

17. Is the eyewitness afraid or nervous with the line up procedure?

Q17

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	9	6.0	6.0	6.0
	2	119	79.9	79.9	85.9
	3	21	14.1	14.1	100.0
	Total	149	100.0	100.0	

Remark: 1=No, 2=Yes and 3=Others?

18. Does the condition of the eyewitness effect the identification of the suspect?

Q18

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	7	4.7	4.7	4.7
	2	137	91.9	91.9	96.6
	3	5	3.4	3.4	100.0
	Total	149	100.0	100.0	

Remark: 1=No, 2=Yes and 3=Others?

19. Do you think the eyewitness will feel more comfortable to select the photographs from the computer criminal database?

Q19

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	18	12.1	12.1	12.1
	2	124	83.2	83.2	95.3
	3	7	4.7	4.7	100.0
	Total	149	100.0	100.0	

Remark: 1=No, 2=Yes and 3=Others?

20. Do you agree with the following statement 'Some empirical evidence indicate that eyewitnesses tend to identify the person from the line up who, in the opinion of the eyewitness, look most like the culprit relative to the other members of the line up'?

Q20

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	26	17.4	17.4	17.4
	2	123	82.6	82.6	100.0
	Total	149	100.0	100.0	

Remark: 1=No, 2=Yes

21. Do you believe that there is a strong relation between eyewitness 'identification confidence' and eyewitness 'identification accuracy'?

Q21

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	9	6.0	6.0	6.0
	2	140	94.0	94.0	100.0
	Total	149	100.0	100.0	

Remark: 1=No, 2=Yes

22. The eyewitness who was "completely certain" about the accuracy of the identification are more likely to identify the right culprit.

Q22

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	28	18.8	18.8	18.8
	2	121	81.2	81.2	100.0
	Total	149	100.0	100.0	

Remark: 1=No, 2=Yes

23. The eyewitness who was "somewhat uncertain" about the accuracy of the identification are more likely to give a "false identification" of a suspect.

Q23

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	47	31.5	31.5	31.5
	2	102	68.5	68.5	100.0
	Total	149	100.0	100.0	

Remark: 1=No, 2=Yes

***24.* What are the factors that influence the "false identification"?** *(you can check more than one answer)*

Q24A

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	34	22.8	22.8	22.8
	1	115	77.2	77.2	100.0
	Total	149	100.0	100.0	

Remark: 1=An individual capability of memorizing the event

Q24B

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	77	51.7	51.7	51.7
	1	72	48.3	48.3	100.0
	Total	149	100.0	100.0	

Remark: 1=The gap between the crime actually happened and when it is reported is too long

Q24C

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	76	51.0	51.0	51.0
	1	73	49.0	49.0	100.0
	Total	149	100.0	100.0	

Remark: 1=The different between the night and day the crime took place

Q24D

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	140	94.0	94.0	94.0
	1	9	6.0	6.0	100.0
	Total	149	100.0	100.0	

Remark: 1=Personal bias, e.g., racism etc.

25. Would an identification of scar or birthmark help the police narrow down the scope of the suspect?

Q25

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	2	1.3	1.3	1.3
	2	147	98.7	98.7	100.0
	Total	149	100.0	100.0	

Remark: 1=No and 2=Yes

26. Is it useful to have a scar or birthmark defined?

Q26

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	4	2.7	2.7	2.7
	2	145	97.3	97.3	100.0
	Total	149	100.0	100.0	

Remark: 1=No and 2=Yes

27. Some obvious scar and birthmark are easy to remember and help in solving crime.

Q27

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	3	2.0	2.0	2.0
	2	146	98.0	98.0	100.0
	Total	149	100.0	100.0	

Remark: 1=No and 2=Yes

28. Do you like the idea of using the sketch to find the similar photo in the computer database?

Q28

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	18	12.1	12.1	12.1
	2	121	81.2	81.2	93.3
	3	10	6.7	6.7	100.0
	Total	149	100.0	100.0	

Remark: 1=No and 2=Yes and 3=Others

29. **Will a display of a few similar photograph effects the decision of the police or eyewitness?** *If the answer is Yes, please explain the reason.*

Q29

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	7	4.7	4.7	4.7
	2	137	91.9	91.9	96.6
	3	5	3.4	3.4	100.0
	Total	149	100.0	100.0	

Remark: 1=No and 2=Yes

30. Looking at a few similar photographs will make it easier to identify the culprit.

Q30

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	26	17.4	17.4	17.4
	2	110	73.8	73.8	91.3
	3	13	8.7	8.7	100.0
	Total	149	100.0	100.0	

Remark: 1=No (Disagree), 2=Yes (Agree) and 3=Others (Neutral)

31. Have you ever come in contact with the "false identification"?

Q31

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	35	23.5	23.5	23.5
	2	91	61.1	61.1	84.6
	3	23	15.4	15.4	100.0
	Total	149	100.0	100.0	

Remark: 1=No and 2=Yes

32. There are cases where the suspect is let off because the eyewitness was "uncertain" about the accuracy of the suspect identification.

Q32

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	19	12.8	12.8	12.8
	2	125	83.9	83.9	96.6
	3	5	3.4	3.4	100.0
	Total	149	100.0	100.0	

Remark: 1=No, 2=Yes and 3=Others

33. Some identification will be false and lead to mistaken arrests of imprisonment?

Q33

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	7	4.7	4.7	4.7
	2	137	91.9	91.9	96.6
	3	5	3.4	3.4	100.0
	Total	149	100.0	100.0	

Remark: 1= No, 2=Yes and 3=Others

Section Three: Proposed Image Retrieval Method Performance Evaluation Questions (Q34-Q45)

Participants were asked to indicate their degree of agreement with each of the following statements by circling how they feel about the given presentation of the use of IT and image retrieval for the crime investigation

Remark: 1=Strongly Agree, 2=Agree, 3=Neutral, 4=Disagree and 5=Strongly Disagree

34. Presentation regarding the use of IT for police work is clear

Q34

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	32	21.5	21.5	21.5
	2	52	34.9	34.9	56.4
	3	59	39.6	39.6	96.0
	4	4	2.7	2.7	98.7
	5	2	1.3	1.3	100.0
	Total	149	100.0	100.0	

35. Photograph image is important for the crime investigation

Q35

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	77	51.7	51.7	51.7
	2	65	43.6	43.6	95.3
	3	7	4.7	4.7	100.0
	Total	149	100.0	100.0	

36. When scar or birthmark is specified on the suspect, it is easier for the police to search the criminal record

Q36

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	75	50.3	50.3	50.3
	2	47	31.5	31.5	81.9
	3	27	18.1	18.1	100.0
	Total	149	100.0	100.0	

37. Presentation regarding the use of Self-Similarity Search for image retrieval is clear and understood

Q37

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	16	10.7	10.7	10.7
	2	52	34.9	34.9	45.6
	3	55	36.9	36.9	82.6
	4	13	8.7	8.7	91.3
	5	13	8.7	8.7	100.0
	Total	149	100.0	100.0	

38. Image retrieval should be used in a crime investigation process?

Q38

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	79	53.0	53.0	53.0
	2	55	36.9	36.9	89.9
	3	14	9.4	9.4	99.3
	5	1	.7	.7	100.0
	Total	149	100.0	100.0	

39. Self-Similarity Searching Method is practical for image retrieval?

Q39

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	36	24.2	24.2	24.2
	2	42	28.2	28.2	52.3
	3	43	28.9	28.9	81.2
	4	23	15.4	15.4	96.6
	5	5	3.4	3.4	100.0
	Total	149	100.0	100.0	

40. Self-Similarity Search Method is useful for the crime investigation?

Q40

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	63	42.3	42.3	42.3
	2	65	43.6	43.6	85.9
	3	21	14.1	14.1	100.0
	Total	149	100.0	100.0	

41. Should the crime investigation unit adopt the Self-Similarity Searching Method for criminal image retrieval?

Q41

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	81	54.4	54.4	54.4
	2	58	38.9	38.9	93.3
	3	10	6.7	6.7	100.0
	Total	149	100.0	100.0	

42. It is worthwhile for the government to invest in IT to better the government service?

Q42

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	87	58.4	58.4	58.4
	2	52	34.9	34.9	93.3
	3	10	6.7	6.7	100.0
	Total	149	100.0	100.0	

43. You are willing to use the computer for the image search if your station has one?

Q43

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	82	55.0	55.0	55.0
	2	57	38.3	38.3	93.3
	3	6	4.0	4.0	97.3
	4	4	2.7	2.7	100.0
	Total	149	100.0	100.0	

44. Do you have any prejudice against the computer technology?

Q44

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	5	3.4	3.4	3.4
	2	6	4.0	4.0	7.4
	3	15	10.1	10.1	17.4
	4	64	43.0	43.0	60.4
	5	59	39.6	39.6	100.0
	Total	149	100.0	100.0	

45. There should be more research on the use of IT for the Thai Police

Q45

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	86	57.7	57.7	57.7
	2	57	38.3	38.3	96.0
	3	6	4.0	4.0	100.0
	Total	149	100.0	100.0	

T-test Analysis Q1&Q7 : Computer Literacy and actual use for crime investigation

Group Statistics

	COMSKIL	N	Mean	ştd. Deviatior	d. Error Mea
Q7	1	74	1.64	.485	.056
	2	75	1.41	.496	.057

Independent Samples Test

		evene's Test for Equality c Variances		t-test for Equality of Means						
									% Confidence Interval of t Difference	
		F	Sig.	t	df	ig. (2-tailed)	ean Differenc	d. Error Differen	Lower	Upper
Q7	Equal variances ass	1.407	.237	2.761	147	.006	.22	.080	.063	.381
	Equal variances not			2.761	146.988	.006	.22	.080	.063	.381

T-test Analysis Q6 & Q38

Q6: Respondents who know how computer can be used to assist the criminal investigation

Q38: Image retrieval should be used in a crime investigation process

Group Statistics

	Q6	N	Mean	Std. Deviation	Std. Error Mean
Q38	1	30	2.20	.961	.176
	2	119	1.43	.546	.050

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q38	Equal variances assumed	18.762	.000	5.817	147	.000	.77	.133	.509	1.034
	Equal variances not assumed			4.227	33.849	.000	.77	.183	.400	1.142

T-test Analysis Q6 & Q7

Q6: Knowledge of computer for crime investigation
Q7: Actual use of Computer for crime investigation

Group Statistics

	COMSKIL	N	Mean	td. Deviatio	d. Error Mea
Q6	1	74	1.80	.405	.047
	2	75	1.80	.403	.046

Independent Samples Test

		evene's Test for Equality c Variances		t-test for Equality of Means						
									% Confidence Interval of Difference	
		F	Sig.	t	df	ig. (2-tailed)	ean Differenc	. Error Differen	Lower	Upper
Q6	Equal variances as	.007	.935	-.041	147	.967	.00	.066	-.133	.128
	Equal variances no			-.041	146.949	.967	.00	.066	-.133	.128

Group Statistics

	COMSKIL	N	Mean	td. Deviatior	d. Error Mea
Q7	1	74	1.64	.485	.056
	2	75	1.41	.496	.057

Independent Samples Test

		evene's Test for Equality o Variances		t-test for Equality of Means						
									% Confidence Interval of t Difference	
		F	Sig.	t	df	ig. (2-tailed)	ean Differenc	d. Error Differen	Lower	Upper
Q7	Equal variances ass	1.407	.237	2.761	147	.006	.22	.080	.063	.381
	Equal variances not			2.761	146.988	.006	.22	.080	.063	.381

T-test Analysis : Q7&Q38

Group Statistics

	Q7	N	Mean	Std. Deviation	Std. Error Mean
Q38	1	71	1.83	.828	.098
	2	78	1.36	.509	.058

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q38	Equal variances assumed	9.342	.003	4.233	147	.000	.47	.111	.252	.692
	Equal variances not assumed			4.144	114.174	.000	.47	.114	.246	.698

T-test Analysis : Q7 & Q39

Group Statistics

	Q7	N	Mean	Std. Deviation	Std. Error Mean
Q39	1	71	2.62	1.047	.124
	2	78	2.31	1.166	.132

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q39	Equal variances assumed	1.114	.293	1.713	147	.089	.31	.182	-.048	.672
	Equal variances not assumed			1.721	146.977	.087	.31	.181	-.046	.670

T-test Analysis : Q7&Q40

Group Statistics

	Q7	N	Mean	ŧtd. Deviatior	d. Error Mea
Q40	1	71	2.04	.620	.074
	2	78	1.42	.635	.072

Independent Samples Test

		evene's Test for Equality o Variances		t-test for Equality of Means						
									% Confidence Interval of t Difference	
		F	Sig.	t	df	ŝig. (2-tailed)	ean Differenc	d. Error Differen	Lower	Upper
Q40	Equal variances ass	5.382	.022	6.014	147	.000	.62	.103	.416	.823
	Equal variances not			6.021	146.277	.000	.62	.103	.416	.822

T-test Analysis : Q7&Q41

Group Statistics

	Q7	N	Mean	Std. Deviation	Std. Error Mean
Q41	1	71	1.82	.661	.078
	2	78	1.26	.439	.050

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q41	Equal variances assumed	8.384	.004	6.143	147	.000	.56	.091	.380	.741
	Equal variances not assumed			6.031	119.959	.000	.56	.093	.376	.744

T-test Analysis : Q7&Q43

Group Statistics

	Q7	N	Mean	Std. Deviation	Std. Error Mean
Q43	1	71	1.65	.588	.070
	2	78	1.45	.784	.089

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q43	Equal variances assumed	1.568	.212	1.741	147	.084	.20	.114	-.027	.425
	Equal variances not assumed			1.764	141.957	.080	.20	.113	-.024	.422

T-test Analysis : Q1 & Q38

Group Statistics

	COMSKIL	N	Mean	Std. Deviation	Std. Error Mean
Q38	1	74	1.61	.637	.074
	2	75	1.56	.793	.092

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q38	Equal variances assumed	1.905	.170	.408	147	.684	.05	.118	-.185	.281
	Equal variances not assumed			.409	141.258	.683	.05	.118	-.185	.281

T-test Analysis : Q1&Q39

Group Statistics

	COMSKIL	N	Mean	td. Deviatio	d. Error Mea
Q39	1	74	2.57	1.021	.119
	2	75	2.35	1.202	.139

Independent Samples Test

		evene's Test for Equality o Variances		t-test for Equality of Means						
									% Confidence Interval of Difference	
		F	Sig.	t	df	ig. (2-tailed)	ean Differenc	d. Error Differen	Lower	Upper
Q39	Equal variances ass	5.891	.016	1.208	147	.229	.22	.183	-.141	.582
	Equal variances not			1.209	143.835	.229	.22	.183	-.140	.582

T-test Analysis : Q1&Q40

Group Statistics

	COMSKIL	N	Mean	Std. Deviation	Std. Error Mean
Q40	1	74	1.77	.732	.085
	2	75	1.67	.664	.077

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q40	Equal variances assumed	.460	.499	.905	147	.367	.10	.114	-.123	.330
	Equal variances not assumed			.904	145.250	.367	.10	.115	-.123	.330

T-test Analysis : Q1&Q41

Group Statistics

	COMSKIL	N	Mean	Std. Deviation	Std. Error Mean
Q41	1	74	1.58	.641	.075
	2	75	1.47	.600	.069

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q41	Equal variances assumed	.668	.415	1.125	147	.263	.11	.102	-.087	.315
	Equal variances not assumed			1.124	146.081	.263	.11	.102	-.087	.316

T-test Analysis: Q1&43

Group Statistics

	COMSKIL	N	Mean	Std. Deviation	Std. Error Mean
Q43	1	74	1.64	.769	.089
	2	75	1.45	.622	.072

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q43	Equal variances assumed	1.034	.311	1.588	147	.114	.18	.114	-.044	.408
	Equal variances not assumed			1.586	140.052	.115	.18	.115	-.045	.408

Appendix F

Presentations and Questionnaire Distribution Record

Station #	Participated Police Stations	Number of Participated Police Inspectors	Capital City/ Province	Date
1	Thongmahamake	16	Bangkok	Sep 02
2	Thonglor	14	Bangkok	Sep 02
3	Muggasan	12	Bangkok	Oct 02
4	Pravate	15	Bangkok	Oct 02
5	Sumlongneur	15	Samutprakan Province	Oct 02
6	Amphoe Muang	21	Samutprakan Province	Dec 02
7	Bangpakong	14	Chachoengsao Province	Dec 02
8	Amphoe Muang	16	Chachoengsao Province	Dec 02
9	Banglamoong	14	Chonburi Province	Jan 03
10	Amphoe Muang	12	Chonburi Province	Jan 03
Total	10 Participate Stations	149 Participants	3 Provinces / 1 Capital	Jan 03

Questionnaires (English Version)

The major parts of the interview with questionnaires is divided into four sections:

Section 1: Introductory Questions
Section 2: Eyewitness Identification Procedure
Section 3: IT and Image Retrieval Method for Crime Investigation
Section 4: Open Question for Comments

General Instructions

Please respond to each item on this questionnaire.
Please read each question carefully and indicate your response to each item with a checkmark. Please follow carefully the instructions provided for each question.

Section One: Introductory Questions (1 - 8)

First I would like to get a general idea about your job as a police officer at the crime investigation unit.

1. My computer skills are :

[ ] Very good
[ ] Good
[ ] Medium
[ ] Poor

2. How often do you use the computer at the police station?

[ ] Everyday
[ ] Only when needed
[ ] Never
[ ] Others?

3. What are the purposes of using the computer at your station/ unit? *(You can check more than one)*

[ ] Database management
[ ] Intranet
[ ] Internet connections
[ ] Others? Please describe: ____

4. Do you know that the Royal Thai Police (RTP) are implementing a nationwide database network system to aid in the operations of police offices from the police headquarters to the police station level?

[ ] Yes
[ ] No
[ ] Others?

5. Do you have any idea what Police Information System (POLIS) is about?

[ ] Yes

[ ] No
[ ] Others?

6. Do you have any idea how the computer can be used to enhance or assist the criminal investigation? *If the answer is Yes. In what area is the computer used most for the police work in Thailand?*

[ ] No
[ ] Yes, :______________________________

7. Have you ever use computer for crime investigation purpose? *If the answer is Yes. How did you use it?*

[ ] No
[ ] Yes, I use it for: ______________________________

8. If provided with computers and IT resources, will you be interested in learning more about IT for crime investigation? *If the answer is No, please explain why?*

[ ] Yes
[ ] No, because ______________________________

Section Two: Criminal Record Keeping and Procedures for Eyewitness Identification of Suspects Questions (9 – 32)

9. How do you keep the record of the criminal?

[ ] Manually by the book of record (a mug books)
[ ] The criminal record are kept in the computer
[ ] Some are kept in the book and some are kept in the computer database
[ ] Others?

10. What is an approaches used at your unit when it comes to the witness identification of suspects procedure? *(You can check more than one answer)*

[ ] Photospreads Procedure
[ ] Lineups Procedure
[ ] Computer database representation of the Criminal Record
[ ] Others?

11. How long does it take for arranging a lineup?

[ ] One day
[ ] One Week
[ ] One Month
[ ] Others?______________

12. Is the lineup repeated? *If the answer is Yes, please explain the reason*

[ ] No
[ ] Yes, because ______________________________

13. How often do you get the result from a lineup or photospreads procedure?

[ ] Every time
[ ] Sometimes
[ ] Others? ____

14. The lineup and photospreads procedures give you an effective result.

[ ] No
[ ] Yes
[ ] Others? ____

15. Is there a cost involved with the lineup procedure? *If the answer is Yes, how much does it cost by estimation for each lineup procedure*

[ ] No
[ ] Yes, it cost ____
[ ] Others? Please explain: ______________________________________

16. Do you think it cost would be cheaper to use the computer?

[ ] No
[ ] Yes
[ ] Others?

17. Is the eyewitness afraid or nervous with the line up procedure?

[ ] No
[ ] Yes
[ ] Others?

18. Does the condition of the eyewitness effect the identification of the suspect?

[ ] No
[ ] Yes
[ ] Others?

19. Do you think the eyewitness will feel more comfortable to select the photographs from the computer criminal database?

[ ] No
[ ] Yes
[ ] Others?

20. Do you agree with the following statement 'Some empirical evidence indicate that eyewitnesses tend to identify the person from the line up who, in the opinion of the eyewitness, look most like the culprit relative to the other members of the line up'?

[ ] No
[ ] Yes

21. Do you believe that there is a strong relation between eyewitness 'identification confidence' and eyewitness 'identification accuracy'?

[ ] No
[ ] Yes

22. The eyewitness who was "completely certain" about the accuracy of the identification are more likely to identify the right culprit.

[ ] No
[ ] Yes

23. The eyewitness who was "somewhat uncertain" about the accuracy of the identification are more likely to give a "false identification" of a suspect.

[ ] No
[ ] Yes

24. What are the factors that influence the "false identification"? *(you can check more than one answer)*

[ ] An individual capability of memorizing the event
[ ] The gap between the crime actually happened and when it is reported is too long
[ ] The different between the night and day the crime took place
[ ] Personal bias, e.g., racism etc.
[ ] Others? Please explain: ______________________________

25. Would an identification of scar or birthmark help the police narrow down the scope of the suspect?

[ ] No
[ ] Yes

26. Is it useful to have a scar or birthmark defined?

[ ] No
[ ] Yes

27. Some obvious scar and birthmark are easy to remember and help in solving crime.

[ ] No
[ ] Yes

28. Do you like the idea of using the sketch to find the similar photo in the computer database?

[ ] No
[ ] Yes
[ ] Others?

29. Will a display of a few similar photograph effects the decision of the police or eyewitness? *If the answer is Yes, please explain the reason.*

[ ] No
[ ] Yes, because ____

30. Looking at a few similar photographs will make it easier to identify the culprit.

[ ] Strongly agree
[ ] Agree
[ ] Disagree
[ ] Strongly Disagree
[ ] Others?

31. Have you ever come in contact with the "false identification"?

[ ] No
[ ] Yes,

32. There are cases where the suspect is let off because the eyewitness was "uncertain" about the accuracy of the suspect identification.

[ ] Strongly agree
[ ] Agree
[ ] Disagree
[ ] Strongly disagree
[ ] Others?

33. Some identification will be false and lead to mistaken arrests of imprisonment?

[ ] No
[ ] Yes
[ ] Others?

Section Three: Proposed Image Retrieval Method Performance Evaluation Questions

Please indicate your degree of agreement with each of the following statements by circling how you feel about the given presentation of the use of IT and image retrieval for the crime investigation

No	Questions	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	Presentation regarding the use of IT for police work is clear	SA	A	N	D	SD
2	Photograph image is important for the crime investigation	SA	A	N	D	SD
3	When scar or birthmark is specified on the suspect, it is easier for the police to search the criminal record	SA	A	N	D	SD
4	Presentation regarding the use of Self-Similarity Search for image retrieval is clear and understood	SA	A	N	D	SD
5	Image retrieval should be used in a crime investigation process?	SA	A	N	D	SD
6	Self-Similarity Searching Method is practical for image retrieval?	SA	A	N	D	SD
7	Self-Similarity Search Method is useful for the crime investigation?	SA	A	N	D	SD
8	Should the crime investigation unit adopt the Self-Similarity Searching Method for criminal image retrieval?	SA	A	N	D	SD
9	It is worthwhile for the government to invest in IT to better the government service?	SA	A	N	D	SD
10	You are willing to use the computer for the image search if your station has one?	SA	A	N	D	SD
11	Do you have any prejudice against the computer technology?	SA	A	N	D	SD
12	There should be more research on the use of IT for the Thai Police	SA	A	N	D	SD

Section Four: Interviewees Attitude towards the Research and Concluding Questions

12. What do you think of the Self-Similarity Searching Method for the Crime Investigation Purpose?

13. Do you want to add anything that you think is applicable for this research? Please explain why?

แบบสอบถามความคิดเห็นเกี่ยวกับการใช้คอมพิวเตอร์และภาพเหมือนในการสืบสวนสอบสวน

ส่วนที่ 1 : เรื่องทั่วไป
ส่วนที่ 2 : เรื่องการเก็บข้อมูลอาชญากร และการชี้ตัวผู้ต้องหา
ส่วนที่ 3 : เรื่องความคิดเห็นเกี่ยวกับการใช้คอมพิวเตอร์เทคโนโลยีและภาพเหมือนในการสืบสวนสอบสวน
ส่วนที่ 4 : เรื่องความคิดเห็นส่วนตัวเกี่ยวกับงานวิจัยทางด้านนี้

กรุณาตอบคำถามทุกข้อโดยกาเครื่องหมาย [X] ในช่องที่ตรงกับความคิดเห็นของท่านมากที่สุด

ส่วนที่ 1 : เรื่องทั่วไป (1 - 8)

1. ทักษะในการใช้ใช้คอมพิวเตอร์ของท่าน
   [ ] ดีมาก
   [ ] ดี
   [ ] ปานกลาง
   [ ] ได้แต่ไม่ดีนัก
   [ ] ไม่เคยใช้เลย

2. ท่านใช้คอมพิวเตอร์บ่อยแค่ไหนที่สถานีตำรวจของท่าน
   [ ] ทุกวัน
   [ ] เมื่อจำเป็น
   [ ] ไม่เคยเลย
   [ ] อื่นๆ

3. จุดประสงค์ในการใช้เครื่องคอมพิวเตอร์ในการทำงานของท่านที่สถานีคือ (ตอบได้มากกว่า 1 ข้อ)
   [ ] ใช้ในการเก็บข้อมูล
   [ ] ใช้ค้นหาข้อมูลในเครือข่ายที่เชื่อมโยงระหว่างสถานีของท่านกับสำนักงานตำรวจแห่งชาติ
   [ ] ใช้ในการค้นหาข้อมูลทางอินเตอร์เน็ต
   [ ] อื่นๆ โปรดระบุ

   ____

4. ท่านทราบหรือไม่ว่าสำนักงานตำรวจแห่งชาติได้จัดทำระบบเครือข่ายข้อมูลเชื่อมโยงระหว่างสำนักงานใหญ่กับส่วนสถานีย่อยในจังหวัดต่างๆ
   [ ] ทราบ
   [ ] ไม่ทราบ
   [ ] อื่นๆ

5. ท่านทราบหรือไม่ว่าระบบสารสนเทศสำหรับงานตำรวจคืออะไร
   [ ] ทราบ
   [ ] ไม่ทราบ
   [ ] อื่นๆ

6. ท่านทราบหรือไม่ว่าคอมพิวเตอร์เทคโนโลยีสามารถนำมาใช้ในการสืบสวนสอบสวน ถ้าคำตอบของท่านคือใช้ กรุณาให้ตัวอย่าง
   [ ] ไม่ทราบ
   [ ] ทราบ

   ____

7. ท่านเคยใช้ คอมพิวเตอร์เทคโนโลยีในการสืบสวนสอบสวนหรือไม่ ถ้าคำตอบของท่านคือใช่ กรุณาให้ตัวอย่างว่าท่านนำมาใช้อย่างไร หรือ คอมพิวเตอร์ช่วยท่านอย่างไรในการสืบสวนสอบสวน
   [ ] ไม่เคย
   [ ] เคย

   ____

8. ถ้ามีการติดตั้งระบบคอมพิวเตอร์ที่สถานีของท่าน, ท่านจะยินดีที่จะเรียนรู้การใช้เทคโนโลยีสารสนเทศในการสืบสวนสอบสวน ใช่หรือไม่ ถ้าคำตอบของท่านคือไม่ กรุณาให้เหตุผล
   [ ] ใช่
   [ ] ไม่ เพราะ

   ____

ส่วนที่ 2 : เรื่องการเก็บข้อมูลอาชญากร และการชี้ตัวผู้ต้องหา (9-35)

9. ทางสถานีของท่านมีการเก็บข้อมูลอาชญากรอย่างไร
   [ ] เก็บในแฟ้มอาชญากรรม
   [ ] เก็บในคอมพิวเตอร์
   [ ] บางส่วนเก็บในแฟ้มอาชญากรรม และบางส่วนเก็บในคอมพิวเตอร์
   [ ] อื่นๆ

10. ทางสถานีใช้วิธีการใดในการชี้ตัวผู้ต้องสงสัย (ตอบได้มากกว่า 1 ข้อ)
   [ ] ใช้สมุดภาพ
   [ ] ใช้คอมพิวเตอร์ที่มีรูปคนร้ายในอดีต
   [ ] นำผู้ต้องสงสัยมาเรียงแถว แล้วให้ผู้เสียหายชี้ตัว
   [ ] อื่นๆ

11. การชี้ผู้ต้องหาใช้เวลาเตรียมการกี่วัน
   [ ] 1 วัน
   [ ] 1 อาทิตย์
   [ ] 1 เดือน
   [ ] อื่นๆ

12. การชี้ตัวผู้ต้องหามีกรณีที่ต้องทำซ้ำในบางกรณีใช่หรือไม่ อย่างไร
   [ ] ไม่ใช่
   [ ] ใช่, ในกรณีที่ ______________________________

13. บ่อยครั้งแค่ไหนที่ท่านได้ตัวผู้ต้องหาจากการชี้ตัว หรือ จากการใช้สมุดภาพ
   [ ] ทุกครั้ง
   [ ] บางครั้ง
   [ ] อื่นๆ

14. การชี้ตัวผู้ต้องหา และการใช้สมุดภาพให้ผลลัพธ์เป็นที่น่าพอใจใช่หรือไม่ อย่างไร
   [ ] ไม่
   [ ] ใช่
   [ ] อื่นๆ

15. การจัดการชี้ตัวผู้ต้องสงสัยมีค่าใช้จ่ายไหม (ถ้ามี) ประมาณเท่าไหร่
   [ ] ไม่มี
   [ ] มี ประมาณ ______________________________
   [ ] อื่นๆ

16. ท่านคิดว่าในระยะยาว การนำคอมพิวเตอร์มาใช้จะสะดวก และถูกกว่าไหม อย่างไร
   [ ] ไม่ถูกกว่า
   [ ] ถูกกว่า
   [ ] อื่นๆ

17. ผู้เสียหายหรือพยานที่มาชี้ตัวผู้ต้องหามีอาการตื่นเต้น หรือหวาดกลัวบ้างหรือไม่
   [ ] ไม่
   [ ] มี
   [ ] อื่นๆ

18. ความปรกติของสภาพร่างกายและจิตใจของผู้เสียหายมีผลต่อการชี้ตัวผู้ต้องหาหรือไม่
   [ ] ไม่
   [ ] มี
   [ ] อื่นๆ

19. ท่านคิดว่าผู้เสียหายจะรู้สึก ตื่นเต้น หรือ หวาดกลัวน้อยลงหรือไม่ ถ้าการชี้ผู้ต้องหาสามารถทำได้ด้วยคอมพิวเตอร์
   [ ] ไม่
   [ ] มีอาการหวาดกลัวน้อยลง
   [ ] อื่นๆ

20. ท่านเห็นด้วยกับคำกล่าวนี้หรือไม่ "ผู้เสียหายหรือพยานมักจะชี้ตัวผู้ต้องสงสัยที่มีหน้าตา หรือลักษณะคล้ายกับผู้กระทำผิดที่สุด"
[ ] ไม่เห็นด้วย
[ ] เห็นด้วย

21. ท่านเชื่อหรือไม่ว่า "ความเชื่อมั่น หรือความแน่ใจของผู้เสียหาย" มีความสัมพันธ์กับ การชี้ตัวผู้ต้องหาที่ถูกต้อง
[ ] ไม่เชื่อ
[ ] เชื่อ

22. ท่านเห็นด้วยหรือไม่ว่า พยานหรือผู้เสียหายที่ "มีความแน่ใจมาก" ในการชี้ตัวผู้ต้องหา คือ
คนส่วนใหญ่ที่มักจะชี้ตัวคนร้ายได้ถูกต้อง
[ ] ไม่เห็นด้วย
[ ] เห็นด้วย

23. พยานหรือผู้เสียหายที่ "มีความไม่แน่ใจ" ในการชี้ตัวผู้ต้องหา คือ คนส่วนใหญ่ที่มักจะชี้ตัวคนร้ายผิด
[ ] ไม่เห็นด้วย
[ ] เห็นด้วย

24. อะไรคือปัจจัยที่ทำให้พยานหรือผู้เสียหายบอกรูปพรรณสัณฐานของคนร้ายผิด หรือชี้ตัวผู้ต้องหาผิด
[ ] ความสามารถในการจำของผู้เสียหาย
[ ] เวลาที่เหตุเกิด กับตอนไปแจ้งความ มีระยะเวลา ห่างกันนานเกินไป
[ ] เวลากลางวัน และกลางคืนที่เหตุเกิด
[ ] อื่นๆ

25. การที่พยานหรือผู้เสียหายสามารถระบุรอยสัก ปาน ไฝ หรือ แผลเป็น ของผู้กระทำผิด
สามารถมีส่วนช่วยในการหาตัวผู้กระทำความผิดได้ง่ายขึ้นใช่หรือไม่ อย่างไร
[ ] ไม่ใช่
[ ] ใช่

26. การระบุรอยสัก ปาน ไฝ หรือ แผลเป็น บนใบหน้าของผู้กระทำผิด มีประโยชน์ต่อการสืบสวนสอบสวนใช่หรือไม่
[ ] ไม่ใช่
[ ] ใช่

27. รอยสัก ปาน ไฝ หรือ แผลเป็น ที่เด่นชัดบนใบหน้าของผู้กระทำผิด
สามารถทำให้การค้นหาตัวผู้กระทำความผิดได้ง่ายขึ้นใช่หรือไม่
[ ] ไม่ใช่
[ ] ใช่

28. ท่านชอบความคิดในการนำรูปสเกตของผู้ต้องสงสัย มาหาภาพเหมือนในคอมพิวเตอร์ใช่หรือไม่
[ ] ไม่ใช่
[ ] ใช่
[ ] อื่นๆ

29. การที่คอมพิวเตอร์สามารถหารูปเหมือนผู้ต้องสงสัย 3-4 ภาพ มีผลต่อการตัดสินใจของพยาน ผู้เสียหาย หรือตำรวจหรือไม่อย่างไร
[ ] ไม่มี
[ ] มี
[ ] อื่นๆ

30. ถ้าเรามีรูปถ่ายซัก 3-4 ภาพ ที่มีหน้าตา คล้ายกับคนร้ายที่ผู้เสียหายระบุไว้
จะช่วยให้การหาตัวคนร้ายหรือชี้ตัวคนร้ายง่ายขึ้นใช่หรือไม่
[ ] ไม่ใช่
[ ] ใช่
[ ] อื่นๆ

31. ท่านเคยพบคดีที่ผู้เสียหายชี้ตัวผู้ต้องสงสัยผิด ใช่หรือไม่ (บ่อยแค่ไหน)
[ ] ไม่ใช่
[ ] ใช่
[ ] อื่นๆ

32. เคยมีคดีที่ผู้เสียหายหรือพยานเกิดกลัว หรือไม่แน่ใจในรูปพรรณสัณฐานของผู้ต้องสงสัยเมื่อจับได้แล้วแต่ต้องปล่อยตัวไป
ใช่หรือไม่
[ ] ไม่ใช่
[ ] ใช่
[ ] อื่นๆ

33. การที่พยาน หรือผู้เสียหาย ชี้ตัวผู้ต้องหาผิด นำมาซึ่งการจับกุม และลงโทษผู้บริสุทธิ์ใช่หรือไม่
[ ] ไม่ใช่
[ ] ใช่
[ ] อื่นๆ

34. จำนวนคนที่ต้องกลายมาเป็นผู้ต้องสงสัย เพราะถูกชี้ตัวจากสมุดภาพ ในปี 2000-2001

35. จำนวนคนที่ต้องกลายมาเป็นผู้ต้องสงสัย จากการชี้ตัวผู้ต้องหา ในปี 2000-2001

คำถามส่วนที่ 3: เรื่องความคิดเห็นเกี่ยวกับการใช้คอมพิวเตอร์เทคโนโลยีและภาพเหมือนในการสืบสวนสอบสวน
กรุณาตอบคำถามทุกข้อโดยกาเครื่องหมาย [X] ในช่องที่ตรงกับความคิดเห็นของท่านมากที่สุด

ข้อ	คำถาม	เห็นด้วยมาก	เห็นด้วย	ความเห็นเป็นกลาง	ไม่เห็นด้วย	ไม่เห็นด้วยมาก
1	ท่านเข้าใจความหมายเกี่ยวกับการใช้เทคโนโลยีสารสนเทศในงานของตำรวจอย่างชัดเจน					
2	รูปถ่ายมีส่วนสำคัญในการการสืบสวนสอบสวน เช่น หาตัวคนร้าย หรือ คนหาย					
3	รอยสัก ปาน ไฝ หรือ แผลเป็น ที่เด่นชัดบนใบหน้าของผู้กระทำผิด เมื่อถูกระบุ สามารถทำให้การค้นหาตัวผู้กระทำความผิดได้ง่ายขึ้น					
4	ท่านเข้าใจการบรรยายเกี่ยวกับการใช้ทฤษฎีภาพเหมือน (Self-Similarity)ในการหารูปผู้ต้องสงสัยจากคอมพิวเตอร์อย่างดี					
5	ระบบค้นหารูปถ่ายด้วยคอมพิวเตอร์ควรมีใช้ในการสืบสวนสอบสวน					
6	ทฤษฎี Sequential เหมาะสมกับการนำมาใช้ในระบบค้นหารูปภาพมากกว่า ทฤษฎี ภาพเหมือน (Self-Similarity)					
7	ทฤษฎีค้นหาภาพเหมือนมีประโยชน์ต่อการสืบสวนสอบสวน หรือ ค้นหาตัวคนร้าย					
8	แผนกอาชญากรรมควรที่จะมีระบบคอมพิวเตอร์ค้นหารูปถ่ายของผู้ต้องสงสัย ที่ใช้ทฤษฎีภาพเหมือน					
9	เป็นการคุ้มค่าที่หน่วยราชการจะลงทุนในเรื่องของเทคโนโลยีสารสนเทศเพื่อนำมาช่วยเหลือในการทำงานของหน่วยราชการ และการให้บริการกับประชาชน					
10	ท่านมีความยินดีและพร้อมที่จะเรียนรู้การใช้คอมพิวเตอร์ในการค้นหาข้อมูล หรือรูปถ่าย เพื่อการสืบสวนต่างๆที่จำเป็น ถ้าสถานีของท่านมีอุปกรณ์พร้อม					
11	โดยส่วนตัวแล้วท่านมีอคติ หรือไม่ชอบคอมพิวเตอร์เทคโนโลยี					
12	ควรจะมีผลงานวิจัยเกี่ยวกับการใช้เทคโนโลยีสารสนเทศกับงานตำรวจในเมืองไทยให้มากกว่านี้					

ส่วนที่ 4 : เรื่องความคิดเห็นส่วนตัวเกี่ยวกับงานวิจัยทางด้านนี้

1. ท่านมีความคิดเห็นส่วนตัวอย่างไรเกี่ยวกับการนำระบบคอมพิวเตอร์มาใช้ในงานของตำรวจ

2. ท่านมีความคิดเห็นส่วนตัวอย่างไรเกี่ยวกับการใช้คอมพิวเตอร์ ร่วมกับ ทฤษฎีภาพเหมือน (Self-Similarity) ในการหาตัวผู้ต้องสงสัย

3. ท่านมีข้อเสนอแนะเพิ่มเติมที่จะเป็นประโยชน์ต่องานวิจัยชิ้นนี้อย่างไร

Interviewee Contact Details

No	Name / Position	Organization / Address	Date/Time
1.	Mr. Sawarng Srisakuna (Governor of Chacheonsao)	Chacheonsao Administration Office Roungwut Rd, Moung, Chacheonsao 12400 Tel: (038) 511-217	-10th May 2000 at 10.30 am. -3rd March 2001 at 14.00 pm.
2.	Mr. Surachai Srisarakham (Director of DOLA)	Department of Local Administration 59 Bongthonglang, Lumlooka, Pathomthani, 12150 Tel: (02) 791-7000/-91 Fax: (02) 791-7136	-13th May 2000 at 12.30 pm. -18th June 2001 at 10.30 am.
3.	Mr. Apinun Jantarangsri (Moung Head District Officer)	Moung District Office, Chacheosao Provice, Thailand Tel: (038) 511-343	- 22nd June 2001 at 13.00 pm
4.	Mr. Supachai (Bangprakong Head District Officer)	Bangprakong District Office, Chacheosao Province, Thailand Tel: (038) 512-786 Fax: (038) 512-483	13th Dec 2000 at 16.30 pm.
5.	Mr. Trairat Chatkaew (Senior IT Consultant)	Sun Microsystem (Thailand) Limited 23rd Floor, BKK City Tower, Sathorn Rd, Bangkok 10120 Tel: (01) 696-1000	13th May 2000 at 17.00 pm.
6.	Pol.Capt.Satapana Choonnawat Sub-Inspector (Investigation)	Thongmahamake Police Station 505, Soi Souanplu, Kwang Thungmahamek, Khet Sathon, BKK Tel: (01) 967-7788	-1st Oct 2002 12.30 pm. -15th Dec 2002 13.30 pm.
7.	Pol. Capt. Somchai Sarachon Inspector (Investigation)	Moung Police Station, Ampur Moung, Chacheonsao 12400 Tel: (01) 812-2198	17 Dec 2002 at 11.00 pm.
8.	Pol. Lt. Parkpoom Pitsamai Sub-Inspector (Investigation)	Somloungnour Police Station Samutprakarn Province Tel: (02) 287-2321	19 Dec 2002 at 12.00 pm.
9.	Mr. Natchai Mapraneat (Judge)	Bangkok South Civil Court, 1721/1 Chareonkrung 63, Satorn, BKK 10210 Tel: (02) 210-4268 Fax: (02) 210-4530	20th Aug 2003 at 12.30 pm.

10.	The Governor of Samutprakarn	Samutprakarn Administration Office Suthipirom Rd, Paknum, Ampur Moung Samutprakarn 10270 Tel: (02) 389-0660	10 Dec 2002 at 9.00 am.
11.	The Governor of Chonburi	Chonburi Administration Office Montrasavi Rd, Bangprasoi, Ampur Moung, Chonburi 10380 Tel: (038) 274-741	8 Jan 2003 at 11.00am.

Remarks: 1) Some interviewees preferred their name to be kept anonymous

2) Some interviewees conveyed their acceptance through telephone and some others through letter. The acceptance letters received follow this record. A few of these are written in Thai and the rest are in English.

2nd April 2000

Governor of Chacheosao
Chacheosao Administration Office
Chacheosao, 12400

Dear Sir,

Inquiry for the possibility of the interviewing the "Administration Officers"

I'm currently doing my doctoral degree at the University of Wollongong, Australia. My research is about "the use and uptake of IT by the Thai Government". The overall aim of this study is to explore the use of Information Technology in the Government Sector.

I'm expecting to be in Thailand during May-June to conduct the research interview and presenting my work to you and your colleague at the Administration Office. I would highly appreciate if you could possibly pass this request to your secretariat and provide me the name lists of the administration officers that interested in participate in an interview with me. Please kindly let me know the possibility to have an interview with you too. I can be contacted on Tel: (02) 322-3415 or Fax: (02) 321-9842.

Thank you very much in advance for your kind consideration and I'm looking forward to hearing from you soon

Yours sincerely,

Vilasinee Srisarkun
Email: vs12@uow.edu.au
vicky@s-t.au.ac.th

2 April,2001

To : Mr. Trairat Chatkaew
Senior Consultant
Sun Microssystem (Thailand) Limited
179 South Sathorn Rd, Bangkok 10120

From : Ms. Vilasinee Srisarkun
Dept. of Information & Communication Tech.
Faculty of Informatics, University of Wollongong
NSW 2500 Australia

Subject: Inquiry for the possibility of interviewing

Dear Sir,

I'm currently doing my doctoral degree at the University of Wollongong, Australia. My research is about "the Environmental Influences on the Adoption of National Information and Technology Infrastructure in Thailand". The overall aim of this study is to explore the use of Information Technology in the Government Sector. A case study of the Department of Local Administration is used to develop a better understanding of how IT has been used in the area of government services like the Population DBMS, National Identification Card, and other Registration services.

As you are one of the IT expertise who has been involving with a lot of government project in Thailand including the development of the Registration Processing at the Department of Local Administration. I would therefore like to have an in-dept interview with you regarding the matter. Should you be available for the interview during June-July 2002, I shall be much appreciated.

I'm looking forward to hearing from you soon

Yours truly,

Vilasinee Srisarkun
Email: vs12@uow.edu.au

30 August 2002

Mr. Sawarng Srisarkun
Governor of Samutprakarn
Samutprakarn Administration Office
Samutprakarn, Thailand

Dear Sir,

Inquiry for the possibility of the interviewing the "Administration Officers"

I'm currently doing my doctoral degree at the University of Wollongong, Australia. My research is about "the use and uptake of IT by the Thai Government". In this research I've proposed an image retrieving method to ease the crime investigation process. The method has been proved for its effectiveness over the tradition searching method. However, this study needs to be reviewed by the real user, which are the government administration officers and the police officers. Therefore, the interview together with the questionnaires is conducted to evaluate the result of the image retrieving method and to rise the awareness of the further research. After successful completion of my Ph.D. research, I also would like to provide a copy of my research to the Thai Royal Police Department and Department Local Administration.

I'm expecting to be in Thailand during 6th-31th of October and the whole month of December to conduct the research interview and presenting my work to you and your colleague at the Administration Office. I would highly appreciate if you could possibly pass this request to your secretariat and provide me the name lists of the administration officers that interested in participate in a brief presentation and interview with me. Please kindly let me know the possibility to have an interview with you too. I can be contacted on Tel: (02) 322-3415 or Fax: (02) 321-9842.

Thank you very much in advance for your kind consideration and I'm looking forward to hearing from you soon

Yours sincerely,

Vilasinee Srisarkun
Email: vs12@uow.edu.au
Vicky@s-t.au.ac.th

Professor Joan Cooper
PhD. Supervisor
Dean, Faculty of Informatics
University of Wollongong

31 May 2001

Mr. Surachai Srisaracam
Director of Registration Processing center
Department of Local Administration
Nakhonsawan Rd, Bangkok 10300 Thailand

Dear Sir,

Inquiry for the possibility of interviewing the "Director of RPC"

I'm currently doing my doctoral degree at the University of Wollongong, Australia. My research is about "the Environmental Influences on the Adoption of National Information and Technology Infrastructure in Thailand". The overall aim of this study is to explore the use of Information Technology in the Government Sector. A case study of the Department of Local Administration is used to develop a better understanding of how IT has been used in the area of government services like the Population DBMS, National Identification Card, and other Registration services.

Since you are the Director of the Department and have been directly involved with the project from the beginning, I'd like to request an in-dept interview with you regarding the matter.

I will be in Thailand during June-July and would very much appreciate it if you could see me during this time. I can be contacted on Tel: 322 3415 or Fax 321 9842.

I'm looking forward to hearing from you soon

Yours truly,

Vilasinee Srisarkun
Email: vs12@uow.edu.au

Professor Joan Cooper
PhD Supervisor
Dean, Faculty of Informatics
University of Wollongong

30 August 2002

Superintendent, Inspector
Somrongneur Police Station,
Samutprakran Province

Dear Sir,

Inquiry for the possibility of the interviewing the "Investigation Police Officers"

I'm currently doing my doctoral degree at the University of Wollongong, Australia. My research is about "the use and uptake of IT by the Thai Government". In this research I've proposed an image retrieving method to ease the crime investigation process. The method has been proved for its effectiveness over the tradition searching method. However, this study needs to be reviewed by the real user, which are the government and the police officers. Therefore, the interview together with the questionnaires is conducted to evaluate the result of the image retrieving method and to rise the awareness of the further research.

I need to interview at least 5-10 police officers from the crime investigation unit and can assure that the information gathered from your organization will be maintained with a full confidentially. I'm expecting to be in Thailand during 6th-31th of October and the whole month of December to conduct a presentation and the research interview. I would highly appreciate if you could possibly pass this request to your secretariat and provide me the name lists of the police officers that will participate in a brief presentation and interview with me.

However, if you have a very busy schedule on that proposed month, please feel free to fit me in some other time at your convenient as I'm also aware that a police work is very busy and in demand 24 hours a day. Therefore, individual interview can be arranged to fit one's schedule. Please kindly let me know the possibility to have an interview with you too. I can be contacted on Tel: (02) 322-3415 or Fax: (02) 321-9842.

Thank you very much in advance for your kind consideration and I'm looking forward to hearing from you soon

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30 August 2002

Superintendent, Inspector
Moung Police Station,
Chonburi Province,

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Thongmahamak Police Station
Khet Satorn, Bangkok

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30 August 2002

Superintendent, Inspector
Pravate Police Station,
Pravate, Bangkok,
10250 Thailand

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Professor Joan Cooper
PhD. Supervisor
Dean, Faculty of Informatics
University of Wollongong

30 August 2002

Superintendent, Inspector
Moung Police Station,
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Thailand

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Professor Joan Cooper
PhD. Supervisor
Dean, Faculty of Informatics
University of Wollongong

30 August 2002

Superintendent, Inspector
Moung Police Station,
Samutprakarn Province,
Thailand

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Yours sincerely,

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Professor Joan Cooper
PhD. Supervisor
Dean, Faculty of Informatics
University of Wollongong

15th September 2002

Superintendent, Inspector
Thonglor Police Station,
Bangkok , Thailand

Dear Sir,

Inquiry for the possibility of the interviewing the "Investigation Police Officers"

I'm currently doing my doctoral degree at the University of Wollongong, Australia. My research is about "the use and uptake of IT by the Thai Government". In this research I've proposed an image retrieving method to ease the crime investigation process. The method has been proved for its effectiveness over the tradition searching method. However, this study needs to be reviewed by the real users, which are the government and the police officers. Therefore, the interview together with the questionnaires is conducted to evaluate the result of the image retrieving method and to rise the awareness of the further research.

I need to interview at least 5-10 police officers from the crime investigation unit and can assure that the information gathered from your organization will be maintained with a full confidentially. I'm expecting to be in Thailand during October-January to conduct a presentation and the research interview. I would highly appreciate if you could possibly pass this request to your secretariat and provide me the name lists of the police officers that will participate in a brief presentation and interview with me.

However, if you have a very busy schedule on that proposed month, please feel free to fit me in some other time at your convenient as I'm also aware that a police work is very busy and in demand 24 hours a day. Therefore, individual interview can be arranged to fit one's schedule. Please kindly let me know the possibility to have an interview with you too. I can be contacted on Tel: (02) 322-3415 or Fax: (02) 321-9842.

Thank you very much in advance for your kind consideration and I'm looking forward to hearing from you soon

Yours sincerely,

Vilasinee Srisarkun
Email: vs12@uow.edu.au

The Governor's Office
Chacheonsao Province
Ampur Moung, 12400
Tel: (038) 654-873
Fax: (038) 654-876

5th May 2000

Subject : Inquiry about the possibility for interviewing the "Governor of Chacheosao"

Dear Ms. Vilasinee Srisarkun

Reference was made to your letter dated 2nd April 2000 requesting the possibility for interviewing the Governor of Chachoengsao who are directly involved in the government administration at Provincial level. I am pleased to inform you that I have made an arrangement for you to meet the Governor at his office on May 10th,2000 at 10.30a.m.

Please kindly contact me before your arrival at the governor office.

Yours sincerely,

Kitisak Raktranachai
(Secretary of the Governor)

Sun Microsystems (Thailand) Limited
17th Floor, Abdulrahim Place
990 Rama IV Road, Silom, Bangrak,
Bangkok 10500

8th May 2000

Dear Miss Srisarkun:

I have received your letter of April 2nd, 2000 and have considered your interview request regarding the e-Government in Thailand. I hope my experience as a Senior IT Consultant in numbers of government projects can help you gain more understanding about the subject.

You can meet me at the conference room#, Sun Microsystems which is located on the 17th floor of Abdulrahim Building, Rama IV Road, at 14.30 pm on May 13th.

Yours faithfully,

Trairat Chatkaew
(Senior IT Consultant, Sun Microsystems Thailand Limited)

JAVA™

Dept. of Local Administration
59 Lumlooka, Bongthonglang
Pathomthani, 12150

10 June 2001

Dear Ms. Vilasinee S.

We write to inform you that the Director of Department of Local Administration Mr. Surachai is much interested in your interview requested. He would be grateful if you could meet him at his office on 18th June 2001.

Yours truly,

Kietisak Tronsiri

(Secretary)

Tel: (02) 791-7000-9
Fax: (02) 791-7136

NO. CH 0018/4614

Muang District Office
Roungwut Rd.
Chachoengsao Province
24000

15 June 2001

Dear Miss Vilasinee,

Please kindly be informed that your request for an in – dept interview with the Muang Head District Officer is accepted. Mr. Apinun will be available on Friday 22 June, from 13.00 – 14.30 hrs. at Muang District Office. Should there be any reason that you can not presence on the date arranged, please let us know. Otherwise he'll be seeing you on the date appointed.

Faithefully yours,

Bunpoj

Mr. Bunpoj Submuang
Senior Assistant District Chief Officer
Acting Muang District Chief Officer

Somrongneur Police station
Samutprakarn

5th September 2002

Dear Miss V. Srisarkun

Please be informed that your request for interview with the police investigation officers at Somrongneur Police Stations is accepted with pleasure. My fellows and I will be available for your brief presentation and interview on Wednesday 11th October, from 14.00-15.00pm at the meeting room number 2.

Faithfully yours,

Pol.Lt. Parkpoom Pitsamai

Somrongheur Police Station Tel: (02) 234-4322

ที่ ตช 0011.(บก.5)05 / พิเศษ

สถานีตำรวจนครบาลทองหล่อ
สุขุมวิท 55 แขวงคลองตันเหนือ
เขตวัฒนา กรุงเทพฯ 10110

ตุลาคม 2545

เรื่อง ขอความร่วมมือตอบแบบสอบถาม

เรียน คุณวิลาสินี ศรีศกุณ

อ้างถึง หนังสือขอความร่วมมือตอบแบบสอบถาม ของ มหาวิทยาลัยวูลองกอง แห่ง ประเทศออสเตรเลีย

ตามหนังสือที่อ้างถึงดังกล่าวข้างต้น คุณวิลาสินี ศรีศกุณ นักศึกษาปริญญาเอก แห่ง มหาวิทยาลัยวูลองกอง ประเทศออสเตรเลีย ได้ขอความร่วมมือให้ทางสถานีตำรวจนครบาลทองหล่อ ตอบแบบสอบถามเกี่ยวกับงานสืบสวนสอบสวนในระดับสถานีตำรวจ ของ สำนักงานตำรวจแห่งชาติ ตามความละเอียดแจ้งแล้วนั้น

ขอเรียนว่า เจ้าหน้าที่ตำรวจฝ่ายสืบสวนสอบสวนของสถานีตำรวจนครบาลทองหล่อ ได้ตอบแบบสอบถามดังกล่าวเรียบร้อยแล้ว จึงขอส่งแบบสอบถามดังกล่าวคืนกลับมายังท่านเพื่อดำเนินการในส่วนที่เกี่ยวข้องต่อไป หวังเป็นอย่างยิ่งงานวิจัยของท่านจะสำเร็จลุล่วงไปได้ด้วยดี และเป็นประโยชน์ต่อการทำงานสืบสวนสอบสวนของเจ้าหน้าที่ตำรวจต่อไปในอนาคต

ขอแสดงความนับถือ

ร้อยตำรวจโท

(สมเกียรติ เมืองแก้ว)

พนักงานสอบสวน (สบ 1) สถานีตำรวจนครบาลทองหล่อ

สถานีตำรวจนครบาลทองหล่อ โทร 3902240-3

Pravate Police
Station
Pattanakarn Road,
Sounloung, Bangkok
10250

11 October 2002

Subject: Request to conduct the presentation and distribution of questionnaire

Dear Miss Srisarkun,

On behalf of police officers at Pravate Police Station, we are pleased to participate in your research.

Please come to see me or one of our staffs for further arrangement.

Your sincerely,

Somsak Anurakan

ที่ ตช.0011.(บก.5)03 / พิเศษ

สถานีตำรวจนครบาลทุ่งมหาเมฆ
แขวงทุ่งมหาเมฆ เขตสาทร
กรุงเทพมหานคร 10120

15 ตุลาคม 2545

เรื่อง ขอความร่วมมือตอบแบบสอบถาม

เรียน คุณ วิลาสินี ศรีศกุณ

อ้างถึง หนังสือขอความร่วมมือตอบแบบสอบถามเกี่ยวกับการใช้เทคโนโลยีสารสนเทศในการทำงานของตำรวจ

ตามหนังสือที่อ้างถึงดังกล่าวข้างต้น ขอเรียนว่า เจ้าหน้าที่ตำรวจฝ่ายสืบสวนสอบสวน ของสถานีตำรวจนครบาลทุ่งมหาเมฆ และสถานีตำรวจนครบาลมักกะสัน มีความยินดีที่จะให้ความร่วมมือในการตอบแบบสอบถามทุกประการ และได้ดำเนินการตอบแบบสอบถามดังกล่าวให้เป็นที่เรียบร้อยแล้ว

ทั้งนี้ หากท่านต้องการสัมภาษณ์ หรือ สอบถามรายละเอียดเพิ่มเติม กรุณานัดหมายล่วงหน้าอีกครั้ง และหวังเป็นอย่างยิ่งว่าข้อมูลดังกล่าว จะเป็นประโยชน์ต่อการศึกษาของท่าน และเป็นแนวทางในการพัฒนาเทคโนโลยีสารสนเทศเจ้าหน้าที่ตำรวจต่อไป

ขอแสดงความนับถือ

ร้อยตำรวจเอก

(สถาปนา จุฌณวัตต์)
รองสารวัตรสืบสวนสถานีตำรวจนครบาลทุ่งมหาเมฆ

ฝ่ายสืบสวน สน.ทุ่งมหาเมฆ
ร้อยตำรวจเอกสถาปนา จุฌณวัตต์ โทร. 02-2861138 , 01-6947788

Thungmahamek Police Station
505 Soi Suanplu , Sathron ,
506 Bangkok 10120
Tel: 02 - 2861138
01 - 6947788
Fax: 02-2861138

18 November 2002

Dear Miss Srisarkun,

It gives me great pleasure to accept your interview request on December 15th,2002 at 12.30PM. Personally I believe your contribution to this research will benefit in the police work in Thailand.

Best regards,

Pol.Capt.Satapana Choonnawat
Sub-Inspector (Investigation)

Bangprakong District Office

29th November 2002

Dear Vilasinee Srisarkun,

Your letter requesting for an interview arrived yesterday afternoon and I have read it with great interest. I will be available for your interview on 13th December 2000, either between 10.30-11.30 a.m. or 14.00-15.30 p.m. Please let me know whichever convenient for you. I can be reached directly at (01-7545468)

Faithfully yours,

(Supachai Loungsangthong)
Head District Officer