Banking and Innovation: The Case of Payment Systems Modernisation in Thailand

By

Tanai Khiaonarong

Department of Information Systems

London School of Economics and Political Science

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ProQuest LLC
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106-1346

To my dear parents, Dej and Bunnag,
with love and appreciation

ABSTRACT

This thesis examines the role of banks in influencing innovation and analyses their links to payment systems modernisation. The main argument is that banks are a type of technological institution having the potential to promote innovation, although such roles may be implicit or secondary. This role is investigated in eight chapters. The first three chapters review the major innovation models and progress in payment system. An analytical framework, based on evolutionary and resource-based views, is developed to examine how resources and routines which reflect an organisation's stock of skills, influence innovation, and assist them in sustaining competitive advantage.

The following three chapters present the empirical results. In a survey of innovation in the banking industry, research results suggested that although there were relatively high levels of information technology awareness and application, particularly in payment system automation, there remained a moderate level of innovative capabilities among the banks studied. Further analysis through four mini case studies of the largest commercial banks also suggested similar increases in technological investments, but replication rates were also relatively high. Thus, it is argued that such investments may gain, but not sustain, competitive advantage, whereby the latter requires banks to innovate by acquiring, accumulating, and advancing their stock of skills. In this respect, the role of the central bank in creating a conducive environment for innovation is also important which may be seen through its involvement in payment systems modernisation.

The final two chapters discuss the policy and research implications. It is argued that central bank policies oriented towards payment system reform, along with new payment product and services development by commercial banks, have come to play an important part in promoting technological innovation in banking. Such roles in reforming rudimentary payment systems have helped strengthen national information infrastructures, especially in emerging market economies, and moreover, have influenced the set-up of a national innovation system in banking which underpins economic development.

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ACRONYMS

ATM	Automated Teller Machine
BAHTNET	Bank of Thailand Automated High-Value Transfer Network
BIS	Bank for International Settlements
DVP	Delivery Versus Payment
ECH	Electronic Clearing House
ECS	Electronic Cheque Clearing System
EDI	Electronic Data Interchange
EFT	Electronic Funds Transfer
EFTPOS	Electronic Funds Transfer – Point of Sale
IS	Information Systems
IT	Information Technology
IMF	International Monetary Fund
NECTEC	National Electronics and Computer Technology Centre
NSTDA	National Science and Technology Development Agency
OECD	Organisation for Economic Co-operation and Development
RTGS	Real-Time Gross Settlement System
R&D	Research and Development
S&T	Science and Technology
SET	Stock Exchange of Thailand
TBA	Thai Bankers Association

CHAPTER 1: INTRODUCTION

> Economic logic prevails over the technological and in consequence we see all around us in real life faulty ropes instead of steel hawsers, a clumsy money economy instead of a cheque circulation.
>
> Schumpeter, *Theory of Economic Development* (1934, p. 15)

1.1 OVERVIEW

How can banks strengthen financial systems? To answer this question, this thesis examines the relationship among banking, innovation, and payment systems modernisation. The development of innovative services has become increasingly important for banks, resulting from the liberalisation of world financial markets. Such trends have increased in scale and speed through globalisation and computerisation, and as a result, the reform of fundamental flaws in financial systems, and the creation of competitive advantage through payment systems, have become major concerns for central banks and commercial banks alike.

The payment system is a core group of strategic information systems (IS) which contribute towards economic development, especially in emerging economies, and forms the foundation for financial sector and national information infrastructure developments (Listfield and Montes-Negret, 1994; Talero, 1997, p. 288). This has become a key concern for central banks in developing countries seeking to improve national financial infrastructures and to increase their potential of becoming major financial centres. Comparatively, commercial banks have introduced innovative payment services to increase competitive advantage, apart from automating internal banking processes.

The background of this thesis is on electronic payment systems modernisation. The foreground illustrates the capabilities and constraints faced by developing country banks in reforming rudimentary payment systems. This reform is influenced by the availability and uniqueness of resources, particularly related to information technology (IT). As a result, the capabilities of central banks and commercial banks to innovate depend on the study of such resources. Thus, these issues are studied in three themes.

The Role of Innovation

The first theme examines the role of innovation. This forms the theoretical background of the study. Innovation models have evolved from early linear-oriented to more integrated, networked, and strategic types. Such developments reflect an increased understanding in the unique nature of innovations and the appropriate approach required studying them. Nevertheless, the use of the innovation diffusion model across many disciplines has remained dominant (Rogers, 1983). In this respect, the diffusion model has been widely applied in IS research, although there have been marginal developments in the use of alternative approaches. Such relatively recent approaches seek to re-conceptualise innovation in a much broader view, rather than focusing on technological innovations. This has included the integrated, institutional, and resource-based approaches which are discussed in Chapter 2.

The thesis combines concepts in evolutionary and resource-based views in studying innovation. This seeks to analyse the characteristics and conditions of resources which influence innovation and the sustaining of competitive advantage. Basically, the rate of resource replication in firms is determined by the attributes of such resources. The implications of this approach are twofold. First, conventional models of innovation have limitations when applied in a non-westernised context, particularly in developing countries. The models provide an inadequate approach in capturing the complexity of the innovation process in such contrasting settings.

Second, there is a need to develop alternative analytical frameworks that are more appropriate for the analysis of dynamic innovation processes in developing countries. Evolutionary and resource-based perspectives provide one alternative approach, as they focus on the unique characteristics and conditions shaping innovation in a specific context. In this respect, the study of innovations, or more precisely, the study of factors influencing resource replication among firms, can be analysed in a developing country context, while avoiding the limitations in conventional innovation models.

The Role of Banking

The second theme examines the role of banking in innovation. This includes the role of the banking industry and banking institutions, and conceptualises banks as a type of technological institution which (a) are a major part of the service sector, (b) influence some sectors of the service economy, and (c) affect other sectors, particularly all

industries that borrow from them. Moreover, this theme builds upon previous studies which argue that banks play a constructive role in promoting and shaping national policies for technological development, particularly in developing countries (Jequier and Hu, 1989; Barras, 1990).

Since the early 1980s, there have been many developments in both bank-related and electronic funds transfer (EFT) research in IS studies. For example, this has included the development of an historical tradition and its application in a commercial bank context (Mason *et al.*, 1997; McKenney *et al.*, 1997). In other studies, the role of IS was examined in relation to bank re-engineering, bank mergers, strategy formulation, and strategies of electronic banking systems in an emerging market economy context (Mentzas, 1994; Oppenheim and Shao, 1994; Dutta and Doz, 1995; Remenyi and Cinnamond, 1996; Johnston and Yetton, 1996; Curie and Willcocks, 1996).

EFT has been one of the major subjects studied since the 1980s. This included the forming of an agenda for future research, and the analysis of its impact on society and public policy (Kraemer and Colton, 1980; King and Kraemer, 1980). For example, Clarke *et al.*, (1990) studied such public policy implications in a survey of the practices and intentions of the Commonwealth government agencies in relation to EFT systems, EFT at point of sale (EFTPOS), and electronic data interchange (EDI). In their guidelines for future research, King and Kraemer (1980) argue that institutions played an important role in EFT development. This is mainly because of the bias created by chosen definitions by different institutions which may focus on payment systems, financial systems, electronic technologism, total systems, and media or communications. The choice of a specific definition suggests an institution's maneuvering step towards an advantageous position.

This thesis adopts the payment systems approach. It aims to study how banks support payment systems modernisation. The study attempts to balance the bias in definition by addressing the important role that the central bank, together with the commercial banks, play in developing wholesale and retail payment services. Their roles in shaping national policies for technological development are also examined.

Banks play a central role in the innovation process. This is particularly the case for central banks and commercial banks in a developing country context. They invest relatively large amounts of physical, organisational, and human resources related to IT, which are aimed to increase productivity and to improve efficiency in work routines. For example, Cassiolato (1992) studied the important role of user-producer relations towards the diffusion of new technology in Brazil's banking industry, while Fincham *et al.*, (1994) examined the relationship among strategy, technology, expertise, and innovation in the financial services sector.

Banks acquire technology from both local and foreign sources. Such replication of resources may include the importation, imitation, and transfer of technology in tangible and intangible forms. However, the rate of resource replication will be determined and affected by attributes. For example, Pennings and Harianto (1992) argued that the innovation adoption decisions of commercial banks depended on their stock of skills accumulated over time, incorporating IT experiences and inter-firm relationships. Moreover, this needs to be adapted to the unique conditions in a specific country's financial and banking systems. Through this process, indigenous managerial and technological capabilities are developed and strengthened.

Banks also diffuse innovations. This process occurs within and among them, and also includes other payment participants such as business firms, government agencies, and households. The decision to diffuse a specific innovation may vary among the types of banks. For example, this may be progressive for commercial banks which aim to profit from introducing new payment services and to maintain a technological advantage over their competitors. Alternatively, this may be more cautious for central banks which aim to maintain stability, security, and reduce risks in the payment systems.

The Role of Developing Countries

The third theme examines innovation in a developing country context. This theme addresses the unique conditions in such countries, focusing on the importance of the organisational, social, political, and cultural factors which influence IS development (Walsham, *et al.*, 1990; Chatterji, 1990; Bhatnagar and Odedra, 1992). For example, some studies have addressed the development of appropriate IS methodologies (Bell and Wood-Harper, 1990) and analysed the role of culture (Robey *et al.*, 1990; Davies and Wood-Harper, 1990; Walsham, 1998).

Thailand provides a case of studying IS in a developing country context. However, technology-related research has been marginal, focusing on the technology strategies, the technical changes, and the technological capabilities of firms in electronics and manufacturing industries in the country (Chantramonklasri, 1986; Tiralap, 1990; Mukdapitak, 1994). Other studies have attempted to analyse the country's science and technology (S&T) plans and policies, further highlighting the limitations of the literature and data available in this area (Juangbhanich, 1988). Similarly, research related to innovation in banking and financial services has remained marginal (Uchupalanan, 1998). In a broader perspective, there has been increased interest in using the country as a unique case study, as illustrated in studies concerning science, economics, society, and culture (Gohlert, 1990; Kurlick, 1992; Warr, 1993; Muscat, 1994; Krongkaew, 1995; Phongpaichit and Baker, 1996; Yuthavong and Wojcik, 1997).

Four unique conditions make Thailand an interesting case. Firstly, the country was one the world's fastest growing economies.[1] This provides an opportunity to study the factors that drove the country's dynamic economy, particularly in the area of IT. As a developing country, it was ranked as one of the highest-performing Asian economies, which has been attributed to rapid growth in terms of GNP per capita, when compared with other regions of the world, particularly countries in Sub-Saharan Africa, South Asia, and Latin America (World Bank, 1993). This achievement has been attributed to supportive public policy, and it has been argued that although institutions in East Asia may be authoritarian, paternalistic, and interventionist, they have been willing to delegate authority to a technocratic elite or key leaders of the private sector. However, the role that IT has played towards economic development has been least studied in Thailand, as compared to the country's regional counterparts.

Secondly, the country has experienced pervasive IT impacts. This is particularly relevant for the manufacturing and services sectors, as suggested by the employment shifts between the primary, secondary, and tertiary sectors (Warr, 1993). Moreover, the production of computer parts and components, together with integrated circuits, have become the country's second and sixth principal export items in the mid-1990s respectively. However, the demand for technically qualified and experienced personnel

[1] Thailand experienced an economic growth rate of approximately 8% in the early-1990s to mid-1990s. However, this economic expansion was largely affected by the Asian financial crisis in 1997.

in the country's services' sector remains constrained, mainly because of shortages of skilled manpower. Capability building to resolve such constraints has become a common issue shared by most developing countries. In Thailand, public policy has responded with the set-up of an institutional framework to support S&T developments, particularly in the area of IT (Khiaonarong and Liebenau, 1997).

Thirdly, the country has a unique payment systems modernisation experience. Unlike many emerging economies which have acquired financial and technical assistance from international aid agencies, the country's central bank has played a very constructive role in investing, developing, enhancing, and managing three major payment systems (Khiaonarong, 1998). This has been a significant development in the use of IT to increase efficiency in processing payments, and to improve outdated payment procedures and arrangements. The study of this development process provides an opportunity to learn how the central bank and commercial banks contributed towards wholesale and retail payment systems modernisation with advanced IT, and also provides an analysis of their capabilities and constraints.

Lastly, the country has some of the leading commercial banks in the world. In 1996, four of the country's commercial banks received high-level rankings in the world's leading 1000 commercial banks.[2] More importantly, these four leading banks are studied to examine their experiences in innovation which partly contributed to the improvement of overall bank performances, and the development of new products and services. This includes analysing the background of the commercial banks, determining the role of IT, and identifying the major sources of innovation.

In sum, although Thailand has its own specific social and economic problems and processes, the country provides an interesting and promising opportunity to explore the relationship between banking and innovation in a developing country context. For example, Pongpaichit and Baker (1996) discuss the forces that drove the country's dynamic economy, and analysed their impact on society, politics, environment, and culture, but doubt the direction of such developments. Muscat (1994) focused on

[2] The world rankings of international commercial banks is based on Tier One capital, as defined by the Bank for International Settlements. See Chapter 5 for further details.

development policies, and examined the positive and negative implications of political and social changes, as a result of rapid economic development.

1.2 RESEARCH OBJECTIVES

The study aims to identify the types of IT related resources that serve as a source of innovation in banking. These resources include the interrelationship among the physical, organisational, and human aspects of IT. Their unique characteristics and conditions are analysed to assess their strengths and weaknesses as a source of sustained competitive advantage among firms in the banking industry. This is examined in the context of payment systems modernisation in Thailand.

The two levels of analysis are the banking industry and banking institutions. Their relationship is examined to identify the linkage between macro-level and micro-level factors, providing a better understanding of the dynamic innovation process. Moreover, this complementary approach reflects the evolutionary and resource-based views which focuses on industry-specific and firm-specific analyses of innovation, and forms the foundation of the analytical framework used in the study.

Firstly, the banking industry is studied to identify the underlying factors which influence innovative payment services development among commercial banks. This particularly seeks to examine the utilisation of various types of IT, the automation of payment routines, and the identification of the major sources of innovation among banks in the industry. Such an industry analysis, based on the use of survey results, assists in determining the driving forces behind innovation in the industry as a whole, with a particular emphasis on payment services.

Secondly, banking institutions are studied to examine experiences in innovation. Such experiences are important as they identify the characteristics and conditions of unique resources which either contributed to or constrained innovation in banking. The central bank is studied to identify such capabilities and constraints which influenced payment system modernisation. Similarly, four leading commercial banks are selected as mini case studies to examine their capabilities in new product and services development.

The thesis raises both theoretical and practical questions. What types of IT resources are unique? How do such resources contribute towards innovation and the sustaining of competitive advantage? How do attributes affect the rate of resource replication? What are the major channels whereby banks acquire new technology and know-how? How do such sources of information influence new product and services development? How do banks build and strengthen their managerial and technological capabilities? What are the major constraints inhibiting innovation in banking? What are the potential roles of banks in influencing innovation, particularly in promoting technological development in the banking system and in shaping national technology and innovation policies? The thesis attempts to answer such questions.

1.3 RESEARCH METHODOLOGY

The study uses a pluralistic approach, combining surveys and mini-case studies through quantitative and qualitative data collection methods. Proponents of this multi-method view suggest that it provides an complementary approach (Attewell and Rule, 1991), an alternative rather than a competing source of evidence and ideas (Danziger and Kraemer, 1991), and an adequate approach to address the full impact of IT (Kling, 1991). Such an approach helps address the dynamic nature of innovation and analyses the unique characteristics of resources, and how attributes affect their rate of replication. Therefore, the use of multiple data sources helps identify and explain the sources of innovation, and moreover, strengthens and supplements the findings through the triangulation of data. This research methodology, however, provides only one way in conducting the study, as suggested by the alternative approaches available to the researcher.

Philosophical Position and Perspectives

There is a range of philosophical perspectives and methodologies available to the researcher. This provides the epistemological and methodological basis for analysing the empirical elements of the research which may have provided richer insights into the findings. Most importantly, this awareness of alternative approaches has become an increasingly important issue in IS studies (Mumford *et al.*, 1985; Boland and Hirschheim, 1987; Buckingham *et al.*, 1987; Kraemer, 1991; Nissen, 1991; Nissen *et al.*, 1991; Galliers, 1992).

The dominance of a particular perspective in IS research has been pointed out as early as the 1970s (Mason and Mitroff, 1973). Thereafter, there have been attempts to introduce alternative approaches. For example, Galliers and Land (1987) developed a taxonomy of IS research approaches, arguing that the traditional, scientific-oriented research views are not the only, or the most appropriate approach, and suggest newer modes of research that are interpretive in nature. Smithson (1991), however, argues against this taxonomy, suggesting that the categorisation of a research method as positivist or interpretivist was misleading. Such debates have increased the importance of understanding the range of philosophical perspectives and research approaches available which departs from the use of any dominant research method in understanding the complex phenomena underlying IS (Galliers, 1991).

The argument against dominant research assumptions and approaches can be explained through the conceptualisation of IS as social systems (Land and Hirschheim, 1983; Walsham *et al.*, 1990). This argument does not view IS as independently technical systems, but social systems, which have behavioural and social consequences at both societal and organisational levels, and where IT forms only one function (Liebenau and Backhouse, 1990).. Such a treatment of IS as social phenomena thus requires an improved way of understanding and capturing the complex nature of the social system which is beyond the scope of a single research perspective. For example, Burrell and Morgan (1979, pp. 21-35) suggest four paradigms for analysing social phenomena, which are organised around the subjective-objective dimension debate, and include the functionalist, the interpretive, the radical humanist, and the radical structuralist paradigms.

Hirschheim and Klein (1989) adapted such paradigms in the context of IS, and argued that a majority of studies were focused on the functionalist paradigm which limited the development of different approaches. Similarly, Orlikowski and Baroudi (1991) compared and contrasted the positivist, critical, and interpretive research philosophies which influence the assumptions and approaches in IS research. To put the paradigms and philosophies into perspective, three alternative approaches are briefly discussed to illustrate how they might have been applied in the current and future research on payment systems.

The positivist perspective

The aim of studies under the positivist research perspective is to test theory which may be achieved through structured means of measurement in 'formal propositions, quantifiable measures of variables, hypotheses testing, and drawing inferences about a phenomenon from the sample to a stated population' (Orlikowski and Baroudi, 1991, p. 5). The positivist perspective assumes that the relationship between social reality and humans are independent, descriptive, deterministic, objective, factual, and has a cause and effect relationship.

There are two types of research in the positivist perspective (Orlikowski and Baroudi, 1991, p. 5). Firstly, there is the descriptive type which focuses on the objective researching and reporting of facts in a straightforward manner. Secondly, there is the traditional theoretical type which focuses on working within an established theoretical tradition, interpreting the facts, and in some cases, developing grounded theory. Therefore, there are attempts in the interpretation of facts in the second type.

Three characteristics make the current study of the traditional theoretical type. First, the study adopts theories in evolutionary economics and resource-based perspectives to guide the empirical research. These two perspectives are based on established theories and have also been applied in IS research. Second, the study employs survey questionnaires to identify broad-level indicators of innovation in banking. This makes use of simple statistical analysis to identify the strengths and weaknesses of sources of innovation in average percentages. And third, the study interprets these facts and figures, in addition to the interview results. This attempts to balance the objective (survey results) and subjective (interview results) findings.

Alternatively, a descriptive positivist perspective in payment systems study might have adopted theoretical guidance from traditional economic theories, such as the theories of money, finance, and production. For example, this may be illustrated with the economist approach in studying payment system efficiency. This is based on the MV = PT equation, where M is the stock of money (currency and demand deposits), V is the velocity of circulation of money, P is the price level, and T is the volume of trade or transactions in the economy (Fisher, 1911).

This theory provides an established approach grounded in economic theory. For example, the equation helps identify the relationship between monetary aggregates and the real economic sector which also guides the management of monetary policy and the setting of payment system pricing strategies (Lempinen and Lilja, 1989). Nevertheless, the equation is far from perfect. The role that IT plays in increasing efficiency and reducing transaction costs of payments, thus increasing the velocity of money, which is represented by V, is not addressed by this model and although there are attempts, the results remain fundamentally functional and positivistic.

Positivist research approaches may include theorem proof, forecasting, simulation, surveys, and case studies. For example, a researcher may collect payment system statistics and make mathematical calculations or econometric analysis to test the velocity of money or to further develop or modify the model. The research results may include the identification of past, present and future payment trends, which are available as statistical indicators that need to be further interpreted.

The testing of the 'velocity of circulation of money' model is useful but restrictive. The model is particularly useful from the standpoint of economists and academics concerned with the conduct of a country's monetary policy. Alternatively, practitioners and academics may be interested in studying the underlying factors that influenced payment system modernisation which is the main subject of this study. The latter agenda, which is concerned with socio-economic factors, is partly addressed by the interpretation of facts in the traditional theoretical type of positivist perspective, but may be further enriched through the use of an interpretive perspective.

The interpretive perspective

The aim of studies under the interpretive research perspective is 'to understand the inter-subjective meanings embedded in social life' (Gibbons, 1987, p. 3). In contrast to the positivist perspective, which assumes reality as given and the independent relationship of humans, the interpretive view argues that social interactions and processes of humans shape reality. This relativistic relationship assumes that the understanding of any phenomenon is subjective, non-deterministic, and requires the consideration of cultural and contextual factors.

The interpretive view, although marginal in number as compared to positivist research, has become an increasingly important approach in the study of IS (Boland, 1985, 1991; Lee, 1991; 1994; Walsham, 1993, 1995; Myers, 1995). This is partly explained by four reasons. First, there has been an increased interest and importance of organisational and managerial issues, in comparison to technical issues. Second, the perspective provides the potential to study the richness of reality, in contrast to controlled laboratory environments. Third, the perspective provides the ability to study the social interaction between people and the complex environment. And fourth, the perspective provides an opportunity to study qualitative elements which may otherwise have been overlooked or inaccessible in quantitative methodologies.

There is a wide range of interpretive research approaches which have been applied in IS. For example, this includes deconstruction (Beath and Orlikowski, 1994), ethnographic studies (Bentley *et al.*, 1992; Harvey and Myers, 1995), grounded theory (Orlikowski, 1993), hermeneutic analysis (Boland and Day, 1989; Boland, 1991; Myers, 1995), in-depth interpretive case studies (Walsham, 1995), phenomenology (Boland, 1985; Rathswohl, 1991), and language interpretation such as in semiotic studies (Liebenau and Backhouse, 1990).

An interpretive perspective in payment systems study might have used an in-depth interpretive case study to analyse system development efforts in the central bank. The author may have chosen to become an involved researcher analysing the payment system project during its period of implementation. This participant observation or action research approach may have involved the interviewing of people in the payment systems project, particularly from the IT, payment systems, and legal departments. Moreover, it requires the researcher to reduce his distance with bank personnel, as compared to an outside observer status.

This approach provides an in-depth analysis of the central bank organisation. However, the nature of payment systems development involves other participants, particularly the commercial banks which have contributed in implementing retail funds transfer systems. Most importantly, however, the payment system also affects individuals, societies, and countries in a much wider context. The consideration of this

broader context, and its potential conflict, may be partly explained by the critical perspective.

The critical perspective

The aim of studies under the critical research perspective is to analyse how humans may be released from existing social arrangements. This process of emancipation from domination and alienation involves the identification of sources of conflicts and contradictions in society, and critiquing them to eliminate humans from such constraints in society. The critical perspective has been least adopted by IS researchers, as compared to the two previous perspectives, and makes several assumptions (Orlikowski and Baroudi, 1991, pp. 19-21).

Firstly, the perspective is historically constituted, totality in nature, and potentially develops new phenomena. Secondly, the perspective is grounded in social and historical practices, for which a certain phenomena may only be understood through historical analysis. Lastly, the perspective is exemplified through the role of the researcher, who makes transparent the restrictive conditions of the status quo, and initiates a process of social change, eliminating alienation and domination.

Soft systems methodology and its use in IS provides one illustration (Checkland, 1990; Checkland and Holwell, 1998). This approach uses the concept of 'world view' to analyse a problem situation that is part of a rich picture, helps address the dialogue between participants in the situation, and roughly sketches the totality of the phenomena under study. Moreover, this phenomenon undergoes an iterative process until consensus is reached among the participants. Thus, through this iterative process, a more effective IS that addresses the real needs of the participants may be achieved.

A critical perspective in payment systems study might have involved a critical analysis of value conflicts and social choice, as suggested in a study by Kling (1987). This study adopts a 'political' view of electronic payment systems, in contrast to dominant research approaches which have conceptualised them as 'economic instruments'. Kling (1987) argues that electronic payment systems are political, and are a potential source of conflicts in choices of social values. These conflicts can be eliminated through educating the public with pro-social policies on electronic payment system

developments which seek to balance the issues relating to consumer convenience, consumer protection, system security, system availability, and public interests. Thus, this critical view aims to emancipate individuals, in this case the payment systems user, through balancing public and institutional interests.

In sum, the three major philosophical perspectives provide unique insights into the phenomena of payment systems. The use of a particular perspective, however, must also acknowledge their underlying assumptions which affects the way conclusions are drawn from research results. The following discussions, which elaborate on the research methodologies used in the study, illustrate some of the strengths and weaknesses in the positivistic perspective.

Quantitative Method

The fieldwork was carried out in Thailand in early-1997, eight years after the start of the two three-year financial development plans during 1990-1992 and 1993-1995 respectively. The site selection was based on the local banking industry and banking institutions, while the unit of analysis included senior-level executives who were responsible for the IT and payment system departments in the central bank, and departments related to IT, IS, and electronic banking, in four leading commercial banks.

The study used survey questionnaires as a quantitative data collection method. The aim of the survey was to study how commercial banks acquired technology, created capabilities, and applied them in new product and services development.[3] This also identified broad-level indicators of innovation, focusing on the major characteristics contributing to innovation among the banks. The design of the questionnaire was modified from earlier studies which basically analysed technological capability acquisition among firms.[4] Modifications were minor, focusing on selected types of products and services, and applied in the context of payment services provided by the banks. The survey included a combination of questions, which mainly requested respondents to rate on a five-point scale, the relative importance of innovation.[5]

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[3] See Appendix 1.

[4] See Appendix 2. The survey questionnaire design was modified from previous research on technological capability acquisition among Indonesian commercial banks (McKendrick, 1989; 1992) and similar studies in South Korea (Westphal *et al.*, 1984).

[5] The term technology was used in a general sense in the survey, including technological applications, sources of information, technical and managerial knowledge, and technological capabilities.

The questionnaire was organised into two main sections to identify two broad-level indicators of innovation. The first group of indicators identified commercial bank product and service offerings. This included the types of payment services provided by the banks, the awareness and application of selected information technologies, and the level and origin of automation among selected payment services. The second group of indicators identified the sources of technology acquired by the banks. This included the major sources of information and the key sources of managerial and technological know-how which contributed to the development of current and future range of products and services. In addition, commercial bank capabilities were also identified, including their acquisitive, operative, adaptive, and innovative capabilities.

A pilot study was conducted during mid-October 1996 to test the questionnaire, and as a result of the feedback, the questionnaire was slightly modified. Thereafter, the questionnaires were sent to 70 presidents/directors of 15 Thai commercial banks in early-January 1997. This included departments related to electronic banking, electronic data processing, IT, IS, and IS audit. The first and last response was received in mid-January and late-March 1997 respectively. The number of respondents was 20, giving a 29% response rate. This improved response rate, as compared to the previous pilot study, was partly influenced by four factors. This included the administration of postal surveys in Thailand, the follow-up process through telephone conversations, the planned distribution of survey results to respondents, and most importantly, the referencing of the central bank to increase the legitimacy and importance of the study.

Although the response rate may represent a relatively small sample, it provides a fair representation of the commercial banking industry in three respects. Firstly, the sample represents all 15 Thai commercial banks which account for a majority of assets in the total financial system.[6] Secondly, the sample included responses to a long and detailed questionnaire, including over 100 questions grouped into eight main questions. And thirdly, the sample represents the co-operation of commercial banks to participate in the survey, considering their usual reservations on the basis of company secrecy.

The survey data was analysed with simple statistical methods. This mainly involved the analysis of average percentages in each category of questions which

[6] See Appendix 3.

identified and assess the strengths and weaknesses of various sources of innovation. These broad-level indicators, however, partly explain, in quantitative terms, the major sources of innovation among the banks. They do not seek to provide a conclusive finding which has been a major problem in using statistical analysis in IS research (Baroudi and Orlikowski, 1989). Therefore, the results were supplemented with qualitative data.

Qualitative Method

The study used semi-structured interviews and archival material as qualitative data collection methods. These two sources of data, particularly the interviews, helped in the construction of mini case studies. This sought to capture the complex innovation process experienced by banks in the context of a changing payment system structure, and to understand the 'how' and 'why' questions that was not possibly answered in the survey questionnaires. This is also some of the reasons for selecting the case research strategy in IS (Benbasat *et al.*, 1987, p. 370), although there may be methodological problems which can be addressed by the scientific methodology, as suggested by Lee (1989).

The aim of the interviews was to study how banks were acquiring, learning, and applying technology in new products and services development.[7] These innovation issues were examined in six major areas, based on an interview topic guide, and were conducted with senior-level executives at the central bank and each of the four commercial banks.[8] Although the total number of interviews was relatively small, they were significant, representing senior-level management perspectives on firm-specific innovation strategies and policies.

The semi-structured interviews were organised around six major topics.[9] This included: (1) the bank's background, the role of the department, and the growing importance of IT; (2) the use of IT for the automation of internal bank operations and payment systems; (3) technology transfer, diffusion, and capability building issues; (4) the barriers to technology transfer; (5) the overcoming of such obstacles; and (6) the potential role of banks in influencing innovation policies.

[7] See Appendix 4.
[8] See Appendices 5-6.
[9] See Appendix 5.

The interviews were tape-recorded, translated, and transcribed accordingly. The translation from Thai to English language may have caused some minor misinterpretations of the interview results. This is fully acknowledged as one constraint in conducting interviews in a foreign language, apart from other limitations such as in extracting useful data from the transcripts, and most importantly, the reliance on experienced social and personal skills on part of the interviewer. Nevertheless, the main ideas and issues from the interviews were captured during the translation process.

Although the topic guide may have looked structured around six topics and accompanied with a fixed set of questions, this only provided guidelines during the interviews which enabled the grouping of responses into major themes during the transcription and analysis of the interviews. The nature of the questions, which were asked during the field studies, varied from one interviewee to another, but was focused around an established theme. The advantages of using semi-structured interviews is the opportunity of respondents to talk at length and in detail, and the ability to identify, clarify and amplify emerging issues during the interview process. They also helped illuminate, illustrate, and strengthen specific categories of responses in the survey.

The study also analysed archival materials. These data sources were used to supplement both the survey questionnaire and semi-structured interviews. This included annual company reports, official government reports, and newspaper articles. The use of newspaper articles was particularly important, mainly because both economic and technological developments in the banking sector were relatively recent and reported on a daily basis. Moreover, the availability of electronic data sources has helped in retrieving and analysing important developments, as in contrast with other sources of materials which may be relatively outdated.

1.4 CONTRIBUTIONS

The study makes three major contributions. The first contribution focuses on the use of evolutionary and resource-based views in IS studies. These two perspectives provide the foundation of the analytical framework which aims to examine the importance of IT resources. Such resources are analysed based on their attributes which affects their rate of replication among firms in an industry. Recent innovation studies in IS have been largely

dominated by the innovation diffusion model, although there have been recent, but marginal, developments to introduce alternative approaches which are based on social, economic, and management theories.

The second contribution focuses on institutional factors that influence innovation. Although King *et al.*, (1994) introduced a framework to analyse such factors in IT innovation, studies under this view remain limited. For example, this has included research on governmental roles in the development of an information society (Gurbaxani *et al.*, 1990), and the role of government policy in supporting economic development and diffusion of computers (Kraemer *et al.*, 1992). Nevertheless, such studies are limited to studying the role of governments in general, and not an individual institution, or a group of institutions, in particular. In this thesis, the banking industry and banking institutions are examined, focusing on the role of the central bank and commercial banks in inducing innovation in the context of payment systems modernisation. Firm-specific and sector-specific factors are analysed. In the central bank and commercial bank cases, their background, IT introduction, and sources of innovation, which support new product and services development, are analysed. In the banking sector case, the unique characteristics, capabilities, and constraints are analysed. Moreover, government policies that helped create a conducive environment for innovation in banking and how this role may also be reversed, are examined.

The third contribution focuses on studies in a developing country context. The study of IS in developing countries has been marginal as compared with mainstream research. Moreover, recent studies have focused on particular regions or countries such as Africa and India. For example, there has been research on the political economy factors influencing IT diffusion in Southern Africa (Kluzer, 1993), the study of IS capability in Eastern and Southern Africa (Grant, 1996), and the study of decision support systems in debt management and development planning in Egypt (Kamel, 1994). In India, there has been studies on the impact of computerised rural IS in development management (Madon, 1991) and the role of state policy in supporting software industry development (Harindranath, 1997). Other studies have focused on failures in IT policies and applications in the Commonwealth developing countries (Odedra, 1993). Such studies have made major contributions, but under-represents other developing countries.

Thailand provides the case of a developing country in the Southeast Asian region. Recent studies in the region relating to innovation have concentrated on countries that have achieved strong economic growth. The study of innovation in these so-called 'miracle economies' have also focused on countries such as South Korea, Taiwan, Singapore, and Malaysia (Amsden, 1989; Hanna, 1994; 1996; Hobday, 1995; Lall, 1996; Kim, 1997). Although Thailand also experienced strong economic growth from the late-1980s to the mid-1990s, there have been relatively few studies that examined the role of innovation behind the country's economic development. For example, the government has played a progressive role in promoting S&T related activities, including IT developments. Thus, Thailand's experience may also provide relevant and invaluable lessons to other developing countries.

1.5 LIMITATIONS

There are three major limitations to the study. The first limitation concerns the use of a specific innovation model and research methodology. The application of the analytical framework, which is based on evolutionary and resource-based views, provides only one alternative approach to studying innovations. There are numerous innovation models that have been developed to address the dominance of the diffusion model and the limitations of the linear model. Each model has its strengths and shortcomings which are discussed in Chapter 2. The current study views innovations as being determined by unique resources, whose rate of replication is influenced by a set of attributes. Alternatively, the use of other models may also provide the interpretation of the same data from a different perspective. Similarly, the use any research methodology also has limitations. For example, the interview of senior bank managers, which is illustrated in Chapter 5, only provides the senior-level opinions, while overlooking middle or lower level employees.

The second limitation concerns time. The analysis made in the research attempts to include major past and present developments. However, this may not be possible, considering the rapid introduction of new innovations, the unexpected changes occurring in the national and international contexts, and the unique preconditions prevailing in specific countries. This was particularly the case of Thailand which experienced unexpected and dramatic economic changes during the course of the study. Thus, the current study does not examine these implications in detail, although there are some

recent studies, for example by Lauridsen (1998), that have sought to identify the causes and consequences of the country's financial crisis.

The study analysed conditions prior to the country's economic crisis. The research results were primarily based on data sources such as survey questionnaires, semi-structured interviews, and archival materials, which were collected during a fieldwork, carried out in early 1997, prior to the economic crisis. These unexpected events, which surfaced in mid-1997, caused a major devaluation in the country's currency and also downgraded the international rankings of local commercial banks. Moreover, the country's financial crisis spread to neighbouring nations in Asia, and subsequently, to the major industrialised economies by 1998. In Thailand, the financial and monetary authorities issued a financial restructuring package on August 14, 1998 (Bank of Thailand, 1998).

The commercial banks were required by the central bank to recapitalise their financial positions which resulted in changes to existing management and shareholder structures. This also included the establishment of a new commercial bank called Radhanasin, partly funded by a 4 billion Baht structural adjustment loan from the World Bank and the Asian Development Bank, and was aimed to allow foreign investors to hold up to 40% of the company's shares.[10] As of February 1999, six commercial banks were intervened with the following measures, as shown in Table 1.1.

Table 1.1 Intervened Thai Banks, as of February 1999

Intervened Banks	Measure
Bangkok Military Bank and Siam City Bank	Privatised
Bangkok Bank of Commerce	Transformed into a non-bank financial institution (in the form of an Asset Management Corporation)
First Bangkok City Bank	Integrated with Krung Thai Bank
Laem Thong Bank	Integrated with Radanasin Bank
Union Bank of Bangkok	Integrated with Krungthai Thanakit

Source: Ministry of Finance (1999)

[10] See "New commercial bank to open next month" (*The Nation* 20 January 1998).

The central bank also experienced major changes. First, there was a change in its governorship, following recommendations made in a government-commissioned report and ongoing public pressure. Second, the central bank underwent a wide-ranging modernisation plan. This institution-building initiative basically involved the supervision of financial institutions, the management of the foreign exchange system, and the planned installation of a new management IS linked to selected real-time financial information of commercial banks which will be used as an early warning system for the economy.[11] Moreover, this also included a plan to set-up a monetary policy committee, the strengthening of staff skills in the examination of financial institutions, and the acquisition of technical assistance from former senior international central bankers.

On the technological front, the Ministry of Finance also considered initiating computer-related reforms. This mainly included a plan to implement a government fiscal management integrated IS to improve macroeconomic management. The goal of this IS, with the financial assistance of approximately US$10 to US$50 million from the World Bank, was to improve the capabilities of public-sector managers in planning, controlling, monitoring and evaluating government agencies, personnel, and projects more accurately.[12] The project, which is a major part of a wider public sector reform program, seeks to improve timely disclosures of main economic indicators that assists in formulating better decisions and reducing risks in future financial crisis.

The third limitation concerns the replication of lessons. Although the study aims to illustrate the process of payment systems modernisation in a developing country context, the lessons learned are not completely transferable. This is mainly because different countries face unique social, economic, and cultural conditions that shape the development of IS. An understanding of such circumstances is necessary, not only for systems development purposes, but also for the building and strengthening of indigenous capabilities. Cultural factors provide one illustration. The role of culture in IS studies has increased in interest and importance. For example, Rohitratana (1998) examined the role of Thai values in shaping IS implementation, and argued that the failure in implementing an MRP system was due to the social values of the users. Shore and Venkatachalam

[11] See "Former chiefs of foreign banks to help" (*Bangkok Post* 7 May 1998) and "Top bankers to advise on BOT reform" (*The Nation* 20 April 1998).
[12] See "Finance Ministry mulls GFM to tap economic changes" (*The Nation* 31 March 1998).

(1996) analysed the role of national culture in IT transfer. Such factors provide potential areas for further research, but is beyond the scope of this study.

1.6 STRUCTURE OF THESIS

The thesis is organised into eight chapters. The first three chapters provide a conceptual overview. Chapter 2 presents an analytical framework based on evolutionary and resource-based perspectives. The major models of innovation are reviewed, and their contributions and shortcomings are discussed. Thereafter, the major concepts in evolutionary and resource-based views are examined, compared, and used to form the foundation of the analytical framework. Lastly, the application of the framework in IS studies is considered. Chapter 3 examines the role of payment systems in financial sector development. Payment principles and practices are reviewed, particularly in their technological and international contexts. These major concepts are illustrated in the case of Thailand which provides an overview of the country's payment system, and discusses the implications brought by banking and payment reforms. The chapter creates the context for the survey and mini-case studies.

The following three chapters present the empirical results. Chapter 4 examines innovation in the commercial banking industry. Survey results on the commercial banking sector are presented and interpreted, including an analysis of the underlying factors that contributed to innovative payment services development. The survey results provide broad-level indicators of innovation in the banking industry, the level of automation among selected payment routines, and the major sources of capabilities. Chapter 5 examines innovation in four leading commercial banks. The four mini case studies help illustrate the common characteristics shared in innovation, focusing on their background, usage of IT, and sources of innovation. Chapter 6 examines innovation in the central bank. This includes a discussion of its historical development, innovation in two departments, capability development, and its role in creating a conducive environment for innovation through payment systems modernisation.

The final two chapters examine the policy and research implications. Chapter 7 examines the policy aspects of payment systems in relation to a national innovation system. The role of banks in such as a system is analysed, discussing how the involvement of the central bank and commercial banks in payment system modernisation can influence innovation policy at the national level. Lastly, Chapter 8 provides a conclusion to the thesis. The major lessons are summarised, the implications to innovation theory and policy are discussed, and finally, the potential areas for further research are raised.

CHAPTER 2: ANALYTICAL FRAMEWORK

This chapter outlines the analytical framework used in the study and is organised into four sections. Section 2.1 reviews selected models of innovation, identifying their main contributions and shortcomings. Section 2.2 discusses the evolutionary and resource-based perspectives as alternative approaches in studying innovation. Section 2.3 presents the analytical framework which is based on combining concepts in evolutionary and resource-based views. Lastly, section 2.4 discusses the application of the analytical framework in the context of innovation studies in IS research.

2.1 BACKGROUND

This section reviews selected models of innovation, identifying their main contributions and shortcomings. The definition of innovation is in itself diverse. Schumpeter (1934, p.68) viewed innovation as the carrying out of old and new combinations, 'employing existing resources in a different way, in doing new things with them, irrespective of whether those resources increase or not'. Innovation is also seen as the combination of invention and commercialisation which forms the foundation of firm competitiveness (Freeman, 1982; Porter, 1990). From the organisational standpoint, innovations are defined as 'the adoption of ideas that are new to the adopting organisation' (Rogers, 1983). Moreover, the types of innovations may include technical, administrative, product, and process innovations (Damanpour, 1991; Utterback, 1994).

Models of Innovation

This study approaches innovation from a broader perspective. Apart from studying innovations as 'technological innovations', which are embodied in products and processes, the study examines 'the new way of doing things'. This view considers how firm capabilities, competencies, and distinct resources contribute towards innovation, which, in turn, determines the sustaining of competitive advantage of firms, industries, and countries. The development of different innovation models helps illustrate the major contributions and shortcomings in understanding the innovation process.

The linear model

The linear model views innovation as following a determined sequence of stages. The ideas that shaped the model were introduced as early as the seventeenth century in

Francis Bacon's *The Advancement of Learning* (Bacon, 1605). Bacon argued that government should fund and support academic research, contributing to advances in pure and applied sciences, technological progress, and economic growth, and such arguments were in favour of expanding knowledge through government involvement, particularly by the monarchical establishment (Kealey, 1996, pp. 4-5). Bacon's ideas led to intellectual progress during the medieval period. Most notably was the inductive approach which allowed researchers to develop new laws upon discovering new facts. This was in contrary to deduction, which used established laws of nature to explain existing phenomena, and moreover, was closely confined by the Church. Although Bacon's argument was convincing during his time, arguments against the model, particularly the role of government initiatives in supporting science, followed one century thereafter in Adam Smith's *The Wealth of Nations* (Smith, 1991).

Smith advanced the argument against the linear model. This was based on free trade principles and the role that technology played in promoting economic growth. Smith disagreed with Bacon by arguing that the origins of new technology were not dependent on the government support of academic sciences in universities. Alternatively, the sources of new technologies were shaped by the development of pre-existing technologies, and moreover, industrialists working outside academia also developed them (Kealey, 1996, pp. 8-11).

These early arguments illustrated the limitations of the linear model. The arguments advanced by both philosopher and economist have influenced contemporary innovation research, and have partly shaped past and present national policies in science and technological development. Moreover, the underlying basis of the linear model has greatly influenced the development of similar and alternative models used in research in different disciplines, for example, in IS studies.

The limitations of the linear model are further illustrated in economics. The argument against the model is relatively strong and suggests that 'the linear model is dead', particularly in explaining the linkages between S&T factors in innovation (Rosenberg, 1994, p. 139). From the economist perspective, the linear model fails to capture the richness of the innovation process. This is based on the assumption that the increase in the number of a given input would result in the relative increase in output.

For example, an increased investment in research and development (R&D) would produce more patents. Alternatively, economists have argued that the heart of innovation lies in the transformation process, whereby the inputs are processed into outputs and more importantly, the process whereby institutional factors influence innovation.

Scientists have also supported this argument. For example, Kealey (1996) argued that the linear model is reversible and is inadequate in explaining the complex interface between government funded research, pure science, applied science, and technologies which contribute to economic growth.[13] This main argument suggest that the free market approach, characterised by the combination of old and new science and technologies, has been by far the most successful model to innovation, as compared to the linear model which emphasises the role of government in funding science and technological development.

Kline (1985) further argued that innovation was a non-linear process, and proposed a linked-chain model which illustrates the feedback and connection relationships among research, invention, innovation, and production. Rothwell (1992) reviewed the development of major innovation models, and suggest that there has been a shift from the simple linear 'technology push' and 'need pull' models of the 1960s to a more 'strategic integrated and networked' model in the 1990s.

The diffusion model

The linear model is commonly associated with the widely used innovation diffusion theory which defines diffusion as 'the process by which an innovation is communicated through channels over time among members of a social system' (Rogers, 1983, p. 34). This model explains how an innovation follows a particular path during diffusion, progressing in sequential stages. The model, although commonly criticised, has been widely used in different disciplines, including IS studies, and suggests that innovation diffusion follows a linear direction. Four major factors influence innovation diffusion under this model - innovation characteristics, communication channels, time, and social system. Moreover, the process of diffusing innovations involve two general stages, the adoption stage, involving knowledge acquisition, learning and decision-making; and the

[13] Kealey's (1996) interpretations of the economic laws of scientific research, however, have been widely debated by economic historians. See, for example, David (1997).

implementation stage, involving organisational changes and the support for technological deployment.

The strengths of the model are fourfold (Rogers, 1983, pp. 88-91). Firstly, the model provides a common conceptual ground for researchers addressing a field of study that has divergent methodologies and is multidisciplinary in nature. Secondly, the model provides a pragmatic approach that yields solutions that can be utilised by individuals and organisations and can also be used to address social problems. Thirdly, it allows researchers to accumulate empirical findings as they progress in the research field and this could be used as the basis for higher-level generalisations that are of a more theoretical nature. And lastly, diffusion research provides clarity and straightforwardness for the researcher in gathering and analysing data as these approaches are well established.

Rogers (1983, pp. 91-126) also raises four main limitations. Firstly, the model has taken a pro-innovation bias, implying that innovations should be diffused and adopted rapidly by members of the social system, and not re-invented or rejected. Secondly, the model has taken an individual-blame bias towards holding individuals responsible, rather than the system to which the individual belongs. Thirdly, the model has faced the recall problem whereby respondents have provided inaccurate accounts of when they adopted a particular innovation. And lastly, the model raises the issue of equality for which the socio-economic gaps between members of a social system are widened as a result of introducing innovations. These limitations are partly explained by the linear-orientation of the model which focuses on the relationships between innovations, and their diffusion through a sequence of stages.

The innovation dynamics model

The model of innovation dynamics analyses product-process relations of innovations (Utterback, 1994; Abernathy and Townsend, 1975; Abernathy and Utterback, 1978). The main argument is that most innovations follow a general pattern over time, including three major phases - the fluid, transitional and specific phases. The fluid phase is characterised with high rates of product innovation in an industry, as firms compete in new product design development. However, there is a low rate of process innovation which increases in the transitional phase. In the transitional phase, the rate of process

innovation overtakes product innovations, which slows down but contributes to the emergence of dominant designs of a particular product, prior to entering the specific phase, characterised by low product and process innovations. The role of dominant designs is important in this model and is defined as:

> 'the one (product class) that wins the allegiance of the marketplace, the one that competitors and innovators must adhere to if they hope to command significant market following. The dominant design usually takes the form of a new product synthesised from individual technological innovations introduced independently in prior product variants' (Utterback, 1994, p. 24).

The model suggests that as a firm enters a particular phase, it will require a range of capabilities to profit from an innovation. For example, this implies that a firm having strong competencies in the design and development of new product innovations is more competitive, as compared to firms lacking such strategic resources in the fluid phase of the model. The model successfully explains the entering and exiting of firms in an industry with regard to new product-process innovation development. However, it does not address how firms can create the necessary competencies to compete, how firms can develop dominant designs, and most importantly, how firms can compete on the base of unique resources.

Teece's model

David Teece identified two major factors influencing innovation in firms (Teece, 1986). Firstly, the 'appropriability regime' of a firm can protect it from competitors imitating its technologies, particularly through the provision of intellectual property (patents, copyrights, trademarks and trade secrets) and the protection of technology. Secondly, the 'complementary assets' of a firm contributes to the creation of capabilities required in innovation which also influences the development of an integrated research organisation (Teece, 1988). These assets include a firm's unique characteristics in manufacturing, marketing, distribution, services, reputation, and brand name.

For example, Abernathy and Clark (1985) argue that a firm's marketing capabilities are equally important in influencing innovation, as compared to its technological capabilities. Patel and Pavitt (1997) also argue that the technological competencies of large firms are influenced by complexity and path-dependency, suggesting that there is multiple product innovation development, but based on and

limited to the principle products of the firm. Teece and Pisano (1994) and Teece *et al.*, (1997) support this view, arguing that the dynamic capabilities of firms are related to their routines and history, represented in processes, positions, and paths.

The implications of the model to innovation studies are twofold. Firstly, firms have a higher potential to profit from innovations that have high 'appropriability regimes', implying that the ability of competitors to imitate innovations are limited and constrained by a firm's strategic boundaries. Secondly, the competition between firms in innovation is largely based on whether 'complementary assets' are specialised or not, which, in turn, influences the ability to imitate innovations. In this respect, these views support the resource-based view of the firm which is discussed in section 2.2.

The people perspective

Individuals also influence innovation in firms, mainly because they are in a position to identify and promote the potential of technological innovations. This may include, for example, the idea generator, the gatekeeper, the champion, and consultants. The idea generator are individuals that possess a mix of specific and general skills, characterised by a depth of knowledge in a particular discipline combined with the ability to integrate a breadth of knowledge in a wide range of areas, for example in the development of new products between different functions of a firm (Iansiti, 1993).

The gatekeeper serves as a bridge between a firm and its environment, identifying external sources of information and translating them into a language the organisation could understand (Allen, 1984; Tushman and Nadler, 1986). The champion is characterised by an individual who transforms his vision or an idea generator's suggestion of a particular innovation into reality, and this is usually supported with an organisation's resources and commitment (Schön, 1963; Roberts and Fusfeld, 1981; Howell and Higgins, 1990; Beath, 1991; McKenney *et al.*, 1995). Consultants also play an important role in the transfer of technology, particularly in bridging the 'managerial gap' which is required to absorb and assimilate new technology inputs (Bessant and Rush, 1995).

The Bank of America provides one illustration (McKenney *et al.*, 1997; Mason *et al.*, 1997). The case study, adopting an historical approach to the analysis of major

technological innovations, identified three major types of individuals who played key roles in introducing dominant designs for banking operation during 1958-1964. This included a non-technological 'leader' who possessed a vision to introduce technological innovations, a 'maestro' who fully understood the technological and business aspects of the company, and the 'supertech' who are team members that work on the detailed managerial and technological tasks to fulfil the leader's vision. The importance of people under the resource-based perspective is primarily important, as human resources are unique, and are a major source of innovation, and sustained competitive advantage.

The profit chain

The profit chain model attempts to integrate major innovation concepts in explaining how firms can profit from innovation. The model considers a range of factors that contribute towards the generation of company profits, including the characteristics of competencies, endowments, knowledge, environment internals, and the nature of innovations (Afuah, 1998, pp. 2-4). One of the key factors in this model is knowledge, which forms the foundation for developing low cost or differentiated product innovations, and is largely influenced by a company's competencies and endowments.

The competencies of a company are similar to its skills. For example, this may include capabilities in new product design and development. The endowments of a company ranges from non-skill-related factors which strengthen existing competencies, such as brand names, patents, reputation, geographic location, client relations, and distribution channels. The competencies and endowments of a company are in turn reinforced by its underlying marketing and technological knowledge, which together contribute to the development of new products and services. Moreover, Afuah and Bahram (1995) argue in their 'hypercube of innovation' model that a firm's learning and innovation process influences, and is in turn influenced, by its customers, suppliers and complementary innovators. These views support the resource-based perspective, as they emphasise competencies and endowments in furthering innovation in firms.

The services model

One of the common shortcomings in the previous models is that they are oriented towards product innovations, providing relatively weak analysis of innovation in services. Guile and Quinn (1988a,b), for example, suggest that although services have

become the largest and fastest growing sector in the United States economy, it remained understudied, as compared to the manufacturing sector. There have been attempts to develop theories which interpret innovation processes in the service sector by the conceptualisation of 'products' as encompassing both manufacturing and services (Lancaster, 1966). Gallouj and Weinstein (1997), for example, argue that innovation in services can be analysed from a product's final, technical, and process characteristics, which reconciles the 'science-push' and 'demand-pull' perspective in innovation studies.

The reverse product cycle also attempts to provide an innovation model in services (Barras, 1986). The model mirrors the product cycle theory, which explains the development of new products based on new technology, but operates in opposite directions in three major phases. These phases include the use of new technology to increase efficiency in existing services, the use of new technology to improve the quality of services, and lastly, the use of new technology to develop new services. The three phases interact with the innovation process in the product cycle and reinforces each other in the transformation and generation of new products and services.

For example, the study of financial services innovation suggest that it represents a vanguard economic sector, characterised by retail banks using new technology to increase efficiency through back-office computerisation, the application of automated teller machines (ATM) to improve customer services, and the use of new technology to develop new network services (Barras, 1990). Buzzacchi *et al.*, (1995) also developed a conceptual model to analyse innovation in electronic payment services in banking, and argued that demand-pull factors stimulated innovative behaviours in 'smart automation' regimes, as contrasted to innovation in 'mass automation' regimes, which was limited by cumulative and learning-by-doing effects in back-office automation. These views also support the resource-based perspective, as they attempt to distinguish between behaviours in innovation in the manufacturing and services sectors.

The developing country model

There are also limitations to the generalisation of the previous innovation models, as they were developed in the context of advanced industrialised nations, disregarding the context of developing countries which possess unique conditions. Several studies have suggested that the process of technological development in such countries proceed along

a set of stages such as the alpha-beta stages, and learning through the elementary-intermediate-advanced stages (Enos, 1962; Lall, 1980). However, technological innovations do not follow sequential stages and require further elaboration through dynamic innovation models (Fransman and King, 1984; Fransman, 1985; 1986). The key innovation concepts, as discussed in previous innovation models, have been applied and adapted by several authors, contributing to the development of integrated analytical frameworks (Lee *et al.*, 1988; Kim and Dahlman, 1992; Hobday, 1995; Wei, 1995; Kim, 1997).

Kim (1997), for example, introduced four analytical frameworks to examine the dynamic learning process from imitation to innovation in industries. This includes the global technology framework, the institutional environment framework, the firm dynamic learning framework, and the technology transfer framework. The first framework extends the innovation dynamics model by incorporating a three-stage model – acquisition, assimilation, and improvement – to examine technological trajectories in advanced and catching-up countries, and the accumulation of indigenous technological capabilities by firms in an industry (Kim, 1980). The second framework argues that three major mechanisms influence the creation of technological capabilities in firms namely, interactions with the international community, interactions with the domestic community, and in-house efforts. These three mechanisms interact and reinforce each other, and are influenced by five factors – the market/technology environment, formal education, socio-culture, organisational structure, and public policy. Lastly, the third and fourth frameworks emphasise the importance of individual and organisational learning processes in the firm which is influenced by absorptive capacities, discontinuous learning patterns, and the nature of the knowledge being either tacit or explicit. Moreover, firms can strengthen existing capabilities through formal and informal technology transfer channels from foreign suppliers. This may include foreign direct investment, foreign licenses, and turnkey plants through the former, and printed information and observation of foreign plants in the latter channel.

In sum, the previous discussion illustrates how different models of innovation were developed to address the dynamic nature of innovations. These models further support the argument that innovation research is shifting away from the linear oriented view of innovation towards more integrated and networked approaches. This shift partly

reflects the increase in understanding of innovations as being dynamic, and not exclusively static, as embodied in product and process innovations. The main contributions of these models are summarised in Table 2.1. It must be emphasised, however, that the selected models are not exhaustive, and only represent some of the major developments in studying innovation.

Table 2. 1 Summary of Selected Innovation Models

Model	Key Features
The linear model	Innovations follow a determined sequence of stages which is linear.
The diffusion model	Innovations are communicated through channels over time among members of a social system., and also diffuse through the adoption and implementation stages.
The innovation dynamics model	Innovations pass through fluid, transitional, and specific phases. A firm requires different set of capabilities to innovate in each phase.
The Teece model	The factors influencing innovation in firms are strategically boundary-related, including their 'appropriability regimes' and 'complementary assets'.
The people perspective	Individuals in firms influence innovation, including the idea generator, gatekeeper, champion, leader, maestro, and supertech.
The profit chain	The ability of firms to generate profit from innovations is based on its competencies, endowments, knowledge, environment internals and the nature of innovations.
The services model	Innovation in services follows a sequence of three stages in a reverse product cycle, including the use of technology to increase the efficiency of services, to improve the quality of services, and to transform or develop new services.
The developing country model	Innovation is influenced by four major factors - global technological trajectories, institutional environment, dynamic firm-learning, and technology transfer.

Summary

This section reviewed the contributions and some shortcomings of selected innovation models. The review suggests a shift in innovation models from a linear oriented view towards a more integrated, networked, and strategic perspective. Moreover, this shift also reflects an increased understanding of innovation as being dynamic, as contrasted by earlier views, which viewed innovation as only products and processes. One alternative approach in studying the dynamic nature of innovation focuses on their behavioural characteristics, which is represented by the evolutionary and resource-based perspectives.

2.2 EVOLUTIONARY AND RESOURCE-BASED MODELS

This section discusses the evolutionary and resource-based views of studying innovation. The two perspectives, although oriented towards the economic or strategic management literature, have common and contrasting characteristics. These models, however, are not

exclusively categorised as evolutionary or resource-based models, partly because the major innovation concepts are related and are widely applied between both perspectives.

Evolutionary Perspectives

Early economists, apart from Adam Smith, were interested in the importance of innovation. Marx (1867) argued that innovations created markets, which was a key factor in economic growth, while Hicks (1932) argued that innovation reduced factor of production prices, creating shifts among them accordingly. These early studies, however, were inadequate as they mainly explained initial choices of innovation possibilities based on factor price models, but failed to discuss the dynamic nature of the innovation process, as argued from four major perspectives in evolutionary economic theory.

Schumpeter

One of the earliest economists to use evolutionary approaches to study innovation was Joseph Schumpeter who made two major arguments (Schumpeter, 1934). Firstly, there was a positive relationship between entrepreneurs and innovation. Secondly, there was a higher potential for larger firms to innovate. These propositions suggested that there was a strong relationship between the size of a firm and its ability to innovate, implying that the greater the control a firm has over the means of production would influence its innovative capabilities in industry. Moreover, the propositions also suggest that monopoly furthered innovation, creating a 'gale of creative destruction' during the process (Swedberg, 1991, pp.156-157). Such arguments also assume a stronger tendency for innovation to be more frequent in monopolistic industries than in competitive ones.

These arguments, however, did not amplify the process of 'creative destruction'. This process, involving new firms entering and old firms exiting an industry in the presence of new technological innovations, inspired the work of economists in the demand-pull versus the technology-push perspectives (Schmookler, 1966; Scherer, 1984; Elam, 1993; Stoneman, 1995). The first perspective argues that innovations are based on economic opportunities, while the latter view focuses on the role of strong technical bases in influencing innovation. Furthermore, economists have attempted to understand the relationship between both perspectives through the study of key social and institutional factors influencing the innovation process in a broader national system of innovation (Freeman, 1982; Lundvall, 1992; Nelson and Winter, 1982).

Freeman

Christopher Freeman introduced a taxonomy of technical change, pointing to the role of the techno-economic paradigm which requires an understanding of the social and institutional factors influencing innovation processes and national systems of innovation (Freeman, 1982, 1987; Freeman and Perez, 1988). This taxonomy distinguishes four categories of innovation, namely incremental innovations, radical innovations, changes in technology systems, and changes in techno-economic paradigm. Comparatively, these innovations differ in their intensity and impact on economies.

The implications toward innovation studies are twofold. Firstly, Freeman (1987) identified a third rationale that influenced innovation, in addition to the conception of innovations based on rational choices and cumulative small modifications. This was based on new combinations of radical innovations, linking major advances in S&T with organisational and social innovations. Furthermore, this rationale has been particularly important, as it addressed the intangible factors in technological learning activities and their linkages among institutions which have been ignored in earlier models of innovation (Patel and Pavitt, 1994). The techno-economic paradigm also addresses both continuous and discontinuous technical changes which include the interplay between scientific advances, economic factors, and institutional variables (Dosi, 1982). These changes influence the innovation process, including the formation of firm innovation strategies which may be characterised as offensive, defensive, imitative, dependent, traditional, and opportunist (Freeman, 1982, pp.169-183).

Secondly, these factors played important parts in a national system of innovation. This system is defined as 'the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies' (Freeman, 1987, p.1). This suggests that the rate of technical change in a country does not simply depend on the magnitude of R&D or other technical activities, and the competitiveness of firms should not depend on such factors.

Alternatively, technical change also depends on the appropriate manner whereby a country's resources are well managed and organised at the enterprise and national levels. Thus, Freeman (1987, p.3) concludes by arguing that 'the national system of innovation may enable a country with rather limited resources, nevertheless, to make

very rapid progress through appropriate combinations of imported technology and local adaptation and development'. These arguments, for example, have been illustrated with how the Japanese Ministry of International Trade and Industry accelerated technical change, influenced industrial policy, and supported the IT industry with subsidies and tax incentives to stimulate R&D (Freeman, 1987; Johnson, 1982; English and Brown, 1984).

National innovation systems, however, are far from ideal. There is no perfect model of national innovation systems, partly because different institutions in different countries do not follow a fixed set of policies in promoting technological innovation. Nevertheless, there have been attempts in modelling national innovation systems, for example from regional, industrial, and enterprise perspectives (Padmore *et al.*, 1998; Padmore and Gibson, 1998; Cooke *et al.*, 1997). Therefore, there is a need to understand the range of factors influencing the ability of institutions to innovate, particularly at the sector and firm levels.

Lundvall

Bengt-Åke Lundvall developed the argument for national innovation systems, focusing on the relationship between innovation and interactive learning (Lundvall, 1992). This theoretical approach is based on two fundamental assumptions. First, knowledge is the most important resource in a modern economy, while learning is the most important process. Second, learning is largely interactive, being a socially embedded process which addresses both institutional and cultural contexts.

The main argument is that interactive knowledge is embedded in organisational routines. Innovation is viewed as a cumulative process, implying that the 'most important forms of learning may fundamentally be regarded as interactive processes, and that together the economic structure and the institutional set-up form the framework for, and strongly affect, processes of interactive learning, sometimes resulting in innovations' (Lundvall, 1992, p.9). This argument also implies that learning processes are discontinuous and non-linear in nature (Meyers, 1990), and requires an organisation to develop an absorptive capacity to further innovation (Cohen and Levinthal, 1990).

Lundvall also argued that technical change does not solely depend on the scale of R&D functions of firms. Alternatively, learning is acquired from workers through the

production structures, and innovations arise from routine activities such as in the process of production, distribution, and consumption. Such workers, who are in direct contact with these processes, interactively learn from them, further producing new knowledge for innovations. This argument is supported by the concepts of 'learning-by-doing' (Arrow, 1962) and 'learning-by-using' (Rosenberg, 1981).

This approach suggests that institutions provide some stability to uncertainty in a national innovation system which reflects the argument advanced by North (1990). Institutions provide a guidepost for action and change, and also serve as routines. This routine reinforces learning in the production structure, covering the production, distribution, and consumption processes. Moreover, in addition to the learning process, the processes of searching and exploring are also creative inputs into the innovation system, pointing to the importance of institutions in a national system of innovation.

> '(There is) a distinction between a system of innovation in the narrow sense and a system of innovation in the broad sense. The narrow definition would include organisations and institutions involved in searching and exploring - such as R&D departments, technological institutes and universities. The broad definition which follows from the theoretical perspective includes all parts and aspects of the economic structure and the institutional set-up affecting learning as well as searching and exploring - the production system, the marketing system and the system of finance present themselves as sub-systems in which learning takes place'. (Lundvall, 1992, p.12)

Lundvall's (1992) theoretical approach analyses what constitutes the social and institutional factors that influence innovation. This mainly focuses on routines existing in both production structures and institutional set-ups. The role of routines provides workers with the basis to learn, use, search, and explore creative inputs into the innovation process. Nelson and Winter (1982) also support and extend this argument by viewing routines as similar to genes that can be transferred across organisations.

Moreover, the level of analysis addresses sub-systems, social institutions, and their linkages within a broader national innovation system. For example, such studies have focused on the past and potential roles of the public sector in influencing national systems of innovation (Gregersen, 1992), the relationship between finance and innovation (Christensen, 1992), and the sectoral patterns of technical change (Pavitt, 1984). Klevorick *et al.*, (1995) also argue that inter-industry differences in innovation are

based on three major sources of technological opportunities: advances in scientific knowledge and technique, advances in industry and private-governmental institutions, and feedback from industry.

The limitation of the approach is the abstractness of learning. The approach makes an important assumption that knowledge and the learning process are very important for innovation, and this can be assessed through the focus on routines. However, the interactive learning of these routines, which contribute to innovation, are constrained by the explicit and tacit characteristics of knowledge. Such limitations partly determine whether knowledge can be transferred between individuals accordingly.

Nelson and Winter

Richard Nelson and Sidney Winter further analysed the key role of routines in innovation which were characterised as genes that are transmittable across organisations (Nelson and Winter, 1977; 1982; Nelson, 1979). This biological analogy of organisational routines, or organisational genetics, is analogous to individual skills, implying that the study of routines in innovation requires the analysis of these traits or individual skills which can be characterised into two main areas.

First, individual skills are similar to programs. For example, such skills are analogous to computer programs, including programs functioning as a unit, being serial, operating automatically, and performing efficiently and accurately. In this respect, human skills function as units in various levels of the organisation. Moreover, its serial organisation reflects its structure, determining the order in which skills should be executed and carried out automatically.

Second, individual skills are tied to tacit knowledge (Polanyi, 1973). This holds that although a very skilful individual may carry out a work performance efficiently, this does not imply that he can articulate it clearly. In harnessing such knowledge to strengthen organisational capabilities, determining the degree of tacitness, or the limits of articulation of different situations, is primarily important. Moreover, this involves a 'never-ending spiral' process of converting both individual and organisational knowledge that are tacit and explicit by nature (Nonaka, 1994; Nonaka and Takeuchi, 1995). For

example, the role of tacit knowledge in a particular performance may be high, provided that the situation is non-standardised, uncontrolled, or complex.

Institutions play a central role between individuals and innovations. Organisational routines are analogous to individual skills and reflect its capabilities. Moreover, such routines, originating from individuals, provide a potential source of innovation. This creates diversity among firms which develop different strategies, structures, and core capabilities (Nelson, 1991). Therefore, the role of routines in innovation in this theory is particularly important and involves two major roles.

The first role of routines in innovation is in organisational memory. This serves as storage for an organisation's knowledge or the location of its capabilities. Nelson and Winter (1982, p. 99) define this as the process of 'remember by doing' on the part of an organisation. A typical routine operation in an organisation would involve, for example, the interpretation of incoming tasks by individuals who respond with an appropriate performance from their 'repertoires'. These repertoires are defined as 'a set of skills or routines that a particular member in an organisation could perform in some appropriate environment' (Nelson and Winter, 1982, p. 98). This operation would generate successive messages for other individuals in the organisation for interpretation and performance accordingly.

There are several conditions or capabilities, however, that organisations must satisfy to carry out routines productively. This includes the character of individual member's repertoires, the ability of such members to operate plant and equipment, and the exercise of member's capabilities. It is important to stress the latter point that through the exercise of skills, an individual can remember by doing. This is in contrast to increasing productivity solely through the co-ordination of operations because individual skills, once exercised, are maintained, and in turn, refreshes organisational memory.

The second role of routines in innovation is through its use as a target for control, replication, and imitation. The first target states that an organisation faces difficulties in maintaining control of its routines that is subject to new inputs, for example, new recruits or new computer equipment. It may attempt to counter this through the processes of selection, modification, monitoring or adaptation. However, this applies only to a certain

extent, as the changing environment may be dynamic, calling for non-standardised routines. Consequently, organisational routines undergo mutation, which may foster productivity and innovation, or vice versa.

The second target states that an organisation attempting to replicate or improve its template based on a more successful routine from another organisation does so imperfectly. This problem may be problematic, taking into consideration the extent that knowledge can be transferred despite its tacit nature, and potentially leading to the mutation of routines. Nevertheless, the primary objective behind replication should be to strive to acquire an overall efficiency that is parallel to the original routine.

The last target states that an organisation that aims to imitate the routines from another source does so based on economic criteria. In contrast to replication, the process of imitation does not involve the use of templates. This makes the mutation of routines increasingly substantive, not considering the transfer of knowledge. However, the practice in acquiring such skills may be non-conventional, such as in the hiring away of skilled personnel from a competitor or the seeking of inside information.

This theoretical approach advances the analysis of routines in innovation. However, the definition and interpretation of routines remains a debating issue (Cohen *et al.*, 1996). For example, Winter (1987) points to the ambiguity of 'assets' and argues that this encompasses the knowledge and competence of organisations which are strategic assets. Comparatively, routines may be defined as 'an executable capability for repeated performance in some context that has been learned by an organisation in response to selective pressures' (Cohen *et al.*, 1996, p. 683).

In sum, the use of evolutionary economic perspectives provides an established theoretical standpoint in the analysis of dynamic innovation processes. However, this is also a shortcoming, as it is macro-oriented, which needs to be supplemented with further micro-level analysis of firm-specific sources of innovation. In this respect, resource-based innovation models help amplify the analysis of internal and external firm-specific factors influencing innovation.

Resource-Based Perspectives

The resource-based perspective is a relatively recent view of studying how a firm's unique set of resources influences its growth (Foss, 1997). This view argues that firm competitive advantage is sustained through a set of unique resources. Penrose (1959, p. 25) was one of the earliest proponents of this view, arguing that 'it is never resources themselves that are the inputs in the production process, but only the services that the resources can render'. This implied that firms are conceptualised as a 'bundle of resources' and differ in their innovative capabilities, while they transform resources into potential services, making them distinct and influencing their growth. Itami (1987) illustrates these resources as 'invisible assets', including the knowledge, skills, and experience of committed people.

The importance of resources has also been emphasised in strategic management studies. For example, Chandler (1962) argues that the structure of firms follows its strategy, suggesting that entrepreneurial decisions and actions affect operating decisions, particularly in the allocation and reallocation of resources. Andrews (1987) points to the central role of resources in corporate strategy in converting distinctive competence into competitive advantage. Kay (1993) introduces the term distinctive capabilities, which represents a firm's source of competitive advantage including architecture, reputation, innovation, and strategic assets.

Although the role of resources has been identified as important, there has been less emphasis on the analysis of their attributes. For example, Porter (1990) argues that a nation's competitive advantage is determined by four major attributes in his 'diamond' framework, including factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and rivalry. This structural view of resources, however, overlooks their underlying behavioural attributes (Nonaka and Takeuchi, 1995, pp. 46-47). Prahalad and Hamel's (1990) core competence argument acknowledges the importance of behavioural aspects in collective learning in firms, but does not analyse the acquisition of competence. Stalk *et al.*, (1992) further argue that core competence has a strong orientation towards the production and technological aspects of the firm along specific points in the value chain, and suggests that the concept of capabilities complement this with a more visible and broadly-based analysis in the whole value chain.

The shortcomings of the resource-based view are a lack of a comprehensive theoretical framework and empirical research. For example, Nonaka and Takeuchi (1995, p. 49) argue that the resource-based approach does not address how different parts in a firm interact over time to influence innovation, and introduce an analytical framework based on examining explicit and implicit knowledge. Robins and Wiersema (1995) suggest that empirical research in the resource-based view has been relatively difficult due to the concepts of capabilities and tacit knowledge which resists direct measurement.

However, proponents of the resource-based view suggest that the approach contribute to a new theory of the firm, incorporating a range of related theoretical perspectives (Conner, 1991; Mahoney and Pandian, 1992). There has also been the development of theoretical frameworks in support of such arguments. Wernerfelt (1984) developed an economic analysis approach, focusing on the relationship between resource-product matrices. Barney (1991) introduced a firm resource model which analysed the potential of firm resources based on their value, rareness, imitability, and substitutability attributes. Grant (1991) developed a framework to analyse the relationship among firm resources, capabilities, competitive advantage, and strategy.

Peteraf (1993) argues that there are four conditions influencing competitive advantage. This included superior and heterogeneous resources, imperfect mobility of resources, ex post limits to competition (competition which is limited subsequently after a firm has gained a superior position over competitors), and ex ante limits to competition (competition which is limited prior to a firm gaining a superior position over competitors). In sum, the resource-based view has been a widely applied approach, suggesting that its use may potentially become 'automatic' rather than 'noteworthy' (Wernerfelt, 1995, p.173). The main contributions of the evolutionary and resource-based perspectives are summarised in Table 2.2.

Table 2. 2 Summary of Evolutionary and Resource-Based Views

Model	Key Features
Evolutionary perspectives	
Schumpeter	The size of firms influences their ability to innovate. The potential to innovate can be found in entrepreneurs and monopolistic firms.
Freeman	The role of social and institutional factors influences innovation, apart from national investment in R&D activities. Institutions play a key role in influencing innovation in a national system of innovation.
Lundvall	The role of interactive learning processes influences innovation.
Nelson-Winter	The change of routines influences innovation. Routines are the stock of skills and 'genes' of an institution which are transferable across organisations.
Resource-based perspectives	
Penrose	The firm is a 'pool of resources' and innovations are influenced by the 'services' that these resources can render.
Wernerfelt	The strategic options for innovation are based on firm's resource position barrier and resource-product matrices.
Barney	The sources of sustained competitive advantage are influenced by four attributes - value, rareness, imitability, and substitutability.
Peteraf	The conditions influencing sustained competitive advantage are superior and heterogeneous resources, *ex post* limits to competition, imperfect resource mobility, and *ex ante* limits to competition.

Comparison of Views

Evolutionary and resource-based perspectives share common and contrasting characteristics, and there have been attempts to synthesise the two views (Foss *et al.*, 1995; Montgomery, 1995). Nevertheless, both perspectives have their strengths and weaknesses, and it is important to understand their limitations, particularly when used in any analytical framework. These issues are better understood by briefly reviewing three main relationships between the two theoretical perspectives.

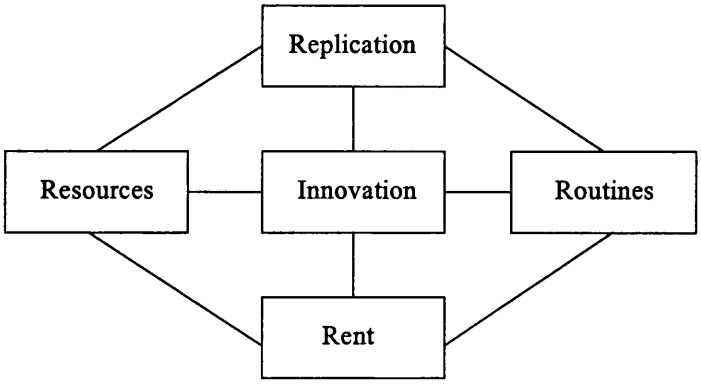
Firstly, the two views are grounded in economic theory. The evolutionary perspective has its historical roots from *The Theory of Economic Development* (Schumpeter, 1934) and articulated in *The Evolutionary Theory of Economic Change* (Nelson and Winter, 1982). Comparatively, the resource-based perspective originated from the *Theory of the Growth of the Firm* (Penrose, 1959) and advanced by numerous theorists (Wernerfelt, 1984; Barney, 1991; Peteraf, 1993). Their applications, however, have been relatively mixed, with the evolutionary view being macro-oriented, and the resource-based view firm-specific. Moreover, the evolutionary view focuses on the environment and innovation processes in industry, whereas the resource-based view is dynamic, process-based, and analyses how firms can compete on unique resources to sustain competitive advantage.

Secondly, the two views share similar terminology. There has been diversity in the use of terms which basically reflect the same concept. This has included assets, capabilities, competencies, knowledge, know-how, resources, routines, and skills. For example, Wernerfelt (1984, p. 172) has defined resources as 'anything which could be thought of as a strength or weakness of a given firm...(tangible and intangible) assets which are tied semi-permanently to the firm'. One of the most important issues, however, is in determining their 'strategic state description' which is in identifying and characterising organisational behavioural patterns that are sources of long-term success in firms (Winter, 1987, p. 180). Furthermore, Winter (1995) examines the interrelationships among the concepts of rent, resources, routine, and replication. This is amplified below.

Lastly, the two views are converging. For example, Conner (1991) has suggested that the resource-based view is reaching for a new theory of the firm, based on a critical review of five theoretical traditions in industrial organisation economics. Similarly, Knudsen (1995) reviews the major theories of the firm and argues for the integration between the evolutionary, the resource-based, and the transaction cost theories. However, there remain outstanding issues in integrating the two views, particularly in linking the industry-firm interrelationship. Levinthal (1995) suggest that the evolutionary and resource-based views should be bridged through the analysis of interrelationships between industry-firm forces influencing diversity and innovation. Foss and Eriksen (1995, p. 45) support this argument by emphasising the need to study industry capabilities which are 'non-proprietary capabilities that are shared among a group of firms, and may yield rents'. Wernerfelt (1995) suggests a stochastic model approach in integrating the two views.

The two views may also be compared by the '4 Rs' relationship (Winter, 1995, p. 148). This is illustrated in Figure 2.1, including the links among rents, resources, routines, and replication which influence innovation. For example, routines may be considered as a web of resources which may be replicated among firms to generate rent. Firms earn Ricardian rents when they are the owners of unique factors (Montgomery and Wernerfelt, 1988). However, the rate of resource-routines replication among firms is influenced by behavioural conditions. The process of innovation, in turn, contributes towards profitability and the sustaining of competitive advantage (Afuah, 1998).

Figure 2. 1 The Evolutionary and Resource-Based View Relationship



In sum, the two views provide a complementary analytical approach. This is particularly important in innovation research and the current study, as the understanding of industry-specific and firm-specific factors are equally important in identifying the sources of innovation that contribute towards sustained competitive advantage. Foss (1997) summarises and supports this point very well with the following argument.

> 'There are many other important similarities between the two approaches, and the resource-based perspective in particular may benefit from being infused with a dose of evolutionary economics. For example, evolutionary economists have cultivated an advanced understanding of the mechanisms of technological change - insights that may both help develop a more refined resource-based analysis of the environment and help understanding the process of creation of new resources through innovation. Thus, one attractive way ahead for the resource-based perspective is to strike a closer intellectual strategic alliance with evolutionary theorists, most importantly because evolutionary economics adds a dynamic dimension and does so in a rather precise and formal way' (Foss, 1997, p. 360).

Summary

This section reviewed the evolutionary and resource-based perspectives as an alternative model of innovation. The evolutionary perspective provided a macro-level analysis of innovation, whereas the resource-based perspective provided a micro-level analysis accordingly. This complementary approach analyses both internal and external source of innovation which influences firm-specific capabilities. The following section presents an analytical framework which is based on these two perspectives.

2.3 ANALYTICAL FRAMEWORK

This section presents an analytical framework which integrates the key concepts from two major theoretical perspectives. This integration of innovation models reinforces the strengths in the two approaches, providing a macro and micro level analysis of the dynamic innovation process. The unifying theme in these models is characterised by behavioural factors influencing innovation which is largely reflected in evolutionary and resource-based perspectives (Nelson and Winter, 1982; Barney, 1991).

These two theoretical perspectives treat the innovation process as a dynamic rather than a static and structural process which is represented by the competitive-forces framework (Porter, 1990). For example, this dynamism is represented by the change of routines in evolutionary economic theory (Nelson and Winter, 1982), and the services rendered by resources in resource-based theory (Penrose, 1959, p. 25; Barney, 1991). Moreover, this view also addresses the inadequacies of diffusion model, which is basically static and assumes that innovations are adopted, diffused and implemented along a predetermined set of stages. This analytical framework is discussed below and is followed with a discussion on the key roles of resources and attributes in IS research.

Types of Resources-Routines

The framework treats resources and routines dependently. Firm resources may be tangible and intangible in nature. The tangible form of resources may include human, financial, physical, technological, and organisational resources. The intangible form of resources may include 'invisible assets' or 'strategic assets', including consumer trust, brand image, control of distribution, corporate culture, reputation, knowledge, know-how, capabilities, competencies, management skills, and technical skills (Itami, 1987, pp. 12-13; Winter, 1987).

The role of strategic regulation, for example, can be a resource, and as a source of sustained competitive advantage, as suggested by its stimulation of demand and protection of rent-producing resources in the audit industry (Maijoor and Witteloostuijn, 1996). The ability of firms, sectors, and nations to compete rests on acquiring, adapting, and advancing such resources which are the sources of innovation. For example, one firm may replicate the technological resources from another firm through technology transfer and imitation to gain or sustain their competitive advantage in the same sector.

The firm, however, faces difficulties in the replication of resources. The difficulty in resource replication, or the transfer and imitation of resources, is partly due to their homogeneity and mobility characteristics. The rate of resource replication is relatively low when the resource is heterogeneous and immobile. For example, a firm may have a unique set of resources, resulting from the set-up of strategic boundaries or 'appropriability regimes' which may include intellectual property rights provisions (Teece, 1986). Therefore, these resources are not widely available to other competing firms in the market and difficult to imitate. Amit and Schoemaker (1993) suggest that the differences in the range of resources controlled by firms may be related to resource-market imperfections and discretionary managerial decision in developing and deploying resources. Zander and Kogut (1995) developed an empirical test of knowledge transfer, suggesting that the codification and the teachability of capabilities influence the speed of transfer and imitation of knowledge among organisations.

Alternatively, the rate of resource replication is relatively high when the resource is homogenous and mobile. For example, a firm may compete with a rival company through the purchase of a similar software program used by their competitor, provided that the software is widely available in the market and relatively simple to imitate. The mobility of the resources also determines the difficulty of transfer. For example, the transfer of a single software program is much simpler than transferring the complete IS, which includes the computer software, computer hardware, and the people who operate them. The importance of IT as a resource, and the differences in rates of resource replication, provides a further illustration to the analytical framework.

IT Resources

IT may be seen as a type of strategic resource which is a source of sustained competitive advantage to firms, sectors and countries (Clemons, 1991; Clemons and Row, 1991; Mata *et al.*, 1995). However, the resources related to IT are not exclusively embodied in computer hardware and software components. For example, Ross *et al.*, (1996) argue that there are three IT assets that have an interdependent relationship, including human assets, technology assets, and relationship assets. Powell and Dent-Micallef (1997) also suggest that IT was not a sole source of sustained competitive advantage, but rather its use in leveraging intangible and complementary human and business resources, including culture, strategic technology planning, and supplier relationships. Such IT assets may also be viewed as a firm's physical, organisational, and human resources.

Firstly, physical resources include the IT infrastructure. This includes investments in IT projects, particularly in computer hardware, computer software and telecommunications equipment, aimed to increase efficiency in internal working processes and to improve the delivery of customer services. For example, Keen (1991, pp. 39-40) views this infrastructure as the 'IT platform' which is a shared information service delivery base, influencing a firm's 'reach' in linking computer systems locally and internationally, and its 'range' in determining what information can be shared across systems and services. Ross *et al.*, (1996) suggest two distinguishing characteristics of technology assets which include a sharable well-defined technology architecture, and data and platform standards.

Secondly, organisational resources include firm-specific strategies influencing IT investments. For example, Weill and Lucas (1992) proposed a 'pyramid' of IT investment, arguing that firms have four major types of management objectives which influence technological investments - strategic, informational, transactional, and infrastructure. Broadbent *et al.*, (1994) further examined this 'pyramid' through the relationship among business process redesign, strategic context, and the role and capabilities of the IT infrastructure. Moreover, firms may formulate a strategy specifically aimed at acquiring the necessary IT resources, for example through joint ventures and company cooperation. In the case of financial services, Hopper (1987, pp. 330-1) suggests the integration of IT resources into a company's broader strategy. Nevertheless, Pennings (1998) suggest that there are delayed benefits in IT investments by organisations, as they require time, approximately over 10 years, to absorb and learn the technology.

Lastly, human resources include managerial-technical skills specific to IT. The case of Citicorp provides one illustration (Glaser, 1988, p. 109). Early attempts by the bank to develop the ATM were unsuccessful, although the company's senior management provided full support. Notwithstanding such failures, the bank formed a subsidiary company, following an agreement with another computer firm, which involved the transfer of 30 technical staff from the latter to the former firm. This created the necessary human resource capabilities and technical skills required for ATM development.

Mata *et al.*, (1995) further distinguished between managerial and technical IT skills in a company, and argued that the former type of human resource is the sole source of sustained competitive advantage, as compared to other firm resources, including capital, proprietary technology, and technical skill resources. Henderson (1990) also suggested the critical need to create a connection between line managers and IS managers through partnerships, although this strategy may be difficult to implement or inappropriate in individual cases.

Several survey studies also support the need for managerial-technical skills. For example, Boynton *et al.*, (1994) study of IT use in large organisations suggest that usage of technology was largely influenced by managerial IT knowledge, apart from the technology management climate. Lee *et al.*, (1995) research on the skills and knowledge required by IS professionals also suggest a demand for multi-dimensional staff who are trained in technical, managerial, and interpersonal skills.

Keltner and Finegold (1996) argue that human resource innovations, particularly in service firms, should shift from the tendency towards transactions-oriented to a more relationship-oriented approach through the development of competence-based strategies, modularised training, internal recruitment and promotion, and cooperation with education providers. Scarbrough (1998, p. 20) suggested that the strategic use of IT depended on the interaction between IS expertise and senior management knowledge, including political and learning process influences. These arguments commonly suggest that human resources, particularly managerial IT skills, are incorporating the need for non-technical skills, and may be the most important but difficult resource to acquire.

The rate of resource replication is central in the analytical framework. This rate does not imply direct measurement in the replication of resources but represents the difficulty of transfer. Firstly, the replication of tangible resources is relatively less difficult which is represented by physical resources. Secondly, the replication of intangible resources is relatively more difficult which is represented by the 'invisible assets' embodied in human resources. And thirdly, the replication of 'intermediate' resources is moderately difficult which organisational resources represent. The reasons influencing resource replication can be further explained by their attributes, which determine the sources of innovation and sustained competitive advantage.

Source of Innovation

The analytical framework includes four major attributes influencing the replication of resources. These attributes influence innovation through their behavioral characteristics, and are the major sources of sustained competitive advantage. For example, Winter (1987, pp. 170-173) provides a taxonomic dimension of knowledge assets, arguing that the attributes influencing knowledge transfer include their tactiness, observability, complexity, and independence. Grant (1991) suggests four characteristics of resources and capabilities, including durability, transparency, transferability, and replicability. Barney (1991) developed a resource-based model, which examined the value, rareness, imitability, and substitutability attributes of resource. The characteristics of four attributes are discussed below.

The first attribute is the value of resources. Resources are valuable if they improve firm efficiency and effectiveness, and reduce costs and increase revenues. However, a resource is only considered valuable, provided that it exploits opportunities and neutralises threats in the firm environment (Barney, 1991). For example, a firm's installation of a strategic IS, which it has imitated from a competitor, may help it gain competitive parity or competitive advantage over other companies, but may not contribute towards innovation and sustaining that advantage in the long-term. Alternatively, if the firm does not implement a particular IS, it has competitive disadvantage to firms that have installed the system.

The second attribute is the rareness of resources. Resources are rare if they are unique in character. The scarcity of resources among firms determines their competitive position with one another. If all firms share the same resources or the ability to acquire homogenous resources that are widely available in the market, they are in a competitive parity position. However, if the resources are heterogeneously distributed across firms, there is a potential for a firm to gain a temporary competitive advantage or a sustained competitive advantage, provided that the resource is mobile (Mata *et al.*, 1995).

The third attribute is the imitability of resources. The imitation of resources depends on their tacitness which determines the possibilities in teaching and articulating them (Polanyi, 1973). For example, Nonaka and Takeuchi (1995, pp. 56-73) distinguishes between the tacit and explicit knowledge in individuals and organisations,

suggesting that there are four modes of knowledge conversion among these different dimensions - socialisation, externalisation, internalisation, and combination.

The replication of resources is influenced by their imperfect imitability. For example, this includes differences in individual memory repertoires such as skills to operate computer equipment. Moreover, although an organisation can increase capabilities through the replication and imitation of resources from competitors, these mechanisms are constrained through their mutation and the inherently tacit nature of knowledge. This imperfect imitability of resources, which is a potential source of innovation and sustained competitive advantage, is influenced by three main factors.

The first factor is the role of historical conditions. The history of a firm can be a source of imperfect imitability, provided that the firm experiences unique opportunities during a particular period in time. This implies that historical conditions contributed to the firm's competitive position and are relatively costly to recreate or imitate. This source of competitive advantage can be described as the 'accumulation of asset stocks' (Dierickx and Cool, 1989) and the path-dependency nature of technological change (Rosenberg, 1994). The second factor is causal ambiguity. This source of imperfect imitability is based on a firm's incomplete understanding of how a particular resource can be used for innovation to gain competitive advantage. For example, this causal ambiguity may result from the 'invisible' nature of assets which are difficult to imitate (Itami, 1987). The third factor is social complexity. This source of imperfect imitability is based on resources that are related to complex social phenomena. For example, this may include a firm's corporate culture, reputation, and close customer relationships that are difficult for competitors to imitate.

The last attribute is the substitutability of resources. The substitution of resource may be achieved through the use of similar and different resources. The use of similar resources may involve, for example, the duplication of a technology policy team of one firm from another one. Similarly, the use of different resources may involve the establishment of a formal planning system within a firm which formulates its technology strategies. These substitutions of resources, however, vary among firms and may be a potential source of innovation, provided that they are unique.

In sum, these four attributes influence the replication of resources. They have behavioral characteristics and represent the dynamic processes involved in innovation, which influences the three types of resources in the analytical framework - physical, organisational, and human. Moreover, these attributes are the conditions that influence the competitiveness of firms, sectors, and countries. The analytical framework presented in this section will be used to explain the dynamics of innovation in banking in the forthcoming chapters, which will focus on the development of electronic payment systems, and capability development at the central bank and four commercial banks.

Summary

This section introduced an analytical framework which is shaped by evolutionary and resource-based perspectives. Firm resources, including routines, tangible assets, and intangible assets, were broadly grouped into physical, organisational, and human resources. These three major resources are, in turn, shaped by a set of attributes. This determines the rate of resource replication, distinguishes the uniqueness of resources, and identifies the potential source of innovation, leading to sustained competitive advantage.

2.4 APPLICATION OF FRAMEWORK

This section considers the application of the analytical framework in IS research, and its use in the current study. Firstly, innovation studies in IS are reviewed to determine the dominant model of innovation commonly used in the discipline. Secondly, the development of alternative innovation models in IS is discussed. And lastly, the application of the analytical framework in the current study is considered.

Innovation Studies in IS

The study of innovations in IS has been mainly based on the diffusion model, although there has been marginal developments in alternative approaches. Different stages of the diffusion model have been widely applied in IS research, and a common characteristic of such studies is the assumption that innovation progresses in sequential stages. Moreover, a majority of studies are focused on organisations, as suggested by the emphasis of the IS unit and intra-organisational levels, in comparison with studies on inter-organisational impacts (Prescott and Conger, 1995).

These studies have also focused on IS as innovations, contrasted by their characteristics which influence innovation adoption decisions. Furthermore, they have concentrated on the study of innovations in an organisational context, providing a limited analysis of how external factors influence the innovation process, and also suggesting that the diffusion model is inadequate in capturing the dynamic innovation process in an inter-organisational setting. This view of innovation is relatively limited, as they treat IS as technological innovations embedded in products and services, and moreover, considers innovation only in an organisational environment. A selection of innovation studies in IS is summarised in Table 2.3.

Table 2. 3 Summary of Selected Innovation Studies

Year	Author	Innovation	Focus
1980	Perry and Danziger	Computer applications	Local government sector
1982	Zmud	Software processes	IS departments
1984	Hannan and McDowell	ATMs	Firm size
1985	Huff and Monro	IT	IS strategies
1986	Manross and Rice	Intelligent telephone	Organisation
1988	Leonardo-Barton and Deschamps	Expert systems	Professionals
1990	Nilakanta and Scamell	Database development	Organisation
1990	Cooper and Zmud	MRP	Organisation
1990	Brancheau and Wetherbe	Spreadsheet software	End-user computing
1990	Gurbaxani *et al.*	IT	Country (Singapore)
1991	Moore and Benbasat	IT	Individual characteristics
1991	Lind and Zmud	IT	Users and providers
1992	Attewell	Business computing	Service bureau's
1992	Loh and Venkatraman	IT outsourcing	'Kodak' effect
1992	Fuller and Swanson	Information centre	IS departments
1992	Kraemer *et al.*	IT	Country (Pacific region)
1992	King *et al.*	IT	Country (Asia-Pacific
1993	Fichman and Kemerer	Object orientation	Software engineering
1993	Orlikowski	CASE	Organisations
1993	Dedrick and Kraemer	IT	Country (Australia)
1993	Yip *et al.*	Information centre	Sector (Hong Kong banks)
1994	King *et al.*	IT	Institutions
1994	Lai and Guynes	ISDN	Corporations
1994	Neo *et al.*	EDI	Sector (Trading community)
1994	Tyre and Orlikowsi	CASE	Organisations
1994	Kraemer *et al.*	IT	Country (Hong Kong)
1995	King and Kraemer	Information Infrastructure	Country (United States)

Source: Author's compilation and adaptations from Swanson (1994), and Prescott and Coger (1995)

This summary of studies helps illustrate the wide use of the diffusion model. A majority of these studies focuses on identifying the factors influencing innovation along the sequence of stages in the diffusion model. This includes the adoption, assimilation, and implementation of particular types of technological innovations in the context of organisations, departments, and individuals. For example, Attwell's (1992) research on business computing in firms found that service bureaus played an important role in mediating diffusion in organisations. Fuller and Swanson (1992) argued that the success

of early adoption and implementation of information centres in an organisation's IS department depended on host organisational factors. Brancheau and Wetherbe (1992) suggested that success in the adoption of spreadsheet software in organisations were influenced by professional and user-led factors in firms.

These studies provide a firm-level focused analysis of innovations. This emphasis on the organisational context, however, partly explains dynamic innovation processes. Other factors that influence innovation may originate from a particular economic sector, such as the deregulation of industry, or conditions that are unique characteristics of a country. These factors, although external to the firm, play an important role in influencing their ability to adopt, apply, and advance technological innovations.

Comparatively, there have been a marginal but increasing number of studies determining sector-specific and country-specific sources of innovation. For example, Johnston and Carrico (1988) suggest that industry environmental factors, such as in the deregulation of industry, influences the strategic deployment of IT in organisations. Johnston and Vitale (1988) argue that there is a relationship between the introduction of inter-organisational IS and the impact on industry structures which further suggests that the influence of innovations are also sector-specific. Neo *et al.*, (1994) examined the relationship between a country's social system and innovation characteristics in the adoption of EDI in a trading community. There has also been studies attempting to identify the role of institutions in influencing innovation, particularly through government intervention in diffusing information technologies (King *et al.*, 1994).

For example, the study of a country's computer policy has suggested that governments played a participatory role in computerising the government sector, computerising the country, and transforming the country into an information society (Gurbaxani *et al.*, 1990). There have also been studies that examined the contrasting relationships between the role of government policy and the diffusion of IT among countries (Kraemer *et al.*, 1992; King *et al.*, 1992; Dedrick and Kraemer, 1993; Kraemer *et al.*, 1994; King and Kraemer, 1995; Kraemer and Dedrick, 1995). These studies have sought to explain the dynamics behind the diffusion of innovations through the use of social and economic theories, as compared to using the diffusion model.

Moreover, these studies have aimed to move beyond the diffusion model by applying alternative theoretical approaches in explaining dynamic innovation processes. Apart from analysing the internal factors that influence innovation in firms, they also examine the external factors, considering the context beyond firm boundaries. In this respect, there have been attempts to apply new theoretical perspectives in the study of IS innovation, including the use of the evolutionary and resource-based perspectives.

Alternative Approaches

There have been recent attempts to integrate innovation studies and introduce new innovation models in IS. These developments may sound contradictory, as the purpose of one perspective is to unify the fragmented studies in the field, while the other aims to broaden the scope of innovation studies in IS. Although such attempts aim to increase discipline and diversity in innovation research simultaneously, one of the most important implications is that there are alternative models that provide rich insights into studying innovation, apart from the diffusion model.

Kwon and Zmud (1987) argued for a unifying framework of fragmented innovation models in an attempt to increase discipline in IS research. The development of the tri-core model which aims to analyse IS innovation among organisations illustrates this (Swanson, 1994). This model extends the dual core model which identified the role of administrators and technical employees as two distinct factors influencing innovation processes in organisations (Daft, 1978).

The tri-core model introduces a third core which is represented by the IS function located between the administrative and technical cores, and includes three major types of innovation. Firstly, Type I innovations are characterised by process innovations restricted to the functional IS core. Secondly, Type II innovations are characterised by IS products and services applied to the administrative core of organisations. And thirdly, Type III innovations characterised by IS products and services integrated with the core business technology which also impacts general business administration (Swanson, 1994). The diffusion of these three different types of innovation in an organisation are determined by the 'innovation diffusion circuit' which is a mechanism used to explain the relationship between the IS professional environment and the host business environment.

The tri-core model is relatively ambitious, as it aims to integrate isolated innovation studies in IS, and attempts to develop a theory of IS innovation in organisations. Although the testing of the model with empirical evidences further support theory development (Grover, *et al.*, 1997a), there have been attempts to extend the model. For example, Grover (1997b) argued that the tri-core model is incomplete and introduced strategic and technological contingencies which further explain external variables influencing the strength of relationships in the model. This argument also suggests that other variables should be considered in the model, including characteristics of industry sector, competitiveness and industry concentration, and further implies that the model makes assumptions, but does not addresses, the dynamic nature of innovations. There has also been attempts to re-conceptualise innovation theory and introduce new innovation models in IS research. This includes the use of theories in different disciplines, for example structuration theory in sociology (Tyre and Orlikowski, 1994) and institutional theory in economics (King *et al.*, 1994). We group and review three alternative approaches.

Firstly, there is the integrated approach. These approaches combine the use of various models of innovation from different disciplines to develop an integrated framework which analyses innovation from multiple perspectives. It can be argued that such developments reflect the shift from using the linear model, since the 1960s, to more strategic, integrated, and networked models of the 1990s (Rothwell, 1992). For example, Zmud (1984) examined push-pull theory in process innovations by drawing on literature in three major research areas, including (a) organisational science; (b) engineering, research, and development management; and (c) management science, operational research, and management IS. Baskerville and Pries-Heje (1997) analysed the diffusion of IT innovation based on a three-model approach, including the integrated push-pull model, the linked chain model, and the emergent innovation model. Damsgaard and Lyytinen (1997) studied the adoption process of EDI based on a multi-theoretical framework of institutional, industry-specific, and organisational factors. Furthermore, McMaster *et al.*, (1997) argued that diffusion theory was inadequate in analysing technology transfer, and introduced a translation approach based on actor-network theory, while Larsen (1998) developed a framework focusing on a human activity systems view.

Secondly, there is the institutional approach. The institutional perspective argues for an institutional point of view in IS research, suggesting that long-established neo-classical economic and organisation theories are inadequate in explaining innovation, and draws on theoretical perspectives from economic history and contemporary sociology (King *et al.*, 1994). The approach provides an analytical framework that helps determine the different dimensions of institutional intervention, including the intersection between the regulatory-influential powers of institutions, and the supply-push and demand-pull factors of innovation. Furthermore, the approach suggest a range of institutional actions, including knowledge building, knowledge deployment, subsidy, standards, mobilisation, and innovation directives.

The adoption of this analytical approach, however, has been marginal in IS research. For example, Christiaanse and Huigen (1997) provide one of the earliest studies that analysed inter-organisational IS implementation with an institutional perspective, suggesting cultural bias, structural order, and supply-push/demand-pull as factors that influenced innovation. Nevertheless, this study also suggests further research into the role of institutions in influencing innovation in complex network settings.

Lastly, there is the resource-based approach. The resource-based perspective analyses the role of resources and their attributes in influencing innovation. For example, Lucas (1989, pp. 7-8) provides a framework which views information as a resource, requiring management in a company. Clemons (1991) argue that IT should be viewed as a strategic necessity, rather than a source of competitive advantage. This view enables firms to leverage their strengths and weaknesses with resources, particularly through co-operation in innovation (Clemons and Knez, 1988). Ross *et al.*, (1996) point to the role of three IT assets - the human asset, the technology asset, and the relationship asset, which firms need to build and leverage to develop long-term competitive advantage.

The application of a resource-based theory in IS research, however, has remained marginal. For example, Clemons and Row (1991) examined how differences in structural resources, which include vertical integration, diversification, and resource quality, influenced innovation in firms. In this respect, they suggest further research in expanding the theory beyond the boundaries of the firm to consider inter-organisational co-operation, and the development of more empirical tests. Mata *et al.*, (1995) developed a

more comprehensive resource-based model of competitive advantage and applied it in the study of IT attributes, including capital requirements, proprietary technology, technical IT skills, and managerial IT skills. Ciborra and Andreu (1998, pp. 90-96) applied the resource-based approach in developing an organisational learning model which emphasises the relationship among strategic, capabilities, and routinisation loops in core capability development. Grant and Liebenau (forthcoming) combined evolutionary and resource-based views in developing an organisational IS capabilities framework which focuses on the relationship among routines, contexts, and resources.

Application of Framework

The review of innovation studies in this section has two implications towards IS research. Firstly, although the use of the diffusion model is dominant in the discipline, it has shortcomings, namely, the treatment of innovation as technological innovations, the focus of innovation diffusion in an organisational context, and the assumption that innovations are diffused along a determined sequence of stages. Secondly, there is a need to adopt alternative approaches which addresses the dynamic, behavioural, and non-linear nature of innovations. The adoption of the evolutionary and resource-based perspectives, as discussed extensively throughout this chapter, provides a more general view of innovation. The application of the framework in the context of the current study, which focuses on innovation in banking, will examine the interrelationship between firm-specific and sector-specific sources of innovation which contribute towards sustained competitive advantage.

The first unit of analysis will be the banking industry. This aims to analyse sector-specific resources influencing innovation in electronic payment systems development from an evolutionary perspective. Firstly, the analysis focuses on the automation of payment systems which are conceptualised as routines. Secondly, the analysis focuses on identifying and assessing the major types of resources contributing to innovation, and new product and services development. The use of evolutionary theory to study innovation is not novel in this respect. For example, McKendrick (1989) and Pennings and Harianto (1992) have applied evolutionary economic theory to study the acquisition of technological capabilities and the diffusion of technological innovation in the commercial banking industry, respectively.

The second unit of analysis will be the banking institutions. This aims to analyse firm-specific resources influencing innovation in the central bank and the four largest commercial banks from a resource-based perspective. The analysis will mainly focus on three major IT resources outlined in the framework namely, physical resources, organisational resources, and human resources. Their relationships and the attributes influencing the rate of replication will be discussed. This analysis will assist in assessing the strengths and weaknesses of each particular resource, and in identifying the sources of innovation which contribute towards sustained competitive advantage.

Summary

The aim of this chapter was to introduce an analytical framework in studying innovation. The review of major innovation models suggests a shift from the linear-oriented towards increasingly strategic, integrated, and networked models. Use of evolutionary and resource-based perspectives, which forms the foundation of the analytical framework, reflects this transition. Moreover, this shift is also being reflected in IS research, which has seen a marginal number of studies applying alternative models of innovation, apart from the dominant diffusion model. The following chapter examines electronic payment systems development and establishes the context for the survey and mini case studies.

CHAPTER 3: THE PAYMENT SYSTEM

This chapter discusses the role of payment systems in financial sector development and is organised into four sections. Section 3.1 provides a review of payment system principles and practices. This includes a discussion of their basic characteristics, the impact of technological innovations, and developments in international perspective. Section 3.2 provides an overview of payment systems modernisation in Thailand. Section 3.3 discusses the role of reforms, particularly in the areas of banking and payment systems. And lastly, section 3.4 discusses the role of modernised payment systems as a source of competitive advantage for financial systems and institutions.

3.1 BACKGROUND

This section discusses the basic principles and practices in payment systems, and reviews recent innovations and developments in international perspective. Research in payment systems has been relatively recent, multi-disciplinary, and broad (Kokkola, 1992; Hancock and Humphrey, 1998). The speed of technological innovations, the lack of theoretical foundations, and the strong emphasis of studies in developed countries have together influenced the direction of research in this area. For example, the policy aspects of payment systems have raised a range of research issues, including:

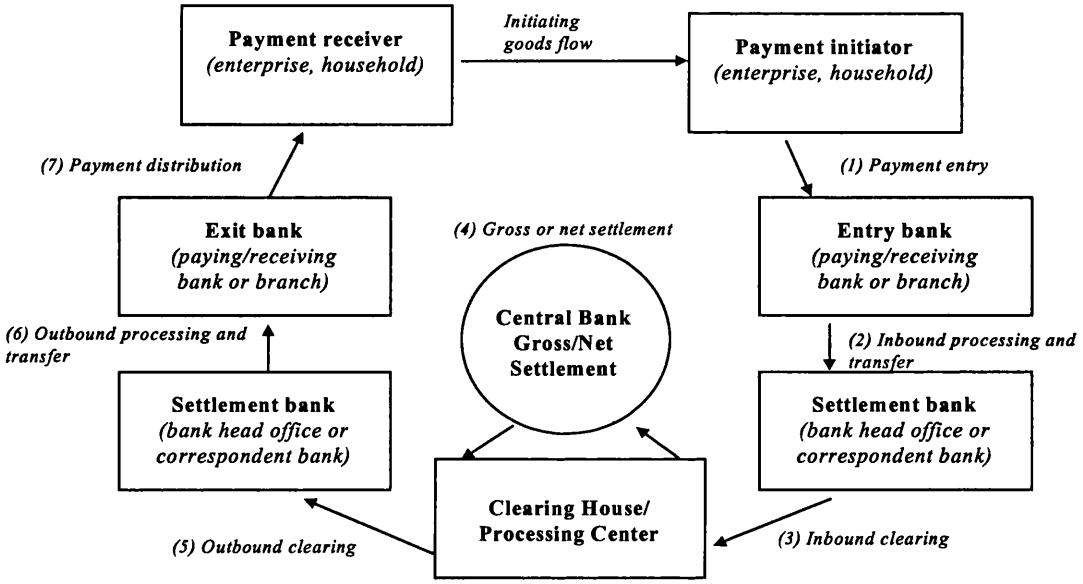
> '(1) the measurement of systemic risks; (2) the optimal pricing for credit risks in central bank lending, especially intraday; (3) the effects of fees and caps on daylight overdrafts; (4) assessing the optimality of queuing arrangements; (5) the effect of payment system development and arrangements on the demand for international liquidity; (6) the impact of daylight overdrafts on interest rates and the price level; (7) the possible role of the central bank in the development of private intraday markets; (8) measuring the effects on the demand for money of new payment instruments; (9) estimating the social cost of float; and (10) the optimal policy mix for appropriate internationalisation of the costs of float and of the costs and benefits of augmenting operational reliability' (Johnson, 1998, pp. 167-168).

More importantly, payment systems play a major part in financial sector and economic development, particularly in developing countries (World Bank, 1990). This improves macroeconomic management, releases funds from the clearing and settlement functions for more productive use, and reduces float levels, improving the control of monetary aggregates. Moreover, firms in different economic sectors use the payment

system to transfer funds and to provide competitive financial services.

The principles of payment systems involve the discharge of financial obligations between two or more payment participants (Humphrey, 1995). This basically aims to provide the financial market promptness and certainty in the payment and settlement of borrowed and invested funds. In addition, it also provides consumers the convenience of time and location, the choice of payment options, and the privacy and low cost of making payments. The conceptual model of a typical payment cycle is illustrated in Figure 3.1.

Figure 3. 1 Conceptual Model of the Payment System



Source: Sato and Humphrey (1995)

The payment cycle involves the transfer of funds that differ in volume and value. This excludes the use of cash because the presentment of this payment instrument between a payer and payee is considered final by principle, and does not involve clearing and settlement functions like non-cash payments. The principles for small and large value payment systems differ by the value and volume of financial transactions, originating from the payment initiator and completing at the payment receiver.

A small-value funds transfer system, also called a retail payment system, usually involves high-volume, low-value transactions. This includes the clearing and settlement of transactions conducted by cheques, GIROs, debit cards, and direct debits, and is typical among household and consumer transactions. Alternatively, a large-value funds transfer system, also called a wholesale payment system, involves low-volume, high-

value transactions. This includes the timely clearing and settlement of commercial transactions conducted between businesses and the settlement of cross-bank payment positions.

The recent reform of payment systems has been influenced by two major trends. The first trend involves broad banking reforms, resulting from the deregulation and liberalisation of world financial markets (Oritani, 1990; 1991). In developed countries, this has led to the harmonisation of large-value payment systems, particularly in foreign exchange clearing systems in the European Union (Munchau, 1997; Graham, 1997). In addition, there has also been increased competition among national payment service providers, which is in response to the integration of European central bank payment systems, called TARGET, in support of the region's monetary union (Fisher, 1997). In developing countries, such reforms have become a precondition for economic development (Bhala, 1995; Listfield and Montes-Negret, 1994, 1995; Sato and Humphrey, 1995).

The second trend involves the computerisation of work processes in banking. The automation of banks has played a major part in replacing the use of manual operations with advanced computer applications, ranging from batch on-line systems to integrated financial networks (Chorafas and Steinmann, 1988). In addition, there has also been a trend for a majority of transactions to be conducted by electronic means distant from a bank's physical location in the mid-1990s (Gart, 1992). Thus, both banking reforms and automation have been catalysts in the modernisation of payment systems.

Types of Innovation

The type of innovations in payment systems may be grouped into product and process innovations. Product innovations relate to payment instruments, while process innovations to payment processes. Firstly, product innovations basically involve the evolution of payment instruments or money. These innovations arise from the needs of both providers and users of such instruments in seeking alternative means of payment. Different types of money have been innovated to serve as a medium of exchange, a standard of value and the specialisation of production. For example, product innovations in money have evolved from the use of commodity money, credit money, and fiat money to more novel electronic payment methods (Solomon, 1997).

For example, commodity money consists of materials such as gold, silver, copper, and bronze. Comparatively, credit may take the form of paper money, such as cheques backed by promises by the issuer, whether a government or a bank, to pay an equivalent value in the standard monetary metal. Fiat money consists of paper money such as currency that is not redeemable in any other type of money and the value of which is fixed merely by government edict. Recently, there has been electronic money which consists of digital cash, electronic transfer of funds, and electronic cash (Panurach, 1995).

Product innovations

Innovation in money may be cash and non-cash-based. Cash-based innovations have become increasingly sophisticated with the use of technology, particularly in the prevention of forgery. These innovations have been incremental or on a continuous basis. For example, computer aided design software has been used extensively in the design of bank notes, such as in the case of the redesigned $US 100 note. Furthermore, the combination of electro-mechanical devices in cash dispensing and automated teller machines have also provided users with payment services previously restricted at branch offices. A more radical innovation has been the introduction of digital bank notes that are electronically identifiable through tags, such as that provided by the Electronic Monetary System of Citicorp bank based in the United States.[14]

Cheque-based innovations have also been influenced by technology. The use of magnetic ink character recognition and optical character recognition techniques in cheques have enabled machine readable characters, embedded in paper documents, to be read by machines for electronic processing. In a fully automated cheque clearing system, cheque truncation curtails or eliminates the physical movement of cheques within a bank, between banks, or between a bank and its customers. Electronic records of the contents replace this, either wholly or partly, for further processing and transmission.

Card-based innovations have also made extensive use of technology. Payment service providers have offered an array of card-based services to customers. This ranges from cash cards, charge cards, cheque guarantee cards, credit cards, debit cards, retailers cards, and chip cards. For example, the chip card, also called the integrated circuit or

[14] See "Digitising dollars" (*The Economist* 30 March 1996, p. 90).

smart card, operates with an embedded microprocessor and can be used as an access control device to funds transfer systems or as an authorising key. Other innovations have combined various card services into a single integrated card (Yamaguchi, 1993).

Process innovations

Process innovations relate to the use of technology in the processing of financial transactions. A process innovation combines computer and communication technologies, together with the development of computer software, to create an electronic payment system that provides a mode of transport for the different types of payment instruments. There has been an extensive application of technology towards both small and large value payment systems.

The automation of cheque clearing houses provides one illustration. In addition to increasing efficiency in the processing of direct deposits and direct credit transactions, an automated clearinghouse also facilitates electronic interbank payments and settlements. For example, an EFT system transfers funds between bank accounts through the use of dedicated electronic systems. These systems may range from proprietary systems such as Barclays Global Payments to international payment systems such as SWIFT (Welch, 1994). More interestingly, the Internet has also provided an alternative payment method, which may be illustrated by the initiation of an 'e-check' program in the United States, involving a consortium of commercial banks and computer companies implementing a system to facilitate the payment of cheques electronically.[15]

EFT has also been an innovation in providing banking services. For example, Howells and Hine (1993) studied how systems in network innovation, in particular EFT systems, have been managed and marketed to become an important financial innovation for the banking industry. They argue that such innovations require the development of new decision-making processes and strategies for adopting new technology and technological change in traditional institutions.

An EFT/POS system extends EFT functions, involving retailers and their customers. First, this involves the installation and integration of EFTPOS terminals to

[15] See "U.S. Treasury to inaugurate new system for paying checks over the Internet" (*Wall Street Journal Europe*, 30 June 1998, p. 9).

the cash registers or checkout counters of retailers. This arrangement provides the personal identification on each customer payment card. Second, it allows a particular transaction to be transmitted electronically to the customer's financial institution. And lastly, provided that the transaction is authorised, funds equivalent to the transaction is transferred instantly from the customer's to the retailer's account.

A financial EDI system also extends EFT functions (Dingle, 1991). A typical EDI system provides a computer-to-computer transfer of structured messages, particularly between business enterprises. Alternatively, financial EDI involves banks, acting as financial intermediaries, to transfer financial messages between trading partners. This has led to the set-up of value-added banks, for example, in North America (Emmelhainz, 1993). However, such services have been marginal because of wide usage of EDI in logistical areas of business transactions (O' Hanlon, 1993).

In addition to funds transfer among payment participants, process innovation in payment systems also provides electronic linkages between the exchange of different monetary assets. This includes money, foreign exchange, securities or other financial instruments. For example, there is more than one fund transfer system involved in processing payment obligations that are generated in an exchange-for-value settlement system or a delivery versus payment system. This innovation process potentially permits the dematerialisation or elimination of physical certificates or documents of title, which represent the ownership of securities so that they exist only as accounting records. Such innovations have wide ranging implications towards the concept of delivery versus payment in securities settlement systems, and contribute to a country's financial market development (BIS, 1992).

Payment Systems in International Perspective

At the international level, the range of reforms in payment systems have focused on: (1) the co-operative arrangements in developed nations to reduce risk in cross-border payments; (2) the harmonisation of payment systems in specific regions; (3) the co-operative arrangements in clearing and settlement in non-industrial nations; and (4) the increased involvement of international financial institutions (Johnson, 1998). Payment systems may be characterised as mature or rudimentary, depending on their level of development. The former type may be characterised by the adoption of advanced payment arrangements and technologies, as compared to the latter. Alternatively,

payment systems may also be grouped into developed and developing countries, whereby the latter group may include emerging market economies, formerly socialist republics, and transitional economies.

In developed countries, the G-10 central banks have developed approaches and conceptual frameworks in coping with common concerns in many areas.[16] This includes payment and settlement services of cross-border and multi-currency transactions (BIS, 1993), delivery versus payment in securities and settlement systems (BIS, 1992), settlement risk in foreign exchange transactions (BIS, 1996c), clearing arrangements for exchange-traded derivatives (BIS, 1997d), and the relatively recent development of real-time gross settlement systems (BIS, 1997b).

The use of technology in mature payment systems has also increased in importance. For example, a majority of the G-10 payment systems were automated between 1980-1990.[17] In the early 1980s, the Bank for International Settlements (BIS) raised concerns on the security of electronic payment systems (BIS, 1982). In the 1990s, this was followed by a range of reports addressing personal computer safety (BIS, 1990), security and supervisory concerns in electronic money (BIS, 1996a,b; 1997a), and more recently, supervisory concerns on payment systems that are compliant with century date changes (BIS, 1997c).

The maturity of such payment systems can be further examined through statistical indicators. The first group of indicators is the percentage of cheques used in each G-10 country, as compared to the total volume of cashless transactions.[18] Comparatively, the use of cheques in cashless transactions has decreased in all countries, although at different rates. For example, there is a high dependency rate in the use of cheques in the United States, despite a decreasing rate in the use of cheques. This is mainly due to the disaggregated nature of the country's banking structure, increasing the use of cheques. Resolving this problem is possible, provided that policy actions are taken to support shifts from checks to electronic payment methods, as in the case of imposing penalty tax on cheque floats in Canada (Humphrey and Berger, 1990). The second group of

[16] The G-10 countries include Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, the United Kingdom, and the United States
[17] See Appendix 7; Table A1.
[18] See Appendix 7; Table A2.

indicators is the percentage of payment cards used in each G-10 country, as compared to the volume of cashless transactions.[19] Comparatively, there is an increased use of payment cards in all countries, although at different rates. Similarly, this parallels the increase in the use of cash dispensers, ATMs, and EFTPOS terminals.[20]

In developing countries, payment systems are rudimentary and undergoing reform. Moreover, there exist a limited number of related studies and statistics in developing countries, as compared to their developed counterparts. For example, Dott and Shanmugham (1994) argue that payment system statistics have been limited to the G-10 countries and provided a study based on data from twenty-three developing countries. Other attempts have included the organisation and comparison of statistics in Asia based on currency in circulation, cheque and card penetration, and EFTPOS terminalisation penetration.[21]

International aid agencies have recently increased interest in payment system studies in developing countries. This ranges from countries located in Asia, Latin America, and Central and Eastern Europe (Balino *et al.*, 1994; Bhala, 1995; Folkers-Landau *et al.*, 1994; Hook, 1992; Listfield and Montes-Negret, 1994, 1995; OECD, 1993; Sato and Humphrey, 1995; Scott, 1993; World Bank, 1995; Johnson, 1998). Such studies have raised two major issues. Firstly, the central bank has a role in payment system reform. For example, central banks have contributed towards the automation of clearinghouses, as this provided the basic infrastructure to further develop modern payment instruments and arrangements. Secondly, the central bank has an important role in reducing payment system risks to maintain systemic stability in the banking system (Schoenmaker, 1996). Such risks vary from liquidity risks, operational risks, credit risks, and systemic risks. Central banks, assuming the role of lender of last resort, also become the guardians of the payment system. Such risks may be monitored, and if detected, contained in a timely manner to prevent other payment participants from being affected.

In a survey of central banks in developing countries, the nature of payment system reforms was examined (Fry *et al.*, 1996). The research results indicate that a majority of central banks experienced such reforms since 1975. Moreover, 16 central

[19] See Appendix 7; Table A3.
[20] See Appendix 7; Tables A4-A5.
[21] See "Annual Asian payments system data" (*The Asian Banker* 15 June-14 July 1997, pp. 30-32)

banks in the study initiated them. Such developments have been technological by nature, for example, in the automation of cheque clearing houses through IT.[22] However, the study has two limitations. Although it focuses on central banks in developing countries, it is restricted to members in the Bank of England Group. Furthermore, the survey provides a broad overview of reforms and does not discuss in detail how the central banks carried about such changes.

Listfield and Montes-Negret (1994) raised the issue of unique conditions found in developing countries experiencing payment systems modernisation. Such regions include Asia, Latin America, and Eastern and Central Europe. In this respect, the Asian financial crisis, which surfaced in mid-1997, suggested structural weaknesses in the region's financial systems, and prompted central banks to further improve their national financial infrastructures, including payment systems (Montagnon, 1997).

In Asia, there have been recent reforms in payment systems which has also included the emergence of electronic commerce initiatives (EIU, 1996). For example, China received World Bank financial assistance in support of two major payment system projects, including approximately US$2.5 million for technical assistance and design, US$400 million for computer hardware, and US$500 million for bank automation respectively (Listfield and Montes-Negret, 1994, p. 19). Such financial and technical aid have supported the co-operative efforts between the People's Bank of China, the country's central bank, and commercial banks, in developing a national clearing system (Keppler, 1995). Furthermore, central bank co-operation with Visa International led to the development of Chinese banking card standards to support Internet-based banking (Simon, 1997).

In this respect, China's Hong Kong Administrative Region Government (1997) has also initiated financial technology infrastructure development plans, including an Internet-based payment system which is aimed to develop the region into a 'Financial Super City'. Similarly, Vietnam received US$ 1 million for technical assistance and design, and approximately US$30 million for computer hardware for reform programs initiated by the State Bank of Vietnam (Listfield and Montes-Negret, 1994, p.19).[23]

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[22] See Appendix 7; Table A6.

[23] See "Vietnam upgrades payment system" (*The Asian Banker* April 1996, p. 2)

Malaysia's central bank, Bank Negara Malaysia, also played an important role in implementing new payment arrangements to improve the efficiency of the country's financial system (Singh, 1993). This ranged from supporting computerisation to the modernisation of bank operations. Among these developments included the set-up of the Kuala Lumpur Automated Clearing House in 1984, the implementation of a day-one settlement system in 1989, the operation of an electronic inter-bank funds transfer system in 1989, and the set-up of a scripless securities trading system in 1996.

Indonesian commercial banks also experienced impacts from using IT (McKendrick, 1992). The study, which identified the catalysts behind bank computerisation and efforts to liberalise Indonesian financial markets in 1983, argued that computerisation did not contribute to bank financial performance during 1980-1987, although this may have improved customer services. One reason is because Indonesian banks incurred learning cost in integrating IT to current bank procedures that were in formation. Thus, the study concluded that bank performance increasingly relied on managerial and organisational skills, in contrary to technical competence.

Thailand also experienced early payment systems development (Supapongae and Hataiseree, 1993). This included the introduction of the first ATM by a Thai commercial bank in 1983 and the set-up of the first EFTPOS in 1985. Bank reforms have also influenced dramatic changes. The country's central bank initiated two major financial development plans, including an ambitious payment system reform project. This included the development of three major payment systems. Firstly, there was the set-up of an electronic cheque clearing system in the capital to be operational in 1996. Secondly, there was the implementation of an EFT system for retail payments in 1996. And thirdly, there was the establishment of an EFT system for wholesale payments. In addition, future development plans include the enhancement of previous systems and the automation of securities delivery and payment settlement systems.

In Latin America, there were similar reforms. For example, Listfield and Montes-Negret (1995) examined the factors driving payment systems reform among countries in the region, including financial liberalisation and rapid technological changes. The study examined the major barriers to payment systems modernisation in Colombia and El Savador, and identified slow developments in the use of cheque standards, particularly in

Colombia which delayed the use of automation in cheque processing. Furthermore, the study suggests the development of automated cheque clearing houses, aimed to facilitate the flow of direct deposits and direct credit systems, apart from serving as a foundation for implementing electronic inter-bank settlement systems.

Several recommendations were suggested. First, the central bank and banking associations needed to provide strong leadership roles in payment system reform. Second, there was a need to create incentives in adopting common cheque standards. Third, there was a need to improve cheque sorting and encoding, microfilming, and manual data processing. Fourth, there was a need to introduce alternative payment mechanisms and to set-up a private cheque-processing centre. And lastly, there was a need to make securities settlement through several banks, instead of a single bank.

The reform of payment systems has been rather progressive in Brazil (Listfield and Montes Negret, 1996). This mainly included the development of a highly automated payment system that supported high inflationary conditions in the country. In addition, innovative payment methods were introduced, including the use of cobrancas, bar-coded remittance documents used to pay bills, and finally, Documentos de Credito, an electronic method of processing intrabank funds transfer and interbank credit payments. Such alternative payment methods increased payment system access to customers without checking accounts with commercial banks.

Frischtak (1992) examined the relationship between banking automation and productivity change in Brazil. This study suggested a positive relationship between the diffusion of IT and productivity. In this respect, the Central Bank of Brazil played a constructive role, particularly through the use of IT which helped dampen financial instability in the country. This is illustrated with Sisbacen, a multi-faceted IS that captures market and institutional data and informs certain actions that should be taken. Thus, Frischtak (1992) concludes that the Brazilian central bank's IS has exemplified that IT plays an important role in supporting the stability of the financial system, and in increasing the efficiency of financial markets. As a result, any necessary intervention of the financial market or the liquidation of financial institutions, on the part of the central bank, can be taken in a more timely manner.

In Eastern and Central Europe, there has also been progressive developments in payment systems of formerly centrally planned economies (OECD, 1993). The region also received significant amounts of financial assistance from the World Bank. For example, Hungary received US$13.5 million and US$40 million to fund computer hardware and bank automation respectively; while there were plans to extend loans of approximately US$200 million and US$250 million to Russia, to fund computer hardware and bank automation, respectively (Listfield and Montes-Negret, 1994, p.19).

Conditions in Eastern and Central European countries are unique (Folkerts-Landau *et al.*, 1993; Balino *et al.*, 1994). These studies identified existing primitive payment system arrangements, reflecting traditional mono-bank-based systems. Such conditions existed in Hungary, Poland and Bulgaria. Scott (1993) discussed developments of a new GIRO-based payment system in Hungary in which an initiative, introduced by the National Bank of Hungary, involved an investment of approximately US$30 million, part of which was a World Bank US$15 million loan. However, the study argued that the successfulness of the new system was difficult to assess, considering the range of uncertainties and problems involved. For example, the bankruptcy of many small Hungarian banks in 1992 prompted the central bank to increase control in the payment system.

Scott (1993) further discusses developments in Poland. This included the case of the Art-B affair in 1991 which was a major banking scandal that exploited existing weaknesses in the Polish cheque system. Such problems included a large and variable level of cheque float, an unreliable timing for payments order execution, a high credit risk, inefficiency caused by current multiple clearing accounts, and unreliable clearing arrangements. The National Bank of Poland attempted to address such problems and implement measures to increase improvement (Balino *et al.*, 1994). However, the problems amassed into significant losses on the part of the central bank, and created further difficulties in monetary management and control. As a result, the central bank introduced several risk reduction measures, including the establishment of a National Clearinghouse among 17 major commercial banks and the central bank in 1991, and the set-up of an inter-bank settlement department within the central bank accordingly.

Similarly, Balino *et al.*, (1994) discussed the problems and measures related to payment system reform in Bulgaria. The country's conditions were partly similar to Poland, characterised with current payment systems that consisted of a large and variable level of cheque float, and the extension of unnecessary unlimited overdraft facilities to banks. Such conditions exposed the Bulgarian National Bank to huge credit risks and created difficulties in monetary management. Therefore, measures introduced to improve the country's current payment system included the introduction of electronic queuing facilities in 1992, aimed to alleviate previous problems.

Recent reforms in Eastern and Central Europe suggest the underlying weaknesses in rudimentary payment systems. The Russian case provides another cautionary lesson. This involved the malfunctioning of a computer modem, a part of a newly developed payment system in the country, causing a complete interruption in the interbank loan market on 24 August 1995. Consequently, one major bank was unable to fulfill a 400 billion rouble payment which created systemic risks in the financial system and bankrupted two more Russian banks.[24] The Russian case partly reveals the inadequacies of foreign assistance programs in delivering robust payment systems. The adoption of top-down solutions from consultants without regard to commercial bank participation in the design of the system may lead to sub-optimal solutions. Similarly, Central and Eastern European banks, particularly in Poland and the Czech Republic, have experienced difficulties in adjusting their banking systems with new technology, since they could not cope with the changes in new rules and legislation imposed by their central banks.[25]

Summary

This section reviewed the principles and practices of payment systems, the impact of technological innovations, and recent developments in international perspective. The purpose of the payment system is to discharge financial obligations between two or more payment participants. Technological innovations have increased the range of payment products and processes in facilitating funds transfer. This has been particularly the case of developed countries, which have adopted advanced arrangements and technologies for

[24] See "And then there were 2,500" (*The Economist* 2 September 1995, p. 103)
[25] See "Wiring Central European banks" (*The Economist* 9 December 1995, p. 101-104)

processing payments, as compared to their developing counterparts that have rudimentary systems undergoing reform.

3.2 THE THAI PAYMENT SYSTEM

Background

This section provides an overview of payment system modernisation in Thailand. The country's payment system was characterised by primitive payment practices, prior to the issuance of paper currency in the latter part of the nineteenth century (Sithi-Amnuai, 1964). In the conduct of domestic trade, silver and cowrie shells were used as payment instruments. Comparatively, the Indian Rupee was used for foreign trade with Burma (Myanmar), while the Straits dollar and Mexican dollar were used with Malaya (Malaysia). The basic unit of currency during this period was the Baht which was based on the silver standard. From 1888 to the Second World War, the Thai financial system would experience four significant changes, shaping the future payment system.

The first change was the set-up of the first commercial bank in Thailand. In 1888, the Hong Kong and Shanghai Banking Corp was the first foreign commercial bank to be established in the country. This was followed with the set-up of other banks, including the Chartered Bank in 1894, and the Banque de I' Indochine in 1897. Thai banks were later established in the twentieth century. As a result, the early banks were mainly foreign, particularly British banks that maintained trading interest with the country. One of the important developments that such banks initiated was the issuance of their own paper currency as an alternative payment instrument. Moreover, Thai banks, which were establishing themselves, acquired professional training and operations from them.

The second change was the institutionalisation of the financial system. This provided the precedent for payment system modernisation in the long-term. The National Banking Bureau was one of the key financial institutions established during this period. The Banking Bureau was a predecessor to the current central bank, whose establishment during this period was seen as inappropriate. Nevertheless, it carried out the functions of a central bank. The regulation of the issuance of currency and the providing of a clearinghouse service to commercial banks were among some of the early services provided. Prior to the provision of a clearing house, commercial banks maintained individual bank accounts at other banks for the purposes of clearing cheques drawn on

them. Moreover, the means of payment delivery was through messengers which was very inefficient. Thus, the role of the Banking Bureau as a clearinghouse enabled commercial banks to deposit part of their cash balances with them for cheque clearing purposes.

The third change to the financial system was the expansion of Thai commercial banks. This development was during the Japanese occupation of Thailand in World War Two which was characterised by the suspension of all foreign commercial bank activities except Japanese operations. Thus, the emergence of Thai commercial banks was largely influenced by the experiences and training acquired earlier by local professionals from foreign commercial banks. In addition, branch banking also influenced the expansion of Thai commercial banks. Their roles were to act as a deposit institution, a loan giving institution, and a transmitter of funds. The latter function has been significantly important for Thailand. Due to an inefficient internal postal system, the use of cheques among traders in different provinces was unpopular, as it required weeks to transfer money. This was relatively improved with alternative means for money transfer, such as the use of radiophones or telegraphic transfers.

The last change was the establishment of the Bank of Thailand in 1942. The central bank served as a successor to the Banking Bureau. It resumed functions of note issuance from the Treasury and also established an official clearinghouse. As mentioned, the Banking Bureau played the role of a convenient clearinghouse to commercial banks. However, this was not an official establishment, in contrast to the Bangkok Clearinghouse set-up in 1945. This clearinghouse provided cheque-clearing facilities for commercial banks located primarily in the Bangkok and Thonburi areas, increasing efficiency for commercial banks and their customers. The clearing for provincial cheques, however, was more troublesome and time consuming. As mentioned, the internal postal system was inefficient, and moreover, cheque transactions originating in different provinces were required to be verified at commercial bank headquarters in the capital, and to be cleared at the clearinghouse. Thus, a common payment instrument used among Thai businessmen was post-dated cheques.

Two general observations can be made from these early developments. First, foreign commercial banks took the initiative in introducing payment system innovations. They issued the first forms of paper currency as an alternative payment instrument, as

compared to the use of cowrie shells and silver. Moreover, commercial banks expanded rapidly into the provinces. This positioned them in the role of transmitter of funds. Payment services such as the use of radiophones or telegraphic transfers became the mode of communication to effect transactions, as compared to the inefficient use of the internal postal system.

Second, there was public support. The National Banking Bureau, to be succeeded by the Bank of Thailand, started issuing paper currency in the early periods of the twentieth century, and provided the necessary clearinghouse for cheques, increasing the convenience for commercial banks. This working relationship provided the foundation for further developments in the payment system. The chronology of selected significant developments in the Thai payment systems is summarised in Table 3.1.

Table 3. 1 Chronology of Early Payment System Modernisation in Thailand

Year	Nature of Development
> 1851	Payment instruments used for domestic trade include silver and cowrie shells. Payment instruments used for foreign trade include Indian Rupee, Straits dollar and Mexican dollar. The Baht became the unit of currency and was based on the silver standard.
1888	The first commercial bank is established in Thailand. The issuance of the first paper currency.
1903	The Department of Paper Currency is established and the issuance of Thai paper currency is introduced.
1939	The National Banking Bureau is established, providing an early clearinghouse for commercial banks.
1942	The Bank of Thailand is established and resumes the issuance of notes from the Treasury.
1945	The Bangkok Clearinghouse is established.
1962	The Commercial Banking Act legislation is introduced.

Structure of Financial System

The structure of the country's financial system may be categorised into banking and non-banking institutions. The whole system includes the central bank, commercial banks, government banks, finance firms, securities companies, insurance companies, and related financial institutions. This is illustrated in Table 3.2.

Table 3. 2 Structure of Financial System, as of 31 December 1995

Type of Financial Institution	No. of Institutions	No. of Branches
Banking Institutions		
Central bank	1	3
Commercial banks (domestic)	15	3,209
Commercial banks (foreign)	14	14
Government Savings Bank	1	537
Government Housing Bank	1	32
Bank for Agriculture and Agricultural Co-operatives	1	362
Foreign bank representative offices	43	Na
Export-Import Bank of Thailand	1	Na
Non-Bank Financial Institutions		
Finance companies [a]	91	59 [b]
Credit foncier companies [c]	14	Na
Securities companies	62	Na
Industrial Finance Corporation of Thailand	1	8
Mutual fund management companies	8	Na
Pawnshops	373	Na
Small Industry Finance Corporation	1	Na
Small Industry Credit Guarantee Co-operation	1	Na
Life insurance companies	12	1,159 [d]

Source: Bank of Thailand. Na = not available. [a] Includes Finance and Securities Companies. [b] Includes 122 Securities Brokerage Offices. [c] Mortgage Companies in Thailand. [d] As of 30 September 1994.

Payment service providers include both banking and non-banking financial institutions. Comparatively, Thai banks have become very innovative in providing a range of diverse payment instruments and services to their customers. Similarly, finance and securities companies, being non-bank financial institutions, have increasingly provided payment services, particularly to support the payment and settlement of securities transactions originating from the Stock Exchange of Thailand (SET).

The central bank plays two important roles in the payment system. Firstly, it provides the issuance of paper currency. This bears a direct relationship with the control of the country's money supply through its conduct of monetary policy. Secondly, they operate the payment system. It is interesting to know that the activities of the central bank moves beyond its conventional roles in a developing country like Thailand. For example, Sirivedhin (1988) argued for the role of the central bank in development.

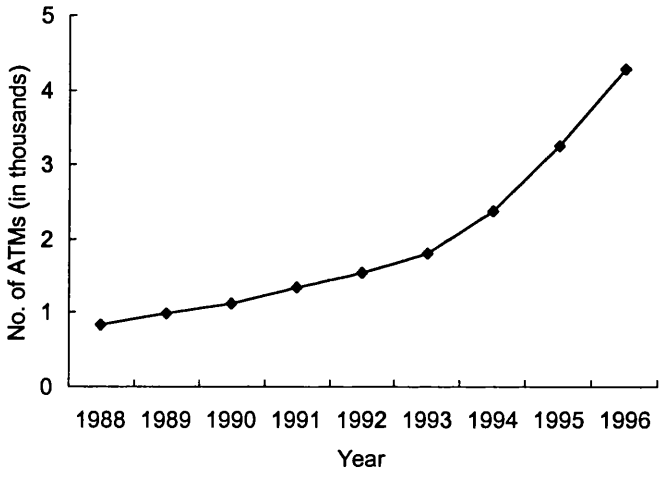
The institutions mentioned above evolve according to the country's changing economic environment. This may be the entrance of new payment service providers in the market, the providing of more innovative payment services by existing institutions, or the combination of both. Increases in business transactions, international trading activities, foreign direct investment, and portfolio investments have all played a part in

increasing pressure on the current payment system. As existing payment infrastructures were inadequate and inefficient to cope with changing requirements, subsequent banking and payment systems reforms followed.

Role of Private-Public Sectors

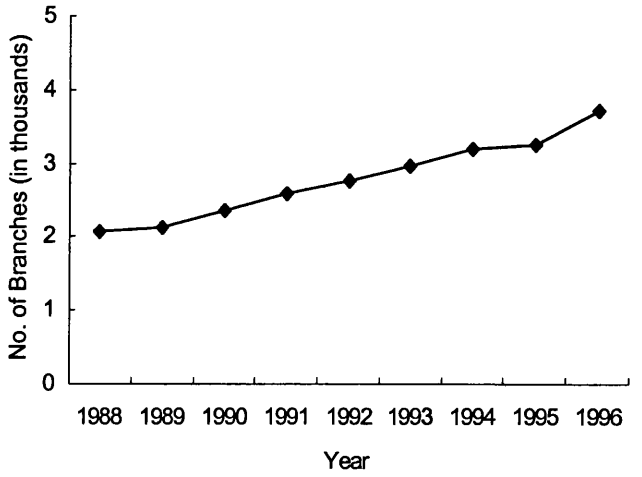
The role of the private sector preceded the public participation in payment system development. Prior to the central bank's involvement, Thai commercial banks have introduced the first ATM machine in the country in 1983. This was followed with the introduction of credit cards and EFT systems in 1984, and EFTPOS in 1985. Figures 3.2-3.3 illustrate the growth of ATMs, as compared with growth in bank branches between 1988-1996.

Figure 3. 2 Growth of ATMS, 1988-1996



Source: Bank of Thailand

Figure 3.3 Growth of Bank Branches, 1988-1996



Source: Bank of Thailand

The growth rate of ATMs was relatively high. There was a four-fold increase from approximately 1,000 to 4,000 units between 1990-1996. This was partly influenced by the relaxation of central bank regulations since the early 1990s, including the expansion of service hours and the installation of machines without requesting for prior permission. This period also coincided with the introduction of two major financial development plans which aimed to deregulate and liberalise the local financial system.

Comparatively, the growth rate of bank branches was relatively lower. There was only a two-fold increase of bank branches from approximately 2,000 to 4,000 branches, as compared with ATM units during the same period. Such developments were partly influenced by two factors. First, the commercial banks needed to improve their internal business operations to increase productivity and efficiency. The use of ATMs automated routinised tasks such as the deposit and withdrawal of money, alleviated bank branches from customers demanding basic services, and increased their ability to address more non-routinised services.

Second, the commercial banks were in competition. The improvement of payment services was aimed to increase customer satisfaction. Extension of bank payment services to customers became more convenient and efficient, as compared to the use of bank branches. This was followed with commercial bank co-operation in developing integrated computer networks in the form of national ATM networks. The two networks, Siam Net and Bank Net, included the membership of a group of commercial banks that provided customers cross-bank ATM services.

The public sector also plays an important role. This is particularly the case of the central bank. Watanagase (1994) makes a comparison of several payment system statistics between Thailand and several other countries. In 1991, the ratio of cash to money supply, measured by M_1, was 67% for Thailand.[26] This compares with 7% to the United Kingdom, 29% to Japan and the United States, 46% to Singapore, and 64% to the Philippines respectively. Such figures indicate that Thailand has a high dependency rate on the use of cash as a payment instrument which has been increasing on an annual basis.

[26] The definition of M_1 varies in different countries. In Thailand, this is defined as currency held by the public and demand deposits held by the non-bank private sector. M_2 is defined by M_1 plus time and savings deposits held by the non-bank private sector.

The implications for the central bank included increased investment in printing houses to accommodate high demands in bank notes. This may be seen as an inefficient allocation of resources. Moreover, commercial banks also incurred additional handling, storage, and security costs for bank notes. When we examine the use of alternative payment instruments in relation to total non-cash payments in Thailand, we see another concentration. This is the dependency on non-cash paper-based payment instruments, particularly cheques.

There is a high usage of cheques, in addition to cash, in Thailand. In 1991, this accounted for 63.3% in volume and 97.9% in value of all non-cash payment instruments respectively.[27] Furthermore, there has also been a growth in the volume and value of cheque transactions processed by the Bangkok Clearinghouse since 1988, coinciding with the financial deregulation and liberalisation measures which started as early as 1989.[28]

The high usage rate of cheques, as compared to other types of non-cash payment instruments in the country, poses long-term problems. One important concern is the problem of cheque float. Float decreases the turnover of funds in the economy, thereby reducing the ability to channel funds into more productive use and constraining the efficient functioning of the economy. To put this issue into context, it helps to examine the problem of float in the United States economy which constitutes 81.2% of all non-cash payment transaction volumes and represents one of the world's highest cheque-dependent country.[29]

Humphrey and Berger (1990) argue that market failure occurs in the misallocation of resources related to cheque floats in the United States payment system, as there exist a mismatch between the private costs of using cheques by the user and the social cost in producing and processing it. From a social viewpoint, users of payment instruments tend to minimise on their private cost by obtaining cheque float advantages, thereby increasing the tendency for overusing it.

[27] See Appendix 7; Tables A7-A8.
[28] See Appendix 7; Table A9.
[29] See Appendix 7; Table A7.

Preference in cheque usage affects the use of other payment alternatives. For example, although electronic payment systems are efficient and low in social cost, they incur higher social cost to users because they generate no float advantages. This is the main reason why more advanced payment practices have not been fully utilised. In alleviating such problems, a distinction among the types of cheque users and the payment alternatives available to them should be addressed.

The advantages of cheque float and their associated private and social costs differ among consumers, businesses, and governments. Cheque transactions carried out by consumers only generate a small float benefit, signalling a small mismatch between private and social costs and a minor market failure accordingly. However, similar transactions carried out by businesses and governments generate larger float benefits. This creates a large mismatch between private and social costs.

Humphrey and Berger (1990) further suggest that the provision of electronic payment systems, particularly in the use of EDI, are beginning to be adopted by governmental agencies in the United States. As a result, this will help alleviate the problem of cheque float and market failure to a certain extent. However, the main problem that still remains is the widespread use of cheques in the business sector. Unless such enterprises voluntarily adopt advanced payment alternatives, such as EDI, market failure would remain in the United States payment system. The experience of market failure caused by cheque float in the United States payment system also raises important policy issues. This equally applies to Thailand and other developing countries which have a high dependency rate in cheque usage as a non-cash payment instrument. In order to examine the wide spread use of cheques in Thailand and their likely concentration among various users, it helps to discuss briefly their developments.

In a study of payment practices in Thailand, Sithi-Amnuai (1964) argues that the bill of exchange is used to a very limited extent. Consequently, this led to an increased use of cheques, primarily between commercial banks and customers, and between the various customers of a particular bank that trusted each other. Moreover, confidence in the use of cheques was supported through legislation, dictating that the use of bad cheques amounted to a criminal activity. Thus, the use of cheques, which was backed by law, became popular in comparison with other payment instruments such as the bill of

exchange or promissory notes. In addition, Sithi-Amnuai (1964) analysed that the use of cheques is primarily used by businesses. This is justifiable because the use of cheques by consumers is not wide spread as the use of cash. He makes the following argument.

> 'monetary transactions (in Thailand) are still preferred to be done by cash instead of cheques. Government departments, for example, more often insist on the use of cash instead of a bank guarantee or simply by the issuance of a cheque. In the commercial world, it is difficult to have a cheque accepted in normal transactions. For paying household bills such as electricity and water, a cheque is still not accepted' (Sithi-Amnuai, 1964, pp. 186-187).

This analysis further suggests that the concentration of cheques among Thai businesses contributed to cheque float in the country's payment system. Moreover, this signals a market failure, as argued by the analysis of Humphrey and Berger (1990). Nevertheless, IT developments have provided a productive platform to develop alternative payment instruments and arrangements. ATM development provides a further illustration. While commercial banks provided early technological innovations in the form of ATMs, the central bank gradually relaxed restrictions on their operations accordingly. In addition, the central bank managed to reach a compromise with commercial banks in the increase of cross-bank transaction fees to recover operating costs in early-1997 which it previously felt has increased inconvenience and cost to consumers.[30] This is illustrated in Table 3.3.

Table 3. 3 ATM Regulation and Reform in Thailand, 1983-1997

Year	Type of Reform
1983	Introduction of first ATM by a Thai commercial bank
1984	Introduction of credit cards and Automatic Funds Transfer System
1985	Introduction of first EFT/POS
1991	Bank of Thailand expands service hours for ATM machines to be from 7:00 to 22:00.
1992	Bank of Thailand permits banks to operate ATM machines 24 hours a day.
1994	Bank of Thailand allows commercial banks to open ATM machines without seeking its prior approval and prescribes rules for electronic funds transfer services.
1995	Bank of Thailand initiates guidelines for the management of derivative transaction risks. This includes commercial banks adopting a suitable risk control system. Bank of Thailand regulates credit card service.
1997	Bank of Thailand approves commercial bank collection of cross-bank transaction fees.

Source: Bank of Thailand Quarterly Bulletins, various issues

[30] See "Central bank approves ATM service fee hike" (*The Nation* 25 July 1997) and "ATM users forced to take more" (*Bangkok Post* 7 February 1997)

Summary

This section provided an overview of early payment systems modernisation in Thailand. The factors, which influenced early development, included the establishment of the first foreign commercial bank in the country, the institutionalisation of the payment system, the expansion of domestic commercial banks, and the set-up of the central bank. Such historical conditions partly shaped the context of current reform programs and are discussed in the following section.

3.3 THE ROLE OF REFORMS

This section discusses the role of reforms, particularly in the context of banking and payment systems. The payment system is a major infrastructure in need of improvement in Thailand, considering the rate of economic expansion experienced by the country. In this section, we briefly outline the two three-year financial development plans which preceded the modernisation of the country's payment system.

Financial Development Plans, 1990-1995

The first plan, covering the period 1990-1992, addressed four main areas of financial development. The first area was the deregulation and liberalisation of financial markets. Such measures included the liberalisation of interest rates, the relaxation of foreign exchange control, the expansion of financial institutions' scope of activities, and the improvement of portfolio management efficiency. The second area was the improvement of financial institution supervision. The objectives of this plan were to promote the transparency of financial institutions conditions, to increase consumer protection, and to increase the stability of the financial system. Such universal measures adopted included the BIS capital adequacy requirements which was raised to 8% in 1995. The third area was the development of financial instruments and services which was aimed at finding alternative sources of funding to support the credit needs of businesses. Such instruments included debentures, convertible instruments, multi-Asian currency notes, securitised instruments, unit trusts, warrants, and financial derivatives. Lastly, the fourth area was the development of the payment system. Such reforms provided the necessary infrastructure to integrate financial institutions and instruments. The objective was to provide a more systematic, efficient, and secured approach in the clearing and settlement of financial transactions. Thus, the modernisation of the payment system with IT was increasingly introduced.

The second plan, covering the period 1993-1995, addressed three main areas of financial development. The first area was the mobilisation of savings. This was to ensure an adequate level of savings to support the long-term growth of the country's economy. Such measures included the expansion of provincial branch network of commercial banks and finance companies. The second area was the extension of financial services to rural areas. The objective was to increase the availability of credit and financial services to the provincial regions of the country. Moreover, this included the promotion of capital market development in the regions, rather than being concentrated in the country's capital. Lastly, the third area was the development of the country's capital into a financial centre. This plan capitalised on the geographical proximity of Thailand to the Indo-Chinese countries, supporting the country's potential to develop itself into a funding centre for international trade and investment, including three major stages.

The first stage involved the development of the country's capital into a regional centre of funds. Early developments have been in the form of permitting both domestic and foreign commercial banks based in Bangkok to provide international banking facilities. This included the mobilisation of funds from abroad for re-lending to Thailand or Indo-Chinese countries. The second and third stages were more evolutionary, including the development of the funding centre into a restricted financial centre, providing a range of specialisation of services, and then further developing it into a full-service centre.

Constraints

There remain constraints in the country's financial system development plans which have also influenced payment system reform. For example, Tivakul and Svetarundra (1993) highlight three main problems. Firstly, the Thai financial industry has long been dominated by a high concentration of commercial banks. The five largest commercial banks in the country play a key role, accounting for more than 60% of the banking industry's market share alone. Secondly, there are infrastructure problems. This encompasses the need to enhance Thai financial institutions. And lastly, there are human resource constraints, particularly in relation to qualified professionals at the managerial level.

Such constraints also affect the provision of payment services. The lack of an efficient payment system infrastructure may be compared to the lack of an advanced, efficient, and safe transportation system. This infrastructure is needed to support the transmission of funds among financial institutions. Similarly, the extension of electronic payment services to the provinces depends on the volume of local business transactions that justify system development along with the capacity and efficiency of the country's telecommunications infrastructure to support them. Moreover, a need for qualified personnel also implies the need for professionals to be increasingly educated and trained in skills related to payment system development. This involves the acquiring, applying, and advancing of related payment technologies and knowledge. In addition, this innovation process involves the building and strengthening of capabilities.

Payment Systems Modernisation

An important part of the financial development plans was the modernisation of the Thai payment system, aimed to create an efficient financial infrastructure to support the growth of financial transactions (Watanagase, 1995). Thailand's payment system is highly cash-oriented. The ratio of public-held cash to the country's money supply is approximately 70%, reflecting a highly cash-dependent economy. Moreover, the main non-cash payment instrument is the cheque, accounting for nearly 90% of transactions under this category. This creates the problem of cheque float. The remaining 10% of non-cash transactions are spread among credit cards, debit cards, direct debit, and credit transfers payments (Bank of Thailand Quarterly Bulletins). Introducing electronic payment systems was aimed to reduce the country's cash dependency ratio. Like many developing countries, Thailand's payment system was characterised by labour-intensive operations. Such constraints on economic development prompted the central bank to devise a master plan for the payment system that includes three core systems which were largely influenced with IT.

Cheque clearing system

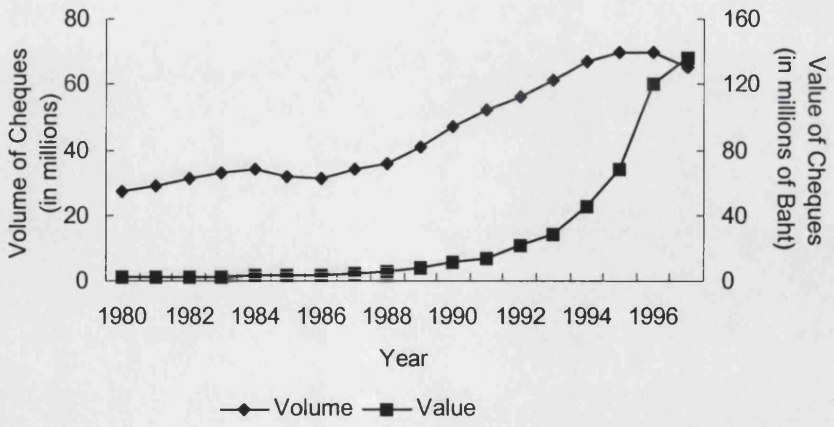
The Bangkok Clearinghouse, established in 1945, provided commercial banks with the convenience in cheque clearing. This service, however, was limited to a certain extent and posed several problems. First, its geographic coverage was limited. Cheque clearing was made available only to commercial banks operating in Bangkok and its environs, Thonburi. This implied that in the clearing of cheques across provinces, the branches of

commercial banks sent a cheque to its headquarters in Bangkok for verification and for further clearing at the Bangkok Clearinghouse.

Second, existing clearing routines delayed the availability of funds. This stems from the requirement that commercial banks needed to forward cheques, in physical form, to the clearinghouse to calculate its net debit or credit positions with other banks. As a result of this requirement, certain time restrictions were imposed. Customers presented cheques to banks by 10.00 a.m. in order to accommodate time for cheque delivery to the clearinghouse by 1.00 p.m. Thereafter, settlement of reserve accounts is effected at 3.30 p.m. on the same working day. Thus, funds are unavailable to a customer if a cheque is presented after 10.00 a.m. thereby losing interest earned on that sum accordingly.

Lastly, the system maintenance cost was very high. This includes the use of manual labour to collect, sort and deliver cheques that are very time-consuming. For example, the delivery of cheques by messengers from banks to the clearinghouse for settlement is subject to traffic that may be very unpredictable. The process was also error prone. For example, the use of unstandardised cheques was sometimes mishandled by a magnetic-ink character recognition machine and created system errors. The increase in the volume and value of cheques processed between 1980-96 is illustrated in Figure 3.4.

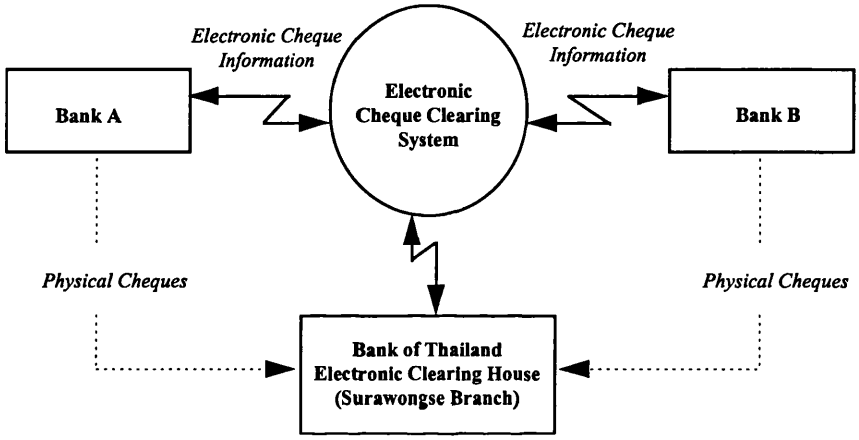
Figure 3. 4 Clearinghouse Transactions, 1980-1996



Source: Bank of Thailand Quarterly Bulletins, various issues

An Electronic Cheque Clearing System (ECS) was developed to resolve the problems. IT was used to improve three basic procedures. First, a cheque encoder reader captures information written on cheques. Second, the information is sent and received through telecommunications links between front-end processor machines located at both commercial banks and the central bank. Lastly, cheque information in original physical form is delivered and matched with their electronic versions for verification and settlement in the evening. Figure 3.5 illustrates this new procedure.

Figure 3.5 Context Diagram of ECS



The ECS has two advantages. First, new requirements created by the improved system extend the time restrictions imposed on bank customers presenting cheques. As a result, funds become available to bank customers the next working day, and moreover, they can also benefit from gaining interest on that sum. Second, labour-intensive procedures are replaced by IT, hence minimising costs and increasing productivity.

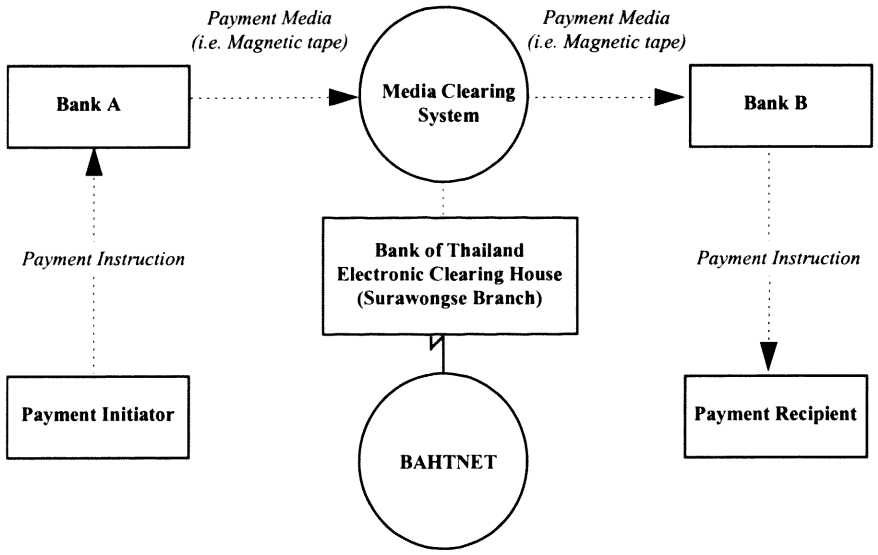
Small-value funds transfer system

A small-value funds transfer system is characterised by the exchange of financial transactions that are low in value but high in volume. Thai commercial banks have provided various small-value funds transfer or retail payment services. This mainly includes recurring payments, for example, debit transfers for utilities payment or credit transfers for employee salaries. Such payment practices have often been conducted on a bilateral basis, where the payment initiator and receiver maintained accounts at a common commercial bank. However, this posed the problem of decentralisation. Bank customers maintained multiple bank accounts to conduct payments with different utilities

companies holding different bank accounts. Moreover, the delivery of this information recorded on magnetic tape and transported through messengers was subject to traffic congestion. The overall impact is increased inefficiency in the payment system.

A more centralised approach was introduced. The provision of a Media Clearing System, which utilised existing facilities of the Electronic Clearinghouse, facilitated the transfer of retail payments. This procedure included the preparation of customers' recurring payment information on magnetic disk by commercial banks and is conducted off-line. Thereafter, the payment medium is delivered to the Electronic Clearing House for further sorting and settlement. Figure 3.6 illustrates this new procedure.

Figure 3.6 Context Diagram of Media Clearing System



The Media Clearing System provides one key improvement. As the payment media is received by the system, EFT settles the net debit or credit positions of each commercial bank in the payment system. This is connected to a large-value fund transfer system created by the central bank called the Bank of Thailand Automated High-Value Transfer Network (BAHTNET).

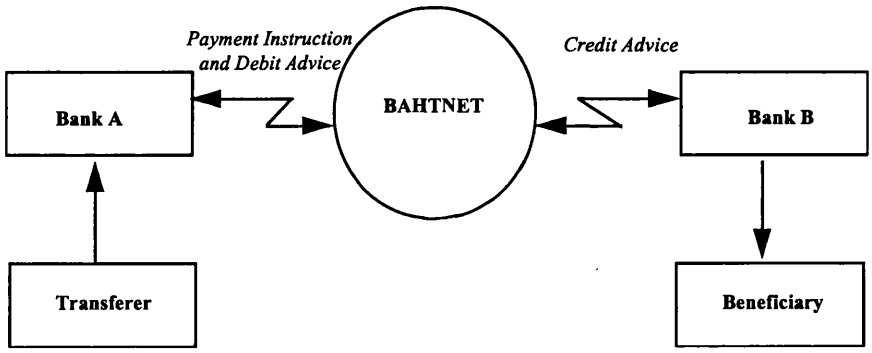
Large-value funds transfer system

A large-value funds transfer system is characterised by the exchange of financial transactions that are high in value but low in volume. Transactions originating from inter-bank loans and among business entities are in this category. Prior to the use of IT to facilitate the transfer of funds, these transactions were conducted by the use of cheques,

being delivered to the ECS or deposited with the central bank. Disregarding the payment method, this was subject to payment risks. When one bank faced liquidity risks, it may fail to fulfil financial obligations to another bank consequently leading to the spread of systemic risk in the payment system.

BAHTNET, a large-value funds transfer system, was developed. The range of services that was provided was beyond its main function of electronic interbank funds transfer originating from interbank loans and foreign exchange transactions. This also covered third-party funds transfer, account inquiry, bilateral communication, and message broadcasting. Figure 3.7 illustrates BAHTNET procedures.

Figure 3.7 Context Diagram of BAHTNET



BAHTNET provides convenience to both commercial banks and other payment participants. EFT carries out the payment instructions through computer terminals and telecommunication lines located at the payment initiator and recipient's premises. This reduced the use of cheques. Moreover, this involves a real-time gross settlement (RTGS), reducing the possibility of liquidity and systemic risks accordingly.

The introduction of RTGS in BAHTNET provides a test case for leapfrogging. This is partly because Thailand has been one of the few countries among the developing countries to adopt an advanced approach to reducing risks in wholesale payments systems. As of 1996, RTGS has been in operation in the G-10 countries, with the exception of Canada, and in other countries such as the Czech Republic, Hong Kong, and Korea. Furthermore, there are planned adoption of RTGS in Australia, China, New

Zealand, Saudi Arabia, and finally, in the European Union member states which is in support of stage three of economic and monetary union (BIS, 1997).

Performances

The early performances of the payment systems were relatively satisfactory. This is based on the central bank's payment statistics available for the initial operational periods. The comparison of the three systems is difficult, as their launch dates are different and very recent. Therefore, their performances are based on broad indicators that are available at the time of publication. This may be based on either a yearly, quarterly or monthly basis.

The ECS started operation in mid-1996. The volume of received cheques processed by the system was relatively stable, being approximately 17 million cheques for each quarterly period during 1996. Since the launch of ECS in July 1996, there has been a relative decline in the number of returned and default cheques. The percentage of returned cheques to received cheques was reduced from 47% during the fourth quarter of 1996 to 40% and 33% for the first two months of 1997. Comparatively, the percentage of default cheques to received cheques was reduced from 25% during the fourth quarter of 1996 to 22% and 17% for the first two months of 1997 respectively (Bank of Thailand). In late-1997, the ECS comprised of 72 member companies, including both banks and finance firms. The original total membership of 90 was slightly changed after the mid-1997 financial crisis, excluding 26 failed finance firms and including 8 new foreign banks that have been upgraded into full-branch status.[31]

The Media Clearing System started operation in early 1997. The volume and value of transactions processed by the system are unavailable at the time of publication. One broad indicator, however, is the number and value of transactions of credit cards. There was a two-fold increase in the number of credit cards, from approximately 900,000 to 1.8 million cards between 1991-1995. Comparatively, there was a two-fold increase in the value of transactions, from approximately 54 million to 1 billion Baht during the same period (Bank of Thailand).

[31] See "ECS to get 8 new bank customers" (*The Nation* 11 December 1997)

BAHTNET began operation in mid-1995. Since the systems' launch date, the number of participants has increased approximately three-fold, from 33 to 102 members between 1995-1997. The volume of transactions has increased approximately ten-fold, as compared by the number of funds transfer and third party funds transfer transactions processed by the system that is approximately 8,000 and 80,000 transactions between the months of May-December in 1995-1996 (Bank of Thailand).

Summary

This section discussed the role of banking and payment systems reforms. Thailand's two three-year financial development plans responded to the liberalisation of international financial markets. This included a range of reforms in the financial system, particularly the modernisation of the national payment system. Three major payment systems were developed, including the cheque clearing system, the small-value funds transfer system, and the large-value funds transfer system. The contribution of these systems towards increasing competitiveness in the country's financial system, however, partly depends on the historical conditions, constraints, and capabilities which have shaped the financial system. These conditions are discussed in the following chapter.

3.4 DISCUSSION

This section discusses the role of modernised payment systems as a source of competitive advantage for a country's financial system and institutions. The analytical framework, which was introduced in the previous chapter, will be used to guide the discussion. This mainly examines how the rate of resource replication, in the process of payment systems modernisation, was influenced by the role of historical conditions in the country's financial and banking systems.

RTGS Replication

Thailand has become one of the earliest adopters of an RTGS system in the world. The adoption of this advanced real-time gross settlement system, mainly for wholesale funds transfers, has positioned the country's payment system among the leading financial infrastructures internationally. As of 1996, Thailand was among the world's 14 countries which operated RTGS. In order to discuss this achievement, the replication of the system should be put into perspective.

RTGS may be conceptualised as a physical payment system. This makes the system a physical IT resource which includes computer hardware, software, and telecommunications equipment. Apart from adding value by increasing efficiency in the clearing and settlement of financial transactions, RTGS also reduces the associated liquidity and systemic risks among payment participants. In this respect, RTGS may be seen as a source of competitive advantage for nations. This is particularly the case for countries which aim to establish themselves as an international or regional financial centre. The implementation or improvement of existing national information infrastructures has therefore become an increasingly important issue, and this has particularly included the modernisation of payment systems which facilitate the transfer of funds in an economy.

RTGS, however, may not provide a sustained source of competitive advantage. This type of physical payment system does not share the characteristics of being either heterogeneous or immobile which limit the rate of resource replication. On the contrary, RTGS may be imitated by central banks which have the capabilities to implement the system, as suggested by their planned adoption in several other countries (BIS, 1997).

This imitation may also be explained through the rate of resource replication. Theoretically, the rate of resource replication is relatively high, provided that they are in physical form. The imitation of these resources may be through the purchase of available computer hardware and software in the domestic or international markets, or the contracting of consulting companies to develop such types of payment systems. Conversely, the rate of resource replication is relatively low, provided it is related to organisational and human factors.

These latter types of resources provide a degree of differentiation which may not be readily available or acquired in the market. They may include organisational capabilities and characteristics that are unique to the central bank or commercial banks. Most importantly, they may include the distinct managerial and technical IT skills possessed by staff which have been identified as a source of sustained competitive advantage (Mata *et al.*, 1995). Such issues are addressed in the following chapters.

The Role of History

The discussion of unique historical conditions, which shaped the country's banking and financial systems, may also help identify the source of competitive advantage. This historical view helps outline some of the significant developments which contributed to or constrained the adoption of RTGS in the mid-1990s. In order to put this into perspective, we discuss three significant developments experienced by the country since the early nineteenth century.

The first development was the acquisition of technologies from foreign sources. This included the acquisition of technological capabilities to manufacture coins and print paper currency. In the mid-1800s, Thailand purchased the country's first modern coin-minting machine from a British-based company called Taylor & Challen Limited. This decision was very important, as the production of older types of coins, called Pot Duang, were inadequate to cope with increased international trading activities. The machine was installed within the compounds of the Grand Palace and was a major technological innovation used in the newly established Royal Mint. Similarly, the country's Royal Financial Office contracted a German-based company, called Gieseche & Devrient, to print paper currency in the late-1800s. The reorganisation of the Royal Financial Office was followed with the establishment of the Thai Notes Department which resumed the issuance of paper currency.

The import of technological innovations, however, was not a potential source of competitive advantage. For example, the purchase of coin-making machines may be readily acquired by other countries in the international market, suggesting that the rate of replicating these modern machines is relatively high. To identify Thailand's source of competitive advantage during this period, we need to examine the organisational and human resources.

Leadership skill was a source of competitive advantage. For example, the politics behind the importation of the coin-minting machine in the mid-1800s included the personal involvement of the monarchies of Great Britain and Thailand. This was particularly the result of a request from King Rama IV of Thailand to Queen Victoria of England. The two countries also benefited from trade in the region and their governments

maintained close diplomatic relations during this period, as suggested from the appointment of a British envoy and financial advisor to Thailand.

Most importantly, Thailand was never colonised by a foreign country, as compared to her regional counterparts. This unique historical condition partly contributed towards the country's early attempts to develop indigenous capabilities, as compared to relying fully on foreign influences. For example, the establishment of a Royal Mint and the Thai Notes Department during this period may be seen as the adaptation of western ways of working which helped formed an institutional framework that guided future developments in payment systems modernisation.

The second development was the acquisition of commercial banking skills. During the late-1800s, the establishment of foreign commercial banks in the country, which were mainly British, provided the opportunity for Thai people to acquire professional training in banking practices and operations. This early learning process would later play an important part in the establishment of local commercial banks during the Japanese occupation of Thailand during World War Two.

During the mid-1900s, all foreign commercial banks, with the exception of Japanese banks, were ordered by the Japanese government to cease operations in the country. This unique historical condition provided the opportunity for Thai people to establish their own commercial banks which was partly attributed to the professional training and working experiences acquired from foreign commercial in the late-1800s. Under this economic situation, the formation of local commercial banks did not face competitive pressure from their foreign counterparts. Two of these commercial banks are examined as mini case studies in Chapter 5.

Commercial banks were also expanding through branch banking. They increasingly established bank branches within the capital and in the provincial areas. This was particularly important in the latter case, as they reflected the commercial banks response to the government's policy of distributing income into the outer regions of the nation. As a result, inter-provincial banking provided commercial banks the opportunity to experiment with technological innovations such as the radiophone and telegraphic transfers in the movement of funds.

The role of branch banking was a source of competitive advantage to commercial banks. This established existing banking networks which were necessary in the delivery of financial products and services to customers located in different geographical areas of the country. Moreover, this nation-wide network would also form the basic infrastructure which extended the capabilities in delivering electronic banking and payment services. Such developments are discussed in Chapters 4 and 5.

The third development was the establishment of the country's central bank. The historical conditions were in Thailand's favour, as suggested from events which preceded the establishment of the country's central bank. During World War Two, Thailand declined the demand from Japan to establish a monetary authority which was to be staffed by Japanese officials. The implications were clear, as Thailand would have lost its control in the conduct of the country's monetary policy, and more importantly, its economic policies.

This demanding situation led to the establishment of the central bank in 1942. Prior to this major development, the National Banking Bureau, which was formed in the earlier years, provided Thailand some experiences on the roles and responsibilities of a monetary authority. More importantly, the National Banking Bureau provided the earliest clearinghouse services in the settlement of accounts between commercial banks in Thailand. This was to form the foundation for payment systems modernisation in the future, for example in the establishment of the Bangkok Clearinghouse in 1945.

The set-up of the country's central bank was a source of competitive advantage during this period. The historical conditions demanded the country to create a central bank. Otherwise, it would have lost its independence in planning economic and monetary policies to foreign control. Thus, the management of the central bank by Thai officials ensured that appropriate regulations and laws are enforced to protect the nation's interest. This situation further demanded the central bank to build and strengthen its own organisational and human resource capabilities which contributed towards its reputation as an elite national institution. Such developments are discussed in Chapter 6.

In sum, these three major historical conditions played a central role in shaping the modernisation of the country's payment system. However, they are not all sources of

sustained competitive advantage. Although Thailand may have benefited from the acquisition of such early technological and managerial capabilities, the country remains to face fundamental constraints, particularly in the concentration of assets among commercial banks, the inadequate nature of national infrastructures, and the shortage of managerial skills (Tivakul and Svetarundra, 1993).

Summary

The aim of this chapter was to illustrate the role of payment systems modernisation in financial sector development. The adoption of an advanced large-value funds transfer system in a developing country like Thailand illustrated that the rate of resource replication was relatively high for physical IT resources. The sources of innovation, which contribute towards the gaining of competitive advantage, were examined in the context of historical conditions which shaped the financial and banking systems. This included the early acquisition of innovations from foreign sources, the acquisition of professional training in banking practice and skills from foreign banks, and the establishment of the central bank. Such historical conditions provide the context for analysing the commercial banking industry which is discussed in the following chapter.

CHAPTER 4: THE BANKING INDUSTRY

This chapter examines innovation in the commercial banking industry. The survey results summarise the broad-level indicators of innovation and are organised into four main sections. Section 4.1 provides an overview of IT introduction and usage in the commercial banking industry. Section 4.2 discusses the level of automation among the selected types of payment routines. Section 4.3 examines the major sources of commercial bank capabilities contributing to, or constraining, innovation. And lastly, section 4.4 interprets the survey results and discusses their implications.

4.1 BACKGROUND

This section provides an overview of IT introduction and usage in the commercial banking industry. Thai commercial banks have experienced a wide range of technological changes in face of financial liberalisation. This has included the introduction of organisational changes through re-engineering programs, the application of IT into current working processes, and the increased importance given to skilled staff in financial service development. Such changes, particularly in bank re-engineering, have received an impetus as a result of the country's financial crisis in 1997.[32] For example, government-owned banks and commercial banks alike have experienced such changes.

In the case of government-owned banks, this has included the Government Savings Bank and the Government Housing Bank. In 1996, the Government Savings Bank, under a new managerial leadership, introduced organisational changes which included the decentralisation of executive decision making powers to branch managers. Counter services were improved through the installation of on-line computers among all branches, and a credit scoring system was adapted from Bangkok Bank.[33] In addition, the bank developed its financial IS, upgrading them to international standards.[34]

In 1997, the Government Housing Bank installed its first ATM as part of its expansion strategy into electronic banking. The bank contracted T.N Nixdorf Computer to provide 20 machines in 1997 and 52 machines by 2001. Moreover, it applied for

[32] See "Can Thai banks re-engineer out of trouble" (*The Asian Banker Journal*, 1997, 3 (3), pp. 10-11).
[33] See "Fresh ideas for a state bank" (*Bangkok Post*, 22 March 1997).
[34] See *Money and Banking*, February 1996, p. 211.

network membership in the TBA, permitting the bank's 800,000 customers to gain access to over 3,500 ATMs located nation-wide.[35] In 1997, the two government banks were also approached by TN-Nixdorf Computer to install 'elecTRA' terminals which was aimed to provide non-cash transactions services to customers through the Internet.[36]

In the case of commercial banks, technical changes have influenced large, mid-sized, and small-sized banks alike. Such changes experienced by the two latter groups are discussed in this chapter, while changes experienced by the large banks are examined in Chapter 5. Three major changes may be observed among the mid-sized and small-sized commercial banks.

The first major change was in bank reengineering. Mid-sized and small-sized banks introduced reengineering programs, aimed at improving organisational structures and banking operations. One of the main strategies, in contrast to the large banks, has been the identification of market niches in the industry, and the strengthening of capabilities to serve customers in specific areas. This has often involved the focusing of firm resources in a particular area of expertise. The Union Bank of Bangkok, for example, has mainly focused resources on retail banking to compete with larger banks. This was supported with newly developed on-line computer systems which provided fibre-optic and satellite connection between the commercial bank's head office and branches.[37] Moreover, the bank established benchmarks for its working processes. For example, the average time to process a customer ATM card application was set at approximately 10 minutes, while the withdrawal or deposit of cash was below 3 minutes.[38] Alternatively, other commercial banks like Nakornthon Bank identified the firm's expertise in corporate banking, import-export, risk management, and technology acquisition. Elsewhere, Siam City Bank focused on a two-prong organisational strategy in both wholesale and retail banking services.[39]

The second major change was in the acquisition and strengthening of skilled staff. This development was part of organisational restructuring programs aimed to professionalise banking operations. Family-owned banks, for example the Bank of Asia

[35] See "GHB introduces 10 ATMs in Bangkok" (*Bangkok Post* 11 September 1997).
[36] See "Banks to get smarter with TN-Nixdorf" (*The Nation* 12 February 1997).
[37] See *Money and Banking*, August 1997, pp. 205-6.
[38] See "From family tiffs to big, bold strategies" (*Bangkok Post* 3 March 1997).
[39] See "Skill is the trick on the level playing field" (*Bangkok Post* 3 March 1997).

and the Bangkok Metropolitan Bank, appointed professional bankers from both the central bank and other commercial banks to key managerial positions. Elsewhere, in 1997, the Bank of Asia appointed a former central bank governor as chairman of the bank. This development also included the appointment of another former central bank assistant governor who overlooked the commercial bank's internal auditing.[40] Such recruitment strategies sought to acquire professional banking skills, particularly from former central bank officials, to strengthen the managerial capabilities of the bank.

Similarly, the Bangkok Metropolitan Bank also acquired banking expertise. The bank adopted an 'open door' policy by appointing external experts to manage the organisation which was largely owned by the Techapaibul family, as of 1997. In 1993, the bank appointed a former executive vice-president of the state-owned Krung Thai Bank as managing director which was almost equivalent to the president's position. Moreover, it appointed a former president of the Thai Military Bank as executive chairman.

However, the bank failed to retain former senior-level bank executives. Prior to the aforementioned appointments, the bank acquired banking experts, including a former central bank deputy governor and a former Government Savings Bank director general. Nevertheless, many senior-level executives left partly because the appointees experienced a lack of clear management roles and responsibilities which were controlled by family members of the bank.[41]

Such recruitment strategies have partly helped banks adopt professional banking standards. The training of staff was also important. This included the introduction of new banking policies which preferred the training or retraining of current employees, as compared to the recruitment of new personnel. One of the main reasons is due to the monitoring of management costs introduced through the reengineering programs.

The third major change was increased investments in IT. This was partly influenced by reengineering programs. Technological developments within several mid-sized and small-sized commercial banks help illustrate such multi-million Baht IT investment

[40] See "Wide restructuring aimed at top quality" (*Bangkok Post* 24 January 1997).
[41] See "BMB looks to professionals" (*Bangkok Post* 26 February 1997).

plans and projects. In 1997, Siam City Bank announced technological improvement plans, costing approximately 400 million Baht.[42] This budget covered the improvement of computer network standards, the introduction of a Business Process Improvement project, the implementation of a customer IS, the upgrading of software to support twenty-four hours ATM services, and the modification of an EXIMBILL system to support international trading activities. Moreover, the plans included an investment of approximately 110 million Baht on computer software upgrades for the bank's accounting system.[43] The new computer system, called Oracle G/L, was adopted from the Union Bank of Switzerland and included capabilities such as the transmission of financial reports to the SET and the integration of internal management communication systems.

The Bank of Asia also introduced a five-year reengineering program, costing approximately 600-700 million Baht which included the upgrading of current computer software and systems in support of retail and information services.[44] This resulted in the bank reducing the recruitment of new employees and instead emphasised the training of current staff. Since early 1996, the bank reduced its staff from 2,800 to 2,570 employees, emphasising the recruitment of new personnel with strong skills in marketing and IT.

Nakornthon Bank invested approximately 300 million Baht, since the early 1990s, as part of its technological improvement program.[45] The bank's strength in technology acquisition, as mentioned earlier, influenced its ability to compete with larger financial institutions in niche markets. Moreover, the bank has gradually acquired modern technology and expertise through foreign joint venture partnerships.

Bangkok Bank of Commerce also prepared an IT investment budget of approximately 200 million Baht, as of early 1998.[46] One of the major objectives was to change existing computer and communications infrastructures among the bank's branches from a decentralised UNIX-based to a centralised client-server-based system. Part of the budget, of approximately 46 million Baht, was set aside for implementing a Branch Automation System which aims to collect and analyse information from bank

[42] See *Money and Banking*, June 1997, pp. 199-201.
[43] See "Siam City Bank upgrades software" (*Bangkok Post* 30 August 1997).
[44] See "Bank of Asia sets sights on upturn" (*Bangkok Post* 14 April 1997).
[45] See "Skill is the trick on the level playing field" (*Bangkok Post* 3 March 1997).
[46] See "BBC in 46m baht deal for branch automation" (*Bangkok Post* 1 April 1998).

branches more effectively. Moreover, the bank planned to develop a customer IS and financial IS which seek to contribute towards the development of telephone banking, office banking, and Internet-based banking services.

Bangkok Metropolitan Bank invested approximately 188 million Baht in branch automation.[47] This includes the installation of 7-8 personal computers in the front and back offices of branches which are connected to a BMB communications network. This network includes direct computer connections between metropolitan-based branches and the bank's head office, as compared to satellite connection between provincial branches and the head office. The bank also enhanced existing ATM systems to support credit card transactions originating from international credit card companies such as Master Card, and has developed EFTPOS with other third parties. In addition to ATM developments, the bank planned, as of 1997, to introduce innovative financial services such as advanced loan systems, telephone banking, and Internet-based banking services.

Laem Thong Bank, which is the smallest commercial bank in terms of network and customer base, partnered with a local telecommunications company to provide electronic banking services.[48] This partnership strengthened the commercial bank's technological base in providing a competitive range of retail banking services. For example, this includes the planned introduction and adaptation of existing telecommunications infrastructure to provide new delivery channels for payment services through the Internet, call centres, satellites, electronic information kiosks, or even services delivered through a network of convenience shops.[49] In the last type of delivery channel for payment services, this included installation plans of 2,000 ATMs nation-wide, covering 240 convenience shops owned by the United Communications Industry, and 1,500 service stations owned by the national petroleum organisation.[50]

The previous illustrations help highlight one significant development in the commercial banking industry. Banks within the medium and small-sized categories have

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[47] See *Money and Banking*, January 1997, p. 221.

[48] See "Ucom set to drag local banking out of Ice Age and into IT Age" (*Bangkok Post* 19 September 1997). In 1997, the bank increased its capital at 2.9 billion baht. Part of the new shares was acquired by United Communication Industry (20 million shares), Multimedia and Services Company (15 million shares) and Total Access Communications (15 million shares). The latter two firms are subsidiaries of United Communication Industry (UCOM).

[49] See "MMS to help upgrade bank's electronic service" (*Bangkok Post* 10 March 1997).

[50] See "Slow and steady wins the race" (*Bangkok Post* 11 December 1997).

adopted IT to increase efficiency and to provide innovative financial products and services. Although their size is small in terms of assets or branch networks, they are using IT as a base to gain competitive advantage, particularly in the provision of payment services. One main question may be the origins of such technologies, and how they are transferred and replicated among the banks.

One main source of technology is from computer and consulting companies. Such companies, which are mainly foreign-based, develop and distribute new technologies though their local joint venture firms or subsidiaries. For example, in 1997, General Asia Bank adopted a customer servicing software called Alliant from Fiserv, a foreign financial software house. The computer system, which is part of a 800 million Baht five-year IT investment plan, was adapted from similar installations in Birminghams Midshire Building Society and Prudential Bank based in the United Kingdom.[51] International computer companies, for example Hewlett Packard, also partnered with local systems integration firms to promote and provide data warehousing services to commercial banks.[52] Moreover, it developed Internet-based banking software for local commercial banks which was distributed through its local subsidiary, Security First Technologies.[53]

The introduction of smart card technology by international card-issuing organisations into Asia also illustrates this point.[54] This includes, for example, the marketing and development of the Mondex smart card program by a joint-venture partnership in Asia between Master Card International and the Hong Kong and Shanghai Banking Corporation.[55] Such a joint-venture agreement marks a strong strategic partnership between the marketing and technological expertise offered by each firm.

This overview provides the background to the survey which sought to identify how banks acquired, adapted, and advanced technologies to provide innovative payment services. The types of payment systems, as categorised in Chapter 3, were grouped into small-value and large-value funds transfer systems. This is further discussed in Section 4.2. To provide a general overview of technologies used in the banking industry, IT

[51] See "General Asia adopts 'Alliant' technology" (*The Nation* 28 March 1997).
[52] See "H-P urges banks to adopt data warehousing" (*The Nation* 4 March 1997).
[53] See "Cyber-cash management deal signed" (*The Nation* 1 August 1997).
[54] See *Asian Banker*, May 1996, p. 5.
[55] See "New off-line smart cards coming soon to Thailand" (*The Nation* 21 November 1997).

usage and awareness levels are listed in Table 4.1. These technologies and systems were selected to identify and assess new delivery channels for providing payment services by the banks as of 1997.

Table 4. 1 IT Usage and Awareness in the Commercial Banking Industry

Technology/Application	Using Respondents	(%)	Plan to Use Respondents	(%)	Aware Respondents	(%)	Unaware Respondents	(%)
Image processing	11	55	7	35	2	10	-	0
Optical filing	8	40	6	30	4	20	2	10
Encryption	19	95	-	0	1	5	-	0
Smart cards	3	15	10	50	7	35	-	0
Electronic data interchange	6	30	4	20	10	50	-	0
Fault tolerant technology	11	55	3	15	5	25	1	5
VSAT technology	16	80	1	5	2	10	1	5
Object oriented technology	10	50	6	30	4	20	-	0
Telephone banking	15	75	5	25	-	0	-	0
Home banking	4	20	12	60	4	20	-	0
Electronic banking	14	70	6	30	-	0	-	0
Internet banking	3	15	10	50	7	35	-	0
Video banking	6	30	7	35	7	35	-	0
Average		**48**		**30**		**20**		**2**

Source: Survey questionnaire

The survey results suggest wide usage of key technologies in the commercial banking industry. The aggregate results indicate that 48% of the banks used the technologies and applications, 30% have planned to use them, 20% were aware and a minor 2% were unaware. The results also suggest progressive IT plans among the banks in introducing new types of technologies, for example home banking (60%), smart card systems (50%), and Internet-based banking (50%).

The results also indicate the slow adoption of major technologies. The adoption of EDI provides one illustration. Although EDI services have been available in Thailand since the early 1990s, there remain unresolved problems that are beyond the scope of banks. First, the government was slow to establish a national EDI service provider. Although an EDI feasibility study for international trade was commissioned in 1993 and completed in the following year, the final decision to establish a national EDI service provider, named TradeSiam, was not reached until 1997. Furthermore, international value added network service providers like IBM, which operated similar services, perceived the government's set-up of a national EDI service provider as the monopolising of such services in the country. The government's slow stance towards the establishment of this service provider and the criticisms made by similar service providers both played a part in inhibiting the early adoption of EDI in Thailand.

Similarly, the banks experienced slow EDI adoption due to such unclear developments between the public and private sectors.

Second, business enterprises have remained reluctant on EDI benefits. Several banks have started to provide EDI services as illustrated in Table 4.1. Such services take the form of financial EDI, involving the exchange of payment details between the IS of different trading partners. However, very few companies have used this service which is partly due to the speed of technological changes outpacing legal changes in the country.[56] On a much broader perspective, this is a common problem faced by commercial banks in the European Community and the European Free Trade Association countries in adopting financial EDI (ANA, 1993).

Summary

This section provided an overview of recent technological developments in the commercial banking industry. Three major changes were discussed, including the introduction of wide-ranging reengineering programs, the acquisition of managerial capabilities, and increased investments in IT. The survey results suggest relatively high IT usage and awareness levels among the commercial banks, although there may a slow adoption of advanced applications, particularly EDI. Such multi-million Baht investment plans and projects particularly include payment services development which is discussed in the following section.

[56] See "Going on-line for efficiency" (*Bangkok Post* 24 April 1997).

4.2 LEVEL OF PAYMENT AUTOMATION

This section summarises the survey results which identified the level of payment system automation among the commercial banks. These systems were selected to examine their level of preparedness in relation to the development of three major payment systems by the central bank which include wholesale and retail EFT systems. The characteristics of commercial bank payment routines were assessed based on the level of computerisation, the sources of computer software, and the make or buy origins of the computer software accordingly.

The introductory dates of commercial bank payment services are indicated in Table 4.2. Payment services have become an alternative area for commercial bank sources of fees-based income, particularly in the form of transaction cost incurred by parties transferring funds between financial institutions, business enterprises, government agencies, and individuals. This includes, for example, the charging of high transaction fees for high-value but low-volume financial transactions and vice versa.

Table 4. 2 Dates of Bank Establishment and Payment Service Introduction

(1) Cashing cheques
(2) Salary payment
(3) Dividend payment
(4) Utilities payment
(5) Interbank funds transfer
(6) Third party funds transfer
(7) International payment
(8) Securities (bond) payment
(9) Securities (stock) payment
(10) Managing foreign exchange

Bank	Birth	1	2	3	4	5	6	7	8	9	10
B1	1944	1973	1979	1986	1982	1996	1984	1979	1989	1989	1994
B2	1945	1984	1984	1984	1984	1990	1992	1995	ND	ND	ND
B3	1966	1966	1984	1990	1992	1996	1996	1984	1990	1990	1994
B4	1906	1982	1988	1994	1992	1983	1995	1983		1994	1991
B5	1957		1987	1987	1988	1995	1997				
B6	1934		1996		1990	1997	1996	1990			
B7	1950	1985	1990	1997	1990	1996	1996			1997	1997
B8	1949	ND	1992		1992	1996	1996	1988			1988
B9	1944	1990	1991		1990	1995					1990
B10	1941	1988	1991	1991	1991	1996	ND	1994	1996	1996	1995
B11	1949	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B12	1945	1987	1987	1990	1990	1996	1994	1987	ND	ND	ND
B13	1933	ND	ND		1990	1995	1995				
B14	1939	1996	1993	1997	1993	1996		1993			1994
B15	1948	1996	1996		1993	1997		1986			1994

Source: Survey questionnaire. Notes: ND - Service offered but no dates provided

Thai banks gradually improved their payment processes. In the early periods of introduction, payment services were primarily paper-based and involved manual processing and handling. Since the first introduction of computers for the batch processing of customer data in the early 1970s, Thai banks gradually applied IT to automate other banking functions. This has been particularly important in the automation of routines in payment services.

Payment Routines

The role of routines in innovation was introduced in Chapter 2. Routines were defined as sources of skills, which when changed, contribute to innovation (Nelson and Winter, 1982). The scope of routines in our study is focused on payment processes. The payment routines in Table 4.2 can be grouped into retail and wholesale systems accordingly. Retail payment routines are characterised by recurring high-volume but low-value financial transactions. For example, this primarily includes the processing of personal cheques, salary payment, dividend payment, utility payment, and third party funds transfer.

Alternatively, wholesale payment routines are characterised by low-volume but high-value financial transactions. This primarily includes, for example, the processing of high-valued cheques between businesses, the transfer of funds between financial institutions, international payment, securities payment, and the settlement of foreign exchange transactions. Moreover, this may also involve the transfer of large amount of funds between governmental bodies in the financial system.

This classification, however, is not exclusive. The transaction volumes and values of some payment services vary, for example in third party funds transfer systems, and may be represented in both groups. One of the main objectives of the survey was to identify the sources of innovation in ten types of payment routines. The mode of payment routines operated by Thai banks, as of 1997, is illustrated in Table 4.3. Three modes are identified, namely manual, partly computerised, and fully computerised payment routines.

Table 4. 3 Mode of Payment Routines

Payment Routine	Manually No. of Banks	(%)	Partly Computerised No. of Banks	(%)	Fully Computerised No. of Banks	(%)
Cashing checks (n=14)	2	14	3	21	9	64
Salary payment (n=15)	-	0	3	20	12	80
Dividend payment (n=12)	2	17	4	33	6	50
Utilities payment (n=15)	-	0	5	33	10	67
Inter bank funds transfer (n=14)	1	7	4	29	9	64
Third party funds transfer (n=13)	1	8	5	38	7	54
International payment (n=11)	1	9	4	36	6	55
Securities (bonds) payment (n=9)	3	33	4	44	2	22
Securities (stocks) payment (n=9)	3	33	4	44	2	22
Managing foreign exchange (n=13)	1	7	8	62	4	31
Average		**13**		**36**		**51**

Source: Survey questionnaire

The aggregate results suggest a majority of payment routines were completely computerised (51%). This was particularly true for payment routines which involved the cashing of checks (64%), salary payment (80%), utilities payment (67%), inter bank funds transfer (64%), international payment (55%), and third party funds transfer (54%). The results also suggest the slow introduction of IT in other payment routines, such as in securities payment which have only started to be computerised by the banks and the central bank as of 1997.

The mode of payment routines was partly influenced by the central bank. In Chapter 6, we will discuss the role of the central bank in creating a modernised payment system. This includes the development of three main payment infrastructures, including an electronic cheque clearing system, a small-value payment system, and a large-value payment system. The central bank made the necessary preparations for commercial banks and other financial institutions to support the technological capabilities in the new payment system. For example, this included the setting of membership requirements and the provision of packaged computer software.

The survey results further suggest that the sources of commercial bank computer software were mainly custom-made. This is indicated in Table 4.4, and includes the development of payment systems tailored for individual requirements among a majority of the banks (52%), particularly in salaries payment (11%), utilities payment (11%), and foreign exchange management (8%). The results also indicated a majority of banks used packaged computer software, particularly in international

payments (80%), inter-bank funds transfer (50%), and third party funds transfer (50%). The sources of computer software packages originated from standardised SWIFT messaging systems in the first system and from the central bank in the latter two systems.

Table 4.4 Sources of Computer Software

Payment Routine	Packaged No. of Banks	(%)	Modified No. of Banks	(%)	Custom-made No. of Banks	(%)
Cashing checks (n=11)	3	27	4	36	4	36
Salary payment (n=15)	2	13	2	13	11	73
Dividend payment (n=10)	1	10	3	30	6	60
Utilities payment (n=15)	2	13	2	13	11	73
Inter bank funds transfer (n=14)	7	50	3	21	4	29
Third party funds transfer (n=12)	6	50	3	25	3	25
International payment (n=10)	8	80	1	10	1	10
Securities (bonds) payment (n=6)	2	33	-	0	4	67
Securities (stocks) payment (n=6)	-	0	1	17	5	83
Managing foreign exchange (n=12)	3	25	1	8	8	67
Average		**30**		**17**		**52**

Source: Survey questionnaire

The aggregate results also suggest that the banks have strong capabilities in developing payment systems. Table 4.5 indicates a majority of the banks have developed their computer software for payments in-house (66%), while a small number have purchased them (34%). Moreover, a large number of banks have relatively strong systems development capabilities, particularly in salaries payment (93%), dividends payment (80%), and utilities payment (86%).

Table 4. 5 Software Purchased or Developed?

Payment Routine	Purchased No. of Banks	(%)	Developed in-house No. of Banks	(%)
Cashing checks (n=9)	3	33	6	67
Salary payment (n=14)	1	7	13	93
Dividend payment (n=10)	2	20	8	80
Utilities payment (n=14)	2	14	12	86
Inter bank funds transfer (n=11)	8	73	3	27
Third party funds transfer (n=9)	6	67	3	33
International payment (n=6)	4	67	2	33
Securities (bonds) payment (n=5)	1	20	4	80
Securities (stocks) payment (n=6)	-	0	6	100
Managing foreign exchange (n=11)	4	36	7	64
Average		**34**		**66**

Source: Survey questionnaire

The survey results suggest relatively strong technological capabilities among the commercial banks. A majority of the payment systems developed were custom-made and developed in-house. This indicates commercial bank capabilities in the development of IS and the decreased dependence from external sources of computer software. The payment systems, however, have largely been systems for recurring payments, particularly for salaries and utilities payments. Such types of payment systems are less sophisticated, as compared to the development of securities settlement systems and international payment systems.

The central bank helped strengthen these technological capabilities. The development of three main payment systems contributed to the integration of commercial bank computer networks which were originally private or co-operative on-line systems. This reduced investment cost and enhanced the existing capabilities of present payment systems. For example, the development of BAHTNET permitted the transfer of funds between commercial banks or third parties without payment participants having to maintain multiple bank accounts.

Summary

This section summarised the survey results which examined the level of payment systems automation among the commercial banks. The survey results suggest that a majority of payment routines were fully computerised. Moreover, a majority of computer software supporting these systems was custom-made and developed in-house. At the aggregate level, these indicators suggest that the local commercial

banking industry have relatively strong capabilities in developing payment systems. These sources of capabilities are further identified in the following section.

4.3 SOURCE OF CAPABILITIES

This section summarises the survey results which identified the sources of capabilities in the commercial banking industry. Sources of capabilities may involve the transfer of technology through formal and informal channels. Formal channels may include the transfer of technology through direct foreign investment, wholly owned foreign subsidiaries, foreign controlled joint-ventures, on-the-job-training, and other related sources. This group can also include internal or external transfers. Internal transfers are characterised by, for example, the flow of knowledge from foreign investors and experts to a local work force within foreign subsidiaries or foreign controlled joint ventures. External transfers occur through the spread of technology from international commercial banks to their domestic counterparts.

Informal channels may include the transfer of technology through unpackaged mechanisms. This transfer of technology takes the form of published information, trade exhibitions, international conferences, technology contracts with foreign consultants, turnkey arrangements, and other related sources. The scope of technology involved in both formal and informal channels is non-deterministic and encompasses both tangible and intangible forms of technologies. These technology transfer channels form the sources for acquiring, building, and strengthening commercial bank capabilities.

Indicators of Innovation

The survey identified three broad-level indicators of innovation. The statistical averages helped determine the strengths and weaknesses within each category of questions. The first group of indicators was information which influenced new product and service development. This was categorised as sources originating from companies, customers, competitors, and other sources. For example, this included information acquired through the training and travel of bank staff in foreign countries and companies, local and foreign customers and competitors, related sources such as

bank overseas representative offices, and joint venture contracts with both local and foreign counterparts.

The second group of indicators was learning mechanisms. Four main mechanisms were identified, including private, foreign, governmental, and other sources. The main sources of innovation included commercial bank technical agreements and assistance, the working experiences of bank staff, the use of computer companies, and the contracting of consulting companies. The other important sources of technology included quasi-governmental institutions and associations like NECTEC, TBA, and SET.

The third group of indicators was technological capabilities. This included the identification of strengths and weaknesses in acquisitive, operative, adaptive, and innovative capabilities among the banks. These four levels of capabilities help determine the level of commercial bank capabilities in each category. For example, commercial banks have higher levels of technological capabilities, provided that they have relatively strong innovative capabilities which are characterised by their ability to conduct R&D and make major modifications with technology. To begin, the survey results for sources of bank information are illustrated in Table 4.6.

Table 4. 6 Sources of Information

Source of Information	Very Important Respondents	(%)	Important Respondents	(%)	Fairly Important Respondents	(%)	Not Very Important Respondents	(%)	Unimportant Respondents	(%)
Company Sources										
1. Your own staff	13	65	5	25	2	10	-	0	-	0
2. Your own staff arising from travel in foreign countries	1	5	10	50	7	35	-	0	2	10
3. Your own staff arising from training in foreign countries	2	10	11	55	7	35	-	0	-	0
4. Your own staff arising from training with foreign companies	1	5	10	50	9	45	-	0	-	0
5. Your own staff arising from training in Thailand	2	10	12	60	5	25	1	5	-	0
6. Your own staff based on foreign magazines, newspapers, etc.	1	5	6	30	9	45	3	15	1	5
7. Your computer staff	10	50	7	35	3	15	-	0	-	0
Average		**21**		**44**		**30**		**3**		**2**
Customer Sources										
8. Thai customers	18	90	-	0	2	10	-	0	-	0
9. Foreign customers with whom you have direct contacts	5	25	9	45	5	25	1	5	-	0
10. Foreign customers with whom you have no direct contacts	3	15	4	20	11	55	2	10	-	0
Average		**43**		**22**		**30**		**5**		**0**
Competitor Sources										
11. Observing Thai competitors	17	85	2	10	1	5	-	0	-	0
12. Observing foreign competitors	9	45	9	45	1	5	1	5	-	0
Average		**65**		**28**		**5**		**2**		**0**
Other Sources										
13. Your representatives or branch offices in foreign countries	5	25	5	25	6	30	4	20	-	0
14. Your foreign joint venture partner	2	10	9	45	7	35	2	10	-	0
15. Your domestic joint venture partner	1	5	11	55	6	30	1	5	1	5
Average		**13**		**42**		**32**		**12**		**1**

Source: Survey questionnaire

Sources of Information

The first group of innovation indicators was sources of information. A majority of banks ranked these sources positively which influenced new product and services development. The average percentages, as indicated in Table 4.6, were relatively high for each main category of information, namely competitor (65%), company (44%), customer (43%), and other sources (42%). The survey results also suggest that these sources were relatively important factors in creating capabilities and formed the basis for new financial services development. The strengths and weaknesses within each main category can be examined in their sub-categories.

The first source of information was from within the companies. In this category, the sources of information was the strongest from staff (65%), being mainly based on computer staff (50%). The strengthening of staff skills was strongly influenced by training in the country (60%), training in foreign countries (55%), travel in foreign countries (50%), and training with foreign companies (50%). The survey results also suggest that bank personnel contributed towards acquiring information for their organisations, whether they may be through training or travelling.

The second source of information was from customers. In this category, the source of information was strongest from Thai customers (90%). However, these sources were relatively important for foreign customers who were indirectly connected (55%) and directly related (45%). The survey results suggest the high consideration given by the banks to customers. In some banks, for example Siam Commercial Bank, this has led to customer-based business process management.

The third source of information was from competitors. In this category, the sources of information were strongest from the observation of Thai competitors (85%) and relatively strong from foreign competitors (45%). For example, Cash and Mookerjee (1990) studied how Thai Farmers Bank created competitiveness from a newly developed IS in response to its domestic competitor, Siam Commercial Bank, who was the first Thai commercial bank to introduce ATM systems in the country in the early 1980s.

The last source of information was from other sources. In this category, the sources of information were relatively important. The strong sources of information included local joint venture partners (55%) and foreign joint venture partners (45%). There are, however, some interesting developments. For example, Siam Commercial Bank benefited indirectly from its joint venture partnership with a semi-autonomous organisation called NSTDA. This helped promote the transfer of managerial and technological capabilities from foreign firms to local companies, including the commercial bank itself.

Sources of Learning

The second group of indicators was sources of learning. This included the acquisition of technical and managerial knowledge which influenced new products and services development. Such sources of 'know-how' form the basis of introducing innovative banking services and were grouped into four main categories. The first source of learning was from private sources in Thailand. This is illustrated in Table 4.7. In this category, the overall ranking for the sources of know-how was important (48%), and mainly included sources originating from technical assistance with local joint-venture partners (60%). The sources of learning from staff were equally important. This included technical staff whom have acquired working experiences in other companies (55%), and technical staff whom have accumulated working experiences from the company (50%).

The indicators were similar for managerial staff. This included managerial staff whom have acquired working experiences in other companies (55%), and managerial staff whom have accumulated working experiences from the company (55%). Other important sources included the acquisition of know-how from local suppliers of computer systems and software (55%), and to a lesser degree source of learning from local consulting firms (45%).

The survey results suggest the importance of skilled staff. Rankings in technical and managerial staff were relatively similar. First, the commercial banks have attracted skilled technical and managerial staff, for example from the central bank or other computer companies, although this may not be explicitly stated in their policies. And second, policies have promoted the improvement of staff skills through training centres, rather than increasing employment.

Table 4. 7 Private Sources of Learning

Sources of Learning	Very Important Respondents	(%)	Important Respondents	(%)	Fairly Important Respondents	(%)	Not Very Important Respondents	(%)	Unimportant Respondents	(%)
Private Thai Sources										
1. Licenses or technical agreements with Thai firms	5	25	6	30	6	30	3	15	-	0
2. Technical assistance from Thai parent company	1	5	9	45	8	40	-	0	2	10
3. Technical assistance from Thai joint venture partner	2	10	12	60	1	5	3	15	2	10
4. Technical staff who previously worked with other Thai firms	1	5	11	55	7	35	1	5	-	0
5. Managerial staff who previously worked with other Thai firms	1	5	11	55	7	35	1	5	-	0
6. Technical staff with experience primarily from working in your firm	5	25	10	50	4	20	1	5	-	0
7. Managerial staff with experience primarily from working in your firm	5	25	11	55	3	15	1	5	-	0
8. Thai suppliers of computer systems or software	4	20	11	55	4	20	1	5	-	0
9. Thai consulting firms	1	5	9	45	7	35	3	15	-	0
10. Thai customers	5	25	6	30	5	25	4	20	-	0
Average		**15**		**48**		**26**		**9**		**2**

Source: Survey questionnaire

The second source of learning was from foreign sources. This is illustrated in Table 4.8. In this category, the overall ranking for the sources of know-how was also important (50%), mainly including sources from foreign consulting firms (65%). The other main sources of learning were from technical assistance from foreign joint-venture firms (55%), technical and managerial staff whom have working experience with foreign firms (55% respectively), and lastly, foreign suppliers of computer systems and software (50%).

The survey results suggest the reliance on foreign sources of technology. For example, commercial banks have entered into co-operative agreements with international credit card companies and foreign commercial banks to provide more innovative and competitive financial services. Moreover, commercial banks have hired foreign consulting firms to advise on the formulation of technology policies, strategies, and the re-engineering of banking operations.

Table 4. 8 Foreign Sources of Learning

Sources of Learning	Very Important Respondents	(%)	Important Respondents	(%)	Fairly Important Respondents	(%)	Not Very Important Respondents	(%)	Unimportant Respondents	(%)
Foreign Sources										
11. Licenses or technical agreements with foreign firms	6	30	7	35	5	25	2	10	-	0
12. Technical assistance from foreign joint-venture companies	3	15	11	55	4	20	-	0	2	10
13. Technical staff who previously worked with foreign firms	1	5	11	55	5	25	3	15	-	0
14. Managerial staff who previously worked with foreign firms	3	15	11	55	3	15	3	15	-	0
15. Foreign suppliers of computer systems or software	7	35	10	50	3	15	-	0	-	0
16. Foreign consulting firms	2	10	13	65	5	25	-	0	-	0
17. Foreign customers	1	5	7	35	8	40	4	20	-	0
Average		**16**		**50**		**24**		**9**		**1**

Source: Survey questionnaire

The third source of learning was from government sources. This is illustrated in Table 4.9. In this category, the overall ranking for the sources of know-how was not very important (29%). The weakest sources of knowledge were from staff with acquired working experiences from other government agencies (55%) and licenses or technical agreements with government firms (40%). Similarly, the sources of learning were also relatively important for technical assistance from key government ministries (40%), and government joint venture partners (40%).

Two government sources of know-how, however, were ranked as very important. This included the sources of know-how acquired from the Bank of Thailand (50%) and the Ministry of Finance (35%). Senior level officials from the Ministry of Finance and the central bank have played key roles in advising and sometimes managing Thai banks. The Bank of Thailand, in particular, has played a leading role in supporting Thai banks in the modernisation of the national payments system.

The survey results suggest the weak role of government as a source of know-how. Nevertheless, there was also an indication for a strong role to be played by both governmental and quasi-governmental institutions in IT innovation. For example, commercial bank non-cooperation in the development of a national payment system led the central bank to take a leading role in investing, developing, and managing a new electronics payment system. The central bank helped develop the necessary computer software systems and trained payment participants, including the major financial institutions accordingly.

Table 4. 9 Government Sources of Learning

Sources of Learning	Very Important Respondents	(%)	Important Respondents	(%)	Fairly Important Respondents	(%)	Not Very Important Respondents	(%)	Unimportant Respondents	(%)
Thai Government Sources										
18. Licenses or technical agreements with government firms	3	15	1	5	8	40	8	40	-	0
19. Technical assistance from government parent company	2	10	2	10	8	40	5	25	3	15
20. Technical assistance from government joint-venture partner	2	10	2	10	8	40	7	35	1	5
21. Technical staff who previously worked with other government agencies	1	5	4	20	3	15	11	55	1	5
22. Managerial staff who previously worked with other government agencies	2	10	3	15	7	35	7	35	1	5
23. Technical staff with experience primarily from working in your firm	3	15	9	45	5	25	3	15	-	0
24. Managerial staff with experience primarily from working in your firm	3	15	7	35	6	30	4	20	-	0
25. Government suppliers of computer systems or software	1	5	2	10	5	25	6	30	6	30
26. Government consulting firms	1	5	3	15	5	25	6	30	5	25
27. Government customers	6	30	3	15	1	5	7	35	3	15
28. Ministry of Finance	7	35	5	25	3	15	4	20	1	5
29. Bank of Thailand	10	50	6	30	2	10	2	10	-	0
Average		**17**		**20**		**25**		**29**		**9**

Source: Survey questionnaire

The last source of learning was from other sources. This is illustrated in Table 4.10. In this category, the overall ranking for the sources of know-how was important (40%). There are many other important sources of know-how in Thailand. This includes, for example, key quasi-governmental institutions and associations that have interest in the use of IT for payment system development. This mainly included the SET (45%), the TBA (40%), and to a lesser extent NECTEC (40%).

These institutions contribute towards innovation which may be on an explit or implicit basis. The SET, for example, developed and operated an automated securities system called ASSET. The TBA represents the interests of Thai commercial banks such as in the raising of ATM service fees to recover increased operational costs. NECTEC is a leading quasi-govermental institution which has helped promote the use of IT nationally, including applications in the financial services area. The important role of these institutions in a national system of innovation is discussed in Chapter 7.

Table 4. 10 Other Sources of Learning

Sources of Learning	Very Important Respondents	(%)	Important Respondents	(%)	Fairly Important Respondents	(%)	Not Very Important Respondents	(%)	Unimportant Respondents	(%)
Other Sources										
30. NECTEC	2	10	7	35	8	40	3	15	-	0
31. TBA	6	30	8	40	5	25	1	5	-	0
32. SET	2	10	9	45	5	25	4	20	-	0
Average		**17**		**40**		**30**		**13**		**0**

Source: Survey questionnaire.

Sources of Technological Capabilities

The third group of innovation indicators was sources of technological capabilities. The bases for building technological capabilities among the banks were discussed in the preceding sections. This included the identification of the strengths and weaknesses in the sources of information and the main sources of learning which contributed to new product and services development. The survey identified four main categories of commercial bank technological capabilities which are summarised in Table 4.11.

Table 4. 11 Sources of Technological Capability

Source of Technological Capability	Very Strong Respondents	(%)	Strong Respondents	(%)	Fairly Strong Respondents	(%)	Weak Respondents	(%)	Very Weak Respondents	(%)
Acquisitive Capability										
1. Searching technology for your bank	5	25	9	45	5	25	1	5	-	0
2. Negotiating technology for your bank	3	15	12	60	5	25	-	0	-	0
3. Procuring technology for your bank	3	15	10	50	7	35	-	0	-	0
4. Assessing technology for your bank	2	10	10	50	7	35	1	5	-	0
5. Installing technology for your bank	5	25	9	45	5	25	1	5	-	0
Average		**18**		**50**		**29**		**3**		**0**
Operative Capability										
6. Operation of technology in your bank	4	20	10	50	5	25	1	5	-	0
7. Control of technology in your bank	4	20	8	40	7	35	1	5	-	0
8. Maintenance of technology in your bank	5	25	9	45	4	20	2	10	-	0
Average		**22**		**45**		**27**		**6**		**0**
Adaptive Capability										
9. Understanding technology	4	20	10	50	5	25	1	5	-	0
10. Making minor modifications with technology	1	5	13	65	4	20	2	10	-	0
Average		**12**		**58**		**23**		**7**		**0**
Innovative Capability										
11. Making major modifications with technology	3	15	8	40	7	35	1	5	1	5
12. Conducting research and development	1	5	8	40	9	45	2	10	-	0
13. Inventing new products or services	3	15	7	35	8	40	1	5	1	5
Average		**12**		**38**		**40**		**7**		**3**

Source: Survey questionnaire

The first category was acquisitive capabilities. This indicated a commercial bank's ability to search, negotiate, and procure relevant technologies, in addition to being able to transfer, install, and assess their operational know-how accordingly. The acquisitive capabilities of the commercial banks were ranked as strong (50%), particularly in the negotiation for technology (60%) and the procurement and assessment of technology (50% respectively).

The second category was operative capabilities. This indicated a commercial bank's ability to operate, control, and maintain computer and telecommunications equipment efficiently. This also included the provision of quality control in terms of IT standardisation in the commercial banking industry. The operative capabilities of commercial banks were also ranked as strong (45%), particularly in the operation of technology (50%).

The third category was adaptive capabilities. This indicated a commercial bank's ability to acquire know-how, absorb technology, and carry out minor modifications of existing information technologies and systems. The adaptive capabilities of commercial banks were also ranked as strong (58%). This includes the abilities to make minor modifications with existing technology (65%) and to understand technology (50%).

The last category was innovative capabilities. This indicated a commercial bank's ability to perform its own R&D, and also involves major modifications or inventions to create innovative financial products and services. The innovative capabilities of commercial banks, in contrast to the three preceding types of capabilities, were ranked as fairly strong (40%). Although the survey results indicate strong capabilities in making major modifcations with technology (40%), the commercial banks remain to have relatively strong R&D capabilities (45%).

The survey results suggest relatively strong technological capabilities in the banking industry. This mainly included the categories of acquisitive, operative, and adaptive technological capabilities. The survey results, however, also indicated relatively weak innovative technological capabilities. Although the banks have strong

capabilities in adapting existing information technologies and systems to suit local conditions, such capabilities were limited to minor modifications. Alternatively, the major modifications were constrained, in part, by slightly strong R&D capabilities.

Summary

This section summarised three major groups of innovation indicators in the commercial banking industry. The survey results suggest the following. Firstly, customer and competitor sources of information were major factors which contributed towards new product and services development among the banks. Secondly, private and foreign sources of learning mainly contributed towards new products and services development, as compared with government sources of learning. And lastly, the banks have relatively strong technological capabilities, except in their innovative capabilities.

4.4 DISCUSSION

This section interprets the survey results which were presented in the previous sections. The interpretation is based on analysing resource replication in the context of banking and payment systems modernisation. The section firstly focuses on the role of IT and payment systems as physical resources, while later discussing the important role of skills in organisational and human resources, as a potential source of sustained competitive advantage among commercial banks.

Replication of Technology

The replication of resources played a major part in influencing innovation in the commercial banking industry. This replication was mainly focused on major investment plans and projects in relation to using IT to increase operational efficiency, improve services, and gain competitive advantage. Table 4.12 summarises how a group of selected medium and small-sized commercial banks have gradually replicated IT, as suggested from a review of each commercial bank's budget in section 4.1.

Table 4. 12 Summary of IT Investments in Selected Commercial Banks.

Bank	Budget (millions of Baht)	Period	Type of Replication
Bank of Asia	600-700	1997	• Introduction of 5-year re-engineering program • Upgrading of current computer software and systems in support of retail and information services
Siam City Bank	460	1997-98	• Improvement of computer network standards • Introduction of business process improvement • Implementation of customer information system • Upgrading of ATM computer software • Upgrading of accounting computer software • Modification of EXIMBILL system
Nakornthon Bank	300	1990s	• Technological improvement program
Bangkok Bank of Commerce	200	1998	• Changing of current computer and communications infrastructure • Implementation of branch automation system • Implementation of customer information system • Implementation of financial information system
Bangkok Metropolitan Bank	188	1997	• Branch automation • Enhancing ATM systems • Introduction of advanced loan system, telephone banking, and Internet-based banking
Laem Thong Bank	Na	1997	• Planned introduction of Internet-based banking services, call centers, satellites, and electronic information kiosks • Planned installation of 2,000 ATM machines nationwide, covering 240 convenience shops, and 1,500 service stations

Source: Bangkok Post, The Nation, Money and Banking, various issues. Note: na - not available.

Theoretically, the rate of replication of physical resources is relatively higher than organisational and human resources. Three major types of replication are illustrated in Table 4.12. Firstly, there is the upgrading and enhancing of computer software to accommodate changes in user requirements, for example, in delivering 24-hour ATM services. Such modifications have been initially introduced by the larger commercial banks, as we will see in the following chapter. Secondly, there is the upgrading of current computer and communications infrastructure which is mainly aimed to support the automation of bank branches. And thirdly, there is the planned implementation of different types of IS and payment services. In this respect, the latter

two types of replication reflect the imitation of bank re-engineering programs, which have been successfully introduced, again, by the larger banks to gain competitive advantage.

The homogeneity and mobility characteristics of resources further explain this relatively high rate of replication. If computer hardware and software are widely available and purchasable, they have relatively high homogeneity and mobility. This implies that commercial banks can purchase IT in the markets to gain competitive advantage. This is the case of Thailand. Alternatively, a commercial bank seeking to gain and sustain competitive advantage will need to acquire IT which is heterogeneous and immobile in the market. Such strategies, for example, may include the development of unique computer software, which is protected by copyright, and difficult to imitate or substitute by competitors. Teece (1986) calls this the 'appropriability regime'.

The unique commercial banking industry structure also shaped innovation. For example, the relative size of commercial banks influenced their objectives in investing in IT and systems. In Thailand, large commercial banks invested significant financial resources, as compared to their mid-sized and small-sized counterparts. This type of industry structure influenced the creation of technology leaders, whose successfully adopted innovations are replicated by technology followers through routines. The technology followers, which are reluctant to implement costly and risky technologies, adopt, apply, and advance these innovations at a later stage.

The survey results identified the introduction of IT into the major payment routines. This helped assess the preparation of commercial bank payment systems in relation to the development of three major electronic payment systems by the central bank. The survey results indicated a relatively high level of computerisation of payment routines, for which a majority was custom-made and developed in-house, suggesting relatively strong system development capabilities. This was clear in two areas.

First, a majority of payment systems were custom-made to suit commercial bank conditions. This was mainly due to the high importance given to the security and reliability in electronic payment systems which involve the development of confidential encryption systems. The survey results also suggest that the commercial banks acknowledge the inhibiting factors in purchasing packaged computer software or modified software due to the mismatch with local requirements which further indicated commercial banks initiatives in strengthening technological capabilities.

Second, a majority of payment systems were developed in-house. These early indicators suggest relatively strong technological capabilities in developing payment systems, as compared to the purchasing of packaged computer software from external sources. The survey results suggest that the commercial banks have built and strengthened such capabilities through the use of skilled staff who are technically experienced and well trained at the commercial bank training centres. Thus, a majority of commercial bank payment routines were automated. This indicated relatively high-levels of preparedness with regards to the modernisation of the country's payment systems.

The commercial banking industry also experienced structural changes through the impact of IT. Multi-million Baht investment plans and projects suggested the potential of medium and small-sized commercial banks to gradually develop and strengthen their technological capabilities. For example, joint-venture partnerships with telecommunications and computer companies were a source of adopting advanced technology and expertise, and provided the necessary infrastructure for introducing innovative payment services. They also strengthened the unique niche positions of the medium and small-sized commercial banks.

Alternatively, the adoption of IT may not be a source of sustained competitive advantage for commercial banks. Some commercial banks may have achieved early mover advantages in the initial periods of introducing an innovative financial service, but such innovations were major targets for replication from competitors which seek to gain a competitive parity in the industry. To further illustrate this replication

process, four major developments in the context of payment systems modernisation in Thailand are discussed.

Replication of Payment Systems

The first major development phase was private on-line systems. In the late-1970s, Bangkok Bank successfully installed on-line computer systems for its entire branch network in the capital. Prior to this achievement, the bank pioneered the first use of minicomputers in the mid-1960s, and introduced batch processing retail systems in the early 1970s. This early move to modernise the commercial bank's services helped increase its competitive advantage and banking leadership in the early 1980s. However, Bangkok Bank's major technological breakthrough was soon replicated by other commercial banks who also implemented their own private on-line computer systems.

The follow-up innovation was the development of ATMs. Bangkok Bank, however, did not pioneer this development. Instead, the initiative came from Siam Commercial Bank which was regaining its leadership rankings in the industry after falling from the first position it maintained in the early 1960s. Siam Commercial Bank embarked on an aggressive strategy in its retail operations by introducing ATMs in 1983. This strengthened the use of private on-line computer systems, and once again, was also replicated by other commercial banks. The structure of the commercial banking industry started to change, whereby ATMs provided commercial banks competitive advantages in improved customer services, wider geographic coverage, and reduced investment and operational costs in bank branches.

This point is further illustrated with Thai Farmers Bank. In response to these developments, particularly in the introduction of private on-line and ATM systems among the leading commercial banks, Thai Farmers Bank adopted an aggressive strategy introducing IS as a source of competitive advantage (Cash and Mookerjee, 1990). The commercial bank studied the use of on-line branch and ATM systems in similar international commercial banks in the 1980s, and contracted a foreign consulting company to seek recommendations and to implement centralised computer systems. This replication of IT from a foreign supplier was seen as a source of

competitive advantage during this period, and would later contribute towards bank-wide reengineering programs.

The second major development phase was co-operative on-line systems. The growth in ATM systems and services, which was provided by different commercial banks, led to the development of co-operative on-line systems. These systems sought to share investment cost in infrastructure, for example in computer hardware, computer software, and telecommunications equipment. Moreover, the shared network increased the availability and coverage of ATMs to customers of different commercial banks. The two national ATM networks, called Siam Net and Bank Net, were formed by two groups of Thai commercial banks, and provided interconnected ATM services for customers. These changes were considered minor, as banks were only required to make small modifications to existing computer software to provide the interconnection of services.

The third development phase was integrated computer networks. The central bank intervened in the development of a national payment system in Thailand, as commercial banks failed to reach a compromise in the share of investment costs and voting rights in the systems. This was aimed to interconnect the existing computer systems among different payment participants, including commercial banks, non-bank financial institutions, and other related parties. Such changes required major modifications, including significant investment costs in basic communications infrastructure, and the necessary computer hardware and software components.

This introduced three new major payment systems including BAHTNET, Electronic Cheque Clearing System, and Media Clearing. As a part of its payment system initiative, the central bank further encouraged the TBA to develop an on-line retail funds transfer system. This system permitted commercial bank customers to conduct low-value but high-volume transactions on-line between different banks and branches through the existing ATM networks.

In developing the three major payment systems, the central bank gained co-operation from the leading commercial banks which have acquired early experiences

in the implementation of on-line branch and ATM systems. This co-operation helped in designing a high-level payment system policy for the country's banking system. Moreover, the central bank acquired recommendations from international aid agencies for policy recommendations related to risks and pricing, and also contracted foreign consulting companies to conduct feasibility studies and systems implementation.

The fourth development phase was the introduction of innovative payment services. In this phase, commercial banks have experimented with new delivery channels in providing banking and payment services. This has mainly included telephone banking, home banking, office banking, and Internet-based banking. In Internet-based banking, for example, the large commercial banks have started to conduct electronic commerce pilot projects, as we will discuss in the following chapter. If such developments are successful, they will, again, be major targets for replication by the medium and small-sized commercial banks. However, this may not be the case, as the latter two groups of commercial banks may focus their resources on niche markets, particularly in retail payments, and introduce low-cost, Internet-based payment services.

In sum, increased investments in IT have been perceived as a source of commercial bank competitive advantage. However, they are not a sustained source of competitive advantage. Technological developments in the banking industry suggest that a majority of commercial banks have commonly adopted this perspective. This was translated into IT strategies, which were in some cases, part of a broader bank-reengineering program. Theoretically, this adoption of technology also suggests that the rate of replicating physical resources was relatively high. In such cases, commercial banks would have gained a competitive parity. In order for commercial banks to identify potential sources of sustained competitive advantage, the replication of skills, which are located within organisational and human resources, have become equally important in the study of innovation.

Replication of Skills

The replication of physical resources partly explained the transfer of tangible forms of technologies and is incomplete without addressing their intangible dimension. In this section, the discussion focuses on the role of organisational and human resources

which represent the stock of skills within firms. Changes in commercial bank routines suggest that the routines are a source of innovation. The survey results examined these routines by identifying three major sources of commercial bank capabilities, including sources of information, sources of learning, and sources of technological capabilities.

Theoretically, the replication rate of human and organisational resources is relatively lower than physical resources. More specifically, the replication of skills is much more difficult to transfer than technology in physical form, involving the replication of re-engineering programs, which are unique to individual institutions, and the replication of intangible resources, which may have a tacit dimension. This makes skills a potential source of sustained competitive advantage, as they may provide commercial banks with a unique type of resource which is not homogenous and immobile. For example, Mata *et al.*, (1995) argued that managerial IT skills, as compared to technical skills, was a more important source of sustained competitive advantage. More importantly, the role of human resource innovations has become an important factor in adding value to commercial bank services (Keltner and Finegold, 1996). Table 4.13 compares and contrasts between relationship-oriented and transaction-oriented strategies among banks.

Table 4. 13 Comparison of Relationship-Transaction-Oriented Banking Strategies

	Relationship-Orientation	Transaction-Orientation
Competitive Principles	Customising and advising 'one-stop' service	Price competition Self-service
Use of IT	Medium investment in IT IT complements human capital	Heavy investment in IT IT replaces human capital
Skill and Staffing Needs	Broad skills Low employee turnover	Job-specific skills Interchangeable employees
Job Design	Broad job responsibilities Non-standard transactions	Narrow work tasks Standardised transactions
Training	Self-directed learning Modularised training program	Limited frontline training Front-loaded graduate training
Recruiting and Promotion	Competence-based career ladders Priority on internal recruiting	Limited upward mobility Heavy external recruiting

Source: Adapted from Keltner and Finegold (1996, p. 60; 65).

This comparison further implies the importance of skill-based competition. Transaction-oriented strategies have a tendency to focus on investing large amounts of financial resources to acquire physical resources in the form of IT. Such strategies underplay the importance of human resources as a unique source of competitive

advantage. Alternatively, relationship-oriented strategies have a tendency towards investments in human resource development, in addition to IT. Such strategies seek to create commercial bank capabilities in order to gain and sustain competitive advantage.

Bank personnel were a major factor which contributed towards new service and product development among the commercial banks, as suggested by the survey results. This was particularly the case of computer staff. Through their training and travel in the country, and more importantly, in foreign countries and companies, they were exposed to new ideas, and in the process, acquired technical skills and know-how. Comparatively, the reliance on published information was fairly important, for example through the reviewing of foreign magazines and newspapers.

Theoretically, although bank personnel acquired skills through these learning mechanisms, they are relatively difficult to articulate among individuals. Bank sponsored seminars that are organised to transfer such skills among other bank employees may be partly successful, as unique working experiences may have been acquired through learning-by-doing by individual staff, and moreover, is far more difficult to codify or articulate in simple and well-understood language.

The role of managerial and technical staff in contributing towards commercial bank capabilities was rated as equally important. This was the case of staff who acquired skills from working within the commercial bank, and working in other local and foreign firms. However, the contribution of managerial and technical staff from the government sector was rated as fairly important, and in some cases, such as technical staff who worked with other government agencies, not very important.

Such a situation suggests that the stock of managerial and technical skills within the government sector are relatively less competitive, in terms of professionalism and technological sophistication, as compared with the private sector. Furthermore, the importance of both managerial and technical staff skills also reflect that such types of human resources are sought after, and in some cases, given increasing importance by the commercial banks. Thus, the survey results implicitly suggest that personnel

movement within the commercial banking industry is relatively stronger among firms in the private sector, as compared to the government sector. However, this may not always be the case, as commercial banks may seek to acquire bank personnel, whom have worked within government agencies, to strengthen contacts with the government sector.

In sum, the survey results support the importance of skilled staff among banks. Comparatively, the replication of staff skills is much more difficult than IT. Theoretically, the replication rate of human resources is relatively lower than physical resources. This further implies that difficulties in imitating intangible resources may be seen as a potential source of competitive advantage, as compared to their tangible counterparts. The more unique and scarce the skills embedded in bank personnel are, the more heterogeneous and immobile such resources become which is one of the preconditions for firms seeking to gain and sustain competitive advantage. Thus, the successful shift from transactions-oriented to relationship-oriented banking strategies would partly depend on the development of human resources.

Summary

The aim of this chapter was to examine innovation in the commercial banking industry. The survey results suggest relatively high usage and awareness levels of IT, particularly in the automation of payment systems. The identification of broad-level indicators of innovation further suggests that the banks largely depended on customers, competitors, and foreign sources of information and learning, as compared to company, private, and government sources. Although the replication rate of IT among the commercial banks was relatively high, the potential sources of sustained competitive advantage resided in the imitation of human and organisational resources which is further discussed in the following chapter.

CHAPTER 5: THE COMMERCIAL BANKS

This chapter examines innovation in four large commercial banks and is organised into five sections.[57] Sections 5.1 to 5.4 present four separate mini-case studies which discusses each commercial bank's background, examines the role of IT, and identifies their sources of innovation. The mini-cases illustrate the relationship between innovation and the maintenance of banking leadership in the country, and their common characteristics are discussed in the last section.

5.1 SIAM COMMERCIAL BANK

The First Thai Bank

Siam Commercial Bank was officially established in 1906, following its transformation from a 'Book Club' set-up in 1904. The Book Club, which was a private trust, formed the modern basis of the bank, providing basic banking functions such as deposits, loan extensions, and foreign exchange. It was operated by local people and primarily served Thai and Chinese clients in the local business community. The bank became the first Thai commercial bank formed after the first foreign bank, Hong Kong Shanghai Banking Corporation, began operations in the country in 1888. Most importantly, it has served as a model for many Thai commercial banks in the early and modern periods. In 1996, the bank was ranked the fourth largest Thai commercial bank in terms of total assets, and the 211th largest international commercial bank (KTB, 1997).[58]

Siam Commercial Bank was an early experiment in Thai commercial banking. Prince Mahisararajaharuetai, a Royal Treasury Minister, introduced modern ideas acquired from Europe during the early 1900s in the Book Club. The prince initiated a pilot project to learn banking operations, for example in book keeping, credit extension, deposit taking, account clearing, funds transfer, and payment through cheque order. As a result, the bank pioneered a range of financial instruments,

[57] This chapter is mainly based on interviews.

[58] See "Top 1000 by country", *The Banker*, various issues. The world rankings of international commercial banks is based on Tier One capital and is defined by the Bank for International Settlements. Tier One includes common stock, disclosed reserves and retained earnings, but excludes cumulative preference shares, revaluation reserves, hidden reserves, sub-ordinate and other long-term debt, which are defined as Tier Two capital.

including the use of cheques, savings bank deposits, deposit at calls, and shipping guarantees.

The bank's formation years were characterised by skill acquisition. Thailand lacked banking experts, and more importantly, the banking know-how. The building of managerial capabilities and skills in banking were learned and applied accordingly. During the transformation years, foreign commercial banks were invited to hold shares in a newly proposed commercial bank which was aimed at acquiring foreign technology to support international banking businesses. Among them included the Deutsch Asiatische Bank of Germany and the Den Danske Landmancls Bank of Denmark, which were invited to hold 330 shares and 240 shares respectively, of the total 3,000 shares in the new commercial bank.

The acquisition of banking know-how continues with the learning organisation concept adopted by the bank's chief executive officer (Senge, 1990). This is further supported by the bank's strategy in developing knowledge workers who are 'enknowledged personnel performing quality work to best serve our customers' (SCB, 1997). Bank restructuring based on the principle of customer-based business process management, has also contributed to a flatter organisation with small business teams capable of responding rapidly to customer needs.

Role of IT

Siam Commercial Bank has been progressive in the use of IT through senior-level management support which has helped shape its visions and strategies. For example, the active involvement of the chief executive officer has led to investments in data warehousing technology to learn more about the bank and, more importantly, customer information.[59] Furthermore, the chief executive officer has clearly defined two main objectives in the use of IT: (1) to facilitate daily banking activities between the bank and customers, and (2) to develop new methods in delivering financial services. [60]

[59] See "Siam Commercial Bank invests in information" (*The Asian Banker Journal*, 15 August 1997).
[60] See *SCB Technologies* (November 1996, pp. 8-9).

More interestingly, the bank surprised the banking community in early-1998 by announcing an increased investment in its IT budget by 2-3% over its Baht 900 million investment in the previous year.[61] This was despite the country's financial crisis which caused a change in the exchange rate regime, the devaluation of the local currency, and the cutting of costs across companies. Moreover, in response to the financial crisis, the bank established a non-profit organisation to serve as a job placement centre for potential employers and employees, while also providing language and computer training for unemployed IT professionals.[62]

Such an aggressive strategy was well supported by the bank. For example, the bank's first executive vice president for technology suggested that the organisation's continued investment in IT was based on the transformation of problems into opportunities, particularly during the period of financial crisis in the country. In support of this argument, the bank noted that the development of an Intranet and inventory control system helped reduce internal expenses to approximately Baht 13 million annually and helped reduce non-performing loans to approximately 6%.[63]

Bank functions related to IT are mainly organised in the technology group. In addition, the information system audit department located within the human resource and control group also has a technological role. The technology group, following the initiation of ideas in the early-1980s and a reorganisation in 1996, reports directly to the bank's chief executive officer, and is divided into five main units. [64]

[61] See "Siam Commercial Bank to increase 1998 IT budget" (*Bangkok Post*, 14 January 1998).
[62] See "Body to be set up to help IT staff made redundant" (*Bangkok Post*, 27 August 1997).
[63] See "IT has special relevance in today's troubled times" (*Bangkok Post*, 10 December 1997).
[64] See *SCB Technologies* (May 1996, pp. 6-7).

Firstly, the technology policy division overlooks broad technological developments and provides a centre of co-ordination. It prepares and monitors policies, plans, and the bank's expenditures in IT. Secondly, the system engineering department develops, implements, tests, operates, and maintains the bank's computer systems. Thirdly, the technology and process engineering department overlooks the management of the bank's two main computer centres, controls the operating systems, and manages the bank's data warehouse located in mainframe computers. Moreover, it also overlooks the purchase of computer equipment. Fourthly, the business relations department manages the bank's call centre, promotes the use of IT in the bank and to the public, and finally, overlooks the bank's customer information facility system, credit monitoring, and collection system, and black list system. And lastly, the applied technology department conducts research into the use of new information technologies, maintains computer software, and manages computer hardware, software, and communication standards. This last function has played a particularly important role in building and strengthening bank capabilities which is later discussed.

IT development plans

In 1983 the bank prepared two major technological development plans. The first nine-year plan covered the period between 1983-1991, and the second six-year plan between 1992-1997. The first plan was divided into three phases, each covering a three-year period. The first phase was aimed to improve customer services with IT. During this phase, the bank introduced the first ATM in Thailand in 1983. This major development became a very successful innovation as the bank's customer base expanded and market share increased. This later required central bank co-ordination of ATM-related activities introduced by other Thai commercial banks accordingly.

In the second phase, the bank used IT to automate routines and to increase productivity. In bank automation, paper documents, work processes and the required time to accomplish tasks were reduced. While work processes were shortened, this increased the speed in delivering customer services. This was further supported with an office automation project aimed to facilitate the flow of information within various working units in the bank. In the third and last phases of the first plan, the bank

prepared plans to position itself in the information society. IT projects were aimed to strengthen the bank's overall technological infrastructure further. For example, a management IS was developed to connect four main sub-systems related to customer, financial, marketing, and personnel management. Additionally, the bank co-operated with large computer vendors, such as IBM, to modernise its hardware and software technologies.

The second plan is also divided into three phases, each covering a two-year period. In the second plan, efforts were directed to strengthen existing technological infrastructure of the bank, including the upgrading of computer, telecommunications, and database technological capabilities to support ongoing and forecasted expansion of banking activities.

Bank automation and innovation

Computers were first introduced in 1975. This mainly supported deposit functions located at the bank's head office. Early use of IT was extended to more sophisticated bank operations, and financial products and services. The pioneering ATM provided a new method of delivering payment services and was widely adopted by other local commercial banks which diffused nation-wide accordingly. In the 1990s, the bank once again became a pioneer in introducing on-line electronic banking communications in Thailand, particularly in tele-banking and info-banking systems.

The bank introduced two major changes in the early 1990s. They were the adoption of customer-based business process management and organisational restructuring at the bank's head office. Price Waterhouse was contracted to advise on improving the bank's commercial lending and counter services, for which the consultants studied customer requirements and modified the bank's work processes to help address their needs. This partly resulted in the increased use of IT.

Moreover, relationship banking 2020 (RB 2020) was initiated. This project, jointly developed with IBM, helped shift the bank's focus from an account-based to a customer-based system. RB 2020 restructured the way retail banking was delivered to bank customers since the early 1970s, and moreover, pioneered an analytical

capability that assists in identifying the most suitable services for a specific target group of customers. This project, introduced in early 1996, was to be widely diffused and installed in over 400 bank branches nation-wide.

The bank also adapted and applied object-oriented technology to support the delivery of financial services. For example, loan authorisation systems were built based on expert systems which has decision-making capabilities based on a 100-points scale. If a loan application scored high points, the computer approved the loan. Otherwise, an average or low score further considered or rejected the application accordingly. Furthermore, the bank built a mobile loan authorisation system which efficiently analysed and approved a customer loan application data, following on-line verification by portable computers with its head office. Such services provided new channels for delivering financial services and improved customer convenience. Table 5.1 illustrates the new types of automated systems introduced as of 1995.

Table 5. 1 Siam Commercial Bank - Type of Automated Services

Type of Service	Details
Corporate banking system	Mobile loan authorisation system
Commercial lending formula system	Mobile loan authorisation system
Mortgage financing system	Mobile loan authorisation system
Customer management system	Monitoring of customers payments
Loan collection system	Assessment of customer credit conditions
Credit scoring system	Facilitate credit authorisation process
International business	Improve foreign exchange, international trade and international banking systems

Source: Siam Commercial Bank Annual Report (1995)

IT is also applied to improve personnel management and promotion.[65] In 1994, the bank's human resource and control group introduced a personnel IS that recorded all personnel particulars including education, work experience, and training. Thereafter, an employee promotion system was successfully introduced in 1995. This was aimed to support the bank's concept of a learning organisation. The second system was later enhanced to support decision-making in personnel promotion, and was aimed to make personnel information widely available to specific bank departments and branches located nation-wide.

[65] See *SCB Technologies* (December 1996, pp. 8-9).

Sources of Innovation

The sources of innovation can be grouped into five main areas. The first source is from the bank's applied technology department.[66] This department, established in 1996, conducts R&D into the application of new IT in financial services. Departmental tasks are grouped into five different teams - IT standards, technology selection, R&D, prototype, and support services. After the R&D team creates a new innovation, it is tested by the prototype team and considered for bank-wide diffusion by the systems engineering department.

The department, for example, introduced a pilot electronic commerce project using the Internet and a newly established transaction centre in late 1997.[67] As a result, the bank became one of the earliest commercial banks in the country to provide Internet-based banking services, in the form of 'SCB Cash Management' for retail customers which provides account and statement inquiries, funds transfers, and bill payment services.[68] In addition, 'SCB Trade' provided corporate customers with international trading related services. Vichit Amonviratskul, the bank's first executive vice president for technology describes the role of this office.

> In our applied technology office, staff would observe new products and examine what is appropriate for the bank. We try to recruit new staff who have recently completed their university studies and not rely on recruits with old working experiences. These recruits can be out-of-date easily. For example, the head of our applied technology office has a recent doctoral degree from a Japanese university with several months of working experiences acquired from that country. We try to attract new people.

[66] See *SCB Technologies* (June 1996, pp. 6-7).
[67] See "Bank establishes pilot electronic commerce project" (*The Nation*, 3 June 1998).
[68] See "Banking revolution set to unfold" (*The Nation*, 26 November 1997).

The second source is from co-operation with computer companies. Computer firms have introduced many innovative products and ideas to the bank, as suggested previously in IBM's involvement in RB 2020 development. In 1995, the bank's collaboration with Lines Technology led to the development of electronic systems that helped identify target customers, and provide personalised products and services. This included the introduction of the SCB video banking system that provided individual bank customers on-line financial, business, and stock market information.

In 1998, the bank, in collaboration with a local computer company, jointly developed a smart card system for Chulalongkorn University, and further announced an aggressive strategy of entering into joint-venture partnerships with computer hardware companies.[69] Furthermore, in response to the country's financial crisis, increased investments in IT were focused on the development of software with computer software companies. In co-operation with IBM, the bank planned to develop the first Workspace on Demand pilot project in Asia which aims to reduce the ownership cost of IT by shifting from a personal computer to network computer working environment, resulting in a 'Zero Administration Environment'.[70]

The third source is from bank-affiliated companies. Such companies created management and technological capabilities, and served as a consulting arm to strengthen the bank's competitiveness. In 1991, an affiliate company called Siam Information and Processing Company Limited (SIPCO) was established, mainly for the purpose of processing air tickets for the International Air Transportation Association. Thereafter, this company expanded its activities to outsourcing services, consulting services, and developed advanced software applications for the banking and financial services sectors which also became beneficial for the bank. Most interestingly, the company provides a packaged banking solution software, which uses modern software development tools, such as object orientation and rapid prototyping.

[69] See "SCB plans e-purse for university" (*Bangkok Post*, 14 January 1998).
[70] See "Siam Commercial Bank to increase 1998 IT budget" (*Bangkok Post*, 14 January 1998).

In 1994, the bank established Siam Commercial Link (SCL). The aim was to aid the development of new value-added industries through the transfer of technology. SCL includes two divisions. The first is a 'technology link', which serves to form international business collaborations, and the second is a 'management link', which aims to handle the recruitment of mid-level and top-level managers. In 1996, the bank entered a joint-venture agreement with the National Science and Technology Development Agency (NSTDA). As a result, SCL was renamed as Science Commercial Link. This served as a source of venture capital for domestic and overseas companies seeking to enter into partnerships or invest in technology-related areas in Thailand. The bank was also innovative in other areas. In 1995, SCB Business Services installed new software and security systems that permitted Mastercard customers to obtain cash advances from worldwide Cirrus-affiliated ATMs.

The fourth source is from the strengthening of staff capabilities. A major source of technology originated from bank personnel. Senior-level management, particularly the bank's chief executive officer, has driven much of the bank's technological initiatives. Bank employees are sent to international seminars and computer trade exhibitions to learn, acquire, and transfer new sources of skills and technology to the bank. Vichit Amonviratskul further describes the importance of skilled staff.

> We do not hire or have a high degree of dependency on consultants. A major source of innovation originates from bank staff. We have opportunities to attend seminars, read books or follow related developments. This includes staff in the technology group and other departments. Our managers have the opportunity to undertake training and make bank visits. This is similar for other employees. Every year, our employees have the opportunity to attend overseas seminars and computer shows such as COMDEX and CEBIT. Over ten of our staff attend these exhibitions every year. So the sources of technology comes from these managers and staff.

Moreover, employees are trained and retrained on a continual basis. Two training centres provide general programs that help educate and train staff on the bank's background and specific skills in banking. Video-conferencing systems also help in inter-office communication, meetings and information exchanges. The bank has planned agreements with local technological universities to offer computer

courses at its premises. Upon completing such courses, employees obtain postgraduate degrees either in management IS or computer science. Vichit Amonviratskul also notes the importance of staff development programs.

> The training centre is only a tool for improving the quality of staff on a continuous basis. The centre is not aimed to increase the number of employees. I think that what is more helpful is the organisation of a postgraduate course for our staff. For example, the quality of entry-level staff varies from different disciplines and educational institutions. Technology is rapidly changing. The postgraduate course can help upgrade them. Our employees are very interested in this project and have a positive demand for it.

The last source is consultants. However, the degree of dependency is minimal, as mentioned. Computer software for minor programs, such as in client-server related projects, are developed in-house. To leverage such capabilities, the bank readily consults its in-house R&D department or affiliated companies. However, for major programs that are unavailable in the market, software packages are purchased from outside sources and later modified to suit the bank's requirements. The bank maintains that this principle is necessary, as the organisation cannot continually depend on consultants. The bank builds its own capabilities by using purchased software packages as basic program structures which are then adapted to changing user requirements. It also changed working processes by outsourcing selected technology functions to overseas companies thereby focusing on more important and efficient areas. For example, this included the replacement of old methods of developing software from COBOL to object-oriented computer languages.

Summary

This section examined innovation in Siam Commercial Bank. Strong senior-management support in IT suggests that the bank has become a leading and forward-looking financial institution in the country and perhaps in Asia. Apart from investing heavily in IT, the bank also gradually created capabilities through the set-up of an in-house R&D capability, the development of human resources, the co-operation with computer companies, and the set-up of bank-affiliated companies.

5.2 BANGKOK BANK

Thailand's Biggest Bank

Bangkok Bank was established by the Sophonpanich family in 1944 and is the largest Thai commercial bank. The bank gained wide recognition regionally and internationally. In 1996, it was ranked the largest Thai commercial bank in terms of total assets, and the 121th largest international commercial bank (KTB, 1997).[71] The bank was also recognised by IBCA, a leading rating institution in Europe, to be the world's second most profitable bank in 1994-1995. In 1995, the bank was presented with an award for excellence as the "Best Domestic Bank" in Thailand (Euromoney, 1995), having been the largest commercial bank in Southeast Asia, and moreover, having expanded its international operations, particularly in the Indo-Chinese region and in the People's Republic of China.

The bank's two-fold vision is "to continue to be a quality full-service bank and to become one of the leading international banks in Asia, providing world-class services to all its customers". In order to achieve this vision, the bank has focused on the development of human resources, operational efficiency, and technology. Technology has been particularly important for the bank since it started using computers in the early-1970s which advanced towards the use of on-line computers connecting over 450 bank nation-wide branches. Furthermore, the bank also set up electronic connections with its overseas branches through a global communications network. As of 1996, this included 27 branches and representative offices located around the world, with a majority of 23 situated in the East and Southeast Asian regions.

Role of IT

Bangkok Bank's chairman, together with senior-level management, have clearly defined the bank's future theme as being focused on electronic banking and IT which is in support of providing innovative financial services and generating fees-based income.[72] Such a technologically oriented theme was well supported with regular five-year technological improvement plans. For example, an approximate sum of Baht 400-500 million was allocated, as of 1998, for the replacement of computer hardware

[71] See "Top 1000 by country", *The Banker*, various issues
[72] See "Bangkok Bank revamps part of growth strategy" (*Bangkok Post*, 18 March 1997).

and software among the bank's nation-wide branches.[73] Nevertheless, Kajornvut Tayanukorn, the bank's senior vice president for systems development, suggests that the support of such a strategy involves not only investments in IT.

> I think the bank's new growth strategy (which is based on fees-based income) is the trend in the commercial banking industry, as the profit margins from interest have been decreasing. The financial service area supplements this fall in income by differentiating services to customers. However, product differentiation is more important than the use of new technology. This is where we can provide value-added products and services to customers. One example is the clearing of provincial cheques, which originally took around one week to clear. This may take one day with electronic banking. Realistically, it takes the bank three days to clear provincial cheques, increasing the turnover rate.

IT related functions of the bank are located within a technology division which is part of broader support service operations. This includes other 'housekeeping' divisions like financial information services, operation, general service, and personnel. In the technology division, there are two departments headed by an executive vice president in charge, including the system development, and information-processing departments, which are, in turn, headed by senior vice presidents and managers.

Bangkok Bank pioneered the use of IT in many areas (Bangkok Bank Annual Reports). For example, it was the first Thai commercial bank to install supercomputers for data management, the first to develop and to integrate a computer software program based on Thai characters into the bank's on-line computer system, and the first bank in Asia to connect personal computers to UNIX-based computer systems. In other areas, the bank initiated the installation of MICR encoder and reader machines for processing cheque among its branches. Most interestingly, it pioneered the use of satellite technology in banking. Teera Aphaiwongse, the bank's senior executive vice president for support service operations, explains the early use of satellite technology.

> In the early days, the bank's computer on-line functions were concentrated in Bangkok. However, there were problems with the telephone lines. Bangkok Bank actually became the first commercial bank to expand operations in the

[73] Interview with Kajornvut Tayanukorn, Bangkok Bank. See Appendix 6.

provincial areas. This was supported with a policy that every branch should go on-line, being able to link with one another. However, there were not enough telephone lines in the provinces. In the first stage, there were no satellites yet. We contacted the Telephone Organisation of Thailand to use microwave technology and thereafter, we began to use satellites. Using microwave was like using telephone lines, being out of order or even damaged sometimes. The satellite became an alternative.

The application of satellite technology supported branch banking in the provincial areas. In addition, this supplemented the use of telephone lines in such remote areas which were inadequate in number and were also relatively unreliable. Therefore, the bank innovated by combining two types of technologies - satellite and microwave technologies. Teera Aphaiwongse further explains the potential and problems in this choice of innovation.

We learned about the use of satellites and examined the various costs. The use of satellites did not depend on distance as compared to using microwave technology. For example, using microwaves between Bangkok and Ayudhya (a province in the central regions) incurs a small cost. However, there was an increased cost between Bangkok and Maehongson (a province in the northeastern region). But satellites are the same price. There are both pros and cons. Satellites are prone to weather such as storms, rain and sunspots, which may cause error rates. So, we are using both satellites and microwave. However, we use it differently from other banks. Other banks used satellites as a single route and for backup functions. Bangkok Bank thinks that using it for backup purposes is a waste of financial resources. Waiting for satellites to face sunspots then using microwave is not practical so we use both of these technologies. We have a network management system, which is similar to a traffic controller. This distinguishes the two types of technology and helps balance the workload.

Pioneer in re-engineering

Bangkok Bank also pioneered bank re-engineering in Thailand. This preceded Thai Farmers Bank which introduced bank reengineering in the early 1990s. However, due to the latter's wide publicity, the bank is usually credited as the first Thai commercial bank to reengineer. The first re-engineering exercise at Bangkok Bank was introduced in the early 1980s when the bank adopted computer machines for bank tellers. As a result, the bank improved its time in dealing with customers from approximately 20 minutes to 3 minutes.[74] The bank teller was also given greater responsibility, reducing

[74] Interview with Teera Aphaiwongse, Bangkok Bank. See Appendix 6.

the work of 7 bank staff to only one person. Otherwise, non-routine task or transactions were co-signed by another supervisor

Early re-engineering exercises taught three lessons. Firstly, it improved the efficiency of bank and customer services. Secondly, it minimised staff. Prior to the 1980s, the bank's work process involved, for example, a bank slip that passed through 7 persons and the data was keyed into 4 or 5 available on-line terminals in the bank's back office. Reengineering permitted a one-stop service with the use of computers by each bank teller. And thirdly, the bank re-designed its human resources development and training programs completely.

The bank strengthened staff capabilities accordingly. Its retraining programs in 1979 were in preparation of bank re-engineering in the early 1980s. An approximate number of 7,000 staff were relocated, retrained, and reallocated back to various positions and functions.[75] Thereafter, the bank monitored and managed expected improvements in staff performance in two ways. Firstly, employees were required to work in achieving a 'service level agreement'. This agreement included the maximum and approximate amount of time required by employees to deliver a specific type of transaction to customers, for example, in the issuance of a letter of credit.

Secondly, the measurement is matched with cost accounting. A specific job function or service incurred increased costs when it required more time to accomplish from employees. Therefore, each division in the bank was measured to help reflect cost accordingly. Such measurement is tied to productivity. If staff salary were to increase 8-9% a year, this implied an increase in their productivity.[76] To support such skill development, over 200 basic training courses were provided to over 25,000 employees, and the bank's on-the-job training and special overseas courses were made compulsory for employees at key managerial positions.

[75] Interview with Teera Aphaiwongse, Bangkok Bank. See Appendix 6.
[76] Interview with Teera Aphaiwongse, Bangkok Bank. See Appendix 6.

The improvement of bank operations was aided through the adoption of information technologies. The bank examined alternative channels for delivering bank services, resulting in the expansion of new and improved businesses. This included providing financial services through delivery channels unconstrained by time, for example, in telephone banking, home banking, and ATMs. Tables 5.2 and 5.3 illustrate the automation of bank operations and the introduction of new payment services, as of 1995, respectively.

Table 5. 2 Bangkok Bank - Type of Automated Operations

Type of Bank Automation	Details
Risk management system	Used technology to improve treasury and custodian operations
Data management system	First bank to install supercomputer to support data management
Data warehouse system	Used technology to help in planning, work monitoring and assessment
Electronic mail system	Adopted cc-mail for top management and overseas bank branches

Source: Bangkok Bank Annual Report (1995)

Table 5. 3 Bangkok Bank - Type of Payment Services

Type of Payment Innovation	Details
Customer self-help services	Installed automatic passbook updating machines Installed automatic currency exchange machines (24 hour service in 23 languages) Installed automatic cash deposit machines
Electronic download system	Introduced on-line request of customer payment data via personal computers
Debit payment system	Introduced electronic payments at point of sale by ATM and debit cards
Telephone banking system	Introduced a phone service to receive payments of mobile phones, pagers and cable television charges
Credit scoring system	Used technology to facilitate the issuance of bank credit cards

Source: Bangkok Bank Annual Report (1995)

Sources of Innovation

The sources of innovation can be grouped in four main areas. The first and most important source is bank personnel. At the organisational level, the bank introduced a range of policies and programs aimed at promoting the quality of staff and services. For example, personnel development was supported through programs such as 'Star', 'Quality Persons' scheme, the brain bank project, 'QC Circle, and '5S activities' (Bangkok Bank Annual Report, 1994).

Since the bank began to use computers in the early 1970s, employees working in a particular department became familiar with their tasks, leading to user-driven innovation. Departmental employees, who are owners of specific job functions,

gained familiarity with particular routines and used them as a basis for defining user requirements. Teera Aphaiwongse emphasised this point.

> Today, the decision of whether or not to use a particular type of technology, or how much to invest, rests with the user. We need to seek their opinions. For example, employees working in the export and import division since the early 1970s have probably been promoted to managerial positions today. As a result, they have grown very familiar with their work and know how computers, introduced in the bank in 1970, can facilitate their tasks. These users, not the technology group, are the owner of such tasks and are fully responsible for them. Thus, there is no way information technology staff would know everything.

This suggests that the technology division plays a supporting role to other departments. As the decision to use or to invest in a particular type of technology remains with the user, the search for new IT rests with users. For example, staff from specialised bank divisions may request for new technology after learning about new applications from overseas travel and training. Thereafter, the technology division addressed such user requirements accordingly.

The bank also initiated a project to improve IT literacy, aimed at educating and training bank employees with basic computer knowledge and skills. The bank's training centre teaches three-week basic computer courses for a group of 50 people, and is provided all year round which has proven highly successful. Innovation in different departments was also encouraged with an Intranet project, whereby individual departments compete in creating home pages to provide information. Moreover, senior-level employees are strongly encouraged to use electronic mail instead of communicating with the telephone. Kajornvut Tayanukorn describes the approaches to technological skill improvement.

> The minimum entry requirement for employees is a first degree in disciplines such as computer science, mathematics, and statistics. We have an annual training program, including internal training conducted by our experienced senior-level staff. For example, this includes a two months training on our methodologies and training on the control of our documents. We also have external training programs which includes special classes arranged with computer vendors.

The second source, which is computer companies, is a result of such outward-oriented training programs. For example, this has included training with computer companies such as IBM which provided courses on project management and programming skills. In addition, the bank organised training courses with Microsoft at the bank's premises and at the software firm's authorised training centres. Such courses have specifically included server administration which is a required skill in non-mainframe technology and has become an emerging trend in the country, particularly networking in LAN and WAN environments.[77]

In some cases, the bank acquired technology from computer companies through staff involvement. For example, one of the bank's recent project with Digital involved the upgrading of existing computer systems to Windows-based operating systems which engaged employees of both organisations developing a pilot project. Such co-operation, in the form of prototype development, enabled the bank's employees to acquire capabilities, within the period of 2 months, from the research unit of the computer firm.[78] In other cases, computer vendors provided training in computer software packages which helped the bank make minor modifications. Kajornvut Tayanukorn illustrates this capability to cater to local conditions.

> We develop system enhancements to suit the domestic market. In the case of BankTrade, our computer vendor would train us on their system, particularly in the program structure, programming, and database techniques. This learning of the product knowledge is considered in terms of what functions are related to end-users and other technical areas. We try to avoid enhancing the core part of the system which would have been the responsibility of the computer vendor.

The third source is the systems development department which has been behind the bank's pioneering use of IT. As the bank was the first to develop computer on-line systems in the country, it enjoyed an early mover advantage, and more importantly, acquired and build-upon these early technological capabilities. Kajornvut Tayanukorn further suggesst that such capabilities may be partly attributed to the systems development department, which has focused its strengths, for example, in the development of retail payment systems.

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[77] Interview with Kajornvut Tayanukorn, Bangkok Bank. See Appendix 6.

> I think we were the first commercial bank to develop salary and utilities payment systems, since we pioneered on-line computer systems. This started with simple batch processing systems, whereby we received data from our customers. In the mid-1990s, we changed this process to file transfer systems, whereby our customers send data directly from their offices to be verified with our bank branches. We have also developed money transfer systems between 1982-84 when our provincial branches went on-line. These are the payment systems that were developed in-house.

The department further demonstrated its capabilities through the implementation of an electronic securing system. This system, which uses electronic workflow and imaging technologies, focuses on the establishment of a cheque-processing centre to replace work previously done by different banks or bank branches (Bangkok Bank Annual Report, 1996). As a result, the centre will receive and verify customer cheques and update their accounts accordingly. Such capabilities suggest that the department is relatively strong in retail payment system development, as compared to wholesale systems. In the latter case, the bank has purchased software packages, for example in support of investment banking and treasury functions, as it lacks the know-how, and moreover, as most products are readily available from foreign sources.

The fourth, and least important source, is consulting companies. During the re-engineering of its work processes, the bank contracted consulting firms, for example Booz and Allen, to assist in developing new credit processes, credit lease management, and credit workflow systems. Although such firms have served as the bank's idea catalysts and informer of market and technology trends in banking, such source of knowledge have provided a limited contribution. The bank made two reservations. Firstly, although foreign firms were more experienced, as compared to their local counterparts, this did not suggest that all foreign consultants were experts. Secondly, foreign firms merely made recommendations but faced difficulties in implementing project details. Thus, the bank strongly supports self-reliance and self-judgement, and even argued that 90% of consultant recommendations were widely available in textbooks.[79]

[78] Interview with Kajornvut Tayanukorn, Bangkok Bank. See Appendix 6.
[79] Interview with Teera Aphaiwongse, Bangkok Bank. See Appendix 6.

Summary

This section examined innovation in Bangkok Bank. With a relatively strong support and a clear direction from senior-management, the bank embarked on an ambitious plan to utilise IT to generate fees-based income through innovative financial services. The sources of innovation was mainly derived from strengthening staff capabilities, co-operating with computer companies, and developing retail payment systems to suit local conditions. Alternatively, the role of consulting firms played a limited role.

5.3 THAI FARMERS BANK

Catalyst of Bank Re-engineering

Thai Farmers Bank was established by the Lamsam family in 1945. Although Bangkok Bank may have claimed to pioneer re-engineering in the early-1980s, we will later see that the catalyst of this change was Thai Farmers Bank in the early-1990s. Apart from gaining wide publicity for its proactive bank re-engineering programs, the bank's successful use of IT to gain competitive advantage in the 1980s also attracted international attention, resulting in a case study conducted by the Harvard Business School (Cash and Mookerjee, 1990).

At the organisational level, the bank has set a mission of "the spirit of excellence", as well as the philosophy of "dedication to banking excellence", which aim to provide high-value added financial services and support to clients, while balancing societal and national concerns (Thai Farmers Bank Annual Report, 1995). In 1996, the bank was ranked as the third largest Thai commercial bank in terms of total assets, and the 182nd largest international commercial bank (KTB, 1997).[80]

Innovation has become a major factor contributing to the bank's leadership. Bank re-engineering, in particular, helped strengthen the bank's capabilities and competitiveness, and further prompted preparations for more efficient working processes that are comparable to and competitive with international banking standards. Most importantly, the bank's senior-level management has played a key role in initiating the use of advanced IS and supporting the reengineering of bank branches nation-wide. In 1984, the bank's chairman demonstrated his complete

[80] See "Top 1000 by country", *The Banker*, various issues

support to the senior vice president of the computer department in adopting ATMs which followed recommendations made from a study of such machines at Banco International, Mexico's fourth largest commercial bank (cited from Cash and Mookerjee, 1990, p. 1).

> I still want to see the first Bangkok branch go on-line by the year-end, most of the others by the end of next year, and also 15-20 up-country branches. Siam Commercial Bank already has on-line branches and over 50 ATMs in Bangkok. Unless we catch up fast, they will capture a significant portion of our market share. You will have to manage a turnaround. I know you can do it. You have my total commitment of the bank's resources for this project.

Role of IT

The bank's computer department was established in 1975. As the department head was technically-oriented, there was a weak link with business strategy, and moreover, there was an emphasis on batch retail processing systems, without considering the emergence of on-line systems being introduced by competitors (Cash and Mookerjee, 1990, p. 5). This changed in 1983, when the bank's chairman became involved in technology planning, established a high-level technology committee, and contracted a consulting company called Peat Marwick. As a result, the bank wrote-off its existing systems and considered the installation of IBM mainframe computers to support on-line computing.

As of 1997, the bank's use of IT was focused on four main areas. Firstly, the IS processing department overlooks banking operations, including the gathering of input data, the processing of output information, and the backing-up of information on a 24-hour daily basis. Secondly, the IS engineering department develops the bank's computer software. Thirdly, the telecommunication department supports inter-bank functions. And lastly, the newly established research and process development department, which studies and advises on the improvement of the bank's business processes, conducts research related activities.

The bank's president started and supported re-engineering in the early 1990s. In 1993, the president, who is a Harvard Business School graduate, attended a seminar on re-engineering organised in the United States by Michael Hammer (Hammer and Champy, 1993). As a result, such ideas formed the basis for organisational reforms, a

change which was not only radical to the bank, since it was established in the mid-1940s, but also to the local banking community. Nevertheless, the bank's president was capable of communicating and convincing employees the main concepts and contributions behind re-engineering.

Firstly, foreign consulting firms helped the bank re-think. In 1992, early feasibility studies conducted by Booz Allen and Hamilton suggested a focus on retail banking businesses. Two more consulting companies were contracted, including Immacon focusing on bank restructuring, and Andersen Consulting concentrating on IT strategies. In 1993, a joint team of 11 employees, between the bank and IBM, helped develop a new computer system to pilot the bank's first re-engineered branch. Together, these gradually build the bank's managerial and technological capabilities, and have led to re-engineering without the use of foreign consulting companies.[81]

Secondly, the bank learned to re-design itself. The bank's president took a progressive position towards re-engineering by selecting 6 bank staff to jointly work with the consulting companies. This included research and analysis into the problems of the bank's current business processes and a comparative study of financial service delivery between Thai commercial banks and their foreign counterparts. The results suggested that Thai financial institutions were constrained by multiple working processes which unnecessarily slowed the time to provide customer services. As a result, this early work materialised in the establishment of the bank's own research and process development department.

The bank re-designed its branches and business processes. For example, the front and back offices were rearranged to increase customer services areas to 80-90%.[82] Financial services were grouped into five main service stations - cash services, personal services, general services, loan and marketing services, and electronic services. In electronic services, for example, this included the automation of routines such as in the updating of bank balances or in the depositing of cheques. Furthermore, the bank restructured its branch services, foreign service centres, liabilities, credit authorisation, funds transfer, and credit card services.

[81] See "Re-engineering in Thailand" (*The Economist*, 11-17 October 1997, pp. 128-9).

Lastly, IT helped the bank re-tool. This included the development of new computer systems and self-service machines for customers. For example, computer software was re-coded, and personal computers replaced dumb terminals, which connected the computer file servers located among branches and the bank's communication networks. In addition, bank tellers working with personal computers were empowered to authorise transactions within a predetermined sum of money, without seeking prior supervisory approval which helped provide improved customer services and reduced overall cost.

The results of re-engineering suggested successful operating performances. This is based on the comparison between the time required to deliver a specific service before and after branch re-engineering. Generally, the average time in providing financial services required approximately 60-72% time (Thai Farmers Bank Annual Report, 1995). For example, the maximum and minimum time which was required to cash a cheque was approximately between 10-5 minutes before re-engineering, as compared with approximately 5.2-1.6 minutes after re-engineering (Thai Farmers Bank Annual Report, 1995). As of 1997, the bank claimed that re-engineering has reduced annual remuneration by 6.36%, when compared to figures in the previous four years, and moreover, has also reduced the number of employees to 15,740 persons, as compared to 16,400 persons in 1995.[83]

In sum, re-engineering was progressive and sequential. The performances of the first re-engineered pilot branch proved successful. Thereafter, the bank aimed to re-engineer all remaining branches located nation-wide by 1996 with an average of 30 branches per month. The bank benefited from both managerial and technological innovations. For example, the adoption of a unitary queuing system meant that a single file of customers waited for the first available position, in contrast to standing in several queues, and moreover, bank tellers were empowered with modern computer systems to authorise basic financial transactions.

[82] Interview with Phongthawat Phuangkanok, Thai Farmers Bank. See Appendix 6.
[83] See "Overhauled TFB cuts wage bill" (*Bangkok Post*, 16 April 1997).

Sources of Innovation

The sources of innovation can be grouped into four main areas. The first and most important source is bank personnel. Personnel development was one of the bank's priority, as it once experienced a shortage of skilled staff since the early 1980s. During this period, the bank was required to strengthen the capabilities of the computer department, in order to support ATM development plans, by recruiting employees experienced in data communications and on-line system skills. Although the bank experienced the problem of 'brain drain', whereby the turnover of employees in the computer department was less than 5% annually between 1975-1983, the chairman strongly emphasised the importance of developing personnel whom are well qualified and educated (cited from Cash and Mookerjee, 1990, pp. 1-2).

> My top priority over the next two decades was to build a cadre of high-quality professional managers in the bank. I decided to develop people in the bank rather than shop around for people from outside. We gradually raised salary levels to match Bangkok Bank, to attract bright, young people. We also set up a scholarship to sponsor a few Thai Farmers Bank employees each year for advanced degrees at U.S. schools. These students had to sign a bond to work two years at Thai Farmers Bank, for each year of schooling. Many of them are still with us. Today we have the most qualified people in the industry: many of our managers have MBAs from Harvard, Wharton, Chicago, etc.

The policy towards retaining and training employees, rather than recruiting, was also adopted during the period of bank re-engineering. In some bank branches, although re-engineering affected 70 of the 200 employees, or one third of the workforce, unemployment did not increase.[84] Alternatively, the bank reduced the recruitment of new employees and strengthened the skills of existing employees by retraining and reassigning them to newly established branches. Such was the case for employees who were affected by the automation of cheque processing routines whom were retrained.

The bank resolved redundancy caused by re-engineering in several ways. This included the set-up of marketing teams, the conducting of research into bank customers, the building of computer databases, and the retraining of staff. Moreover, the bank expected employees to be regularly trained or retrained twice a year at its

[84] See "Re-engineering in Thailand" (*The Economist*, 11-17 October 1997, pp. 128-9).

learning centre. This centre, a simulated bank branch environment, provided training courses ranging from the improvement of foreign language proficiency to IT skills. Employees are trained to understand the bank's working processes so that they were familiar with each departmental requirement and would also help facilitate them to work more efficiently.

In addition, the bank encourages employees to undergo local and overseas training. For example, the bank acquired training from computer vendors in a project connecting electronic mail, included in the Lotus Notes software package, with the Internet. In other areas, the purchase of a specific computer software from an overseas company may involve the set-up of a team which travels overseas to examine the software and learn possibilities in modifying them to suit the bank's requirements. In return, the team reports and presents the materials acquired from the international software firm to other employees.

The second source is the management of information. Apart from supporting technological improvement programs, the bank's president also initiated innovative ideas which manages the use of information. For example, in responding to the country's financial crisis, the president has initiated an information-based internal risk management division in the bank which is in addition to a 'command centre' previously set-up to monitor world news through electronic media for senior-level management.[85] Phongthawat Phuangkanok, the bank's first vice president for IS processing, illustrates how information, in addition to IT, has become the bank's source of innovation.

> In the past, Thai Farmers Bank relied on employee experiences to make adjustments to every specific situation. Today, we give increased importance to information. We examine and analyse information such as the bank's budget. That is why my department was renamed from computer processing department to information systems processing department. Being a computer centre is not well defined. Thai Farmers Bank has given great importance to information in evaluating everything.

The third source is the research and process development department. Early re-engineering experiments led to the development of this department which gradually

[85] See "TFB gets set to analyse risks affecting banks" (*The Nation*, 3 June 1998).

acquired skills and know-how from working co-operatively with consulting companies. As a result, the department has served as the bank's consulting arm in re-engineering related areas. For example, the department initiated plans to introduce an Internet-based banking service which is an investment of approximately Baht 10 million awarded to a local computer company.[86] From 10 corporations co-operating during the pilot phase, the department expects to provide such services to all 1,500 corporate customers of the bank.

Furthermore, the department works on the identification of innovative ideas from senior-level management. After idea generation, a research group, consisting of relatively young employees aged below forty, some holding doctoral degrees, studies the bank's current business processes, searches for new computer software, and suggests alternative approaches for improvement. For example, the loan approval process was studied and an approach was suggested to shorten the approval time from 1 month to 7 days. In other areas, research projects have considered the improvement of bank branches, international trading activities, credit scoring, and the analysis of consumer behaviour.

The fourth, and perhaps an increasingly unimportant source, is consulting companies. Through such contacts, the acquisition of managerial and technological capabilities was made possible, and later served as a basis for building company capabilities. As re-engineering has continued without the presence of foreign consultants, the bank remains relatively independent for such sources of know-how. This may be seen as the specific reason behind the set-up of an internal research and process development department which acts as the bank's own consulting arm. For example, the bank's policy in computer software development is relatively flexible. They are developed in-house, provided that there is an adequate source of skills from staff, as experienced by the joint-development of a new computer system with IBM employees for the bank's first pilot re-engineered branch. Otherwise, the bank purchased and modified an internationally well-known software package which has already been the case for supporting international trading and financial management.

[86] See "Net banking on the way" (*Bangkok Post*, 1 April 1998).

Summary

This section examined innovation in Thai Farmers Bank. Although the bank was not a pioneer of re-engineering, it was a major catalyst for such radical changes. Through relatively strong senior-level management support, the bank demonstrated that IT played a key role in gaining competitive advantage back in the early 1980s, and more importantly, has shown that this potential relied on personnel development. In addition, other important sources of innovation included the set-up of an in-house research and process development department, and the innovative management of information. Although consulting firms were a main source of innovation in the early periods of re-engineering, recent changes suggest a decrease in their dependency.

5.4 KRUNG THAI BANK[87]

Innovative State Bank

Krung Thai Bank was established in 1966 as a state enterprise after a merger between the Agricultural Bank and the Provincial Bank. This status slightly changed in 1989 when the bank became the first state enterprise to be listed on the stock exchange, and again in 1995, when the government categorised the bank as a "Group 1 State Enterprise". This permitted the bank to increase operational independence and involvement in innovation. For example, the bank was allowed to establish affiliated companies which provided more comprehensive customer services in competition with other commercial banks. In 1996, the bank was ranked the second largest Thai commercial bank in terms of total assets, and the 209th largest international commercial bank (KTB, 1997).[88]

The bank also played a leading role in branch expansion. In 1988, it became the first Thai commercial bank to operate 288 branches in all 73 provinces, and this was followed with the nation-wide installation of ATMs (Krung Thai Bank Annual Report, 1995). The bank also expanded internationally by being the first foreign branch, of a Thai commercial bank, to set-up in New York in 1982, and this was followed with the establishment of 12 foreign branches and representative offices by 1996.

[87] The bank absorbed First Bangkok City Bank as a result of the 1998 financial restructuring package.
[88] See "Top 1000 by country", *The Banker*, various issues

Role of IT

The bank's computer group reports to the executive vice-president and is divided into five main departments. These departments include computer co-ordination, computer operation, consumer finance, credit card, and electronic banking. One of the most recently established departments is electronic banking, which was set-up in the mid-1990s, and aims to support increases in bank customers and work volumes. For example, the bank increased the number of employees to support the introduction and subsequent expansion of ATMs from 10 to 700 machines.[89]

At the organisational level, senior-level management has strongly supported the introduction of IT as part of bank re-engineering. In 1995, the bank contracted the Boston Consulting Group to conduct a study to examine customer needs and branch operations. As a result, the research recommended that the bank's branches should be increasingly specialised, restructured, and most importantly, improvements in working methodology were essential, with increased support through computers to increase efficiency and accuracy (Krung Thai Bank Annual Report, 1995). This research led to a re-engineering program scheduled for implementation between 1996-2000, and involved the increased use of IT as a core component. For example, in late 1995, the bank introduced new computerised systems including pilot projects on the dealing room system, the trade finance system, and the credit management system. In 1996, a loan origination system was introduced to facilitate loan applications and approvals.[90]

The bank formulated policies aimed at providing value-added services for 1996. For example, this included the introduction of modern management ideas such as the network organisation. Moreover, this involved the planned introduction of new computer software which enhanced existing system capabilities, and provided 24-hour ATM services without disruptions or operational failures during peak periods. Other plans included the centralisation of three main computer centres to provide efficient services and the improvement of corporate decision making.

[89] Interview with Chaiyong Wongwuticomjon, Krung Thai Bank. See Appendix 6.
[90] See *Money and Banking* (February 1996, pp. 209-211).

Many innovative services were also introduced. For example, telephone-banking services allowed customers to inquire about their personal bank account information, to purchase and sell open-end funds, and to register for academic studies in selected universities. The bank also introduced Krung Thai Information System, permitting customers to use an on-line personal computer to retrieve personal financial information from the bank's computer database, including the transfer of funds between bank accounts, the payment of public utility bills, and the retrieval of supplementary services.

The bank also innovates through affiliated companies. In 1994, Krung Thai Computer Services (KCS) was established, for which the bank held a majority of shares. KCS, which is chaired by a member of the bank's senior-level management, is organised into nine departments dealing with different operations, namely computer audit, front office, electronic banking, head office, international business, self-service banking, technical support, data communication, and finance and administration. The main objective of this new company was to support the bank's working units and subsidiaries through IT which also covers consulting services concerned with organisational development and enhancement. Moreover, the company has long-term plans to provide consulting services to outside organisations.

The bank builds consulting capabilities through KCS. The range of services provided by the company is similar to consulting firms. This particularly includes system development work, covering IT strategy planning, feasibility studies, system maintenance, system integration, computer procurement, computer auditing, and technical training. Such areas assist the strengthening of managerial and technological capabilities, and furthermore, serve as a potential source of competitive advantage in generating innovative financial services.

Krung Thai Card is another affiliated company. This firm provides a range of card-based services to customers, and in some cases, co-operates with non-banking institutions in introducing innovative card-based services, for example, for use in entertainment companies and educational establishments. Moreover, Krung Thai Bank became the first commercial bank in Southeast Asia to develop an Internet-based, 24-

hour ticket-less reservation system, a co-operative service jointly developed with the country's national airline which aims to permit members to reserve, change, or cancel their flights through the Internet.[91]

Sources of Innovation

The sources of innovation can be grouped into three main areas. The first source is consulting companies. The Boston Consulting Group was contracted to advise on bank re-engineering and re-organisation, and this resulted in a four-year program which plans to increase the use of IT to improve current working processes. Such an approach to re-engineering may have been in response to competitors which have embarked on similar programs. This was not the only case of large commercial banks, but also their mid-sized and small-sized competitors, as was illustrated in the previous chapter. However, the bank created its own 'consulting' team which worked closely with the management consultants. As a result, this led to the creation of the bank's own computer and consulting company, KCS, which has become a potential source of competitive advantage.

The second source of innovation, which may perhaps downplay the importance of consulting firms in the future, is affiliated companies. Bank affiliated companies provide a strong base for innovation, a direct result of the bank being upgraded to a 'Group 1 State Enterprise' in 1995. For example, the establishment of KCS in 1994 helped the bank retain skilled staff who otherwise may have searched for better employment prospects in other companies, providing higher remuneration. Chaiyong Wongwuticomjon, the bank's senior vice president for electronic banking, describes how KCS resolved previous problems in retaining skilled employees.

> In the past, we experienced a brain drain. Our former employees moved to other companies which offered more attractive benefits. This resulted in a severe lack of human resources. As a result, when we developed computer software in-house and encounter problems with staff, it was devastating. Alternatively, if we purchase software, we needed to depend on other people. Therefore, we established a computer company to compete with the outside labour market. We are now stable.

[91] See "Fast lane to THAI seat for KTB clients" (*The Nation*, 26 November 1997).

This approach helped the bank provide more competitive salaries to staff. Otherwise, the bank, which is a state enterprise and provides an equivalent of government-level salary, faced loosing experienced and highly skilled employees to other financial institutions which provided more attractive remuneration packages. Since the company was established in 1994 with 71 employees, there was an approximately four-fold increase in the number of personnel to 317, as of 1998 (KCS report). In principle, the bank can create companies that will contribute to overall competitiveness, and this has helped prepare the bank to compete with local and overseas financial institutions which have also initiated similar strategies.

The third source of innovation is personnel development. Krung Thai Bank is among a very few commercial banks in the country which has established a clear position in promoting human resource development. At the national level, the bank has continually emphasised the need for the government to take proactive policies and measures towards its human resources skills development plan for 1995-2001. In addition, the bank attempted to establish an overseas working loan project jointly organised with the Department of Employment, although the project faced start-up problems, concerning collateral and the duration of loan repayments (Krung Thai Bank Annual Report, 1995, p. 20).

At the organisational level, educational scholarships were provided and seminar attendance was supported. For example, in 1995, there were 417 training courses involving more than 14,000 employees, and moreover, educational scholarships were also provided for employees and the public, including 44 local and 15 overseas scholarships (Krung Thai Bank Annual Report, 1995, p. 61). Moreover, the bank encourages staff training, and in 1995, built a new training centre capable of accommodating 250 employees. This centre simulates a bank branch environment and is equipped with modern computer equipment, for example, audio-visual production facilities, computer networks, sound laboratory, and a library. New employees undergo on-the-job training and computer vendors help provide training on new technologies.

However, the problem of staff quality, particularly in computer related functions, remains to be a slight problem. Although KCS has been capable of maintaining and retaining a relatively satisfactory number of employees, there are specific non-technical skills, an issue noted as a constraining factor to innovation by Chaiyong Wongwuticomjon.

> There are no problems with the quantity of staff. Alternatively, there are problems with their quality. They lack several skills. Although everyone is industrious and responsible, they may lack general or survival skills in contacting the outside world which may be partly because they are state enterprise staff. They may also be weak in the command of the English language. As technology comes with language, we will be unable to communicate without their full understanding of the language.

These problems are non-technical by nature. Comparatively, the bank does not face technical problems, as it views technology as having a life cycle. For example, the bank's computer software are changed and corrected during a 5-year period prior to becoming obsolete. Such importance given to foreign language skills also imply the need to clearly communicate with foreign consultants or computer vendors in designing the bank's IS, and also raises the need to strike a balance between technical and language skills. Such issues concern the replication rate of specific resources which is further discussed in the following section.

Summary

This section examined innovation in Krung Thai Bank. Although the bank is a state enterprise, its senior-level management has given support towards innovation, particularly though bank re-engineering. As a result, the bank established affiliated companies which served as a consulting arm to improve current bank functions, and may perhaps downplay the dependence on foreign consulting firms in the future. To support such strategies, the bank has emphasised the importance of personnel development organisationally and nationally.

5.5 DISCUSSION

This section discusses the common characteristics shared by the four commercial banks. As discussed in Chapter 4, the commercial banking sector is concentrated. As of 1997, this mainly included 15 Thai commercial banks which can be organised into three groups, including 4 large banks, 6 mid-sized banks, and 5 small-sized banks. Although there has been widespread developments in IT in the banking sector, as suggested in the previous chapter, major technological developments and trends were initiated by the large commercial banks. Therefore, this group has become technology leaders and their involvement has served as a precedent, or in some cases as a catalyst, to the adoption of new information technologies in the commercial banking sector.

Banking Leadership

The first common characteristic is leadership in banking. The four commercial banks dominate the domestic commercial banking industry's market share in total assets and total deposits. In 1996, the combined market share of total assets and total deposits owned by the four commercial banks were 60.4% and 60.85% respectively (KTB, 1997). These figures comparatively outweigh the market shares of both mid-sized and small-sized commercial banks, as illustrated in Table 5.4.

Table 5. 4 Market Share of the Four Big Banks in 1996

Bank	Total Assets (%)	Total Deposits (%)
Large-sized banks		
Bangkok Bank	22.81	21.87
Krung Thai Bank	14.14	15.08
Thai Farmers Bank	12.76	13.55
Siam Commercial Bank	10.69	10.35
Large-sized banks (total)	60.40	60.85
Mid-sized banks (total)	31.39	31.86
Small-sized banks (total)	8.22	7.56
Grand Total	100.00	100.00

Source: KTB (1997); Note: Numbers may not add to 100 due to rounding.

The four banks are also among the largest regional and international commercial banks. In comparison with 200 commercial banks in the Asian region in 1997, Bangkok Bank ranked 13th, Thai Farmers Bank 22nd, Krung Thai Bank 25th and Siam Commercial Bank 28th (Banker, 1997). Similarly, in comparison with 1000 international commercial banks in 1996, the rankings were 121st, 182nd, 209th, and

211th for each respective commercial bank.[92] Table 5.5 illustrates the rise in rankings of the four commercial banks in comparison to their international counterparts from 1991-1996.[93]

Table 5. 5 International Rankings of the Four Big Banks, 1991-1996

Bank	1991	1992	1993	1994	1995	1996
Bangkok Bank	195	172	149	148	139	121
Thai Farmers Bank	313	337	575	236	201	182
Krung Thai Bank	375	361	300	283	223	209
Siam Commercial Bank	391	321	308	284	297	211

Source: Top 1000 by country, *The Banker*, various issues

These rankings suggests that the size of commercial banks may have been an important factor influencing their international standings. Moreover, they may also indicate the preparedness of the commercial banks to compete regionally and internationally. Nevertheless, such figures do not fully explain the relatively strong fundamentals which have come from banking policies directed towards developing resources, particularly in personnel, IT, and bank re-engineering.

Role of Skilled Staff

The second common characteristic is the use of skilled staff. This ranged from skilled senior-level management who help form long-term banking visions and strongly supported the commitment of organisational resources towards investments in personnel development. Such characteristics have helped the four commercial banks acquire, apply, and advance modern management techniques which strengthened their managerial capabilities. The main sources of skilled staff can be organised into two main groups.

The first group of staff is senior and mid-level management executives. A majority of senior-level bank executives from the four commercial banks were educated in foreign universities and hold high-level positions such as president, chairman, and chief executive officer. This includes personnel who have earned academic degrees ranging from economics to business administration from some of the world's most outstanding universities. For example, the president of Thai Farmers

[92] See "Top 1000" by country, *The Banker*, various issues.

[93] See footnote 1 for an explanation of international rankings. The aim of *the Banker* survey is to illustrate each commercial bank's soundness in relation to the BIS requirement of a minimum Tier One capital on risk-weighted assets of 4%.

Bank, who was a catalyst behind branch reengineering and bank computerisation, studied at the Harvard Business School (Thai Farmers Bank Annual Report, 1995). The president and chief executive officer of Siam Commercial Bank, who is a former central bank official, is an economics graduate from the University of Pennsylvania and the Massachusetts Institute of Technology (Siam Commercial Bank Annual Report, 1995). Krung Thai Bank's chairman, who was a former Finance Ministry permanent secretary, read mechanical engineering and economics at Cambridge University (Krung Thai Bank Annual Report, 1995). Such high educational qualifications were also common characteristics shared by a large number of mid-level managers who overlook senior vice-president positions.

The board of directors also played an important role in the four commercial banks. This includes individuals who have become influential figures in the country's political and economic affairs. For example, the board of directors of Bangkok Bank includes a former Foreign Affairs Ministry minister and the Board of Investment secretary general (Bangkok Bank Annual Report, 1995). Similarly, Siam Commercial Bank has a former Prime Minister and a former assistant central bank governor represented on its board (Siam Commercial Bank Annual Report, 1995). As for Krung Thai Bank, the bank's board of directors include an attorney general and two assistant central bank governors (Krung Thai Bank Annual Report, 1995), while a former Police Department director general is a board member at the Thai Farmers Bank (Thai Farmers Bank Annual Report, 1995). In these cases, although the commercial banks may not have benefited directly from bank-specific skills, the political skills and connections possessed by such influential individuals provide a potential source of competitive advantage which is necessary in conducting the bank's affairs with other key figures in both the public and private sectors.

A large number of senior-level bank executives also have prior professional banking experiences. One key institution that is a source of skilled staff is the central bank which has adopted a long-standing policy in promoting human resource development. Since the early 1950s, the central bank scholarship program has provided financial assistance to educate eligible Thai students in leading overseas

universities, for which this group of students return to work for the central bank upon completing their studies.

In some cases, central bank officials are sought for by Thai commercial banks. In other circumstances, they are a source of skilled staff. The chief executive officer of Siam Commercial Bank, for example, has worked as the central bank's director of the financial institution supervision and examination department, prior to joining the commercial bank. Similarly, Bangkok Bank and Krung Thai Bank have senior-level management executives with prior working experiences with the central bank (Bangkok Bank Annual Report, 1995; Krung Thai Bank Annual Report, 1995).

The second group of staff is lower-level personnel. From early-1990s to mid-1990s, the four commercial banks invested in the building of staff training centres, which provided a simulated branch bank environment. Entry-level employees were trained on basic banking knowledge and on improved working processes, which are supported through modern computer-based IS. In other cases, the training centres provided experienced employees to update their skills through training seminars. In addition, the training centres also provided re-training programs. Although many bank personnel may have been made redundant through re-engineering, bank policies were aimed at reducing the recruitment of new employees, and increasing the efficiency of the current workforce. Such policies was supported through an increased use of IT which empowered bank clerks, for example, in authorising a predetermined amount of cash withdrawal or loan application.

Table 5.6 illustrates a rise in the number of employees since the late 1980s and a gradual decline in employee growth rates in the four commercial banks between 1995-1996. This may partly be a result of reengineering, which was popularised in the mid-1990s, and the promotion of progressive bank policies favouring the training and retraining of current personnel, as compared with the recruitment of new employees. However, the employee efficiency ratio of the four commercial banks, indicated by net profit earned per employee in Table 5.6, are higher than the commercial banking industry average in Thailand.

Table 5. 6 Employee Numbers and Efficiency Ratio at the Four Big Banks, 1988-1996

Bank	1988	1989	1990	1991	1992	1993	1994	1995	1996
Employees (persons)									
BBL	20,040	20,838	22,270	23,642	24,035	24,689	25,355	26,310	26,218
KTB	12,216	13,031	14,968	15,553	16,358	16,550	16,650	16,655	16,561
TFB	12,299	12,858	14,092	15,039	15,865	16,300	16,000	16,086	15,740
SCB	7,436	8,289	9,361	10,060	11,287	12,467	12,147	12,935	12,909
Net profit/employee[1]									
BBL	0.09	0.12	0.21	0.31	0.44	0.56	0.68	0.75	0.79
KTB	0.01	0.04	0.07	0.08	0.17	0.26	0.49	0.61	0.62
TFB	0.08	0.12	0.22	0.23	0.33	0.49	0.65	0.72	0.75
SCB	0.10	0.13	0.23	0.27	0.37	0.39	0.51	0.60	0.70
Industry average									
	0.07	0.09	0.16	0.19	0.28	0.38	0.51	0.57	0.58

Source: Krung Thai Bank (1997); Note: [1]Millions of Baht per employee; BBL - Bangkok Bank, KTB - Krung Thai Bank, TFB - Thai Farmers Bank and SCB - Siam Commercial Bank

In sum, skilled staff was a major factor influencing innovation among the four commercial banks. Firstly, senior-level management demonstrated relatively strong support to strengthen managerial and technological capabilities. Bank managerial capabilities, for example, were strengthened with the acquisition of former central bank officials and the appointment of influential individuals in the bank's board of directors. Secondly, lower-level employees received training, and in some cases re-training, according to bank policies promoting personnel development. The four commercial banks were committed to human resource development through the set-up of specialised training centres which provides training on foreign languages and basic computer skills. Moreover, bank personnel also received re-training, particularly in cases which responded to reengineering programs which was aimed to prepare them to work with improved business processes and computer systems.

Role of Re-engineering

The third common characteristic is the introduction of re-engineering programs. Such changes have been a response to increased competition in the Thai banking system, resulting from financial liberalisation initiated in the early 1990s. For example, local and foreign commercial banks were allowed to operate international banking facilities, increasing the availability and flow of foreign capital in and out of the country. Moreover, the four commercial banks faced competition from non-bank financial institutions, for example, finance firms, securities companies, and insurance companies, which were allowed to provide a range of similar, and in some cases, more competitive and innovative financial services.

Re-engineering began with the contracting of consulting companies. This ranged from foreign firms providing management and IT consulting. The main management advice's were aimed at organisational restructuring, for example, to create flatter organisational levels, and to promote teamwork among bank personnel. Additionally, consulting companies helped formulate IT strategies, and in some cases, assisted the development of computer-based IS.

Re-engineering was aimed to improve current business processes. Routine functions in current working processes were identified and modified accordingly which was followed with use of IT to increase operational efficiency. Re-engineering started at bank head offices as pilot programs, and thereafter, the operational results, before and after the program, were evaluated and diffused to bank branches located nation-wide accordingly. In some cases, bank personnel were also retrained to learn changes in working practices.

There were, however, reservations to re-engineering. Although the four commercial banks realised the importance of consultants in re-engineering, they have initiated projects to decrease the dependency on consultants. For example, two commercial banks in the mini-cases created their own teams to work closely with consultants, and as a result, this joint-team effort helped the two commercial banks learn more about re-engineering in general and about their current problems in particular. Furthermore, one of the commercial banks established a new research and process development department to support re-engineering, while another set-up an independent company serving as the bank's own consulting unit. Such initiatives increased their indigenous capabilities in re-engineering and reduced their complete reliance on consultants.

Role of IT

Lastly, the fourth common characteristic is the increased use of IT. The mini-cases illustrated how the four commercial banks pioneered the use of IT in banking in their own unique ways. For example, this may have been the introduction of ATMs, satellites, or specific Internet-based banking applications. As a result, such early mover advantages have positioned them as technology pioneers, leading both mid-sized and small-sized commercial banks in major technological applications. Large

and risky investments in IT projects were initiated by the four commercial banks to test the market, and if the pilot project are successful, they are generally replicated by the two latter groups whose aims are to catch up in technology to gain competitive parity. Nevertheless, the large commercial banks have committed significant investments in IT, partly to maintain their market shares in the sector. Table 5.7 illustrates the growth of ATM units of the four commercial banks in comparison with the overall industry average.

Table 5. 7 ATM Growth in the Four Big Banks, 1988-1996

Bank	1988	1989	1990	1991	1992	1993	1994	1995	1996
ATM (units)									
BBL	155	203	232	274	308	334	431	634	878
KTB	158	197	261	319	351	383	410	487	690
TFB	144	152	171	201	229	270	402	499	579
SCB	130	145	159	183	207	250	325	429	522
Industry Total	797	935	1,097	1,323	1,513	1,757	2,313	3,154	4,145
Market share (%)									
BBL	19.45	21.71	21.15	20.71	20.36	19.01	18.63	20.10	21.18
KTB	19.82	21.07	23.79	24.11	23.20	21.80	17.73	15.44	16.65
TFB	18.07	16.26	15.59	15.19	15.14	15.37	17.38	15.82	13.97
SCB	16.31	15.51	14.49	13.83	13.68	14.23	14.05	13.60	12.59
Industry Total	100	100	100	100	100	100	100	100	100

Source: Krung Thai Bank (1997). Note: BBL - Bangkok Bank, KTB - Krung Thai Bank, TFB - Thai Farmers Bank and SCB - Siam Commercial Bank

The four commercial banks maintained their dominant market share in ATM units during 1988-1996. However, their growth rates in ATM units were increasingly lower than the mid-sized and small-sized commercial banks categories. In 1989, the figures were 17.26% (large banks), 17.07% (mid-sized banks), and 17.31% (small-sized banks) for each group respectively. By 1996, the difference in growth rates widened, being 29.80% (large banks), 41.38% (mid-sized banks), and 31.42% (small-sized banks) for each group respectively (KTB, 1997). Such changes indicate the relatively high rate of replication in ATM technology which further suggest that IT may not become a potential source of competitive advantage.

There were also clear IT strategies and plans. By forming strategies through the assistance of consulting companies, senior-level management has helped in preparing plans which ranged from long-term to short-term periods. Such plans formed the basis for bank computerisation through IT investments, and served as early exercises, whereby the four commercial banks were required to invest in human

resource development, particularly in the retraining of bank personnel to suit new and increasingly efficient working processes.

In addition, the four commercial banks pioneered the use of IT in banking. Bangkok Bank pioneered the use of satellite technology for provincial banking, while Siam Commercial Bank successfully introduced ATMs. Although not the pioneer of re-engineering, Thai Farmers Bank was a catalyst behind the change which was widely popularised in the country. Krung Thai Bank, in co-operation with the country's national airline, introduced the first Internet-based, credit card ticket-less reservation system in Southeast Asia.

The four commercial banks promoted the use of IT in two main areas. Firstly, this was to automate bank routines. This formed a part of wider programs in branch re-engineering, including the use of new computer systems connected to terminals located in the front office. In addition, this empowered bank clerks and increased the physical area for serving customers, shifting non-customer related work to the back offices, which, in turn, used computers to process routine transactions. Secondly, this was to improve customer services and satisfaction. While IT improved current working processes, it also increased efficiency in delivering banking services to customers. In addition, IT was applied to support a range of financial services, including, for example, the authorisation of loan applications. Other innovative services, for example, telephone-based banking, electronic banking, and Internet-based banking, were introduced accordingly.

Replication of Resources

In cases where commercial banks shared common characteristics, there may be competitive parity among firms. Alternatively, some commercial banks may distinguish themselves on the uniqueness of specific resources which may become a source of sustained competitive advantage. Such uniqueness may vary in their rate of replication which is further influenced by a set of attributes characterised in physical, organisational, and human resources.

Firstly, the replication of physical resources is relatively easy to carry out as compared to organisational and human resource replication. The mini-case studies

suggested that IT, which is a physical resource in form, were being increasingly acquired, applied, and advanced by the large commercial banks. The ATM provides one illustration. Although Siam Commercial Bank enjoyed early-mover advantages in the early-1980s when it pioneered ATMs, other commercial banks replicated such technologies. Thai Farmers Bank was one of these earliest competitors which rapidly responded by developing telecommunications and on-line computer capabilities to catch-up with the technology leader. There were more interesting changes in the 1990s, as suggested by the growth rates in ATM units among mid-sized and small-sized commercial banks outgrowing their larger counterparts. Although this may be partly due to the initiation of co-operative computer networks among a group of commercial banks, it also suggests that the smaller firms have focused and expanded their banking activities into the retail market. This high rate of replication in ATM technology further suggest that such physical resources are a weak source of competitive advantage, as they are homogenous, mobile, and readily available for purchase in the markets.

Nevertheless, some interesting developments have been emerging. For example, commercial banks have developed and modified their own computer software to support ATMs, as compared to purchasing them. This suggests the building of software development capabilities, and more interestingly, commercial bank affiliated companies are increasingly becoming an important source of innovation. Such affiliated companies can develop, in the long-term, innovative financial products and services which are unique. Furthermore, if successful, the company can create an appropriability regime to protect such innovations which may potentially become a source of sustained competitive advantage (Teece, 1986).

Secondly, the replication of organisational resources is moderately difficult. Although commercial banks have the resources to invest in IT, the linkage with company strategy is equally important. The case of re-engineering provides one illustration. Through recommendations made by consulting companies, commercial banks have learned to a great extent about their working processes, and more importantly, how to improve them. However, the application of recent re-engineering concepts and modern management techniques may not suit each commercial bank

similarly, as their organisations have unique characteristics. In order to address such issues, some commercial banks have initiated an in-house research unit to work closely with consultants, expecting to learn more about their organisations themselves, and most importantly, to be capable of initiating the re-engineering of other potential processes on their own. For this research unit to be a source of sustained competitive advantage, however, there is a need for skilled bank personnel to conduct studies, analyse alternatives, and make recommendations.

And thirdly, which follows on from the previous point, the replication of human resources is relatively difficult to carry out as compared to physical and organisational resource replication. For example, since specific skills residing in bank personnel are intangible, they are not well-coded and difficult to transfer. Such expertise, for example in designing an IS, is tacit knowledge to a specific person and may be difficult to articulate. Thus, the education and training of specific individuals become an organisational routine or the repository of knowledge for the organisation.

This stock of skill is one of the most important sources of innovation an organisation could use to gain or sustain competitive advantage. Therefore, it is not surprising that the commercial banks committed resources in this area by investing in training centres and the supporting of further education for bank personnel. Such strategies seek to develop and support employees in specific technical skills, and who are familiar and trained to work with computers and re-engineered working processes.

Most importantly, however, is the acquisition of personnel at the senior-management level. Although such policies are not explicit, it has become one of the common characteristics among the commercial banks. Such individuals have been recruited, or in some cases appointed, to acquire managerial skills. Interestingly, in the four mini case studies, senior management was actively involved in setting IT strategies. In addition, it is also interesting to note that in Thailand, where a large number of commercial banks are family-controlled, there has been the appointment of influential figures in the country to key organisational positions. This has largely been to gain and maintain political and social connections in government and business.

Thus, such invisible human resources are unique and difficult to transfer, but would provide a potential source of competitive advantage.

Summary

The aim of this chapter was to examine innovation in four Thai commercial banks. The combined four mini-case studies helped identify the major sources of innovation which contributed towards banking automation and payments system modernisation. Although such sources included skilled staff, IT, and re-engineering, their potential as a source of sustained competitive advantage varied. In order to develop and provide innovative products and services, commercial banks increasingly depend on the development or acquisition of skilled bank personnel, in contrast with increased investments in IT, or even in bank re-engineering. One such source has been the central bank which we turn to in the following chapter.

CHAPTER 6: THE CENTRAL BANK

This chapter examines innovation in the central bank and is organised into six sections.[94] Section 6.1 reviews the central bank's historical development. Section 6.2 discusses innovation in two departments. Section 6.3 illustrates a central bank automation project. Section 6.4 examines the payment systems modernisation project. Section 6.5 discusses the development of central bank capabilities. And lastly, section 6.6 discusses the main points of the chapter.

6.1 BACKGROUND

The Formation Years, 1900-1942

Thailand began to modernise in the early 1900s. The building of basic infrastructures and institutions, mainly based on western models, were introduced, and the set-up of a central bank was one of many ideas. National leadership during this period was very important as colonial influences from England and France were spread throughout the Indo-Chinese region. King Chulalongkorn, who ruled Thailand between 1868-1910, was the country's champion of change and his pioneering travels to Europe during this period provided the country contacts with a diverse range of people and ideas. Thailand started to engage foreign financial advisers during this period, as the King realised that the country's independence partly rested on its internal financial stability. Poor economic situation would have served as a precondition for the country's colonisation by foreign powers. A British financial adviser was summoned from the Bank of England to consult on economic affairs. He offered conservative advice which formed a model for the establishment of the country's central bank in the post-war period (Warr and Bhanuphong, 1996, p. 9).

In 1904 the Ministry of Finance established a Book Club Association. This was to be the first banking office owned by a Thai citizen. Prior to this, the first commercial bank which began operations in the country, was the Hong Kong Shanghai Bank Corporation in 1888. In 1914, Prince Mahisra Raj Haruetai, a former finance minister, engaged Sir Bernard Hunter, a British banker. His role was to study the transformation of the Book Club Association into a central bank. The plan,

[94] This chapter is mainly based on interviews. See Appendices 4, 5, and 6.

however, did not materialise, but was used to upgrade the association into a commercial bank, called Siam Commercial Bank, after the 1932 coup d' etat in the country (Warr and Bhanuphong, 1996, p. 10).

The idea to set up a central bank was revived in 1939. The government passed legislation to establish the National Banking Bureau. The agency received departmental status attached to the Finance Ministry and became operational in 1940. Its initial functions were similar to a normal central bank, including the provisions for receiving deposits from the government and banks, monitoring exchange control, and managing government borrowings. In charge of this early central bank model was Praya Sonauraraj, a Comptroller General, who became the bureau's first director.

In the 1940s a full-fledged central bank was finally established. In this period Thailand experienced Japanese occupation during World War Two, and as a result, was requested to consider three proposals for monetary changes in the country. Firstly, the value of the Thai Baht was to be fixed to the Japanese yen at the exchange rate of 1:1. Secondly, the transactions between both countries were to be conducted in Japanese yen. And thirdly, a central monetary authority was to be established in Thailand with advisers and key personnel appointed from Japan. As a result, this implied the establishment of a central bank with foreign control. Thailand accepted the first two proposals. However, it rejected the third demand which was a catalyst for legislative changes.

In 1942 the Bank of Thailand was established. This was swiftly followed by the Thai government, which approved the Bank of Thailand Act in April 1942, and was enacted as a bill 8 months later by Parliament. The legal process was urgently required to prevent the direct control of the Japanese government over the country's economy. As of 10 December 1942, the Bank of Thailand, an official central bank, which was conceived earlier in the 1900s, became operational, and was headed by the first central bank governor, Prince Wiwattanachai Chaiyan.

The central bank experienced foreign influences in its early formations years. Firstly, the Bank of England contributed conservative financial advice which has been

well practised since. Secondly, the Japanese brief occupation of the country highlighted the importance of an independent central bank. Furthermore, it pointed to the need for well-trained Thai personnel who were to play an important role in directing the country's economy in the future. Thus, the central bank was required to build its own capabilities.

Senior central bankers, a majority of whom have received overseas education, have come to play prominent roles in the development of the country's commercial, banking, and economic systems. For example, Prince Wiwattanachai, the son of a former finance minister, who studied at Cambridge University and Ecole des Sciences Politique, was an adviser to the Finance Ministry in 1938 and the National Banking Bureau director in 1940, prior to becoming the first central bank governor. Puey Ungphakorn, educated at the London School of Economics, became a successful academic, economist, and the longest-serving central bank governor.

Bank of Thailand, 1942-1998

The central bank also supplied highly capable human resources to the country. For example, Supachai Panitchpakdi, educated at Rotterdam University, became a successful commercial banker and politician. Pisit Leeatham, a graduate of the same school, joined Bangkok Bank in a senior-level management position. Olarn Chaipravat, educated at the Massachusetts Institute of Technology, became the Chief Executive Officer of Siam Commercial Bank. Such senior-ranking persons were former central bank scholars who were educated in some of the world's most outstanding schools, and were required to work for the central bank upon their return.

By constitution, the central bank is governed by a Board. The make-up of the six members includes the finance minister, who is the Board's chairman, the governor, the deputy governor, and another 11 members appointed by the King. With respect to the Bank of Thailand Act of 1942, the finance minister is empowered to oversee the general affairs of the central bank. Currently, the central bank's key responsibilities include the formulation of monetary policy, advising on economic policy for the government, supervising financial institutions, developing and supervising the financial system, promoting priority economic sectors, and printing and issuing bank notes.

Following the set-up of the central bank, technological and economic developments drove changes to its organisation structure. Firstly, the central bank re-organised technology-related activities under a new IT department, and also set up a payment systems department, resulting from modernisation programs undertaken in this area. This is discussed in the following section. And secondly, the central bank underwent a major re-organisation which was a direct result of the country's financial crisis in mid-1997.

In Thailand, rapid reform of the central bank was urged, as the institution played a major part in a failed defense of the country's currency. As a result, the country's exchange rate regime was changed from a fixed-rate to a managed-float system, the currency was devalued, and a request for international financial assistance followed. These developments were to cause a major change to the central bank which included changes to the governorship and other wide ranging reforms. The Nukul Commission report was a direct result of such changes which directly recommended measures to address the structural weaknesses and capabilities of the central bank.[95]

The appointment of an international advisory committee was one major reform. This included former senior-level international central bankers from the United States Federal Reserve, the Bank of England, the Monetary Authority of Singapore, and the Bank of Thailand.[96] In this respect, the appointment of the panel was aimed at improving the credibility of the central bank through better banking supervision, increasing the sharing of financial information among banks through a real-time IS, and developing the central bank into a leading institution in the region.[97]

[95] See "BOT failed to nurture capable management" (*The Nation*, 5 March 1998); and "Nukul Committee Report: Analysis and Evaluation of the Facts Behind Thailand's Economic Crisis" (*The Nation*, 1998).
[96] See "International advisers to BOT rescue" (*The Nation*, 5 April 1998).
[97] See "Top bankers to advise on BOT reform" (*The Nation*, 20 April 1998).

In addition, the central bank underwent further re-organisation. Responding to the recommendations raised in the Nukul Commission report, it re-organised by delayering its chain of command.[98] As a result, the central bank governor receives support from two deputy governors, who are in turn supported by six assistant governors overseeing a group of specific departments. For example, departments responsible for economic research, banking, and foreign activities were organised under one umbrella. This change addressed the former structural weaknesses which was characterised by separated departments being unable to co-ordinate work among their personnel. Furthermore, the central bank established a new litigation department to support banking supervision, and has also provided former employees the opportunity to consider early retirement and remuneration schemes.

Summary

This section provided a brief overview of the Bank of Thailand. Early foreign influences were factors which pushed forward the establishment of the country's central bank. Most notably, the Japanese occupation of the country raised the need to create indigenous capabilities. As a result, the central bank became one of the earliest institutions in the country to promote the development of human resources, providing scholarships for students to earn an education in internationally renowned universities. However, although these scholars returned to work for the central bank, some of them moved to work in the private or elsewhere in the public sector. The aftermath of the country's economic crisis only proved that there remain structural weaknesses within the central bank, and as a result, there have been wide ranging reforms.

6.2 INNOVATION IN TWO DEPARTMENTS

This section discusses innovation initiatives in two central bank departments. During the 1990s, the central bank experienced organisational restructuring like most of the country's commercial banks. Such changes were aimed at improving work processes and using IT to facilitate organisational routines. In the central bank, technology-related developments were experienced at both the departmental and project levels. This section discusses such changes and the following section will examine the implementation of selected projects.

[98] See "BOT heads for revamp amid woes" (*The Nation*, 28 May 1998).

The IT Department

In the early days of the central bank, the current IT department played only a very minor role.[99] In fact, it began only as a small machinery and equipment division. The main responsibilities were to support the on-going functions of other departments. Presently, it has played a major role in the formulation of the central bank's master plan and the development of the national payment system. The division was soon upgraded to departmental status. This was called the information planning and operations department. The name of the department, however, confused many senior central bank officials, who were uncertain whether the department was responsible for overall planning or only operations. When organisational restructuring started in mid-1995, this was renamed as the IT department.

The work of the department, prior to restructuring, was functional. Departmental activities were clearly divided into specific areas, including system development in various projects, computer operations, and technical support. Under this structure, however, the department did not operate flexibly to support the central bank's overall activities. Staff mobility and the completion of various tasks depended highly on the work status of IT personnel in other departments.

The organisation of work, after restructuring, shifted from functional to divisional units. All departmental tasks were divided into smaller work divisions. For example, system development and technical support were divided into 12 and 6 divisions respectively. These divisions are then managed by a shorter chain of command, including a director, 1 to 2 deputy directors, and several assistant directors. As a result, this new structure helped improve departmental flexibility which was in contrast to having a single deputy director. This change was more appropriately structured according to the needs of the user divisions. Thus, the increase in the number of deputy and assistant directors enabled the department to respond rapidly to tasks which overlapped. For example, the department's technology specialists, who were well- trained in UNIX systems, helped form the core team which modernised the country's payment system. Thus, this new way of working was aimed to support the

[99] See *Phra Siam* (February-March 1996, pp. 11-16).

central bank's overall computerisation and master plans, as suggested by Niyada Kanishtarat, deputy director of the information technology department.

> We have 9 projects to implement between 1996-1998. In fact, the department regularly formulated three-year computerisation plans as early as 1976. This provided the work plans and guidelines during a period when the first computers were introduced at the central bank. Such plans were suppose to support the central bank's broader master plans.

However, the central bank began to formulate master plans in early 1990. Unfortunately, phase one of the master plan, which covered the period from 1990-1992, was not in parallel with the department's computer plans. There were some overlapping activities which prevented work progressing in the same direction. Therefore, the department's most recent computer plans was adjusted to support phase three of the central bank's master plan, covering the period from 1995-1998.

Currently, the department has increasingly become professionally oriented. It has specifically formulated clear objectives, policies, and duties. Firstly, the department aims to adopt new technologies in facilitating central bank work and to make it more international. This supports the central bank's overall policy in improving work processes, including the reduction of personnel, the shortening of the chain of command, the improvement of staff skills, and the promotion of team work. Secondly, department policies have changed from being reactive to proactive. It has expanded its roles to support both front office and back office work. Prior to this, the department was viewed only in supportive roles. To achieve this, it has stressed its core competence, including self-development of both technical and banking skills, teamwork, and openness between directors and departmental staff in communication. Lastly, the department has redefined its duties after restructuring. This includes work in the following four areas: (1) provide technical training and support to other departments, and the bank's customers, for example commercial banks, finance and securities companies, and insurance firms; (2) provide daily computer operations; (3) manage the central bank's technical library and services; and (4) assesses the computer hardware, software, and communication technologies, prior to being adopted by the central bank.

The computer literacy rate of central bank staff has been relatively high which has been estimated at 70%.[100] In this respect, the diffusion of personal computers, which were introduced around 1986, was partly a contributing factor. Prior to this period, the central bank's computer system was centralised and connected to a data processing centre receiving user commands, and generating feedback through reports. Presently, users have become more involved through client/server-based systems and the department has played a supportive role in providing them with appropriate training.

Shortage of staff

There remain unresolved problems despite restructuring. The department's director clearly suggested that although the central bank may have seen the importance of IT, by restructuring the department and authorising the number of needed personnel requested, there remains a recurrent problem which required time to resolve.[101] This was the acquisition of human resources which would match the central bank's work demands adequately. The problem was magnified with the mismatch between the high demands of senior-level bank officials and the inadequate supply of computer personnel, as suggested by Niyada Kanishtarat.

> Senior-level executives have expected early completion of tasks, while the department has been unable to find an appropriate number of employees. The department sees the task of searching for prospective staff time-consuming, and in some cases, vacant positions have taken years to occupy. As a result, this has become an on-going problem for the IT department. Moreover, there are currently vacant positions in the department, even at the levels of deputy and assistant directors, which are still undergoing consideration.

Resolving such problems has also been attempted through the personnel department. For example, the department attracted prospective personnel through a summer internship program, which was aimed for local and overseas Thai students, who wanted to learn more about the central bank responsibilities, by working on a part-time, and on-the-job training basis. The recruitment strategy was changed from accepting students in their third year of study to final year students. This was aimed to

[100] See *Phra Siam* (February-March 1996, pp. 11-16).
[101] See *Phra Siam* (February-March 1996, pp. 11-16).

screen students for their technical skills within 2 months, assess their abilities, and examine the extent they can adapt to the central bank's work.

However, this was a partial solution. The recruitment strategy focused on personnel at the entry level. In more realistic terms, technology-related work involved increasingly complex and technical skills. As a result, the department required the skills of computer experts and experienced employees as well. In doing so, the central bank has resorted to the Thai labour market, but unfortunately, they were unable to compete with highly competitive remuneration packages which have been offered by other companies.

Moreveor, the department has never achieved an exact match between computer personnel and job vacancies, although it faced increasing and accumulating workloads. This problem is emphasised by Niyada Kanishtarat.

> Department personnel occasionally resign or are transferred on an on-going basis. As a result, the problem in preparing human resource plans has affected not only the department, but more importantly, the ability of the central bank to meet the expectations of its senior-level officials in modernising the institution's internal operations.

Outsourcing was also considered but was seen as a partial solution. Computer contracts were awarded to specific companies which would help alleviate the workload of the central bank. This reduced the problem, but only to a limited degree, and has not been seen as a perfect model. In this respect, the department remained responsible for the appropriate selection of the outsourcing company, which was never a simple task, and moreover, was required to follow-up on their activities.

The Payment System Department

Thailand's payment system has evolved from being one of the most rudimentary to one of the most technologically advanced systems in the Southeast Asian region.[102] This effort has been carried out over a 10-year period, involving several central bank governors.[103] Moreover, continual enhancements have increased the system's capabilities, and this has been particularly the responsibility of the payment system

[102] See *Phra Siam* (June-July 1996, pp. 20-24).
[103] See *Phra Siam* (June-July, 1996, pp. 9-12)

department which was established to accommodate this new central banking role. Tarisa Watanagase, director of the payment system department, makes this point.

> In the early days, central bankers thought that they have two main duties. The first duty was to safeguard the financial integrity of the country, while the second was to supervise the stability of financial institutions. Recently, central bankers have increasingly realised that another major responsibility was in providing payment system efficiency and reducing related risks.

The payment system department began as a working group set-up in 1991. The number of employees was less than 10 persons during this period. In 1993, this working group was upgraded as an office for payment system development with approximately 51 employees. In 1994, the central bank's clearing house was moved from the deposits and bonds department to this new office, and as a result, was renamed as the Electronic Clearinghouse (ECH).

The ECH employed approximately 121 employees due to the broad scope of work which expanded from the former clearinghouse. Consequently, the work of the payment system development office started to involve operational and system development functions. In early 1996, the restructuring of this office into a department reflected the wide range and increasing volume of work it undertook. This can be seen from the increase in the number of employees from 51 in 1993 to 191 in 1996 - a fourfold increase. Thus, the ECH accounted for approximately 60% of personnel in the department.

The set-up of the department contributed to flexible management. The chain of command, like the IT department, was kept short. The work divisions were small which made it suitable for teamwork. As the development of payment systems has been a novel experience for the central bank, due to its wide scope, this required collaboration, coordination, and teamwork among various participants. For example, a small team within the department made the division of responsibility much clearer.

Work on payment system development was divided into two phases. Phase one involved three main projects - BAHTNET, ECS, and Media Clearing. Phase two, scheduled for 1996-1998, involved twelve projects, for example, the upgrading of

specific features of systems developed in the previous phase. Other planned projects included a bond management system, delivery versus payment (DVP), and the clearing of inter-provincial cheques. Moreover, system enhancements were planned. This included shortening of the clearing time for provincial cheques from 7-14 days to approximately 5-7 days.[104] More importantly, however, there is a need for the department to develop and provide technical training for its employees which is required to further develop, enhance, and manage the ECH operations. Such a strategy will be relatively difficult, considering the shortage of IT personnel employed in the IT department. We should turn to this point again in section 6.4.

Summary

This section discussed innovation initiatives in the central bank's IT and payment system departments. Although the role of IT has gained an increasingly prominent position as compared to the past, there remains a shortage of staff, particularly in computer related areas. In the area of payment systems, demand for skilled staff was more evident, as the central bank aimed to increase its capabilities in further enhancing payment systems which were implemented in previous phases. In the following section, we observe some other initiatives related to bank automation which are aimed to expose personnel to advanced computer technologies.

6.3 CENTRAL BANK AUTOMATION

In the mid-1990s, the central bank began to automate its internal working processes. This included a 350 million Baht investment budget planned for re-engineering the technological infrastructure of its head office and provincial branches.[105] Such improvements were aimed to support the central bank's main policy in areas related to financial management, payment system development, international banking facilities, and the integration of the country's financial markets with foreign counterparts.

[104] Interview with Tarisa Watanagase, Bank of Thailand. See Appendix 6.
[105] See "Bank of Thailand prepares for the hi-tech era by adopting smart office". (*Money and Banking,* February 1996, pp. 195-197).

Computer and communication technologies became increasingly important components for financial integration. Such advanced technologies were to support planned open market operations in the country's financial markets, including the country's currency, the bond re-purchase market, and the foreign financial markets. As a result, such technical changes were aimed to improve the liquidity positions of the central bank and related financial institutions. Moreover, these changes, which have previously functioned independently, were connected to the payment systems, increasing the central bank capabilities in overseeing the country's financial system.

Investments in computer workstations and communications equipment were divided into two areas. The first area was in the central bank's internal working processes, while the second was in the improvement of information exchange, which is particularly trade-related and with external parties. For example, one of the developments included the installation of a computer system into the central bank's library in 1994. The system, called DYNIX, uses bar code technology and is aimed to facilitate work at the library and information centre.[106] Prior to this new system, most of the work relied on manual processes and the personal assistant of librarians.

Smart Office Project

Smart Office was one of the central bank's major IT projects. The project's implementation, which spanned between 1996-1998, coincided with phase three of the central bank's financial system development plans. Smart Office was aimed to improve the central bank's existing data and IS, contributing to work efficiency in the organisation. Furthermore, this was seen as a step towards office automation.

Smart Office can be viewed as the automation of the central bank with computer networks. The central bank's vision was to improve personnel productivity and to streamline its workflow with the aid of existing microcomputers. This would include reducing the use of paper documents, increasing communication by electronic mail, and retrieving information through electronic means. Thus, work between different departments and personnel were facilitated through value added into the existing computer networks.

[106] See *Phra Siam* (December 1996-January 1997, pp. 40-41).

Within Smart Office, the central bank implemented the BOT-WEB, a system that makes use of Intranet and Internet communications. Such communications were connected to an information centre which organises and distributes central bank information. In addition, central bank personnel may gain access to work schedules, broadcast news, and retrieve information from different departments. This is further connected to BOT-NET, another system that forms the central bank's main communications infrastructure.

Project implementation

The project team responsible for implementing Smart Office included personnel from the IT department and a specially formed working group on document management systems development.[107] This group included the following senior-level bank officials: assistant governor, IT and legal department directors, office of the governor director, organisation and management office director, administrative services office director, and library and information centre director. In this respect, an assistant director from the IT department acted as the working group's secretariat

Smart Office implementation involved the following:[108] (1) the project team studied the technology options, while selecting the most appropriate alternative; (2) the team examined the types of internal documents suitable for testing; (3) the necessary computer equipment and programs were prepared; (4) the operational procedures were introduced to IT personnel; (5) a target group among central bank personnel was identified to test the system; (6) the team evaluated and assessed the system; (7) the system was rolled out; and (8) the team made necessary system adjustments, provided basic technical training, and improved central bank regulations and standards to accommodate the system.

[107] See *Phra Siam* (December 1996-Janaury 1997, pp. 22-25).
[108] See *Phra Siam* (December 1996-Janaury 1997, pp. 22-25).

The diffusion strategy was further divided into two phases. In phase one, the pilot phase during August-December 1996, Smart Office was first introduced in the IT department. The strategy was to develop multipliers in the department, who were technically competent, and will further support the system's full implementation. Thereafter, the system expanded to the central bank's working group on document management systems and to senior-level executives, whereby the latter group was to stimulate the use of smart office among lower-level staff within the central bank. In phase two, from January 1997-December 1998, there were expansion plans for bank sections which have technological potential and are well prepared. This would diffuse from head of sections and departments to operational-level staff within three years.

The multipliers were aimed to act as change agents in diffusing Smart Office. They were divided into two groups. The first group included personnel from the computer group such as system analysts, system designers, and technical support staff, while the second included personnel from other departments who have basic IT knowledge, or who need to use computers extensively in their work. The latter group received training, and if any department faced problems, multipliers were consulted.

Smart Office was designed to support the central bank's current client server system. The main components included three computer servers - the message server, the BOT-WEB server, and the document image server. These servers were connected to microcomputers which were located throughout the head office and branches. The other main parts of the system included computer hardware, for example printers, scanners, and optical jukeboxes to store data. In addition, software programs included Microsoft Office, an electronic mail program, groupware, the BOT-WEB, and document image programs.

Smart Office was further connected to the BOT-NET. BOT-NET was extended to link external parties, for example commercial banks, financial institutions, the Customs Department, the Commerce Ministry, and other governmental agencies. In this respect, BOT-NET and Smart Office supported each other and have proper back-ups. The two systems were further aimed to support the central bank's four provincial branches which follows the earlier diffusion of computers to these branches.

Currently, there are local area networks installed in these regional branches. The BOT-NET, developed during 1996-1997, enabled such electronic communication. Therefore, an electronic message from the head office can be sent to central bank personnel in the outer regions simultaneously. In other areas, the central bank's current account system also benefited. Its database, located at the head office, can be accessed, or even updated on a daily basis, by regional branches which have their own computer servers. This has not only supported regional banking, but also supported the regional expansion of BAHTNET.

Barriers to change

The main difficulty in implementing Smart Office was in changing the working habits of senior-level central bank executives and diffusing the technologies to lower level personnel, as suggested by Niyada Kanishtarat.

> The difficulty has been to understand and use IT in a short period of time. Nevertheless, the central bank has been relatively optimistic about developing a more modern organisation and aims to see the use of computers by personnel in different managerial levels. Most importantly, the central bank wants personnel at the lower operational levels to be capable of gaining access and using such technologies.

The scope of Smart Office was initially limited to three categories of internal documents. These documents were mainly used in the administrative services department. However, automating other types of documents in various departments also required the consideration of document characteristics and their workflow. As a result, guidelines for Smart Office development were suggested as the following:[109] (1) direction and support from senior-level executives was required; (2) there should be coordination between various departments and sections; (3) there should be readiness from staff at all levels to accept and change current work processes; (4) there should be readiness of technology ranging from the quantity, equipment capabilities, and technical support; (5) the training of staff would be very important to increase their understanding, knowledge, and confidence; and (5) the central bank's operational plans would have to accommodate such changes.

[109] See *Phra Siam* (December 1996-Janaury 1997, pp. 22-25).

Summary

This section discussed developments in the central bank's Smart Office project. Re-engineering programs aimed at improving internal working processes were experienced by the central bank, a change similar to commercial bank initiatives. Although there has been aims to automate the central bank's head office, and similarly, its regional branches, there have also been some constraints to change. Most notably, two key success factors would partly depend on senior-level support and the training of personnel to increase technological capabilities in using the system.

6.4 THE PAYMENT SYSTEMS PROJECT

A project's life cycle has been argued as the main carrier of a bank's conspicuous technological role (Jequier and Hu, 1989, pp. 53-85). This can be clearly seen in the identification, preparation, and execution stages of the project, but more importantly, can be determined by the bank's capabilities in specific areas. Comparatively, the central bank's experience in the payment systems project demonstrates its capabilities and constraints in acquiring technology. This section discusses the source of funds, the use of foreign consultants, the use of technical assistance, the development of the payment system, and the underlying constraints.

Source of funds

The source of funds for the payment systems project was acquired from the central bank's own budget. This is in contrast with the modernisation of payment systems in some other developing countries and former socialist economies undergoing transition, as central banks and commercial banks in such countries have obtained financial assistance from international aid agencies (Listfield and Montes-Negret, 1994). Large investment outlays required in such ambitious projects are also another main reason.

In Thailand, the project cost was estimated at approximately 200 million Baht in the first phase of development.[110] This included BAHTNET and THAI CLEAR systems, the latter combining the ECS and Media Clearing systems. The funds have

[110] Interview with Niyada Kanishtarat, Bank of Thailand. See Appendix 6.

all originated from the central bank's own budget, and apart from this, some of its own revenue has also been used to purchase computer equipment requested by various departments, as compared to other countries seeking foreign loans for bank automation. Individual departments in the central bank would set a budget during November for purchasing computer equipment the following year. This covers computer hardware, software programs, and consulting costs. The IT department would then screen this budget based on the system requirements and types of technology requested. Thereafter, it would match the budget with equipment prices which are available in the market, and procure the necessary equipment and services.

The central bank invested up-front for the payment systems. This idea was based on the concept of collecting fees from members after the system was developed. It expected to break-even within 8 years of operation.[111] Therefore, the central bank's projections took into account the proper pricing which would generate a return on investment within the specified timeframe. From earlier accounts, the whole idea of the central bank being involved in the modernisation of the cheque clearing system, and later investing in it, originated more than 20 years earlier. Tarisa Watanagase recounts the project's early constraints.

> Thai commercial banks, rather than the central bank, delayed the progress of the project. The problem resulted from the difference between the size of large and small commercial banks. As the negotiations and share of investment cost between banks were difficult to resolve, agreements on voting rights were also difficult to settle because larger banks were not satisfied with a single vote. Thus, Thai commercial banks found it very difficult to reach any agreement. At one point, Bangkok Bank proposed to be the project initiator. However, the central bank failed to agree. This brief history illustrates what constrained the project's progress. As a result, the central bank was convinced of its involvement and invested in the project.

[111] Interview with Tarisa Watanagase, Bank of Thailand. See Appendix 6.

Despite the set-up of a TBA, which acts as a forum for commercial bank co-operation, the central bank felt that further discussions with it would have repeated previous problems. In reality, what was discussed 10-20 years earlier was concerned with the facilitation of the cheque clearing process, the main problem being the slow speed in cheque clearing. For example, the clearing of provincial cheques took approximately 15 days.

In 1991, the central bank began to examine payments with a working committee. This looked into various issues which were of concern, for which the facilitation of the cheque clearing process was one aspect. In fact, there were other important areas. For example, the central bank felt a need to introduce an electronic payment system, and therefore, started to consider the BAHTNET and Media Clearing projects. Thus, the central bank initiated the investment of three sub-projects.

Use of foreign consultants

The development of an electronic payment system was a novel concept for the central bank so it hired foreign consultants to help develop the systems. Prior to this period, the central bank examined payment trends by focusing on three major systems - BAHTNET, Media Clearing and Cheque Clearing. Thereafter, it developed a master plan and hired a consultant. As a matter of fact, the central bank intended to hire a consulting firm, which was competent in payment matters, in order to help develop a turnkey project. However, the hired consulting firm was a software company, suggesting that the consultant was a technical and not a payment expert.[112]

The consultants were selected on an open-bidding process. The central bank distributed invitations to various parties, whereby approximately 10 companies showed an interest.[113] A central bank committee considered and selected the proposals based on each company's background, reputation, experience, and price-performance ratio. After the feasibility reports were reviewed, three companies, which were from Singapore, New Zealand and Japan, were considered and each firm was requested to provide a presentation.

[112] Interview with Tarisa Watanagase, Bank of Thailand. See Appendix 6.
[113] Interview with Tarisa Watanagase, Bank of Thailand. See Appendix 6.

The selection criteria were based on these presentations. The ideas and prices, which were recorded in each company's documents, were compared. As for the price, there was a slight difference between the companies. In terms of selection, the Japanese consulting firm, Nippon Telephone and Telegraph International (NTTI), sent over 10 representatives for the presentation, including staff who were responsible for computers and communication networks which largely impressed the IT department. Comparatively, the New Zealand consulting firm sent two representatives, where one person was a payment expert. However, the representative, in the absence of the whole team, was unable to respond to technical issues raised during the meetings. As for the Singapore firm, the central bank felt that they were a small but efficient team, having acquired considerable experiences in Hong Kong. However, the firm was not selected.

NTTI was selected as the preferred bidder. The payment system department, however, raised doubts, due to the fact that the company was a software company and not a payment expert.[114] Nevertheless, the IT department suggested that computers and communication networks were very important to the project. Therefore, the payment systems department was required to agree to this, since the IT department was the party coordinating activities in developing the payment system.

The payment system department defined the system's business requirements. NTTI developed and tested the software programs, and furthermore, subcontracted many parts of the project to other firms from India, the United States, and Thailand. The IT department conducted an in-house acceptance test of the software programs to examine whether they matched requirements and internal systems. Lastly, running test were conducted with external parties, for example, with domestic commercial banks. The central bank further organised a core team to coordinate the project. This included a team of three parties which consisted of personnel from the IT department, the payment system development office, and the consulting firm. The core team then held regular meetings and co-ordinated all activities.

[114] Interview with Tarisa Watanagase, Bank of Thailand. See Appendix 6.

The diversity of the project increased the role and expectations of NTTI. In terms of having project advisers, the consulting firm sought further advice from external consultants because of its unfamiliarity with the Thai banking system. The consulting company also played two roles in the project which sometimes created reluctance on the firm's part.[115] While the firm was a technological expert, it was weak in consulting in the payment systems area. It was not only required to develop the system, but was also required to gain familiarity with the Thai banking system and act as the central bank's adviser.

These roles were in conflict on the part of NTTI. The consulting firm, working alone, did not posses the expertise in both technical and payment areas. On the contrary, the company's expertise was in developing software which required it to further seek for project advisers in the areas of payments and banking. For example, there were several sub-contractors which were hired. Some of the staff in these companies would have doctoral degrees, and were hired on a 4-5 month job-by-job basis, for example, in conducting surveys.[116]

The use of Thai consultants played only a minor role. For example, in the master plan of the country's payment system, the structure of the project team illustrated the NECTEC's director as a senior project adviser. However, this role was very minimal throughout the project, and moreover, the central bank did not have any direct consulting agreements with the centre.

Technical assistance

The IMF extended its technical assistance to the project. However, this assistance did not arrive during the early stages of the project. Prior to this period, the central bank worked on its own to a large extent, having acquired and studied documents related to payment systems, for example, from reports published by the BIS. The IMF mission arrived approximately 2 years after the start of the project, although the central bank made an earlier request for technical assistance, for which the aid agency was unable to organise a mission.

[115] Interview with Tarisa Watanagase, Bank of Thailand. See Appendix 6.

The IMF made approximately 3 missions to Thailand. Each mission involved a group of approximately 4-5 persons who remained from 7 days to 2 weeks.[117] For example, one of these missions included the study of recent developments and further policy recommendations in Thailand's payment system (Johnson *et al.*, 1995). Such individuals, apart from IMF staff, included retired officials from the United States Federal Reserve, whom were over 60 years of age and had worked in the payment systems area for over 20 years. In other missions, IMF staff also helped examine the detailed design and programming phases of the project. However, in terms of systems design as a whole, this was too late for the mission to provide any feedback. In other areas, the IMF helped examine the commercial and regulatory aspects of the payment system.

Previous working experience was also a factor which facilitated the IMF mission. Coincidentally, the payment systems department director worked at the IMF for 3 years prior to being assigned to the project in early 1991.[118] This enabled the director to establish personal contacts with IMF personnel in the United States which was followed with a terms of reference detailing the types of assistance the central bank required.

The report published by the IMF mission in late 1995 made several reviews and recommendations. This included the implementation of previous technical assistance, the discussion of planned initiatives in the payments area, and the recommendation of policies related to pricing and credit (Johnson *et al.*, 1995). Furthermore, the mission particularly examined progress related to BAHTNET, Cheque Clearing, Media Clearing, the clearing and settlement of inter-provincial checks, the delivery versus payment of securities, and the credit policy issues for large value transfer systems.

The IMF mission also evaluated the scope and requirements of the system as compared with developments elsewhere. This included examining what was implemented or omitted at each project phase, as compared with a set of recommendations. The mission also discussed issues with members within the central

[116] Interview with Tarisa Watanagase, Bank of Thailand. See Appendix 6.
[117] Interview with Tarisa Watanagase, Bank of Thailand. See Appendix 6.
[118] Interview with Tarisa Watanagase, Bank of Thailand. See Appendix 6.

bank's core team, including representatives from the following: information planning and operations department, payment system development office, legal department, deposits and bonds department, audit and inspection department, banking department, and financial institutions supervision and development department.

Apart from the IMF missions, there were other sources of assistance. The central bank conducted research on system requirements with support from the Bank of Japan. However, it felt that although some recommendations made in the research report was useful, some were also not applicable to the country's unique conditions For example, although NTTI sub-contracted parts of the project to experienced personnel from the Bank of Japan, Thai central bank officials defined the system requirements. In this respect, the Japanese payment systems, the BOJ-NET and ZENGIN systems, were not very technologically advanced, which might have resulted in the Bank of Japan providing restrictive recommendations. Within the project's scope and budget, the central bank's system requirements, after the basic or conceptual design, may have not have been as flexible as originally expected.

BIS publications on payment systems also aided the central bank. However, such reports were largely related to developments in European or North American countries. As the central bank was uncertain about differences in development stages between the country's payment systems and progress elsewhere, it observed recent reforms within the Asian region, particularly in Japan, Hong Kong, Singapore, and Malaysia.

The BIS, in contrast to the IMF, did not play a major role in extending technical assistance. Moreover, the central bank never requested for any aid. However, when the central bank was required to examine specific issues, for example in payment system law, it would approach the BIS for general guidelines. Nevertheless, the central bank was well aware that the BIS, together with the IMF, have made assistance available in the form of training. Such schemes included joint BIS-IMF training courses offered in Vienna. This includes two types. The first includes a series of seminars organised for participants from Eastern European countries, focused on creating awareness and operations of payment systems. The second includes a series

of seminars for payment experts. The speakers may be from IMF or other concerned central banks. For example, the IMF would have a pool of experts from international central banks, whom would discuss and update one another about the focus and trends in payment systems and provide tutorial sessions for payment experts alike.

Systems design, development, and enhancement

The initial designs of the payment system were completed by the central bank. In the early 1990s, the idea of a modernised payment system was novel. When the system's design became increasingly structured, the central bank sought the requirements of its members, particularly commercial banks, which provided recommendations ranging from security control to operations, and may have differed from the central bank's requirements. However, these recommendations were made towards the start of the testing phase of the system. As a result, the design and programming of the systems were relatively fixed from the beginning.

A wide view for payment system design was adopted. This view examined the whole system, apart from focusing on IT during implementation. For example, in setting regulations, the project's core team would include a team from the legal department. The payment system department was also required to draft regulations which supported the system's design. These draft regulations were then disseminated to commercial banks for further consideration and to gain feedback for improvement.

The central bank considered whether commercial bank suggestions required major or minor modifications. However, the project team considered such changes and did not incorporate them in improving the system's design which was basically the same. Nevertheless, the central bank directed its technology team in the IT department to make enhancements for the system which was undergoing the testing phase. Such changes were to take effect prior to the end of the maintenance agreement with NTTI in late 1997.

The design of the Thai payment system differs slightly from the guidelines suggested by the World Bank. In one of its policy research working papers, the set-up of a national payments council to coordinate the activities between a country's central

bank and commercial banks was suggested.[119] This council applies to developing countries and formerly socialist economies, and focuses on the key role played by the central bank in initiating the set-up of a discussion forum with commercial banks, and to serve as a channel in absorbing technical assistance.

In Thailand's case, the central bank established a payment system development committee to monitor the implementation of the project. This high-level committee was chaired by the central bank deputy governor and other senior ranking officials in other departments, and would coordinate activities with another committees set-up to address the interest of Thai commercial banks. For example, this included the set-up of a committee for commercial bank coordination, and included 4-5 representatives from commercial banks who were appointed by the TBA. The representatives included senior-level bank executives from some of the largest commercial banks, for example, Bangkok Bank and Thai Farmers Bank. Thus, the central bank viewed this high-level involvement as a top policy for payment system development. As a result, this committee provided a forum for top level meetings, where suggestions on implementation were made.

The committee included working groups in different aspects of the payment system. This may, for example, include a group working on the THAI CLEAR system which aims to coordinate the process of inter-provincial cheque clearing. Generally, there was coordination between central bank management and commercial bank representatives, as well as co-operation at the working group level. In the central bank, this working group was in the form of a core team comprised of personnel from several departments. This team worked together whether it may be in requesting for suggestions in defining system requirements, coordinating efforts in system testing, systems implementation, or the evaluation of commercial bank readiness prior to becoming a network member.

In this respect, the coordinating committee served as a national payments council. This helped coordinate the work between the central bank and commercial banks. However, this committee did not include representatives from Thai finance and

[119] See Appendix 8.

securities companies, although they have gained membership to the payment system at a later period. The central bank maintains that the reason is because the TBA or commercial banks are the parties which have the rules, laws, and regulations.

Software development was completed by NTTI. This ranged from the conceptual design, with central bank co-operation, to the programming phases of the project. In some cases, for example with BAHTNET, NTTI sub-contracted work to another software firm located in Japan. As for the THAI CLEAR, there were 2-3 sub-contractors, which helped develop the software, for example Datamatic and NCR. The software for the BAHTNET system was programmed according to the central bank's requirements. On the contrary, software for the THAI CLEAR system was partly customised because the central bank previously purchased and modified a software package to support the automated clearinghouse operations. As for the ECS, which read and sorted physical cheques into electronic data, sub-contractors also helped develop the necessary software.

It is clear that personnel from the central bank were not directly involved in software development for the BAHTNET and THAI CLEAR systems. The software was either custom-made by the Japanese contractor, or purchased and modified by the central bank's own personnel. There was no software for the payment system which was developed in-house. However, the central bank suggested that if there were minor changes or enhancements required, it was capable of developing or changing the program modules.

System enhancements were planned to increase operational efficiency. In the case of BAHTNET, enhancements to the existing system with file transfer and queuing mechanism functions were considered. The first enhancement, on file transfer, was aimed to enable the transfer of financial data without having to re-key them at the receiving end of the transaction. This enabled one party in the transaction to upload their data at workstations. In this respect, the central bank suggested that there were limitations in the NTTI built-systems which were not implemented according to the original scope of the project. As a result, this required cancellations of some agreements specified in the original contract, as it stipulated that the central

bank could not interfere with the contractor work which may interrupt maintenance tasks.

The second enhancement was the development of a queuing mechanism function. This was aimed to improve the liquidity position of banks and facilitate the circulation of funds in the economy. In the central bank's current account system, where commercial banks cleared their net credit and debit positions, the function will reject any member having unavailable funds in its account. A pre-determined set of priorities and regulations, jointly devised by commercial banks, meant imposing first-in and first-out (FIFO), or pre-emptive, rules.

System enhancements were to be completed by central bank personnel. With regard to its capabilities and skills, the queuing mechanism was nearly complete as of early 1997, and was undergoing the testing phase. The schedule was similar for enhancing the file transfer functions. However, a lack of human resources was noted for enhancements in this area. Although major changes to the main system were required, an extension to the central bank's current account system was necessary.

Furthermore, enhancements for file transfer functions required major modifications to the original system. As a result, central bank personnel were sent to study such details in Japan.[120] This required a large amount of effort as the central bank was concerned that although it jointly designed the system from the start, it was working with program details which were not previously developed by itself. Consequently, the central bank suggested that it would need to be very cautious if it planned to maintain or enhance the system by itself in the future.

Nevertheless, the central bank was capable of managing the file transfer and queuing mechanism enhancements. However, further enhancements planned in late 1997 suggest that it needed to increasingly depend on its own capabilities. Such enhancements include the introduction of the DVP mechanism in the trading of securities. This project, taking approximately 3 years to complete, further suggest that the central bank would be required to organise and coordinate the activities of many

[120] Interview with Niyada Kanishtarat, Bank of Thailand. See Appendix 6.

working groups on the conceptual design for the system. As a result, the central bank will play an increasing role in the future enhancements of the payment system.

Project constraints

One of the main project issues was in defining suitable system requirements. This covers both the BAHTNET and THAI CLEAR projects. The central bank suggested that no organisation was capable of providing it with recommendations. For example, the World Bank or the IMF recommendations provided only a basic structure. This can also be studied from the BIS member banks such as the Japanese and German payment systems. The central bank attempted to study what was the most suitable requirement, but with so many alternatives, it was difficult to select the best option.

The central bank finally decided to develop its own system which it knew was subject to changes in computer technology. Furthermore, it realised that current requirements were perhaps not the most perfect choice. The lack of human resources also meant that the central bank was required to hire foreign consultants for many years. It reflected the inadequate number of personnel it employed to cover the work. For example, over 10 employees were involved in organising an operational team in the project's conceptual and system design stages, and moreover, defining system requirements used approximately 60-70% of the system development time.[121] System testing with users was another time consuming phase. Every team in the project had a detailed testing plan which was to be integrated with the central bank's current account system. A tremendous amount of time was used in this area but the central bank felt that the results were very satisfactory.

The central bank also experienced slight problems in commercial bank co-operation. Prior to system testing, commercial banks were required to be aware of new or changed regulations. For example, they were required to consider changes to their own regulations or internal systems, as a member of BAHTNET. Moreover, bank personnel required to operate both BAHTNET and THAI CLEAR systems, are also required to determine the appropriate computer hardware and software equipment

[121] Interview with Niyada Kanishtarat, Bank of Thailand. See Appendix 6.

which need to be prepared to be in support of the central bank's systems. Thus, the central bank was required to inform commercial banks in different periods.

However, the central bank suggested that it might not have been well prepared in introducing such changes. Although the central bank organised groups of commercial bank employees for training in different periods to allow enough time for system migration, it was criticised by some banks which were not made aware of the provisions of such services and training. In such circumstances, the central bank attempted to receive feedback and establish contact with such banks to provide proper training. To further resolve such issues among commercial banks, the central bank would invite the 4-5 largest commercial banks for a brainstorming session, whereby these banks would discuss the issues and spread their knowledge to other commercial banks.[122]

In Thailand, the reason for hiring a consultant was because the central bank was ambitious, as it wanted to develop three systems in three years.[123] Such achievements, however, largely depended on the level of ability and understanding of central banks in different countries. For example, one country may not have done its homework properly or lack adequate human resources. Therefore, finding a good consultant may have helped.

Alternatively, the central bank would not have been able to complete the projects in three years, if they were developed in-house.[124] In terms of skills and capabilities, the central bank could have developed the systems. For example, payment experts may have been sought from technical assistance programs. Moreover, if the central bank had enough time, it would also have been able to develop the systems technologically. However, the central bank had never developed a large and ambitious project like this before, and as a result, a consulting company was seen as speeding up the development of these systems.

[122] Interview with Niyada Kanishtarat, Bank of Thailand. See Appendix 6.
[123] Interview with Tarisa Watanagase, Bank of Thailand. See Appendix 6.
[124] Interview with Tarisa Watanagase, Bank of Thailand. See Appendix 6.

The problems arising from the consultant, as mentioned earlier, was it being a software company and not a payment expert. Problems that have arisen may be from the detailed requirements of the system which the consultants have requested. On the other hand, if the consulting firm was a payment expert, it would have been capable of advising the central bank on such requirements and having it agree to it. If such conditions existed, the central bank suggested that it would have facilitated the development process.

Moreover, if the consultant was a payment expert, the central bank suggested that it would have advised it on maintaining flexibility in requirements to match trends or changes. As a result, the central bank would only have to make minor and avoid major modifications to the system, and this would have been a tremendous help. Whether consultants have helped in the development process is significant or not varies. However, the central bank suggested that the disadvantage of hiring a consultant was that of dependency after the system was developed.

The central bank stipulated in its contract that there must be the transfer of technology from the contractor. For example, after the software programs for the system were programmed, NTTI would have to provide the central bank with the source code of all the software programs. Nevertheless, the central bank only presumed that it could fix and maintain the system itself. This would have to depend on whether the system methodology used was easy to fix and maintain or not.

Summary

This section discussed the central bank's payment systems modernisation experience. The development of three major projects in three years was an ambitious aim and this was approached through the contracting of a foreign consulting firm. The hiring of a consultant, however, caused a loss of project control by the central bank. After the consultants completed system development, the central bank was required to further hire them to maintain the system during the initial period. During system maintenance, interference with the contractor's work was not permitted. Initially, the central bank received feedback on how it should improve the system which required minor or major modifications. Even though the central bank can make minor modifications, it was not permitted to change the contract's conditions. It would have

to either employ consultants to complete the work or to delay the plans for a later period when the contract ended. Thus, although the central bank suggest that it can rely on its own capabilities in systems maintenance and enhancement, the conditions of the consulting company were seen as a barrier to further innovation.

6.5 DEVELOPMENT OF CENTRAL BANK CAPABILITIES

This section discusses the development of central bank capabilities. The central bank has created capabilities through many channels. Some of these channels have included self-study programs, scholarships, summer internship programs, and finally, project experiences acquired from payment systems development.

Firstly, a self-learning centre was established to support the self-improvement of staff skills.[125] The first centre was opened at the central bank's Surawongse branch in 1994, while a second centre was set-up at the head office in the following year. The main purpose of these centres was to enable central bank personnel to improve their computer and foreign language skills that helped support their work. The modes of learning are based on media such as conversational programs, tape, facsimile and others means.

Secondly, scholarships were awarded to eligible staff and students educated in domestic and foreign universities. Table 6.1 indicates the number of scholarships awarded during 1990-1995. This has included degrees such as business studies, computer science, economics, and international relations. In 1996, the central bank co-ordinated with the London School of Economics in granting the Puey Ungphakorn Scholarships to eligible Thai students studying at the school. Interestingly, this scholarship was named after the longest-serving central bank governor, who was also a current honorary fellow of the college.

[125] See *PhraSiam* (April-May 1996, pp. 16-18).

Table 6. 1 Number of Central Bank Scholarship Awarded, 1990-1995

Year	Bank Employee	Outside Individuals	Total
1995	6	15	21
1994	4	15	19
1993	2	23	25
1992	5	22	27
1991	9	16	25
1990	9	12	21

Source: Bank of Thailand Annual Economic Report, various years

The distribution of staff also reflects the central bank's policy of maximising the use of human resources. The organisation underwent downsizing and restructuring to enable it to streamline operations, which was aimed at reducing overlapping jobs, combining common duties, and relaxing unnecessary control. For example, during 1995, three departments - the personnel and organisation department, the administrative services department, and the information planning and operations department - were restructured. During 1990-1995, the number of employees was maintained within the 5,000 region. However, the proportion of employees holding bachelor degrees or higher relatively increased proportionately to the total number of employees, with the exception of 1991-92 and 1994-95. Further analysis of these figures indicates that while one in two persons held a bachelor's degree in 1991 and 1995, this was not the case for the two other categories. While one in eleven employees held a postgraduate degree in 1991, this ratio improved to one in nine by 1995. Moreover, while one in thirty employees held a doctorate degree in 1991, this was one in twenty by 1995. This is depicted in Table 6.2.

Table 6. 2 Percentage of Employees with Bachelors Degree or Higher, 1990-1995

Year	Employees	Bachelors Degree or Higher (%)	Bachelors Degree (%)	Masters Degree (%)	Doctoral Degree (%)
1995	5,027	60.0	49.0	10.5	0.5
1994	5,068	67.8	55.8	11.6	0.4
1993	5,068	56.4	46.6	9.4	0.4
1992	5,071	54.3	45.3	8.6	0.4
1991	5,133	57.0	47.3	9.4	0.3
1990	4,050	54.0	na	na	na

Source: Bank of Thailand Annual Economic Report, various years. Note: na - not available

And thirdly, the central bank summer internship program was used to search for a potential source of staff. Thai students in local and foreign universities are selected every year to join the program which aims to introduce them to the roles and responsibilities of the central bank. Moreover, they undergo on-the-job training. From the central bank's perspective, this program offers it the opportunity to screen prospective students who may become a potential source of personnel.

6.6 DISCUSSION

This section discusses the characteristics of the central bank's resources. Firstly, the central bank, like the large commercial banks discussed in the previous chapter, made large IT investments. This involved multi-million Baht investments to support central bank automation and to develop three major payment systems projects. Therefore, apart from improving organisational efficiency, the plans were also in support of financial sector development. The payment systems project, in particular, led to opportunities in technological capability building. As previously mentioned, a project's life cycle is a main carrier of a bank's conspicuous technological role (Jequier and Hu, 1989, pp. 53-85). Although the RTGS introduction into the country's financial system may be seen as one of the earliest and most advanced in the world, the nature of the system, which is basically computer hardware and software, may be easily replicated by other central banks. This may be through similar investments or system modifications. Thus, although a RTGS may facilitate funds transfer and strengthen basic financial infrastructures, it may not necessarily provide a country's financial system a sustained competitive advantage over other financial centres. Alternatively, this competitive advantage may come from other types of resources that are more difficult to replicate.

Secondly, the central bank initiated organisational reforms. As mentioned, some of the planned central bank reforms in the post-crisis period were based on the advice of former foreign senior central bankers. For example, this involved delayering the chain of command and reorganising departments under newly appointed assistant governors. The IT and payment systems departments, however, were set up before the crisis and suggests that such areas, which have received a limited role in the past, have

started to increase in importance. The IT department evolved from a machinery and equipment division into a full status department. Its roles stretched beyond basic technical support to more macro-oriented tasks such as in drafting master plans for the central bank's computer and payment systems modernisation plans. Similarly, the payment systems department evolved from being a development office to a full status department. Its roles were beyond cheque-processing but involved payment system maintenance, development, and further enhancement. But above all, the department is responsible for the central bank's micro objective in maintaining financial stability, particularly through the payment system. Thus, the set up of these two departments suggests how the central bank has made the necessary organisational arrangements to accommodate for technological changes and increased responsibilities, and to start concentrating and developing its capabilities in such specific areas.

And thirdly, although the central bank has progressed in terms of physical and organisational resources, it remains constrained by human resources. A shortage of skilled staff was clearly evident in the IT department. Moreover, the completion of three payment systems projects in three years also stretched its capabilities. Nevertheless, there have been some improvements at the organisational level both in terms of training staff, awarding scholarships, and conducting summer internship programs. While there has been a gradual decrease in the total number of employees, there has been an increase in the number of employees holding advanced degrees at the postgraduate and doctorate levels.

Summary

The aim of this chapter was to examine the capabilities of the central bank. Like many commercial banks, the central bank introduced re-engineering programs and gave increased important to IT usage. This has been reflected in the increased role played by the IT and payment system departments together with wider office automation projects. Nevertheless, the central bank faces a shortage of skilled staff. The IT department, in particular, has experienced a mismatch in the demand and supply of computer staff. In addition, the payment system department's project experience also suggests a lack of personnel, and more importantly, the need to improve capabilities to develop and enhance payment systems in the long-run.

CHAPTER 7: POLICY IMPLICATIONS

The role of routines, resources, and their replication, along with how they influence innovation, were illustrated and discussed in the three previous chapters. This chapter turns to the policy aspects of payment systems and examines their role in a national system of innovation. A discussion of the key players in the payment system is organised into four sections. Section 7.1 discusses the role of central banks in a national innovation system. Sections 7.2-7.3 illustrate the potential role of the central bank and commercial banks in the innovation system in Thailand respectively. Lastly, section 7.4 discusses the potential role of banking institutions in influencing innovation in a national technology policy framework.

7.1 THE ROLES OF CENTRAL BANKS IN ECONOMIC DEVELOPMENT

This section discusses the role of banks, particularly the central bank, in relation to a national innovation system. The roles of central banks in influencing economic development, particularly in promoting technological innovation, are discussed. This includes their role in the payment system, their relationship with commercial banks, their role in development, and finally, their role in an innovation system.

Role in Payment Systems

The role of central banks in the payment system has increased in importance, although discussion on such relationships have been limited (Goodhart, 1995; Burstein, 1991). The mission of central banks, as contrasted to other types of financial institutions, may explicitly or implicitly define this role. For example, the G-10 central banks have shared a common stand towards maintaining the stability, reliability, security, and efficiency of national financial systems. This includes the payment system. More importantly, the payment system has become a micro-objective for central banks, as suggested in the tercentenary symposium of the Bank of England which discussed the future of and developments in central banking as the following.

> Besides their macro objective of price stability, central banks have a micro objective of maintaining financial stability, especially in the core areas of the payment system and the commercial banks who operate it (Capie *et al.*, 1994, pp. 91-92).

As a result, central banks, in no case, can neglect their responsibility in minimising systemic risks in payment systems, as the public has entrusted them with this duty (Padoa-Schioppa, 1992). Furthermore, central banks have to carefully consider their role in the evolution of payment systems (De-Mattia, 1985). This addresses the degree of competition or co-operation, which is likely to meet the multiple objectives of payment users and payment providers in the context of introducing innovations. Thus, the role of central banks can involve the introduction of measures to adjust the degree of competition or co-operation, which may be satisfactory or vice versa.

There are three main areas for central bank involvement in payment systems. These roles, which are contrasted in the level of central bank involvement, include the formulation of payment system policies, the co-ordination of payment regulations and standards, and the operation, or oversight, of a country's payment settlement services. Firstly, there is central bank involvement in payment system policy formulation. This is due to its profound implications towards the development of a country's financial sector and to the functions of the central bank itself. Developments in the deregulation of interest payments on deposits and the automation of payment systems have significant implications for the central bank's monetary policy (Tobin, 1987). In addition, central bank policies directed towards the deregulation of interest rates, restricted activities, and restricted geographies have profound implications for payment systems, but are also affected by it in return (Horvitz, 1984). This also includes their role in maintaining financial stability through the banking and payment systems of a country (Schoenmaker, 1996).

The role of the central bank, on the contrary, may also diminish because of the payment system. For example, a study of the Finnish payment system suggested that the role of the central bank in the conduct of monetary policy might gradually be reduced (Lempinen and Lilja, 1989). Furthermore, payment system efficiency depended on the centralisation or decentralisation of the system, and moreover, the form of operation, which may be contrasted between private sector, or complete control and operation by the public sector. A reduced central bank role is further supported by arguments against conventional monetarists, which suggests that

overcoming inflation will not be by means of controlling the money supply, but rather through the ceasing of fiat money (Brittan, 1994). Such arguments imply that the use of cash as a payment instrument would dwindle in the future, leading to a post-monetary society and would reduce, or even eliminate, the role of the central bank.

Secondly, there is central bank involvement in overseeing payment standards and regulations. In a study of payment system modernisation in developing countries, the establishment of a national payments council was suggested to provide an organisational structure in supporting unique banking structures and indigenous capabilities development (Listfield and Montes-Negret, 1994). The central bank assumes the chairmanship in this structure and oversees legal, regulatory and standard issues, while delegating the operational and automation responsibilities to commercial banks.[126] The argument against central bank involvement also exists. For example, the setting of standards through market forces has been suggested as a more appropriate approach (White, 1984). This argument is based on observing payment patterns, which develop in the successes and failures of various standards, relating to perceived need, use of old or new technology, quality of standard design, and industry commitment for use. Thus, such arguments support the set-up of standards according to market mechanisms, as compared to any authoritative body, particularly the central bank.

Lastly, there is central bank involvement in providing and regulating payment services (Tucker, 1990; White, 1983). One major issue is whether the central bank should intervene in the market for payment services or promote private competition. One argument suggest that in the provision of monetary payments' services, collective-investment funds can provide payment services, apart from commercial banks which raises the question of whether additional regulatory and supervisory arrangements are required by the central bank (Goodhart, 1987). In this respect, the asset portfolios of banks are fixed in value, while collective-investment funds is dictated by the market, requiring the central bank assistance in reducing risk. The central bank, acting as Lender of Last Resort, is in a position to increase or decrease reserves into the payment system, maintaining the systems' soundness, stability, and

safety (Goodhart and Schoenmaker, 1995; Schoenmaker, 1996). In addition, although the central bank has regulatory and supervisory roles, it may not be required to undertake an operational role, provided that sufficient information with real-time monitoring are obtained (Goodhart and Schoenmaker, 1995). For example, this approach has been adopted in the United Kingdom, although arrangements may differ in other countries. Alternatively, the United States Federal Reserve has resumed the role of payment system operator, particularly for large-value transfers, such as in Fedwire (Spindler and Summers, 1994).

Relationship with Commercial Banks

Central banks also play an important role in private sector development. This is particularly the case for the commercial banking sector. In this respect, the historical relationship between the two types of banks can be summarised into three phases, evolving from a competitive, or even an adversial relationship, to a limited regulatory role, and finally, to an increasingly uncertain role caused by competition, IT, inflation instability, and de-regulation (Capie *et al.*, 1994, pp. 79-80). More importantly, the relationship includes the supervision of the banking system and the maintaining of minimum reserve balances in case of bank failure. Central banks can also influence or inhibit innovation by introducing legal, regulatory or technological changes in the payment system, and requiring commercial banks to make system modifications.

Commercial banks also play a major role in payment systems innovation. This is more transparent, as compared to central banks, due to the technological innovations they diffuse to payment participants, including consumers, business enterprises, and government agencies. The implementation of computer networks has become a competitive method for commercial banks, as they can feasibly contact customers through computer connections, and provide more sophisticated services, while reducing manual processing costs (Chorafas and Steinmann, 1988). For example, commercial banks have formed consortiums to provide check-clearing functions in direct competition to the central bank.[127]

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[126] See Appendix 8.

[127] See "U.S. Treasury to inaugurate new system for paying checks over the Internet" (*Wall Street Journal Europe*, 30 June 1998, p. 9).

The introduction of innovations has also raised risk issues. Such developments are characterised by synergistic innovations in the payment system, for example, the providing of EFTPOS (Howells and Hine, 1993), and the combining of EFT and EDI applications (Essinger, 1992; O' Hanlon, 1993; Box, 1994; Ewbank, 1995). In addition, recent innovations have involved the use of the Internet in banking and credit card applications.[128] Although such initiatives are conducive for competition and financial sector development, security and legal issues have also increased in importance for both commercial banks and central banks (Welch, 1994). This is due to the potential of technological innovations to increase uncertain risk. In addition, the payment system may become a contagion channel, which spread such risk among payment participants, and as a result, one alternative approach in monitoring such events has been to co-ordinate payment activities with the central bank.

Role in Development

The central bank also plays an important role in economic development. This is particularly the case of developing countries. For example, central banks in such countries operate in different conditions as compared to their developed counterparts (Fry *et al.*, 1996). Such conditions faced by developing country central banks influence how they dictate the terms and conditions whereby other financial institutions should operate, an increase in responsibility which is in contrast with central banks in developed countries. The case for central bank involvement in payment systems is even stronger for a majority of countries which is suggested by a survey study of such developments as the following:

> The responsibility of central banks in developing countries for the evolution and improvement of such systems (payments, banking and financial systems) in their own countries is even stronger because of their more predominant role within their own country's financial system. (Fry *et al.*, 1996, p.56).

The role of central banks in development is not novel. For example, developing country central banks have functions and concerns which range beyond the conventional conduct of monetary and financial policy (Farrell, 1990). Furthermore, this role should be appreciated, and moreover, should facilitate, and not

[128] See "Banking on the Internet" (*Economist*, 7 October 1995, pp. 123-124). "Credit cards in cyberspace" (*Economist*, 7 October 1995, p. 124).

hinder, the promotion of a developing country's growth and development. In addition, developing country central banks have contributed in orienting economic growth toward a country's economic development objectives, for example, in assisting development institutions and acting as a development adviser to the government (Brimmer, 1971). In this respect, developing country central banks have also assisted in payment system modernisation, mainly because of the lack of financial, technical, and human resources in such countries (Zulu *et al.*, 1994; Mitiukov, 1994). Moreover, such countries have unique conditions and contexts which need to be addressed in the design, development, management, and supervision of payment systems.

Role in Innovation

The central bank also plays an important role in innovation. This role is implicit and is illustrated by their promotion of technological innovation in the payment system. Like any other form of institution, the central bank operates in an techno-economic paradigm which is characterised by the impact of a major technological innovation on entire economic sectors. For example, the impact of IT influences the operation of the central bank, and alternatively, the central bank uses IT to modernise the national payment system, influencing the payment participants inside the system. For example, Capie *et al.*, (1994, p. 92) suggest that future developments in central banking will include an increased role in introducing innovations.

> ...looking at the record of domestic price stability, financial market stability, or international monetary order, the recent record is at best spotty. Despite their institutional success, central banks cannot afford to be complacent. There is much to learn, and much room for improvement.

Such an argument also applies to central banks in developed countries which have undergone reforms in a period of transition (Lamfalussy, 1994, pp. 335-336).

> The new financial environment will not make the macro-prudential task of the Central Bank of preserving the stability of the financial system easier. The main reasons are: First, there is the globalisation of financial markets, by which I mean not only international financial integration but also the fading of demarcation lines between financial products as well as between different segments of the financial industry. Add to this the steady progress in information systems and communication technology, and the result is the transmission, with lightening speed, of financial impulses originating in one country or in one market segment to other countries or the rest of the industry.

In this respect, these two arguments suggest an evolving role for central banks, particularly in their potential to promote technological innovation. This is based on the realisation of the pervasive impacts resulting from the new information and communication technology paradigm influencing the central bank and vice versa. Central banks have started to experience these emerging issues and their implications have become far reaching for the conduct of monetary policy (Tobin, 1987).

Summary

The central bank has a range of roles in innovation. This includes the direct involvement in payment systems modernisation, the relationship with the private sector through commercial banks, and their role in development, particularly for central banks operating in a developing country context. Since technological innovations have influenced payment system progress, which has consequently affected the ability to conduct monetary policy, central banks have increased their involvement in this area. Such an involvement positions the central bank as a major institution in a national system of innovation which is a network of public and private institutions promoting innovation in a country.

7.2 THE ROLE OF THE CENTRAL BANK IN THAILAND

This section discusses the role of the central bank in a Thai innovation system.[129] The central bank's key position in the policy-making and payment structures of the country plays an influential part in innovation. This provides a strong potential for central banks in promoting innovation, provided that underlying constraints are resolved such as in the shortage of skilled staff. This section provides a detailed discussion of such institutional factors in the case of the country's central bank.

Policy-Making Structure

One of the most important factors determining a country's economic development is macro-economic policy. These policies indirectly influence the technological development of the country. Thailand's macro-economic policy-making structure is guided by four core agencies (Warr and Nidhiprabha, 1996, p. 69). They are the National Economic and Social Development Board (NESDB), the Fiscal Policy

[129] This section is mainly based on interviews.

Office of the Finance Ministry, the Bureau of the Budget, and the Bank of Thailand. The analyses and advices from these agencies generally guide government ministers in making macro-economic policy decisions. In this respect, such institutions have become the central players in a national system of innovation

The heads of these core agencies also have influential roles. They are customarily represented in the Council of Economic Ministers, serving as a sub-committee of the Council of Ministers – the government's cabinet. Prior to policy implementation by ministers in government, there is co-operation and consultation between the technocrats within these key agencies with regard to policy formulation. The directors of these agencies are therefore key actors in formulating macro-economic policies in Thailand. The location of the core agencies in the overall policy-making framework reflects their degree of autonomy. The NESDB and Bureau of the Budget report directly to the Office of Prime Minister, while the Fiscal Policy Office operates under the umbrella of the Finance Ministry. This limits their degree of autonomy in comparison to the central bank which operates within the framework of a state enterprise. Although the central bank governor reports directly to the finance minister, it remains well respected and maintains a relatively fair degree of independence from political influence (Warr and Nidhiprabha, 1996, p. 233).

The central bank holds a unique role among the four core agencies. As mentioned in Chapter 3, its key responsibilities include the formulation of monetary policy, advising economic policy to the government, supervising financial institutions, promoting priority economic sectors, printing and issuing bank notes, and developing and supervising the financial system. One of the more recent roles has been in financial sector development, particularly in the modernisation of the payment system. This role is particularly crucial for central banks in a developing country context. Some of the common constraints experienced by such countries include the scarcity of resources and the shortage of skilled human resources, resulting in increased roles and responsibilities for the central bank in payment system reform. This increased role was clearly pointed out in a recent World Bank report (Listfield and Montes-Negret, 1994, p.11).

> Central banks in transitional socialist economies and many developing countries have more responsibilities than central banks in market economies in leading and co-ordinating payment system reforms. Although the central bank's involvement in the operation system varies from country to country depending on the strength of its commercial banks, the central bank must play an entrepreneurial or facilitating role in all aspects of payment systems design and development.

The central bank, however, also faces limitations. Such a role in promoting payment system modernisation does not imply that the central bank is equally qualified to operate the system (Listfield and Montes-Negret, 1994, pp. 11-12).

> The central bank's leadership in payment system development does not automatically qualify it to play the role of payment system operator. In some instances, the central bank might become part of the problem, rather than part of the solution when the bank ignores users' needs or adopts heavy-handed, top-down approaches with limited or no commercial bank participation.

Central bank co-operation with commercial banks has become one solution. This is based on the concept of setting-up an organisational structure in the form of a national payments council which overlooks the interests of key players in the payment system. Such a council may cover the provisions of regulation, operations, automation, and standards in the payment system. One major concept of this co-operative structure, however, is that the core players in the payment system, namely the central bank and commercial banks, can promote technological innovation through the existing payment structure.

Payment Structure

The central bank can influence innovation through the payment structure. Theoretically, this structure seeks to support changes in the techno-economic paradigm, involving the diffusion of innovation to individuals, firms, sectors, and nations (Freeman, 1987). In this respect, the payment structure becomes a channel for diffusing innovations, apart from facilitating the flow of funds among consumers, businesses, government, and financial institutions.

In Thailand, the central bank outlined its perspective for a future payment system. This includes the creation of electronic connections among a group of payment participants, including households, government, firms, and financial institutions, and includes planned international connections with foreign markets.

Most notably, the central bank and commercial banks are at the core of this planned payment system. While the former has been progressive in developing a modern large-value electronic payment system, the latter group has co-operated in developing co-operative ATM networks and, more recently, off-line retail funds transfer system.

The creation of a computerised payment system illustrates how a modern banking system can play a key role in a national system of innovation. A modern payment system forms a country's basic banking infrastructure, facilitating the flow of funds among payment participants, and increasing economic efficiency. Behind this modernisation process is a network of institutions, particularly banks which co-operate and co-ordinate activities to adopt, apply, and advance banking technology. Such banks are part of a national system of innovations which has both potential and problems.

Potential for Payment Systems Reform

In the early 1990s, a deputy governor of the central bank pointed to the potential and problem in payment system reform in Thailand (Patamaporn, 1993). The potential of the payment system was partly based on a real-time gross settlement capability, being one of the most advanced technological adoptions in the Asian region. The problem, paradoxically, was constrained by the lack of new technologies for furthering improvements. As a result, the central bank has provided continued commitment towards payment system modernisation. The central bank's role in payment systems goes beyond system development. This includes the institution's role in influencing the direction and diffusion of technological innovations in the payment system, for example in initiating and promoting the use of technology in non-cash based payment instruments. Niyada Kanistarat, the Bank of Thailand's deputy director of IT, points to the central bank's payment policy.

> The promotion of non-cash based payments through technology is the central bank's policy and this is reflected in the payment system development plan. This includes the use of information technology to reduce the use of cash and cheques and to increase the use of electronic mediums. Although commercial banks have been offering this service, we aim to facilitate the transfer of funds among them through the payment system and this is particularly to support both large-value and small-value funds transfers.

This point was illustrated in the mini-case studies. The large commercial banks invested in IT in the early 1970s, and have continuously pioneered and applied them in a wide range of areas in financial services. For example, this included the introduction of ATM networks to support retail banking, and the formation of co-operative computer networks between commercial banks. However, this has not clearly cover the transfer of large-value payments, and although the central bank intended to influence innovation in this area, the institution was partly constrained by bureaucracy.

The procurement process provides one illustration. Due to the bureaucratic nature of the central bank, which is a quasi-governmental institution, the procurement of computer equipment is a lengthy process taking over 3 to 4 months, as compared to 20 days for commercial banks. This has partly influenced the slow adoption rate of key computer technologies and systems by the central bank, and has also lengthened the technology catch-up process, as compared to the commercial banks, a point emphasised by Niyada Kanistarat.

> Whether the Bank of Thailand plays a leading role in information technology or not, I would say that most central banks are behind commercial banks in pioneering the use of information technology. However, in terms of policy formation, the central bank should set the directions and provide the necessary push for the commercial banks. This may include developments in smart card technology, retail funds transfer payments, co-operative ATM networks or the promotion of joint ventures with international banks.

This formation of policy partly influences the direction and diffusion of IT in the payment system. The reduction of cheque float provides one illustration. The use of electronic payment alternatives, for example, financial EDI applications, have been very limited and early developments were related to international trading activities conducted through the Customs Department. The central bank thus encouraged the use of existing technological infrastructure.

The approach to reduce cheque float involved two main measures. The first measure was to increase the volume of high-value cheque-based transactions to BAHTNET, aimed at increasing the turnover rate of outstanding cheques. The second

measure involved the expansion of the electronic cheque clearing process into the provincial and district areas of the country, thereby influencing the diffusion and adoption of technology into distant regions. This latter measure involved increasing the capabilities of the existing electronic cheque clearing system, as the coverage and capability of the cheque clearing system, developed during phase one of the payment system modernisation plan, was restricted to the capital and the surrounding suburbs. During phase two of the project in 1997, the central bank aimed to increase this coverage nationally, but in doing so, some concerns in extending the system's capabilities were raised by Tarisa Watanagase, the Bank of Thailand's payment system director.

> The project's scope is wide and would take considerable time to complete. This will involve the clearing of cheques originating from different districts within the same province. In the early days, the clearing of cheques was approximately 7 to 8 days due to the lack of a central clearing point. The central bank is currently examining such practices in each province over a two-year period. Moreover, we aim to halve the 15 days clearing time for inter-provincial cheques across the different regions. We would use another electronic connection rather than EDI to reduce the movement of physical cheques one-way instead of two-ways.

The central bank, operating in a semi-autonomous status under the government, is also authorised to introduce or review regulations related to banking. This role is clear in the regulation of payment systems, whereby terms and conditions are set-up for members in managing related risks. However, this does not imply that the central bank has imposed strict regulations on technological innovations in the payment system. On the contrary, a more progressive position towards promoting innovation was taken, as pointed by Niyada Kanistarat.

> In our previous meetings, we decided that potential providers of innovative payment services, for example in Internet-based banking would need to report their services to the central bank. We attempt to exert control this way, rather than impose restrictions due to the lack of existing laws, as our own regulations do not cover such provisions.

The central bank's policy has been cautionary but progressive towards innovation. Firstly, this is because technological changes have superseded legal changes. The amendment of existing laws or the drafting of new legislation is a

lengthy process in Thailand. For example, the legal groundwork for EFT laws to support the admissibility of electronic evidence in court has not been considered by parliament as of the mid-1990s, although there have already been the provision of such services in the country since the 1980s. Alternatively, the time to introduce innovations in the payment system is relatively short, and most importantly, their implications are not always clear. Secondly, central banks in developed countries share this uncertain view. The implications of innovations in the payment systems towards central banks in developed countries are not fully understood due to the unpredictable character of the innovations. For example, a joint study on the security implications of electronic money by central banks in the G-10 countries suggests the following recommendations and conclusion (BIS, 1996, p. 15).

> The development of e-money and the associated policy assessments discussed in the report are subject to considerable uncertainty that is likely to influence the nature and timing of any regulatory response. Designing an appropriate regulatory framework for electronic money involves balancing different objectives including the stability and financial integrity of the issuers, protection of consumers and the promotion of competition and innovation.

The impact to the conduct of central bank monetary policy was slightly significant. The report further concluded that in terms of monetary policy, the measurement of monetary aggregates was the most significant factor of policy implementation, unless there was an extensive substitution of electronic money for cash payments. In such circumstances, the central bank needed to select policy options such as the incorporation of electronic money into the monetary aggregate measurement or the adjustment of balance sheets to support far more significant shifts in the use of electronic money.

The Bank of Thailand shares this view. The central bank agreed that the introduction of technological innovations in the payment system created impacts, but argued that this would not reduce the role of the central bank in controlling monetary policy. Such an argument is based on the careful examination of the country's monetary aggregates, whereby the relationship between money supply and economic activity are measured. Tarisa Watanagase points to the management of such implications.

> The impact is more homework. We would examine the relationships between money, velocity, and real activity. We normally assume that velocity remains unchanged. Otherwise, we would examine through empirical economic research and formulas to study whether velocity shifts are temporary or permanent to control monetary policy. In early developments, the velocity factor may be unstable and fluctuate so we need to be alerted. Thus, electronic payments do not reduce our ability to control monetary policy.

Problems: Shortage of Skilled Staff

The central bank faces a shortage of skilled staff in promoting technological innovation. This problem is commonly faced by most institutions in the country and developing countries elsewhere. Nevertheless, the role of most developing country central banks are significant, as it is an institution where a pool of skilled staff is concentrated (Fry *et al.*, 1996). As a result, such conditions increase the responsibilities of central banks in developing countries which may be beyond their primary role in monetary policy. Niyada Kanistarat points to one of these roles in the promotion of technological innovation.

> We intend to become a leading institution in Thailand and this is reflected in the central bank's plan. In the information technology department, we also hold this view and aim to be a technology leader. However, we have human resource constraints in terms of implementation.

The shortage of skilled computer staff stems from two major reasons. The first reason is related to compensation. The central bank has been unable to compete with commercial banks in providing an attractive start-up salary for prospective employees. For example, while the central bank may provide a monthly salary of approximately 9,000 Baht to a new employee, commercial banks may provide 20,000 Baht to the same applicant.[130] This results in strong competition from commercial banks in the labour market. The problem is worsened with the selection of prospective staff. There are further problems in recruitment due to a mismatch between the skills of new recruits and the skills required by the institution. The preferences for graduates in computer science and statistics disciplines from some of the most outstanding state universities in the country are usually unmet, as this group of prospective staff may have been offered employment by private sector firms upon completing college. As a result, most applicants to the central bank are graduates from lesser-qualified teacher

[130] Interview with Niyada Kanishtarat, Bank of Thailand. See Appendix 6.

colleges or vocational schools. Niyada Kanistarat provides one solution to this shortage in skilled staff.

> The central bank tries to resolve the problem through awarding scholarships to students or training them during summer vacation. This may attract prospective staff to the central bank although the salary may not be very attractive. Nevertheless, the information technology department is still worried about job changes and competition in computer-related professions which is extremely high. This problem, however, is also faced by the commercial banks.

The second reason is related to personnel quality. This is particularly in the area of software development whereby the central bank, according to recruiting experiences, has experienced the lack of guidelines in software development. One point raised was the overemphasis of educational institutions towards the teaching of computer programming languages rather than on the learning of different software packages. Niyada Kanistarat further stresses this point.

> Students may have learned 6, 7 or 9 programming languages, but they have not learned from software packages. For example, although new staff may have learned programming languages such as C, Basic, Pascal or Delphi from school, they still need to be re-trained to work with software packages. The students may have only studied such subjects for 2 months of one school term. If the central bank aims to be a technology leader, such staff quality would need to be seriously considered.

Nevertheless, the central bank has a vision of becoming an innovative institution. The central bank realises that prior to being a technology leader in the country's banking system, it would need to resolve many problems. One of the most important problems is related to human resource development and training. The need for central bank personnel to constantly learn and accumulate new technologies is equally important in terms of building indigenous capabilities. Niyada Kanistarat also raised the role of commercial banks as an example in such a learning process.

> The technology trends between the central bank, the commercial banks, and the banking industry can be compared to study how the Bank of Thailand can work towards its vision of becoming a technology leader under conditions of a national shortage of skilled human resources in information technology.

Summary

There is a clear vision of creating a modern central bank in Thailand. Through senior-level management support, the development of electronic payment systems was made possible. However, problems inhibiting innovation remain, which are related to the quantity and quality of personnel, and the central bank's bureaucratic institutional set-up. Nevertheless, the central bank has a relatively strong potential in promoting innovation which is a view shared among the four largest commercial banks.

7.3 ROLE OF COMMERCIAL BANKS

This section discusses the role of commercial banks in a Thai innovation system.[131] The central bank noted that commercial banks competed for skilled staff in IT but on a much broader scope. This lack of human resources is a shared problem and beyond the boundaries of the banking industry, being a national problem that inhibits technological innovation in the industry. Nevertheless, the commercial banks maintain that there are relatively strong roles for banks, particularly the central bank, in promoting technological innovation in the sector, and more broadly, in the country.

Role in Innovation

The role of commercial banks in promoting technological innovation is diverse. The first role is through branch banking. Commercial banks are in a position to diffuse technological innovations, for example ATMs and electronic banking services, through their branches which are located in urban and remote areas nation-wide. This reflects the central role played by the commercial banks in transferring funds from one firm to another and is clearly pointed out by Chaiyong Wongwuticomjon, senior vice president for electronic banking at Krung Thai Bank.

> I think that commercial banks are at the heart of technology. The transfer of funds may pose a problem in a country's monetary system and this is a burden for the Finance Ministry and the central bank. The authorities want to computerise this process and this involves commercial banks working in the interest of other companies or consumers, as they have national and foreign networks to serve their clients.

[131] This section is mainly based on interviews.

Such branch networks influence a majority of firms through the provision of electronic banking services. The use of Internet-based banking, for example, may involve the debiting or crediting of customer bank accounts, and the commercial banks are in a unique position to provide such services. Chaiyong Wongwuticomjon of Krung Thai Bank illustrates how electronic banking services, provided to students of a local university, may have much broader implications to educational reform.

> We have been providing electronic banking services to Sukhothai Thammatirat University. Students can call through the interactive voice respond system and register for a course by pushing a button. The system responds by informing the fees and if the student agrees, he would push another button that credits the university account, debits his account and generates a receipt in two following days. This is a value-added service, a relatively simple and cost-effective project to implement and helps the educational sector. I think the service would be used on a much wider scale in the future.

The second role is through the use of IT. Commercial banks have become major users of IT in the country's private sector, partly because of the high-level of competition in the industry. This leading position is second only to the public sector which includes a range of government agencies. Nevertheless, the technology leadership of the commercial banks puts them in an influential position, including cases whereby commercial bankers are appointed as committee members in national IT projects and as organisers of major computer-related events and demonstrations. Moreover, public and private organisations seek for professional advice from commercial banks. The development of a data warehouse by one of the commercial banks, for example, was observed and later adopted by the Customs Department, for which the government agency sought for further advice in computer-related problems. Vichit Amonviratskul, first executive vice president for technology of Siam Commercial Bank, provides another illustration.

> The Social Security Office has requested me to help evaluate the system specifications of their project master plan, aimed to develop a very large multi-million Baht computer system. They hired a consulting company and have requested me to criticise the advantages and disadvantages of the project. This is the role that the private sector can play in promoting technological innovation. This includes both individuals and institutions seeking our assistance.

This involvement also extends to educational institutions. For example, a senior-level manager of one commercial bank was requested by a local university to hold a directorship in the school's department of IS. One of the main reasons was to acquire information on how to structure course work and how to devise teaching methods within the technological institute which would suit industry demands. As a result, this has partly helped the matching between the demand and supply of computer skills, and has also addressed the issue of compensation of academics. In the latter case, the university has been capable of attracting and maintaining qualified staff with higher salaries who would otherwise seek alternative means of employment in the private sector to supplement their low income.

The third role is through investment. This has particularly taken the form of establishing companies or joint venture partnerships related to IT. In the latter case, the aim of joint ventures is to acquire venture capital and foreign managerial and technical expertise into the country. The commercial bank has taken a mediating role between foreign and domestic companies by organising the meeting between both parties. Vichit Amonviratskul of Siam Commercial Bank provides one illustration.

> We have recently established a company to attract venture capital. This involves the matching of foreign firms that are technologically advanced with their local counterparts requiring the technologies. We would organise meetings between both parties or bring local businessmen and industrialist abroad to observe new types of technology. On the contrary, foreign firms may be looking for local partnerships.

Such a company is a joint venture in itself. This involves the co-operation between the commercial bank and a semi-autonomous organisation driving the development of science and technological capabilities in Thailand. The company, called Science Commercial Link, aims to promote the bridging between the technology users or investors in the country, and the technology suppliers who are primarily foreign firms. On a broader scope, this company has a more ambitious agenda, as suggested by Vichit Amonviratskul of Siam Commercial Bank.

> This is one role we play in promoting technological innovation and these ideas originate from our chief executive officer. We view that the reliance on using competitive cheap labour in the industrial base of the country would change. If

> we don't upgrade our technology to a higher level, we would not be able to compete with countries such as Vietnam, China and Indonesia.

One major barrier to innovation, however, is taxation. This is a common problem constraining organisations, particularly the commercial banks who have to purchase licensed computer software. The taxation levels for computer software have been particularly high in the country, as compared with computer hardware components, a point emphasised by Phongthawat Phuangkanok, first vice president for IS audit of Thai Farmers Bank.

> We have been paying so much money for software licenses and this has been approximately 10 million Baht. If taxation levels can be reduced, this would greatly benefit banks. As for hardware, their prices have gradually been going down already.

Thongchai Pingkarawat, senior vice president for IS audit of Siam Commercial Bank, supports this view and further suggests how tax reduction may contribute towards the country's technological development.

> One measure to promote technological innovation would be to exempt tax from information technology equipment covering both hardware and software computer components. If our nation is to develop rapidly as other nations, there should be no barriers in using information technology. This would benefit the people and country because it is not a luxurious or conspicuous product.

In sum, commercial banks influence, and are influenced by innovations. They exert influence through providing electronic banking services through branch networks and investing in joint venture companies to acquire technology. On the contrary, the high taxation levels on computer software have also constrained their technological development. Apart from such roles, commercial banks view the importance of creating an environment conducive for innovation, suggesting a potential role to be played by the central bank.

Role for Central Bank

One of the primary roles of the central bank is in regulation. The introduction of regulations can either initiate or inhibit innovations in the banking system. The former case is relatively stronger for the central bank in Thailand. The creation of an electronic clearing system in the country reflected commercial bank disagreements

over unequal investment cost and voting rights. Phongthawat Phuangkanok of Thai Farmers Bank illustrates how early developments restricted network membership and later improved commercial bank co-operation.

> The banking community used to negotiate between 20 to 30 years to organise a clearing system. All 15 commercial banks were required to be technically ready to implement something and small banks were reluctant to invest in technology because of high investment cost. More recently, an individual bank that is ready may gain network membership prior to other banks. Much has changed today.

These changes were in fact constrained by commercial banks themselves. This was in part due to the highly concentrated nature of the commercial banking industry and the high level of competition. Thus, the development of a large-value funds transfer system, as mentioned in Chapter 3, through commercial bank co-operation failed and resulted in the initiation of the project by the central bank. Chaiyong Wongwuticomjon of Krung Thai Bank illustrates this.

> Someone has to implement BAHTNET. It was either the central bank or the commercial banks that would have to joint-invest. Thai commercial banks were, however, non co-operative and that is why the central bank resumed responsibility.

This relatively weak commercial bank co-operation also affected further developments in integrating ATM networks. Chaiyong Wongwuticomjon of Krung Thai Bank makes this point.

> It looked as if Thai banks were co-operative in implementing an ATM Pool. What happened recently in pricing policies, however, reflected how uncooperative we are. We failed to discuss such issues with one another. We are allies but fail to inform each other on recent developments. I have drafted a message to call for a meeting but most banks have not been responsive saying that they need some time to organise data.

This lack of co-operation led to central bank involvement. This was particularly clear in the gradual relaxation of ATM regulations. Thongchai Pingkarawat of Siam Commercial Bank, points to the role for the central bank in promoting technological innovation in this respect.

> The central bank does not really interfere with us. For example, they have relaxed their regulations with regard to ATMs. They have not regulated the use of technology so commercial banks can use any type of technology as they wish. Every month, we would prepare information systems audit reports to the central bank and report on the number of ATMs. Today, they are less restrictive on the number and location of ATMs.

The central bank also supported the development of a co-operative ATM network. This network, called ATM Pool, provided interconnection between two major existing ATM networks and increased accessibility of services to different commercial bank customers. The co-operative network also improved the otherwise high investment costs of individual commercial banks as illustrated by Phongthawat Phuangkanok of Thai Farmers Bank.

> The central bank has supported the creation of an ATM pool for commercial banks. This shared investment among member banks helps reduce the investment cost of technology, as the set-up of a machine would be based on real necessity. I think the central bank has reduced its regulatory role in this respect, and has become more liberal in encouraging commercial bank co-operation to develop such networks.

This increasingly liberal position followed with changes in ATM pricing policy. Prior to regulatory changes in mid-1997, the central bank controlled the collection of cross-bank transaction fees by commercial banks. While the central bank took into consideration consumer interest, the commercial banks were incurring increased operating costs originating from cross-bank transactions. Vichit Amonviratskul of Siam Commercial Bank illustrates such problems on pricing.

> The providing of banking services through technology has been relatively liberal. There used to be restrictions with regard to the installation of ATM machines. It is only pricing now that I think has to be more liberal. The central bank should permit commercial banks to compete with one another. There would be self-adjustment and wouldn't be an advantage against customers at all.

Vichit Amonviratskul of Siam Commercial Bank further illustrates, in lengthy detail, the costs incurred by commercial banks in handling financial transactions and the role that the central bank can play in introducing cost measures for cross-bank transactions.

The pricing of technology is an issue. We sometimes feel that our technological investments should be shared between the service providers and customers. Customers may benefit from improved services but in terms of pricing, it is very difficult to change due to central bank regulations. For example, we allow customers to use ATM machines between different banks so there is increased cost, say, 7 Baht per transaction. The central bank has not permitted commercial banks to charge this, although there may be increased costs. As a result, some banks have tried to avoid other bank customers using their ATMs services through various methods, for example, in making balance inquiries possible only with their own customers. Otherwise, a bank would be required to pay 7 Baht for that particular transaction. Moreover, when there are no costs incurred by customers, the use of such services go beyond their necessary needs. Some customers may request for a balance inquiry before and after cash withdrawal, and this would involve 3 transactions. The central bank should have a role in introducing cost measures that are well balanced and in support of ATM use in necessary transactions only. This would help our investment and reduce our costs. The central bank should not only regulate such services but also cater to customers and provide public relations. This is the role where most commercial banks want the central bank to play.

The relatively weak role of banking associations in promoting technological innovation has also pointed to the importance of the central bank in this respect. Kajornvut Tayanukorn, senior vice president for systems development of Bangkok Bank, points to the lack of strong commercial bank co-operation with respect to the century date change problem in computer systems.

The Thai Bankers Association has recently addressed the century date change problem. This has gained good co-operation among the commercial banks, but I would say only on the consultative stages. There is, however, less action in reality. There remain a few barriers in the sharing of technology and knowledge.

Chaiyong Wongwuticomjon of Krung Thai Bank further illustrates the limitations of the banking association by pointing to the underlying competition existing between commercial banks, although they have jointly developed a small-value funds transfer system.

The retail funds transfer system is currently under development. The Thai Bankers Association is similar to the Hotel Association of Thailand. During a meeting, members may talk with one another nicely. However, they may compete outside the meeting room with tactics. This is the character of a market. The set-up of an association does not really facilitate developments as required. Advantages and disadvantages exist.

Promoting Technology

The central bank faces two conflicting roles in promoting technological development. The first role is in regulating technological innovations to help maintain the integrity and security of the banking system. The second role is in promoting technological innovations, as in the modernisation of payment systems, and the support provided to commercial banks. Thongchai Pingkarawat of Siam Commercial Bank points to this conflicting role and encourages the central bank to promote technological innovation.

> Generally speaking, this may conflict with the central bank's role which is to regulate the payment system. Their role has not been to promote innovation. Their role is to regulate and not stimulate. Stimulating innovation on the part of commercial banks would be on an individual basis. The central bank monitors, but if they want to change their role to promoter, this would be very beneficial.

This conflicting role also extends to the regulator and operator of technology, and is particularly relevant with respect to the central bank's role in regulating and operating the payment system. The key issue is whether there would be the promotion of competition within the payment system or not, as the central bank may partly monopolise the provision of such services. Teera Aphaiwongse, senior executive vice president for technology of Bangkok Bank, illustrates this point.

> The central bank cannot circumvent its role as regulator. Another role that depends on each individual central bank is to decide whether to be an operator or not. There should be a clear division in this respect. Being both the regulator and operator is very difficult. Would there be competition? I think no one would want to compete with the central bank. Will it be a monopoly or something that is similar? Where the central bank stands, I think, would depend on its policy.

The potential role of the central bank is also partly consultative. Such role is actively participating in various associations and working committees whereby representatives from commercial banks and securities firms, for example, may be consulted. Teera Aphaiwongse of Bangkok Bank clearly makes the following point.

> The central bank can promote innovation through consultative channels. They can give signals whether the time is right or not. We have various committees such as the Thai Bankers' Association and the Financial Companies Association. The central bank should be involved in such working committees. Whatever the central bank initiates, commercial banks would think in business terms, and if it

is not useful or profitable, they would not want to get involved. I believe in market mechanisms.

The central bank can potentially promote innovation through market mechanisms. This may be accomplished in two areas. The first area concerns the study of specific innovations and the reasons influencing their rate of diffusion, while the second area concerns the changing of central bank regulations to support technological innovations in banking, as suggested by Teera Aphaiwongse of Bangkok Bank.

> (Firstly) Most commercial banks are aware of new technology but unaware of the reasons influencing their adoption. The technologies may be expensive. For example, although Thai Farmers Bank introduced smart cards in 1995, and most commercial banks were aware of such technologies, the project was stopped temporarily. There are innovations in banking but not on a large scale. (Secondly) There may be barriers with regard to rules and regulations. In this respect, the central bank can help make changes to existing regulations. They can find ways to reduce costs or increase profits. For example the private sector would like to establish credit bureau's but their remains a legal problem. The central bank can help resolve such problems.

The perception of the central bank as a bureaucratic institution, however, has also created an attitude of inefficiency. This point was particularly relevant in our discussion in the previous section which illustrated how bureaucratic procedures have affected the adoption rate of new technological developments in banking. Vichit Amonviratskul of Siam Commercial Bank points to a need for the central bank to change its attitude, particularly towards promoting technological innovation.

> Commercial banks may feel that the central bank may be regulating more than supporting. This may be because of its major role in regulation that has created a conception that is carried on. We want to see the central bank increase its supporting role in technological innovation. This is because over-regulation would make changes very difficult. The central bank should reconsider this point - their attitude.

Summary

There is a potential role for the central bank in promoting technological innovation. This was illustrated with their role in ATM development. The achievement of such a role, however, partly depends on the central bank's capability to change. This ranges from changes in regulation to changes in attitude. These issues, as raised by the

commercial banks, have wider implications. The central bank, being a national institution, has a unique role in influencing the direction and diffusion of technologies in a national system of innovation. To put this role into context, the technological environment and establishments influencing innovation in banking are discussed in the following section.

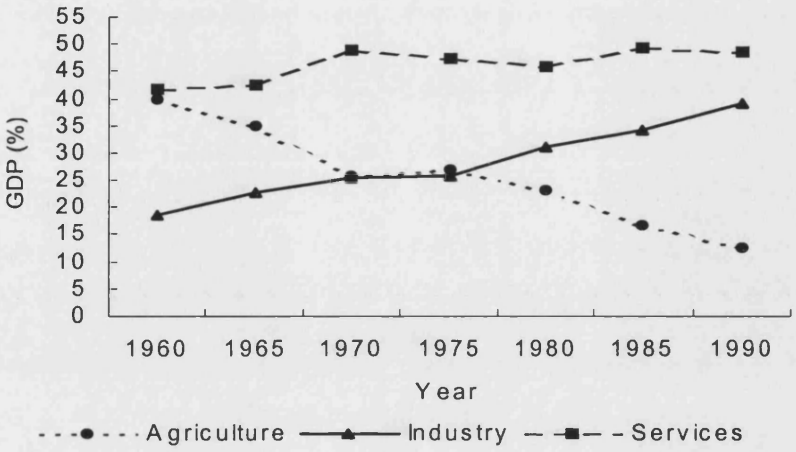
7.4 DISCUSSION

This section discusses how innovation in banking influences and is influenced by the national technology policy environment in Thailand. This includes a discussion of lessons learned from early industrialisation, the promotion of S&T, the promotion of IT, the major policies and problems related to IT, the key factors in innovation, and the role of banking institutions in innovation.

Lessons from Industrialisation

Prior to rapid IT developments in Thailand during the early 1990s, the country experienced considerable technology transfers in the form of foreign direct investment. Two other main catalysts were foreign trade and tourism. Like many other developing countries, Thailand adopted an industrialisation policy to stimulate economic development. Moreover, this mainly focused on the manufacturing sector as Thailand provided an investment base with abundant and cheap labour supplies. As depicted in Figure 7.1, the composition of the country's GDP from 1960 to 1990 shifted away from agriculture to industry, while the services sector has contributed to a large percentage of the country's GDP during the same period.

Figure 7. 1 Composition of GDP, 1960-1990



Source: National Economic and Social Development Board. Notes: Industry sector includes: manufacturing, construction, mining, electricity, and water supply. Services sector includes: transportation, communication, trade, banking, real estate, ownership of dwellings, public administration, defence and others.

Technology transfer studies in Thailand have suggested an incomplete understanding of the process. For example, in a study of technology transfer in the Thai textile industry, it was argued that the most useful role of modern large-scale manufacturing industries is in generating skills rather than employment (Santikarn, 1981). In another study on the Thai machinery and electronics industries, the role of technology and skills in the industrialisation of the country was strongly emphasised (Khanthachai *et al.*, 1987). In practice, however, such studies in Thailand have often revealed the opposite outcome.

The main lesson learned from this early process of technology transfer highlighted the importance of technological capabilities. Several important points for technological development in newly industrialising countries have been emphasised (Dahlman *et al.*, 1985). First, it is necessary to acquire these capabilities for efficient production and investment. Second, combining both foreign and local technological elements provides a base from which to develop local capabilities. Third, acquisition of these skills is achieved through conscious effort. Lastly, the conducive economic environment determines how productively a country's resources are utilised.

Studies on technological capability development in Thai industries raised similar issues (Vongpanitlerd, 1992; TDRI, 1989). They compared Thailand to South

Korea prior to the 1960s when both countries were strongly agricultural based. South Korea then embarked on an industrialisation program in the early 1960s, investing heavily in S&T and became a newly industrialised country thereafter. Thailand, on the contrary, did not adopt this development path. The study also identified problems such as the inadequate supply of human technical resources, particularly engineers. Moreover, entrepreneurial attitudes against human resource development only helped to exasperate the situation. This indicated a lack of innovative elements as compared with other strong factors such as operative capabilities. The implication was that public policy measures needed to be redirected to enhance the development of human capital or, more precisely, S&T manpower in the country.

The lessons brought by industrialisation in Thailand are clear. First, there was an insufficient emphasis previously on the importance of S&T. Foreign direct investment brought with it the flow of technology to increase the efficiency and productivity of Thai and foreign industries in the country. This major development occurred while the country's scientific and technological bases were weak. Second, there was a mismatch between the generation of employment opportunities and skills among Thai labour (Vongpanitlerd, 1992). The flow of capital intensive equipment did not really contribute to the promotion of technical and managerial skills among the Thai workforce. And third, these earlier problems would possibly escalate with the development of the country's capabilities in electronics and IT-based industries. Apart from facilitating and increasing productivity, these new technologies would differ from previous technologies in that it will demand a higher level of creative and innovative skills from the Thai workforce. Before amplifying our discussion on this last point, technological developments in Thailand during the transitional period are discussed in the next section. Then we will look at their prospects.

Science and Technology

The promotion of S&T activities aims to resolve some of these problems which has also become a common initiative introduced among a number of Southeast Asian countries (Mervis and Normile, 1998). This may cover a range of developments from emphasising the role of S&T in the country's social and economic development plans, to supporting the growth of particular technologies such as IT. We discuss both the breadth and depth of such developments. The Thai government has experienced both

success and failures in its early S&T initiatives (Chantramonklasri, 1997). In 1956, the National Research Council of Thailand (NRCT) was formed to fund public-sector research ranging from basic science to social science. In 1963, the Thailand Institute of Scientific and Technological Research (TISTR) was set-up, providing public funds for scientific and technological research. In 1979, a Ministry of Science, Technology and Energy was established, but played only a minor political role. In 1985, a Science and Technology Development Board (STDB), resulting from a $50 million co-operative project between the United States and Thailand, was established.

These early initiatives, however, did not achieve a significant degree of success. The NRCT and TISTR experienced problems of spreading their resources unevenly. Moreover, the technology-push factors originating from public research institutes and universities did not interface well with the demand-pull factors consisting of the users of such technologies in industry. The STDB carried out research activities that were not in its original mandate. This was to help strengthen the R&D capabilities of public-sector researchers, extend grants and loans to private companies, and provide information and consultancy services. In practice, there was an over-emphasis on building the capabilities in government agencies and universities.

There have been three more recent developments concerning the promotion of S&T in Thailand. The first measure was the establishment of an institutional framework. In 1991, a funding and research organisation called the NSTDA was formed. Operating autonomously under the guidance of the Ministry of Science, Technology and Environment, this supervises three national research centres that are the driving forces behind S&T developments in Thailand. They are the National Centre for Genetic Engineering and Biotechnology (BIOTEC), the National Metal and Materials Technology Centre (MTEC), and the NECTEC. Some other activities that the agency encourages are: providing research funding for both public and private sectors; information services; institution strengthening; human resource development through scholarship programs; and technical and consultancy services.

The second measure was the promotion of S&T education. In Table 7.1, the composition of Thai students in various fields of studies during 1993 indicates that there is a strong tendency towards the social sciences (52.01%) as compared to S&T related disciplines (4.6% in engineering, 5.68% in natural sciences and 6.66% in medical and health sciences). These figures clearly indicate a mismatch between the country's ambitions in becoming a newly industrialised country and its human resource capabilities.

Table 7. 1 Number of Students in State Educational Institutions in Various Fields, 1993

Field of Study	Number of Students	Percentage
Humanities	24,919	3.80
Education	51,237	7.82
Fine arts	2,682	0.41
Social sciences	340,831	52.01
Law	103,052	15.73
Engineering	30,145	4.60
Natural sciences	37,235	5.68
Medical and health sciences	43,625	6.66
Agriculture	20,287	3.10
Others	1,254	0.19
Total	655,267	100.00

Source: Ministry of University Affairs

One of the government's main initiatives has been the set-up of a project called the Development and Promotion of Science and Technology Talent. The main objective was to attract exceptionally capable students and provide them with financial support for education, ranging from secondary level to more advanced degrees. The rationale was to encourage graduates in S&T related fields to work in government, universities and research institutes. This program was highly successful with an increase from 30 students who joined the program in 1984 to 375 students as of 1990.

The last measure is in R&D activities. Progressive government support in the building of R&D capabilities has been in the form of tax incentives and the establishment of R&D-related projects. The first initiative was targeted to promote private-sector R&D for projects that are endorsed by the government. This new law aims to reduce the amount of tax paid by companies and at the same time encourage private companies to pay more attention to R&D.

The second initiative (in education) involved the development of several projects. For example, in introducing measures to solve the country's 'brain drain' problem, the government devised plans to establish an International Earth Observation Satellite project which will involve the co-operation of Thai experts who live abroad to help develop the country's R&D capabilities in IT. In a related project, the Telephone Organisation of Thailand and NECTEC have planned to establish jointly a R&D centre. Such initiatives include R&D projects related to: telecommunications equipment; the service industry for value-added services such as cable television and Internet; operations and maintenance; and systems standards. There is great breadth of S&T developments in Thailand. To provide a more detailed discussion, we will amplify on the developments in IT which has been very rapid.

IT

In 1992, the government's initiative to promote IT materialised in the establishment of the National IT Committee (NITC). This committee comprises 22 members from both the public and private sectors and is chaired by the Deputy Prime Minister in charge of social and economic development. This key position is very important as it serves as a bridge to recommend IT plans to the Council of Ministers (NITC, 1995). The main agency that carries out and co-ordinates the activities of the NITC is the NECTEC which acts as its Secretariat. The structure and activities carried out by NITC are grouped into eight sub-committees. They are responsible for promoting EDI for international trade; planning IT policy; developing human resources related to IT; utilisation of IT in the public sector; developing a legal infrastructure for IT; developing public awareness of IT; promoting R&D related to IT; and developing a national information infrastructure. These eight sub-committees assist in national IT developments. The promotion of IT through the Thailand IT Year 1995 national campaign aimed to provide much stimulus and awareness to the Thai public. There were three main objectives: to celebrate the golden jubilee of the King's accession; to raise the awareness of the Thai general public about IT; to stimulate the utilisation of IT in all economic sectors to increase the efficiency of production and services.

The monarchy serves as a focal point for Thailand. This focus has been extended to IT development. As the assessment of promotional efforts may be unclear or immeasurable, the monarch plays a central role in mobilising the unity of the

general Thai population. In relation to national IT policy, it is the objective of planners to create awareness and use of IT through this mobilisation. Learning from their regional counterparts has also provided Thailand a strong base of knowledge. For example, in studying the feasibility of EDI for international trade, successful models in Australia, Singapore and Taiwan were adopted and modified to suit the country's purposes (Andersen Consulting, 1994).

There are three main recommendations made in Thailand's national IT policy. These encompass building an equitable national information infrastructure, investing in people, enhancing government services, and forging a strong information industry. We discuss two of these, focusing on the hardware and infrastructure in this section, and the software and emphasis on people in the following section.

A five-year rural communications expansion and modernisation program has been seen to support the national information infrastructure. Some of the specific goals are 'to install telephone lines to no less than 12,000 remote tambons (hamlets) and villages with over 6,000 million Baht a year for five years so as to provide nationwide universal service by the year 2000' and 'to provide all villages with 20 households or more with at least one public telephone booth, and also ensure the overall public telephone penetration rate in the provincial areas to be over 3: 1,000 population' (NITC, 1995).

These goals are ambitious. Economic development and the promotion of IT imposed strains on the country's infrastructure, particularly in telecommunications. The major development that would help to alleviate this bottleneck was the expansion and modernisation of the country's telephone network. Although Thailand received World Bank loans to improve its international and inter-provincial telephone services, this concentrated mainly in the metropolis and comprised 68% of all lines. In recognition of this problem, the government provided telephone line concessions to the private sector. As a result, two new projects include the development of two million telephone lines in Bangkok and one million in the provinces. In 1993, the country's first communication satellite, Thaicom 1, was launched and will be used primarily for television, telecommunications and computer processing. This launch will

be followed by subsequent launches of larger satellites that will eventually make the Thai telecommunications industry more competitive. This significant development will serve as a stimulus in the development of IT.

Policies and Problems

Thailand has formulated policies to address problems, particularly in IT manpower. Thailand has developed a new technology-based economy like many other developed and developing countries. Changes brought forward under this new environment do not have a limited influence on a particular technology system or several economic sectors only. On the contrary, they have a more profound impact with widespread effects in all sectors of the Thai economy. This affects, and creates shifts among, the three economic sectors - agriculture, manufacturing and services. One of the more important policy initiatives, as we have mentioned earlier, has been to address the shortage of human resources. A significant feature is to make the investment in people comprehensive. The strategic direction behind this recommendation is clear: '[we must] make IT an integral tool in education and training at all levels. The use of IT in education must not be restricted to science and technology, but to include the humanities and the arts as well' (NITC, 1995).

Three other policy recommendations support this initiative: implementing a National School-Informatization Action Program; establishing a National Interactive Multimedia Institute to facilitate the development of educational courseware and application software; and intensifying IT manpower production at all levels. We discuss briefly some of these objectives. The National School-Informatization Action Program aims to diffuse the use of personal computers in all state schools throughout the country. The target is to have at least one personal computer per 80 primary and 40 secondary school pupils respectively. Moreover, it aims to 'connect all universities, colleges, and later on, secondary schools to the Thaisarn/Internet so as to allow students, teachers and lecturers to communicate with one another as well as to access libraries, databases, and computing resources nationally and globally' (NITC, 1995). Thaisarn or the Social/Scientific, Academic and Research Network, together with a Network Technology Laboratory located at NECTEC, were formed in 1992. This enabled network connections between universities, government agencies and

increasingly other institutions in Thailand. Prior to these developments, there was a computer network called TCSNET operating as early as 1988.

One of Thailand's key problems, raised over a decade ago and re-emerging in a new form, is the inadequate supply of human resources. Studies on the development of human resource development in IT support this concern (NECTEC, 1995; Durongkaveroj, 1993; Charmonman and Chiraphadhanakul, 1993). This points to the lack in quantity and quality of manpower in both public and private sectors. With a total of 22,000 qualified personnel in Thailand, 25% are employed in the public sector and 75% in the private sector, reflecting the unequal distribution of manpower and the tendency for employment shifts between the sectors (NECTEC. 1995).

Further analysis of the demand and supply of human resources only reinforces this problem. The demand forecast for manpower in IT indicates that, in 1995, Thailand needed to educate 32,533 persons as compared with 138,534 in 2006 which coincides with the end of the 8th national economic and social development plan (NECTEC, 1995). This implies that the country needs to increase the supply of skilled human resources from 6,000 persons in 1995 to 12,000 in 2006. Comparing with existing capacities, this indicates that the country would lack approximately 300 persons in 1995 and 6,000 in 2006. Moreover, if figures for previous years were calculated, this would amount to a shortage of 4,500 persons in 1995 and 31,000 in 2006.

This discussion has highlighted the chain reaction caused by the lack of skilled human resources in Thailand. This problem was recognised early on, since technology was acquired from foreign direct investment. Unfortunately, it is reappearing in the development of IT in Thailand. The lack of IT manpower has been cumulative from early industrialisation and will remain a bottleneck or even escalate in the future if no counter measures are applied. The case of Thailand also illustrates one point. This is the growing importance given by governments in IT innovation. This materialised in the forming of an institutional framework to strengthen IT developments in the country. Such an approach is not novel in East Asian countries and is supported by an institutional point of view (King *et al.*, 1994).

Institutional Factors in Innovation

Thailand's experience points to the importance of institutional factors in strengthening the country's technological capabilities. This institutional point of view highlights the importance of theoretical viewpoints from economic history and the new institutionalism in sociology (King *et al.*, 1994). This provides a unique standpoint in the study of institutional factors behind IT innovation. If this prospect is to be applicable in Thailand, we need to address several of the developments that are taking place. One of the broadest observations that we can make is the involvement of key institutions in Thailand that are helping to promote IT.

The policies and objectives of the National IT Committee have been equally progressive and ambitious. This has helped prepare Thailand in entering the new phase by carrying out a year-long public relations and awareness program, Thailand IT Year 1995. It also assisted in setting out the long-term plans that are in parallel with regional and international counterparts such as in the feasibility study of EDI for international trade and the plans for building a national information infrastructure. Nevertheless, it is still too early to assess the degree of achievement of such projects. The vision is long-term and is relatively hard to measure both in qualitative and quantitative terms.

Another pressing problem is the focus of national IT developments within only one institution or body, NECTEC. It is not suggested that other institutions do not exist. In fact, the collaboration of key institutions and parties were sought in organising the events during Thailand IT Year 1995 (NECTEC, 1994). What we argue is that, for these institutions to be more supportive in promoting innovation, a national system of innovation should be formed. This is defined as: 'the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies' (Freeman, 1987).

What happens within this system has become increasingly important. For example, as we have seen, the interface between S&T highlights several policy issues (Rosenberg, 1991). These include the need for creating interdisciplinary research among organisations, co-operation between scientist and technologist, and private

sector involvement. Hence, technology policies and capabilities are equally shaped by non-technology policies and instruments (Radosevic, 1991).

A Thai system of innovation may be difficult to achieve. A network of institutions in the public and private sectors would require political leadership and commitment as well as the co-ordination of various ministries that are involved in the promotion of S&T in Thailand. Such commitment and co-ordination is difficult within the framework of the existing coalition government in Thailand. Nevertheless, it is argued that, despite political turmoil, the stance of policy-makers in Thailand has been very cautious, enabling it to avoid major mistakes and helping it to achieve stable adjustment and sustained growth (Warr and Nidhiprabha, 1996).

A Thai system of innovation may be strengthened through various initiatives. First, there is a need for other basic infrastructures, particularly in building national libraries that will serve as a repository of S&T related materials. This stock of knowledge can either be gradually phased in the National Library that already exists or be newly built with appropriate funding. Moreover, it can serve as a gateway to sources of information located in libraries, universities and other institutions world-wide. This source of information would provide a basis of research and also act as a channel in the transfer of technology to Thai firms and people alike. This can support the acquisition of know-how locally instead of emphasising the funding of Thai students at overseas educational institutions to assimilate such knowledge. Extending this infrastructure in the long-term, Thai students who have been educated abroad may use their acquired skills to carry out further research and professional work in their areas of interest.

Second, there is an increased need for both bibliographic and commercial information services. Such services support production activities at the firm-level which lead to value-addition and economic growth. Thaisarn has been used widely. However, to optimise it, several bottlenecks may have to be cleared. Some state universities provide limited access to their libraries making information sought by the public difficult to locate. Moreover, the databases of various university libraries would have to be provided in standardised electronic form in order for an inter-

university library information service to operate efficiently. Similarly, small and medium scale enterprises would benefit from industrial and commercial information services that address their special needs. Such initiatives have started, for example, the NSTDA provides information services through its Technical Information Access Centre.

Third, there is a need for industry-university co-operation. In Thailand, the NSTDA has initiated a PhD Consortium Project that aims to achieve such objectives. The goals, both within and outside Thailand, of this tripartite of the NSTDA, universities and the private sector, are to develop human resources in S&T, to help both universities and businesses to acquire technological capabilities and to support on-going R&D. At the regional level, the NSTDA with other Thai institutions has established an APEC (Asian-Pacific Economic Co-operation) Centre for Technology Foresight which aims to conduct joint research with APEC member institutions on future technologies for the region and in the world context.

Lastly and most importantly, there is a need for other institutions to be involved in technological development in Thailand. Foremost, it must be clearly understood that such roles are not reserved to technology institutes, such as the Ministry of Science, Technology and Environment, NECTEC, university research departments, national research institutes, or privately operated think tanks like the Thailand Development Research Institute. The central bank provides one illustration of such an institution, being a key actor in national policy-making, and having played a leading and constructive role in modernising the national payments system.

Role of Banks

Central banks are among a group of other financial institutions that contribute to a country's technological development. These institutions include international development banks, regional development banks, national development banks, commercial banks, government-owned banks and commercial banks. The World Bank provides an illustration. The international aid agency has increasingly given importance to the role of IT in relation to lending policies, technological diffusion, economic development and the strategic management of technological learning (Hanna, 1991; 1993; 1995; 1996). The World Bank has also been analysed as a

technological institution based on its approach in addressing the technological needs of developing countries without prior assumptions of such a role (Jequier and Weiss, 1984). This technological involvement is twofold.

First, the linkage between technology and development projects enables the World Bank to accumulate technical experience that is used as a basis in assessing, evaluating and allocating large sums of investment to recipient countries. Second, the aid agency plays an active role in the choice of technology that is appropriate for certain conditions and mobilises local technological capabilities for its accomplishment. Bank-sponsored projects are at the centre of this technological role (Jequier and Hu, 1989). Through a bank's design and financing of projects, the World Bank is in a position to influence the process of innovation, the choice of technology, the building up of a country's technological capabilities and the creation of new employment opportunities. This accumulation of functional and technical experiences through projects can be theoretically viewed as routines (Lundvall, 1992).

The World Bank is implicitly a technological institution. This includes roles in contributing towards technological innovation, promoting technology transfer, and building technological capabilities in developing countries (Jequier and Weiss, 1984). In addition to being a financial institution, the aid agency is also a technological institution in its own right. This is in parallel with other organisations such as government research laboratories, universities, and R&D departments of enterprises that have as their primary function the promotion of technological development.

Comparatively, the central bank is also implicitly a technological institution. This is particularly the case of central banks in developing countries and focuses on their role in modernising the payment system with technological innovations. This does not primarily include the central banks function in monetary issues, although there may be an existing relationship. The central bank may overlook the importance of its underlying mission in promoting technological innovation as payment systems form a major part in a country's financial sector development.

Central banks also accumulate experiences during the development of payment systems. This is particularly important for developing countries as their payment systems evolve from primitive to more matured systems. Compared to the World Bank, the central bank is involved in technological development through bank automation and payment system modernisation projects. This ranges from analysing, designing, implementing, operating or enhancing the payment system. In addition, this involvement gives them a technological role in the transfer of technology, the diffusion of innovations and the building of technological capabilities in the domestic banking industry.

In sum, the central bank is a central actor in the payment system. Most importantly, the central bank has an implicit role. This is in promoting technological innovation in developing countries through payment system modernisation. The process of designing, developing and managing the payment system project permits technological learning. The result of this process, a modernised payment system, in turn plays an important part in a national system of innovation. This includes the creation of a network of banking institutions that adopt, apply and advance the use of IT to provide innovative financial services, particularly in payment services. On a broader level, the central bank has a potential role to play in formulating a framework for a country's technology policies.

Summary

The aim of this chapter was to examine the role of payment systems in a wider national system of innovation. Payment systems may be seen as a type of strategic IS or a main part of national information infrastructure initiatives. Behind payment systems reform is banking institutions, particularly the central bank and commercial banks. Together, they are the key actors influencing innovation in the payment system. Apart from influencing technological innovation in a country's banking system, they have an increasingly important role, as other types of technological institutes, in promoting technological development.

CHAPTER 8: CONCLUSION

This thesis has shown how banks have contributed towards innovation through payment system modernisation. Set in a developing country context, the factors which influenced innovation were illustrated and discussed. This final chapter seeks to answer the research questions set out in Chapter 1 by bringing together the three themes of the thesis, summarising the major findings, drawing implications for innovation theory and policy, and identifying some areas for further research.

In Chapter 1, we asked how banks could strengthen financial systems. Although a broad question, this focused on the modernisation of payment systems which forms an important part of a matured financial system, and more importantly, is a key component in a national information infrastructure. This thesis attempted to answer the question by examining three related research themes - innovation, banking, and developing countries, which was further illustrated with the case of payment systems modernisation in Thailand, and the role of banks in promoting innovation.

How have banks contributed towards innovation through payment systems modernisation? Basically, the central bank's modernisation of a country's payments infrastructure not only serves the primary purpose of facilitating funds transfer among consumers, businesses, government, and financial institutions. More importantly, a modern payments infrastructure serves a secondary purpose whereby commercial banks used this foundation to further develop, diffuse, and provide innovative payment products and services to a wider population.

How have banks overcome, resolved, or removed their weaknesses? There were four main ways. First, they made large IT investments to automate internal operations and to develop new payment delivery channels. Second, they introduced wide-ranging re-engineering programs with the assistance of foreign consulting companies. Third, they developed their own technological capabilities by establishing joint ventures, bank affiliated companies, and in-house research and development departments. And fourth, they strengthened staff skills by training employees and providing educational scholarships.

To further examine capability development, we raised the following questions in Chapter 1. What types of IT resources are unique? How do such resources contribute towards innovation and the sustaining of competitive advantage? How do attributes affect the rate of resource replication? To identify the sources of innovation, an analytical framework was introduced to identify the types of resources which were potential sources of sustained competitive advantage. Basically, unique resources are such sources of advantage. However, a range of attributes influences their replication, including their homogeneity and mobility characteristics. For example, there is a relatively high replication rate of tangible resources such as physical IT resources. Alternatively, there is a relatively low replication rate in the case of much more intangible resources like managerial and technical skills of bank personnel. In the context of the study, a bank seeking to compete on the basis of superior technology may gain, but not sustain, competitive advantage. In order to compete on the basis of innovative capabilities, the bank needs to acquire, accumulate and advance its stock of skills. It needs to search for resources that are hetoregenous and mobile in characteristic. This framework was used to examine innovation in the survey and mini case studies which focused on the commercial banking industry, the four largest commercial banks, and the central bank.

8.1 SUMMARY OF MAJOR FINDINGS

In Chapter 1, we raised the following questions. What are the channels whereby banks acquire new technology and know-how? How do such sources of information influence new product and services development? How do banks build and strengthen their managerial and technological capabilities? What are the major constraints inhibiting innovation in banking? The following summary of survey and mini case study results seek to answer these questions.

The Banking Industry

The survey results of the commercial banking industry suggest the following. Firstly, there was a relatively high usage level of major information technologies and applications. For example, this included technologies related to encryption, satellite, telephone-based banking, electronic banking, and image processing. In addition, there was also a high awareness level of emerging technologies, for example EDI, smart

cards, video banking, and Internet-based banking which the banks planned to introduce. Such indicators reflect strategies aimed at increasing competitive advantage since financial liberalisation started in the early 1990s. In this respect, increased investments in IT were mainly introduced as a component of wide ranging re-engineering programmes, in addition to being used for new product and service development.

Secondly, there was a relatively high level of automation among payment systems. For example, this included salary payment, utility payment, inter-bank funds transfer, cheque processing, and third party funds transfer. One major factor contributing to automation was the system development capabilities of banks which mainly focused on custom-made and in-house developed computer software. Although such capabilities are basic, they illustrate the development of indigenous innovative capabilities. Another factor contributing to automation was the modernisation of the national payment system by the central bank which further facilitated the transfer of funds between banks and third party payment participants.

Thirdly, the sources of information, which were used for new product and services development, mainly came from customer, competitor, and foreign channels, while company sources were slightly lesser important. For example, in the customer category, this suggests that banks were shifting from a transactions-oriented to a customer-oriented focus. Such developments have led to the set-up of relationship-based strategies by some of the large commercial banks through re-engineering programmes. Although company sources were less important, bank personnel was emphasised as a very important source of information.

Fourthly, the sources of learning, which were also used for new products and services development, mainly came from private and foreign channels, while government sources were not very important. For example, in both private and foreign categories, some of the important learning mechanisms included technical assistance from joint-venture partners, foreign consulting firms, and personnel who have acquired working experiences from other companies. Although government sources was a weak source of learning, this was not the case for the central bank, which is a

quasi-governmental institution, and has provided guidance and support to the modernisation of the national payment system.

Finally, technological capabilities were particularly stronger for the acquisitive, operative, and adaptive categories, in comparison with the innovative category. For example, a majority of banks were much stronger in making minor modifications with technology, as compared with making major modifications, conducting R&D, or even inventing new products and services. Technological capabilities, as suggested in the latter case, exist in the banking industry, but mainly focused on the larger banks, and only marginal for medium and small sized banks.

In sum, the survey results suggest that there is a widespread use of IT in the commercial banking industry, whether this may be for bank automation or for providing innovative financial services. This supported the modernisation of both retail and wholesale payment systems. While sources of innovation varied, such information and learning channels were the basis behind new product and services development. Although the survey further indicates that the banks have system development capabilities in the area of payment services, this was mainly restricted to basic payment routines. Furthermore, when technological capabilities are observed, there is also an indication that bank innovative capabilities are fairly strong. As the survey provided only a broad indication of innovation in the banking industry, mini case studies were conducted to acquire a more detailed analysis of innovation activities behind the banks.

The Four Big Banks

The four mini case studies suggest the following. Firstly, while the four big banks introduced wide-ranging re-engineering programmes, their medium and small-sized counterparts replicated such reforms. This suggests that re-engineering may not be a source of sustained competitive advantage, as the know-how may be acquired from foreign consulting firms, and used to increase efficiency, to improve customer services, and to gain competitive advantage. However, re-engineering was a potential source of competitive advantage in cases involving banks which have initiated the set-up of in-house consulting capabilities. Such initiatives have helped them learn from the consulting firms, build indigenous capabilities, seek solutions to problems, and

develop new products and services. Alternatively, banks that have not considered such initiatives faced increased competition from medium and small sized banks which have focused their strategies, resources, and market positions in a particular market segment. For example, some small banks have concentrated on the retail market, developing partnership strategies with local firms which have a national network of branches, and delivering innovative banking services through such channels.

Secondly, while IT was adopted and applied to gain competitive advantage, innovation related activities advanced them. This suggests that IT investments may gain, but not sustain, a bank's competitive advantage, for which the latter requires a firm to acquire, accumulate, and advance its stock of skills. As computer hardware and software are widely available in the markets, this suggests that it is not relatively difficult to purchase them to gain a competitive parity. Furthermore, the more homogenous, meaning the more standardised, the physical resources are, there is a relatively high rate of replication among the banks. The stock of skills is the sources of innovation in banks. In the mini cases, this particularly included the use of skilled staff, the development of in-house consulting capabilities, the set-up of R&D units, and the establishment of bank affiliated companies which supply technology related know-how.

And thirdly, while the technical skills of bank personnel was important, senior-level management involvement was a key success factor in providing direction and support in the use of IT. The four banks adopted a policy to retain rather than recruit their bank personnel. Such strategies focused on providing training, and in some cases, re-training opportunities for staff. In this respect, the training programmes were tailored to simulate actual working environments in the post re-engineering period and were also used for regular training sessions for mid-level managers. Most importantly, the leaders of the banks were themselves committed to changing their organisations. Although some banks were largely family-oriented, such practices gradually changed through the appointment of professionals who were, in some cases, former central bank officials. Such acquisition of skilled senior-level personnel strengthened the bank's managerial capabilities, influenced the use of IT, and was a source of sustained competitive advantage.

In sum, the four large banks have sought to maintain leadership through introducing re-engineering programs and IT. This helped increase efficiency, improve customer service, support new service development, and facilitate payment system modernisation. However, medium and small sized banks have replicated such initiatives which suggests a competitive parity situation. Two distinct characteristics of these banks, however, have been the continued commitment of their senior-management, breaking away from family focused management styles, and more importantly, their ability to initiate innovation. Such types of firm resources make them unique which is a potential source of sustained competitive advantage.

The Central Bank

The central bank case study suggests the following. Firstly, in terms of capability, the central bank remains one of the most abundant sources of highly skilled personnel in banking. This has been a direct result of a progressive policy towards human resources development, including the awarding of scholarships to eligible staff and students to acquire higher education in some of the world's most outstanding universities. Such policies have indirectly benefited the country's banking industry which has seen former central bank officials being appointed to senior managerial positions in the private sector. In some cases, former personnel have also been appointed to high level ministerial positions in government. However, looking from a different perspective, such movements of personnel may also mean a brain drain situation for the central bank, as highly skilled individuals are acquired by the private sector which have offered much more attractive remuneration. This has particularly been the case of former central bank scholars. In addition, the case study also showed that staff working in IT related areas were relatively difficult to maintain or acquire, as employment prospects in the private sector have been much more attractive. More importantly, such problems in maintaining highly skilled staff was one factor, in addition to mismanagement which was cited as the central banks' failed attempt to defend the country's currency in the wake of the Asian financial crisis in mid-1997. This subsequently led to a wide-ranging reform of the central bank which also involved re-engineering.

And secondly, despite such constraints, the central bank has demonstrated that it can play a leading role in the promotion of IT in banking. This was clearly shown in its involvement in the modernisation of the nation's payment system. It invested, designed, developed, managed, and enhanced the country's payment system. Such wide ranging responsibilities were a direct result of commercial banks failing to reach an agreement in joint investment because of disagreement over the allocation of voting rights in the payment system. As a result, the central bank pioneered the project and pushed forward payment systems modernisation which was among the world's most advanced systems when it was initiated. Apart from developing a modern payment infrastructure to strengthen the fundamental weaknesses of financial systems in developing countries, the payment system may also be seen as a major component of a national information infrastructure. Most importantly, however, the involvement of the central bank, which helped create co-operation among the commercial banks in the payment system, illustrates a form of national innovation system. Such a system is a 'network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies (Freeman, 1987, p. 1). In this context, the central bank has helped build strong fundamentals which served as a foundation for further innovations that the commercial banks planned to introduce. Such was the case of the country's small value funds transfer system which facilitated both commercial banks and their customers in conducting cross-bank financial transactions. Such was also the case for government plans to promote the use of EDI in international trade and other economic sectors.

In sum, central bank involvement in the payment system influenced innovation. Prior to this initiative, the lack of commercial bank co-operation hampered modernisation plans. Apart from being a regulator, the central bank was also responsible as the operator of the payment system. However, this may have been in contrast with some countries which have promoted payment services competition in their matured systems. In Thailand, this may also be the case in the long-term, as competition is encouraged among the financial institutions to provide innovative payment services, and in such cases, new developments will be facilitated with the basic infrastructure already laid down by the central bank.

8.2 IMPLICATIONS

In Chapter 1, we raised the following question. What are the potential roles of banks in influencing innovation, particularly in promoting technological development in the banking system, and in shaping national technology and innovation policies? The following summary of impacts on innovation theory and policy seek to answer this question.

Innovation Theory

The thesis has two implications towards theory. Firstly, it provides an alternative analytical framework to study innovation in services, particularly in financial services. The type of innovation models used to study innovation in services has been relatively limited as compared to the manufacturing sector (Guile and Quinn, 1988a,b). For example, in the area of financial services, this has included the reverse product cycle (Barras, 1986) and a conceptual model to study mass and smart automation regimes in electronic payment services (Buzzacchi *et al.*, 1995). Elsewhere, there have been attempts to use evolutionary theories, by focusing on routines and resources, to explain innovation in banking and financial services (McKendrick, 1989; Pennings and Harianto, 1992). The analytical framework introduced in this thesis combined evolutionary and resource-based views to study innovation behind banking and payment system modernisation. The framework sought to analyse innovation based on the attributes of resources which particularly contributed to the development of managerial and technical capabilities among banks. At the heart of this framework was the question of whether the resources in question were relatively simple to replicate or not. In this respect, the sources of innovation were identified and further assessed whether they were potential sources for sustained competitive advantage for firms or not.

And secondly, the thesis has helped illustrate that innovation models have started to shift from simple linear 'technology push' and 'need pull' models of the 1960s to a more 'strategic, integrated, and networked' model in the 1990s (Rothwell, 1992). In IS research, such developments have started to emerge, but only marginally. One main reason, which may partly explain such limited development, is the dominance of the innovation diffusion model. Due to its wide application across

disciplines, the model has been widely applied in IS studies. However, the model has an inherent weakness which is notably its linear nature. Moreover, it provides only a limited view of the innovation process. As innovation is non-linear in nature, subsequent models were developed which address the dynamics behind innovation. The analytical framework in this study reflects a more strategic approach to the study of innovations.

Innovation Policy

The thesis has three implications towards policy. Firstly, developing countries, which have followed the linear-oriented innovation diffusion model, have acquired a limited view behind the dynamics of innovation. Such a view argues against the simple acquisition and application of IT to increase work efficiency and gain competitive advantage. Alternatively, in order for firms in such countries to catch-up with technology, they might consider advancing them. This may be through the strengthening of staff capabilities, the tailoring of re-engineering programmes to suit company conditions, the set-up of in-house research, development, and consulting capabilities, and the establishment of affiliated companies which act as a consulting arm in technical matters. Therefore, in addition to linking the banking and national innovation policies of a country together, there is a need to focus on the development of strategic resources.

Secondly, as central bank involvement in payment system matters has increased, which is a part of their mission to maintain the price stability of the financial system, it has become an important player in designing a country's innovation policy. Central banks in developing countries have become increasingly responsible for a wide range of matters, in contrasts to their developed counterparts. This may be partly because the amount of resources in such countries are limited, for which the central bank is among the few number of institutions with the adequate know-how and skills to take up such responsibilities. For example, in Thailand, the central bank has invested, designed, developed, and operated the payment system. Such initiatives not only helped strengthen strong fundamentals in the country's financial system, but also formed a key part of a national information infrastructure. In such circumstances, there is a need for the central bank to be integrated, with other national technological institutions, in the design and execution of national policies

which promote innovation. However, this should only be a secondary role from maintaining price stability and sound macro economic management of the country, which are the primary objectives of such institutions.

And thirdly, innovation policies have increased in importance among commercial banks in face of financial liberalisation. Such policies may not be explicit and may be under the responsibility of the IT department. Nevertheless, the lack of a clear innovation policy only inhibits the promotion of innovative capabilities required for new product and services development. The introduction of wide ranging re-engineering programs coupled with increased use of IT may gain a bank competitive advantage, but may not sustain it as such. Innovation, which is the basis behind new product and services development, requires a bank to acquire, accumulate, and advance their stock of skills. Such skills are located in the unique resources and routines residing in organisations and bank personnel. Therefore, commercial bank innovation policies might consider creating firm capabilities by first identifying key resources, and thereafter, gradually building and strengthening such stock of skills in the long-term.

8.3 FURTHER RESEARCH

There is a range of research issues that this thesis has not addressed and which may provide potential areas for further research. Firstly, there are cross-cultural issues. The role of culture has become an important factor which has influenced and shaped the development of IS. For example, this may include the provision of cross-border payment systems, which puts into context, the possible use of different computer software systems. Secondly, there are organisational learning issues. The study explained the role of IT in capability development, thus focusing on commercial bank technological capabilities. Although the survey attempted to examine the sources of innovation, this did not focus, in detail, how banks developed their managerial capabilities. Thirdly, there are technological diffusion issues. Although Thailand has developed three major payment systems, their performances have not been fully evaluated. For example, future studies may examine why payment initiators prefer the use of cheques rather than advanced alternatives, such as financial EDI, in the transfer

of large amount of funds. And lastly, there are post-crisis issues. Although the research setting was in a developing country which underwent wide ranging banking and financial reforms, this focused on issues prior to the recent financial crisis in Thailand. Thus, another potential research area is to study the role that innovation may play in supporting economic recovery.

APPENDIX 1: SURVEY COVER LETTER

January 14, 1997

Dear Sir/Madam,

We have great pleasure in inviting you, among many other respected bankers in Thailand, to participate in a study of technology in banking. Such surveys have been very important and common in other developed countries but rare or non-existent in Thailand.

Banks in Thailand have increasingly used technology for automation and more recently, to provide electronic payment services. These have been used to increase efficiency, improve customer services, expand customer base, and to provide more competitive products and services. However, there remain several unanswered questions. How are banks acquiring new technology? How are banks learning this technology? And how are banks using it to develop new products and services? This survey serves to address such questions.

The results will aim to identify how banks in Thailand transfer technology, diffuse it and create their own technological capabilities. Moreover, it will help your bank identify its position within the industry, learn what other banks are doing, and compete in providing more innovative services. The survey questionnaire is part of a wider research project examining the role of developing country banks in technological development. The results will be equally important for central banks, commercial banks and government banks alike.

Please respond to the attached questionnaire and return it with the enclosed addressed envelope *or* send it by fax to the following number (+44 171 955-7385; Attention: Tanai Khiaonarong). To be included in the study, please reply by **February 15, 1997**. A summary report of survey results, reported in aggregate only, would be kept confidential and only made available to respondents who have participated in the study. If you have any questions regarding this study, please contact Tanai Khiaonarong by e-mail (T.Khiaonarong@lse.ac.uk) or telephone (44 171 9556044-5).

We look forward to your reply and hope that the survey would be met with your favourable consideration. Thank you very much in this regard.

Respectfully yours,

Dr Jonathan Liebenau and Tanai Khiaonarong
London School of Economics

Enclosed: Survey questionnaire

APPENDIX 2: SURVEY QUESTIONNAIRE

Guidelines:
1) Please complete the 2 sections of the survey by marking (√) or circling your choice.
2) Please return the forms in the enclosed addressed envelope *or* send by fax to the following number (+44 171 955-7385, Attention: Tanai Khiaonarong)
3) Please reply by **February 15, 1997**

Name: _____
Position: _____
Department/Division: _____
Name of Bank: _____

SECTION 1: PRODUCT AND SERVICE OVERVIEW

1. Please indicate with an (√) the types of payment services you provide and the year they were introduced:

Service		Year	Service		Year
1. Cashing checks	____	_____	6. Third party funds transfer	____	_____
2. Salary payment	____	_____	7. International payment	____	_____
3. Dividend payment	____	_____	8. Securities (bonds) payment	____	_____
4. Utilities payment	____	_____	9. Securities (stocks) payment	____	_____
5. Interbank funds transfer	____	_____	10. Managing foreign exchange	____	_____

2. Please indicate your usage or awareness with the following technologies and applications (Please circle only one number in each row).

Technology/Applications	Using	Plan to Use	Aware	Not Aware
1. Image processing	1	2	3	4
2. Optical filing	1	2	3	4
3. Encryption	1	2	3	4
4. Smart cards	1	2	3	4
5. Electronic data nterchange(EDI)	1	2	3	4
6. Fault tolerant technology	1	2	3	4
7. VSAT technology	1	2	3	4
8. Object oriented technology	1	2	3	4
9. Telephone banking	1	2	3	4
10. Home banking	1	2	3	4
11. Electronic banking	1	2	3	4
12. Internet banking	1	2	3	4
13. Video banking	1	2	3	4
14. Other (please specify)				

3. Please indicate with an (√) how you process the following:

Service	Manually	Partly Computerised	Fully Computerised
1. Cashing checks			
2. Salary payment			
3. Dividend payment			
4. Utilities payment			
5. Interbank funds transfer			
6. Third party funds transfer			
7. International payment			
8. Securities (bonds) payment			
9. Securities (stocks) payment			
10. Managing foreign exchange			

4. Please indicate with an (√) whether the computer software for the procedures below are packaged, modified or custom-made for your bank.

Service	Packaged	Modified	Custom-Made
1. Cashing checks			
2. Salary payment			
3. Dividend payment			
4. Utilities payment			
5. Interbank funds transfer			
6. Third party funds transfer			
7. International payment			
8. Securities (bonds) payment			
9. Securities (stocks) payment			
10. Managing foreign exchange			

5. If your computer software was modified or custom-made for the procedures below, please indicate with an (√) whether they were purchased or developed by your own bank staff.

Service	Purchased	In-house
1. Cashing checks		
2. Salary payment		
3. Dividend payment		
4. Utilities payment		
5. Interbank funds transfer		
6. Third party funds transfer		
7. International payment		
8. Securities (bonds) payment		
9. Securities (stocks) payment		
10. Managing foreign exchange		

SECTION 2: SOURCES OF TECHNOLOGY

6. Please rate the importance of the following sources of information that contribute to the improvement of your company's current and future range of products or services (Please circle only one number in each row).

Company Sources	Very Important	Important	Fairly Important	Not Very Important	Unimportant
1. Your own staff	1	2	3	4	5
2. Your own staff arising from travel in foreign countries	1	2	3	4	5
3. Your own staff arising from training in foreign countries	1	2	3	4	5
4. Your own staff arising from training with foreign companies	1	2	3	4	5
5. Your own staff arising from training in Thailand	1	2	3	4	5
6.. Your own staff based on foreign magazines, newspapers, etc.	1	2	3	4	5
7. Your computer staff	1	2	3	4	5
Customer Sources					
8. Thai customers	1	2	3	4	5
9. Foreign customers with whom you have direct contacts	1	2	3	4	5
10. Foreign customers with whom you have no direct contacts	1	2	3	4	5
Competitor Sources					
11. Observing Thai competitors	1	2	3	4	5
12. Observing foreign competitors	1	2	3	4	5
Other Sources					
13. Your representatives or branch offices in foreign countries	1	2	3	4	5
14. Your foreign joint venture partner	1	2	3	4	5
15. Your domestic joint venture partner	1	2	3	4	5
16. Other (please specify) _____					

7. Please rate the importance of the following sources of technical and managerial knowledge for developing and providing your products or services (Please circle only one number in each row).

Private Thai Sources	Very Important	Important	Fairly Important	Not Very Important	Unimportant
1. Licenses or technical agreements with Thai firms	1	2	3	4	5
2. Technical assistance from Thai parent company	1	2	3	4	5
3. Technical assistance from Thai joint venture partner	1	2	3	4	5
4. Technical staff who previously worked with other Thai firms	1	2	3	4	5
5. Managerial staff who previously worked with other Thai firms	1	2	3	4	5

6. Technical staff with experience primarily from working in your firm	1	2	3	4	5
7. Managerial staff with experience primarily from working in your firm	1	2	3	4	5
8. Thai suppliers of computer systems or software	1	2	3	4	5
9. Thai consulting firms	1	2	3	4	5
10. Thai customers	1	2	3	4	5

Foreign Sources	Very Important	Important	Fairly Important	Not Very Important	Unimportant
11. Licenses or technical agreements with foreign firms	1	2	3	4	5
12. Technical assistance from foreign joint-venture companies	1	2	3	4	5
13. Technical staff who previously worked with foreign firms	1	2	3	4	5
14. Managerial staff who previously worked with foreign firms	1	2	3	4	5
15. Foreign suppliers of computer systems or software	1	2	3	4	5
16. Foreign consulting firms	1	2	3	4	5
17. Foreign customers	1	2	3	4	5

Thai Government Sources	Very Important	Important	Fairly Important	Not Very Important	Unimportant
18. Licenses or technical agreements with government firms	1	2	3	4	5
19. Technical assistance from government parent company	1	2	3	4	5
20. Technical assistance from government joint-venture partner	1	2	3	4	5
21. Technical staff who previously worked with other government agencies	1	2	3	4	5
22. Managerial staff who previously worked with other government agencies	1	2	3	4	5
23. Technical staff with experience primarily from working in your firm	1	2	3	4	5
24. Managerial staff with experience primarily from working in your firm	1	2	3	4	5
25. Government suppliers of computer systems or software	1	2	3	4	5
26. Government consulting firms	1	2	3	4	5
27. Government customers	1	2	3	4	5
28. Ministry of Finance	1	2	3	4	5
29. Bank of Thailand	1	2	3	4	5

Other Sources	Very Important	Important	Fairly Important	Not Very Important	Unimportant
30. National Electronics and Computer Technology Centre (NECTEC)	1	2	3	4	5
31. Thai Bankers Association	1	2	3	4	5
32. Stock Exchange of Thailand	1	2	3	4	5
33. Other (Please specify) _____					

8. Please rate the strength of your company's capabilities in the following areas: (Please circle only one number in each row).

Acquisitive Capability	Very Strong	Strong	Fairly Strong	Weak	Very Weak
1. Searching technology for your bank	1	2	3	4	5
2. Negotiating technology for your bank	1	2	3	4	5
3. Procuring technology for your bank	1	2	3	4	5
4. Assessing technology for your bank	1	2	3	4	5
5. Installing technology for your bank	1	2	3	4	5
Operative Capability					
6. Operation of technology in your bank	1	2	3	4	5
7. Control of technology in your bank	1	2	3	4	5
8. Maintenance of technology in your bank	1	2	3	4	5
Adaptive Capability					
9. Understanding technology	1	2	3	4	5
10. Making minor modifications with technology	1	2	3	4	5
Innovative Capability					
11. Making major modifications with technology	1	2	3	4	5
12. Conducting research and development	1	2	3	4	5
13. Inventing new products or services	1	2	3	4	5

THANK YOU VERY MUCH FOR YOUR CO-OPERATION

APPENDIX 3: LIST OF SURVEY RESPONDENTS

Bank	Position/Department
1. Bangkok Bank	Senior Vice President and Manager Systems Development Department
2. Siam Commercial Bank	Senior Vice President Information Systems Audit Department
3. Siam Commercial Bank	Senior Team Leader Applied Technology Office
4. Thai Farmers Bank	First Vice President Information System Processing Department
5. Thai Farmers Bank	Vice President Information System Engineering Department
6. Krung Thai Bank	Senior Vice President Electronic Banking Department
7. Thai Military Bank	First Vice President Computer Department
8. Bank of Ayudhya	Senior Vice President and Vice President Computer Audit Department
9. Bank of Ayudhya	Assistant Vice President Retail Banking
10. Bank of Asia	Senior Vice President Information Technology Group
11. Bank of Asia	Vice President Applied Information Technology Department
12. Siam City Bank	First Vice President Computer Audit Centre
13. Siam City Bank	President Siam City IT
14. First Bangkok City Bank	Vice President Computer Development Department
15. Bangkok Metropolitan Bank	Senior Vice President Technology Department
16. Bangkok Bank of Commerce	Assistant Vice President Computer Department
17. Union Bank of Bangkok	Vice President Information Technology Department
18. Thai Danu Bank	Vice President Information Technology Department
19. Nakornthon Bank	Vice President Information Technology Department
20. Laem Thong Bank	First Vice President Bank-Wide Service and Executive Department

APPENDIX 4: INTERVIEW COVER LETTER

December 27, 1996

Dear Sir/Madam,

We are pleased to invite you in a study of technology in Thai banking. To ensure that your opinions are included in this research, we seek your co-operation in an interview scheduled for early February 1997.

Banks in Thailand have increasingly used technology for automation and more recently, to provide electronic payment services. These have been used to increase efficiency, improve customer services, expand customer base, and to provide more competitive products and services. However, there remain several unanswered questions. How are banks acquiring new technology? How are banks learning this technology? And how are banks using it to develop new products and services? Our interviews will aim to address such questions.

We will be conducting a series of interviews with people in both public and private organisations. This includes the Bank of Thailand, the National Electronics and Computer Technology Centre, commercial banks and many other parties. It is our intention to consult your personal viewpoints on a wide range of issues. In this regard, we will contact you again by telephone in early January 1997 to schedule an interview appointment in the following month. We look forward to meeting you and hope that our request would be met with your favourable consideration.

Respectfully yours,

Dr Jonathan Liebenau and Tanai Khiaonarong
London School of Economics

APPENDIX 5: INTERVIEW TOPIC GUIDE

1. Background

- Role of department in bank
- Growing importance of technology
- Duties/responsibilities

2.Use of Technology

How is technology being used for internal bank operations/bank automation? PROBE
How does this improve current systems?
Please illustrate what type of systems?

How is technology being used for external bank operations/payment systems? PROBE
How does this improve current systems?
Please illustrate what type of systems?

3. Technology transfer, diffusion and learning

How is technology transferred to your bank?
How is technology diffused within your bank? Within branches? With other parties?
How is technological capabilities acquired and learned?
Please specify how hardware and software are acquired?

4. Barriers/Issues/Risks

What are the barriers to acquiring technology? Employment? Skills?

5. Overcoming the barriers

How can this be overcome? Probe. HRD? Training?
Educational scholarships? Managerial areas? Technical areas?

6. Promotional strategies/ideas

How can this promote financial sector development?
How can this promote technological development?

APPENDIX 6: LIST OF INTERVIEWEES

Name	Position	Date/Duration
1. Tarisa Watanagase	Director Payment System Department Bank of Thailand	23 December 1997 1 hour
2. Niyada Kanistarat	Deputy Director Information Technology Department Bank of Thailand	27 January 1997 1 hour
3. Teera Aphaiwongse	Senior Executive Vice President Technology Division Bangkok Bank	13 February 1997 1 hour
4. Kajornvut Tayanukorn	Senior Vice President & Manager Systems Development Department Bangkok Bank	9 February 1998 1 hour
5. Vichit Amonviratskul	First Executive Vice President Technology Group Siam Commercial Bank	31 January 1997 1 hour 30 minutes
6. Thongchai Pingkarawat	Senior Vice President Information Systems Audit Department Siam Commercial Bank	21 January 1997 1 hour
7. Senee Vacharasiritham	Vice President Information Systems Audit Department Siam Commercial Bank	21 January 1997 1 hour
8. Phongthawat Phuangkanok	First Vice President Information Systems Processing Department Thai Farmers Bank	24 January 1997 1 hour 30 minutes
9.Chaiyong Wongwuticomjon	Senior Vice President Electronic Banking Department Krung Thai Bank	18 February 1997 1 hour
10. Pichet Durongkaveroj	Director National IT Committee Secretariat	23 January 1997 1 hour

APPENDIX 7: COMPARATIVE TABLES

Country	Payment System (s)	Automated or Manual	Launch Date
Belgium	1) Interbank Automated Clearing House (C.E.C. - Centre for the Exchange of operations to be Cleared)	Automated	1986
Canada	1) IIPS (Interbank International Payment System)	Automated	1976
France	1) SAGITTAIRE (Automated system for the integrated handling and settlement of foreign transactions by telecommunication means)	Automated	1984
Germany	1) Daily Clearing	Manual	1990
	2) CB Express System	Automated	1987
Italy	1) BISS (Bank of Italy real-time Settlement System)	Automated	1988
	2) ME (Memorandum Elettronico system)	Automated	1989
	3) SIPS (automated Interbank Payment System)	Automated	1989
Japan	1) BOJ-NET (Bank of Japan Financial Network System)	Automated	1988
	2) Zengin Data Telecommunication System	Automated	1987
	3) FEYSS (Foreign Exchange Yen Settlement System or Gaitame Yen Settlement System)	Automated	1989
Netherlands	1) Central Bank's current-account system	Automated	1985
	2) Banks' Clearing House-SWIFT System	Automated	1982
Sweden	1) RIX	Automated	1986
Switzerland	1) SIC (Swiss Interbank Clearing)	Automated	1987
United Kingdom	1) CHAPS (Clearing House Automated Payment System)	Automated	1984
	2) Town Clearing	Manual	1946
United States	1) Fedwire (Federal Reserve System)	Automated	1982
	2) CHIPS (Clearing House Interbank Payment System)	Automated	1970

Table A1: Selected payment systems in the G-10 countries
Source: Borio and Van den Bergh (1993)

Country	1988	1989	1990	1991	1992
Belgium	31.1	27.7	23.8	21.5	18.8
Canada	70.9	68.7	66.8	64.8	62.4
France	57.3	55.2	54.5	52.4	50.8
Germany	9.8	9.6	9.9	9.6	8.8
Italy	45.8	45.0	44.2	41.6	40.0
Japan	na	na	na	na	na
Netherlands	17.7	15.9	15.2	14.3	12.3
Sweden	19.5	20.5	14.9	9.9	8.9
Switzerland	8.1	7.6	6.4	5.4	4.4
United Kingdom	56.0	54.0	51.0	49.0	45.0
United States	83.5	83.6	81.5	81.2	80.5

Table A2: Relative importance of payment by cheques (percentage of total volume of cashless transactions)
Source: BIS (1993)

Country	1988	1989	1990	1991	1992
Belgium	7.9	9.1	11.0	13.3	15.6
Canada	24.2	25.9	26.8	27.8	28.9
France	10.5	12.3	13.1	14.4	15.0
Germany	0.7	1.2	1.5	1.8	2.1
Italy	1.0	1.6	2.4	3.1	3.7
Japan	na	na	na	na	na
Netherlands	0.3	1.0	1.6	1.8	2.6
Sweden	5.7	6.0	6.8	8.7	8.8
Switzerland	4.9	5.7	7.0	9.7	11.8
United Kingdom	11.0	12.0	14.0	16.0	19.0
United States	14.7	14.4	16.2	16.3	16.8

Table A3: Relative importance of payment by cards (percentage of total volume of cashless transactions)
Source: BIS (1993)

Country	1988	1989	1990	1991	1992
Belgium	85	92	94	105	109
Canada	242	346	438	484	531
France	206	231	255	284	305
Germany	122	148	141	171	235
Italy	99	135	169	204	245
Japan	556	627	711	795	870
Netherlands	69	124	180	222	263
Sweden	206	227	245	258	254
Switzerland	262	292	335	347	387
United Kingdom	245	275	296	309	316
United States	296	306	321	331	342

Table A4: Cash dispensers and ATMs (number of machines per 1 million inhabitants)
Source: BIS (1993)

Country	1988	1989	1990	1991	1992
Belgium	1,925	2,477	2,828	3,213	4,034
Canada	34	162	345	489	1,076
France	2,154	2,842	3,180	3,568	5,594
Germany	141	174	290	432	640
Italy	76	178	385	805	1,094
Japan	6	14	82	213	264
Netherlands	102	138	148	267	758
Sweden	83	403	711	1,034	1,647
Switzerland	211	322	384	758	1,640
United Kingdom	426	1,311	1,916	3,299	3,806
United States	183	200	240	348	450

Table A5: EFTPOS terminals (number of machines per 1 million inhabitants)
Source: BIS (1993)

Country	Reforms	Nature of Reforms
Argentina	Yes	Deregulation
Bahamas	No	
Bangladesh	No	
Barbados	No	
Belize	Yes	Facilitate and expedite presentation and settlement of financial instruments
Brunei	No	
Botswana	No	SWIFT system is in use as of 1993
Chile	Yes	Electronic transfer of funds system
Cyprus	Yes	Automation of clearing
Fiji	No	
Gambia	No	
Ghana		
Guyana	No	
Hong Kong	Yes	Reforms of payment system under way
India	Yes	Automatic clearing, MICR technology
Israel	Yes	Encoding of cheques, automated clearing house
Jamaica	Yes	
Jordan	Yes	Automation of settlement system
Kenya		
Kuwait	Yes	Occasional procedural changes
Lesotho	No	
Malawai	No	
Malaysia	Yes	Electronic transfer system, automated clearing
Malta	Yes	SWIFT, direct credit, automated clearing
Maritius	No	Automated clearing and payments system under consideration
Mexico	Yes	
Namibia	No	
Nigeria	Yes	Automated system for sorting cheques in 1990
Pakistan	Yes	
Papua New Guinea		
St. Lucia	Yes	Clearing system
Saudi Arabia	Yes	
Sierra Leone	No	
Singapore	Yes	Automated clearing system, interbank GIRO, SWIFT
Solomon Islands	Yes	Current system started 1992
South Africa	Yes	National payment system strategy
Sri Lanka	Yes	Automated cheque clearing, interbank funds transfer
Swaziland	No	
Tanzania		
Trinidad and Tobago	Yes	Special clearing items
Uganda	Yes	Automated clearing, local settlement, inter-town clearing
United Arab Emirates	Yes	
Zambia	No	
Zimbabwe	Yes	Plans to introduce automated clearing

Table A6: Reforms to payment systems of selected developing countries since 1975.
Source: Fry *et al.*, (1996)

Country	Cheque	Credit Card	EFT/POS	Credit Transfer	Direct Debits
Belgium	21.9	2.3	11.2	57.9	6.6
Canada	64.8	27.5	0.3	3.9	3.5
France	57.3	0.0	15.8	16.6	10.3
Germany	9.6	1.7	0.2	51.1	37.4
Italy	42.0	3.2	0.5	46.0	8.3
Japan	8.5	21.8	0.0	29.8	39.8
Netherlands	14.3	<0.5	1.8	61.2	22.7
Sweden	8.5	20.6	20.6	66.0	3.7
Switzerland	8.4	3.0	3.0	79.8	3.1
United Kingdom	48.4	5.6	5.6	21.1	14.2
United States	81.2	0.3	0.3	1.7	0.8
Thailand	63.3	13.2	0.2	17.8	5.6

Table A7: Ratio of each means to total non-cash payments in Thailand, 1991 (volume of transactions)
Source: Watanagase (1994)

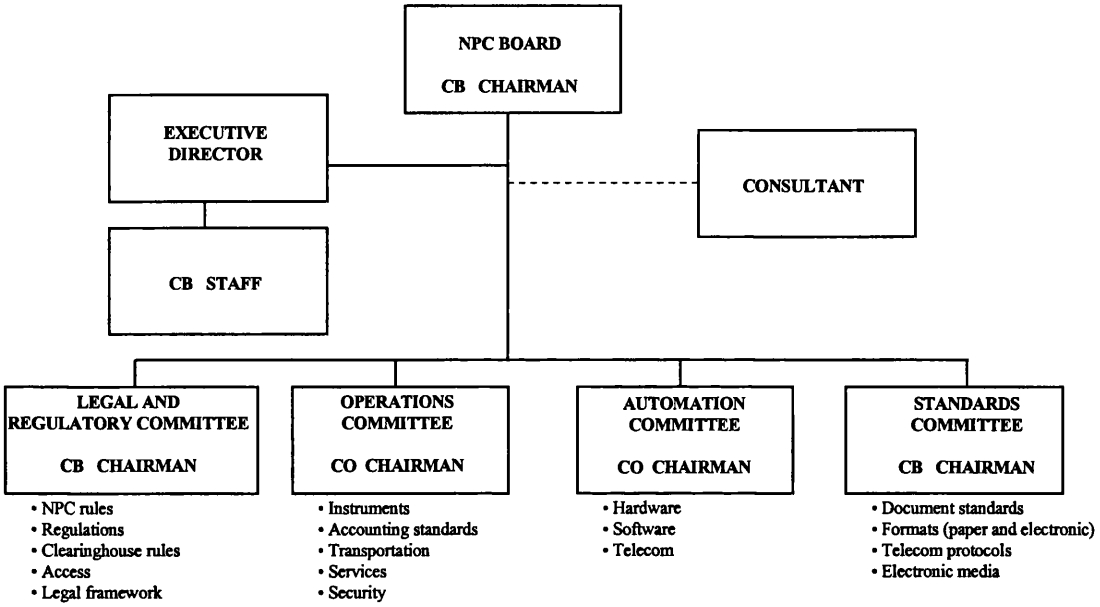
Country	Cheque	Credit Card	EFT/POS	Credit Transfer	Direct Debits
Belgium	3.2	0.0	0.1	96.6	0.1
Canada	99.0	0.3	0.0	0.6	0.1
France	25.9	0.0	0.7	71.0	2.4
Germany	15.3	0.1	0.0	74.6	10.0
Italy	8.0	0.0	0.0	91.1	0.9
Japan	71.2	0.1	0.0	28.4	0.3
Netherlands	0.2	<0.5	0.0	98.4	1.4
Sweden	11.3	0.1	1.1	84.5	3.0
Switzerland	na	na	na	na	na
United Kingdom	16.1	0.1	<0.1	82.6	1.2
United States	13.7	0.1	<0.001	85.2	1.0
Thailand	97.9	0.4	<0.1	1.5	0.2

Table A8: Ratio of each means to total non-cash payments in Thailand, 1991 (value of transactions)
Source: Watanagase (1994); na: not available

Year	No. of Cheques	Balance of Clearings (millions of Baht)	Total Clearings (millions of Baht)
1988	36,858,345	656,841	5,459,092
1989	41,454,606	1,007,333	8,129,191
1990	47,680,443	1,260,895	11,360,192
1991	52,025,718	1,482,803	13,870,543
1992	56,962,586	2,052,244	21,293,595
1993	61,958,181	2,281,234	28,917,192
1994	67,184,072	2,761,196	45,347,391
1995	70,414,434	9,813,899	68,077,252
1996	70,793,495	4,178,489	120,782,387

Table A9: Clearinghouse transactions
Source: Bank of Thailand

APPENDIX 8: STRUCTURE OF NATIONAL PAYMENTS COUNCIL



Organisational structure for a hypothetical National Payments Council
Note: CB = Central Bank, CO = Commercial Bank
Source: Listfield and Montes-Negret, 1994

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