Chapter 1

Introduction & Overview
CHAPTER-1
INTRODUCTION AND OVERVIEW

1.1 INTRODUCTION

This chapter provides us broad idea about the Research topic, need and scope of study. To start with a brief introduction has been furnished about Indian Banking industry, Information technology, various IT Projects/Products implemented by Banking Industry. The various aspects related to technologies adoption and diffusion has also been explored and explained. Followed by justification for the need and scope of the proposed study. Further, it explains the objectives of the research and research methodologies. This study employed, two types of research methodologies: system development research (i.e. engineering research), and case study. The research design includes an explanation of research development based on a system development research approach, methods of data collection, research design in practice, validation and reliability. This chapter explains broad guidelines about the entire dissertation.

1.2 THE INDIAN BANKING INDUSTRY

Banking sector plays a significant role in development of Indian economy. So banks need to optionally leverage technology to increase penetration, improve their productivity and efficiency, deliver cost-effective products and services, provide faster, efficient and convenient customer service and thereby, contribute to the overall growth and development of the country. Technology enables increased penetration of the banking system, increases cost effectiveness and makes small value transactions viable. Besides making banking products and services affordable and accessible, its simultaneously ensures viability and profitability of providers. Technology allows transactions to take place faster and offers unparallel convenience through various delivery channels. Technology enhances choices, creates new markets, and improves productivity and efficiency. Effective use of technology has a multiplier effect on growth and development which is governed by the Banking Regulation Act of India, 1949 can be broadly classified into two major categories, non-scheduled banks and
scheduled banks. Scheduled banks comprise commercial banks and the co-operative banks. In terms of ownership, commercial banks can be further grouped into nationalized banks, the State Bank of India and its group banks, regional rural banks and private sector banks (the old / new domestic) and foreign banks. These banks have over 70,000 branches spread across the country.

In the five decades since independence, banking in India has evolved through four distinct phases. During Fourth phase, also called as Reform Phase, Recommendations of the Narasimhan Committee (1991) paved the way for the reform phase in the banking. Important initiatives with regard to the reform of the banking system were taken in this phase. Important among these have been introduction of new accounting and prudential norms relating to income recognition, provisioning and capital adequacy, deregulation of interest rates & easing of norms for entry in the field of banking.

Entry of new banks resulted in a paradigm shift in the ways of banking in India. The growing competition, growing expectations led to increased awareness amongst banks on the role and importance of technology in banking. The arrival of foreign and private banks with their superior state-of-the-art technology-based services pushed Indian Banks also to follow suit by going in for the latest technologies so as to meet the threat of competition and retain their customer base (Bose Jayshree 2006).

Indian banking industry, today is in the midst of an IT revolution. Combinations of regulatory and competitive reasons have led to increasing importance of total banking automation in the Indian Banking Industry. The first phase of financial reforms resulted in the nationalization of 14 major banks in 1969 and resulted in a shift from Class banking to Mass banking. The next wave of reforms saw the nationalization of 6 more commercial banks in 1979/80. Since then the number of scheduled commercial banks increased four-fold and the number of bank branches increased eight-fold.

After the second phase of financial sector reforms and liberalization of the sector in the early nineties, the Public Sector Banks (PSB) found it extremely difficult to compete with the new private banks and foreign banks. The new private sector
banks first made their appearance after the guidelines permitting them were issued in January 2002. Twenty-seven private sector banks are presently in operation. These banks due to their late start have access to state-of-the-art technology, which in turn helps them save on manpower costs and provide better services.

The industry is currently in a transition phase. On the one hand, the PSBs, which form the mainstay of the Indian Banking system, are in the process of shedding their flab in terms of excessive manpower, excessive Non Performing Assets and excessive governmental equity, while on the other hand the private sector banks are consolidating themselves through mergers and acquisitions.

PSBs, which currently account for approximately 72 percent of total banking industry assets are saddled with falling revenues from traditional sources, lack of modern technology and a massive workforce (RBI report on Trend and Progress in banking in India 2008-2009). The new private sector banks are forging ahead and rewriting the traditional banking business model by dint of their sheer innovation and better service. The PSBs are of course currently working out challenging strategies even as 20 percent of their massive employee strength has dwindled in the wake of the successful Voluntary Retirement Schemes (VRS) schemes.

Private sector banks have pioneered internet banking, phone banking, anywhere banking, mobile phone banking, debit cards, Automatic Teller Machines (ATMs) and combined various other services and integrated them into the mainstream banking arena, while the PSBs are still grappling with disgruntled employees in the aftermath of successful VRS schemes. Also, following India’s commitment to the WTO agreement in respect of the services sector, foreign banks, both new and existing ones, have been permitted to open more branches.

Indian Banking Industry today is in the midst of an IT revolution. A combination of regulatory and competitive reasons has led to increasing importance of total banking automation in the Indian Banking Industry. As on 31st March 2009, out of the more than 67,000 branches of Public Sector Banks, only 42,000 branches had been fully computerized. Lack of computerization among over 67,000 branches of Public Sector Banks provides a huge market for players in IT Industry (RBI report on Trend and Progress in banking in India 2008-2009).
1.3 INFORMATION TECHNOLOGY (IT)

Indian banking industry, today is in the midst of an IT revolution. Combinations of regulatory and competitive reasons have led to increasing importance of total banking automation in the Indian Banking Industry. Information Technology has basically been used under two different avenues in Banking. One is Communication and Connectivity and other is Business Process Reengineering. Information technology enables sophisticated product development, better market infrastructure, implementation of reliable techniques for control of risks and helps the financial intermediaries to reach geographically distant and diversified markets. Information Technology has become a major technological force that has impacted on the financial sector. Organizations of the financial sector are being forced to adopt these technologies not only to seek business and economic opportunities but also to ensure their survival in a vastly competitive scenario.

Information Technology (IT) is composed of hardware, software, telecommunications, database management, and other information processing technologies used in computer-based information systems. Information Technologies (IT) are computer-based technologies use to support information and communication. Information support refers to computer-based applications to support structured decision-making processes whereas communication support refers to computer or telecommunication-based applications for communication purposes. (Sayeed & Brightman, 2006).

Information Technology is considered a powerful tool for both public and private sectors. Not only are the public sectors able to use accurate and timely information to develop policies, allocate and deliver resources to their people more efficiently and effectively, but also private sectors are able to access new market opportunities, better decision-making, and improve work processes. IT is also integrated into strategies for solving the fundamental problems of the nations such as poverty, disease, or environmental deterioration. It is believed that inadequate information increases the competitive gap, which widens the development gap of the country. In addition, IT creates jobs because most information-related services are highly labour-intensive. Therefore, developing countries have great potential to
create jobs both for highly skilled workers (systems analysts, scientists, programmers) or relatively lower-skilled data clerks and keyboard operators for administrative, accounting and other back-office work.

Currently, Information Technologies (IT) are the most pervasive technology having economic effects and exert wide impacts on societies in many respects. First with IT, massive data and digital information can be handled and dispersed with more ease, faster and economically than before. Secondly, thanks to the reduction in transaction costs of information flows, IT enhances efficiency in using resources, improves returns to management functions, and promotes more flexible and decentralized management and decision-making structures. Thirdly, IT results in a major change of the structure of capital investment in service industries. Previously, service organizations such as banks made massive investments on unproductive capital (e.g. buildings). Switching to heavy investments in IT equipment enables them to gain economic returns from their investment and concurrently reduces demand for office space. Fourthly, information itself has increased in potential tradability because information becomes a weapon to take advantages of an easily accessible global market (Rayudu C.S. 2010).

It is proved that the IT industry is a key driver of economic growth of any country. Given the dynamism of IT, it is mandatory that both the economic and social adaptations be carried out in a synchronized manner. This is why it is critical for policy makers to detect emerging trends in the IT industry and not be surprised by technological changes. Although Information Technology (IT) contributes various advantages, critical problems with regard to IT still exist. These include rapid obsolescence of adopted technologies, selection of inappropriate technologies, low productive usage of those adopted, lack of capable employees, and costs of technologies, coupled with an unexpected performance and low acceptance from staff and customers. Therefore, appropriate decisions in regard to adopting useful technology and disseminating it to maximize the full benefits from technology are important.

Although some research has been done in this area by Banknet India having in-depth market knowledge, understanding of technology trends, analytical sense of predicting up-coming demands and trends of Banking & Technology market. Banknet
India brings together the knowledge and experience of consultants and functional experts in specialized areas of Banking & Technology. Banknet India has conducted market research for major banking software companies from Australia & Singapore. This research has enabled these companies to make entry into the Indian market & partner with suitable Indian IT Companies.

Further Banknet India has done number of research assignments for Indian banking software companies to identify potential clients from Indian Banking market. Also Banknet India has conducted the First Banking Systems Survey in India in 2002. In this Survey 58 Indian & 10 foreign IT companies and 24 banks, including four foreign banks participated. Still not much has been done in the area of choice of technology. A prominent study in this field has been made by Intraparirot Arunee which has been taken as base model for this study in India.

1.4 TECHNOLOGY ADOPTION

Adoption of a technology has become a crucial or significant measure of the success or effectiveness of that technology. Revolutionary development in Information Technology (IT) in the past 20 years has impacted individuals as well as businesses in a profound way especially Banking Industry. Information Technology is a radical technological innovation with potential to change the structure and nature of banking. To sustain business competitiveness, more and more banks are transforming from their traditional approach of “bricks and mortar” into a “clicks and mortar” one under the recent emergence of electronic commerce and business. Customer satisfaction and customer retention are increasingly developing into key success factors in e-banking. "Adoption" refers to the stage in which a technology is selected for use by an individual or an organization. "Innovation" is similarly used with the nuance of a new or "innovative" technology being adopted. Also Adoption is a decision to make full use of an innovation as the best course of action whereas rejection is a decision not to adopt an available innovation (Rogers, 2003, p.21). There are two levels of adoption. Initially, innovation must be purchased, adopted or acquired by an organization. Subsequently, ultimate users in that organization and community must accept it. (Manross & Rice, 2006).
1.5 TECHNOLOGY DIFFUSION

"Diffusion" refers to the stage in which the technology spreads to general use and application. "Integration" connotes a sense of acceptance, and perhaps transparency, within the user environment.

Typically, past adoptions of a new technology have signalled a confidence in its potential to alleviate a particular problem or to make a job easier or more efficient. Rarely has bringing about new social and functional conditions been a consideration.

Diffusion of an innovation occurs through a five step process. This process is a type of decision-making. It occurs through a series of communication channels over a period of time among the members of a similar social system. Ryan and Gross first indicated the identification of adoption as a process in 1943 (Rogers 1962, p. 79). Rogers categorizes the five stages (steps) as: awareness, interest, evaluation, trial, and adoption. An individual might reject an innovation at any time during or after the adoption process. In later editions of the Diffusion of Innovations Rogers changes the terminology of the five stages to: knowledge, persuasion, decision, implementation, and confirmation. However the descriptions of the categories have remained similar throughout the editions.

Diffusion is the process during which an innovation is communicated among members of a social system via certain channels over time. A diffusion process consists of four main elements: an innovation, communication channels, time and a social system (Rogers, 2003)

- An innovation is a new idea, practice, or object that is introduced to individuals or organizations.
- A communication channel is the means of transferring messages from an individual/organization that has innovative knowledge to those that do not have it yet.
- Time is involved in a process of technology diffusion in many respects. Diffusing innovative knowledge takes times for an individual/organization to adopt or reject. A rate of adoption is measured as the number of adopters in a given time period.
- A social system is a set of interrelated units (e.g. individuals, organizations, and/or subsystems) that are co-operating to solve a joint problem or to accomplish a mutual goal.
As a result, the diffusion of new IT has increased in the business world, giving rise to significant transformations of traditional business structures. Technology diffusion follows the three broad stages of initiation, decision to adopt, and implementation and is based on a logistic curve (s-shape) rather than a production curve because of a limitation of demand and saturation of a market. At the beginning, it takes some time for people to adopt technology. Then, when people accept the technology, a diffused technology curve takes off and its widespread adoption makes the curve increase rapidly. When a new technology arrives and the market is mature, the curve levels off because the technology cannot be easily diffused. However, there is variation in the slope of the s-shape curve. If technologies diffuse relatively rapidly, the s-shape is quite steep. On the other hand, some technologies may have a slower rate of diffusion and its s-shape will be more elastic (Rogers, 2003).

Once new technologies are adopted, organizations put in great effort to diffuse them quickly, enterprise-wide or throughout customers, to avoid prohibitive costs due to a high obsolescence rate of evolving technology. However, as a matter of fact, new technology often requires a lengthy time before it is widely diffused (Kautish, S. 2008).

Many factors obstruct the rapid rate of technology diffusion process. Some technologies are not compatible with the values, beliefs, and past experience of the social system. Some change agents diffuse technologies based on “innovation-oriented” rather than “client-oriented” philosophies leading to insufficient acceptance or even resistance. Therefore, selecting the most appropriate technology and finding ways to speed up the rate of technology diffusion are still the main concern of many individuals and organizations (Arunee Intrappriot).

1.6 INFORMATION TECHNOLOGY AND INDIAN PUBLIC SECTOR BANKS

With the development of information technology, the world has become a global village and it has brought a revolution in the banking industry. The bank appears to be on fast track for IT based products and services. Deregulation and Liberalization in the financial sector have stimulated financial innovations. Breath taking developments in the technology of telecommunications and electronic data processing have further accelerated these changes. Technology has become the fuel
for rapid change. IT is no longer considered as mere transaction processing or confined to management information system. In its wider definition, it implies the integration of information system with communication technology and of innovative applications to product manufacturing, design and control.

One sector that has undergone fundamental changes as a consequence of the application of IT is banking. The new technology has radically altered the traditional ways of doing banking business. Increasingly the customers in retail sector are doing business with their banks from the comfortable confines of their homes or offices. Customers can view the accounts, get account statements, transfer funds, purchase drafts by just making a few keypunches. Availability of ATMs and plastic cards to a large extent avoid customers going to branch premises. Cards with an embedded microprocessor chip also called smart cards, are adding a new dimension to this scenario (Jayadev, M. and Sensarma, R. 2007).

Another landmark in history of Banking was the setting up of Rangarajan Committee on computerization and mechanization of banking service of 1983. The committee headed by Dr. C. Rangarajan, deputy governor of Reserve Bank of India, was to look into modalities of drawing a phased plan of mechanization in banks in view of further expansion.

Further in 1988, Reserve Bank of India appointed the second Rangarajan Committee to review the progress made in computerization in view of growing volumes of computer technology and problems associated with implementation of the recommendations of the first committee.

The committee was also interested in the task of drawing a perspective plan to computerization in banks and to suggest modalities for implementation of on line computerization at branch level. The committee submitted its report in 1989 and recommended a thrust of computerization in banks for the next five years by fully computerizing 2000-2500 large branches located at high activities areas and centers.

The first serious effort of computerization & mechanization in the banking industry was drawn up in 1983-84. But the process of introducing computerization in the banking industry in India, particularly, in public sector banks, was very slow. As a culmination of the implementation of the recommendations of (Saraf Committee, Shere Committee and Vasudevan Committee), today the transactions of all large
branches of banks have been fully computerized; banks have moved in the direction of inter-branch and inter-bank connectivity. Electronic Funds transfer and delivery versus payment system have been introduced. Bank customers are becoming very demanding and it is the extensive use of technology that will enable banks to satisfy adequately the requirement of customers.

Thus the four major objectives of computerization in banking are:

- Improvement in customer service,
- Better housekeeping,
- Faster decision making, and
- Increase in productivity & profitability.

With the coming into the effort of the IT Act on Oct. 8, 2000, India had reached another significant milestone on the information super highway. The Act provides legal sanctity to electronic commerce and lays down penalties for hacking and other crime. India will become the 12th country in the world to have an IT bill in place for recognizing digital signature and facilitating e-commerce.

IT is also helping in cutting costs by providing cheaper ways of delivering products to customers. Banks are moving into the primary services of helping their customers buy things like automobiles, real estates, in all the areas, IT has been enormous help. The younger age group customers are much more amenable to using electronic delivery channels rather than visiting physical branches. Banks have been cautious in launching new services using IT. The virtual financial services can be largely categorized as fellow. IT has become a major technological force that impacts on the financial sector. Organizations of the financial sector are being forced to adopt these technologies not only to seek business and economic opportunities but also to ensure their survival.

1.7 NEEDS AND SCOPE OF STUDY

In the past decade banks in India have invested heavily in the information technology. Total expenditure incurred on computerization and development of communication networks by public sector banks (PSBs) alone between September 1999 and March 31, 2009 is Rs. 17897 crores (Banknet Survey-2000). Today, information technology seems to be the prime mover of all banking transactions. Trends show that banks in India have been endeavouring to leverage technology to
bring about improvements in; quality of customer services, scale and specialization in 
products, alternative sources of income particularly from fee-based services, 
geographical reach through communication networks and electronic delivery 
channels, risk management practices, housekeeping, internal control systems and 
regulatory compliance and cost efficiencies and scale economies. In other words, 
banks in India started perceiving IT as a tool to achieve improvement in the efficiency 
(more output with less input) and effectiveness (outcomes). An indication of the 
extent of investment and percolation of IT in different categories of banks is evident 
from the data presented in Table1.

It is clear from the data, shown in Table 1 that banks have invested heavily 
over the years in information technology systems. Looking the dependence of banks 
on IT, there is no doubt that, IT over the years has become business driver rather than 
a business enabler. This is clear that banks sustainable development depends heavily 
on effective usage of IT.

**Table 1.1: IT Percolation in crores in Banks in India (as on March 2009)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Nationalized Banks</th>
<th>State Bank Group</th>
<th>Other Public Sector Bank</th>
<th>Old Private Sector Banks</th>
<th>New Private Sector Banks</th>
<th>Foreign Banks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banks</td>
<td>19</td>
<td>07</td>
<td>01</td>
<td>15</td>
<td>08</td>
<td>31</td>
</tr>
<tr>
<td>Branches</td>
<td>39376</td>
<td>16062</td>
<td>510</td>
<td>4673</td>
<td>4204</td>
<td>293</td>
</tr>
<tr>
<td>ATMs</td>
<td>15938</td>
<td>11339</td>
<td>900</td>
<td>2674</td>
<td>12646</td>
<td>1054</td>
</tr>
<tr>
<td>Fully Computerized Branches (%)</td>
<td>92.9</td>
<td>100</td>
<td>100</td>
<td>-</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>IT expenditure (in crores incurred between September 1999 and March 2009)</td>
<td>11802</td>
<td>6095</td>
<td>-</td>
<td>-</td>
<td>3110*</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: RBI’s Report on Trend and Progress of Banking in India, 2008-2009

11
The major risk associated with innovative technology are

- Increased cash flow are not sufficient to cover the implementation cost
- Integration of existing IT set up with new technology
- Emergence of new risks related operations, security and maintenance due to adoption of new technology
- Control of cost

In fact banks have invested in technology in hopes of leapfrogging their rivals in terms of competitive advantages, cost reduction, and coping with an increasing volume of business. Therefore, banking industries have increased technological investment dramatically. Unfortunately technological expenses sometimes as yet more than offset improved productivity and gained promising returns. Customers blame decreased productivity on under-trained employees and an increasing use of computers in self-service systems, whereas bank staff makes excuses blaming customer errors and incompetence in using Information Technologies.

With intense competition and changing market dynamics, banks have to brace themselves for newer obstacles every now and then. Moreover, fresh regulations and compliance requirements, industry consolidations, delivering cost effective products and services, maintaining secure data platform, meeting ever increasing customer demands and other strategic issues have all made banking for more complex than it used to be in the past. In order to handle increasing transactions volumes and do way with issues hovering around the current system banks needs to the right technology in place (Amalesh Banerjee and Shrawan Kumar Singh 2008).

At present, out of the total IT spending undertaken by banks, around 50 per cent goes toward maintenance of existing systems and ensuring that the business of the bank goes through smoothly. Hence, a major exercise in upgrading technical architecture is something many banks may not be able to afford at present. To gain an edge over their competitors and address customer demands effectively, banks need to do a balancing act by diffusing old technologies, and adopting newer technologies.

However, technological adoption and diffusion is still, a controversial issue in India. While, technology is the means for increasing economic growth, achieving a
sustainable competitive advantage, creating business opportunities, enhancing business performances and improving the quality of life, looked at another way, it can also have detrimental effects such as, economic dependency, unwelcome culture transfer, technological mismatches, social retardation, economic stagnation and environmental pollution.

As such, information relating to decision-making issues is provided as a background in order that prospective decision-makers would use appropriate decision-making tools to evaluate technological alternatives and provide ways to maximize benefits from the selected technology. As a consequence, careful planning which requires appropriate decision-making is vital for the success of technological adoption and diffusion. Unfortunately, in reality most organizations have not integrated adoption of new technologies into their strategic plans because management may neglect technological planning or the technologies change too rapidly. Accordingly, the rejection of technology, especially information technologies, occurs frequently.

Making decisions in the fast changing areas of information technology is a difficult process. Initially, the decision-makers are confronted with constraints such as time and resources. Additionally, the problem is more complicated because it involves many dimensions the technological problem itself, but also in other areas such as, the environment, social, economic and political dimensions. Decision-makers, therefore, have to deal with multiple alternatives and criteria in an uncertain environment. Finally, it involves many stakeholders. That is, decision-making is a collective process rather than purely individual. Group decision-making is far more difficult because each decision-maker has his/her own perceptions, attitudes, motivations and personality. It is difficult to find an optimal solution whereby all affected parties are satisfied.

When an organizational environment or a problem becomes more complex, more competitive and subject to fluctuations, subjective decision-making techniques contingent upon experience, judgments and intuition cannot achieve all of the aims of the organization. Hence, appropriate, objective decision-making paradigms are attractive (Parthasarathi, B.N.V. 2008).
It must be emphasized that benefits from information technologies not only come from an appropriate technology selection but also from intensity of usage. That is, prospective advantages cannot be obtained directly from the mere provision of the actual physical technology. Therefore, once technologies are adopted, making a full effort to diffuse them effectively throughout organizations, business units and work groups is a must.

The success in technology diffusion relies on a fabric of many factors, not only technical but also organizational. Furthermore, its diffusion process is contingent upon explicit time dependence (i.e. dynamic) involving technology life cycle stages and relating to variables such as the economic life of the technology and time delays (e.g. training, perceived satisfaction).

Quite often, potentially suitable decision-making models developed by model analysts (or researchers) do not meet executives’ requirements. Whereas researchers may spend years “playing” with their models, executives have a limited time for cooperation or implementation. While researchers may try to work out every little detail, business users require only practical ways to help them solve their problems. Researchers may desire complicated tools to develop their models; executives on the other hand, are willing to use only user-friendly tools. Furthermore, traditional mathematical or statistical results proposed by researchers rarely provide transparent insights for executives and seem difficult to fathom for them, making them reluctant to use these as decision-making tools. Given these consequences, to bridge that requirement gap a decision-making model has to be designed covering all issues.

The Indian economy has witnessed phased changes in the philosophy by which it has to been governed. The banking sector has also witnessed a sea change, especially since the post liberalization era. The movement of the economy from command centric to market centric has paved the way for the need of a robust financial structure to support the development and onslaught of globalization. This is especially true for the banking sector.

Towards this end the banking sector witnessed the growth of public banks and the emergence of private banks and international foreign banks that would create a
competitive environment that could take on the homogenous task of taking on the load of the market economy.

However, a gap in the functioning of the private verses the public banks was witnessed. Partly due to the emerging culture in the private corporate sector and in part due to the technological stronghold held by the private and foreign banks. The level of bureaucratic influence also acted as a hindrance for the public sector banks to catch on. This led to a deepening divide that can be witnessed today.

The Private and foreign Banks are already equipped with latest state of art technology, operating their most of the branches from metros and urban areas. Whereas the Public Sector Banks under compulsions of social banking have been operating even from remotest part of country are having hard time to compete with Private and Foreign Banks (Singh B., and Malhotra, P. 2004). The public sector banks have been investing crores of funds in modernization of their operations and offering latest products. However, there have been many constraints and as such many of the products chosen by them have not yielded the desired results. The Public Sectors banking Industry due to liberalization got stiff competition from private and foreign sector banks, which were already equipped with state of art technology. The new Banks have been catering to refined customer base, whereas Public Sector Banks have been stressed with every type of customer especially under Lead Bank Project. However the presence of hi-tech Private Banks and Foreign Banks forced sudden infusion of various technical products/projects in public sector banks. However, many projects/products have not yielded the appropriate results and as such were dropped midway. Thus generating a genuine need to define some process to decide about the technology to be adopted and diffusing the same to end-users i.e. staff or customers.

Many such issues have been faced by researcher during rich experience of about 15 years while working as Specialist Officer in Information technology Services Department (ITS), at Local head Office (LHO) Chandigarh. The researcher has been instrumental in the implementation and providing support to various IT oriented projects/products implemented across 1100 Branches and Offices under jurisdiction of LHO Chandigarh. The various issues faced by researcher have made him to explore this subject matter.
All these factors discussed above has generated a need to study the choice of technology by public sector Banks and further diffusing it to the end user. Though various efforts have been made distinguished writers to explain the various technologies and their features and other aspects related to banking as explained in Chapter 3. Also Reserve Bank of India has justified the importance of subject matter by setting up IDRBT as an autonomous body for Research and Development in banking technology. However, no formal composite study has been done in this matter in Indian context. Meanwhile, there have been lots of works on similar prospects abroad details of the same are mentioned in chapter 3 including prominent study by Intraparirot Arunee which has been taken as base model for this study in India. The banking system in India is significantly different from that of other Asian nations because of the country’s unique geographic, social, and economic characteristics. India has a large population and land size, a diverse culture, and extreme disparities in income, which are marked among its regions. There are high levels of illiteracy among a large percentage of its population but, at the same time, the country has a large reservoir of managerial and technologically advanced talents. Between about 30 and 35 percent of the population resides in metro and urban cities and the rest is spread in several semi-urban and rural centres. The classification of Rural, Semi-urban, Urban and Metropolitan is made on the basis of the population size, whereby customer need, choice and expectation varies a lot (Tandon, L. 2008).

The recent introduction of Information technology at mass level is changing the face of Indian banking sector, where IT plays crucial role to manage all corners of banking business. The customers feel comfortable with technical products because of convenient, prompt and cost effective services while banks also gain plunge in superior efficiency, reduced costs and more satisfied customers. Information technology has also infused the banks with more competitiveness in global market. These effects of IT in banking sector prompts to review banking system because the banks are introducing many technologies and operating in state of global environment. Issue of efficiency and customer satisfaction is always at the centre stage of discussion in the recent instance of IT usage where banking system is the most triggered area. In India Banking sector is always a centre of attention because it plays dominant role in economic development.
This approach justifies the need of this study which is structured to analyze the adoption and diffusion of most preferred Technology for banking sector in India. The study examines the comparative technologies, on various criteria including customer satisfaction, economy and employees’ state of mind towards IT products in Public Sector Banks. The study highlights the various IT products/Projects implemented to improve banking efficiency with the help MCDM and system Dynamics analysis. To achieve the set objectives of the study, a case study has also been undertaken i.e. State Bank of India apart from studying various public sector banks by arranging them in three categories on the basis of size i.e. number of branches. The study is descriptive and empirical in nature because secondary and primary data is analyzed. The study also analyzes the perceptions of bank customers and employees with respect to IT products. It also embraces service quality analysis to know the customers’ satisfaction level. This analysis is based on primary data collected through questionnaire from Customers and IT officials and general bank employees. The broad aspects of the work done abroad have been taken as base line for this study, including research methodologies.

Further, to have a generic view about Public Sector banks we have covered State Bank of India and its associate banks, Canara Bank, Punjab & Sind Bank and Punjab National bank, accounting more than 50 % of Public Sector Banking operations. Further, as a dedicated study of actual adoption and diffusion process we have considered State bank of India as a case study.

1.8 OBJECTIVES AND RESEARCH QUESTIONS

The main objective of this research, "A study on the adoption and diffusion of information technologies in the Public Sector Banks in India using multiple-criteria decision making and system dynamics approaches ", is to develop

1) A holistic modeling framework for information technologies (IT) adoption.
2) A holistic modeling framework for information technologies (IT) diffusion.
3) A model to detect the inter-relationship among variables, identifies problems, and then find requisite and operational policies for State Bank of India.
The model will be tested and evaluated to gain more understanding with respect to five research questions.

Q.1 What is the current status regarding IT usages of the bank?
Q.2 What is a requisite group model of IT adoption?
Q.3 What is a requisite group model of IT diffusion?
Q.4 What are the requisite policies for adoption and diffusion of IT for the bank?
Q.5 Can information technologies be used as to leverage business strategies to the advantage of the banking industry in India and if so, why and how?

1.9 RESEARCH METHODOLOGY

Research is the systematic investigation into existing or new knowledge. It is used to establish or confirm facts, reaffirm the results of previous work, solve new or existing problems, support theorems, or develop new theories. A research project may also be an expansion on past work in the field. The research, combines two study areas of multiple criteria decision-making (MCDM) and System Dynamics (SD), was supplemented by Case Study of State Bank of India. In order to achieve results qualitative and qualitative analysis both were carried out. Qualitative research has been successfully used previously in the field of Information systems and Information technology (e.g., Hayne and Pollard, 2000) especially, when a deeper understanding is required on the factors that have influence to a relatively new reality. This research method has been chosen in this case in order to understand the objectives.

As per observation of the subject topic and on the basis of previous studies, it is found that the technological issues are to be tackled in a complex collective process, since they exist in a dynamic situation rather than in simple, individual and static ones. Accordingly, multiple-criteria based system dynamics modeling (i.e. the combination of two decision making tools: multiple criteria decision making (MCDM) and system dynamics (SD)) is proposed as a suitable model that may mitigate problems regarding technologies because this approach combines the strong competence of each decision making tool.
MCDM is concerned with structuring and solving decision and planning problems involving multiple criteria. The purpose is to support decision makers facing such problems. Typically, there does not exist a unique optimal solution for such problems and it is necessary to use decision maker’s preferences to differentiate between solutions. The difficulty of the problem originates from the presence of more than one criterion. There is no longer a unique optimal solution to an MCDM problem that can be obtained without incorporating preference information. The concept of an optimal solution is often replaced by the set of non-dominated solutions. A non-dominated solution has the property that it is not possible to move away from it to any other solution without sacrificing in at least one criterion. Therefore, it makes sense for the decision maker to choose a solution from the non-dominated set. Otherwise, he could do better in terms of some or all of the criteria, and not do worse in any of them. Generally, however, the set of non-dominated solutions is too large to be presented to the decision maker for his final choice. Hence we need tools that help the decision maker focus on his preferred solutions (or alternatives). Hence MCDM can be used to tackle actual problems in the real world because it provides ways to select a solution from many alternatives based upon multiple conflicting criteria and under specific constraints. A multiple criteria decision-making process (MCDM) is, therefore, proposed as a suitable decision-making tool to be employed for selecting the most preferable technology during the technological adoption phase because it is capable of evaluating the best alternative from various conflicting criteria.

SD System dynamics is an aspect of systems theory as a method for understanding the dynamic behavior of complex systems. The basis of the method is the recognition that the structure of any system is often just as important in determining its behavior as the individual components themselves. As it has been previously found to be suitable to be incorporated with MCDM to deal with a dynamic approach of the problems and interrelationship among variables. It helps decision-maker to explore factors
that can improve or solve the problems without disrupting routine operations and costs. Further simulation via SD before real implementation prevents an organization from risk potential because of wrong decisions. Therefore, the system dynamics model has been continued to be used as a suitable decision-making tool to develop a diffusion model for preferred technology since found to be capable of managing interrelationships between variables and dynamic aspects.

- During research work we combined two decision-making tools effectively. Initially, MCDM was employed during the technology adoption phase to select the most preferred technology. Followed by, SD for diffusing the most preferred technology during the diffusion phase to manage dynamic aspects and interrelated variables of the selected technology.

1.9.1 Research process - Scientific research involves a systematic process that focuses on being objective and gathering a multitude of information for analysis so that the researcher can come to a conclusion. This process is used in all research and evaluation projects, regardless of the research method (scientific method of inquiry, evaluation research, or action research). The process focuses on testing hunches or ideas in a park and recreation setting through a systematic process. The scientific research process is a multiple-step process where the steps are interlinked with the other steps in the process. If changes are made in one step of the process, the researcher must review all the other steps to ensure that the changes are reflected throughout the process. The major steps in conducting research are:

- Identification of research problem
- Literature review
- Specifying the purpose of research
- Determine specific research questions or hypotheses
- Data collection
- Analyzing and interpreting the data
- Reporting and evaluating research
The steps generally represent the overall process; however they should be viewed as an ever-changing process rather than a fixed set of steps.

As such going by above discussion we conclude that research process comprises understanding the research domains, seeking answers to meaningful research questions and using valid research methodologies for these questions to get conclusions. The research design will comprise data collection and data treatment. The data for this research will be both primary and secondary data.

**Figure 1.1: Research Process**

Source: Adopted from earlier Research work by Arunee Intraparirot

1.9.2 *Research Methodologies in this Study:* taking clue from previous studies Arunee Intraparirot we have used two research methodologies: system development research and case study. The two research methodologies complement and work in a close loop environment by providing valuable feedback to one another. Process of interaction of the research methodologies is illustrated in Figure1.2
1.9.3 System Development Research - System development research process is used from a methodology prospective was employed because the model development of technology adoption and diffusion fits well with the concept and follows the steps of system development research of concept-development-impact. Initially, concepts regarding the ways to adopt and diffuse information technologies effectively were accumulated from literature reviews to identify research questions. Then a generic conceptual framework was constructed to detect answers to those questions, guide the design of computer simulations, and conduct systematic observation using a case study.

1.9.4 Case Study - A case study was used to investigate organizational and managerial processes of an organization to gain more holistic and meaningful characteristics of real world events. It is helpful in describing what actually happens, and generating relevant and useful hypotheses, which can be tested in a more rigorous fashion. An organization suitable for the theoretical framework was selected for the case study. Since social and personal connections are vital for success in data collections. Potential organizations such as the State Bank of India, Canara Bank, Punjab National Bank were initially considered. These organizations were selected based on three
criteria, the market share, the possibility in collecting data and organizational performance regarding technological issues.

Finally, the State Bank of India was chosen as a case study for the following reasons:

i) The bank as an individual identity has the largest market share. If taken together with its associate Bank share crosses one fourth of banking business in India.

ii) Bank has been pioneer in adopting technologies and has invested heavily in information technologies (IT) to enhance its business opportunities, rather is being considered as leader in IT invasion.

iii) Banks’ technologies exert a wide impact on people in all walks of life and the nation as well. There are examples which can be quoted whereby small business units and got recognition after their association with SBI.

iv) The bank management has adopted the concept of "Parivartan" highlighting human resource development, which is compatible with a learning process of the model. This has been considered as transformation exercise of Bank’s aged manpower to adopt new challenges.

v) And last one, researcher is having exposure of approximately 15 years at various levels in IT Department of the bank. Researcher wish to explore the hindrances, thoughts, difficulties faced and felt during this tenure. Also it was felt convenient to have feedback from users of various technologies implemented by Bank.

As such, State Bank of India was employed as a case study in order to get general feeling for what is involved in a research domain, tailor the generic variable to a specific case, and to provide sufficient contextual and environmental conditioned to improve validity.

1.9.5 Computer Simulations - Though earlier studies have mentioned using *ithink* software for simulations to refine theories, test system behaviors and perform sensitivity analysis for strategic policies. However, MapSim, System Dynamics and JdynSim were preferred being open source softwares. Since computer simulations
provide visualized results of model analyses within relatively short time they are useful for enhancing insight about system behaviors and ways of improving them.

1.9.6. Research Design Framework - The research design has been taken from the earlier research by Intraparirot Arunee, whereby the research design has been divided into five stages: problem definition (Stage 1), constructing a conceptual framework (Stage 2), developing system architecture (Stage 3), testing and validation (Stage 4), and policy experiments (Stage 5). The details of each stage are as follows.

**FIGURE 1.3 Five Stages of research**

1.9.6.1 Problem definition - By now topic for decision-making and a case study (i.e. State Bank of India) were finalized. Detailed information regarding the topic and its problems were made available through various sources including in-house journeys, Publications, periodicals, Monthly Journal from International Association of Management of Technology, regular research Papers from Banknet, IDRBT and
SBIICM Publications. Further Video Conference setup across bank was used to discuss and update knowledge acquisition process by sharing views, interviewing, questionnaires and discussions with staff in the bank to understand its existing systems and future requirements. The entire knowledge base supplemented by experience in technical department was used to define system boundaries, and develop a statement of the problem.

**1.9.6.2 Constructing a Conceptual Framework** - Conceptual framework is used in research to outline possible courses of action or to present a preferred approach to an idea or thought. Conceptual frameworks (theoretical frameworks) are a type of intermediate theory that attempt to connect to all aspects of inquiry (e.g., problem definition, purpose, literature review, methodology, data collection and analysis). Conceptual frameworks can act like maps that give coherence to empirical inquiry. Because conceptual frameworks are potentially so close to empirical inquiry, they take different forms depending upon the research question or problem. Information gathered was used to create the preliminary conceptual model. Further information was collected from Bank officials through interview and questionnaire. Bank Officials were asked to do a SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) and were asked to identify possible strategies and the major factors of each strategy regarding information technologies (IT) in order to fulfill the mission of their bank.

This information supported by data from the previous stage, with related written documents, was then organized. Bank’s personnel were asked to evaluate the technological alternatives based on multiple criteria decision-making (MCDM) methodology. The technology evaluation was facilitated by appropriate software to identify most preferred technology. Subsequently data pertaining to selected technology was converted in to system language to create diagrams to develop preliminary conceptual model using System Dynamics methodology.

**1.9.6.3 System Architecture** - Fine tuning of earlier work was done to develop final conceptual model. The preliminary conceptual model was upgraded further on the basis of information based on the knowledge of people in the bank based on interviews and the questionnaire approach. This model was used to create the final
conceptual model. Framed through SD methodology, and simulated with MapSim, System Dynamics and JdynSim softwares.

1.9.6.4 Testing, Validation and Policy Verification: The model was shared with Bank’s authorities at Local Head Office level for vetting for validity and reliability using tests to build confidence in system dynamics models. This stage provided some strategic policies for the problems of concern. Officials can further be questioned using interview or questionnaire techniques to detect policy parameters and structural changes of the model. The proposed policies were formulated and simulated using system dynamics methodology.

The research design framework (figure 1.3) was undertaken in order to provide the answers for the research questions identified earlier in this chapter.

- First research question (What is the current status regarding IT of the banks?) was answered at the end of research design stage 1.
- The answer for the second and third research questions (What is a requisite group model of IT adoption and diffusion), were derived from the research design stages 2, 3 and 4.
- The policy experiment at the end of stage 5 provided answers for the fourth research question (What are the requisite policies for adoption and diffusion of IT for the bank?).
- The answers for the fifth research question (i.e. Can information technologies be used as to leverage business strategies to the advantage of the banking industry in India and if so, why and how?) were analysed from literature reviews, analysis of results and additional information from other bank’s apart from State Bank of India.

1.10. METHOD OF DATA COLLECTION

Data collection is a term used to describe a process of preparing and collecting data, for example, as part of a process improvement or similar project. The purpose of data collection is to obtain information to keep on record, to make decisions about important issues, to pass information on to others. Primarily, data are collected to provide information regarding a specific topic. Four methods of Data collection
including observations, interviews, questionnaires and documentations were used in this study.

1.10.1 The primary data - In primary data collection, you collect the data yourself using methods such as interviews and questionnaires. The key point here is that the data you collect is unique to you and your research and, until you publish, no one else has access to it. In this study primary data was collected from three sources: interviews, questionnaires and observation. **Observations** Observation involves recording the behavioural patterns of people, objects and events in a systematic manner. Observational methods may be:

- structured or unstructured
- disguised or undisguised

This study used an observation technique by working in the bank as IT head posted at one of its Local Head Office in Chandigarh, thus giving in-depth knowledge by attending various programmers at IDRBT and SBIICM. A long association with various vendors working for banking sectors also paved help.

**Interviews** - Interviewing is a technique that is primarily used to gain an understanding of the underlying reasons and motivations for people’s attitudes, preferences or behaviour. Interviews can be undertaken on a personal one-to-one basis or in a group. They can be conducted at work, at home, in the street or in a shopping centre, or some other agreed location. Data from interviews consists of direct replies from people about their experiences, opinions, feelings, and knowledge. Interviews were conducted in order to gain additional information regarding interviewees' perceptions because it is difficult to access perceptual information through session observation, which reveal only overt behaviours.

**Questionnaires** are a popular means of collecting data, but are difficult to design and often require many rewrites before an acceptable questionnaire is produced. In this study questionnaire were derived from previous studies (Mohammed Quaddus n Arunee-2002). A questionnaire is a tool for observing data beyond the physical vision of an observer in order to detect deep data within minds, attitudes, feelings, and opinions of respondents. This study employed both open-ended and closed
questionnaires. Open-ended questionnaires were used to gain understanding and capture the points of view of respondents without predetermining those points of view through prior selection of questionnaire categories. On the other hand, closed questionnaires were used to facilitate respondents understanding of topics of concern, remind them of the points that they may not think about, and involve many respondents within a limited time.

After the preliminary collection of data additional information focusing on the preferred technologies of the bank was scrutinized (e.g. Core Banking, Plastic Money, Internet banking and Mobile banking, Active directory, Cheque Truncation Project, Video conferencing, Green Channel Machines etc.). The data collecting method shifted to use questionnaires in order to get the basic ideas from key persons within a time limit. Most questions came from literature reviews organizing into two parts, open-ended and closed questions. The open-ended questions are for capturing the respondents' information from the top of their heads towards the issues of interest. The closed questions aim at checking considerations, ideas and perceptions of people in the bank about the issues that cited by previous research, and detecting the level of importance of such issues. The information was collected mainly from the following departments relating to the technology group of various banks:

- BPR Department
- ATM department
- Payments gateways section
- Internet Security Services Deptt
- Internet Banking Department
- Networking department
- Information technology Services Department at LHO's
- Central Data Center
- Research Consultancy
- Core Data Center
All the required data were captured to fulfill the objectives of the study with respect to the following five sub-topics; Information technologies (IT), multiple criteria decision-making (MCDM), Core Banking, Internet Banking, Plastic Money, and policy analyses.

i) The "Employed Technologies & Technical problems", questionnaires were shared with senior executives and middle managers, responsible for technical decisions of the bank employed at various technical departments at CDC, Belapur and ITS department at LHOs. Further, being at senior level in the bank, some respondents were interviewed instead over Video Conferencing, in order to gain rich information and opinions. This questionnaire provided answers regarding the fundamental issues of technology adoption and diffusion in the bank such as its vision, technological objectives, problems, technological alternatives, and criteria. The details of this questionnaire are presented in Appendix 1-Questionnaire 1.

ii) The "Evaluation of Banking Technologies" was shared with same level of respondents as the previous questionnaires to evaluate technology alternatives based on the specified criteria (Appendix I- Questionnaire 2). The data from these questionnaires were used to evaluate technological choices based on MCDM analyses and compare decision-making using intuition with that facilitated by computer software.

iii) The “Anywhere/Core Banking Services/Core data Centre (CDC)” Going by Qualitatively analysis (intuitively) respondents preferred “Core Banking/Core data Centre” as most preferred technology to help the bank fulfill its mission (on the basis of information gathered through the " Employed Technologies & Technical problems " questionnaires). Thus, the additional questionnaires namely “Core Banking (CBS)/ Core Data Center (CDC) ” were developed to obtain information about variables used for system dynamics model analyses (Appendix I-Questionnaire 3). The data were collected from 100 bank officials who are in charge of data warehousing technology using both interview and questionnaire techniques and supplemented with bank documents. All the information was integrated to verify the whole picture of this technology.
iv) “Technology and Usages by Bank officials” (i.e. prospective users of Core Banking/CDC). The “Technology Usages by Bank officials” questionnaires were developed for the purpose of identifying the current issues and perception of the bank staff as end users towards the general banking technologies and the data Centre aspects (Appendix I-Questionnaire 4). The questionnaires were distributed to respondents both in the head office and branches around the country.

v) “Anywhere/Core Banking/Core data Centre Usages” The additional questionnaire "Core Banking Services/ Core data Centre" in (Appendix I-Questionnaire 5) aimed at capturing information about current users of the Core Banking and was developed because of insufficient information with regard to current usage, perceptions of users and advantages from the Core Banking. The questionnaires were distributed to personnel from the positions of team members up to executive managers.

vi) “Prospective Customers of Internet Banking” Since technological evaluation was concurrently undertaken with data collection, the result revealed that Internet banking is the most preferable technology of the bank based on MCDM analyses. Therefore, people in charge of Internet banking were interviewed and they completed the “Prospective Customers of Internet Banking ” questionnaires. The contents of this type of questionnaire are similar to those of the “Anywhere/Core Banking/Core data Centre Usages “questionnaire in Appendix I-Questionnaire 5. All the information was used to develop the diffusion model of Internet Banking based on system dynamics analyses. The short questionnaire for "Prospective Customers of Internet banking" (Appendix I-Questionnaire 6) aimed at finding the potential usage of the Internet banking in India. At first, telephone interviewing was employed to gather opinions and perceptions from people who have a computer background and have high positions in companies and the public sector banks in India.

vii) "Policy analysis": Information towards policy analysis was derived from the questionnaires and interviews on "Policy Analysis" (Appendix I-Questionnaire 7). The open-ended part was used to interview executive staff about the policies of the bank and their opinions about how to solve the problems relating to technological issues.
The secondary data: In the secondary analysis of qualitative data, good documentation cannot be underestimated as it provides necessary background and much needed context both of which make re-use a more worthwhile and systematic endeavor. In this study secondary data was obtained from an in depth review of the related literature obtained from various sources including in-house journals, Publications, periodicals, Monthly Journal from International Association of Management of Technology (IAMOT membership subscribed by researcher for four years), regular research Papers n journals from Banknet, IDRBT and SBIICM Publications etc on various topics including banking technologies, multiple criteria decision-making (MCDM), technology adoption and diffusion and system dynamics (SD) in order to define all the related variables and gain knowledge for research development. The data was used for model analyses using two decision-making tools: multiple criteria decision-making (MCDM) and system dynamics (SD). Documents are obtained directly by reading them from program records, memoranda correspondence, official publications, reports, personal diaries, and open-ended questionnaires. Documents provide basic, information as a background for conducting research or making decisions.

The documents of this study derived from the written data obtained from related literature, observations, interview transcriptions, written questionnaires, and information from the Intranet system, other records and publications of various banks in India, IDRBT and SBIICM. Documents promoted more understanding and insight because they can be kept as records to review repeatedly.

1.10.2 Issues related to Data Collection - The problems faced by researcher are summarized below. The practical problems faced by researcher are described in order to acquaint other researchers with them and to rectify them for future research.

1.10.2.1 Seeking an appointment - Considering the busy schedule of top executive It is hard to make an appointment with them, especially in a large organization. One has to convince their PA or PS or secretariat staff having screening authority for their bosses. And even the given appointment may be either cancelled or changed depending upon the busy schedule of bosses. As such having a practical appointment
with bank officials in operations is not easy also because of their full routine workloads.

**1.10.2.2 Secrecy of information** - Generally senior executives share their views or ideas very frankly but at the same time may not like to disclose accurate facts (e.g. figures) because of responsibility. On the other hand, people in charge hesitate to give data, although they have precise data, due to various reasons may be confidentiality break, or relationship within organizations.

**1.10.2.3 Interview** - Many issues are related with the Interviews including Need to set up interviews, Time consuming, Geographic limitations, Can be expensive, Normally need a set of questions, Respondent bias – tendency to please or impress, create false personal image, or end interview quickly, Embarrassment possible if personal questions Some caution has to be taken when interviewing. The interviewer has to ask interviewees whether they mind being recorded (using video conferencing). It is interesting managers feel uncomfortable with recording and dare not reveal some information because they are an aid that the information may give negative effects on them.

**1.10.2.4 Document** - Since the researcher works within the organization alongside other employees, effectively as one of them, the role of the researcher may or may not be explicit and this will have implications for the extent to which he or she will be able to move around and gather information and perspectives from other sources. Although the banks are large and well-informed organizations, the information is still scattered among Corporate Centre, Regional Offices and Branches. The data was therefore derived from documents in the bank’s libraries, staff and the Intranet systems. The data from the Internet system provide an understanding of the work performance of the bank. However, although the bank has developed the data warehouse as the main database, the problem of non-updated or incorrect data occurs frequently leading to difficulties and confusion.

**1.10.2.5 Questionnaire** - Questionnaires are a popular means of collecting data, but are difficult to design and often require many rewrites before an acceptable questionnaire is produced however most of the questionnaires were taken from earlier studies done abroad by Arunee Intraparirot. Still in some cases interpretation of data
was difficult because respondents did not answer the questions clearly. The non-interactive nature of questionnaires did not allow the researcher to validate meanings.

1.11 DATA ANALYSIS

Analysis of data is a process of inspecting, cleaning, transforming, and modeling data with the goal of highlighting useful information, suggesting conclusions, and supporting decision making. Data analysis has multiple facets and approaches, encompassing diverse techniques under a variety of names, in different business, science, and social science domains. In the main analysis phase either an exploratory or confirmatory approach can be adopted. Usually the approach is decided before data is collected. The derived data were analyzed using two decision-making tools: multiple criteria decision-making (MCDM) and system dynamics (SD) in order to detect answers for the identified research questions. Content analysis was used with questionnaires and interviews to answer the first research question, "what is the current status of IT usage in the banks?"

Further, content analysis was used as a method of data analysis by identifying the material to be analyzed (e.g. conversation, interview, and the content of articles, publication and questionnaire).

The second research question, "what is a requisite group model of IT adoption?" was responded by model development using MCDM method and relevant software was used for model and sensitivity analyses to find most preferred technological alternative that can fulfill the mission of the bank. A comparison with intuitively preferred technology was also made during this exercise.

System dynamics was used to develop the models of technology diffusion in order to provide the answer for the third research question "what is a requisite group model of IT diffusion?" The model was thus tested for two most preferred technologies i.e. Anywhere/Core Banking and Internet banking. Policy analyses using computer simulations based on system dynamics (SD) technique provided the answers for the fourth research question, "what are the requisite policies for adoption and diffusion of IT for the bank?"
The answers for the fifth research question regarding the possibility of using information and communication technologies as a lever of competitive advantage for the banking industry in India were analyzed using content analysis.

1.12 VALIDITY TEST

The study has been carried out on large size public sector banks and State Bank of India as a case study. To perform the validity test, and Policy analysis we shall require crucial information, which seems difficult. Further, researcher being employed at senior level as system official, it was not possible to use unauthorized data. However, the models of this study were proposed to be tested and validated based on the earlier research by Arunee Intraparirot; and involved three major stages: structure validity; behavior validity; and tests of policy implications.

1.12.1 Structure validity tests - A structure detection test which distinguishes between linear and nonlinear dynamic effects in the system response is derived. Structure validity has been performed using Turing test.

1.12.2 Behavior validity tests including a behavior-reproduction test, behavior anomaly test and behavior-sensitivity test, are used to measure how accurately a model can reproduce major behavior patterns exhibited in a real system. There are two different types of behavior tests. If a problem involves a transient, highly non-stationary behavior (e.g. an S-shaped growth) it is appropriate to compare graphical/visual measures of the most typical behavior-pattern characteristic. Since the system behaviour of technology diffusion follows an s-shape over time (i.e. logistic function), the system behavior derived from the model analyses was visually compared with the real system behavior.

1.12.3 Policy implication tests are used to verify whether or not response of a real system to a policy change corresponds with that predicted by a model. The study employed two tests: changed-behavior-prediction test and policy-sensitivity test.

However, in order to provide initial answers for this research question, the additional data were collected from two sources: publications with regard to technology from other commercial banks apart from the case study bank, and
interviewing people in charge of technology. There were four respondents (one from a large bank, one from a medium-sized bank and two from small-sized banks).

1.12.4 Model Validation Stage - The state of formal validation activities took place after the initial model formulation had been completed and before the policy analysis/design step. The models were verified based on the selected tests of formal model validation as previously mentioned, and compared with information from literature reviews and the bank.

The results from the model analysis based on two technologies: a data warehouse and Internet banking were proposed to experts in the bank. This type of validation as applied from the Turing test by asking the experts to compare the results with their knowledge and experience, give comments towards the proposed models, and suggest ways to revise the models. Their recommendations were used for model revisions and improvement.

1.13 CHAPTER OUTLINE

The whole study has been conceptualized in 9 chapters. The first two chapters address the general background with regard to aspects of technology and decision-making.

Chapter 1: Gives introduction and overview of the study including need, objectives, research questions, significance, contributions and outlines of the study. Research methodology and research design. This study employed, two types of research methodologies: system development research (i.e. engineering research), and case study. The research design includes an explanation of research development based on a system development research approach, methods of data collection, research design in practice, validation and reliability.

Chapter 2: Provides general backgrounds on information technologies (IT) highlighting technology adoption and diffusion, and banking technologies, which are employed in banks i.e. Plastic Money, Anywhere/Core Banking (Core Data Centre), Mobile phone Banking, Cheque Truncation System/Electronic Fund Transfer and Internet banking service. The details in decision-making issues beginning with decision-making in general are presented and then elaborated to group decision-
making. The decision-making model is divided into two main areas: multiple criteria decision-making (MCDM) and system dynamics (SD).

**Chapter 3:** Explains previous researches and related documentations relating to the research domain. Literatures have been reviewed capturing five main areas: Technology Adoption and Diffusion, Banking Technologies, Decision Making, Multiple Criteria Decision Making (MCDM) and System Dynamics (SD).

**Chapter 4:** Introduces the Indian banking industry and Case study i.e. State Bank of India. The Indian banking industry and State Bank of India are reviewed and introduced in order to understand, objectives, business processes, and current usage of information technologies of the bank. **Research question 1 is addressed in this chapter.**

**Chapter 5:** Explains the IT adoption process using multiple criteria decision-making (MCDM). This chapter for model analyses employing the MCDM approach for technology evaluation. This chapter illustrates how MCDM is used to select identified technological alternatives for the bank. The model analysis is divided into three stages, 1) structuring a problem, 2) eliciting information and values, and 3) evaluating and sensitivity analysis. Variation in results between intuitive perception and MCDM analysis have also been discussed. **Research question 2 is addressed in this chapter.**

**Chapter 6:** Explains the General model of the diffusion of Information Technologies (IT) using system dynamics. Model analyses using the system dynamics approach are subdivided into three models (Chapters 6, 7 and 8) because of differences in the specific properties of each technology. This chapter presents a generic model of diffusion of information technologies (IT). The model is developed based on both qualitative and quantitative system dynamics approaches. Impacts of strategic policies such as training support, a backlog of problems, potential market, and controlled investment on technology diffusion are tested. **Research questions 3 and 4 are addressed in this chapter.**

**Chapter 7:** Explains the applications of Generic model of diffusion of Information technology to Anywhere/Core Banking (Core Data Centre) at SBI. This chapter tailors the model analysis based on the bank staff’s intuitive perceptions (details in
Chapter 5, focusing on Anywhere/Core Banking (Core Data Centre) technology. Policy analyses and testing for validity and reliability are presented. **Research questions 3 and 4 are addressed in this chapter**

**Chapter 8.** Explains the applications of Generic model of diffusion of Information technology to Internet banking at SBI. This chapter presents the diffusion model of Internet banking, the preferred technology based on the MCDM analysis in Chapter 5. The issues covered in this chapter are similar to those of Chapter 7. **Research questions 3 and 4 are also addressed in this chapter.**

**Chapter 9:** Conclusions and recommendations for future research have been narrated in this chapter. This chapter summarizes the entire research and provides a direction for future research. **Research question 5 is addressed in this chapter.** All the information and model analyses are debriefed and discussed. Obstacles, limitations, implications, and potential future research are presented and recommended.

### 1.14 SUMMARY

This first chapter presented an overview of the research. Need, Objectives and the research questions were addressed. Then, the significance of the study was pointed out, and the research contents were outlined. The chapter aims at acquainting the readers with the holistic picture before elaborating on the research theme in the subsequent chapters. This chapter also presents research methodologies and research designs. System development research was the main research methodology selected as it was appropriate for conducting research in information systems domain and it also uses a concept-development-impact process. The study employed system development to transform the concepts of how to adopt and diffuse technologies effectively into the adoption and diffusion models that can be practically used for decision-making or strategic planning. The visual results of the model allow people to observe impacts of variables or strategic policies on the factors of interest. The case study of the State Bank of India was supplementary research methodology to customize the generic models to a specific case.
REFERENCES - CHAPTER 1


- Arunee Intraparirot: Adoption and diffusion of technology of Technology, a research work using MCDM and System Dynamics (Multi Referals).

- Banknet First Banking Systems Survey in India in 2002.


- IT Act October 2000.


- Mohammed Quaddus, Arunee Intraparirot: Management policies and the diffusion of data warehouse: a case study using system dynamics-based decision.


- Recommendations of the Narasimhan Committee (1991)
- RBI, Annual Report 2009-10, P- 78
- RBI Report on Trend and Progress of Banking in India 2009-10, P-55
- Saraf Committee, Shere Committee and Vasudevan Committee