CHAPTER 6

GENERAL MODEL
OF
INFORMATION TECHNOLOGY DIFFUSION
6.1 INTRODUCTION

This chapter has been designed in two parts. First part talks about the development of a model of IT diffusion based on qualitative system dynamics approach starting from: describing problems; identifying actors, goals and decision capturing process structure of the bank; defining organizational boundaries; and analyzing feedback loops. The second part aims at quantifying the qualitative model of IT diffusion using quantitative system dynamics approach. System Dynamics is suitable to deal with a dynamic approach of the problems and interrelationship among variables. A decision-maker is able to explore factors or exert operational policies that can improve or solve the problems without disrupting routine operations and costs. Further, running a simulation via System Dynamics before real implementation prevents an organization from risk potential derived from wrong decisions. Therefore, the system dynamics model is proposed as a suitable decision-making tool to develop a diffusion model because it is capable of handling interrelationships between variables and dynamic aspects.

Once the results come from applying the system dynamics model, it provides the insight of the relationship between variables that can be used for policy analysis in order to increase the rate of technology diffusion more effectively. The specific technology spread among the users (internal and external) of bank under case study has been studied in this chapter.

In Chapter 5 we studied the technology adoption of the Banks. The study revealed predominant technologies of the bank: Anywhere/Core Banking, Internet Banking, Plastic Money and Mobile banking etc. Before proceeding to develop the diffusion models of these technologies, this chapter presents a generic model of IT diffusion.
The model captures key variables, detects constraints and proves propositions for strategic policies in order to provide a guideline on how to diffuse technologies productively. It also gives answers for the research questions 3 and 4 "what is a requisite group model of IT diffusion and what are the requisite policies for adoption and diffusion of IT for the bank".

The banking Industry in India has introduced and implemented numerous technical products/projects post liberalization mainly based on information technologies (IT). The IT era in Indian banking started mainly with back office computerization and highly popular ATM project. Both these have led to the advent of electronic banking in India.

In any organization, IT adoption is initiated generally through equipment purchases and subsequent relevant software applications and peripherals requirements. Similarly in banks, executives have to make crucial decisions in regard to adopting new technologies, maximizing their utility, and finding ways to promote those adopted, as well as mitigating the degree of seriousness of problems deriving from technologies, and integrating those technologies into business performances. Technological adoption and diffusion become a routine practice for decision-makers due to the rapid rate of technological evolution and intense competition in the banking industry.

6.2 QUALITATIVE SYSTEM DYNAMICS BASED MODEL OF DIFFUSION OF TECHNOLOGY

Researchers have extensively studied the various properties of the IOBPCS family of models, in addition to their application for policy design. They propose a general methodology to derive the critical stability boundary from a transfer function, which is further used to develop policy. Lalwani et al. (2006) have also investigated the role of accurately estimating the production/distribution lead time within a decision support system (DSS). Wolstenholme (1990) provides a good reference for the basic principles of system dynamics. System dynamics is often considered to occupy a position between that of operations research and systems thinking. Forrester (1994) examines the methodologies followed by operations research, systems thinking and system dynamics practitioners to determine how these approaches overlap and what their unique contributions are to systems theory Keys (1988) concluded that
even though the exact position of system dynamics remains unresolved, scientists from both domains can relate to it.

'Even though system dynamics uses the formalisms of differential equations to simulate system behavior, diagramming tools are used to communicate the assumptions about the structure of the model' (Lane, 2008). This provides the model with an intuitive, graphical interface for exploring the impact of alternate feedback / feedforward based policies on system behavior. Most system dynamics models are represented using 'causal loop diagrams' and 'stock and flow diagrams' (SFD) otherwise known as feedback loop technique. Accordingly and taking base from the earlier study by Arunee Intraparirot a model of IT diffusion was developed based on qualitative and quantitative system dynamics using a feedback loop technique which consist of description of problem, actors identification, goals and decisions, classification of a process structure, organization boundaries and influence diagrams.

6.2.1 Description of Problem - System dynamics analysis starts with action related to clarify problems that an organization has confronted. As explained earlier among various technological products implemented by bank following few were selected: Plastic Money, Anywhere/Core Banking, Cheque Truncation System/Electronic Fund Transfers (EFTs), Internet banking and Mobile Banking to service customers and facilitate work processes. Although these technologies create many advantages, the bank is still confronting many critical problems such as rapid obsolescence of adopted technologies, lack of capable employees, high costs of technologies, low productive usage of those adopted selection of inappropriate technologies and low acceptance from staff and customers. These problems obstruct the technology diffusion of the bank. Therefore, the model of IT diffusion aims at providing ways to increase the rate of technology diffusion and to mitigate levels of seriousness of the problems to achieve the desired result proposed while selecting the technology.

6.2.2 Actors, Goals and Decisions - As per the definition the various actors involved in this study can be termed as State Bank of India, vendors supplying technologies to bank, competitors i.e. other banks in the operation, its customers with perception and finally bank staff with certain expectation. Each actor differs in his/her objectives and decision-making issues. The details are indicated in Table 6.1.
### Table 6.1 Actors, Goals and decision

<table>
<thead>
<tr>
<th>ACTOR</th>
<th>GOALS</th>
<th>DECISIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBI IT Deptt</td>
<td>Looking for Opportunities from new technologies</td>
<td>Negotiations and procurements</td>
</tr>
<tr>
<td></td>
<td>Ensuring Technology Utilization</td>
<td>Adopting new Technologies</td>
</tr>
<tr>
<td></td>
<td>Reducing Technical Problems</td>
<td>Implementing new Technologies</td>
</tr>
<tr>
<td>Vendors</td>
<td>Sales enhancements</td>
<td>Promoting technology diffusion</td>
</tr>
<tr>
<td></td>
<td>Retaining competitive advantages</td>
<td>Negotiations and sale</td>
</tr>
<tr>
<td>Competitors</td>
<td>Protecting Market Share</td>
<td>Technology Competition</td>
</tr>
<tr>
<td></td>
<td>Higher satisfaction</td>
<td>Technology copying</td>
</tr>
<tr>
<td>Staff</td>
<td>Maximizing technology benefits</td>
<td>Accepting/rejecting technology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Know how about technology</td>
</tr>
<tr>
<td>Customers</td>
<td>Higher satisfaction</td>
<td>Accepting/rejecting technology</td>
</tr>
</tbody>
</table>

Source: Derived from literature reviews, own experience and from previous research works.

**6.2.2.1 Vendors** - As the name suggest Vendors refers to the group of companies who supply technological application/solutions to the bank. Their main objective is sales enhancement by offering appropriate solutions and products to the bank. This can happen both ways they may satisfy the requirement or they may create requirement by their innovative products.

**6.2.2.2 Competitors** - Competitors are all other banks in the banking industry except SBI. The Banking Industry in India is having a mix of affairs including Public Sector Banks, private banks and Foreign Banks. Apart from increasing their market share the other objectives of competitors are to protect their market share and retain their competitive advantage. Competitiveness is one of the factors that force the bank to adopt new technologies to compete with rivals. For large banks, competition for technological leadership is a policy employed to defend their position whereas small banks are inclined to invest in only small and affordable technology by imitating only
successfully proven technologies to support staff and facilitate work processes, which is normally done by following large banks.

6.2.2.3 Actor - While, acting as a actor in this study we refer State bank of India as a unit of many technical department actively involved with Information technology activities of the Bank. The SBI Information technology Section consists of various departments i.e. Networking Deptt, Internet Banking Deptt, ATM Deptt, Core Data Center, Payment Systems, Business Process Re-engineering, Business Operations & Support, R & D and consultancy etc. People in this group are responsible for adopting, implementing and diffusing technologies. The Bank acts as a change agent; therefore, its objectives and decisions are different from those of its staff. The goals of the Bank are to gain opportunities from technologies, diffuse them extensively, and minimize risks and technological problems. Staff in the technology group has full knowledge of technologies and have a close relationship with top executive management.

6.2.2.4 Customer - The final beneficiaries of the product/project or so called technology adopted are known as customers’ i.e. they are actual users of the products and projects, which use or are going to use technologies provided by the bank. Customers use technology to gain maximum advantage or satisfaction from technology usage. As such they are to decide whether to adopt or reject the IT usage in bank. However, in some cases the technology has to be used by Bank Officials and benefit is availed by customers.

6.2.2.5 Staff - The end-user of the adopted technologies, which pass on the benefits of the adopted technology product customers. In this study we have considered staff from administrative offices as well as from Branches. This staff is separated from the SBI (i.e. IT Deptt) acting as Actor, because of different roles and objectives. Each member has two views about technology usage i.e. how to maximize benefits from technologies for an organization and how he or she is benefited with the product.

6.2.3 Process Structure of the SBI - Improving processes means understanding their structure, both internally and in the interactions with other processes. This section gives a basic description of some key elements. Within a process, the 'series of actions' can be broken down into two types:
(a) A simple action, where something is done, and the subsequent action is always the same.

(b) A decision, where nothing is done other than to decide on what the subsequent action should be.

What makes the process systematic is that these actions are not performed randomly, but in a predefined sequence. The most common tool to show this sequence is a Flowchart (see below), which uses different symbols to distinguish the different types of action.

**Figure: 6.1 Process Structure**

Thus we conclude that a process structure is to convert resources between different states. A process is a stock that accumulates the resource, which is relevant to the problem of concern such as staff, money and technological problems. Any change in the value of inflow or outflow of variables regulates the resource. For example, the rate of training increases the number of knowledge workers whereas the rate of staff quitting decreases the number of knowledge workers. A resource can be changed into different states.

For example, unskilled workers are transformed into knowledge workers after they obtain sufficient training. The process structure of the State Bank of India with respect to IT adoption and diffusion consists of four types of resources: technology, money, staff, and customers (see Table 6.2).
Figure 6.2 Process Structure

<table>
<thead>
<tr>
<th>Resources</th>
<th>States of resources</th>
<th>Resource flows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>Non-adopted technology</td>
<td>Rate of negotiation $\rightarrow$ Delay $\rightarrow$ Non-adopted technology</td>
</tr>
<tr>
<td></td>
<td>Newly-adopted technology</td>
<td>Rate of technology adoption $\rightarrow$ Delay $\rightarrow$ Newly adopted technology</td>
</tr>
<tr>
<td></td>
<td>Diffused technology</td>
<td>Rate of technology diffusion $\rightarrow$ Delay $\rightarrow$ Diffused technology</td>
</tr>
<tr>
<td>Money</td>
<td>Profit</td>
<td>Variable cost $\rightarrow$ Rate of cost generation $\rightarrow$ Profits</td>
</tr>
<tr>
<td>Staff</td>
<td>Unskilled Staff</td>
<td>Rate of hiring $\rightarrow$ Rate of skilled quit</td>
</tr>
<tr>
<td></td>
<td>Skilled Staff</td>
<td>No. of unskilled staff $\rightarrow$ Rate of training $\rightarrow$ No. of skilled staff</td>
</tr>
<tr>
<td>Customers</td>
<td>Active Customers</td>
<td>Rate of Customer generation $\rightarrow$ Active customers $\rightarrow$ Rate of Customers loss</td>
</tr>
</tbody>
</table>

Source: Derived from literature reviews, own experience and from previous research works.
6.2.3.1 Technology - Generally technology is divided into three states; non-adopted technology, newly adopted technology, and diffused technology. New technologies are supported by IT officials at various IT Services Departments and support work processes or to fulfill requirements of the bank. Technologies at this stage include available and prospective technologies proposed by technological vendors or suppliers. Negotiations, feasibility and other facts delay the technology adoptions.

The relationship between the rate of negotiation and technology at a market phase is positive. Non-adopted technology will be turned into newly adopted technology under the control of a rate of technology adoption. An increase in the rate of technology adoption affects positively on the amount of the newly adopted technology.

Technologies once finalized by Bank at Corporate centre level are further passed on to Local Head Offices to diffuse it down to the branch level and/or to customers. Diffused technology is regulated positively by the rate of technology diffusion and negatively by the rate of technology obsolescence and the rate of technology abandonment because people normally switch to use more efficient technology. The diffusion process is also a time consuming process.

6.2.3.2 Money - For implementing any solution or technology funds are required. Generally it is assumed that such expanses always reduce profit. As such we can say that investment has inversely proportional relationship with profits. But it is seen that adopted technologies yields positive results. As the rate of cost generation increases, it depletes the profit whereas as the rate of revenue generation increases profit. The rate of cost generation comprises the cost of technologies, which are controlled by the rate of investment in new technology and variable costs (e.g. training costs, equipment, maintenance, overheads, and costs for resolving technological problems). Investment in new technology provides opportunities to increase the rate of revenue generation.

6.2.3.3 Staff - Usually going by generic views Staff comprises two categories - unskilled and skilled staff. Unskilled staff are positively controlled by a rate of hiring and negatively controlled by a rate of unskilled workers quitting. Since being Public Sector Banks the rate of quitting is extremely low or can be ignored. However, unskilled staff is transformed into skilled staff (with a delay) via rate of training.

The number of skilled staff declines by the rate of skilled staff quitting and the rate of technology abandonment. The rate of technology abandonment feeds skilled
staff back as unskilled staff, but at a lower rate. Generally, former skilled staff is able to learn faster than unskilled staff because information technology allows people to increase learning ability and create a common background (Croft, 1995). That is, once one technology is learnt, others can be learnt more quickly.

6.2.3.4. Customers - Bank adopts new technologies assuming that part from retaining existing customers the adopted technologies shall bring about more active customers. Active customers are increased by the rate of customer generation and decreased by the rate of customer loss. Both rates are regulated mainly from perceived customer satisfaction.

6.2.4 Organizational Boundaries - All these process structure once finalized are conceptualized in framing organizational boundaries. These boundaries are defined to clarify which organizations or people control each rate variable in a process. It is useful to set up organizational boundaries because making decisions or exerting policies to improve the process structure may require integrated control strategies in each organization.

Following the guidelines set by in earlier study by Arunee Intraparirot we define organizational boundaries with regard to technology adoption and diffusion of the bank into five actors: the SBI, staff, vendors, customers and competitors. The relationships of each actor in organizational boundaries are illustrated in Figure 6.2.

Figure 6.3 Organizational Boundaries

Source: Derived from literature reviews, own experience and from previous research works.
6.2.4.1 The State Bank of India - The reason that the bank buys technologies is due to the gap between technical setup of new entrants Bank in private sector and foreign banks available in a market, and considers that new technology may fulfill its business objectives. New adopted technology is diffused to staff and customers in terms of better services. The SBI also provides training or educational programs to staff to support technology usage.

6.2.4.2 Vendors - Since bank doesn’t have its own technical setup to the optimum level it depends upon vendors who supply technological solutions/applications, and provide after sales services and support (e.g. training, service and maintenance). Levels of technical support and other services depend on success in negotiation.

6.2.4.3 Competitors - Competition forces the SBI to adopt new technology in order to retain market share. On the other hand, technology investment by the bank also affects its competitors. The competitors as explained earlier are private sector Banks, apart from small public sector banks which can adopt new technologies easily owing to their small size.

6.2.4.4 Customers - Since we have considered the technologies which have been adopted by Bank from Customers point of view we assume that if customers is happy with new adopted technology, the numbers of active customers and activities will increase leading to increasing in profit. Concurrently, an increase in profit influences the bank to introduce new technologies or upgrade existing technologies.

6.2.4.5. Staff - Training is provided to bank officials while implementing and new technical product. The prospective outcomes from staff are improved productivity (Grover, 2007) and the provision of better services to customers and enhanced ability to adopt subsequent new technologies.

The relationships among variables have been derived from Chapter 3 based on Information on technology diffusion deriving from literature reviews. These variables and their relationships were used as a guideline for interviewing and developing questionnaires. The complete picture showing relationship among variables related to technology diffusion as taken from earlier study by Arunee Intraparirot is shown in Figure 6.4.
FIGURE 6.4 (Variables and their Relationship)

Source: Derived from literature reviews, own experience and from previous research works.
The factors that influence the rate of technology diffusion were divided into five groups. In the first group we are considering the technologies where by customer is benefited. There are many factors which make customer comfortable and have positive influence on the rate of diffusion of these technologies i.e. these technologies such as perceived relative advantage, potential of the market, quality, advertising and customer acceptance. Contrary to this, delivery delays, negative word of mouth and frequent switchover of technologies decrease the rate of diffusion. Staff, which are supposed to be the front end users of this technology also plays a critical role to accelerate or decelerates the degree of technological diffusion. As such, factors associated with individual users such as perceived relative advantages, user involvement and ease of use are supposedly the factors which positively influence the rate of technology diffusion. Apart from individual perception organizational environment also plays a crucial role in the diffusion of technology. Many factors like management support, earlier experience in using technology, Industrial relations influence the technology diffusion. Also the technology has to be elaborative, user friendly, reliable, compatible with earlier system, tradable, expandable etc to have rapid rate of diffusion. The support from technical team comprising of vendors and Information Technology officials from in-house team helps in increasing rate of diffusion.

Any technology adopted by bank has multi dimensional benefits and influence the various associated factors. Any product implemented has certain inherited advantages, since banking has changed from “how much” to “how fast”. Suppose by using any technology we get the facility of faster disbursement of money, this shall generate a feeling of satisfaction to the customer resulting positive image which in turn shall get more customer and revenues. Some of such advantages observed are improved decision-making, providing accurate and timely information, increased performance efficiency, decreased costs for performance efficiency and increased image. At the same time technology implementation requires many initiatives and as such bound to have certain problems. Adequate training is required, investment in
training maintenance of technology and operational issues with technology also known as backlog of technologies are always there.

6.3 GENERIC DIAGRAM OF DIFFUSION OF INFORMATION TECHNOLOGY

The variables were summarized based on information from the bank and using own experience gained while working with Information Technology department. The IT diffusion model earlier used by Arunee Intrapirot was used as base model and the variables related to this study were explored by dividing them into four sub-sectors: the bank (IT Department), bank staff, customers, and vendors. Further, feedback loops were used to explain the positive and negative effect of particular variable. The feedback loops derived from literature reviews, own experience and from previous research works were defined using four resources (i.e. technology, profits, staff, and customers) (Figure 6.5).

6.3.1 Feedback Loops - Feedback loops which are used to explain the change in outcome of a system by varying any input. The qualitative system dynamics begins with creating an influence diagram to identify information feedback loops. This analysis helps us in understanding the resultant behavior by various feedback loops. These loops represent the understanding of flow of processes within organizational boundaries, delays, information, and strategies of systems interact to create system behavior. The loop outcome is dependent upon the effect of that particular aspect studied in detail below.
(Figure 6.5) Generic Diagram with Feedback loops

Source: Derived from literature reviews, own experience and from previous research works.
6.3.1.1 Technological Need (negative feedback loop A1: Figure 6.6) - As explained earlier bank adopts new technology because of two reasons: i) being the innovative and ii) to meet the requirement of the customer. So as per the first reason new technology in a market always attracts the bank. As such bank adopted the new technology to bridge the technological gap between "available IT" in the market and a level of "newly adopted IT or investment in IT" displayed by figure 6.6. This gap is reduced by bank by investing further in technology and this investment is subjected to the budget sanctioned.

**Figure 6.6 Technological Need loop**

![Figure 6.6 Technological Need loop](image)

Source: Derived from literature reviews, own experience and from previous research works.

6.3.1.2 Relative advantages and customer satisfaction (positive feedback loops B1 and B2: Figure 6.7) - Once bank has decided to invest in technology, it is bound to stress for the diffusion of same to avail the desired benefits. As such the relationship between "newly adopted IT" and "diffused IT" is positive (see Figure 6.7). As adopted technology yields positive returns and that become drive to diffuse the technology further. Normally, increasing returns driving from technology adoption (e.g. learning ability, economies of scales, infrastructure technologies) is a primary factor that
drives technology diffusion (Caskey & Sellon, 1996; Fichman & Kemerer, 1994). Other factors that drive the rate of technology diffusion are "customer behaviors", "perceived relative advantages", "features of technology", and "bank environments".

Since most technologies bring relative advantages results over a period and these advantages depend up on the features of technology. In case of Core Banking Technology it is better MIS for decision making, whereas in case of Internet banking it is cost saving i.e. relatively cheaper mode of banking.

Positive results in terms of "Relative advantages" will provide increase "profits", which makes bank to invest further. Since Technology diffusion is a time consuming process; therefore, it takes time (delay) for the bank to diffuse technology and ultimately gain profits "Customer satisfaction" is a vital factor for generating "active customers", which leads to accelerating "sales" and then positively impacts on "profits". The loop is then completed through the variables of loop B I (Arunee Intraparirot).

**Figure 6.7 Relative advantages and customer satisfaction loop**

Source: Derived from literature reviews, own experience and from previous research works.
6.3.1.3 Costs (negative feedback loop C: Figure 6.8) - Every IT project requires investment, however Anywhere/Core Banking project by State Bank of India, has been costliest project ever implemented by any Bank across the world. The capital cost and operational cost eat up profits. (Figure 6.8).

Figure 6.8 Cost loop

Source: Derived from literature reviews, own experience and from previous research works.

6.3.1.4 Training (negative feedback loops E and F)

Since every technical change requires skilled staff to manage heavily invested project. The difference between skilled staff available and the one actually required widens the "skilled staff gap", and accordingly bank has to arrange for appropriate trainings for such officials to enable them to manage technical products and to reduce this gap of “Skilled staff gap”. Further, since it involves state of art technology bank needs to have strong team of technical officials apart from having required knowledge worker team to use the data base. The gap in the both these categories have to be met with by arranging training by bank which requires expenditure. Negative feedback loops E and F indicate that the bank has to provide appropriate training in order to compensate for insufficient knowledge worker.
6.3.1.5 Training costs (negative feedback loop G: Figure 6.10) - Upgrading the quality and quantity of knowledge workers via training results in increasing "training costs" and thus decreases "economic gains".

**Figure 6.9 Training loop**

**Figure 6.10 Training loop**

Source: Derived from literature reviews, own experience and from previous research works.
6.3.1.6 A backlog of problems (Negative feedback loops H1 and H2) - Usually new technologies are bound with teething problems because of poor implementation, hardware issues or lack of knowledge. These problems sometime take longer time in getting resolved. Accordingly, a backlog of problems is created which requires expertise resolve. A separate team is constituted to resolve these issues. If end users or customers are annoyed or disappointed, they will abandon that technology. The bank may also hesitate to adopt additional technologies. A backlog of problems results in negative perception, and subsequently reduces the rate of technology diffusion.

Figure 6.11 Backlog Problem loop

Rate of technology adoption/
Rate of investment in IT

Newly adopted IT/
Investment in IT

Delay

Rate of abandonment
Backlog of Problems

Delay

Source: Derived from literature reviews, own experience and from previous research works.

6.3.1.7 Impacts from a backlog of problems (negative feedback loops I 1 and I 2)
- "A backlog of problems" exerts negative impacts on both "relative advantages" (loop B 1) and "customer satisfaction" (loop B 2). These impacts may completely or
partially offset the positive gains from previous feedback loops (Loop B 1 and B 2) (see Figure 6.12).

**Figure 6.12 Impact of backlog loop**

Source: Derived from literature reviews, own experience and from previous research works.

6.3.1.8 **Total costs (negative feedback loop J)** - According to various studies and considering the researcher experience, the cost in Information Technology is bound with many other costs including regular hardware upgradation cost, maintenance cost, training cost, and cost involved in solving backlog problems. So this cost factor is directly proportional to the diffusion of technology more the technology is diffused more is the cost.
6.3.1.9 Potential market (Negative feedback loop K) - Availability of market also infuses technology diffusion. Substantial market potential inspires for technology adoption and diffusion. Market potential also hinders the diffusion process because the numbers of "active customers" cannot be beyond the "potential market", which is limited by population income and numbers of business (Arunee Intraparirot).

Source: Derived from literature reviews, own experience and from previous research works.

Figure 6.14 Potential Market loop

Source: Derived from literature reviews, own experience and from previous research works.
6.3.1.10 Technological investment and profits (negative feedback loop L)

Bank cannot keep on spending on technology as it decreases profit, and has to draw a balance between investment and profits to be retained. (Figure 6.15).

Figure 6.15 Technological Investment loop

Source: Derived from literature reviews, own experience and from previous research works.

6.4 A MODEL OF IT DIFFUSION BASED ON QUANTITATIVE SYSTEM DYNAMICS APPROACH

The qualitative model provides holistic view including the various variables influencing the rate of diffusion of technology. However, to understand the interrelationship between various feedback loops, and their effects on each other, qualitative analysis alone may not be sufficient enough and as such quantitative system dynamics approach was used. The qualitative conceptual model identified by the above feedback loops was quantified and simulated using ithink software (explained earlier). All feedback loops were simulated to complete the system; this enables us to understand the effect of each loop on other variables. For example imparting training increases the number of skilled officials which help in enhancing the rate of diffusion of technology. At the same time training involves expenditure which reduces the profits. The results obtained from this simulation provided a complete model of diffusion of information technologies.

The variables used in this model have been captured on the basis of information received from Bank officials and using researchers own long experience.
as system officials in dealing various IT initiatives of Bank. However these variables can be changed according to the organization thus displaying the dynamisms of model.

6.4.1 List of Variables for quantitative Model

To begin with, the variables were derived from experience and periodicals. Further, concerned officials from State Bank of India, Core Data Centre, Belapur, and Local head Offices were interviewed over video conferencing apart from collecting data through questionnaires. The exact figures for many variables were difficult to get or document as such have been framed. According to the initial data, a level of actual performance is set at 0 for low and 5 for high actual performance. The level of actual performance (i.e. the level of current perceptions of staff) towards each issue was identified using the 1-5 scale (i.e. lowest to desired performance). Then, the level of performance (1 to 5) was transformed to a zero to 1 scale for simulation value in order to facilitate simulation using ithink software (Table 6.2).

Table 6.2. Lists of Variables of IT used for Quantitative Model

<table>
<thead>
<tr>
<th>Name</th>
<th>Initial Data</th>
<th>Value used in ithink model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adoption and diffusion</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Percentage of a backlog of problems</td>
<td></td>
<td>0.10% per year</td>
</tr>
<tr>
<td>1.2 Resolve problem fraction</td>
<td>.80 %</td>
<td>0.80</td>
</tr>
<tr>
<td>1.3 Rate of technology abandonment</td>
<td>2-3 %</td>
<td>0.03 per year</td>
</tr>
<tr>
<td>1.4 Propensity to invest</td>
<td>10%</td>
<td>0.10</td>
</tr>
<tr>
<td>1.5 Customer behaviour fraction</td>
<td>Level of actual performance = 3.1</td>
<td>0-62</td>
</tr>
<tr>
<td>1.6 Perceived relative advantages</td>
<td>Level of actual performance = 3.8</td>
<td>0.76</td>
</tr>
<tr>
<td>1.7 Positive features of technology</td>
<td>Level of actual performance = 3.9</td>
<td>0.78</td>
</tr>
<tr>
<td>1.8 Bank environments</td>
<td>Level of actual performance = 4.1</td>
<td>0.82</td>
</tr>
<tr>
<td><strong>Customer behaviour</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Customer perceived satisfaction</td>
<td>Level of actual performance = 4.3</td>
<td>0.86</td>
</tr>
<tr>
<td>2.2 Number of prospective customers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3 Active customer</td>
<td>Initial number = 1000000</td>
<td></td>
</tr>
<tr>
<td><strong>Staff</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Unskilled staff</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>3.2 Skilled staff</td>
<td>20000</td>
<td></td>
</tr>
<tr>
<td>3.3 Unskilled quit fraction</td>
<td>0.05</td>
<td></td>
</tr>
</tbody>
</table>
3.4 Skilled quit fraction | 0.01
3.5 Level of understanding | Level of actual performance = 3.4 | 0.76

<table>
<thead>
<tr>
<th>Relative advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Average relative advantage</td>
</tr>
<tr>
<td>4.2 Sale price</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 Average costs of technology</td>
</tr>
<tr>
<td>5.2 Training costs</td>
</tr>
<tr>
<td>5.3 Operating &amp; maintenance costs</td>
</tr>
<tr>
<td>5.4 Costs from backlog of problems</td>
</tr>
<tr>
<td>5.5 Minimum investment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1 Time to correct technological gap</td>
</tr>
<tr>
<td>6.2 Time for customization</td>
</tr>
<tr>
<td>6.3 Time for training staff</td>
</tr>
</tbody>
</table>

Source: Values approximated and Data collected through questionnaire and interviews

6.4.2 A Baseline Model of IT Diffusion - A base line model always comprises basic criteria which can be used for further expansion for other parameters. In this model we used following three criteria to design a base model by simulating their respective feedback loops:

- **Technological Need (negative feedback loop A1)**
- **Relative advantages and customer satisfaction (positive feedback loops B 1 and B 2)**
- **Costs (negative feedback loop C)**

In this case these simulations can be considered as base model because we have considered the investment and benefit. The results obtained from base line model can be used to compare while doing analytical analysis for other simulations. Subsequently, all feedback loops were simulated to complete the generic model (figure 6.16). Finally these loops were converted in graphical interpretation of *think* software displayed in (Figure 6.17). From the diagram we find that the model has three system boundaries of the baseline model comprise vendors, the IT Department of the bank and customers.
Source: Derived from literature reviews, own experience and from previous research works.
Figure 6.17 simulation model Using Ithink

Source: Derived from literature reviews, own experience and from previous research works.
As explained earlier bank have two reasons to acquire technologies, technologies available in the market and for the specific need of customers. Accordingly, Bank may purchase technologies which are available in the market. These technologies are subsequently customized to cater to customer or may be to cater a specific need new technologies are purchased by Bank. However the investment in technologies is governed by many such as “Tendency to invest” and “technological expenditure”. Such factors are normally decided by bank in the IT policy revised annually including the sanctioned budget. Another factor that has to be considered is the delay in the implementation of technologies, which may arise because of much internal reason.

Once the technology is finalized, purchased and adopted it is diffused through staff in the organization. Apart from staff attitude or acceptance the diffusion of selected technology depend upon some inherited factors listed below:

- Perceived advantages
- Technological features
- Internal environment
- Customer acceptance
- External environment

The technology diffusion results in certain advantages to the Bank. These advantages shall depend upon properties of technology, however some of the generic advantages are:

- Improved efficiency
- Easy MIS
- Revenue generation
- Cost cutting
- Better decision making

To study the properties of this model we may consider the consider the diffusion Anywhere/Core banking project, which incidentally happen to be costliest and largest project ever taken by any bank across the world. But since it’s been around 4 years bank completed this project, we consider the implementation of latest
IT intensive project “Active directory” across PAN India. However, since this project was implemented in phases so we consider the roll out of this project under Chandigarh circle only covering 1150 branches/offices in the states of Haryana, Punjab, Himachal Pradesh, Jammu Kashmir and Chandigarh. The project was rolled out on 2nd May 2012, and Completed on 12th August 2012. The entire Circle was divided in to four regions and their individual growth is depicted in following figures.

The graphs were drawn using rate at which branches were migrated to the Active Directory and branches on Active Directory platform. The simulation diagram was simulated using focusing on these two variables. The graph has S shape curve, which implies that technology, is gradually diffusing at the first stage, increasing rapidly after roll out, and diminishing after absorbing the potential market.

**Table: 6.3 Diffusion of Active Directory in individual region**

<table>
<thead>
<tr>
<th>week</th>
<th>Jammu Kashmir Region total branches 168</th>
<th>Punjab (Chandigarh) Region total branches 290</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>22</td>
</tr>
<tr>
<td>6</td>
<td>12</td>
<td>31</td>
</tr>
<tr>
<td>7</td>
<td>19</td>
<td>43</td>
</tr>
<tr>
<td>8</td>
<td>28</td>
<td>57</td>
</tr>
<tr>
<td>9</td>
<td>39</td>
<td>71</td>
</tr>
<tr>
<td>10</td>
<td>52</td>
<td>39</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

*Source: Data collected from ITS Department, LHO Chandigarh*
Figure 6.18 Diffusion of Active Directory in Chandigarh Region

Chandigarh Region total branches
290 branches

Source: Data from table 6.3

Figure 6.19 Diffusion of Active Directory J & K Region

Jammu Kashmir total branches 168 branches

Source: Data from table 6.3
6.5 IMPACT OF VARIOUS FACTORS ON TECHNOLOGY DIFFUSION

The prominent factors influencing the diffusion of technology were explored further from the baseline mode for their influence on diffusion of technology. The factors including “training support”, “backlog of problems”, “market potential”, “investment in new technology” and “economic gains” can be tested for their influence on diffusion of technology using different values of variables.

6.5.1 Training Support and Technology Diffusion - It is seen that apart from some inherited qualities/properties of technology the external factors also play a crucial role in increasing rate of diffusion of particular technology. One such prominent factor is knowledge of technology among end-users. Since knowledge among end users can be upgraded by imparting them relevant training. As such, training is considered as a vital tool to improve knowledge. The improved knowledge about the product helps in changing attitude to “opposes any change in surrounding” as a human nature. Also it reduces levels of resistance, apart increasing the skilled manpower. Generally, technology diffusion increases with the level of training support (Arunee Intraparirot).

Further, it acts like a chain reaction, at the time of roll-out of any technology based product, there a feeling of hesitation or resistance to use it. However, with the help of training people find it comfortable to use the technology. This creates learning environments that convince more end users to use the technology and attend trainings to assist them in doing so. We conclude that the training helps in increasing the rate of diffusion of technology as people find it easy to use and more n more people start using the technology. Further, the increased rate of technology will increase the profits which are projects before the technology is finalized or adopted.

This can be verified by taking any project implemented by Bank across Circle, whereby the launch is followed by training sessions at various training centers. Though no exact analytical database could be managed but using previous studies, literature reviews and researchers own experience in this field confirm the results that increased training increases the rate of technology diffusion.
Loops E, F and G were added to the baseline simulation for the purpose of capturing the impacts of training support which is set up to bridge the gap of insufficient technical skills. To analyze these observations we consider the implementation of latest project “Active Directory Project”, recently implemented at all branches/Offices in Chandigarh Circle.

Table: 6.4 Users logging v/s Branches migrated to AD System

<table>
<thead>
<tr>
<th>Week</th>
<th>No. of branches migrated to Active Directory Project</th>
<th>No of Users logging in to AD Server</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>23</td>
<td>45</td>
</tr>
<tr>
<td>3</td>
<td>46</td>
<td>67</td>
</tr>
<tr>
<td>4</td>
<td>78</td>
<td>98</td>
</tr>
<tr>
<td>5</td>
<td>91</td>
<td>456</td>
</tr>
<tr>
<td>6</td>
<td>124</td>
<td>879</td>
</tr>
<tr>
<td>7</td>
<td>137</td>
<td>1435</td>
</tr>
<tr>
<td>8</td>
<td>164</td>
<td>3452</td>
</tr>
<tr>
<td>9</td>
<td>171</td>
<td>4589</td>
</tr>
<tr>
<td>10</td>
<td>174</td>
<td>6532</td>
</tr>
<tr>
<td>11</td>
<td>64</td>
<td>7678</td>
</tr>
<tr>
<td>12</td>
<td>32</td>
<td>8674</td>
</tr>
<tr>
<td>13</td>
<td>39</td>
<td>8879</td>
</tr>
<tr>
<td>14</td>
<td>0</td>
<td>9004</td>
</tr>
</tbody>
</table>

Source: Data collected from ITS Department, LHO Chandigarh
Figure 6.20 Number of Branches Migrated to AD System

Source: Data from table

Figure 6.21 Number of users Logging to AD System

Source: Data from table
The entire Project was completed in 14 months time; initially training was arranged for system team entrusted for the implementation of this project. The end users of this project were imparted necessary training from 5th Week onwards and the successful diffusion is displayed by the rapid increase in number of users’ login to Active Directory Server.

According to Figure 6.19 the rate of technology diffusion supported by training is higher than what was before the users were provided training. Same way the baseline model can be explored by using certain database before training and after training. Further, considering the benefits of technology implemented, we can say that the cost involved in imparting training is justified by the usage of technology and finally bank gains additional profits.

6.5.2 Backlog of Problems and Technology Diffusion - Usually new technologies are bound with teething problems because of poor implementation, hardware issues or lack of knowledge. These problems sometime take longer time in getting resolved. Resulting, a backlog of problems is created which requires immediate redressal. Otherwise negative perception about technology may hamper the diffusion rate. Therefore, if an organization fails to solve the backlog of problems, it may create a kind of uncertainty in the minds of users leading to demoting further adoption. Thus we conclude that backlog of problems decrease the rate of diffusion of technology as well as use of existing diffused technology.

The analytical explanation of this by using some live data may not be feasible for researcher being employee of organization. However, the base line model can be simulated further by adding feedback loop from Loop A to Loop J and their impact can be observed.

Meanwhile, from researcher experience and previous studies we understand that backlog of problems increases many folds if no training is imparted to end users resulting in low rate of diffusion of technology. Since technology is chosen with an idea of improving the efficiency of system it is understood that if technology is diffused it increases the profit. This can be verifies from Baseline model by considering some dummy data (certain percentage of backlog) using the simulation model.

309
6.5.3 Potential Market on Technology Diffusion - Early entrant in market is bound to have advantages in terms of being innovative leader and long-term competitive advantages. We understand from earlier research, experience and literature review that Information technological products in banking industry have long term benefits. However, an organization may hesitate to implement technology because of fear of return and potential market is physically reduced in size by early entrants. Though, the market is always likely to have new potential customers and customers who repurchase. Yet, in reality, it is difficult to know the potential market of a particular product because customers may like to wait for technology to establish. This wait n watch attitude of customers may create confusion about demand to launch the product successfully.

The feedback loop K in is added in order to observe the influence of potential market on sales potential market is completely absorbed. It can be concluded that technology cannot increase sales beyond potential market, although it can be successfully diffused.

6.5.4 "Investment in New Technology" and “Economic Returns on Investment" - We have already explained in earlier chapter 2 and 4, the complex scenario of compulsion of investment, amount of investment, return on investment and choice to invest. Under these compulsions companies invested huge amounts in technology and subsequent up gradations. However, currently, there are increasing concerns regarding technological adoption and the overall gains in return for such investment because high investment not only brings many advantages but it also decreases profits (Takac & Singh, 1992).

The second aspect associated with this is the efficiency of user. It has also been observed that frequent change of technology or system may persuade people to spend time and effort dealing with the technology instead of doing their routine work. As such, it is imperative for any organization to determine a balance between desired investment in new technology and economic returns from such investment. Loop L can be (technological investment and profits) added to the simulation to observe the impacts of technological investment of the bank based on the amount of its profits. The graph can be developed to explain that with the same amount of technological
investment, profits derived from controlled technology expenditure are higher than those without controlled technology expenditure. However, again being employ of SBI it’s not possible to get exact figures to prove this statically at this stage.

6.5.5 **Economic Gains for Investment in New Technology** - From previous research work and literature review we understand that positive relationship between relative advantages and technological adoption has been found (Kwon & Zmud, 1987; Rogers, 1983). However, economic gains from technological investment cannot be obtained generically categorized. Many a times technologies are adopted as a compulsion out if competition or requirement. At the same time technologies when implemented don’t have immediate returns. The core benefits of technologies are lateral achieved. Meanwhile, we found that there are many internal and external factors which require to be taken care for technology to yield positive results.

As such we can say that technologies are to be supplemented by various factors and as such substantial investments in required. This fact can be verified using the investment in IT by various banks. Whereby, it is experienced that investment in the IT products by Banks is an ongoing process though positive gains are observed from early investment.

**6.6 MODEL VALIDATION**

Model verification is essential parts of the model development process if models to be accepted and used to support decision making. Verification is done to ensure that:

- The model is programmed correctly
- The algorithms have been implemented properly
- The model does not contain errors, oversights, or bugs.

Further, Validation ensures that the specification is complete and that mistakes have not been made in implementing the model. Numerical methods for model validation, such as the R2 statistic, are also useful, but usually to a lesser degree than graphical methods. Numerical methods for model validation tend to be narrowly focused on a particular aspect of the relationship between the model and the data.
Numerical methods do play an important role as confirmatory methods for graphical techniques (Charles M. Macal* 2005).

As such valid model is a way to define near real system. This means that a model is valid if it is sufficiently useful for desired purposes and satisfies users. Model validation can also be justified through its development of a gradual process of "confidence building" which arises from satisfaction of the model structure, its general behavior characteristics, and its ability to generate accepted consequences (Arunee Intraparirot).

The diffusion model of IT developed using various concerned variables was verified as valid model by various senior functionaries of State Bank of India. It was observed that various factors included in the model really matters to the implementation of technology. Bank officials consented that many factors influence the diffusion process such as, training and a backlog of problems, market potential, and volume of investment. Further, bank officials agreed that if these factors can be combined together bank can take advantage and can achieve higher rate of diffusion of technology. Since the feedback loop were simulated one by one, followed by exploring their interrelationship using quantative analysis, the process can be categorized as confidence building and can be summarized in following steps:

Step 1. The various variables were identified using own knowledge and literature review. These variables were synchronized in the shape of various feedback loops and model was developed for the diffusion of technology. The model accounted various factors that affect the diffusion process such as, training and a backlog of problems, market potential, and volume of investment. This framework explains a holistic picture of the system behaviors.

Step 2. Then system boundaries were identified and roles of inter-related actors who may influence the diffusion process, or may be affected by the process were summarized. It also captured a process structure and the interactions between each factor. These provide the fundamental background for users to comprehend the system and highlight problems of concern.

Step 3. At this stage after having configured a base model, data was collected from State Bank of India. This can help in customizing the conceptual model to reality.
based or as per perceptions of people. The theoretical framework can be converted to a practical solution. However the researcher being a part of system (employed with Information Technology Deptt), using statics was not possible.

**Steps 4.** However the model was further, simulated taking help of earlier work done by Arunee Intraparirot in order to understand the behavioral patterns and quantify the values of variables of interest (e.g. a pattern of technological diffusion, rate of the technology diffusion, diffused technology).

**Steps 5.** The thus obtained results from the model analysis were compared with the findings from previous literature reviews and reality in order to investigate various propositions and confirm the validity of the model. The findings were shared with Banks functionaries dealing with Systems to confirm its validity or to get comments for model revision.

**Step 6.** The findings and design of model of diffusion of technology were vetted by Bank’s officials. However it was observed that the generic model cannot be used for each technology since each technology contains unique properties. Therefore, to understand the model it was proposed to analyze technologies i.e. anywhere/core banking and internet banking. While Anywhere/Core banking technology is costliest and massive technology and is bank oriented, the other technology i.e. Internet Banking is totally customer oriented. As such two sub-models of a anywhere/core banking (Core Data Centre) and Internet Banking, which are presented in Chapters 7 and 8. Core Banking/Core Data Centre is diffused to end-users in an organization whereas Internet banking is assimilated to bank customers. The diffusion models of the two technologies will provide more understanding and clearer answers for the third and fourth research questions. These two sub-models were analyzed to detect their diffusion processes and test for leveraged strategic policies that enhance the rate of technological diffusion. The results enhance the levels of understanding; confirm their usefulness with regards to helping the bank find ways to diffuse the technologies productively.

Model Validation: Apart from the usefulness and confidence building process, the model of IT diffusion can be further tested and validated based on the formal criteria comprising the three major stages of structure validity, behavior validity, and tests of policy implications. However, since the finding of such tests cannot be

313
documented by researcher being employ of state bank of India, and has been mentioned as shortcomings of this study. However to verify the findings of this model turing test was performed. In Turing test, we test system ability to exhibit intelligent behavior. In turning test, the findings of model under validation are compared with those of the real system based on their experience and knowledge.

6.6.1 Turing test - Turing test by proposing the outcomes of the model to Information Technology Services Departments at 14 Local Head Offices (LHO) across the country, who are experts in technological issues in order to ask them to compare the model findings with those of the real system based on their experience and knowledge. Findings shared by these officials are summarized below:

They agreed that training support is the important factor to drive technology diffusion whereas a backlog of problems obstructs it. The effect of negative perception because of backlog of problems was adversely affecting the rate of diffusion. Market potential plays a crucial role in technology diffusion. Being competitive market every bank is coming up with more or less same technology. As such bank has to be innovative and create market. The potential customers of technology should be migrated to technology users at the earliest. The bank officials also shared concern about investment in banking. Since the rate of technology getting obsolete is very high apart from frequent up gradation required. The exact figures could not be documented but still it was stressed that there has to be a mechanism to manage the balance between need and investment in case of technology. They also agreed that the bank has to invest substantially before gaining returns on the investment. However, the returns on investment are contingent upon types of technology and are not necessarily in the form of monetary returns. For example, the bank has invested heavily on Core Banking/Core Data Centre and the return cannot be directly accounted for. On the other hand bank invested huge amount on Focal Point Processing Centers including few branches at Chandigarh, but the project got abandoned during gestation period only.

6.6.2 Behaviour Validity Tests - This test compromises of three tests: behaviour-reproduction test, behaviour-anomaly test, and behaviour-sensitivity. Behaviour validity test is conducted to measure how accurately a model can reproduce major behaviour patterns exhibited in a real system. Going by the constraint mentioned
earlier, we could perform and document the performance of the behaviour-reproduction test. This model passed the behaviour reproduction test because it generates the behaviour in accordance with the real system such as the s-shape of the behavioural pattern of diffused IT. This model comprises number of variable and was tested for their different values, the outcome followed the same pattern (Quaddus & Intraparirot, 1998). The other two tests i.e. Behaviour-anomaly test, and behaviour-sensitivity could not be documented though can be performed by using requisite data of any variable.

6.6.3 Policy Implication Tests - This test verifies the forecasting capabilities of the model. The prediction from the IT Diffusion model due to change in any policy change is compared with the responses of a real system. This test can be performed in two ways i.e. changed-behaviour-prediction test and policy-sensitivity test. While performing “Changed-behaviour prediction test” the results from IT Diffusion model were found to be correct from the changing policies. Increase in training was supposed to be a leveraged policy and found to be enhancing the rate of diffusion of technology thus economic gains. This test performs the policy sensitivity in any interested variables apart from those presented in this chapter in order to reveal the impacts of exerted policies and detect the risk from using those policies. The policy sensitivity is useful for the bank as a learning tool before implementing policies in the real system.

6.7 REQUISITE GROUP MODEL OF IT DIFFUSION, AND REQUISITE POLICIES FOR ADOPTION AND DIFFUSION: (RESEARCH QUESTIONS 3 AND 4)

The design of the requisite group model of IT diffusion, started with problem definition, followed by defining all the related issues of technology diffusion. The various factors associated with the entire system including bank were summarized. Subsequently, factors influencing the rate of technology diffusion were identified. On the basis of these factors and by defining the system boundaries a holistic view was designed (Figure 6.3). The various variables were identified and their influence of technology diffusion was converted in the shape of various feedback loops. Only key

315
variables identified by bank respondents were used to design a qualitative system dynamic model (Figure 6.4).

However to understand the impact of various feedback loops one each other the qualitative system dynamics model was converted into a quantitative system dynamics approach using data from the bank. The results from the IT diffusion model revealed that the IT diffusion follows the s-curve (Figure 6.16). From this model we could define the important factors which dominate the diffusion of technology. Increased training increases rate of diffusion of technology and economic gains. However, backlog of problems have negative impact on rate of technology diffusion.

Further, bank has to manage desired technology investment against its prospective returns because excessive investment does not assure highly lucrative outcomes. At the same time it was observed that, going by competitive market certain investment is essential to survive and for returns on the investment.

This model provided the answer for the third research question, "what is a requisite group model of IT diffusion?" The model was justified as a requisite group model because it provides enough information for a group of decision-makers in the bank to understand the problems and make appropriate decisions to diffuse IT productively.

It was observed that "training support", "backlog of problem", "market potential", and a "level of investment" are the strategic policies. Bank has to implement these strategic policies appropriately because bank need to increase the training support but reduce the backlog of problems to increase the rate of diffusion factors can be employed to enhance the level of technology diffusion.

The model of IT diffusion helps in understanding the entire process of technology diffusion and also about crucial factors having strong influence on the technology diffusion. However, properties and purpose of deployment of technology varies from one technology to other. The strategic policies explored by this model may change for different technologies. To understand this fact, the model of IT diffusion for two different technologies i.e. Anywhere/Core Banking (Core Data Centre) and Internet banking were considered in coming chapters. While Anywhere/Core banking technology is costliest and massive technology and is bank
oriented, the other technology i.e. Internet Banking is totally customer oriented. The diffusion models of the two technologies will provide more understanding and clearer answers for the third and fourth research questions. As such two sub-models of anywhere/core banking (Core Data Centre) and Internet Banking, which are presented in Chapters 7 and 8.

6.8 SUMMARY

The model analyses of diffusion of information technologies (IT) using system dynamics methodology and data from State Bank of India was explained in this chapter. The IT model explained the following crucial factors: i) training need for an organization, ii) backlog of problems iii) market potential iv) level of investment in technology and need for investment. The influence of these factors was studies and explained in detail in this chapter.

Adequate feedback from interview data, supplemented by researcher’s insight experience in banking technologies and literature review, helped in identifying various variables for this study. These variables were used in designing a qualitative system dynamics model for diffusion of technology. In the subsequent chapters this general model will be elaborated into two specific technologies: Anywhere/Core Banking (Core Data Centre) and Internet banking using selective variables.
REFERENCES-CHAPTER 6

- Ahuja, G., C. M. Lampert. 2001. Entrepreneurship in the large corporation: A.
- Bezdek, R. H., & Jones, J. D. (1990). Economic growth, technological change,
  and employment requirements for scientists and engineers. Technological
  Forecasting and Social Change, 38, 375-391.
- Dos Santos, B. L., & Peffers, K. (1995). Rewards to investors in innovative
  information technology applications: First movers and early followers in
  ATMs. Organisation Science, 6(3), 241-259.
- Forrester, J. W., & Senge, P. M. (1980). Tests for building confidence in
  system dynamics models. TIMS Studies in the Management Sciences. 14, 209-
  228.
- Global Banking Intelligence Corp. (1996). Technology investment in banking
  35(2), 90-100
  when adopting new technologies. Technological Forecasting and Social
  Change, 52, 59-74
  successful introductions of innovations. Marketing Intelligence and Planning,
  10(1), 4-15.
  information system implementation. In R. J. Boland & R. A. Hirschheim

318


• Quaddus, M. A. (1996). *GSS supported system dynamics: A model for IT planning*. Perth, Western Australia: Curtin University of Technology.


