Knowledge-Based Decision Support System for Prevention of NPAs in Commercial Banks

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I, Shri Bimal Deb Nath, hereby declare that the subject matter on the thesis is the original work carried out by me, that the contents of this thesis did not form basis of the award of any previous degree to me or to the best of my knowledge to anybody else, and that the thesis has not been submitted by me for any research degree in any other University/Institute.

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List of Abbreviation

Abbreviation	Full Descriptions
ANN	Artificial Neural Network
ARC	Asset Reconstruction company
ARCIL	Assets Reconstruction Company (India) Limited
ATM	Automated Teller Machines
BIS	Bank for International Settlements
BLAS	Basic Linear Algebra Subprograms
CBS	Core Banking Solution
CMD	Chief Managing Director
CPU	Central Processing unit
CREDEX	CREDIT expert
D/E	Debt to Equity
DBMS	Database Management Systems
DCSSI	Development Commission, Small Scale Industries
DRT	Debt Recovery Tribunals
DSS	Decision Support System
ES	Expert System
FI	financial institutions
FICCI	Federation of Indian Chambers of Commerce and Industry
FINEVA	Financial Evaluation
GDP	Growth Domestic Product
GNPA	Gross non-performing assets
I/O	input/output
IDBI	Industrial Development Bank of India Limited
ISPMS	Intelligent Stock Portfolio Management System
KBDSS	Knowledge Based Decision Support System
LAPACK	Linear Algebra Package
LASS	Lending Analysis Support System
MATLAB	Matrix Laboratory
MBMS	model base management system
NCR	Narasimham Committee Report
NN	Neural Network
NPA	Non Performing Asset
NPL	Non performing Loan
PA	Performing Asset
PE	Processing Elements
PMIDSS	Portfolio Management Intelligent Decision Support System
PNN	Probabilistic Neural Network
PROLOG	programming in logic
SCB	Scheduled Commercial Banks
SIM	Simulation
SSI	Small Scale industries
VB	Visual Basic

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Chapter 1

Introduction

1.1. Indian Banking:

Banks play a very useful and dynamic role in the economic life of every modern state. They are an important constituent of the financial market. They have control over a considerable part of the stock of money; in fact, their lending and investing activities cause changes in the quantity of money in circulation which in turn influences the nature and character of production in any country. Industrial innovations and business expansions become possible through finance provided by banks. They mobilize the ideal and dormant capital of the country and make it available for productive purposes. Thus realization, mobilization, canalization and utilization of savings for productive purposes or capital formation are made possible mostly by the commercial banks in under developed countries. This shows that banks have a deep economic significance. If fact, a country's economic progress is judged and determined by the progress of its banking system, for commercial banks are both the repositories of the community's savings and the purveyors of credit for economic activity. To quote Bhaba (1956), "banking is the kingpin of the chariot of economic progress. As such its role in expanding economy of a country like India can neither be underestimated nor overlooked".

In India ,till end of the 'eighties', the banks were operating in a highly regulated and protective environment characterized by administered interest rates, high level of pre-emption requirements and directed credit. In order to develop the Indian banking system to international standards, the first phase of banking sector reforms was initiated in 1992, based on the recommendation of Committee on Financial System (popularly known as Narasimham Committee-I). The banking sector reforms were basically aimed at ensuring the safety and soundness of financial institutions and at the same time making the banking system strong, efficient, functionally diverse and competitive. The process of banking reforms heralded the beginning of implementation prudential norms consisting of capital adequacy ratio, asset classification and income recognition and provisioning and deregulation of the

operating environment. In the second phase of banking reforms which started with recommendations of the committee on Banking Sector Reforms 1998 (popularly known as Narasimham Committee-II), the prudential norms for capital adequacy and income recognition, asset classification and provisioning were further tightened to bring these on par with international standards (Kumar et al., 2002). Financial sector reforms recognized the fact the Indian banking system had over the years grown and the geographical and functional coverage of the banking system had been truly impressive (Rangarajan, 2004).

In the initial years of financial sector reforms, performance of Indian banks, mainly of public sector banks (PSBs), looked gloomy, as they had shown discouraging results. In spite of experiencing series of challenges and pressures, surprisingly, the public sector banks are adapting to the challenges with agility. Viewed against the backdrop of inert and lethargic Indian psyche and deteriorating work ethics, it is a pleasant surprise that the banks displayed fast reflexes to fit smoothly into the reform process (Reddy et. al., 2002).

PSBs are facing numerous challenges like increasing competition from private and foreign banks, low productivity, high operational costs, pressure on spreads and non-performing assets (NPA) management due to tightening of prudential norms. Corporate clients are demanding loan at sub-PLR due to the availability of alternate avenues to raise funds in the domestic as well as international markets at much cheaper rates. This has forced the banks to look for new avenues for growth and survival by repositioning themselves in new business segments of economy where opportunities are more and risks are comparatively low (Mehrotra,2005). The first shock of reform, in terms of new norms for income recognition, asset classification and provisioning, was served in 1992-93 when 13 out of 20 nationalized banks posted a net loss (Shenoy, 2003).

The winds of freedom and change sweeping across the financial sector due to reforms have thrown open several challenges to the banks and financial institutions. The major challenges relating to introduction of prudential norms, technological up-gradation and transparency, improving operational efficiency in the deregulated interest rates, reduction of NPAs for survival in the competitive market and product innovation

(Reddy et. al.,2002). In the present and forthcoming scenario, efficiency and services have become the keys to the survival of the banking system in view of the enhanced competition from foreign banks (existing as well as new entrants) and new private sector Indian banks. It will, therefore, be advisable for a bank to operate with utmost efficiency for its very existence and sound growth. In order to achieve these objectives an existing bank needs restructuring of financial position and will be required to operate efficiently with focus on growth in business and keeping an eye on the new lines of activities where they can provide satisfactory service with good profitability (Ghosh,1995).

The viability of banks depends largely on the adequacy of profits and profitability. One of the major concerns in the Indian financial sector is the low profits churned out by the commercial banking industry. Profitability in the banking parlance denotes the efficiency with which a bank deploys its total resources to optimize its net profits and thus serve as an index to the degree of asset utilization and managerial effectiveness (Debasish, 2002). It is the most important and reliable indicator as it gives a broad indication of the capability of a bank to increase it earnings (Verghese, 1983). Profitability assumes greater importance in the changing scenario of autonomy and financial sector reforms.

One of the major causes of low profitability is the high presence of NPAs in Indian banking. Going by the number of committees, expressions of concern, papers, programmes, etc. perhaps the issue of NPA has become problem number one continuously for about a decade in the banking industry. Other problems being capital inadequacy, high intermediation costs, technology –transition, etc. (Chhimpa, 2002).

1.2. NPA and Indian Banking

1.2.1. Concepts

Over the last few years Indian banking, in its attempt to integrate itself with the global banking, has been facing lots of hurdles in its way due to its inherent weakness, despite its high sounding claims and lofty achievements. One of the major hurdles Indian banking faces today is its ever-growing size of NPAs over which the top management of almost each bank is baffled. On account of the intricacies involved in

handling the NPAs, the ticklish task of assets management of the bank has become a tight rope-walk affair for the controlling heads, because a little wavering 'this or that side' may land the concerned bank in trouble (Banmali,2001). Gujral (2003) described NPAs problem as one of the greatest and the most formidable problems that has shaken the entire banking industry in India like an earthquake. At the macro level, NPAs have chocked off the supply line of credit to the potential borrowers, thereby having a deleterious effect on capital formation and arresting the economic activity in the country. At the micro level, the unsustainable level has eroded the profitability of the banks through reduced interest income and provisioning requirements, besides restricting the re-cycling of funds leading to serious asset liability mismatches. It has, inter-alia, lead to reduction in their competitiveness and erosion in their capital base as well, to a great extent.

The problem of NPAs not a matter of concern for the lenders alone, but a matter of grave concern for the public as well; as bank credit is the catalyst to the economic growth of the country and any bottleneck in the smooth flow of credit is bound to create adverse repercussions in the economy. The mounting menace of NPAs has raised the cost of credit has made banks more averse to risk, has squeezed genuine small and medium enterprises from accessing competitive credit and has throttled their enterprising spirits as well (Gujral, 2003).The spiraling and the devastating effect of NPAs on the economy has made the problem of NPAs an issue of public debate and of national priority as well. Therefore, any measure of reform on this front would be inadequate and incomprehensive, if it fails to make a dent in NPAs reduction and stall their growth in future, as well (Gujral,2003).

The Narsimham Committee report of 1998 had pointed out that NPAs of the banks constituted a real economic cost to the nation as the scarce capital was locked up in unproductive use and consequently adversely affected the recycling of funds with the banks. With every rupee of standard assets becoming an NPA, the concerned bank is not only deprived of the interest income otherwise available on the standard assets, but is also required to make provision against the said NPA or right it off by making a charge on its profit. Thus, NPAs are depriving the concerned banks of interest income and indirectly eating away the income that is otherwise generated by the

standard assets (Banmali, 2001). NPAs are a drag on the profitability of the banks because the banks have not only to make provisions, but they have also to meet the cost of funding these unremunerative assets (Banmali, 2001). Our efforts to integrate Indian banking with international banking can only be fruitful if our banks reach the international bench marks in the matter of quality of assets for which a complete overhauling of NPAs is a pre-condition (Banmali, 2001).

Bose (2005) in a study of Non performing loans argued that today the toughest problem faced by the entire banking industry is the Non-Performing Assets(NPAs),i.e. the loans where principal and interest cannot be recovered, thus the assets stop earning any income. The unbearable level of NPAs has led to lower interest income and loan loss provisioning requirements which have destroyed the profitability of the banks to a great extent. Besides this, recycling of funds is restricted, thus leading to serious asset liability mismatches. The load of NPAs, amounting over Rs. 1.10 lakh crores on the Indian economy is devastating. The supply of credit to potential borrowers has been blocked which is having a harmful effect on the capital formation and hampering the economic activity of the country. So the NPA problem is an issue of public debate and of national priority(Bose,2005).

The quality of loan assets is the most important factor for the basic viability of the banking system. The overdue advances of banks in India are mounting, and, as a consequence, the non-performing assets in their portfolio are on the rise, impinging on the banks viability. This not only eats into the banks' profitability but also hampers their ability to recycle the productive purposes. The trend needs to be reversed, as the position is being watched by many including international investors, rating agencies (Taori ,2000).

Many Indian authors (Bhagavat, 1990; Narayanan, 2000; Shete, 1999) have identified the NPAs as the non-yielding assets, which does not directly contribute to the corporate profits or contribute to extra value or capital formation. In a general sense, NPA is not only non-performing but also makes the banker and the bank non-performing as it prevents or delays recycling of funds, denies income from the asset by way of interest and erodes profit by way of provisions. As far as back as 1977,the Securities and Exchange Commission of the United States defined non performing

loans as loans which are "contractually past due for 60 days or more as to interest or principal payments; and loans; the terms of which have been renegotiated to provide a reduction or deferral of interest or principal."

In the framework of a time period, "a Non-Performing Asset is a credit facility in respect of which the interest and/or installment of principal has overdue for a specified period of time (Rathi and Sandhane, 2002). While specifying the time frame the author has lucidly defined NPA as "a concept in American bank accounting -- loans are considered to be non -performing when no interest has been paid on them for at least 90 days. When they cross the 90 days threshold (and becoming non-performing) the loans have to be reported as such in bank's accounts. All the interest due (which the banks until then have reported as having come in) has to be pruned out of their income for the period (Hindle, 1985).

Chhimpa (2002) while analyzing incidence of incremental NPA argued that NPA or non-performing loan (NPL) is that part of loans and advances that has stopped earning for the bank and /or the safety of which is endangered. The definition of NPAs, drawing up of norms for loan asset classification and recognition and the provisioning requirements in the Indian Banking system have been developed over the years. In the seventies, NPA accounts were termed as 'hard-core', 'out of order', 'sticky', 'overdue', etc. In November 1985, the RBI introduced an eight-tier Health Code System for all Indian Commercial banks. The banks started classifying their borrowal accounts in to eight categories based on their financial health. In 1988, the Bank for International Settlements (BIS) at Basle formulated its sets of prudential banking norms. The RBI, however, continued with its Health Code System until the publication of the Narasimham Committee Report in December 1991.The new concept of NPA emphasises on the record of recovery of interest and installments irrespective of the availability of security and net worth of the borrowers/guarantors. The essence of this system is the recognition of the record of recovery as the basis for classification of the advances portfolio of the banks (Shete et. al,2000).

1.2.2. NPA classification

Earlier when banking in our country and its system of credit delivery were being viewed almost exclusively as an instrument of social change, the Tandon committee (1973) recommended a concrete quality-wise grading of advance portfolio. Income recognition as a criterion was not thought of. The committee recommended the slotting of borrowal account into four bands: a)Excellent b)Good c)Average d)Unsatisfactory and e)Doubtful. This was followed by the Chore Committee (1980) which also recognized the need for keeping a close watch on the quality of the loan portfolio, and the concern is reflected in its emphasis on regular annual review of all borrowal accounts with a credit limit of over Rs. 10 lacs. It was the recommendation of the Pendhankar Committee (1981) implemented in 1984 that recognized the need for classifying advances into different categories to index the overall quality of the assets portfolio. This was the starting point of the introduction of the health coding system of categorizing banks loan portfolio by the RBI in 1985. This eight band concept of health coding of advances account from health code 1 to 8 was followed in 1989 by a circular to banks, specifying the need to refine the practice of charging the interest on loans and advances by banks on new prudential criteria in line with international practices by ceasing to charge interest on non performing advances.

In sum, a system of transparency and prudential norms was prevalent even prior to 1992-93, specifying non recognition of interest income in accounts which had crossed the sickness stage to the recalled category up to the bad and doubtful categories. Classification of what an NPA has changed with tightening of prudential norms. The RBI directed that banks and financial institution should adhere to the prudential norms on assets classification and provisions correctly and avoid the practice of "ever greening." As per the latest RBI classification an asset becomes non-performing when it ceases to generate income for the bank. Earlier an asset was considered as NPA based on the concept of 'Past Due'. A 'non performing asset' (NPA) was defined as credit in respect of which interest and/or installment of principal has remained 'past due' for a specific period of time.

The specific period was reduced in a phased manner as follows:

Year ending 31st March	Specific period
1993	4 quarters
1994	3 quarters
1995	2 quarters
2004	1 quarter

An amount is considered as past due, when it remains outstanding for 30 days beyond the due date. However, with effect from March 31st , 2001 the 'past due' concept has been dispensed with. Accordingly, as from that date, an NPA is an advance, when a borrower can not pay interest and or installments on a loan, which remains overdue for more than 180 days. The basic factor to determine whether an account is an NPA or not is the record of recovery and not the availability of security .The period of non-performance of 180 days has been reduced to 90 days with effect from March 31st, 2004.

Ever since the introduction of financial reforms in India, the Non Performing Assets of the banking system attracted considerable attention. Banks are asked to classify their advances (assets) into four broad categories i.e. standard, substandard, doubtful and loss instead of erstwhile health code system. Substandard, doubtful and loss assets are individually and collectively known as Non-performing Assets(Sood, 2001; Shete et.al.,2000). As per the RBI classification ,these assets are defined as follows:

Standard Assets

Standard Asset is one which does not disclose any problems and which does not carry more than normal risk attached to the business. Such an asset should not be an NPA.

Sub-standard Assets

With effect from the 31st of March,2001, the sub-standard asset is one which has remained as NPA for a period not exceeding 18 months. However, with effect from the 31st of March 2005 this period of 18 months has been reduced to 12 months.

Doubtful Assets

With effect from the 31st of March 2005, an asset would be classified as doubtful if it remained in the sub-standard category for 12 months. Banks are permitted to phase the consequent additional provisioning over a four-year period commencing from the year ending 31st March 2005, with a minimum of 20 per cent each year.

Loss Assets

A loss asset is one where the loss has been identified by the bank or by internal or external auditors or by the Co-operation Department or by the Reserve Bank of India's inspection but where the amount has not been written off, wholly or partially. In other words, such an asset is considered un-collectable and of such little value that its continuance as a bankable asset is not warranted although there may be some salvage or recovery value.

1.2.3. Magnitude of NPA

Globally, the level of non-performing loans (NPLs) is estimated at about US $1.3 trillion during 2003, out of which the Asian region accounts for about US $ 1 trillion, or about 77 per cent of global NPLs (Table 1.1). Within Asia, Japan and China have NPLs at about US $ 330 billion and US $ 307 billion respectively, thus, together accounting for 49 per cent of global NPLs. Other hot spots of NPLs in the Asian region are Taiwan (US $ 19 billion), Thailand (US$ 18.8 billion), Indonesia (US $ 16.9 billion) and Philippines (US $ 9 billion).

India's NPLs of the financial sector as a whole is reported at about US$ 30 billion, which works out to a little over 2 per cent of the global NPLs. On the basis of information provided in the Report on the Trend and Progress of Banking in India, 2002-03, the level of gross NPAs of public sector banks is estimated at Rs. 68,714 crore, which is equivalent to about US $ 15 billion, *i.e.,* about 1 per cent of global NPAs.

Table 1.1: Global Non performing loans 2003 *

Country	NPLSs($ billion)	Share in Global (%)
Japan	330	25.4
China	307	23.6
Taiwan	19.1	1.5
Thailand	18.8	1.5
Philippines	9.0	0.7
Indonesia	16.9	1.3
India	30	2.3
Korea	15.0	1.2
Total	746	57.4
Asia	1000	76.9
Germany	283	21.8
Turkey	8.0	0.6
Global	1300	100

*NPL for all the financial institution

Source : Global NPL Report 2004, Ernest and Young ,Pp 90.

In terms of the ratio of NPLs to total assets of banking sector, there is evidence that the performance of the Asian region is far lower than that of Europe and the US (Table 1.2). The trend in the NPL ratios of select countries, particularly the emerging countries of East Asia, during the last five-six years provides an interesting insight into the impact of structural reform on the accumulation of non-performing loans by banks. In emerging countries like Thailand and Indonesia, structural reform after the Asian crisis had an immediate impact in removing the accumulated excesses from the financial sector and consequently induced a sharp reduction in NPAs ratio. In Thailand, the NPLs ratio declined by about 25 percentage points from about 43 per cent in 1998 to about 18 per cent in 2003. In a similar manner, the NPAs ratio in Indonesia declined by about 30 percentage points from about 49 per cent in 1998 to 19 per cent in 2003.(Ranjan et. al.,2003).

Table 1.2: Ratio of Non-Performing Loans to Total Loans (in percentage)

Country	1998	1999	2000	2001	2002	2003
Brazil	10.2	8.7	8.4	5.7	5.3	5.7
Chile	1.5	1.7	1.7	1.6	1.8	1.8
Mexico	11.3	8.9	5.8	5.1	4.6	3.7
UK	3.2	3.0	2.5	2.6	2.6	2.2
United States	1.0	0.9	1.1	1.4	1.6	1.3
Japan	5.4	5.8	6.1	6.6	8.9	7.2
France	6.3	5.7	5	5	5	4.9
Germany	4.5	4.6	5.1	4.9	5	-
Greece	13.6	15.5	12.3	9.2	8.1	8.4
Italy	9.1	8.5	7.7	6.7	6.5	
Russia	17.3	13.4	7.7	6.3	6.5	6.1
Turkey	6.7	9.7	9.2	29.3	17.6	14.2
Argentina	5.3	7.1	8.7	13.2	17.5	22.7
China		28.5	22.4	29.8	25.5	22.0
India	14.4	14.7	12.7	11.4	10.4	8.8
Indonesia	48.6	32.9	18.8	11.9	5.8	
Korea	7.4	8.3	6.6	2.9	1.9	2.3
Malaysia	18.6	16.6	15.4	17.8	15.9	14.8
Philippines	11.0	12.7	14.9	16.9	15.4	15.2
Thailand	42.9	38.6	17.7	10.5	15.8	15.5
Srilanka	16.6	16.6	15	16.9	15.7	13.9
Bangladesh	40.7	41.1	34.9	31.5	28	
Pakistan	23.1	25.9	23.5	23.3	23.7	20.7

Source: Global Stability Report, April 2004, IMF, p 91

In absolute terms, the volume of gross NPAs of public sector banks in India has increased continuously, except for the year 1995 (Table 1.3). During the entire period, Gross non-performing assets (GNPA) have increased at a trend rate of 4 per cent. The annual growth rate of gross NPAs of public sector banks has been showing a decelerating trend since 2000. In terms of various NPA ratios, such as GNPAs to gross advances, GNPAs to total assets, net NPAs to total assets and net NPAs to net advances, public sector banks have achieved a remarkable improvement (Table 1.4).

The question of NPA in banks is a cause of worry to all concerned, may it be the management of banks, the government, industry federations or the public at large. Looking at the hopping amount of NPA in banking industry, which constitutes 3.3 percent of total gross advances, as at the end of March,2006 (the gross non-performing assets of all scheduled commercial banks stood at Rs. 51,815 crores as on March 31, 2006); the cause of worry for this is obvious. Although the percentage of gross NPAs to gross advance for PSBs has come down to 3.7 percent in 2005-06 from the previous year figure of 5.5 percent (RBI, 2005-06), the amount is still posing the basic viability question on the efficacy of these banks. The gross NPA level of over 1% for all commercial banks is considered poor and with the growing competition and thin spreads, it is impossible for banks to make money if gross NPAs are more.

Table 1.3: Gross NPAs of Public Sector Banks in India

Year	Rs.Billion	Year	Rs.Billion	Year	Rs.Billion
1993	392.5	1998	456.5	2003	540.9
1994	410.5	1999	517.1	2004	515.3
1995	383.8	2000	530.3	2005	483.9
1996	416.6	2001	546.7	2006	413.5
1997	435.8	2002	564.7	2007	389.6

Source : Report on Trend and Progress of Banking in India, RBI, Various issues,Pp92-94.

Table 1.4: Non-Performing Assets of All Scheduled Commercial Banks

Items	Gross NPAs (Rs Crore)			Percentage to gross advance			Percentage to total assets		
Bank Group	2003-04	2004-05	2005-06	2003-04	2004-05	2005-06	2003-04	2004-05	2005-06
Public Sector	51538	48399	42106	7.8	5.5	3.7	3.5	2.7	2.1
Private Sector	10355	8782	7782	5.8	4.4	2.4	2.8	2.1	1.4
Foreign	2894	2192	19276	4.6	2.8	1.9	2.1	1.4	1.0
SCBs(1+2+3)	64787	59373	51815	7.2	5.2	3.3	3.3	2.5	1.9
Bank Group	**Net NPAs (Rs Crore)**			**Percentage to net advance**			**Percentage to total assets**		
Public Sector	19335	16904	14561	3.1	2.0	1.3	1.3	1.0	0.7
Private Sector	4128	4212	3161	2.4	2.2	1.0	1.1	1.0	0.6
Foreign	933	639	808	1.5	0.8	0.8	0.7	0.4	0.4
SCBs(1+2+3)	24396	21755	18530	2.8	1.9	1.2	1.2	0.9	0.7

Source : Monetary and Banking Developments, 2006 and www.indiabudget.nic.in.

Improved industrial climate and new options available to banks for dealing with bad loans helped in recovering a substantial amount of NPAs in 2005-06 (Table 1.4). Such recoveries during 2005-06 were more than fresh accruals. Gross NPAs of SCBs, which had declined by Rs.5, 414 crore in 2004-05, fell by a further amount of Rs. 7,558 crore in 2005-06. The aggregate amount recovered and written-off increased to Rs. 28,717 crore during 2005-06 from Rs. 25,007 crore in the previous year. NPAs of SCBs, at 1.9 per cent of total assets at end-March 2006, were substantially lower than the 2.5 per cent observed a year ago. The operations of the Assets Reconstruction Company (India) Limited (ARCIL) during 2005-06 helped in NPA recovery. ARCIL acquired 559 cases of NPAs, with total dues of Rs.21,126 crore, from 31 banks/financial institutions (FIs).

1.2.4. Solution to NPA problem

Managing NPAs is perhaps the greatest task ahead of Indian bankers as well as planners. Over the years many strategies have been chalked out to control its menace, but resulted in limited success. Although a total elimination of NPAs is not possible in the banking business owing to externalities but their incidence can be minimized. It is always wise to follow the proper policy for appraisal, supervision and follow-up of advances to avoid non-performing assets (Reddy et al., 2002; Naik, 2001).

There are two sets of conditions contributing to NPAs viz., external and internal factors. Unless required changes in the external and internal factors contributing to NPAs are brought about, it will not be possible to contain and bring under control the potentially grave problem of high magnitude which can cause turmoil in the country's economy (Naik, 2001).

The external surveillance system and other informal forces influencing or directing the decision making of PSBs contribute to two factors affecting quality of advances viz., a) influence to grant credit in respect of cases in which it would not have been granted and b) erosion in decision making capacity to grant finance when badly needed to bring the borrower out of difficulty or to nurse the deserving account which has the potential to revive. The erosion in decision making capacity results from the fear of a lack of appreciation of the credit decision by external surveillance mechanisms not conversant with credit appraisal or business consideration. Even the internal mechanism often falls in time with the external directives rather than taking an independent view (Naik, 2001).

External factors normally do not remain within the control of commercial banks primarily owing to the archaic Indian legal system, which is not well equipped to cope with loan recovery. Most of the time borrowers end up with siphoning of securities. The banks have to play a prudent and critical role in containing NPAs for their survival in the years to come. They can adopt the internal strategies such as Pre-sanction, Post Sanction and General Strategies to contain their level of NPAs (Sood, 2001).

Sergio (1996) in a study of non-performing loans in Italy found evidence that, an increase in the risk of loan assets is rooted in a bank's lending policy adducing to relatively unselective and inadequate assessment of sectoral prospects. Interestingly, this study refuted that business cycle, can be a primary reason for banks' NPLs. The study emphasized that an increase in bad debts as a consequence of recession alone is not empirically demonstrated. It was viewed that the bank-firm relationship will thus; prove effective not so much because it overcomes informational asymmetry but because it recoups certain canons of appraisal.

In a study of loan losses of US banks, McGoven (1993) argued that 'character' has historically been a paramount factor of credit and a major determinant in the decision to lend money. Banks have suffered loan losses through relaxed lending standards, un-guaranteed credits, the influence of the 1980s culture, and the borrowers' perceptions. It was suggested that bankers should make a fairly accurate personality-morale profile assessment of prospective and current borrowers and guarantors. Besides considering personal interaction, the banker should (i) try to draw some conclusions about staff morale and loyalty, (ii) study the person's personal credit report, (iii) do trade-credit reference checking, (iv) check references from present and former bankers, and (v) determine how the borrower handles stress. In addition, banks can minimize risks by securing the borrower's guarantee, using Government guaranteed loan programs, and requiring conservative loan-to-value ratios.

Bloem and Gorter (2001) suggested that a more or less predictable level of non-performing loans, though it may vary slightly from year to year, is caused by an inevitable number of 'wrong economic decisions' by individuals and plain bad luck (inclement weather, unexpected price changes for certain products, *etc.*). Under such circumstances, the holders of loans can make an allowance for a normal share of non-performance in the form of bad loan provisions, or they may spread the risk by taking out insurance. Enterprises may well be able to pass a large portion of these costs to customers in the form of higher prices. For instance, the interest margin applied by Non-Performing loans and terms of credit, financial institutions will include a premium for the risk of nonperformance on granted loans.

Fuentes and Maquieira (1998) undertook an in depth analysis of loan losses due to the composition of lending by type of contract, volume of lending, cost of credit and default rates in the Chilean credit market. Their empirical analysis examined different variables which may affect loan repayment: (a)limitations on the access to credit; (b)macroeconomic stability; (c)collection technology; (d)bankruptcy code; (e)information sharing; (f)the judicial system; (g)prescreening techniques; and (h)major changes in financial market regulation. They concluded that a satisfactory performance of the Chilean credit market, in terms of loan repayments hinges on a good information sharing system, an advanced collection technology, macroeconomic performance and major changes in the financial market regulation.

In another study of Chile, Fuentes and Maquieira (2003) analyzed the effect of legal reforms and institutional changes on credit market development and the low level of unpaid debt in the Chilean banking sector. Using reserve bank of India occasional papers time series data on yearly basis (1960-1997), they concluded that both information sharing and deep financial market liberalization were positively related to the credit market development. They also reported less dependence of unpaid loans with respect to the business cycle compared to interest rate of the Chilean economy.

Altman, Resti and Sironi (2001) analyzed corporate bond recovery rate adducing to bond default rate, macroeconomic variables such as GDP and growth rate, amount of bonds outstanding, amount of default, return on default bonds, and stock return. It was suggested that default rate, amount of bonds, default bonds, and economic recession had a negative effect, while the GDP growth rate, and stock return had positive effect on the corporate recovery rate.

Kent and D'Arcy (2000) while examining the relationship between cyclical lending behaviour of banks in Australia argued that, the potential for banks to experience substantial losses on their loan portfolios increases towards the peak of the expansionary phase of the cycle. However, towards the top of the cycle, banks appear to be relatively healthy - that is, non-performing loans are low and profits are high, reflecting the fact that even the riskiest of borrowers tend to benefit from buoyant economic conditions. While the risk inherent in banks' lending portfolios peaks at the top of the cycle, this risk Non-Performing loans and terms of credit tends to be

realized during the contractionary phase of the business cycle. At this time, banks' non-performing loans increase, profits decline and substantial losses to capital may become apparent. Eventually, the economy reaches a trough and turns towards a new expansionary phase, as a result the risk of future losses reaches a low point, even though banks may still appear relatively unhealthy at this stage in the cycle.

The recovery of money has never been an easy experience for banks, as India's Legal system had so far been more geared to protect borrowers and not lenders. The borrowers in India have been using thousands of delaying tactics to keep lenders at bay. Whereas private money lenders could use strong arm tactics to recover their dues from the defaulters, banks have practically no rights except to slug it out through the legal means, which is expensive and almost never ending. As a result there has been nothing that a bank could do, after the money was disbursed to the borrowers, even if they wanted to get through or tough with the defaulters (Gujral, 2003).

Now, it is time for some tough decisions for the Indian banking industry in more challenging new millennium and needs to re-look within themselves their internal debt recovery mechanism to safeguard the public money with more spirit, drive and sincerity in their action, decisions and strategies reducing their inordinarily high level of NPAs, rather than keeping the total dependence on legal processes at the Debt Recovery Tribunal (Parma, 2000). Credit monitoring needs to be strengthened. Stock inspection, study of ledger book transactions, scrutiny of periodical statements, and discussion with borrower and co-bankers are post-lending activities. Besides these routine functions, new strategies are implemented to prevent NPAs immediately (Kaveri, 2001).

The Narasimham Committee Report (NCR-I) has recommended that in order to wipe out NPAs from the bank book, the government should set up Asset Reconstruction company (ARCs) an institution that will buy out all the NPAS and clean the system in the process. The NCR-II had reiterated its suggestion for ARC and has made a strong case against further recapitalization of banks. While it is true that recapitalization is costly and in the long run unsustainable, there is a need to explore alternatives like ARCs. The Verma Committee Report on weak banks (Sept, 1999)

had also suggested the formation of Asset Reconstruction Fund to recover locked value in NPAs (Singh,2002).

There have been several schemes in the past to facilitate the recovery from NPAs, the success of such efforts in terms of NPA reduction has been far from satisfactory. In 1993, Recovery of Debts due to banks and financial institutions Act was enacted with a view to recover a huge amount of NPAs at a faster pace than through the Civil courts. The DRTs were set up under this act and the banking institutions filed cases against the borrowers in these tribunals. But this act could not live up to its high expectations. So, the banking sector wanted to recover their NPAs on their own without taking the lengthy judicial route. This led to the enactment of SERFAESI Act. Some have described this Act as a fine, comprehensive and extraordinary piece of legislation. No doubt, this is a landmark enactment .But still there is a long way to go to root out the problem of NPA completely from the Indian economic scenario. The only way to put a stop to NPA problem is to attack the problems which are in-built in the system like lack of infrastructure, liberal terms of financing, holding the managers personally responsible for any laziness and negligence on their part(Bose,2005).

In order to get rid of such NPA accounts banks have been adopting different methods. Compromise settlement scheme is one of them. But till the recent past there was no uniformity among banks Compromise schemes. RBI has formulated a lucid scheme for onetime settlement of small NPA accounts after due deliberation with all Public Sector Banks' CMDs(Rao,2002). Banks devised various schemes for loans in different areas. However, the expertise required and the mismatch of assets and liabilities, restrained banks from steaming ahead. Hence, there is a need to workout a 'Loan Policy' with risk limits as to rate, duration's security and follow up and refinance if needed by securitization of the assets. Special branches rather than all the branches dealing with all products, catering to needs of specialized customers was felt necessary and thus helped in generating special data about the customers and also helped centralized control on delinquency. The strategy should be decided by each bank based on its strength, area of operation, type of customers, quality of staff (Kanan ,2001).

It is not possible to eliminate totally the non-performing assets in the banking business but can only be minimized. It is always wise to follow the proper policy appraisal, supervision and follow-up of advances to avoid NPAs. For a reduction of NPAs, though there is a greater need of political threat and effective enactment of laws to recover NPAs, the banks should also take advantage of Debt Recovery Tribunals, the Lok Adalat, legislations enacted by the State Governments and one-time settlement schemes. Banks should not only take steps for reducing present NPAs, but necessary precautions should also be taken to avoid future NPAs (Samal, 2002-2003).

In view of the steep rise in fresh NPA advances, credit monitoring needs to be strengthened. Stock inspection, study of ledger book transactions, scrutiny of periodical statements, and discussion with the borrower and co-bankers are post-lending activities. Besides these routine functions, new strategies as suggested above need to be examined to prevent NPAs immediately (Kaveri, 2001).

To control the NPA menace, preventive measures are necessary. One of the preventive measures is credit appraisal and credit audit. Credit appraisal usually suffers from failures to : a) assess promoters ability to adapt to change, understand the industry and market and raise adequate margins , b) forecast sale ,and c) monitor end use of funds, cash flow etc. Documentation of credit policy, credit audit immediately after sanction and human resources development through training interventions are some of the measures necessary to upgrade the quality of credit appraisal in banks (Taori, 2000).

In view of the growing importance of credit monitoring, banks have set up credit appraisal and monitoring departments/Cells at the corporate offices. Since the same is in operation for a considerable period of time. Its review in terms of prevention of NPAs is called for. Despite a specialized department/cell, the number of potential NPAs is on the rise. So, it is essential to strengthen the same by providing additional staff besides developing expertise in credit monitoring (Kaveri, 2001).

1.3. Banking and Technology

Banking all over the world during the last decade witnessed changes, which perhaps it did not see during its long history. One of the major noticeable factors for this change is Information Technology. Banking no more remains business related to "money" transactions but now it is perceived as business related to information on financial transactions. These changes are not only confined to developed countries, banking in developing countries like ours has also started using Information Technology. Indian banking has been involved in providing banking facilities in neglected areas, sectors and regions of the country on one hand and also providing credit to business and industry groups in relatively well developed sectors and areas of the country on the other. In addition to this dual role, Indian banks now have innovated newer services such as merchant banking, housing finance, customer counseling, commercial paper, leasing project financing etc (Padwal,1996). Bank managements have been provided with tools, which are supported by fruits of the Information Technology Revolution. They have been compelled to face the business challenges, which are global in nature. On one side, it is the increasing number of international banks, setting up their shops with the tested and latest technology, and on the other, the newer Indian Private Sector banks, entering the arena with sophisticated tools and manpower.

The banking sector in India is adapting itself to rapid innovations in technology particularly on the information based technology front to impart efficiency in providing a wide range of products and services to the public at large. Computerization of banking operations had received high importance in 2005-06. Since September 1999 to March 2006, PSBs incurred an expenditure of Rs.10,676 crore on computerization and development of communication networks. Out of 27 PSBs, branches of as many as 10 PSBs were 100 per cent computerized, while more than 50 per cent branches of 12 banks were computerized by end-March 2006.

The number of branches providing 'core banking solutions' (CBS) in recent years is increasing rapidly. Under CBS, a number of services are being provided such as 'anywhere banking', 'everywhere access', and a quick transfer of funds in an efficient manner and at reasonable cost. New private sector banks, foreign banks and a few old private sector banks have already put CBS in place ,PSBs are increasingly adopting a

similar system. The total number of branches of PSBs offering CBS increased from 11.0 per cent as on March 31, 2005 to 28.9 per cent as on March 31, 2006. Total number of Automated Teller Machines (ATMs) installed by the banks were 21,147 at end-March 2006. Nationalized banks with 7,165 ATMs were the largest providers of the ATM service followed by new private banks (6,112), SBI group (5,443), old private banks (1,547) and foreign banks (880).

Globally, Information Technology (IT) drives banking. The liberalization and financial sector reforms have ushered in an era of aggressive competition among banks in India during the last few years. Multinational banks and the newly set up Indian banks entered the market bringing with them the latest technologies and adopting efficient systems and procedures. Banks have now realized that good customers can be attracted and retained only by extending superior service and innovative products addressing their varied needs. These are made possible by the exploitation of Information Technology and through varied electronic delivery systems. Integrated information systems properly designed with the use of IT will enable the banks to reduce credit risks and control non-performing assets (NPAs). Banks are facing the tough task of deployment of its high cost funds without compromising on the quality of assets, at the same time with a reasonable margin (Nandan,1996). Today, technology can be usefully employed to build financial decision support systems that exhibit artificial intelligence.

The key to handle this huge volume of NPA lies with the efficient decision making at the branch as well as at the corporate level. In this context the implementation of adequate Information System is highly essential and desirable as the banking industry in India is on the accelerated path to computerization (Godse,2002).While Expert Systems have been successfully applied to some financial decision tasks, many others are beyond the scope of Expert System technology. The disadvantages of Expert System include the difficulty of programming and maintaining the system, the enormous time and effort required to extract the Knowledge Base from human experts and translate it into the IF-THEN rules upon which the system is based, and the inability of an Expert System to use inductive learning and inference to adopt the rule base to changing situations. These problems may be particularly troublesome in financial analysis and management environments (Hawley et. al., 1990). As an

improvement over these two systems, another intelligent system namely knowledge based decision support system (KBDSS) has been increasilgly finding its place among the decision makers. Knowledge based decision support system provides information and methodological knowledge using analytical decision models, and providing access to data and knowledge bases to support decision makers in making decision effectively in complex and ill structured domains. Thus, designing an intelligent DSS for the management of assets of banks can act as a major catalyst in efforts to handle the repercussions of NPA on banking operating parameters.

1.4. Research problem

Looking to the changing scenario at the world level, the NPA problem becomes more ironic because Indian banking, at this juncture, cannot afford to remain unresponsive to global requirements (Banmali,2001). The problem of NPA is multi -dimensional and unless it is checked and the NPA level is brought down to the international standard of the total loan assets, it is bound to weaken the banking system. No wonder NPA has become an important term in the banking industry because of its far reaching implications on the bottom lines of the banks which are already undergoing rigorous reform processes (Bhattacharya, 2001). NPAs are not a one-time phenomenon, it is a continuous process. Until the root cause of NPAs is eliminated, they will continue to generate with a vengeance (Gujral, 2003). In managing NPAs, one of the most important aspects is the need to curb incidence of NPAs amongst new loans sanctioned/granted by branches. There is utmost need to reduce NPAs at the earliest level (Arora,2000).

Scrutinizing from the initial point of credit granting decision will definitely help in preventing the occurrence of NPAs. The terms of credit are defined over five critical financial parameters: amount of credit, interest rate, maturity of loans, frequency of loan servicing and collateral. Optimizing decision pertaining to the terms of credit can differ from the borrower to that of the creditor (banks). As such, the mutual agreement between the borrower and the creditor may not necessarily imply an optimal configuration for both, which results in default. The most important reason for default could be mismatched between the borrower's terms of credit and the creditor's terms of credit (Ranjan et. al,2003). So, at the very outset the credit appraisal system should

be more effective to prevent future NPAs .The successful banker-client relationship in the credit function of banks involves three important and interlinked phases viz., a)the right type and right amount of credit is given to the right type of client, b) the borrower making proper use of the amount received from bank, and c) the borrower repaying the outstanding loan along with the interest in time (Patel et. al,1997).

All these aspects are envisaged in the proper management of any project. However in reality, things do not happen as they are expected to. That is why many a time there are various snags in the smooth banker-client relationships. One of them may be – "The right amount may not have been given to the right borrower for the right activity and at the right time". As a result, the accounts will be termed as irregular or overdue and the banks may face a situation of non-performing assets. Therefore, bank managers dealing with credit appraisal need to take right decisions to prevent the any future NPAs.

Decision making in several fields related to financial managements is often a very complicated and ill-structured task involving the exploitation and evaluation of various information, data, and alternative solutions or actions. Managers and individual financial decision makers (portfolio managers, financial analysis, NPA managers, investors, etc) face such problems on a daily basis and the existence of a tool which is able to support them in making the appropriate decisions is considered to be of vital importance. Simon (1960) has classified managerial decisions along a continuum from highly structured to highly unstructured. In structured decisions ,the procedures for obtaining the best solution are best known in advance ,and the objectives are clearly specified. In unstructured problems, however, intuition plays a larger role in decision making. The manager may seek help from experts, but the final decision generally involves adhoc analysis and a substantial subjective element.

Decision making in general and specifically financial decision making, has been significantly improved, in the last two decades, through the rapid progress of Information Technology and computer science. Decision making in the financial management field is a very complicated process, where decision makers face, on a daily basis, a large volume of information that should be examined in order to make the final decision concerning the performance or the viability of firm, the granting or

denying of a credit application, the construction and management of a portfolio, the choice of an investment or the construction of a financial marketing plan (Zopounidis et al., 1997).

In this competitive atmosphere, commercial banks have to learn the art of competing as well as collaborating. In this scenario, establishing a 'Decision Support System ' in strategic locations will become a great advantage to take timely and qualitative decisions. In that context, the necessity for timely updating at the input stage will become a matter of serious concern as the database is scattered and distributed over the length and breadth of the country at the numerous branches. Once the systems are built around the corporate web, forward and backward linkages could be provided through a network and flow of access to information will be rendered easy. In a competitive market, the adage 'information is strength: prior information is wealth', will prove to be of immense significance (Doreswamy, 1996).

The combination of decision theory with the new knowledge and the powerful tools offered by computer science and Information Technology, led to the development of new types of information systems able to support decision makers and improve decision making process. Designing intelligent Decision Support System for NPA management can act as a major catalyst in efforts to reduce the incidence of NPAs.

The focus of this research work is thus on the development of Information Technology driven decision system to manage the loan assets which are vulnerable to become non-performing and the new loan assets which are to be sanctioned by the banks. However, some limitation concerning the application of DSSs and ESs in NPA management still exist. KBDSS may overcome these problems and to provide support to decision makers in the field of NPAs. As new technology advances in the fields of multi criteria analysis and artificial intelligence e.g. neural nets are achieved, embedding them in the existing framework of KBDSSs could considerably increase the effectiveness of the provided decision support.

1.5. Objectives

1. To identify factors responsible for rising non-performing assets in commercial Banks and to select the criteria variables on the basis of identified factors

2. To develop a user interface database on the basis of selected criteria and modeling of those criteria for the evaluation of quality of assets.

3. To develop knowledge based decision support system (KBDSS) to handle the prospective NPA problem.

4. To test the validity of the developed KBDSS by using the user interface database.

1.6. Hypothesis

1. Criteria variables capture the dynamics of the NPA situations i.e. criteria variables adequately describe all possible NPA factors.

2. Limits set in the financial modeling stage adequately isolate the NPA and Non-NPA cases.

1.7. Methodology

The methodology is based on the results of the extensive survey with financial analysts, from the academic and banking field, as well as on the international and national literature concerning Non–Performing Assets. The aim is to initially identify and select the criteria (financial ratios and qualitative criteria) that are the most appropriate to use in the evaluation of NPA, in the second stage, to achieve the modeling of the selected criteria, and in the third stage estimation process takes place based on these criteria. Finally there is a validation and refinement where the acquired knowledge is tested through several examples (Fig1.1). The Entire research work is thus divided into the following steps

- Knowledge acquisition
- Knowledge representation

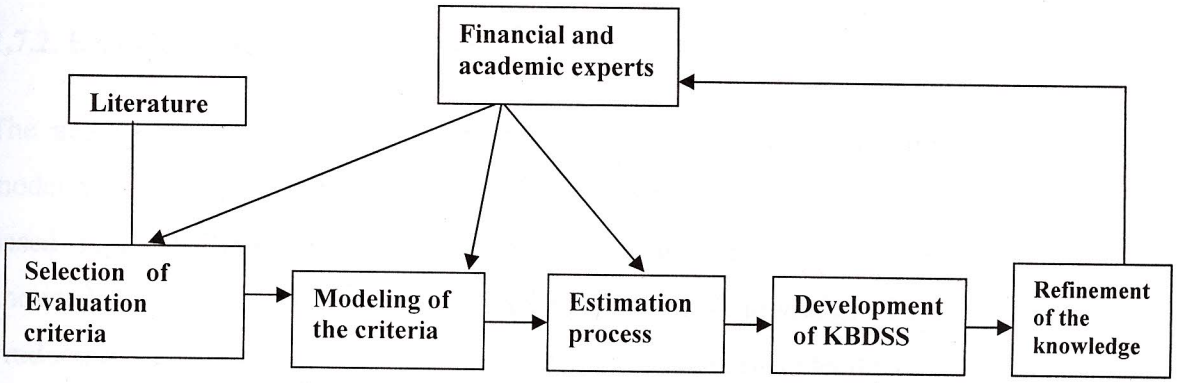
- Estimation
- Development of Neural Network
- Validation and Refinement

1.7.1. Knowledge acquisition

Sources of Data:

Secondary: The aim is to initially identify and select the factors that are most responsible for NPAs. In this regard, the aggregate data published in the RBI publications namely Report on currency and Finance, Statistical Tables related to banks in India and RBI Annual Reports are referred to. Besides, to know more about the nature of NPAs a few specific studies are examined. For this purpose, articles and

Figure: 1.1. System Development Process



papers published in leading journals and periodicals are referred. An initial set of financial ratios and qualitative criteria are chosen from the literature review on the basis of their popularity and their relevance and their contribution to the assessment of NPAs.

Primary: To identify the major factors among these an extensive survey becomes inevitable. This is more so needed in view of scanty published data. In other words, literature available in this regard is limited. An extensive field survey of 100 Credit officers or branch managers is undertaken. Selection of these banks are done keeping in mind chances of collection of Credit officers and sensitive data. Initially Credit officers or Branch managers are interviewed through two sets of structured questionnaire, i.e. one for personal information of the borrower and other for business information of the borrower. Finally, a set of twenty-six financial ratios and qualitative criteria are selected after the analysis of the data collected from the survey.

Each of the selected criteria are modeled using four–point scale: Not Satisfactory, Medium, Satisfactory and Very Satisfactory. The cut-off values for the financial ratios and the corresponding definition of the qualitative criteria are determined from the new series of meetings and survey of experts from NPA fields, in such a way as to represent their practical implementation. Then an easy user-interface is built in Visual basic 6.0 so that credit officers /branch managers can interact with the knowledge based system and data are stored in the database which is created in MsAccess.

1.7.2. Knowledge Representation

The acquired knowledge (i.e. identification of major criteria variables and their modeling) is represented in the knowledge base through production rules. Rules based representation is one of the widest known and implemented forms of knowledge representation in the development of knowledge based systems. Production rules have a very little syntax form and are easily understandable.

A production rule has the form:

IF conditions

THEN conclusions

The conditions part of a production rule may include one simple condition or a number of simple conditions combined with logical operators AND, OR and NOT. If all the conditions are fulfilled, then the rule is verified and the actions in the

conclusion part of the rule are carried out. The result of the component, a score, a weight or a probability, is atomic or monotonic.

Production rules are constructed in Visual basic 6.0.The set of production rules are constructed according to the modeling of the criteria variables.

1.7.3. Estimation

Once a borrower data is entered in the knowledge based system through the user-interface, each criteria variable gets evaluated according to the modeling of the criteria. Then based on the sum of the total ranks of criteria variables, final rank of the borrower is estimated according to the expert view. Three experts in the level of chief managers are consulted for the final estimation based on individual scores. A set of such data is generated through randomization and consequently used for training the neural network part of the knowledge-based system.

1.7.4. Development of Neural Networks

Neural networks are trained to perform complex functions in various fields of application including pattern recognition, identification, classification, speech, vision and control systems. There are various networks for solving classification problems. Among these the most popular are a) Perceptron Network and b) Probabilistic Neural Network.. Using MATLAB (Version 5.2, for educational purposes) Neural Network toolbox this network is developed for evaluation of credit. Both the networks are created with 26-element input (ranges [1 to 4]). Then the network is trained with the set of training data (which consists of randomly generated data plus their estimations). Once the network is trained, the system is ready to use. When a fresh customer data is entered though the software, neural network part of the knowledge based system examines the quality of the borrower and eventually draws inference -such as "Customer can be given loan", "Customer is expected to come under NPA" or "Customer is doubtful".

1.7.5. Validation and refinement

As the last step the developed KBDSS has been tested with a set of extreme and doubtful cases of PA and NPA. The validation of the system is decided on its efficiency in identifying PA and NPA categories of borrowers. As a refinement, the Perceptron Network which isolates only linearly separable data into PA and NPA is replaced by a probabilistic neural network which is able to classify even the doubtful cases. The methodology outlined above is further explained in relevant chapters.

1.8. Significance of the study

The study concentrates on developing a promising method for improving the productivity of the bank by reducing NPAs. The method is applicable to all the commercial banks as the structures of all commercial banks are more or less similar. Since the factors for the incidence of NPAs are common to most of the banks, the software has a wide range of applicability. This proposed application software has the potential to enhance the effectiveness of the management information system of all commercial banks irrespective of their size and regional diversity.

1.9. Limitations

The extent of application of computer technology for business solutions has its own limitations. Further, in this study a concentrated effort has been made on the prevention side of NPAs. Another important aspect of the overall NPAs management, that of recovery of existing NPAs has not been addressed in this study. The study is thus limited with respect to the applicability part of the developed system to the entire spectrum of NPA management. The quality of information provided by the borrowers shall be the deciding factor for the effective operation of the developed system.