STUDY ON EMPLOYMENT CHARACTERISTICS OF SOFTWARE MANPOWER

DEPARTMENT OF SCIENCE AND TECHNOLOGY

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TATA CONSULTANCY SERVICES
NEW DELHI
JULY 1991

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Acknowledged with thanks the receipt of the publication "Study on Employment Characteristics of Software Manpower".

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REF.STS/05/10/90-DST

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PREFACE

The software industry has assumed a special significance for the country in view of the ever growing needs of enhancing export earnings and giving an impetus to computerisation in the domestic organisations. The industry has demonstrated several strengths in the past and is poised for a quantum leap in the future, as a result of successful exploitation of these strengths. One of the known strengths is the 'availibility of a vast pool of trainable human resources'. Ironically, while this is a strength, a major constraint for the Indian software industry is 'the shortage of adequately trained and skilled software professionals, conversent with state-of-the art hardware and software environments'. Obviously there is a need to critically examine the dynamics of various macro-level processess relating to education, training, employment, utilisation and turnover of software manpower in the country, which result in the same factor simultaneously becoming a strength and a constraint.

This Study on 'Employment Characteristics of Software Manpower', conducted by Tata Consultancy Services (TCS) under the sponsorship of Department of Science and Technology (DST), Government of India, under the scheme "Science and Technology Indicators and Manpower Studies" provides a bird's eyeview of the current situation regarding this aspect of software industry. The findings and inferences drawn from the Study and the recommendations emerging therefrom are addressed to the Government, the software industry and the educational and training institutions. It is hoped that the study will provide valuable insight to the policy makers for enhancing effectiveness of software manpower and consequent accelarated growth of the software industry.

Obviously the Study has a specific but limited objective and is not intended to convey the last word on the subject.

ACKNOWLEDGEMENTS

LIST OF ABBREVIATIONS

ACE	American Council of Education
BE	Bachelor of Engineering
CAD	Computer Aided Design
CAE	Computer Aided Engineering
CAM	Computer Aided Manufacturing
CLASS	Computer Literacy and Awareness in Schools.
DCA	Diploma in Computer Applications
DEC	Digital Equipment Corporation
DP	Data Processing
DOE	Department of Electronics
DST	Department of Science and Technology, Government of India.
DTP	Desk Top Publishing
EDP	Electronic Data Processing
GIS	Geographic Information System
H/W	Hardware
HP	Hewlett Packard
IBM	International Business Machines

IIT	Indian Institute of Technology
IIM	Indian Institute of Management
ISO	International Standards Organisation
MAIT	Manufacturers Association of Information Technology.
ME	Master of Engineering
MIS	Management Information System
MNCs	Multi-national Corporations
NASSCOM	National Association of Software and Service Companies
NRI	Non-Resident Indian
OLTP	On Line Transaction Processing
PC	Personal Computer
PGDCA	Post Graduate Diploma in Computer Applications
REC	Regional Engineering College
R&D	Research and Development
S/W	Software
TP	Transaction Processing

EXECUTIVE SUMMARY

1. Objectives of the Study :

This Study on 'Employment Characteristics of Software Manpower' forms a part of the scheme entitled 'Science and Technology Indicators and Manpower Studies' of the Department of Science and Technology (DST), Government of India. The Study is aimed at examining issues related to employment of software manpower, such as supply and demand position, education and training infrastructure, career opportunities, motivation and productivity, mobility, compensation, body shopping etc., and assessing the future trends and opportunities for software manpower. The study is primarily concerned with examining the ground realities relating to the employment of software manpower based on extensive field survey. It also attempts to obtain insights into the anticipated future scenario based on an understanding of the current situation and highlights desirable policy level interventions for minimising the gap between the present scenario and the preferred scenario, given the expectations of the software industry.

A Conceptual Framework of the study demonstrating the linkages amongst various issues examined in the Study has been presented in Exhibit 2.1 of the Report.

2. Method of Study :

The study is primarily based on a field survey conducted with a sample of 104 organisations in the country, representing a mix of software firms, hardware firms, EDP departments/in-house software units in organisations representing other industries, education and training institutions engaged in development of software professionals and institutional respondents such as Government representatives and industry associations. While selecting the target respondents, all regions of the country have been covered and representation has been given to both small and large organisations. The field survey has been supplemented with limited desk research, wherever necessary.

3. Occupational Profile of Software Manpower :

The survey reveals that the typical occupations for software manpower include systems analysts, programmers, data entry operators cum programmers and software marketing personnel. Typically, in software firms, systems analysts constitute nearly 19.6% and programmers nearly 54.4% of the software manpower employed. The ratio of software professionals to the total employee strength in software firms is nearly 75% on an average. In the hardware firms, typical occupations for software manpower include software development and research, software support, software marketing and internal MIS. The ratio of software manpower to the total employee strength of hardware firms is 20.5% on an average. In the EDP Cells, typical occupations for software manpower are essentially the same as in software firms, except that there are no software marketing personnel. The ratio of software manpower to the total employee strength of the organisations with EDP cells is 2.4% on an average. The systems analysts and programmers in EDP cells form nearly 23.1% and 48.4% respectively. In the training and education and institutions, software manpower is employed as faculty.

4. Sources of Recruitment :

Most of the recruitment of software professionals is done from other organisations in the software industry. Nearly 45.6% of the recruitment by software firms are through this source; for hardware firms, this source contributes nearly 67.1%. From the educational and training institutions, the main sources of entry for software professionals are autonomous institutes (viz. Indian Institute of Management, Indian Institute of Science, Indian Statistical Institute, Indian Institute of Technology), universities and regional engineering colleges. Private training institutions as a source of recruitment form a small percentage (7% for software firms, 5% for hardware firms and 5.8% for EDP Cells).

5. Projected Growth Rate :

An average annual growth rate of 41.84% for software professionals has been projected by the respondent software firms. The smaller firms with less than 50 software professionals on rolls have projected a growth rate of 110.70% per annum, those with software professional strength ranging from 50 to 200 , have projected a growth rate of 52.97%, while software firms with over 200 software professionals have projected a growth rate of 36.24%. The hardware firms have also projected an average growth of 30.5% per annum.

6. Compensation :

The average entry level salary of a software professional in the software firms is Rs. 2960/- per month. For hardware firms, EDP Cells and training institutions, the average entry level salary is Rs.2735/-, Rs.3010/- and Rs. 1850/- per month respectively and the average maximum salary drawn by a software professional comes to Rs.7130/-, Rs.8025/-, Rs.10675/- and Rs.8625/-per month respectively. Thus at the entry level, in contrast to the general perceptions of this industry, the remuneration does not appear to be vastly different from the average remuneration package offered in other industries. There are no perks which are specific only to the software professionals.

7. Promotions and Levels of Hierarchy :

Software firms interviewed have 3 to 8 levels of hierarchy and an employee can expect a promotion once in two and a half years. Almost all the software firms pursue a policy of performance- based promotions. The hardware firms interviewed, have 4 to 7 levels of hierarchy and promotions are normally granted once in 2 to 3 years, though they are not time bound. In the EDP Cells, the rise of a software professional is limited to the position of department head of EDP Cell.

8. Overseas Deployment :

Almost all software firms deploy their software professionals overseas. This is mostly for project work, followed by training. Nearly 56% of hardware firms deploy their software personnel overseas, mainly for training on software products but also on software projects. Similarly, 50% of the companies whose EDP Cells were interviewed deploy their software professionals overseas for project work, as well as, for training. Overseas deployment also takes place in the case of faculty from training institutions for seminars/conferences etc.

Overseas deployment appears to be a major motivational factor for all software manpower. However, technically, most of the respondents view provision of high speed data links with countries abroad, as a viable option to overseas deployment.

9. Body Shopping :

Body Shopping refers to sending software professionals overseas on short term assignments mostly on man-day basis to earn foreign exchange. The opinion on body shopping is divided amongst the respondents. Over 30% of the respondents covering hardware and software firms felt that body shopping was beneficial to the industry while nearly 26.6% were not in favour of the practice of body shopping. The rest were either neutral or had no response on this issue.

The reasons leading to proliferation of the practice of body shopping are many. For instance, it is perceived that the foreign firms favour body shopping as against retaining the Indian firms for software projects in view of their lack of confidence in the project management skills of the Indian firms. Other factors conducive to body shopping include preference by the foreign firms to delegate lower end of software work to others, lucrative business opportunities for Indian firms, attractiveness of high remuneration overseas for the software professionals and lack of any Government regulations to discourage body shopping.

The adverse implications of body shopping are perceived to be brain drain and consequent manpower shortage for Indian projects and lack of development of high end skills in the country. On the positive side body shopping is perceived to help in quick infusion of foreign exchange into the Indian firms' accounts and enhancing of the image of Indian software professionals abroad.

10. Migration :

Migration of software professionals abroad has become a significant trend. The most relevant factors motivating the software professionals to migrate overseas, in the order of their importance, are higher remuneration, availability of state-of-the art hardware and software and better quality of life abroad. The obvious adverse implications of migration of software professionals are perceived to be loss of highly qualified manpower, loss of investment in training and manpower development made by the software firms and others, peer group effect leading to more and more software professionals wanting to migrate abroad and adverse effect on on-going software projects being handled by the Indian firms.

11. Motivational Factors on the Job :

The most important factors which provide motivation and job satisfaction to the software professionals in Indian software and hardware firms and EDP cells are attractive remuneration, foreign assignments, job rotation, regular training, performance-based promotions, variety of project exposure, conducive work environment, delegation of responsibility, incentive schemes related to work performance and profit sharing.

12. Employee Turnover :

The employee turnover of software manpower in software firms on an average is nearly 20.7% and that in hardware firms is nearly 11.25%. Exit interviews are conducted by 71% of the software firms and 58% of hardware firms. In the case of training institutions, job switching for better career opportunities is fairly common.

An obvious source of employee turnover is the practice of continual job switching by software professionals, particularly those who have specialization in high end areas of software work. This need not necessarily be a reflection on the low level of job satisfaction for the professionals in their current organisations but is an indicator of the efforts made by the software firms to hire the best software professionals available for gaining a competitive edge over other firms.

13. Calibre of Training Institutions' Output :

41% of the respondents in the software firms perceive major gaps in the knowledge base of software manpower available to them from training institutions for recruitment. It is felt that practical exposure is lacking particularly in the case of recruitment from private training institutions. The general feeling expressed by the hardware firms is in conformity with the above.

14. Training Infrastructure

The infrastructure available with universities offering education programmes for prospective software professionals is perceived to be inadequate and the emphasis appears to be to educate as many persons as possible, regardless of the quality of skills imparted. More often than not, the available faculty strength is less to the extent of 30 to 60% as compared to sanctioned strength, based on standard norms of faculty student ratios. The Regional Engineering Colleges appear to be in a slightly better position than the universities. Autonomous institutions are, however, better equipped resource-wise.

As regards training institutions, over 500 private training institutions have so far been established in the country for meeting the evergrowing demand of software professionals. Of these, nearly 250 have been approved by the Department of Electronics, Government of India. However, it is observed that the emphasis of training institutions is more on teaching programming languages and low end application packages. Practical exposure in terms of application knowledge provided is not adequate. Curricula updation also lags far behind the needs of the industry. Interaction with the industry is also not adequate. Further, there is virtually no filtering of intake of students by these institutions. There is little opportunity available to the faculty members to update their skills.

15. Demand Supply Gap :

As per a NASSCOM (National Association of Software and Services Companies) report on the Indian software industry (1990-1995) it is estimated that a total of 2,25,000 software professionals will be required by 1995 for meeting domestic demand. In addition, 1,85,000

software professionals will be required to achieve the software export target of Rs.3500 crore by 1995. However, this report does not give an estimate of the availability of software manpower and the demand supply gap. The 8th Plan document , on the other hand, estimates the total manpower requirements (including demand for domestic and export business) as 1,95,815 and total supply of software manpower as 1,14,740, thus indicating a substantial demand supply gap of nearly 81000 software professionals.

The field survey conducted by TCS is not an appropriate instrument for assessing the demand supply gap, since it is based on a limited sample of respondents. However, the survey does reinforce the observation related to substantial demand supply gap, arising from mis-match of skills required by the industry and those available from the education and training institutions.

16. **Future Skills** :

Some of the important skills required by the software manpower in the next five years are envisaged to be knowledge of specific hardware and software environment with real life project experience, conversence with productivity tools, software quality assurance and software re-engineering methodologies, networking and communication etc. Besides, skills in international marketing and familiarity with foreign culture will be increasingly in demand.

17. **Recommendations for the Government** :

Based on the analysis presented in the report, it is recommended that Government should provide catalytic support in ensuring that standard curricula are adopted by various training institutions. These curricula should be regularly updated to meet the emerging demands for newer skills. This will require setting up an agency having representation from training institutions, industry and the Government for continual curricula updation. Monitoring and control of all activities related to curricula updation and standardisation should be regularly carried out by the Government.

In addition, the Government should implement several policies already formulated for encouraging software industry.

18. **Recommendations for the Industry** :

The software industry should invest more in training of software manpower in view of the constraints of the training institutions. It should endeavor to enhance the working environ-ment in terms of opportunity to work on the latest hardware and software. Effort should be made to increase the productivity of software manpower by enhancing use of productivity tools and other innovations in software engineering. It should take initiative to discourage one room body shopping business. The industry should encourage persons from other functional areas to take up software development.

19. Recommendations for Training Institutions :

The training institutions should have closer interaction with the software industry so that they can get familiarised with their emerging skill requirements. in addition to providing training in common skills currently demanded by the industry , the training institutions should also focus on providing training in nascent areas of software work which will be in increasing demand a few years hence. They should gradually withdraw providing training in software skill areas,the use of which is phasing out in the industry.

The training institutions should also enhance the skill levels of their faculty members by providing them opportunity for training. Effort should also be made to have industry experts associated with training activities.

CONTENTS

CHAPTER 1

INTRODUCTION

1.1   Background

This Study on "Employment Characteristics of Software Manpower" was conducted by Tata Consultancy Services (TCS) under the sponsorship of the Department of Science and Technology (DST), Government of India. Forming a part of the DST's scheme entitled "Science and Technology Indicators and Manpower Studies", the study is concerned with examining issues related to emerging areas of activities for scientific and technological manpower in the country.

In the realm of scientific and technological activities, software is an emerging thrust area , which can hasten the process of growth and economic development of the country. The software industry has the potential of earning vital foreign exchange for the country. However, the most important and critical resource for the software industry is skilled manpower which is continually motivated and productively utilised to meet the professional demands made on it by the industry as a result of the market forces. This study on the employment characteristics of software manpower therefore, assumes a special significance.

1.2   Need for the Study

The scientific and technological activities play a vital role in the overall economic development of a country and therefore it is crucial for the Government to direct and regulate such activities. Human resources constitute a major input to all scientific and technological activities. The contribution of human resources towards successful utilisation of these efforts can be maximized if planning for these is done on the basis of reliable qualitative and quantitative information on several key indicators of the employment of such human resources. These indicators include, amongst others, the nature of skills required and available, supply and demand position, utilisation, productivity, motivation and career opportunities etc. These indicators need to be regularly monitored and corrective action required to be taken, in case distortions are observed.

The need for such a study on software manpower, is significant due to high expectations of growth of software industry, which in turn is crucially dependent on the key indicators relating to the employment of software professionals.

1.3   Objectives of the Study

The study is aimed at examining the employment characteristics of software manpower in the country, identifying problem areas and drawing logical inferences that will give an insight into the current and anticipated future implications on the working of software industry.

Specifically the study has the following objectives.

- Examine the overall supply and demand position both current and projected.

- Critically examine education and training infrastructure at :
  Universities,
  Training institutions, and
  In-house training centers.

- Study the nature of employment with respect to the :
  Organisations absorbing them,
  Typical occupational profiles,
  Compensation, and
  Body shopping.

- Review the career opportunities
  Within an organisation,
  Outside an organisation, and
  For overseas deployment.

- Examine motivation and productivity linked issues like job satisfaction, and work commitment.

- Critically analyze the issues relating to mobility and migration both within the country and abroad.

- Assess the future trends and opportunities with respect to market forces and institutional support.

1.4 Scope and Terms of Reference

The scope of the study was to collect and analyze information on the following aspects of employment characteristics of the software professionals :

- Total strength of software persons.

- Universities/Institutes output of trained software persons.

- Utilisation of software persons in software profession viz-a-viz. training/education received.

- Profile of employment with reference to:
  type of organization,
  type of work,
  salary/compensation at various levels, and
  promotion avenues.

- Career opportunities available to software persons.

- Effects of and factors affecting
    overseas deployment,
    body shopping, and
    migration abroad.

- Productivity of software persons.

- Qualitative factors affecting employment characteristics like :
    motivation,
    job satisfaction, and
    growth path/career path.

- Effects of and factors affecting migration from one employer to another.

- Migration from/to the software industry.

- Training infrastructure in the country for software persons.

- Future trends and opportunities for software persons regarding their employment.

1.5   Key Features of the Study

The Study is primarily concerned with examining the ground realities relating to the employment of software manpower based on extensive field survey. Efforts have been made to obtain quantitative information as well as qualitative perceptions related to the above subject, through interviews with software firms, hardware firms, training institutions, EDP cells in other organisations and Government representatives. Wherever necessary, the field work has been supplemented with desk research to obtain clearer insights into the various issues involved. The focus of the study has been essentially on understanding the current situation, though wherever possible a futuristic orientation has been given to the inferences drawn from the Study.

1.6   Structure of the Report

This Report comprises five chapters including this chapter.

Chapter 2   discusses the approach and methodology adopted for this study.

Chapter 3   presents the findings of the field survey.

Chapter 4   contains the inferences drawn from the findings of the field survey.

Chapter 5   presents the recommendations which emerged from the study and these are addressed to the Government, the industry and the training institutions.

CHAPTER 2

A CONCEPTUAL FRAMEWORK FOR THE STUDY

The Study on employment characteristics of software manpower can not be conducted in isolation. It should fit into a wider perspective of the software industry. This chapter provides such a perspective by presenting a conceptual framework for the study.

2.1   Conceptual Framework

It is the perception of the consultants that the actions emerging on the basis of observations made from this study should relate to the mission level objective of strengthening the software capabilities in the country. This is linked directly with the commercial success of software development and maintenance activities carried out by hardware firms, software firms, and EDP departments of other organisations. The employment characteristics of software professionals should obviously be made conducive to the needs of software industry, an objective which will facilitate strengthening the software capabilities in the country.

Exhibit 2.1 elaborates the overall conceptual framework of the study developed on the above premise. This exhibit demonstrates the linkages amongst various issues which have been examined in the study and brings out a model of their inter-relationships. Some of the hypotheses in the above conceptual framework are as follows :

a)   Reducing the demand supply gap will facilitate in making employment of software manpower conducive to the needs of software industry.

b)   Enhancing the productivity of software professionals and ability to retain skilled software manpower in the country for software related activities will help reduce demand supply gap.

c)   Enhancing motivation and job satisfaction and making work environment conducive for software professionals will facilitate enhancement of productivity and retention of skilled manpower.

d)   For enhancing motivation and job satisfaction and making work environment conducive, it is necessary to ensure proper match between the capabilities and utilisation of software professionals and providing adequate compensation to them.

e)   Through provision of attractive career opportunities and by ensuring development of requisite skills amongst software manpower, it is possible to match the capabilities and utilisation of software professionals and to provide adequate compensation to them.

STRENGTHEN SOFTWARE CAPABILITIES
IN THE COUNTRY

MAKE EMPLOYMENT CHARACTERISTICS
CONDUCIVE TO INDUSTRY NEEDS

REDUCE DEMAND SUPPLY GAP

ENHANCE PRODUCTIVITY

RETAIN SKILLED MANPOWER

ENHANCE MOTIVATION
AND JOB SATISFACTION

MAKE WORK ENVIRONMENT
MORE CONDUCIVE

ENSURE MATCH BETWEEN
CAPABILITIES AND UTILISATION

PROVIDE ATTRACTIVE COMPENSATION

PROVIDE ATTRACTIVE
CAREER OPPORTUNITIES

ENSURE DEVELOPMENT
OF REQUISITE SKILLS

ENHANCE AVAILABILITY OF TRAINED MANPOWER
FROM EDUCATIONAL AND TRAINING INSTITUTES

UPGRADE HARDWARE
AND SOFTWARE
RESOURCES FOR
TRAINING

ENHANCE
QUALITY OF
FACULTY

ENSURE
REGULAR
CURRICULA
UPDATION

ENHANCE STRENGTH
OF 'QUALITY' EDUCATION
AND TRAINING INSTITUTES

ENHANCE INTERACTION AMONGST
GOVT. INDUSTRY AND
TRNG / EDUCATION INSTITUTES

REVIEW PERSONNEL
MANAGEMENT PRACTICES

REVIEW AND IMPLEMENT
GOVERNMENT'S POLICY
FRAMEWORK

REVIEW APPROACHES TO
EDUCATION AND TRAINING
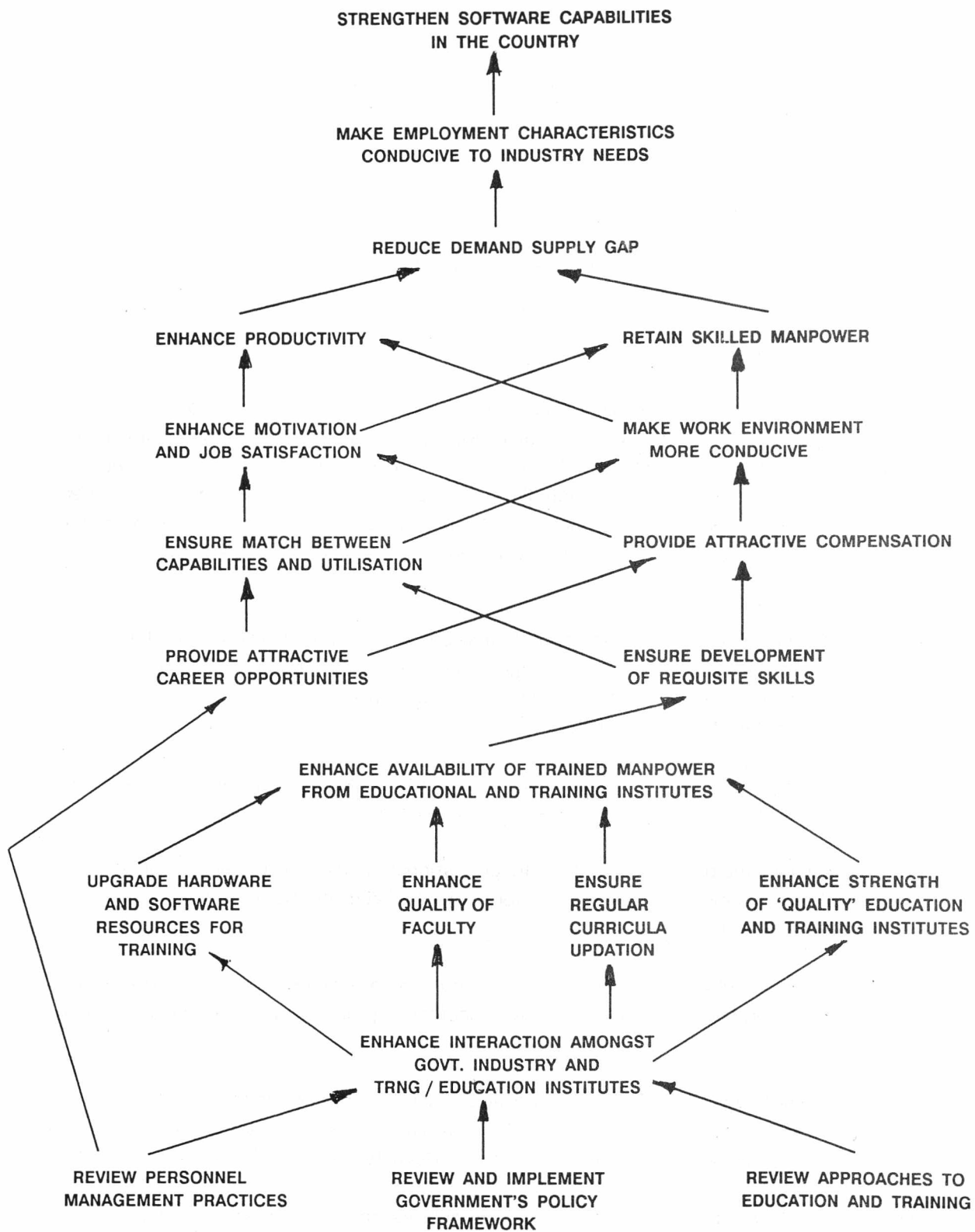
EXHIBIT 2.1
CONCEPTUAL FRAMEWORK FOR EXAMINING
EMPLOYMENT CHARACTERISTICS OF SOFTWARE PROFESSIONALS

f)   It is necessary to increase availability of trained manpower from educational and training institutions for ensuring development of requisite skills. For providing attractive career opportunities, the human resources management practices adopted by the industry need to be   looked at.

g)   The availability of trained manpower from educational and   training institutions can be enhanced by upgrading hardware and software resources available for training, enhancing quality of faculty, ensuring regular curricula   updation and enhancing the strength of "quality" education and training institutions.

h)   Apart from review of human resources management practices   by the industry, it is also desirable to review Government policy framework related to software manpower development and streamline current approaches to   education and training of software professionals.

      The findings of the study and inferences drawn may confirm to or deviate from the above conceptual framework. In either case , practical recommendations would emerge which will help in strengthening the software capabilities in the country.

2.2   Current vis-a-vis Preferred Scenario

The study aims at providing field survey based information on various issues being examined under the above conceptual framework in terms of the following :

a)   What is the current scenario ?
b)   Given the current scenario, what is the likely scenario five years hence ?
c)   What is the preferred scenario, given the expectations of the software industry ?
d)   What is the gap between the preferred and the likely scenario and what managerial and   policy level interventions are required to reduce this gap ?

2.3   Who is a Software Professional

In order to avoid ambiguities of definition resulting in erroneous inferences being drawn from the study, it is essential to define   Software Professional in the context of present study. The following definition is proposed.

A Software professional is a person who has the capability of systems analysis and/ or programming

This definition includes programmers, systems analysts, users of RDBMS (Relations Data Base Management Systems) software project leaders, data administrators, software marketing person- nel and software business managers. It covers all software related work such as application software development, system software development, software maintenance and data processing.

The definition of software professionals excludes mere users of software or mere data entry or console operators.

2.4　　Method of Study

The Study was based on a primary survey with the following interest groups.

- a) Software firms
- b) Hardware firms
- c) EDP departments/in-house software units in organisation representing other industries
- d) Education and training institutions engaged in imparting education and skills to prospective software professionals.
- e) Institutional respondents such as Government representatives and industry associations.

The respondents amongst the above were selected giving representation to the size of the organisation, its field of experience and region of operation. The overall profile of respondents was as follows :

		No: of Respondents
a)	Software Firms	28
b)	Hardware Firms	19
c)	EDP Departments	28
d)	Education and Training Institutions	23
e)	Institutional Respondents	6
	Total	104

The introductory letter from DST to various targetted respondents is placed at Appendix A. The questionnaires are placed at Appendix B. The list of respondents in each category is placed at Appendix C.

Table 2.1 gives a detailed profile of the respondents in terms of region wise distribution.

Table 2.1

Region wise Distribution of Respondents

Region

Nature of Respondents	Delhi & Jaipur	Bombay	Pune	Madras	Bangalore	Hyderabad Warangal	Calcutta	Total
Software Firms	4	8	-	5	6	-	5	28
Hardware Firms	7	3	-	2	4	2	1	19
EDP Depts.	13	5	1	2	2	3	2	28
Edu. & Trg. Instns	9	3	-	2	1	4	4	23
Institutional Respondents	5	1	-	-	-	-	-	6

Separate questionnaires were prepared by the consultants for each category of respondents, keeping in mind their unique features with reference to the objectives of the study. A mix of close ended and open ended questions were included in these questionnaires. Questions where quantitative information was required were more often close ended and those for which qualitative information was sought were more often open ended.

The questionnaires were validated with the members of task force constituted by the DST and their feedback was incorporated. Subsequently, these were pilot tested with a selected number of respondents in Delhi and necessary changes were made in the formats of the questionnaires to suit the normal flow of the interviewing process with the respondents.

During the survey, it was observed that some of the respondents were not willing to participate in the study. Certain other respondents did not like to respond to specific questions where information regarding the firm, deemed confidential by them, was required to be divulged. The consultants substituted the unwilling firms by others so that overall respondent profile was maintained as targeted. However, no substitution was done for firms where respondents did not respond to a few seemingly sensitive questions.

The field survey was supported by desk research which involved study of the scenario of software industry in general and software manpower in particular. The following literature was scanned for this purpose.

  a)   Government sources such as Annual Reports of Department of Electronics, Department of Science and Technology etc.

  b)   Information available with NASSCOM.(National Association of Software and Services Companies)

  c)   Various Computer Journals (such as Dataquest)

2.5 Limitations of the Study

The following limitations of the study are worth mentioning

  a)   Since the study is based on a primary survey with a small sample of respondents, it may not provide accurate quantitative projections for the total population . However, the information obtained from the survey is indicative of the trend in software industry and describes the range of variations which can be considered representing different facets of the software industry.

  b)   As mentioned earlier, certain respondents were reluctant to divulge specific information on certain questions in view of the perceived sensitive nature of such information. However, the number of such respondents was not very significant.

  c)   Though it was possible for the respondents to provide current information, many of them were not in a position to provide the past data, as the same had not been "documented". Many of them were also not in a position to provide reliable projections for the future. However, qualitative responses to the above types of questions were helpful to get the requisite information.

Thus, despite the various limitations mentioned above, the consultants were able to obtain a reasonably accurate picture of the employment characteristics of software manpower through the study.

CHAPTER 3

FINDINGS

This chapter presents the findings of the study based on an analysis of the information collected during the field survey. Both quantitative and qualitative findings have been brought out. Some of the information has been provided in Appendices D and E in the form of tables and graphics respectively.

3.1   Occupational Profile of Software Manpower

3.1.1   Software Companies

Out of the total number of software professionals employed in the **Software Companies** percentages of those employed in the various categories are: Systems Analysts- 19.6% ; Programmers- 54.4% ; Software marketing persons- 4.4% ;Data entry operators cum Programmers- 8.4% ; and other functions- 13.2% (Refer Appendix D.1,E.4). Though data entry operators are not software professionals in the strict sense, the designation "Data Entry Operator" is still used in the industry.

3.1.2   Hardware Companies

Software professionals constitute a low proportion (20.5%) of the total employees in **Hardware Companies**. (Refer Appendix E.1,E.2). The percentages of those employed in the various categories are :

Software development and research	:	52.96%
Software support	:	25.96%
Others(Includes Personnel involved in Internal MIS and Software Marketing).	:	21.08%

(Refer Appendix D.1)

3.1.3   EDP Cells

The percentage of software personnel to the total employee strength of organizations with **EDP cells** is 2.4% and ranges from as low as 0.6% to as high as 6.0%. This shows that an EDP cell forms a very small unit in the entire organization.

Out of the total number of software professionals employed in EDP cells, the percentages of those employed in the various categories are: Programmers- 48.4% ; Data entry operators- 14.97% ; Systems Analysts- 23.13%; Others- 11.76% (Refer Appendix D.1,E.6).

3.2 Manpower Input to the Software Industry

3.2.1 Software Companies

a) The projected average annual demand for software professionals among the **Software companies** surveyed is 41.94% (Refer Appendix D.2). This is a reflection on the high growth rate that is perceived for this industry in the future and the potential it offers for employment.

b) The principal source of recruitment for software companies is experienced professionals from other companies (45.6%). Other sources of fresh recruitment's are: IIT, IIMs- 24.5% ; Universities- 16.3% ; RECs- 6.6% ; Pvt. instns.- 1.6% ; Others- 5.4% (Refer Appendix D.3,E.5).

c) The recruitment procedure adopted for candidates at the entry level in general in Software companies comprises a written test/aptitude test, group discussion, followed by interviews. For senior level positions, technical evaluation is conducted through an interview. Campus interviews are also very common for entry level candidates.

3.2.2 Hardware Companies

a) The projected growth rate for software professionals in Hardware companies is ap ⁻ proximately 30.5% for the next year. This represents a lower figure as compared to the projected demand in software companies. This is because software is only a support function in these companies.

b) The sources of recruitment for hardware companies are:

Universities- 19.2%, RECs- 12.3%, IIT,IIMs- 9.0%, Other companies- 49.1% and Others-5.0% (Refer Appendix D.3,E.3). Here, other companies come out as the principle source of recruitment showing that experience plays an important role.

c) In case of hardware companies, in the recruitment procedure, advertisements in the newspapers and magazines constitute the typical starting point for the recruitment cycle.

3.2.3 EDP Cells

The sources of recruitment for EDP cells are:

Universities- 10.6%, RECs- 4.5%, IIT,IIMs- 10.6%, Other companies- 67.14% and Others- 5.8%. Here, other companies come out as the principle source of recruitment, highlighting the fact that EDP cells generally prefer to recruit trained and experienced manpower from the industry (Refer Appendix D.3,E.7)

3.2.4 Training Institutes

The definition of formal training institutes in the context of the present study constitutes autonomous institutes like Indian Institute of Science, Indian Statistical Institute, Indian Institute of Management, Indian Institute of Technology and universities and RECs which include institutions like Victoria Jubilee Technical Institute, Delhi University, REC Warangal etc.

The informal training institutes referred to in the study are those that are operated by companies in the private sector like Datapro, Brilliant Tutorials, Datamatics, Apple Computer Education etc.

The following observations have been made .

a) Most of the formal training institutes are understaffed to the extent of 30 to 60% of the sanctioned strength. These faculty positions are more often filled by fresh graduates as temporary staff. The institutes do not maintain the mandatory requirement of student to teacher ratio of 4:1 for full time programs and 25:1 for part time programs as insisted by DOE. This is because very few qualified people seek faculty positions. This has resulted in over-extending the existing staff.

b) The faculty in the informal training institutes are mainly experienced professionals from other companies forming nearly 55% of total intake. The other major source is private institutes, more often students of their own institutes and this constitutes 20.4%. Other sources are Universities - 18.2%, RECs - 3.1%, and IITs,IIMs - 13.3% (Refer Appendix D.3, E.10).

3.3 Utilisation of Software Manpower

a) The main areas in a software company where software professionals are absorbed are in software development, maintenance and marketing. Most of the respondent organisations practice job rotation which is considered an important motivational factor.

b) In hardware companies, software manpower is usually placed in the systems department and their main activity is either software development or maintenance. Besides they are also involved in software support and system support for software packages sold on their machines.

c) In formal training institutes a few software professional men in the computer center,and others are absorbed as faculty . However all faculty is not necessarily comprised of software professionals.

d) Professionals in some informal training institutes are also involved in software development and marketing activities in addition to training.

e) In the EDP cells of various companies, the software professionals are utilised for software development or maintenance. Very few companies provide their EDP personnel with training in other functional areas of their organisation.

3.4 Employment Profile

3.4.1 Software Companies

a) The average entry level salary of a software professional in a Software company is Rs. 2,960. In a large firm (software professionals over 200), the average entry level salary is Rs. 3510/- and that for a small firm (software professionals less than 200) is Rs 2000/- per month. The salary range is from Rs.1,500 in small companies to Rs.4,600/- in big companies. The maximum salary a software professional with about five years experience can receive in this industry, on an average is Rs. 7,130. The maximum salary ranges from Rs.4,500 in small companies to Rs.21,000 in big companies (Refer Appendix D.5,E.8). These people usually have an experience of 5-10 years in the industry. There are no specific perks that are associated exclusively with this industry.

b) Generally, software companies have 3 to 8 levels of hierarchy and an employee can expect a promotion once in two and a half years on an average (Refer Appendix D.6). Most of the respondent organisations pursue a policy of performance based promotions (Refer Appendix D.4).

3.4.2 Hardware Companies

a) The average entry level salary given to a software professional in Hardware companies is Rs. 2,735. In a large company the average entry level salary is Rs.3,525, whereas in a small company it is Rs. 1,850. The average salary that a software professional with about 5 years experience can draw in a large hardware company is Rs.8,025 (Refer Appendix D.5,E.8).

Normally, the salary ranges from Rs. 1,200 to Rs.5,000 at the entry level and goes up to Rs. 11,000 at the senior-most level.

b) Generally, hardware companies have 4 to 7 levels of hierarchy (Refer Appendix D.6). Promotions are in keeping with the results from performance appraisals. Though promotions are not time-bound, they are normally granted every 2 to 3 years.

3.4.3 EDP Cells

a) The average entry level salary of a software professional in organisations having EDP Cells is Rs. 3,010. The maximum salary a software professional can draw in such companies, on an average is Rs. 10,675 (Refer Appendix D.5,E.8). The average entry level salary is very high and does not reflect the true picture of the salaries in the industry as most of the organisations surveyed recruit only experienced people.

b) The rise of a software professional in the EDP Cell is limited to the position of departmental head, i.e. the head of the EDP cell.

3.4.4   Training Institutes

The remuneration given to faculty members in **private institutes** is not comparable to that given to those employed in government/autonomous institutes. At the entry level the salary on an average is Rs. 1,850 and senior faculty can receive on an average Rs.6,070 in a private institution (Refer Appendix D.5, E.8).

3.5   Career Opportunities

The field survey reinforced the fact that software professionals choose from the following career opportunities:

- Joining a small software organisation where responsibility is high and learning opportunities are more.

- Joining a large software house where opportunities to go abroad and get exposure to the latest hardware and software techniques abound.

- Joining a systems department in either a hardware company or a large organisation having an in-house EDP cell where the job involves control of information flow.

- Academic positions with institutions of repute where an individual has an opportunity to do research besides his task of imparting education.

3.6   Overseas Deployment, Body Shopping and Migration

3.6.1   Overseas Deployment

a)   Most **Software companies** regularly send their employees abroad to work for their clients. Other reasons for which a software professional could be deployed overseas are either to handle operations of a foreign branch of the organization or to receive training inputs (Refer Appendix D.7)

b)   Nearly 56% of the **Hardware companies** deploy their software personnel overseas. This is mainly for training on software products being sold in India but developed by overseas vendors (Refer Appendix D.7). There are a few hardware companies having software divisions involved in software development for overseas clients and hence send their staff overseas for project work.

c)   **EDP cells** deploy their software manpower overseas for training and project purposes. However, this is not practiced by all companies and the percentage that do so is about 50 % (Refer Appendix D.7).

d)   Faculty too, from **institutions** go abroad to attend seminars, participate in conferences or to deliver lectures.

e) The percentage of **Software companies** that regard a high speed data link as a viable option to overseas deployment is 66.7% as seen in Table 3.1. But as yet such a system has not become operational due to high initial cost outlay. Companies have expressed the view that the government should take the initiative in providing the requisite infrastructure

Table 3.1

Viability of High Speed Datalink

	YES	NO	No Response
H/W (18)	10	5	3
S/W (27)	18	2	7

Note: Figures in parentheses indicate total number of respondents. Total may not match sum of positive and negative responses due to overlap.

f) Nearly 56% of the respondents of **Hardware companies** felt that a high speed datalink could be a viable alternative to overseas software development.

3.6.2 Body Shopping

a) Body shopping is the practice of sending software professionals overseas on short term assignments and earn foreign exchange in the process. Body shopping operates on a simple demand supply premise. Foreign clients need programmers to execute on-going projects, having a limited time frame. Employing local people would be too expensive, more so because these projects last for 12 to 16 months only.

b) The reactions of the respondents to body shopping are given in Table 3.2. It is seen from the table that opinion of both software and hardware companies on body shopping is divided.

Table 3.2

Body Shopping of Software Professionals

	Number of Persons in Favour	Number of Persons Against	Number of Persons Neutral	No Response	Total
H/W	7	3	5	3	18
S/W	8	9	7	3	27

c)   It is also observed that a few of the respondents were not aware of the term body shopping. Some of the definitions given by the respondents are as follows:

"Send body to any other market place. Services are not available within India but abroad."

"Send skilled manpower overseas on time and material basis (T & M) for earning foreign exchange."

"Accepting contracts which enable companies to send individual consultants abroad and earn foreign exchange."

"The activity of trading bio-datas which fit the skill profile of an overseas software house and thereby sending manpower."

"Body-shopping is sending persons overseas for software development on salaries lower as compared to local people there."

"Body shopping is an operation where the employer works out of an one room office with just a fax. and telephone. He has no computing equipment. He recruits people just to send them abroad and earn his commission but does not guarantee prospects or a future to the person recruited."

"Body shopping is working as a recruitment agency under the 'respectability' of software exports."

Body shopping is a phenomenon that has not affected **training institutes** but a local equivalent called poaching of faculty exists in private training institutions. This is due to the existence of phenomenal opportunities for good training faculty as there is a shortage of them.

3.6.3   Migration

a) Migration of software professionals to foreign countries has become a common trend in the software industry. Various factors are attributed to this phenomenon.

b) Higher remuneration was perceived, by both **Software and Hardware companies**, to be a very important factor motivating a professional to migrate overseas as shown in Table 3.3. The respondents also felt that higher remuneration overseas also leads to a better quality of life. An opportunity to work on the state of the art hardware and software was another major factor responsible for migration of professionals from software companies.

Table 3.3

Migration of Software Professionals

MAJOR FACTORS	H/W (18)	S/W (27)
State of the art S/w, H/w	9	16
Quality of life	10	10
Money	14	15
Other factors	5	6
No Response	1	3

Note: Figures in parentheses indicate total number of respondents. Total may not match sum of responses due to overlap.

3.7 Qualitative Factors Affecting Employment Characteristics

3.7.1 Motivation

The following are perceived as motivating factors for software professionals by the organisations employing them.

a) Attractive remuneration packages
b) Foreign assignments
c) Job rotation
d) Regular training
e) Performance based promotions
f) Good job mix/variety of project exposure
g) Conducive work environment
h) Delegation of responsibility
i) Incentive schemes related to work performance
j) Profit sharing.

3.7.2 Productivity

Many of the respondents perceive that the productivity of software manpower is fairly high per se. However, constraints such as non-availability of productivity tools and lack of conversence with latest hardware and software environments in many cases adversely influence their productivity on the ongoing software projects.

3.8   Job Switching in the Profession

3.8.1   Software Companies

- The employee turnover in Software companies varies from as low as 6% to as high as 50% with an average of 20.7% (Refer Table 3.4).

Table 3.4

Employee Turnover of Software professionals

	H/W	S/W
Avg. Turnover	11.25%	20.70%
Range	5 - 18%	6 - 50%
Nos. not responded	10	14

Exit interviews, i.e. interviews of those employees who are leaving their job, are conducted by 71 % of the Software companies surveyed as is evident from Table 3.5.

Table 3.5

Exit Interviews of Software Professionals

	H/W	S/W
Yes	11 (58%)	15 (56%)
No	4 (21%)	3 (11%)
Informally	4 (21%)	4 (15%)
No response	Nil	5 (18%)

3.8.2   Hardware Companies

Exit interviews are conducted by 58% of the Hardware companies surveyed. In the rest of the cases they take the form of informal discussions held between the management and the employee who is leaving the company (Refer Table 3.5)

3.8.3 Training Institutes

Job-switching, for reasons of better opportunities is also common amongst software professionals employed in the training institutes. This ranges from as low as 5% in some training institutes to as high as 50% in others. Most of them take to areas such as software marketing and development.

3.9 Training Infrastructure for Software Manpower

a) The average number of years for which training in software related courses has been provided is 23.6 years for autonomous institutions, 7.6 years for Universities and REC'S, and 5.85 years for private institutes. This implies that in the recent years there has been a profusion of private and small institutions imparting education in software courses, in response to the growth in this industry. Furthermore, the institutes with a fairly long experience in this line are seen to have a better reputation as far as the quality of their output is concerned.

b) Most universities offer a number of programmes in computers like M.E., B.E., MCA, DCA, etc. However their facilities and infrastructure are poor due to the lack of resources. They also lack adequate strength of qualified teaching manpower and often manage with a faculty strength less than sanctioned. The RECs are in a slightly better position than the universities but also face the same problems. The autonomous institutions are better equipped resource-wise .

c) Most of the larger training institutions provide opportunity for in-house training to their faculty members in the form of time and resources to learn by themselves on the job. However the smaller private institutes do not offer similar opportunity. This lack of emphasis given to training of faculty in these private institutions has led to the decline in quality of software manpower trained by them.

d) The main criteria for course allocation to faculty in the training institutes are experience, qualification and communication skills. (Refer Appendix D.9).

e) The emphasis in the training institutes is more on teaching programming languages and low-end application packages. A few institutes have moved to training on high end packages and tools, but still their training is oriented towards developing junior programmers and data entry operators. In any case these institutes do not cater to the needs of the overseas market.

f) The relatively bigger training institutes usually maintain a good balance between teaching and practical exposure on computers. However the smaller ones carry out teaching with limited theory and provide minimal exposure to computers.

g) The curricula of both formal and informal training institutes are generally not regularly updated, leading to coverage of obsolete skills with little relevance to current requirements of the industry.

h) The interaction of the formal and informal training institutes with the industry has improved over the years but has still not attained the requisite level to remove the gap in the university output to the industry requirement. The various forms of interaction have been indicated in Appendix D.10.

i) Many of the pass outs from the institutes require further training to write programs for real life applications in the industry. This training period may extend from six to eight months, during which a lot of hand-holding is required by them.

j) A large number of respondents from software and hardware companies feel that the competence level of the fresh entrants from training institutes leaves much to be desired. Most of them feel that their practical exposure is lacking and that they are not application oriented.

k) All these institutes claim to screen the student input for their aptitude and analytical skills; yet, by and large, all the applicants are selected without adequate filtering. This results in low quality of student intake and consequent output.

l) These institutions are making the new generation (age group of 12 to 25 years) computer literates by creating awareness in computers, but at a very high cost.

m) The rating given by MAIT has not been acceptable to most of the private institutes. They believe that " MAIT has been used by some people for self interest". There was also an extreme view that big institutes are forming a cartel.

3.10 Views of Government Institutions

In the perception of one of the respondents of a Government department, some of the key issues having a bearing on employment characteristics of software manpower are as follows. These have also been substantiated by several other respondents.

- There is a huge Demand-Supply gap in the industry.
- There is lack of innovativeness in Hardware and Software development.
- The domestic software market is very small.
- The domestic industry more often depends on collaboration and tie-ups with MNCs or Foreign Corporations to bring out products.
- A faulty hardware design philosophy prevails in the industry.

3.11 Future Trends in the Software Industry

a) The significant emerging trends as perceived by the respondents are as follows:

- The versatility of software and the fields of application of computers are rapidly growing. Software is also becoming more user friendly. There is, therefore increasing emphasis on software development.

- Hardware, which is basic to this industry has become cheaper, more powerful and more reliable. From around 90% of the total cost of the computer system, it has come down to 50 % and is expected to go down even further.

- The sale of Personal Computers (PCs) is making a significant contribution to the total sale of hardware. Therefore the sale of PC software as a percentage of total software sales has been steadily increasing, from 17.5% of total software sales in 1983 to 21% in 1989.

- A high speed communication environment is emerging, making communications more sophisticated and faster.

- Also, as a fall-out and as an independent activity, portability of application software across systems is becoming possible.

- The market for both packaged and custom designed software is growing.

- Companies are increasingly leaving the development of application packages to software houses rather than developing applications in-house, as the latter choice is more time consuming and costly.

b) As a consequence of the trends listed above, the demand for software manpower will be increasing at a phenomenal pace. Therefore inspite of the fact that India has a vast pool of technically trained people, shortage of trained manpower could be a major bottleneck by 1995.

CHAPTER 4

INFERENCES

This chapter presents the inferences drawn by the consultant's from the findings of the field survey brought out in Chapter 3. For drawing some of the inferences, desk research based information has also been used to supplement the survey findings.

4.1   Occupational Profile of Software Manpower

4.1.1   Software Companies

For companies having software as their principal line of business the ratio of software professionals to the total employee strength is obviously high, ranging from 60% to 90%. The study reveals that majority of this workforce is employed either as systems analysts or programmers, the ratio in a company being determined by the nature of the company's mode of operation as well as its size. Thus, the smaller software companies have a large base of programmers and relatively few systems analysts as compared to larger companies where analysis is a part of the process of problem-solving for which the resources i.e. manpower can be afforded and maintained by the company itself.

For marketing of software, these companies maintain a separate work force but this being a specific activity requiring full time concentration, the manpower involved in it is small in terms of the total strength of software employees. The other software employees, in addition to the above mentioned, include support and maintenance staff, data entry operators, console operators and quality control staff, but in most cases these are few in number and not a universal feature across the sample covered.

4.1.2   Hardware Companies

The major activity for software professionals in the hardware firms is that of software development. This is followed by the activity of providing software support to the client organisations

4.1.3   EDP Cells

In the EDP cells , software development is just a support function involving systems support and development of an in-house Management Information System.

4.1.4   Training Institutes

The study on educational institutions reveals that the government supported autonomous institutions, which have years of experience in this line and have been producing high caliber software professionals, have clearly delineated faculty and MIS departments. The study further revealed that in private institutes personnel involved in R&D functions are almost negligible.

Most of the formal training institutions are understaffed. The Quality Improvement Program (Department of Education) further consumes 15% of the sanctioned strength to take up M.Tech/PH.D., which in turn reduces the effective faculty strength at any given time.

To tackle the problem of faculty shortages, various institutes are sending their faculty in allied disciplines e.g. electronics, for higher studies in Computer Science at RECs and other institutes of excellence. Since the numbers are small it has not altered the situation much. Hence, priority must be given to evolve training programs for the teachers and explore other means of improving the student teacher ratios in all universities and institutes.

4.2 Manpower Input to the Software Industry

4.2.1 Sources of Recruitment

Though almost all companies recruit their software professionals through advertisements, the proportion of this occurring at higher levels is much more than that for employees recruited at the entry level. In such cases, suitability is judged on the basis of experience gained in the industry in addition to the academic background of the candidate. There are also a few companies which recruit only freshers and train them. It was noticed that most organizations make annual manpower plans and then recruit people to meet this target. The organizations also recruit based on need, but those who stated they recruited only based on need, were those involved in bodyshopping.

As far as entry level recruitment is concerned, formal training institutes as a rule are seen to contribute maximum to the number of candidates absorbed by software firms, accounting for 55% on an average of the total number of employees recruited. Autonomous institutes, like the IITs and IIMs also are an important source of supply of good quality software professionals. However, a large percentage of such software professionals migrate abroad leaving relatively few persons for software related jobs in the domestic market .

Faculty for institutions providing training in software development is primarily drawn from autonomous institutes like the IIMs, IITs and the RECs and the universities. People with useful industry experience are also viewed favorably for recruitment provided they are highly qualified, a Ph.D. being very desirable. An observation that emerged during analysis is that very few private institutions recruit fresh candidates from other private institutions for faculty positions, reflecting the fact that the products of these institutions are not regarded as being highly skilled. They do recruit their own students as faculty members in their institutions.

Engineering colleges also rate high in terms of catering to the demands of the software industry, both in terms of number as well as quality of professionals turned out. In the case of private institutes the percentage intake by companies is very low reflecting a skepticism on their part as regards the candidate's ability to operate in a practical work environment. The pattern that emerges is that for lower level jobs the companies opt for students of private institutes.

4.2.2 Quality of Manpower Supply

Based on the industry needs it is seen that universities, autonomous institutes and regional engineering colleges tend to produce the 'right' kind of candidates with good knowledge and the competence needed to adjust to the work environment. On the other hand, private institutes are firstly poorly

equipped in terms of hardware. By admitting a disproportionately large number of students to their courses they are unable to provide them with sufficient computer time. Hands-on experience on the terminal being vital in the job environment, where a student has to finally gain acceptance, lack of the same is a major handicap for these students in getting a good job, even after a heavy investment in terms of time and money which these institutes demand.

In terms of software inputs most of these private institutes offer courses in packages which are either out-dated or are being gradually phased out e.g. DBase, Lotus, etc. which have been replaced by Oracle, Ingress, Sybase, etc. Thus the computer education a student receives does not serve its purpose of preparing him/her to handle the industry requirements. The course content too, is not extensive enough to merit as long a duration as the usual time-frame chalked out by these institutes. Despite these facts, the private institutes are the single largest source of spreading computer literacy throughout the nation and it is in the interest of the entire computer industry that specific efforts be made to tailor the education offered to suit industry needs.

Although, the informal training industry has become far more organized these days, with MAIT and DOE closely monitoring them, these institutes must constantly keep upgrading themselves to respond to the requirements of the industry.

4.3 Utilization of Software Manpower

It is observed that the experienced software professionals, can handle a variety of jobs with equal competence, upgrading their skills to suit the job requirements. In view of this factor, most software companies practice job rotation on a regular basis ensuring that their employees gain an overall experience of their areas of operations. This has been practiced fairly successfully from both the employers and the employees point of view, ensuring that the employees interest level in his job is retained and his/her skills are constantly upgraded. This is a factor that contributes significantly to a person's commitment to his job and consequently to his productivity.

Software marketing is done by professionals who by virtue of their aptitude and skills are allocated to this function. Consultancy is another area where software professionals are placed. This is an area in which good communication skills and expertise in systems and software development are important.

4.4 Employment Profile

4.4.1 Type of Organizations

A recent trend indicates that a large number of big industrial houses have started entering the software business to capitalize on the excellent export potential this industry offers. Their ability to invest in hardware infrastructure, which is very expensive, due to the financial resources at their command is a reason for their diversification into this nascent industry. Besides, there are small software companies, run by professional entrepreneurs, who are able to effectively use a limited resource base to achieve fairly high profits.

The concept of using a computer based MIS has gained acceptance very recently in the Indian industry. The more professional and big companies with a very large volume of information to process are potential organizations for absorption of software professionals. These include hardware firms and other companies having EDP cells.

For software professionals inclined towards academics and research, the avenues open to them include autonomous institutions like IIMs, IITs, universities and private institutions, the first two requiring much higher qualifications than the latter.

4.4.2 Type of Work

All software related jobs demand that a person be highly skilled and have a certain minimum level of education and technical competence. A software professional has the choice of working in application, maintenance, consultancy, software marketing or systems audit based on his/her aptitude and qualifications. A software company offers the best opportunity to software people to refine their skills by way of giving them an overall perspective of the operations of the software industry. Work oppurtunties in systems development are restricted in hardware companies and EDP cells. Their basic work is system maintenance and ensuring its smooth functioning, rather than using their faculties to evolve new systems. Thus, their jobs are more restricted as far as opportunities for enhancement of knowledge and skills are concerned.

4.4.3 Salary and Compensation at Various Levels

At the entry level, in contrast to the general perception of this industry, the remuneration is not vastly different from the average remuneration package offered by companies in other industries. There are also no specific perks that are particular to only the Software Industry. Software professionals receive regular statutory perks like LTA, bonus, PF, etc., while those involved in marketing receive commission on sales similar to other industries. Those deployed overseas get overseas allowance.

The salaries at software companies are perceived to be higher than at hardware companies which are in turn perceived to be higher than salaries in EDP Cells. This perception is not borne out by the study as is evident from Appendix D.5.

4.5 Career opportunities

The typical career oppurtunties available to software manpower along with their key features are as follows.

a) Career in a Small Software Company

On the positive side, these companies offer a high responsibility and opportunity for learning. Since the levels of hierarchy are few, the person has easy access to the top management in an informal organisational culture. This creates a good work environment and helps in increasing productivity.

On the other hand, a small organisation does not have the financial resources to provide high entry level pay/perks and security. A drawback of working in a small company is that opportunities to go abroad are very rare.

b) Career in a Large Software Company

In a large company a professional commands the kind of pay and perks he/she merits. Further, such a company offers more stability and opportunities to go abroad where they can gain hands-on experience in the latest technology/the most recent hardware and software. The association with a big name in the Industry enhances a person's status and earns a good reputation which would stand in good stead in future. However, in such an organisation there are many competent professionals and therefore a stiff competition amongst them.

c) Career in a Systems Department

This kind of a job offers good pay/perks and good initial growth prospects. A person also gets a chance to interact with a wide spectrum of people in the software related industries, enabling one to build a wide network of contacts. However, for such an individual the opportunity to use his entire range of skills is low. Besides, after point, a person tends to stagnate.

d) Academic Positions

The nature of this job is research oriented and generally draws people for whom, working in the industry is not an attractive proposition. Rather than monetary incentives, institutes offer more by way of self-fulfillment for an individual. Besides, such a job is stable and a person by earning a good reputation in his field can subsequently do consultancy, in addition to his primary task of imparting education. For a person inclined towards research this option gives him both the time and the resources to do so.

e) Enterpreneurship

After reaching a stage in one's career where an individual feels that he has gained adequate experience and built the right contacts, the person has the option of starting on his own by either opening a small software firm or a training institute for cultivating software professionals. Since this is a growing industry, both these options offer a scope for profitability and success as has been proved in the past by entrepreneurs who have so decided.

f) Migration

A final option available to a software professional, is migration since his skills demand a high value in the foreign market. Provided, a person has received the right exposure and has shaped his career accordingly, this option offers him a better work environment in which all the educational inputs are fully utilized. The professional also gets exposure to the latest hardware/software, in addition to a higher standard of living.

4.6 Overseas Deployment, Body shopping, and Migration

4.6.1 Deployment of Personnel Overseas

a) Overseas deployment is a major motivational factor influencing a professional's decision to join and continue with a particular software firm. It also brings in foreign exchange earnings for a company. On the other hand, the professionals get exposure to better facilities, work environment, etc. very often resulting in their decision to permanently shift overseas. This ultimately results in a severe loss to the nation by way of brain-drain. It is usually seen that the best quality professionals find the foreign working environment more conducive to their growth.

b) A high speed data-link is seen as a viable alternative to overseas deployment of professionals, but at this stage this is not a practical alternative. Data links currently available are neither fast nor reliable. Far too many bureaucratic controls are involved in the sanction of such links. Most companies desire that the government take the initiative in providing the requisite infrastructure to facilitate the availability of such an option. This would minimize the need for overseas deployment which in turn would reduce migration of professional overseas. This could reduce to a large extent the amount of loss the country is incurring at present by way of investment in education of these professionals.

4.6.2 Body Shopping

a) The concept of body shopping is very common to the Indian software industry, all the factors in the country as they stand today, being conducive to body-shopping. The lucrative nature of this business and the vast reserve of software professionals available makes this phenomenon a prominent and an unavoidable one in the Indian industry.

b) India has an army of software engineers who take up these assignments, complete them and return home flush with dollars. Employing Indians works out 35 to 50 per cent cheaper on an average, for European or American firms.

c) However, the Indian consultants get to work only on lower level technical jobs, essentially as programmers for which they receive comparatively less remuneration than their western counterparts.

d) The key factors affecting body-shopping are as follows:

- There is a lack of confidence on the part of foreign firms, in the ability of Indian firms to execute complete software assignments i.e. foreign companies are not confident about the project handling skills of Indians.

- There is a demand for skilled labour to perform "lower level" technical jobs, which the foreign firms would not like to do themselves because of the laborious nature of the tasks.

- The availability of highly qualified manpower, who perceive that their skills are under-utilized locally.

- There is an absence of any government restrictions/ rules to prevent body-shopping.

- For young professionals, going abroad is lucrative since the standard of living is much better, besides the savings factor.

- Profitability for the body-shopper resulting from the conversion of hard to soft currency is also one of the factors affecting body-shopping.

e) The effects of body-shopping are as follows :

i. **Negative:**

- It results in brain-drain, either temporary or by way of opening of channels for a person to finally migrate.

- The project management skills of Indians do not improve.

- Internal projects suffer as people with relevant experience are deputed abroad, to earn for the company a higher income.

- Body shopping restricts the development and growth of higher level skills.

ii. **Positive:**

- It aids in quick infusion of funds into company accounts.

- It is a source of foreign exchange earnings.

- Body shopping enhances Indian image abroad by way of providing opportunities to Indians to prove themselves in the Western world.

f) Thus, while on the one hand, body shopping contributes towards the commercial objectives of earning foreign exchange for the country, on the other hand, it does not add significantly to the institutionalisation of professional capabilities in the Indian software industry, particularly in managing software projects in higher end application areas. The emergence of one-room body shopping business concerned more with trading bio-datas of software manpower than with handling software projects is a typical malaise of this phenomenon.

g) Suggestions to remedy this situation, as perceived by the respondents, are :

- Proving one's own capability by completing the few foreign assignments which are received, on time and within the budgetary framework and by working on turnkey projects.

- Investments to improve the infrastructure in the country - viable options like a high speed data link, better hardware, etc. should be considered for the future.

- Using Indian experience as leverage to convince foreign clients of the capability of Indian professionals to handle entire projects competently.

4.6.3 Migration

a) Migration has become a much accepted part of the Indian computer industry with the trend in the last few years showing an alarming rise in the number of computer professionals choosing this option. There are many factors (Refer Table 3.3) that have contributed to this situation:

- Higher remuneration coupled with a much better standard of living.

- Better work environment with the facilities to work on the latest hardware and software and develop their skills to the maximum. Access to high level technology is an attraction that these individuals seek.

- Better career opportunities in terms of options available to switch jobs and work in varied environments that would suit a person's career goals.

- Less social responsibilities.

- The appeal of living abroad, especially to young minds which are receptive to changes in lifestyle, culture, etc.

- The migration of members of ones immediate social circle.

b) The effects of migration of competent and skilled professionals are almost always detrimental to the economy since migration results in:

- Loss of good quality manpower.

- Loss of investment in training and education.

- Peer group effect - a person sets the example for his friends/associates to follow.

- The projects that a person is handling for his/her company gets affected because the continuity of work is lost when another person has to replace him/her on the job.

c) On the positive side these people act as representatives of the country who establish a good image for it by displaying very good on-the-job skills.

4.7   Qualitative Factors Affecting Employment Characteristics

a)   Inspite of all the policies/ schemes offered by software organizations to offset the possibility of an employee being de-motivated, the high employee turnover that is associated with industry indicates that employee satisfaction with their job is not upto the desired level. This could be attributed to the fact that these software professionals have many opportunities open to them, particularly of working and even migrating abroad.

b)   Due to the constantly widening demand supply gap for highly skilled manpower, the prices that they command across organizations vary a lot. This causes continuous switching of jobs for better remuneration. Regular switching of jobs neither breeds loyalty in the employee nor the trust of the employer - both being major factors for employee motivation.

c)   In many cases the industry needs in terms of skills of software professionals and the skills possessed by those professionals at the entry level are incompatible. The level of education at autonomous institutions is much higher as compared to the level required by the domestic industry and the kind of infrastructure it can offer them, hence these professionals feel restricted as they are not able to use their skills to the fullest.

d)   The students of private institutions are not up to industry standards in terms of skill requirements. Hence , they are not comfortable in jobs that entail any major responsibility. Due to this they are not able to properly fit in with the work environment and therefore neither the employee nor the employer is satisfied.

e)   Growth prospects in an organization is another factor that contributes significantly to both the motivation and job satisfaction of the employee. In EDP cells and hardware companies the growth prospects of a software professional are limited. After a certain stage, an individual tends to stagnate unless he switches his line of operation or moves into a core software company. The level of motivation and commitment of an employee to an organization depends on its policies regarding the retraining of its employee so that they do not look for alternative options during the course of their career.

f)   It is also observed that the productivity of an individual abroad is much higher than that of the same individual within the country. This may be attributed to the lack of usage of productivity tools, in general, in the software industry in the country.

4.8   Job Switching in the Profession

a)   Job switching is perceived as being endemic to the software industry, the annual turnover of professionals in this line being about 30-35%. This is because opportunities in all directions abound, giving an individual ample scope to choose his/her career path. The actual turnover in software companies is 20.7% but varies from 6% to 50% depending on the company.

b) The flexibility is high and even a person working in a specific functional area can switch over to another area without much difficulty. The caliber of these professionals being high makes job switching easy for them. Besides, this is an industry in which migration abroad is relatively easy as such professionals are in high demand overseas. Given these factors it is not surprising that the annual employee turnover is very high.

c) As a direct consequence the high rate of migration of the skilled manpower widens the existing demand-supply gap for skilled software professionals. Companies, therefore have a limited human resource base to choose from and in trying to attract the best people to their organization tend to act as catalysts for job switching. The employees' loyalty to an organization is not poorly reflected as he is usually not long enough in the organization to imbibe its culture, adjust to it and develop a commitment to it. Therefore, employee loyalty towards the company is not necessarily relevant.

d) From the professional's viewpoint, job switching is beneficial as the remuneration package keeps improving with every job change. There is also the added attraction of moving up in the hierarchy much faster than would be possible otherwise. It gives an individual greater exposure to a variety of systems and enables him to develop his skills and broaden his knowledge base. It is only in the long run that an individual's career can be negatively affected by frequent job switches.

e) In the industry, companies in trying to gain a competitive edge over one another in hiring the best software professionals tend to push up the industry standard of paying its manpower. This also results in a wide disparity between the remuneration received by lower level software employees and those who are highly skilled and therefore much in demand.

f) The work in a company tends to suffer too if it has a high turnover of software manpower This is because when a person leaves the organization another person with the same skills has to be recruited or trained which involves both time and money and which leads to delays in project schedules.

4.9 Training Infrastructure in India

4.9.1 Disparities Between Private Institutes and Universities

a) There is a wide disparity in the range of training facilities available to those aspiring for a career in this industry. The IITs and IIMs, rank as premier institutions the world over in terms of the quality of educational inputs provided to their students. Government institutions like RECs and Universities also turn out high caliber software professionals. But private institutions, which turn out high volume of manpower for this industry do not have the requisite infrastructure to satisfy the requirements of the industry.

b) The autonomous institutes and the universities have facilities at their disposal to provide very good quality education to their students. Through their tie-ups with reputed foreign universities and liberal government funding, they are able to provide their students with the latest technological inputs that enable them to keep pace with changing industry needs. The quality of students admitted to these courses have an above average IQ which adds to its advantage. Finally, these institutions were established with the primary objective of developing highly skilled human resources for the country, and as such imparting education is their main focus.

c) Most private training institutes, on the other hand are highly commercialized and run more like business houses than as educational institutions. These schools of computer education lack the requisite infrastructure, in terms of hardware and latest software. Their faculty skills are not upgraded on a continual basis.

d) The students admitted to these courses in most cases are undergraduates. The admission procedure being quite lax, majority of students admitted do not possess the aptitude for pursuing a career in this line. In most cases the quality of job a student gets on completing the course is not good enough considering the high fees paid by him for receiving the education.

e) As a direct reflection of what has been stated above, the survey revealed that companies which have recruited students from autonomous institutions/universities are often satisfied with their performance, after a brief orientation course. These students are seen to have some practical exposure, job knowledge and the ability to quickly adapt to industry needs. On the other hand, performance of students from private institutions is not rated high by the industry, as they require a lot of training before they are considered competent enough to handle a job with required finesse.

f) As a consequence of the gaps that exist between the industry requirements on the one hand, and the manpower inputs received by them from various schools of computer education on the other hand, re-orientation and in-house training has become a necessity for the industry. Most companies have intensive training programmes to make an employee familiar with the company's individual way of operating (Refer Appendix D.8).

4.9.2 Need to Upgrade Curricula

a) The upgradation of curricula on a continuous basis is rarely undertaken even in institutes of excellence. The updation undertaken in the curricula at these institutes is on an informal basis and by the individual faculty concerned who has the flexibility to supplement their course with their own topics of interest. This is not possible in other institutes and is literally impossible in colleges belonging to a university because of the rigidity in course content.

b) The usual revision of curricula undertaken is not based on Indian industry requirements but based on ACE/ other American university guidelines. This does not take into consideration the disparity in infrastructure/ Computational facilities in the Indian universities as compared to an American institution. This has in turn led to a theoretical bias rather than a balanced input in theory and practice.

c)   The training given in the area of Software Technology is either phased out or is in the process of being phased out e.g DBase III+ vs. 4GLs. This is a major fault of reactive curricula design that is undertaken presently.

For a better balance in curricula design, it is necessary to adopt a proactive approach towards training in software technology. One approach to curricula design is as suggested in Exhibit 4.1. As per this approach, the focus of the training programmes should be on areas which are nascent rather than those which are being phased out or are on the verge of being phased out (please also see page 41 para b).

4.9.3   Closer Industry-Institution Interaction

a)   In most universities the only interaction with the industry is done by the placement cell during final or summer placement. There are very few institutes which undertake project work and consultancy assignments for the industry. Hence, teachers have no opportunity to solve any real life problem which would improve their practical exposure or in taking up any interesting research work which would widen the body of knowledge available to them. In the absence of these, the teaching community is not developing itself at the same pace in which the industry is developing. This develops a major lag in terms of what is required for the industry and what is taught at the institute. This gap keeps widening because of the lack of interaction between the universities and the industry.

b)   As the academic community lags in research and state-of-the-art Information technology knowledge, the industry does not off-load its research work or even problem solving to the universities. The industry is of the opinion that the few institutes having such capability do not commit the required resources in terms of manpower. Their team keeps changing every term and the project is managed very badly. Currently, there is no forum where all concerned agencies (sections of industry, university, DOE, DST, MHRD, dept. of Education etc.) can meet and formulate policies on the nature and degree of interaction required in terms of projects, research, resources, funding etc.

4.10   Views of Government Institutions

a)   Currently, virtually all components from chip sets to cables are being imported. One of the perceptions has been that stress on indigenous and innovative hardware design at the component level would lead to a great reduction in hardware costs. Thus reduced hardware cost implies increased hardware purchasing capability for the domestic industry.

b)   This on one hand is expected to result in increased exposure to computers because of easy accessibility of computers which would in turn result in increasing the quantity and improving the quality of software professional thereby resulting in reducing the demand-supply gap.

STAGES IN TECHNOLOGY DEVELOPMENT

CONTEXTUAL RELATIONSHIP WITH CURRICULUM

PRE-R&D	R&D	PRIME	IMPLEMEN-TATION	PHASE-OUT

← DESIRED CURRICULUM → ← PRESENT CURRICULUM →

EXHIBIT 4.1

35
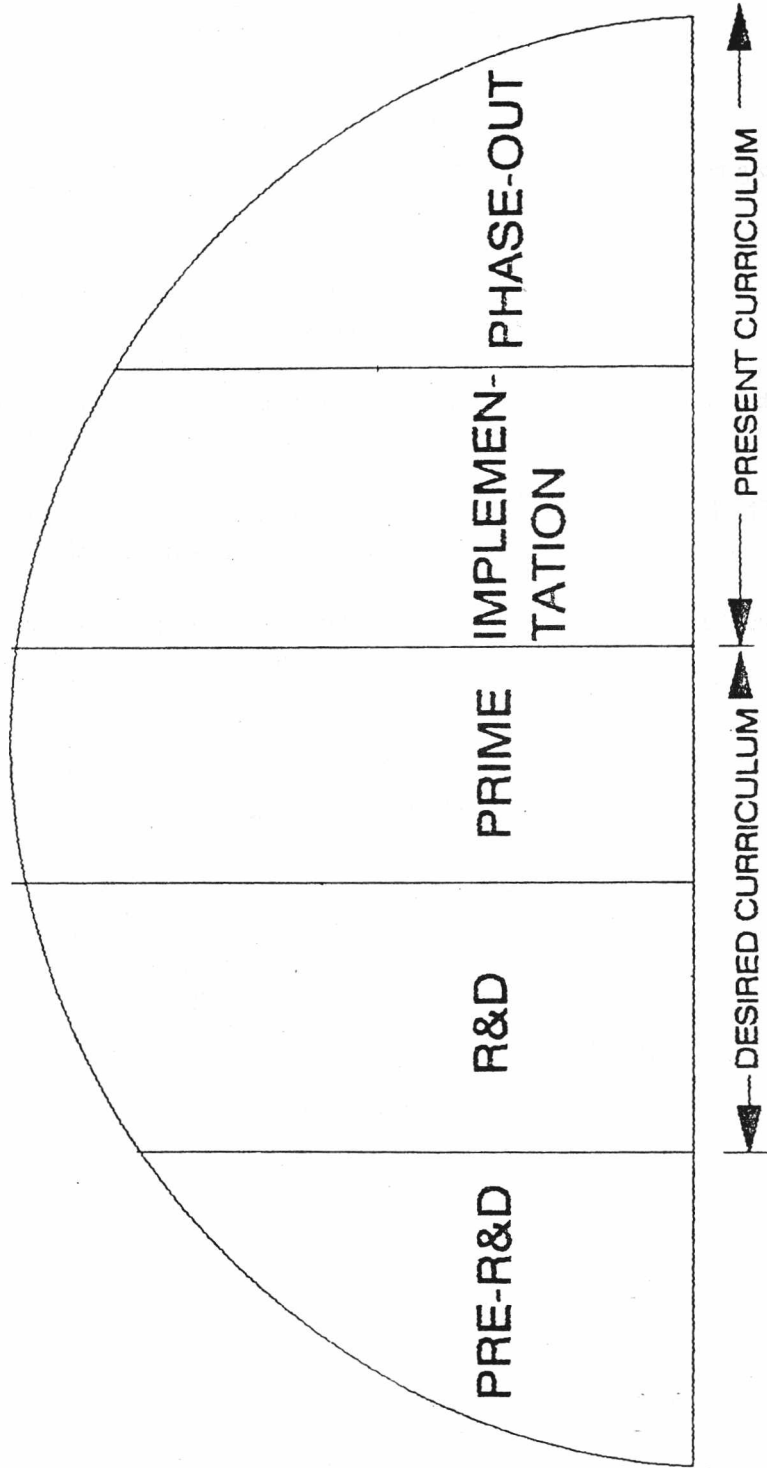
EXPLANATION OF STAGES

1. PRE R & D   :   Areas which are still under conceptualisation
                           (e.g. Neural Networks)

2. R & D   :   Areas which are currently under development
                           (e.g. Artificial Intelligence)

3. PRIME   :   Areas of nascent origin which have a very large potential and
                           for which there is a large demand supply gap (e.g. C++)

4. IMPLEMENTATION   :   Areas which have stabilised over period of time and are
                           currently in wide use (e.g. RDBMS)

5. PHASE OUT   :   Areas which are being increasingly replaced by newer
                           software and are therefore becoming obsolete (e.g. dBase III).

EXHIBIT 4.1 (CONTINUED)

c) It is also expected to increase software demand because of increase in funds available on the computer budgets. This would lead to a growth in the domestic market and to increased competition, which would result in improved product quality. This would in turn facilitate the domestic market to provide:

- Better projects
- Better working conditions
- Increased material gains
- Challenging jobs

leading to increased job satisfaction. This is expected to result in a reduction in

- Migration,
- Brain drain, and
- Body shopping

leading to increased retention of software professionals within the country. This in turn would also reduce the demand-supply gap. The above process is illustrated in Exhibit 4.2.

4.11 Future Trends in the Software Industry

The software industry, which has come to be known across the world as one of the sunrise industries, has been characterized since its inception by a continuing process of innovation and improvement. With increasing maturity of the industry, certain shifts are taking place. Appendix F discusses likely trends in the Indian software industry in the future.

The size of the Indian software market is miniscule compared to the world market. While in developed countries, expenditure on computers currently is 3 to 5 % of GNP, in India by the year 2000 it is expected to be 1% of GNP. This includes expenditure on both hardware and software.

4.11.1 Manpower

While the fact that India has a vast pool of technically trained people is stated and restated often enough, it is now being perceived that shortage of trained manpower could be a major bottleneck set for 1995.

The current requirements for the year 1995 are based on an estimated installed base of 1,000,000 micro computers and several thousand mini computers and super mini computers. It is estimated that 225,000 professionals would be needed to man the machines. In addition, 750,000 full time operators would be required and this is only the internal demand. Exports would be in addition to this. Also, to achieve a Rs. 3,500 crore target by 1995, approximately 185,000 people will be required for software development alone. This figure is based on an employee productivity of Rs. 1.95 lakh per person per annum.

GOVERNMENT VIEWS
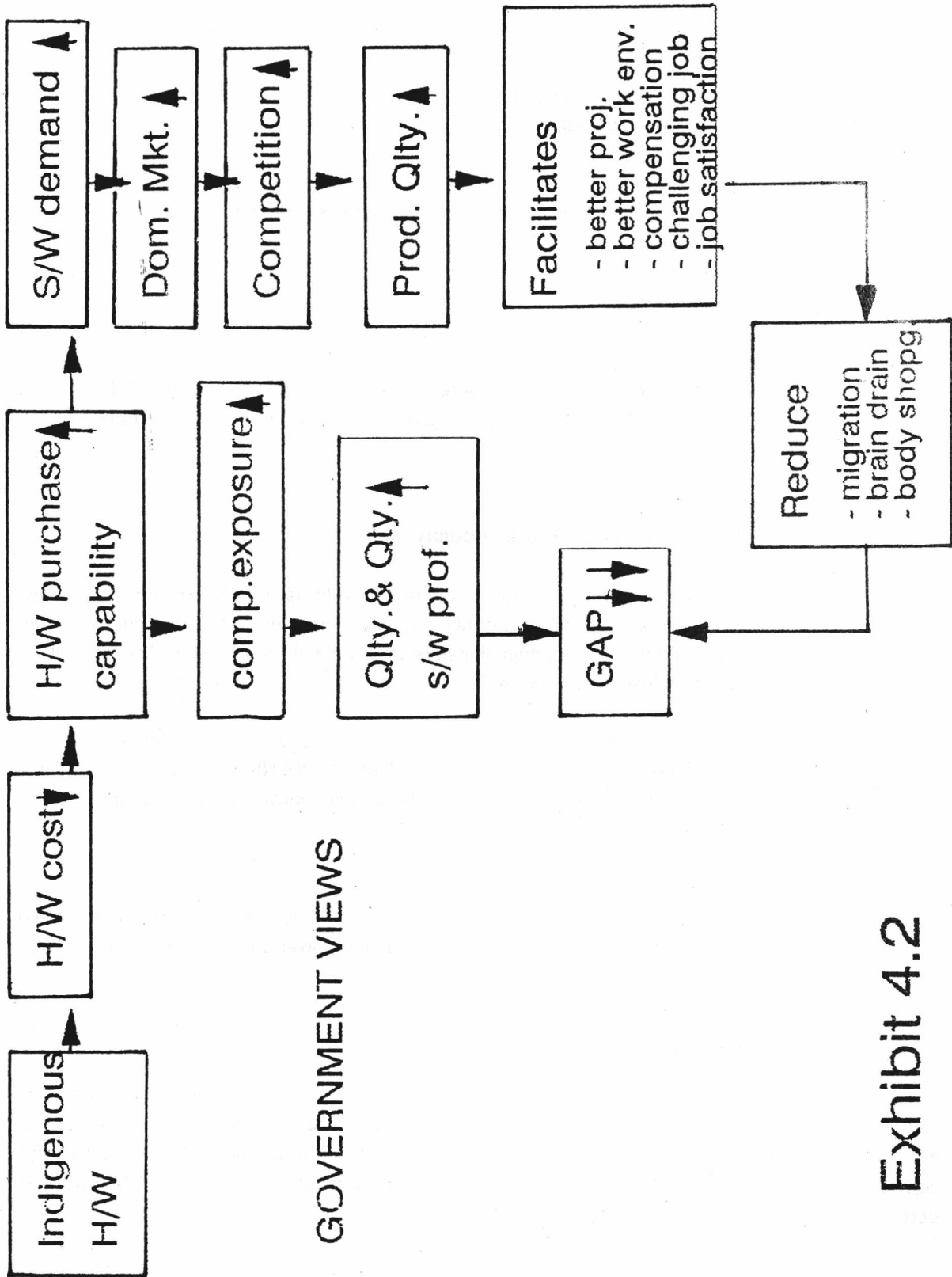
Exhibit 4.2

The Eighth Plan document estimates software requirements and the demand-supply gap of the various categories of software professionals to be as follows:

Demand Supply Gap

Category	Requirement	Supply	Gap
Ph.D	255	240	15
M.Tech	14,355	2,500	11,855
B.Tech	23,945	7,000	16,945
MCA	40,040	18,000	22,040
DCA	98,880	80,000	18,880
DCE	18,340	7,000	11,340
TOTAL	1,95,815	1,14,740	81,075

To fill this gap many of institutions both in the formal sector and informal sector have come up over the last two years. An estimated 500 institutes in the formal sector offer programs in computers while DOE has approved only 250 of these. In the informal sector also computer training institutes have sprung up in large numbers, and have been likened to typewriting institutes by industry people. This has led to the decreasing quality of output and would have to be made more organized and monitored for their output. The DOE, MAIT etc. are already involved in such activity and there is a trend to form more professional bodies representing various category groups in the industry. This, if done in a regulated manner can ultimately be to the benefit of the industry.

4.11.2   Skills   Identified

a)   Skills required for this industry in the next five years have been identified as:

-    Specific H/W and S/W environment knowledge with real   life project experience.

-    Productivity tools and performance enhancement tools.

-    System Analysis design and development methodology.

-    Software project management.

-    Software quality assurance and optimal   code generation.

-    Software re-engineering methodologies.

-    Documentation standards and practices.

-    Networking and communication experience and concepts.

-        Specific application knowledge in the areas of:

. Expert Systems/Artificial Intelligence
. CAD/CAM/CAE
. DTP
. GIS
. MIS
. DP/TP/OLTP.

-        International Marketing and familiarity with foreign   cultures.

These skills have been identified on the basis of likely trends in the software industry as discussed in Chapter 3 (reference 3.11).

b)   There is no body/forum currently involved in training manpower on these skills. Training based on needs has been taken up by individual organisations concerned in their area of expertise. In case of formal education institutions the current programs provide the required conceptual orientation but lack exposure to skill upgradation in specific areas. Private institutes play the marginal role of training in low end applications and software. There is a need for institutions to take up comprehensive training and development of skills outlined above.

CHAPTER 5

RECOMMENDATIONS

Based on the findings of the field survey and the inferences therefrom, recommendations have emerged to achieve optimum utilisation and development of software professionals. The recommendations have been specifically targeted to the Government bodies/institutions, the Software industry and Training Institutes.

5.1 To be Implemented by the Government

5.1.1 Consolidate Computer Courses Offered by Institutions

The Government should provide catalytic support in enhancing the curricula of various courses offered by the training institutes. This is very important in view of the need to keep training and knowledge of software professionals in step with the advances being made in the area of Software.

Attempts should also be made to mobilize mass education programmes during holidays and after office hours. This would be necessary to orient the professionals as well as students towards the requirement of the industry.

Television should also be used to disseminate knowledge in the area of software through programmes on the National Network. This should be supplemented with text books and case studies relating to the Indian environment.

5.1.2 Standardize existing courses offered by private institutions

Since this is the largest source of supply of manpower for the software industry it is of vital importance that the courses offered by them are of a specified standard. Therefore, a standard curriculum should be issued to these institutions and a regular follow-up system implemented to monitor their activities. This curriculum should be regularly updated to suit industry needs. Such a policy would benefit students who are unable to avail of the education offered in premier institutions.

5.1.3 Set up an agency to develop curricula and update it on a continuous basis

a) This agency or Board should have representation from training institutions both formal and informal, Industry representation from hardware/software firms and EDP cells, Government representation from DOE, DST, MHRD, Department of Education etc. This agency can act as a platform or forum where concerned sections of the industry, can formulate policies to develop better manpower and outline the degree and nature of interaction required, commitments to be made in terms of resources, project, research, funding etc. to achieve it.

b) One of the suggested approaches to proactive curriculum development is as follows:

Segment software development technology into five stages namely:

1. Theoretical or pre-R&D .
ii. Research and Development .
iii. Prime or state-of-the-art technology .
iv. Implementation .
v. Technology Phasing out .

The curriculum design for training in software technology should be oriented towards stages **(ii.)** and **(iii.)** above in addition to stages **(iv.)** or **(v.)** as of now.

This would ensure that the training imparted to professionals qualifies him to work in the software industry. This allows sufficient lead-time for the individual to immediately fulfill all the professional requirements.

5.1.4   Implement policies that have been ear-marked for this industry at the earliest possible

There are many policies that the Government has in mind for the progress of this industry. Some of these include :

- Providing incentives like excise duty concessions , easy availability of foreign exchange, etc. to private institutions.

- Sponsored projects for setting up computer education centers within publicly funded education institutions.

- Setting up of a Software Standards Institutes based on the ISO 9000 series which should be adopted as the defacto standard. Industry should be helped in setting up their own Quality programmes and build a commitment towards it and integrate it along with other Software development activities. The culture of Quality software at economical rates should be the objective of the software industry.

The implementation of these schemes should be speeded up so as to check the increasing demand supply gap.

5.1.5   Evolve a policy to retain highly skilled manpower within the country

This policy should not necessarily attempt to debar people from going abroad but should aim at retaining them within the country by providing better infrastructure and work environment. The people in the industry believe that most of the professionals leaving the country for opportunities abroad would want to return back to settle in India. This is more often due to family commitments but a few of them also return because of adjustment problem in the foreign society. These professionals upon returning to India find themselves as misfits on the job because of difference in work environment and infrastructure. These differences and gaps must be removed to accommodate such people. They must also be invited and assisted in setting up their own software units in the country.

5.1.6 Simplify procedures involved in setting up Software development units within the country.

The investors setting up units find themselves in a procedural maze. The procedures involved in setting up units which are solely owned by Indians or NRIs, Joint venture units, units with foreign participation, and units solely owned by overseas investors at least in the Export processing zones and Technology parks need to be made simpler. The procedures for bringing in hardware and software must be made transparent. The legalities involved in taking out capital from the country need to be reviewed and relaxed.

5.1.7 Rejuvenate CLASS or similar program on computer literacy

The U.K. aided CLASS program has not been very successful. The objective of such a program is commendable and would generate computer awareness at the school level. This program must be rejuvenated and IBM compatible PCs must be provided to these institutions maintaining a suitable computer to student ratio. The reach of this program must be expanded to cover all schools in all the districts.

5.2 To be implemented by the Software Industry

5.2.1 Improve training infrastructure and invest more in training

Industry must improve its training and development infrastructure. It is the inherent responsibility of the Software industry to train and develop its own people and become a trendsetter. This should also encompass training abroad where it is necessary. It would also act as motivator by satisfying an employee's urge to go abroad. A few companies spend as much as 15% of their turnover on training as compared to others whose spending on training is negligible. Companies presently having a low investment in training should make conscious effort in improving their training infrastructure.

5.2.2 Improve the working environment and remuneration of software professionals.

The industry should make attempts to provide a better work environment to software professionals. The phenomena of migration of software professionals abroad can be slowed or may even be reversed if the industry takes specific measures in this regard. These could be in terms of providing an opportunity to work on the latest hardware platforms, software packages and providing better remuneration and incentives linked to performance. Furthermore, companies deploying their software professionals overseas should make their compensation package more attractive. This would prevent flight of talent to other countries.

Software development is essentially a desk job. Sports and recreation are especially required to keep employees tuned to their job. Periodic health checkups for effects of terminals on eyesight etc. are the moral responsibility of the Company.

5.2.3 Increase the productivity of software professionals.

The productivity of software professionals can be improved to derive a higher revenue realization per person. The current rate worked out by NASSCOM is only Rs. 1,95,000. Productivity of software professionals can be raised if they are trained in software re-engineering and optimal code generation methodologies. This productivity improvement could also help reduce the demand supply gap.

5.2.4 Discourage one room body shopping business

Those bodyshoppers identified as one room operators trading in biodatas have evoked a negative response from most respondents. The activities of such bodyshoppers should be curbed and they should be made to join the mainstream software development. It is their responsibility to train and educate manpower rather than look at short term profits.

5.2.5 Train people from other functional areas to Software development

According to manpower estimates we find that there is a demand supply gap for software professionals. This gap in the case of application software can be reduced by bringing in trained manpower from other functional areas with the requisite end-user application knowledge into software development. This would be made simpler today because of the availability of fourth generation language tools.

5.2.6 Train and develop manpower in International Marketing skills and allied areas

The industry should make specific attempts to develop manpower skills in the areas of international business and marketing. This would further aid in promoting software exports. The technical skills of Indian software professionals are well known internationally. However, greater emphasis should be placed on learning foreign languages, studying overseas markets, and making conscious efforts to develop a familiarity with foreign cultures and traditions.

5.3 To be implemented by the Training Institutes

5.3.1 Overcome shortage of trained faculty in computer education

There is at present a shortage of fully qualified teachers in the computer discipline. Since it is vital that this problem be rectified, intensive computer training should be provided to teachers of other related disciplines who are interested in computer education. Faculty with specialization in mathematical or physical sciences or any branch of engineering should be sponsored for such courses.

Retired industry professionals can be attracted to take up faculty positions. Industry professionals can also be attracted to take up multiple short term tenures over a period of say ten years, at the university and undertake their Ph.D, while simultaneously involving themselves in teaching and research.

In order to attract talented and skilled Software professionals, the salaries of these individuals should be linked with the Fees that are charged to the students.

5.3.2 Enhance Industry - Institution interaction

Institutions should continuously seek information from the computer industry on developments and needs of the buoyant computer world. More interaction is needed between training institutions and the industry. This interaction could be enhanced by the following:

a. Short term exchanges between Industry and Institutions

Professionals from the industry should be encouraged to take up multiple short term tenures in the university and work towards a Ph.D. Similarly, university faculty must also be encouraged to take up summer positions in the industry and at R&D institutions.

b. Mandatory Industry projects for students

The universities should organize a six month industry project for all students and make it a mandatory requirement of the curriculum. The project work should be jointly evaluated by the university faculty and the industry project leader. This would provide university and industry real time information on requirements from and of either fronts. This is practiced only for B.Tech/B.E/MCA students at the present.

c. Retired Industry experts to Institutions

The age profile of the teaching community is as such very high and would not be affected by attracting retired industry professionals for teaching with tenures of around two to five years. This would help solve the faculty shortage problem and also make the student output more relevant to industry requirement from both the technical and personality development point of view.

5.3.3 Encourage faculty exchange between Institutions

There should be a means for faculty exchange between institutes of excellence and other universities. This can bridge the differences in the quality of instruction between such institutes. There must also be mandatory summer workshops/courses periodically for the second and third tier university teachers at the institutes of excellence. This would transfer teaching skills and also upgrade the knowledge base of the teachers. They must also be funded for attending seminars and workshops in their specialized areas. Organizers also need to subsidize these for the teaching community.

5.3.4 Introduce mandatory computer courses at High Schools and Colleges

Private institutes are making school and college students computer literates with minimal computer awareness at an exhorbitant cost. This role should be taken up by our schools and colleges themselves. Today computers is an optional stream at the Senior Secondary level. It should rather be an essential course along with science, maths and history in our high schools.

5.4 Suggested Further Studies

This study was based on the perceptions of the employers of Software professionals in various segments of the industry. It is suggested that further studies be undertaken where the views and perceptions of software professionals are analyzed in specific areas like :

- job satisfaction and commitment
- level of motivation
- employees' views on promotion policies and compensation
- employees' views on body shopping and overseas deployment, and
- employees' views on career planning and development.

A study should also be undertaken to ascertain the total current and projected strength of software manpower in the country. In order to ensure accuracy in this type of study, a survey of all the companies and institutions employing software professionals should be undertaken.

APPENDIX - A

TO WHOM IT MAY CONCERN

The Department of Science and Technology (DST) vide letter No. STS/05/10/90-DST dated 14.2.91 has requested Tata Consultancy Services (TCS), to undertake a study on "Employment Characteristics of Software Manpower".

To conduct this study, TCS will approach you with a questionnaire. DST requests you to co-operate in furnishing information which is required for this Study.

May we stress that the results and conclusions of this Study will be freely available and that this Study will not be to TCS's advantage in any manner.

Looking forward to your co-operation.

Yours sincerely,

(A.R.Rajeswari)

APPENDIX - B

DEPARTMENT OF SCIENCE & TECHNOLOGY / TCS STUDY ON
EMPLOYMENT CHARACTERISTICS OF SOFTWARE PERSONNEL

Name of the Company :

City   :

Date   :

****

1.   What are your areas of business ? Which business
      would you describe as your principal line of business
      ?

      - H/W

      - S/W

2.   What is the strength of software professionals
      currently employed by your firm ?

      - System Analysts

      - Programmers

      - Data Entry Operators cum Programmers

      - Software Marketing

      - Others

3.   What is the percentage of S/W professionals to total
      employees ?

4.   What is the projected demand of S/W Professionals in
      the next five years ?

5(a). Indicate the principal sources of recruitment.

  - Universities

  - Polytechnics

  - Autonomous Institutions (IIT, IIM)

  - Private Institutes (NIIT etc.)

  - REC's

  - Others

  - From Other Cos

5(b). What is the recruitment methodology ? Do you conduct exit interviews ? Do you feel that there are gaps between industry needs and knowledge base of entrants ?

6. What are the main areas of placement within the Co.? What are the criteria ?

  - Application

  - Maintenance

  - Others

7. What are the range of salaries paid ? What are the non-statutory perks offered by your Firm ? How many levels of hierarchy are there ? What is the level of job satisfaction ? What is the level of commitment ?

8. How often can a person expect a promotion ?

9. How do you define body shopping ? What are the factors affecting body shopping, and how can we remove it ? What are the effects of body shopping ? Any cures/remedies ?

10. Do you deploy personnel overseas ? What are the effects of overseas deployment ? What is the employee reaction to overseas deployment ? Have you considered a high-speed datalink as a viable alternative ?

11. What are the factors affecting migration abroad and what are the effects of migration ?

12. What are the existing policies regarding motivation satisfaction and growth ?

13. Do you impart In-House/External training ? What levels qualify for training ? What is your opinion about training facilties in India ?

DEPARTMENT OF SCIENCE & TECHNOLOGY/TCS STUDY ON EMPLOYMENT CHARACTERISTICS OF SOFTWARE PERSONNEL

Name of the Firm   :

City   :

Date   :

****

1.   What is your principal line of business ?

2.   What is the strength of Software Personnel in your Co. ?

      What is the total strength of empoloyees ?

      (a) System Analysts
      (b) Programmers
      (c) Data Entry Operators cum Programmers
      (d) Software Marketing
      (e) Others

3.   What are the main sources of recruitment ?

      (a) Universities
      (b) Polytechnics
      (c) Autonomous Institutions (IIT, IIM)
      (d) Private Institutes (NIIT etc.)
      (e) REC's
      (f) From other Co's
      (g) Others

4.   Where are the Software Professionals placed within the Co. (Indicate Departments).

5.   What is the range of salaries offered to Software Professionals ? How do they compare with non-software persons in your Firm ?

6.   What are the Promotion prospectus for Software Professionals. To what level of hierarchy can they rise/have risen ?

7.   Do you deploy personnel overseas ?

8.   What are the observations on levels of productivity ?
     What are the salaries/perks ?

9.   What are the policies for motivation, job
     satisfaction and growth ?

10. How do you train software manpower ? Do you offer in-
     house or external training programs ?

     - Programming

     - Analysis & Design

     - RDBMS

     - Others

DEPARTMENT OF SCIENCE & TECHNOLOGY / TCS STUDY ON
EMPLOYMENT CHARACTERISTICS OF SOFTWARE PERSONNEL

Name of Institution :

City   :

Date   :

****

1.   How long ago did you start training ?

2.   How many Software Personnel are involved in your
     organisation for the following courses ?

     - System Analysis

     - Programming

     - Software Marketing

     - Others

3.   Where do you recruit your manpower from ?

     - Universities

     - Polytechnics

     - Autonomous Institutes (IIT, IIM)

     - Private Institutes (NIIT etc.)

     - REC's

     - From other Firms

     - Others

4.   How do you allocate subjects to be taught by manpower ?

     - Qualification

     - Work Experience

     - Others

B-6

5. What are the maximum/minimum salaries ? Do you feel training is a "paying" profession ? What are the perks offered ? Do you feel that trainers are a satisfied community and what can you tell us about the level of their commitment ?

6. What are the avenues for growth in this profession ?

7. Are you affected by body shopping ? What are the effects of body shopping ?

8. Do you deploy your faculty overseas ?

9. Are you aware of migration abroad in the profession ? What are the effects of migration ?

10. What is the level of productivity in the profession ?

11. What are the existing policies for motivation, job satisfaction and growth ?

12. How do you train your trainers ?

13. What type of courses do you offer ? Are they In-house or External ?

   - Programming

   - Analysis & Design

   - RDBMS

   - Others

APPENDIX - C

LIST OF COMPANIES INTERVIEWED

SOFTWARE   COMPANIES

ITC LIMITED	BANGALORE
TEXAS INSTRUMENTS	BANGALORE
SIBA SOFTWARE	BANGALORE
C-DAC	BANGALORE
INFOSYS	BANGALORE
BEL	BANGALORE
MASTEK (PVT) LTD	BOMBAY
TCS	BOMBAY
MCS LTD	BOMBAY
TATA UNYSIS LTD	BOMBAY
KALE CONSULTANTS	BOMBAY
ABACUS COMPUTERS (P) LTD	BOMBAY
PATNI COMPUTER SYSTEMS (P) LTD	BOMBAY
OMEGA SOFTWARE (P) LTD	CALCUTTA
DPS (PVT) LTD	CALCUTTA
ITC SOFTWARE	CALCUTTA
LOVELOCK AND LEWES	CALCUTTA
VEDIKA SOFTWARE	CALCUTTA
SRITEK	MADRAS
BITECH	MADRAS
ULTRA BUSINESS MACHINES	MADRAS
DSRC	MADRAS
ISIL	MADRAS
PRICE WATERHOUSE	NEW DELHI
J K TECHNOSOFT	NEW DELHI
TCIL BELLSOUTH	NEW DELHI
CITIBANK	BOMBAY
CONFIDENTIAL *	NEW DELHI

HARDWARE   COMPANIES

SUNRAY COMPUTERS	BANGALORE
WITL	BANGALORE
PSI DATA SYSTEM	BANGALORE
MICROLAND	BANGALORE
DYNALOG MCROSYSTEMS	BOMBAY
SARA ELECTRONICS	BOMBAY
ZENITH COMPUTERS	BOMBAY

* - The respondent requests anoynimity

BYTE SYSTEMS	CALCUTTA
OMC COMPUTERS	HYDERABAD
VISION LABS	HYDERABAD
INDCHEM	MADRAS
STERLING COMPUTERS	MADRAS
MODI OLIVETT I	NEW DELHI
DCM DATA PRODUCTS	NEW DELHI
ET&T	NEW DELHI
HCL	NEW DELHI
HEWLETT-PACKARD	NEW DELHI
MEERA COMPUTERS	NEW DELHI
UPTRON LTD	NEW DELHI

EDP CELLS

TITAN WATCH LTD	BANGALORE
BEL	BANGALORE
UNIT TRUST OF INDIA	BOMBAY
GTC INDUSTRIES	BOMBAY
LARSEN & TOUBRO LTD.	BOMBAY
CITIBANK N.A.	BOMBAY
HINDUSTAN LEVER LTD	BOMBAY
AVERY (I) LTD.	CALCUTTA
RECKITT AND COLEMAN	CALCUTTA
BHADRACHALAM PAPERBOARD	HYDERABAD
BAKELITE HYLAM	HYDERABAD
MANINDRA LTD	HYDERABAD
ASHOK LEYLAND	MADRAS
SUNDARAM CLAYTON	MADRAS
CITIBANK N.A.	NEW DELHI
JK TYRES	NEW DELHI
ASIAN HOTELS LTD	NEW DELHI
BILT	NEW DELHI
INDIAN AIRFORCE	NEW DELHI
MTNL	NEW DELHI
BHEL	NEW DELHI
C-DOT	NEW DELHI
CRIS	NEW DELHI
EIL	NEW DELHI
RITES	NEW DELHI
CLASSIFIED AGENCY	NEW DELHI
SIEMENS	NEW DELHI
BAJAJ AUTO	PUNE

FORMAL TRAINING INSTITUTIONS

AUTONOMOUS INSTITUTES:

INDIAN INSTITUTE OF SCIENCE	BANGALORE
INDIAN STATISTICAL INSTITUTE	CALCUTTA
INDIAN INSTITUTE OF MANAGEMENT	CALCUTTA
INDIAN INSTITUTE OF TECHNOLOGY	NEW DELHI

UNIVERSITIES & RECs:

VJTI	BOMBAY
JNTU	HYDERABAD
IETE	NEW DELHI
DELHI UNIVERSITY	NEW DELHI
REC	WARANGAL

INFORMAL TRAINING INSTITUTIONS

CCIT	BOMBAY
BITS	BOMBAY
LAKHOTIA COMPUTER CENTRE	CALCUTTA
VIDYASAGAR ACADEMY	CALCUTTA
ACE	HYDERABAD
DATAPRO	HYDERABAD
BRILLIANT TUTORIALS	MADRAS
DATAMATICS	MADRAS
ACE	JAIPUR
DATAPRO	JAIPUR
A-PROMPT	JAIPUR
ICS	NEW DELHI
APPLE COMPUTER EDUCATION	NEW DELHI
ISCT	NEW DELHI

INSTITUTIONS RESPONDENTS

NCST	BOMBAY
DST	NEW DELHI
DOE	NEW DELHI
CSI	NEW DELHI
MAIT	NEW DELHI
NASSCOM	NEW DELHI

APPENDIX - D

APPENDIX D.1

Categories of Personnel in Software Development

(EDP and Software Cos.)

	EDP	Software
Total No. of respondents	23	28
Total No. of S/W professionals	1029	5229
Systems Analysts	23.13%	19.6%
Programmers	48.4%	54.4%
Software Mktg.	1.74%	4.4%
Data Entry Op. cum Programmer	14.97%	8.4%
Others(Comp.Op., Trg.,Buss.Analysts.)	11.76%	13.2%

Categories of Personnel in Software Development

(Hardware Cos.)

Total No. of respondents	:	18
Total No. of S/W professionals	:	1911
Support	:	25.96%
R & D	:	52.96%
Others (MIS, Trg., S/W Mktg.)	:	21.08%

APPENDIX D.2

Projected Demand of Software Professionals

Range	Average Growth (%)	
	Hardware	Software
> 200 empl.	15	36.24
50-200 empl.	15	52.97
< 50 empl.	83.20	110.70
Overall Growth Rate	30.50	41.94
Total No. of Professionals in Sample	1911	5229
Projected No. of Professionals Next Year	2494	7422

APPENDIX D.3

Sources of Recruitment of Software Professionals

	H/W	S/W	EDP	Pvt.Inst.
Total no.of respondents	14	16	14	13
Experienced professionals	49.1%	45.6%	67.1%	45.0%
Freshers				
a. Autonomous Inst.	9.0%	24.5%	10.6%	13.3%
b. RECs	12.3%	6.6%	4.5%	3.1%
c. Univs. (Engg.)	19.2%	16.3%	10.6%	18.2%
d. Pvt. Inst.	5.4%	1.6%	1.4%	20.4%
e. Others (MCAs,MBAs, from Univs.)	5.0%	5.4%	5.8%	-

APPENDIX D.4

Performance Based Promotions - S/W Cos.

Yes	:	22
No	:	2
No Response	:	4

Salary Scales of Software Professionals

(in Rs. per month)

	H/W	S/W	EDP	IFT	FT
Maximum	11,000	21,000	25,000	10,000	10,000
Minimum	1,200	1,500	1,600	1,000	2,200
Avg. Entry level(large)	3,525	3,510	-	-	-
Avg. Entry level(small)	1,850	2,000	-	-	-
Avg.Min.	2,735	2,960	3,010	1,850	3,520

Entry level salary

	H/W	S/W	EDP	IFT	FT
Less than Rs. 2000	1	5	3	1	Nil
Rs.2000 to Rs.3000	5	6	9	4	2
Rs.3001 to Rs.4000	8	12	6	Nil	6
Rs.4001 to Rs.5000	2	1	2	Nil	1
Avg. Max.	-	7,130	10,675	6,070	8,625
Range-Entry Level	1,200 to 5,000	1,500 to 4,600	1,600 to 4,300	1,000 to 3,000	2,200 to 4,500

Legend : IFT - Informal Training Institutes
FT - Formal Training Institutes

APPENDIX D.6

Levels of Hierarchy

	H/W	S/W
Small & New Org.		
Average No. of Levels	5	5
Range	4 - 7	3 - 8
Established Org.		
Average No. of Levels	7	6.7
Range	3 - 10	3 - 12
No response	5	6

APPENDIX D.7

Deployment of Software Personnel Overseas

	YES				NO
	Trg.	Proj.	Studies	Others	
H/W (18)	8	5	-	-	8
S/W (27)	6	20	-	-	4
EDP (23)	5	6	-	1	12
Auto.Inst. (4)	1	-	1	2	2
Univs.&RECs (5)	-	-	1	-	4
Pvt. Inst. (13)	-	-	-	3	10

Note: Figures in parentheses indicate total number of respondents. Total may not match sum of positive and negative responses due to overlap.

Training for Software Professionals

	H/W	S/W	EDP	Pvt.Trg.	Aut.Inst.	Univ.&REC
Formal In-house	15	24	16	9	1	2
Only Trg. on the job	nil	nil	2	4	nil	nil
External Trg.	10	18	18	3	1	2
No Trg.	1	1	1	nil	2	1
No. Response	1	nil	2	nil	nil	nil

Necessity of Reorientation on the Job

	H/W	S/W	EDP
Required	12	16	8
Not Required	Nil	1	Nil
No Response	6	10	16

Major Training Inputs for Software Professionals in EDP Cells

RDBMS	:	10
Analysis & Design	:	10
Prog. Lang.	:	8
Other Trg.	:	6
No Response	:	8

Criteria for Course Allocation in Training Institutes

	Formal Trg.Inst. (9)	Informal Trg.Inst.(15)
Experience	5	8
Qualifications	8	5
Others (Commun. Skills, Interest, etc.)	6	5

Note: Figures in parentheses indicate total number of respondents. Total may not match sum of responses due to overlap.

APPENDIX D.10

## Industry - Institution Interaction in Training of Software Professionals

	Pvt. Inst.	Auto.Inst.	Univs.& RECs
Summer Proj.	Nil	3	1
Corp.Trg.	7	2	Nil
Internal Seminars + Guest lecturers from industry	3	4	Nil
External Seminars + Guest Faculty from Univs.	Nil	3	3
Research Proj.	1	3	1
Campus Recruitment	3	3	2
No Interaction	1	Nil	Nil
No Response	6	1	2

APPENDIX - E

APPENDIX E.1
MANPOWER DISTRIBUTION
(All Hardware Companies)

S/W 20.5%

H/W 79.5%

Manpower

Support 26.0%

Dev.& Research 53.0%

Others 21.1%
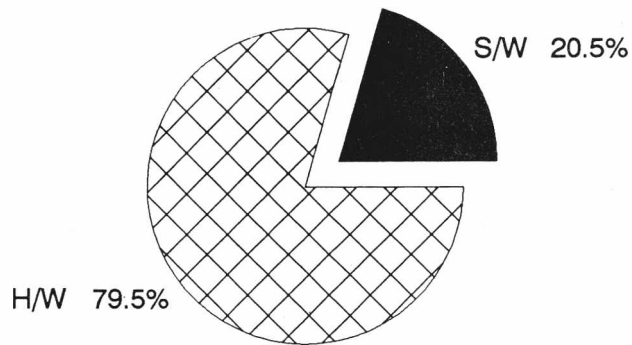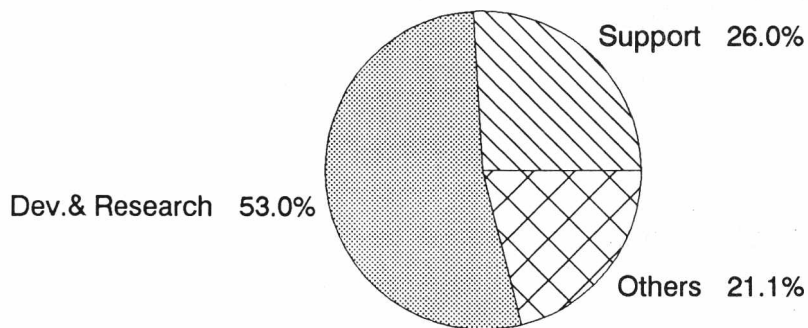
S/W Manpower

APPENDIX E.2
MANPOWER DISTRIBUTION
(70% of H/W Companies)

10.8%

89.2%

S/W

H/W
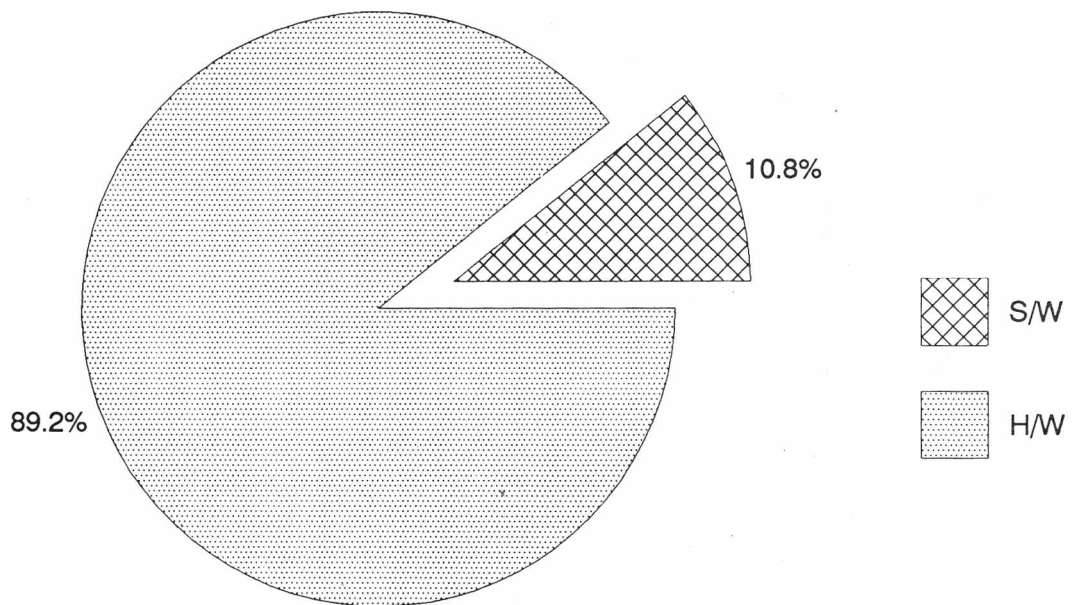
Manpower

APPENDIX E.3
SOURCES OF RECRUITMENT
(H/W Companies)

10.3%

9.1%

12.3%

19.2%

49.1%

Other Cos.

Universities

RECs

IIT,IIMs

Others
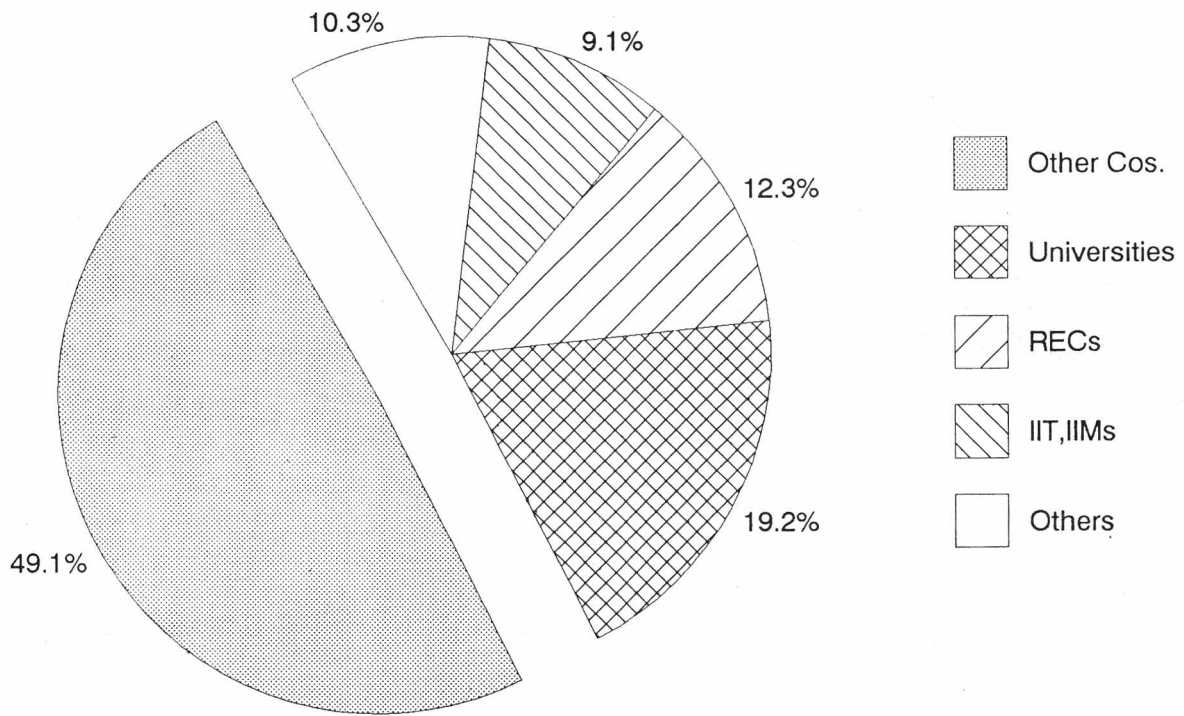
APPENDIX E.4
MANPOWER DISTRIBUTION
(All Software Companies)

13.2%   4.4%

19.6%   8.4%

System Analyst

Programmer

Data Entry operator

S/W Marketing

Others

54.4%
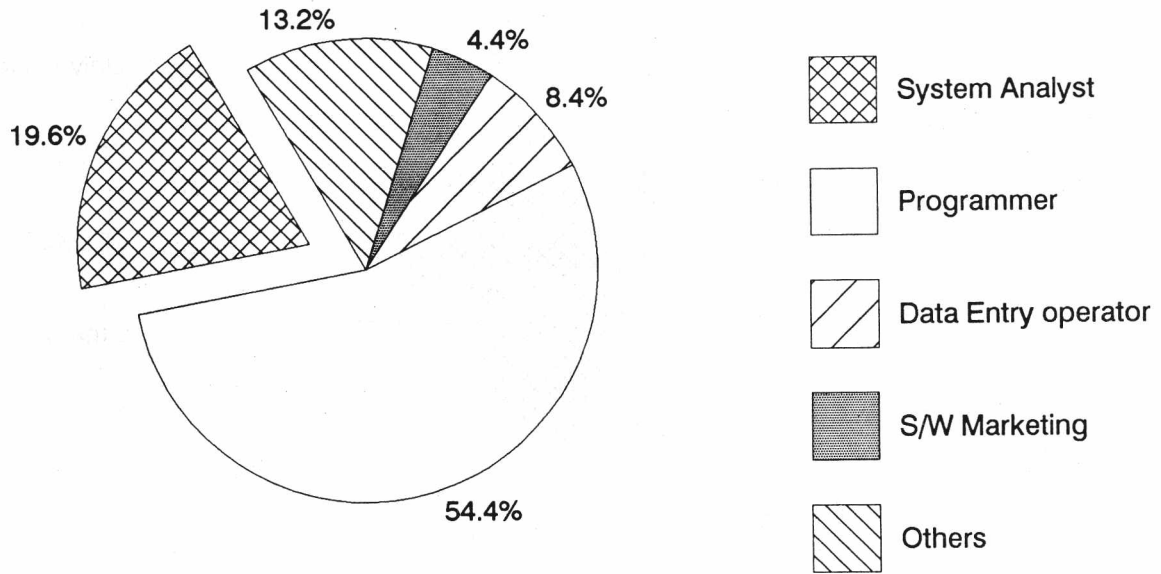
S/W Manpower

APPENDIX E.5
SOURCES OF RECRUITMENT
(S/W Companies)

Legend:
- Other Cos.
- Universities
- RECs
- IIT,IIMs
- Others
- Pvt. Inst.

5.4%
1.6%
24.5%
6.5%
16.3%
45.6%
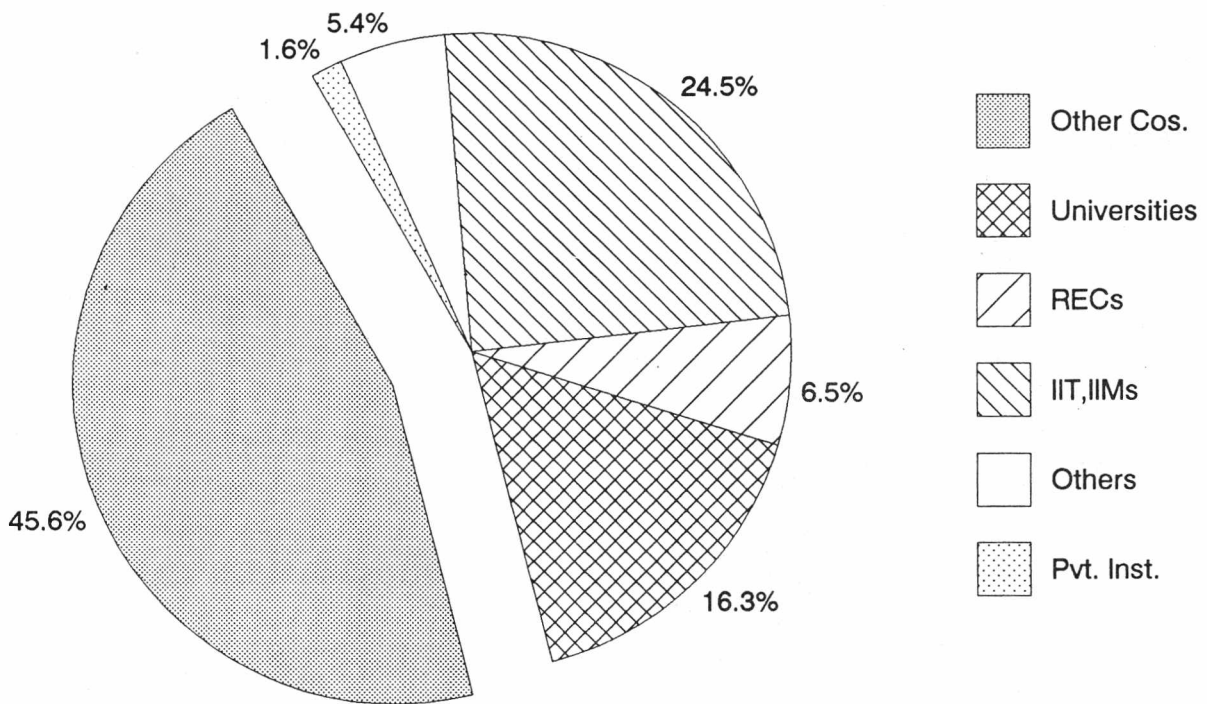
APPENDIX E.6
MANPOWER DISTRIBUTION
(EDP CELLS)

15.0%

48.4%

13.5%

23.1%

- Others
- System analyst
- Programmer
- Data entry op.
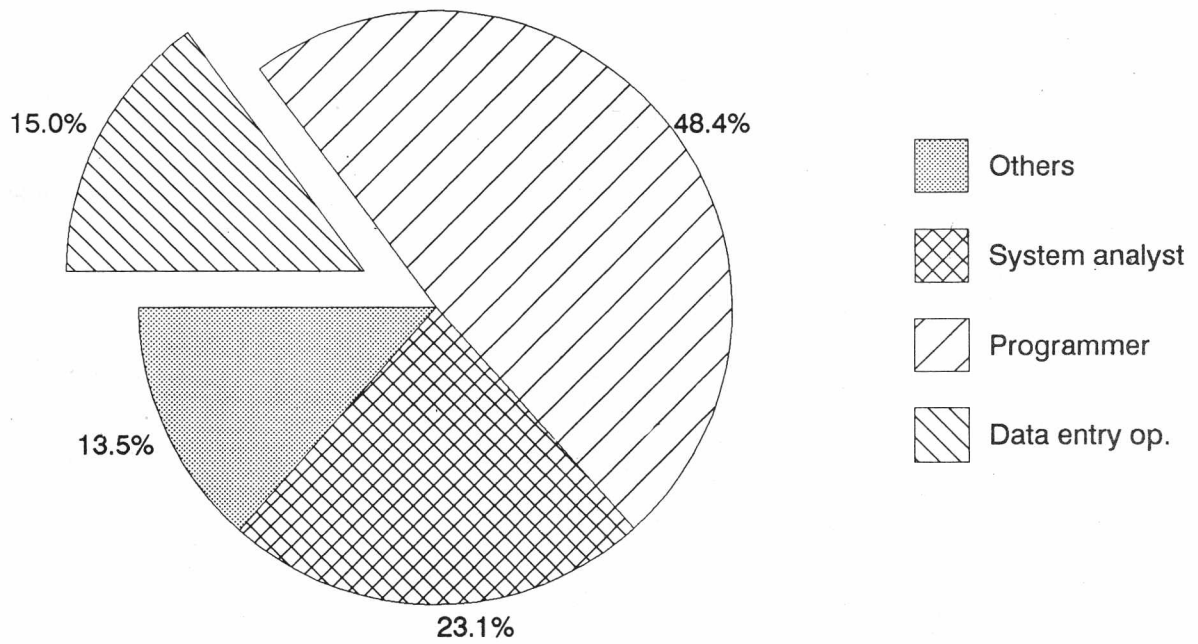
APPENDIX E.7
SOURCES OF RECRUITMENT
(EDP CELLS)

5.8%	
1.4%	10.6%
	4.5%
	10.6%
67.1%	

Legend:
- Other Cos.
- Universities
- RECs
- IIT,IIMs
- Others
- Pvt. Inst.
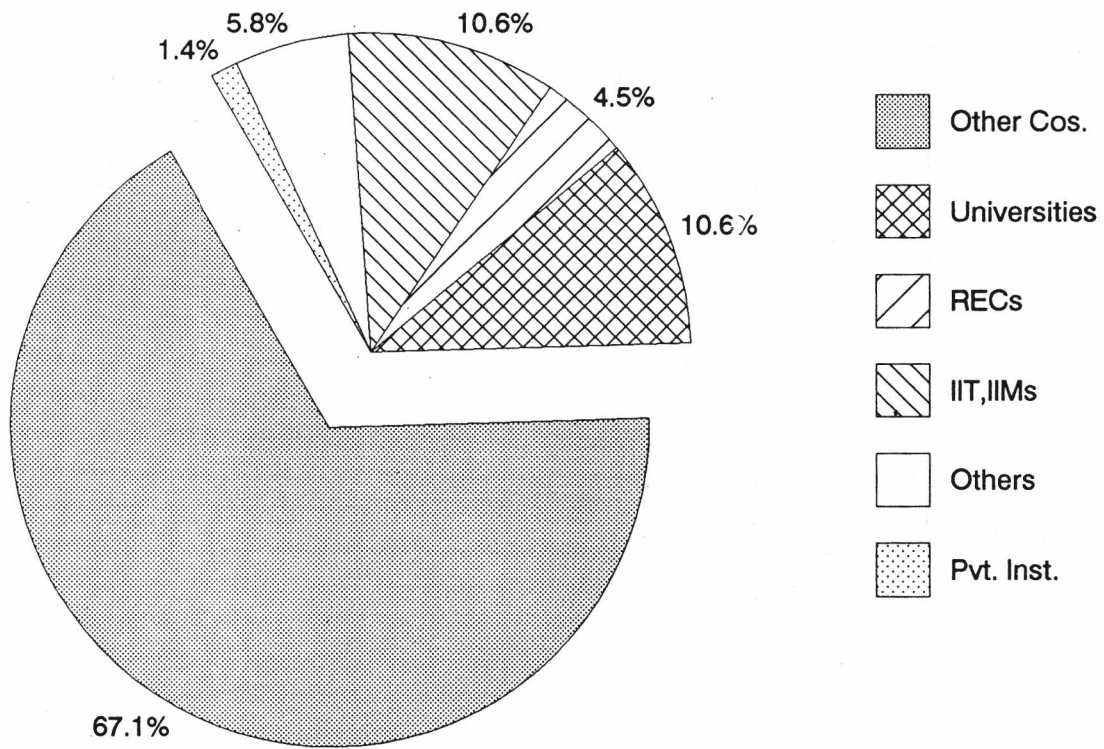
APPENDIX E.8
SALARY DISTRIBUTION

	Minimum	Maximum	Five year sal

Software Cos.
- 2,960
- 0
- 7,950

Hardware Cos.
- 2,740
- 0
- 8,025

EDP Cells
- 3,010
- 10,675
- 0

Private institutions
- 1,625
- 5,500
- 0

Rs.

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000
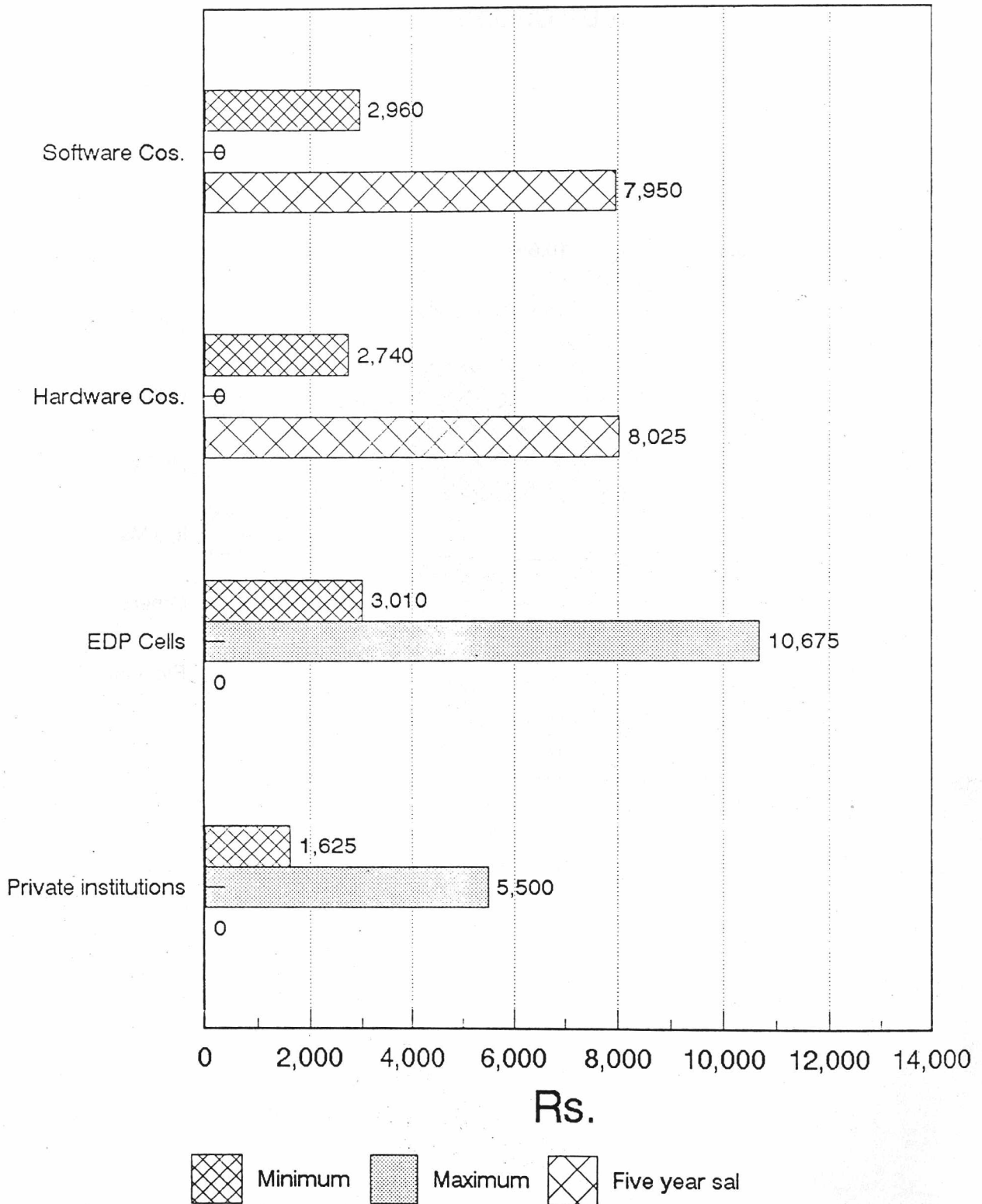
APPENDIX E.9
SOURCES OF RECRUITMENT
(Informal Training Institutions)

Pie chart segments:
- 20.4%
- 13.3%
- 3.1%
- 18.2%
- 45.0%

Legend:
- Other Cos.
- Universities
- RECs
- IIT,IIMs
- Pvt. Inst.
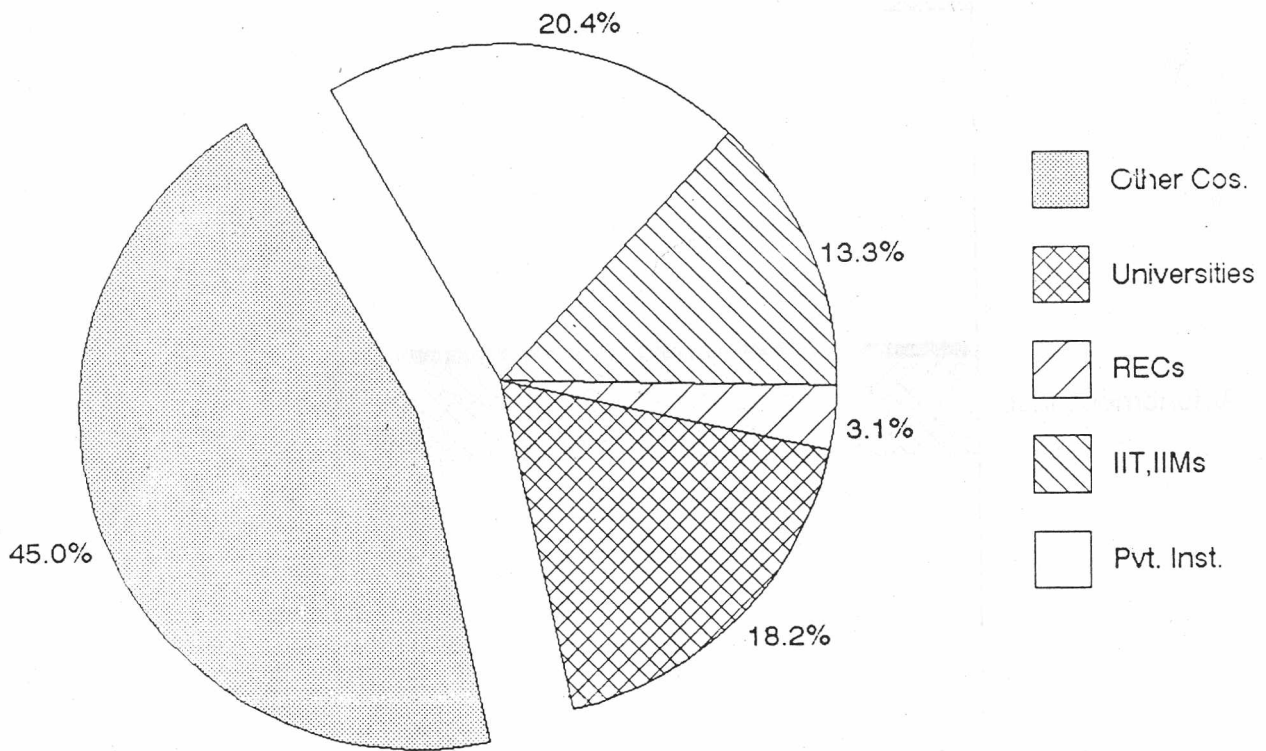
APPENDIX E.10
AVERAGE AGE OF INSTITUTIONS

Private Inst. — 5.9

Autonomous Inst. — 23.6

Univs & RECs — 7.6

Years
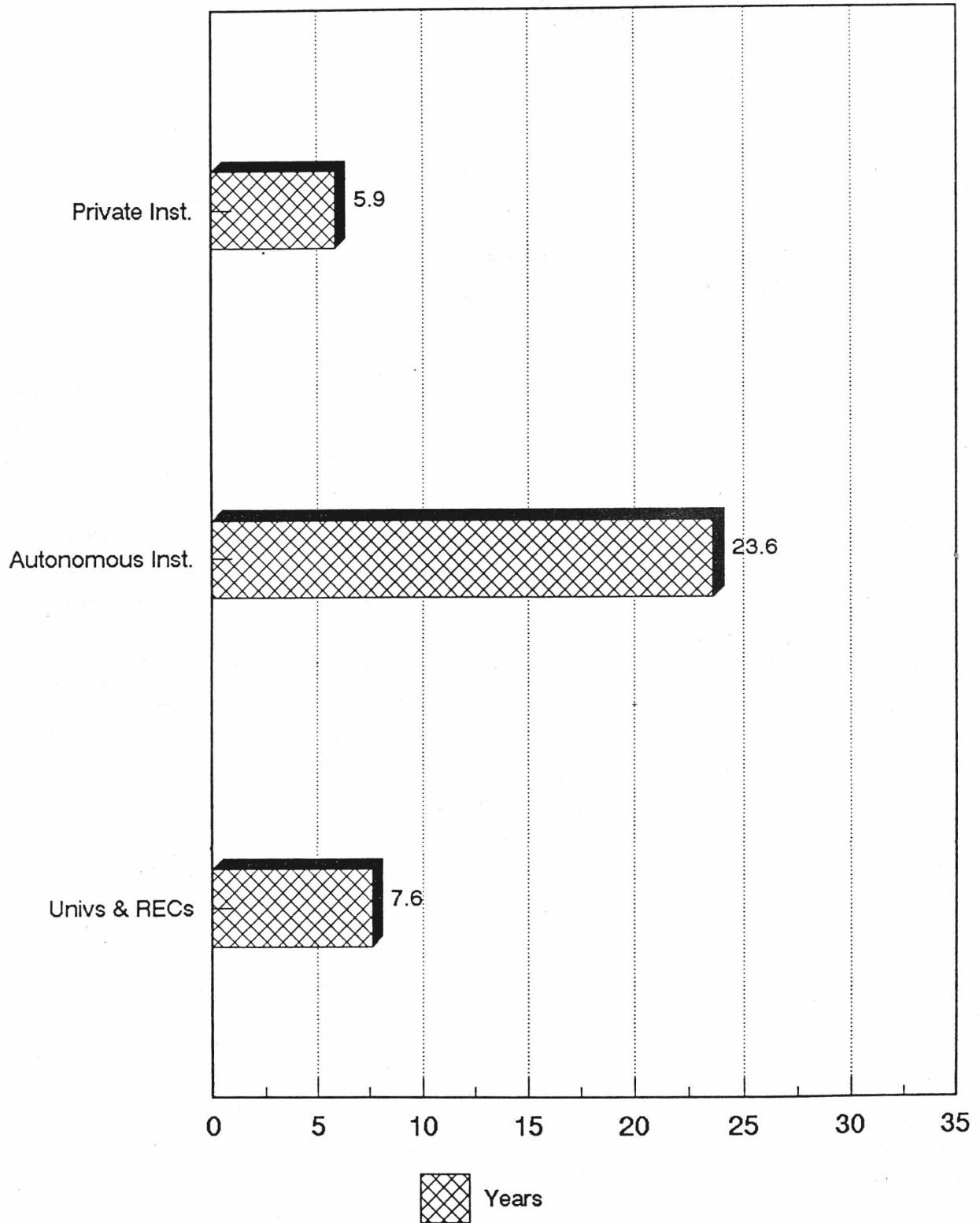
APPENDIX - F

LIKELY TRENDS IN SOFTWARE INDUSTRY

1.   Technology Parks

The trend of starting Software technology parks and Electronic technology parks has caught on in the country. Although, this seems to be a good developmental feature for the industry, there seem to be many lacunae in its implementation.

These parks must provide not just a high speed data link but also world standard hardware platforms. This hardware can be made available at commercial rate on time and material basis which could :

      i.   Maximize return over investment
      ii.   Reduce the export obligation of small entrepreneurs, and
      iii.   Improve effective usage of resources.

These Technology Parks are a concept taken from the ones in the U.S. like the famous Silicon Valley, Research Triangle, Route 128. These have been successful in the U.S. and the critical factors for their success have been identified as:

-    Strong research base through universities or research labs
-    Entrepreneural spirit
-    Venture capital.

Their operational stages are:

Stage 1

The research base would through its research and innovation deliver a prototype of a product to potential entrepreneur with the technological background to absorb the technology for a royalty.

Stage 2

The entrepreneur identifies a market, develops the product and customizes it to the requirements of the market and translates this research output into a commercially viable product. He seeks capital assistance for this from venture capitalists.

Stage 3

The venture capitalist tries to cash on this risk, based on the potential of the product and the credentials of the entrepreneur. To reduce the risk component all resources and infrastructure are shared by a number of entrepreneurs.

This low cost of development and manufacture was also one of the major factors for such products from technology parks to be successful thereby, ensuring success for the concept. Technology Parks, if controlled and managed by the private sector(as originally envisaged) would become an important center for resource sharing, thereby permitting the smaller software developers and exporters to have a cost-effective access to the markets.

None of these ingredients nor operational stages can be replicated in our country and hence a new concept to fit our specific requirements needs to be evolved. This should keep in mind that we can only begin at stage 2 of this cycle as we are not product innovation driven and are only in modification of tested products. We also cannot attract technocrat entrepreneurs. Venture capital is not available although other forms of capital are available if one is willing to go through a procedural maze after bringing in 25 % of project cost. Finally, pooled resources available are limited and hence, increase the cost of production and investment making the venture unattractive.

Thus, this trend should be assessed for its success before further commitments in this direction are made.

2. Domestic Market to International Market Co-relation

There is very little co-relation between the domestic market and the International market. This is because we are on different hardware platforms and software environments. Today the world market is based on proprietary hardware and software like IBM, DEC, HP etc. while the Indian market is based on Unix boxes.

The world market is split up as approximately 10% Unix based environment, which is expected to increase to 26% by 1993, and the rest being proprietary hardware of which IBM has 70 % of the market.

The global trend is towards open systems, Unix is moving towards open systems and other proprietary hardware software manufacturers like IBM,DEC,HP etc., are also moving towards it. This be the case, our domestic industry is in tune with the global trend and our export industry would be in conformity with it, if we provide accessibility to proprietary hardware and upgrade them with every new release.

3. Technology Lag

We lag behind other developed nations in all basic requirements of the computer industry. This lag is as low as six months to a year in Micro and Mini hardware/software. The lag is as high as a decade in the case of domestic and international communication infrastructure.

Drastic development in our communication infrastructure is needed, if we have to develop our domestic industry and make any major breakthrough in the international software market. The basic reason for overseas clients not giving offshore turnkey projects is that, they believe they have no control over the product development. This mistrust can be done away if there are communication links which would aid day to day monitoring of projects. This would also reduce the investment in hardware as people can develop sitting in India and keep testing it dynamically on the clients hardware overseas.

4. Export Strategy

A spectrum of activities has been identified in Exhibit F-1 and it has been found that moving up the spectrum implies maturity and development in the industry. This spectrum is as follows:

As an entry strategy we focused on onshore services but we must now consciously move up the spectrum. Even major players in the industry are still at fifth level of the spectrum. They are curtailed in moving up the spectrum because of lack of infrastructure (telecommunications), inacessibility of H/W and S/W platforms which are world standards (IBM, DEC, UNISYS, etc.).

A time lag in the availability of other H/W and S/W tools which improve productivity and reduce development time. This is where the government can help.

The industry will have to sort its own problems like:

a. Identifying needs/market potentials (niches) and tailoring products to cater to these niches.

b. Packaging these products well so that they are well documented, highly user friendly and very simple to use.

c. Shrinking the product development cycle and increasing the number of products developed so that the few successful products can overcome the high mortality rate and the investments involved in such developments and to bring profit margins.

5. Productivity Tools

The market has been flooded with packages designed to simplify the work of a programmer and monitor project progress. Such tools range from screen painters to Computer Aided Software Engineering Packages(CASE), Automated Standards Auditors, Code Generators and Debuggers. These tools will be used extensively in the future to speed up development and enhance quality.

6. Products

A large client base in India consists of small and medium sized businesses who are reluctant to spend a lot of money on customised software development. This market is effectively catered to by the various products available in the market. These products computerized, Sales & Distribution, Inventory and Materials Management. New additions include Business Managers and Expert Systems.

7. Code Re-usability, Software Libraries

Assuming that the more a piece of software code is used, the more reliable it becomes, companies are developing their own software libraries containing readily available code to reduce development time and effort. It may not be long before some of this software becomes Public Domain Software.
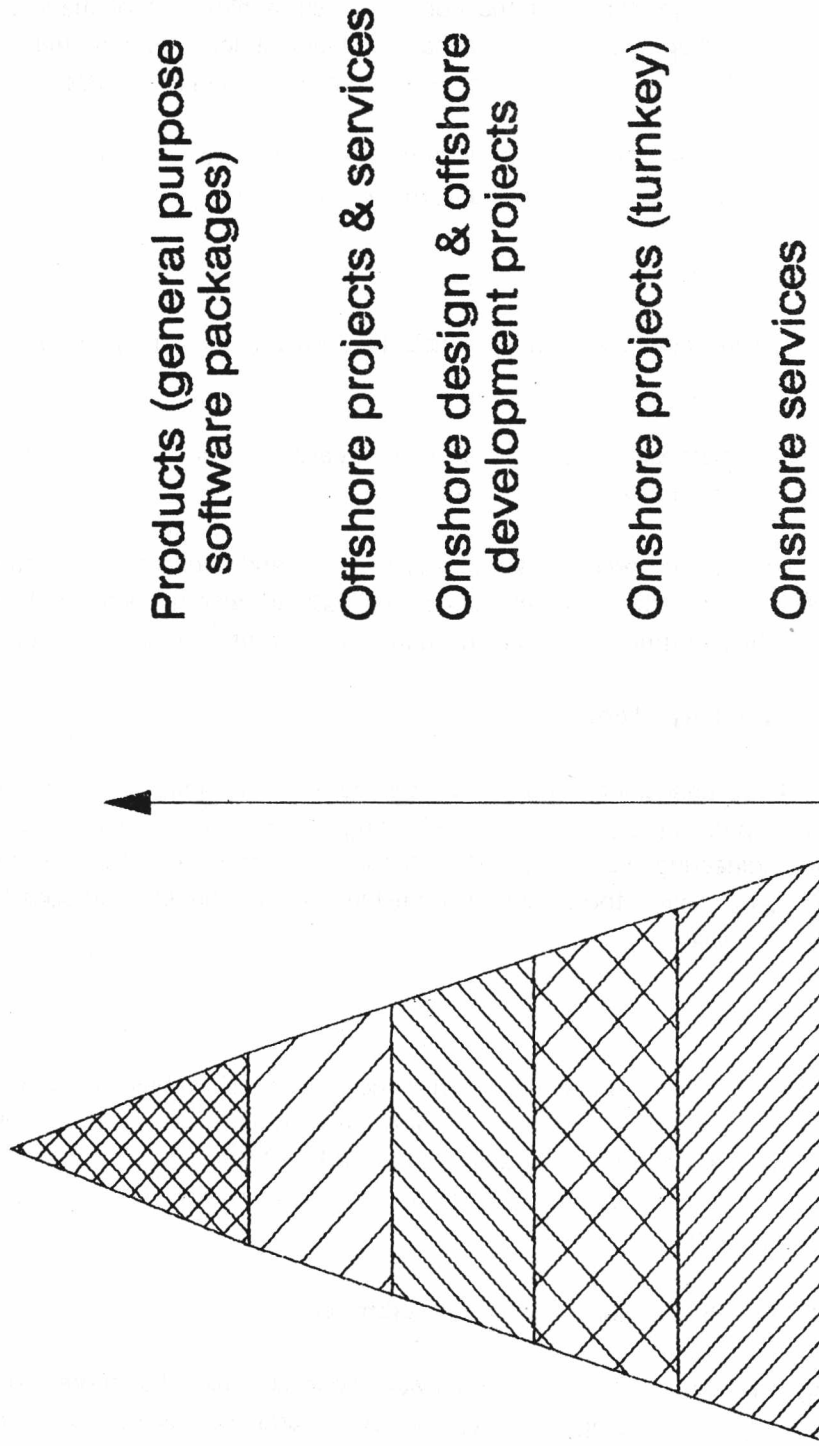
PRODUCT SPECTRUM

Products (general purpose software packages)

Offshore projects & services

Onshore design & offshore development projects

Onshore projects (turnkey)

Onshore services

Exhibit F-I

APPENDIX - G

APPENDIX G

SELECTED REFERENCES

1. Business Computer (Apr.30, 1990.)

2. Business World (Jan.30 to Feb.13, 1990.)

3. Computers Today (July 1990, Jan.1991, May 1991.)

4. Computers and Communications (Nov.1990)

5. CSI Communication (Nov.1990.)

6. Dataquest (Dec.1990, Mar.1991, Apr.1991)

7. "Manpower Development for software exports in Information Technology" - paper submitted at the MAIT

8. Marketing Research Techniques : Boyd, Westfall and Stasch.

9. NASSCOM Report on "Indian Software Industry(1990-1995)" submitted at The National Software Conference,1989.

10. Paper on "Computer and Manpower Development" presented at the 14th Industrial seminar on Computer Industry in India held at Business Economics Association, South Campus, University of Delhi.

11. Relevant articles published in The Economic Times, The Financial Express and The Times of India.

12. Report prepared for World Bank on "Manpower development in Electronics and Computers in India" (Nov.1988.). Authored by: N.J. Rao (IISc,Bangalore), H.S.Jemdagni(IISc,Bangalore),S.P.Ranade(MD,MITCONPune), S.S.Suryanarayanan(Jt.Adv.,Plg.Comm.,New Delhi).

13. Telematics India (Jan.1991.).