Report on

"A Study of Interaction between Technical Institutions and SMEs in the S&T Sector"

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Principal Investigator

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A Research Project sponsored by

NSTMIS Division
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M. K. Sridhar, Ph.D.
Reader

BANGALORE UNIVERSITY
Canara Bank School of Management Studies
(Post Graduate Dept. of Management)

Declaration

This is to declare that the study on "Study of Interaction between Technical Institutions and SMEs in S & T sector" has been carried out by me and my project team exclusively for NSTMIS Division of Department of Science and Technology, Government of India, New Delhi. This is a genuine and bonafide study and has not been part of any other study, report or project.

Bangalore

Date 6/3/2007

(M.K. Sridhar)
Principal Investigator

Bangalore University, Central College Campus, Dr. B.R. Ambedkar Veedhi, Bangalore - 560 001. India.
Tel : Off : (080) 22961973
Res : (080) 26646922
Visit : www.bangaloreuniversity.net
E-mail : bharathvasi@vsnl.net

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Dr. M.S. Thimmappa, Former Vice Chancellor has been very encouragive in this study. I thank him and other staff members of Bangalore University. Dr. K. Janardhanam, Director of Canara Bank School of Management Studies deserves my special thanks for all his encouragement and support. My colleagues in the department Dr. D. Gopalakrishna, Cynthia Menezes and Dr. Y. Nagaraju have encouraged me in completing this endeavour. Dr. K. Aswathappa, former Director, also deserves my thanks. I thank the non teaching staff of the department namely Smt. Adilakshmi, K. Harichandra, Shivarudrappa, Manjula, Krishna, Manjunath and Narasimha Murthy for their support.

Shri. M.V. Ravikumar and Shri. N. Ramesh has put in their untiring efforts in making this study a reality. They supported me all the time. Prof. D.K. Subbakrishna of NIMHANS has provided invaluable support in carrying out the data analysis. I acknowledge their support, encouragement and cooperation with many thanks.

Shri. T.K. Narasimha Babu has played an important role in this effort. I thank him profusely. Shri. A.R. Karthik Subba Rao has been very supportive in this endeavour. Smt.B.R.Saraswathi, Smt.N.Latha Nagesh, Shri.Ullas and Shri.Shiva Kumar have also supported me as members of the team from time to time. I thank my research scholars Dr. R. Karunmoorthy, Dr. M.S. Leela, Dr. S.C. Poornima, Shri. A.R. Sainath, Smt. Manasa Sudarshan and Shri. Paul Jeong also. Dr. S.K.G. Ganesh and Sri. Venkatachalam of Chennai, Dr. Raghupathy of Coimbatore, Prof. C. Balaji of Bangalore and Shri. C.V.S. Raghunath Rao of Hyderabad have helped me in many ways. I also thank all of them.

Many more have encouraged me in this endeavour. Prof. B.R. Ananthan, Dr. Vishnukanth Chatpalli, Prof. P.V. Krishna Bhatta, Dattatreya Hosabale, K.N. Raghunandan, D.M. Kiran and Dr. K.V. Raju are notable among them. Many workers of ABVP have helped me in collecting data at various places. I thank all of them. My family members and friends have supported me in this endeavour. I recollect all their affection and love. This mega effort is not that of an individual. It was supported by many hearts, brains, legs and hands. I acknowledge all these team members with gratitude.

ACKNOWLEDGEMENT OF SUPPORT

First and foremost, I would like place on record the support and research grant provided by NSTMIS Division of Department of Science and Technology, Government of India for undertaking this valuable study. But for this grant, the study would not have seen the light of the day. I thank all those in the Division individually and collectively.

I acknowledge the support, encouragement and help of Shri. Rakesh Chethal, Advisor and Director of NSTMIS Division and Shri. A.N. Rai, Principal Scientific Officer – Sc-D of NSTMIS Division. In fact, they hand holded us at every stage of the study. I am highly indebted to them.

Dr. N.R. Shetty, Chairman of LPAC and Former Vice Chancellor of Bangalore University has been very instrumental in this endeavour. I thank him. I also thank other members of LPAC namely Prof. M.H. Dhananjaya, Dr. M.H. Balasubramanya, Sri. Anant Koppar, Sri. Dilip Patel, Dr. Gopal P. Mahapatra, Sri. V. Krishnan, Sri. K.A. Krishnan, Sri. Nitin Deshmukh, Dr P Narayana Reddy of Hyderabad, Prof Rajan Mani of Chennai and Dr. Vaman Acharya. I pay my tributes to Late Sri. H.R. Gupta, a member of LPAC, who passed away in the course of this study. He had been very encouragive and supportive.

Shri. Nanda Kumar and Sanjay Handoo of MAIT, Sri. Ramappa and Sri. Yogendra of BCIC, Sri. V. Ramachandran of ACMA, Smt. Nandita Chandavarkar of ABLE, Sri. Srinivas and Sri. Mohan Ram of IMTMA, Ms. Akanksha Pundir of NASSCOM, Sri. K. Sathyanarayana of NHRD and Dr. Surjith Angra and Sri Tushar K. Nath of AICTE have provided necessary data base and support in carrying out this study. I acknowledge all their help.

The principals and faculty members of various respondent educational institutions and executives of industrial enterprises have responded enthusiastically and provided data for carrying out this study. I thank all of them.

Executive Summary

The emergence of the Educational- Industrial Complex, both globally as well as locally in our country, has brought in its wake enormous opportunities and attendant challenges – for academia as well as industry. Never before has the Indian economy and its industrial sectors witnessed such sweeping forces of liberalization, globalization and privatization. The Small and Medium Enterprises, especially in the technology-intensive sunrise sectors such as electronics, IT, bio-technology, automotive components etc seem to have the greatest potential to gain or lose and to die or grow in this milieu. In this context, the much debated subject of interactions between the academic institutions and the industrial enterprises has acquired a renewed importance as well as urgency. Unfortunately, the focus of the debate has remained large scale industry-centric. And the discussions in this subject area, hitherto, have been dominated more by generalities and opinionated emotions, than a debate informed by a systematic and objective exploration of the embedded issues and the essential characteristics of interactions. This study has, in the authors' judgment, broken new ground by conducting an extensive survey of academic institutions in both engineering and management and small and medium enterprises in the aforementioned science & technology sectors. The study was aimed at uncovering the current patterns of interactions, the reasons for the same and the expectation and the motivations of the actors involved and the road forward. The findings are supported by rigorous tools and techniques of univariate and multivariate statistical analysis. The highlights of the findings are presented below:

- This quantitative research has attempted to understand the status of interactions between techno- management institutions and the SMEs in the S&T sectors such as electronics, automotive components, machine tools, IT and bio-technology. This was based on an extensive survey of 139 institutions and 122 SMEs spread across Tamilnadu, Karnataka and the city of Hyderabad.

- Factor analysis has revealed the existence of Five Domains of interaction namely 1) Knowledge-oriented, 2) Industry-oriented, 3) Academic-oriented, 4) Long-term Association oriented and 5) Short-term association oriented.

- Factor Mean scores of the 'Extent of the Frequency' of Interaction reveals that the current nature of interactions by the institutions is characterized by 'Industry- & Short-Term Orientation, aimed at seeking support from industry for project work, placement and guest lectures which are course and curriculum oriented.

- The key motivational driver for the institution is 'brand building'. This is supported by the factor analysis of 16 motivational variables and 18 benefit-related variables. Vision, mission and the brand image of the institutions stand out as the key elements in this.

- Industry-related factors (Industry-related type of barrier) have received the highest factor-mean weight as the main barrier in the path of interactions in the knowledge and academic. The factors covered under this are - lack of alignment of priorities, lack of continuity and response from industry.

- The full-time (regular) faculty with industry background rather than doctoral qualification seems to be active in supporting interactions with industry. This category of faculty has exhibited significant correlations with 4 out of the 5 Domains of Interaction

- A frequency profile of the patterns of use of various mechanisms reveals near uniformity across all of them. However, Use of Interaction Cell (87%) and Full Time Placement Officer (86%) stand out as the most dominant.

- The Management Departments exhibit a relatively higher level of interaction with industry, on a 1-5 scale of interaction intensity.

- It is heartening to note that Institutions are looking inward and have identified 'Initiative by the institution ' and 'Mind-set' as the two most important perceptual factors in terms of the expectations of the industry

- The Propensity to Interact, a composite index based on a multi-item scale, points to a very positive and healthy score of 2.9 on a 5 point Likert scale.

- Factor analysis of 19 variables has helped uncover three key domains of interaction engaged in by the Industry namely: Academia-driven Interaction, Industry-Driven Interaction, Short –term and Industry-Driven Interaction, Long Term.

- The relative Factor Weights indicate that the Industry does not interact with institution for seeking technological or management inputs, but prefer to serve the low-end academic needs of the institutions. Institutions set the agenda for such interactions.

- Industry views such interactions more from the 'social responsibility' perspective rather than as a long-term arrangement to exploit the knowledge-base of the academia. This was uncovered by the factor analysis of 19 benefit-related variables. The 'Social Responsiveness' factor had a preponderant weight of 1.1284 compared to 0.6136 and 0.4179 for 'outsourcing Partnership' and 'Strategic Partnership' respectively.

- The main reason for the discontinuation of interaction by the industry has been more perceptual than based on their actual experience. Factor analysis of 11 variables with respect to the reasons for discontinuation, revealed two underlying dimensions namely Conviction-based and Experience-based.

- The importance ranking of the reasons for not interacting with institution reveals lack of initiative on the part of the institutions as well as the lack of confidence in the ability of the institutions to solve the problems of industry.

- Academia -driven domain of interaction exhibits a highly significant positive correlation with size of the firm, in terms of Investment in Plant & Machinery and Annual Sales Turnover.

- IT and the Bio-tech sectors have a relatively higher correlation with Academia-driven domain of interaction than other sectors such as Electronics, Automotive and Machine Tools.

- Analysis of the frequency of interactions between the departments of industry and the various types of institutions presents an interesting picture. HR/Personnel department seem to be interacting more as compared to other departments. This could be due to their functional nature – recruitment, training and development. R&D and Operations/Production departments exhibit a high degree of interaction with technical institutions due to the technical nature of activities. Marketing and Exports/International present a similar pattern of interaction, equally with technical and management institutions.

- Similar to the institutions, the Propensity to Interact has been encouraging at 2.8 on a 5-point scale.

- Mean Scores of the ranking of preference for the Models of Interaction, MOU and Mentoring have been voted as the two most preferred.

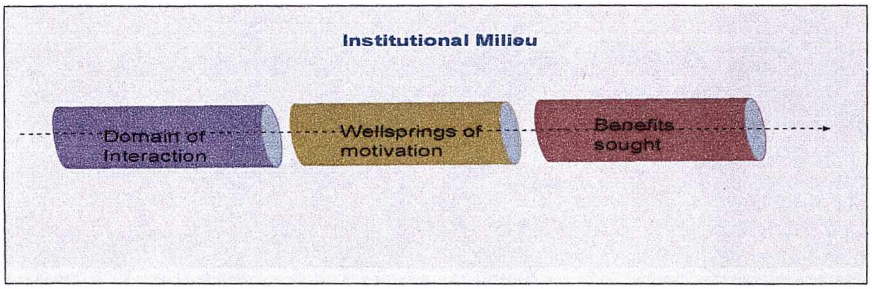
- A correlation of the Model Preference vis-à-vis Sectors of Industry present an interesting picture. Machine Tools exhibit a consistently low preference for all the models except R&D and Market Survey, where they are weak. Automotive seem to

adopt a middle-of-the-road preference for all the models, with the exception of consulting for establishing laboratory. Due to the technology – orientation of Biotech sector, they have indicated a high degree of preference for Consultancy for establishing Laboratory and R&D. It is interesting to note that the electronics sector has low preference for most of the models except Mentoring which may be due to the fact that one-to-one coaching is more beneficial. While Public Limited and Private Limited companies prefer MOU, R&D and Participating in Academic activities, Proprietary and Partnership firms seem to prefer the Mentoring model.

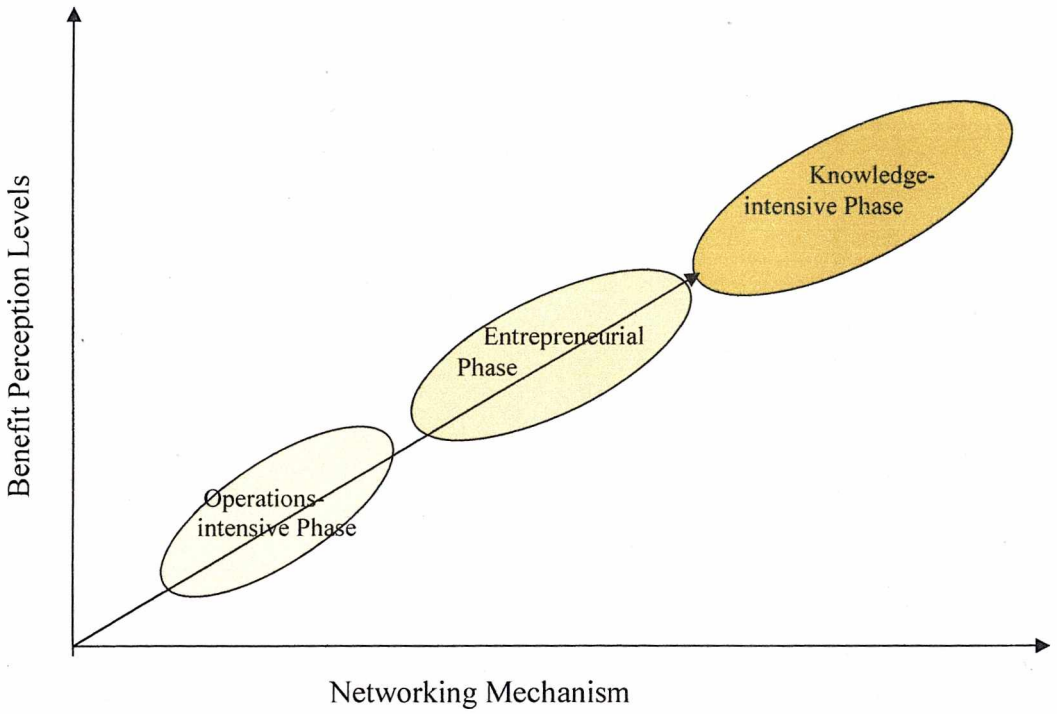
- The road map for enhancing the interactions between the institution and industry is to augment from the current domain short-term, operational and curriculum oriented one towards strategic, long-term and knowledge-oriented.

- This requires an alignment of the domain with motivation and benefit sought. This 'fit' appears to be critical to initiating and sustaining the interaction. This is depicted in the following schema.

Flow of Interaction



- There are three phases of interaction that the study proposes – the current phase which is operations-intensive, the second phase which is Entrepreneurial and the third phase which is knowledge-intensive. The evolutionary progress of this trajectory is presented visually as follows:



Chapter – 1 Introduction

The subject of interactions between industry and academia and its deplorable status in our country has been debated ad nausea. However, the criticality of the need for robust interactions between the two main pillars of the modern economy has never been felt more than it is now in India. The subject of Academia – Industry Interaction (AII) gains greater significance when the discussion turns towards the small and medium enterprises (SME) sector within the industrial sector of the Indian economy. The reasons are not far to seek. The SME sector is widely recognized as vibrant in its contribution to any economy, more so in a developing country such as India. The uniqueness of this sector has been its relatively high potential for providing employment, compared to the large scale sector. Ever since the Indian economy was set rolling on the track of liberalization, privatization and globalization, this sector had been witnessing unprecedented pulls and pressures. But this sector has successfully weathered the disruptive forces, to register growth rates better than their bigger cousin – the Large Scale Sector.

The emergence of technology as a competitive tool offers opportunities as well as poses new challenges to the SME sector. The challenges are much more for the technology-intensive sub-sectors such as electronics, bio-technology, automotive components etc. The need to nurture and sustain technological innovations is getting progressively critical for the firms in this sector. The well-known constraints of both financial as well as technically qualified high-quality human resources heightens challenges of survival and growth of the small and medium enterprises engaged in technology-intensive sectors of the economy.

The higher educational infrastructure in our country has seen dramatic growth since independence. This has enabled supply of technically qualified resources to support the burgeoning demand from industry. However, it has been bemoaned by the representatives of various industries that the proportion of employable graduates is disturbingly low,

resulting in the crunch of human resources. This has led to a paradoxical situation of high demand for quality graduates coupled with increasing unemployment of graduates!

Techno-Entrepreneurship has been another interesting phenomenon being witnessed in our country. This is viewed as another important emerging area of opportunity for the rising number of technically qualified graduates stepping out of the portals of technical institutions. But, the seed of entrepreneurship has to be planted and nurtured and incubated for the vast majority of the first-generation aspirants. The hand-holding is very critical if the start-up venture is engaged in technology-intensive domain with the attendant risks and uncertainly of both the technology and the market.

All in all, the aforementioned trends and implicit challenges cannot be met either by the academia or the industry operating in isolation, in silos. This is the compelling motivational driver for the study undertaken by the authors. NSTMIS Division of Department of Science & Technology, Government of India, has begun playing s pivotal role in catalyzing systematic research-based understanding of the issues involved. This is one such study which addresses the following objectives:

1.1 Objectives

The present research study aims at achieving the following objectives.

- To study the nature, status, experiments and experiences of interaction between technical institutions and SMEs in S&T sector,
- To ascertain the reasons for the extent of interaction between technical institutions and SMEs in S&T sector and extent of awareness about various schemes to promote interaction,
- To investigate the needs, expectations, problems, strengths, weaknesses and perceptions of SMEs and technical institutions in the context of interaction, and
- To suggest appropriate strategy, structure of and road map for interaction between technical institutions and SMEs in S&T sector.

1.2 Methodology

1.2.1 Target Population

The target population of the study includes

- Technical institutions at bachelor and post-graduate levels in the states of Karnataka, Tamilnadu and the city of Hyderabad. Management institutions at post-graduate levels – either as a department of the technical institution affiliated to a University or as an autonomous business school, are also part of the target population, in view of their current as well as the potential contribution to the well-being and growth of the SMEs.

- Small, medium and large enterprises who are members of the select industry associations in the fields of IT, Electronics, Biotechnology, Automotive components and Machine tool sectors in the states of Karnataka, Tamilnadu and the city of Hyderabad. The large enterprises were also considered as part of the population in order to probe likely differences and similarities in the patterns of institutional interactions between the SME and Large scale sectors. This would help in better understanding of the subject matter.

1.2.2 Sampling Frame

The list of technical and management institutions as per AICTE records as on 31st December, 2004 was used as the sampling frame for the institutions.

Courses Offered by Institution	Number of institutes within the geographic scope of study	Number of institutes mailed
Engineering & Management	709	709

The data base of industry associations pertaining to the S&T sectors chosen for the study was used as the sampling frame for small, medium and large enterprises. The industry

associations were NASSCOM, TEMA, ELCINA, MAIT, CETMA, ABLE, ACMA and IMTMA.

Table – 1

List of industry associations selected for data collection

Sector	Industry Association	Membership within the Geographic scope of study	Number of companies mailed
Automotive	Automobile Components Manufacturers' Association (ACMA)	90	90
Machine Tools	Indian Machine Tools Manufacturers' Association (IMTMA)	94	94
Information Technology	National Association of Software and Service Companies (NASSCOM)	266	266
Electronics	1. Manufacturers' Association of IT Products (MAIT)	47	47
	2. Telecom Equipments Manufacturers' Association (TEMA)	26	26
	3. Electronics Components Industries Association (ELCINA)	49	49
	4. Consumer Electronics and TV Manufacturers Association (CETMA)	7	7
Bio-Technology	Association of Biotech Led Enterprises (ABLE)	41	41
Total		**620**	**620**

1.2.3 Sample Size

The institution version of the questionnaire was sent to 709 institutions as per the AICTE database. Similarly, industry version was sent to 620 members of industry associations such as NASSCOM, TEMA, ELCINA, MAIT, CETMA, ABLE, ACMA and IMTMA. This was followed up by personal visits to many of the respondent sites to ensure better

quality and quantity of response. Finally, we received responses from 139 institutions (19.61%) and 122 industries (19.68%). This could be considered a reasonably good rate of response, in the Indian context. The data collection was carried out between July, 2005 and March, 2006.

The following tables present the break-up of the final response in terms of the locations and sectors.

Table 2

Sample size of Institutions

Location	Frequency
Karnataka	62
Tamil Nadu	50
Hyderabad	27
Total	**139**

Table 3

Sample size of Industry

Sector of Industry	Total
Information Technology	48
Biotechnology	7
Electronics	17
Automotive	29
Machine tools	21
Total	**122**

1.2.4 Research tools for data collection

Primary data from technical institutions and enterprises was collected from respondents through a structured questionnaire which was designed exclusively for the purposes of the present study. There were two versions of this questionnaire (see Appendix-3). One is for technical institutions and another for industrial enterprises. Secondary data were collected from books, studies, monographs, journals, websites, other published or unpublished sources and records with the authorities.

1.2.5 Data Analysis

The data collected was analyzed with the help of descriptive statistical techniques like tables, bar diagrams, pie charts, percentages etc. Other analytical techniques such as factor analysis, correlations, cross tabulation etc. have also been used extensively, using the SPSS 14.0 version.

1.2.5 Operational definition

Small and Medium Enterprises were defined, for the purpose of the study, to be those enterprises which satisfied any two of the three following criteria.

1. Investment in Plant and Machinery should not exceed Rs.100 million,
2. Annual Sales turnover should not exceed Rs.1.0 billion and
3. The total number of employees should not exceed 100 persons.

These criteria were based on the legislation of the Ministry of Small Scale Industries on the definition of the 'Medium sector' , the definitions adopted in various countries and the variations in the capital , labor and sales volume intensity of the S&T sectors covered in this study.

IT, Electronics and Biotech sectors are well known as the sunrise industries, driven by intensive application of technologies. These, hence, qualify as members of the S&T sector of our study. These sectors have also been identified among the thrust areas in the S&T policy of the government. Automotive and Machine tool, the two allied sectors, while relatively mature in terms of technology, have been witnessing pressure to upgrade and adopt improvements in their technologies, on account of global competition. Hence, these also qualify to be members of the S&T sector of our study.

1.3 Limitations of the study

The primary limitation of the study is with respect to the representative-ness of the sample. This has to be considered in the context of the practical problems of eliciting response on a subject such as this, especially from the industry. However, in consonance with the exploratory nature of the study and the research objectives, we believe this deficiency should not impair our findings. On the other hand, we have ensured that deliberate heterogeneity is achieved through representation of all categories of respondents – in terms of scale, sector, type of institution, location etc.

In view of the difficulty to qualify the industrial units in terms of their intensity of technological activity, it was not possible to ensure elimination of units which are relatively low on technological intensity.

1.4 Structure of the report

Chapter – 1	Introduction
Chapter – 2	Perspective
Chapter – 3	Analyses -Interaction from institution angle -Interaction from industry angle
Chapter – 4	Road map for Industry-Institute Interaction -Suggestions and recommendations

2.0 Perspective

Economic growth, in an increasingly Knowledge-driven economy, depends on the creation and exploitation of knowledge. While the companies / firms involved in Science and Technology sector have to continuously innovate to remain in business, Academia are repositories of knowledge and they also advance science as well as create new technologies that, when transferred especially to the business firms, help the latter to innovate. Firms / companies hence, are the important agents of technological innovation.

1.1 Technical Education:

The composition of higher education in India has undergone a paradigm shift in the last two decades. The shift is away from general education towards engineering and management education. Engineering institutions have recorded an exponential growth in terms of both number of institutions and the enrolment of students. As presented in Table 1, the decadal growth of the number of institutions during 1980-1990 was nearly 100%, the following decade (1990-2000) registered a growth of 170% and the following six years (2000-06) saw a growth of 44%. Add to this, 1006 MCA and 930 MBA Degree institution's intake of 53000 and 64000 students respectively [Revitalizing Technical Education, Review Committee Report, 2003[1]]. But, The Institute of Applied Manpower Research (IAMR) and National Technical Manpower Information System (NTMS) have estimated huge unemployment in various engineering disciplines. Hence, these major sectors face the challenge of gainfully employing their graduates.

Table - 4

Decadal Growth – Institutions & Student Intake

Particulars	1980	1990	2000	2006
No. of degree engineering institutions (growth)	157	310 (97%)	840 (171%)	1208 (44%)
Sanctioned Intake (no. of students) (growth)	28500	66600 (134%)	185758 (179%)	359721 (94%)
No. of MBA Institutions	NA	55	712 (1194%)	930 (30%)
Sanctioned Intake	NA	3300	57977 (1656%)	64403 (11%)

Source: AICTE annual reports.

The southern states have accounted for a significant share of this explosive growth in the techno-management education in the country, accounting for 54% of the no. of institutions and 56% of the number of students, as revealed in the following Table-2.

Table-5

Share of Southern States out of Institutions & Student Intake

States	Karnataka	Tamil Nadu	Andhra Pradesh	Kerala	Total	% of All India
No. of Degree Technical institutions	111	250	215	73	649	54%
Student Intake	40385	79122	64300	17858	201665	56%

Source: AICTE annual reports

In fact the share of the southern states in student intake has increased from around 45% in 1999-2000 to 56% during 2005-06.

The dramatic growth of techno-management education, especially in the southern part of the country, represents an expanding knowledge-infrastructure. This ought to be leveraged by industry, in general, and the SMEs in the S & T sector in particular. The latter have been witnessing an equally dramatic change in their environment, with increasing emphasis on technological capabilities in the context of globalization.

1.1.1 Specter of Jobless Growth

Indian economy has witnessed a curious combination of growth of the economy coupled with a declining rate of growth in employment. As can be seen from the Table-3, the main cause of this phenomenon is the increasing capital intensity of production in various sectors of the economy, right-sizing initiatives in the public sector which has had a significant overhang of excess labor and structural shift in the economy towards capital intensive activities, driven by globalization and liberalization. Another alarming fact is that the unemployment rate among the technically educated youth has not experienced any significant decline in spite of the increasing knowledge-intensity of the economy[2].

Table-6

S&T Unemployment

Discipline-wise Science and Technology Personnel Borne on Live Register of Employment Exchanges in India (1995 and 1998)

(' 000)

Discipline	1995		1998	
	No. of Live Register	%	No. of Live Register	%
Science Graduates	704.1	48.1	784	45.6
Diploma Holders in Engineering	421	28.8	553	32.2
Science Post Graduates	97.7	6.7	120	7
Engineering Graduates/PG	168.1	11.5	180.9	10.5
Medical Graduates	28.2	1.9	31.3	1.8
Agricultural Graduates	31.3	2.1	36.6	2.1
Others (Veterinary Graduates/PG Medical and Agricultural PG)	12.6	0.9	14.4	0.8
Total	**1463**	**100**	**1720.2**	**100**

Source: Ministry of Science & Technology, Government of India.

1.2.1 Small & Medium Enterprises: Status

Globally, SMEs have been playing a pivotal role in the economy of respective countries – both developed and developing. This sector forms the majority of industrial units and account for the highest proportion of employment in most developing and developed countries (see Table-4). SMEs produce 25% of OECD exports and 35% of Asia's exports[3].

Table-7

Share of SME Sector in GDP, Employment & Exports during late 90s to early 2000 – A Cross Country Comparison

Country	Share in the GDP	Share in employment	Share in exports
USA	50%	50% of private workforce	30%
Japan	51% of the value of manufacturing	78% of the total workforce excluding the primary sector	50%
Germany	48%	64%	27%
India	6.4%	66% of the Organized Sector employment	31%

Sources: a) U.S. Department of Commerce, Exporter Database, Small & Medium-Sized Exporting Companies: A Statistical Overview, 2003
b) OECD SME and Entrepreneurship Outlook 2005

In developing countries, this sector acquires added significance, due to higher potential for employment, in comparison with large-scale sector. In India, the industrial sector, both large scale as well as small scale, had been largely protected through tariff and non-tariff barriers till the late 1980s. The policy environment, since then, has witnessed radical changes. Despite this, in 2001-02 the Small Scale sector (Medium Scale has not been defined by the Government of India, then) contributed 6.4% to the GDP, 31% to total exports and accounted for 66% of the total organized sector employment (GOI, 2002[4]).

1.2.2 Small & Medium Enterprises: Competitiveness

The era of liberalization has exposed the small and medium enterprises to the twin challenges of growth and competition. In order to survive and stay competitive in international market, it is imperative for SMEs to modernize and upgrade their technological capabilities. SME's must innovate and be outward looking if they have to perform in global market[5].

The gravity and the urgency of the problems facing the SME sector and the response of government and non-government agencies, with regard to the centrality of technological issues is captured in the following section and is a powerful indication of the dire need to focus on the management issues of technology in this sector[6] :

- Small-scale industry (SSI) units should upgrade their technologies, management techniques and marketing strategies to face the challenges of globalization[7]

- The dereservation of some items has become necessary, as some of the SSI units are finding it difficult to raise their investment limit beyond the present Re. 1 crore level to meet their investments in modern technology and marketing[8]

- National Small Industries Corporation has taken the step to help the SSI sector face competition from cheaper imports in the post WTO-regime. NSIC has also taken up improvement of quality for the SSI sector through technology development and technology transfer.[9]

- The Small Industries Development Bank of India (SIDBI) has been planning to make the domestic industries competitive during the WTO regime. The Bank has identified 14 sectors among small-scale industries as thrust areas for growth. These sectors are: information technology, food processing, pharma and healthcare, biotechnology, readymade garments, leather and leather goods, electronics, hand tools, glass and ceramics, auto parts, toys, dyes and intermediaries. SIDBI is

preparing a technology paper on SSI to formulate a technology strategy for the sector.[10]

- The government is thinking of raising foreign direct investment (FDI) limit in select small-scale sectors from 24 percent to 49 percent in order to attract foreign technology and encourage joint ventures. FDI limit will be raised in only those high-tech sectors having high export potential.[11]

In short, technological capability is gaining increasing significance as a key competitive weapon. The emphasis of small industry in the 90s has shifted from protection towards promotion of competitiveness through support from technological up-gradation, among others[12].

1.3 S&T Entrepreneurship

Due to significant changes in the socio-economic environment in the post Liberalization, Privatization and Globalization (LPG) era, the scope and demand for S & T entrepreneurship has increased enormously[13]. The last decade of the previous millennium has brought in plenty of new economic thoughts, concepts and practices[14]. The growing LPG process has come speedily necessitating modification in the management strategies and practices. Entrepreneurship and intrapreneurship have assumed greater acceptability and wider relevance[15].

Small enterprises have unique quality of adding value to local resources. In the field of Science and Technology, the small firms are the original points for most of the innovations[16]. The nature and scope of small enterprises have direct bearing on the management responsibility of S & T entrepreneurs. In small firms, the promoter has to play dual role; one of a successful entrepreneur and another that of an effective manager[17]. The combined role is much different and more complex than simple managerial role in a big firm.

Technology, the major strength of S & T entrepreneurship, is changing with greater speed and variety. Telescoping technological changes means rapid parallel and sequential innovations. Innovation deals not just with scientific ideas but also with their imaginative application to the satisfaction of consumers' wants. The emergence of new technology, usually cause shorter and shorter product life cycles. While offering new entrepreneurial opportunities, this also demands greater efficiency in managing change. The emerging technology thus, acts both as stimulator as well as facilitator of change[18]. The 'Management of change', therefore, is the greater concern for making S & T entrepreneurship highly competitive, cost effective and adjusted to the need of the hour.

1.4. Role of DST

Department of Science & Technology (DST) was established in May 1971, with the objective of promoting new areas of Science & Technology and to play the role of a nodal department for organizing, coordinating and promoting S&T activities in the country. DST has been promoting awareness and adoption of S & T across various sectors of the economy, through sponsorship of research, formulation of appropriate policies etc. DST is a key player in the 'S&T System' in India. NSTMIS is one of the Science Groups in DST. It is responsible for collection, collation, analysis and dissemination of information on resources devoted to S&T activities in the country. The S&T information system assumes importance in the light of the S&T policies enshrined in the 10th Plan document which recognizes the enormous significance of S&T for economic growth at the macro level and for building business competitiveness at the micro level. The same document also lays stress on the interface between R&D institution, Industry and Academia, in order to harness indigenous technology to meet the requirements of industry. DST, in general and NSTMIS, in particular plays an important role in creating this synergy.

1.5 Sunrise sectors of Indian economy

In this chapter we profile the four sectors chosen for our study – Automotive Components / Machine Tools Industry, Electronics Industry, Biotech Industry and IT. The purpose of

this chapter is to provide a good background and understanding of the evolution and status of these sectors, so that the subsequent analysis and findings can be related to the context.

1.5.1 Machine Tools & Automotive Sectors

1.5.1.1 Indian Machine Tool Industry:

If the manufacturing sector is considered to be the true backbone of a developed economy, the machine tool sector would constitute its sinews. The Indian machine tool industry has been making rapid strides in building up its capability to serve not only the domestic market, but also the demanding global market. The production has grown from Rs.6 billion in 2000 to Rs.10 billion in 2004. The exports have grown in the corresponding period from a little over Rs.300 million to Rs.500 million. Over 75% of the machines belong to the CNC category. The Indian manufacturing sector, growing at over 9%, is witnessing a voracious demand for machine tools to support sectors such as automotive, capital goods, consumer durables and the intermediate goods. The market demand for machine tools in 2004 was so huge that imports accounted for over Rs.16 billion as against the domestic production of Rs.10 billion.

SMEs have a significant presence, accounting for 20% of the production of the industry. Export thrust remains an important requirement and hence the concomitant emphasis on quality, cost, productivity and new technologies to meet changing requirements of the customers (Annual Report of IMTMA, 2004).

1.5.1.2 Automotive Components Industry

This sector caters to the component requirement of the Rs. 800 billion automobile industry covering two wheelers, tractors, commercial vehicles and passenger cars. The automobile industry has been witnessing growth rates in the region of 28% to 39% (ACMA). The automotive components sector registered an output of over Rs.350 billion in 2003-04, with exports accounting for 15% of the output. The

structure of the auto-components industry, in terms of output is presented in the following table:

Table 8

Analysis of different type of units

Type of unit	Range of output	No. of units	Proportion of units
Small	Up to Rs.250 million	237	60%
Medium	> Rs.250 million, < Rs. 2.5 billion	149	35%
Large	> Rs.2.5 billion	16	5%
Total		**400**	**100%**

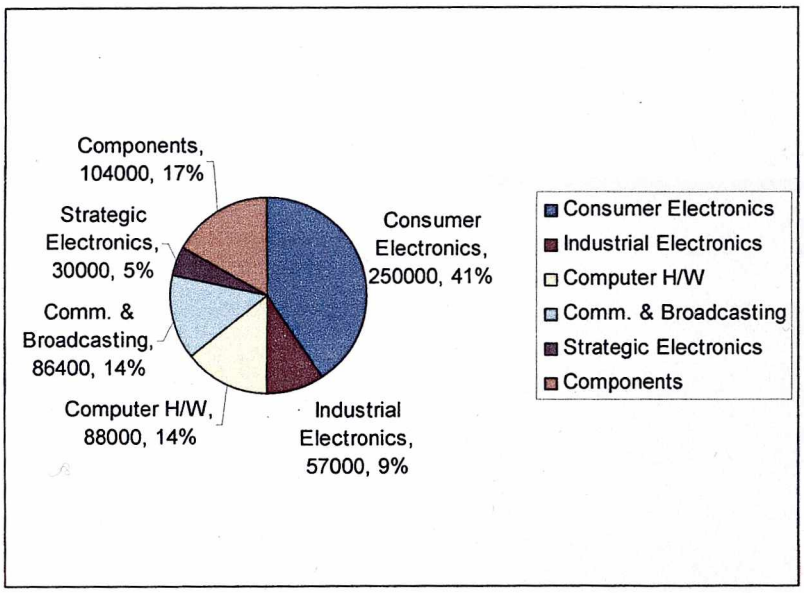
The auto components industry is aiming at an export target of Rs.135 billion by 2010. The competitive advantage is mainly driven by the low cost of wages which constitute 9% of the cost of sale as compared to 39% in developed countries. However, the industry has fortified the wage cost advantage with adoption of appropriate levels of automation, low cost automation, automation and Quality Management tools and techniques in order to achieve PPM levels. The industry's challenge would lie in its ability to graduate to tier-I levels of supplier relationships with global automotive players.

1.5.2. Indian Electronics Industry

India's electronic hardware sector has grown at a fast pace and the production increased from Rs.8.50 billion in 1981 to over Rs. 747 billion in 2005 – a phenomenal growth by any standard. The industry is broadly divided into a) Industrial Electronics b) Consumer Electronics c) Computers d) Communication and Broadcast Equipment e) Strategic Electronics f) Components. The break up of the Electronics hardware is presented in Figure-1.

Figure-1

Composition of Electronics Hardware Industry Sector – 2005-06



Indian electronics industry manufactures high-grade components conforming to international standards. These components are extensively exported to prestigious clients in the US, Europe and the Far East. There are currently more than 95 Indian electronic components manufacturing companies with ISO-9000 certification and 44 having quality and safety approvals from International agencies like UL of the USA, AENOR of France, VDE of Germany and CSA of Canada.

The present scenario affords no place for industries that are uncompetitive in price, quality, delivery and after sales service. The Indian industry will have to be alert to global happenings, changing consumer tastes and market trends. The industry must take advantage of the Internet which offers information flow from across the globe. The Indian industry has an edge regarding cheap manpower, it

should use this to the best advantage to cut down on costs and produce goods of international standards. It should also explore overseas markets to develop trade. The industry should also learn to offer business solutions rather than mere products. It should also develop innovative solutions to cater to problems facing consumers; also it should improve working of utilities and distribution networks to achieve all-round growth. The electronic software volume exceeded that of hardware in 2000-01, at about Rs.378 billion.

1.5.3 Indian Biotech sector:

The Indian biotech industry has grown from Rs.183 billion in 2002-03 to Rs.476 billion in 2004-05. The Indian biotech industry is composed of segments such as bio-pharma, bio-agri, bio-services, bio-industry etc. The break-up of the industry for the year 2004-05 and the segment growth over the previous year, is presented in the following table.

TABLE-9

Composition & Growth of Indian Biotech Industry– 2004-05

Segment	Revenues (in Rs crore)		Market Share (%)		Growth (%)
	2003-04	2004-05	2003-04	2004-05	
Bio Pharma	2752	3570	79.19	75.24	29.72
Bio Services Segment	275	425	7.91	8.96	54.55
Bio Agri	130	330	3.74	6.95	153.85
Bio Industrial	238	320	6.85	6.74	34.45
Bio informatics	80	100	2.30	2.11	25.00
Total Industry Size	3475	4745	100.00	100.00	36.55
BioPharma corners three-fourths of Indian market ($811 million out of $1070 million)					

Bio-pharma accounts for the lion's share of the industry, at about 75% of the total. However, the bio-agri and bio-services have been growing very fast. The industry exports, on an average, 42% of its production.

The top 10 companies account for 47% of the industry sales. There are a large number of small and medium companies with turnover of less than Rs. 50 million, among a total population of 280 companies.

1.5.4. Information Technology Sector:

The Indian IT success story is too well known to require any repetition! It has been growing at rates in the range of 30% -40% CAGR. Exports have been the main engine of growth and survival in this industry – accounting for over 75% of the total revenue. The USD 23 billion (Rs.1000 billion) IT industry has a number of small and medium players. The small players with revenue of up to Rs.500 million accounts for 81% of the total number of players and the mid-size companies with revenue in the range of Rs.500 million – Rs.2000 million accounts for 8% of the total.

The following table presents the broad composition of the industry in terms of sector such as IT services, BPO services, Engineering, R&D and Products and IT hardware.

Table 10

IT Industry-Sector-wise break-up

USD billion	**FY 2004**	**FY 2005**	**FY 2006E**
IT Services	**10.4**	**13.5**	**17.5**
-Exports	7.3	10.0	13.2
-Domestic	3.1	3.5	4.3
ITES-BPO	**3.4**	**5.2**	**7.2**
-Exports	3.1	4.6	6.3
-Domestic	0.3	0.6	0.9
Engineering Services and R&D, Software Products	**2.9**	**3.9**	**4.8**
-Exports	2.5	3.1	3.9
-Domestic	0.4	0.7	0.9
Total Software and Services Revenues	**16.7**	**22.6**	**29.5**
Of which, exports are	**12.9**	**17.7**	**23.4**
Hardware	**5.0**	**5.9**	**6.9**
Total IT Industry (including Hardware)	**21.6**	**28.4**	**36.3**

Source: NASSCOM website

Total may not match due to rounding off

* NASSCOM estimates have been reclassified to provide greater clarity

- Revenues from Engineering and R&D services and Software Products reported separately (erstwhile clubbed with IT Services / ITES-BPO)

- Historical values for a few segments have changed

- For ease of comparison, details for two preceding years have been restated as per the new classification.

1.6 Conceptual Framework

1.6.1 Introduction

Academia - Industry Interactions are difficult to create and maintain because universities and industry have fundamentally different cultures, the nature of the work and products of universities and firms differ, and there are unexpected events or exogenous shocks, that can affect the relationship[19]. Universities and enterprises are very different institutions from one another, operating with different time schedules, agendas, actors, and with different mission and objectives. Each needs to adapt to the other's requirements and cultures. It is, hence, suggested that universities should develop new modes of operation, institutional leadership and more flexible institutional management[20].

1.6. 2 Forms of AII Partnership

Partnership is defined, in its broadest sense, as any form of linkage of mutual benefit or mutual interest between academia and industry. The questions that arise are[21]:

1.6.2.1 What are the ways in which researchers and academics describe their partnership?

1.6.2.2 Do these take the traditional forms or new forms of networks and collaborations?

1.6.2.3. What are the levels at which partnership happen? - Individual, group, department, institution, sector and country[22]?

1.6.2.4 Which forms of Partnerships are found in which types of institutions given their historical legacy, uneven research capacity, institutional capacity and financial base[23]?

An analytical matrix has been proposed by Glenda Kruss[24] (2005). She has also proposed a matrix to classify the type of response by institutions towards partnership with industry.

1.6.3 Rise of the Triple Helix Model

Ekzkowitz & Mello[25] (2004) have studied 'the rise of the triple helix culture' in Brazil, involving the government, academia and the industry, in fostering innovation. Haribabu etal[26] (2005) report, based on their case study of interactions between Public R&D institutions and Private firms in the bio-tech sector, different forms and content of networking. Sujit & Praveen[27] have studied the different types of linkages, the perceptions of the actors involved in the linkages with regard to the factors and barriers of interactions and the role of government in facilitating these linkages. This was based on a pilot survey of seven universities and three firms in the Bio-pharmaceutical sector. The authors have reported 'mixed results' of the current state of the art of Industry Institute Interaction (3I) and concluded that the role of government has been rather weak. They opine that in terms of the Triple-Helix model, the current state of 3 I could be characterized as 'Laissez-faire'.

1.6.4 AII – Benefits & Costs

There is significant amount of research conducted and reported on the multi-dimensional benefits of AII. Benefits have been classified as Financial, Technological and Strategic; Economic, Social and Other. University is in the midst of a paradigm transformation from the 'traditional' to one of that is entrepreneurial – this is causing tensions in the university by raising new and important issues that are yet to be fully resolved. However, they stress that the real issue is how Universities can contribute to regional and national economies while preserving its integrity and autonomy.

Costs of AII, mainly intangible, have also been reported upon in the literature. The world of values and principles guiding academic pursuits which set the academic standards could be undermined. This could damage the academic community and pose an overall risk to university reputation as the primary source of knowledge and talent creation. The other risks:

- Industry may exert undue influence on the co-op program and the nature and direction of future programs & research endeavors

- Sponsored projects may not provide the appropriate educational experience, proving detrimental to the quality and nature of instruction

- Conflict of duty & commitment in view of the new responsibilities

- Prospect of commercial gain may create financial conflict of interest

- Intellectual freedom and right to publish may be inhibited

- Industrial involvement in campus may unduly influence the long term educational mission

- Incompatibility issues
  - Value scales
  - Disciplinary nature of academic research
  - Free communication versus Secrecy
  - Organizational incompatibility

These could lead to what is called 'academic capitalism' - a contamination of academia. Critics of AII have expressed concerns regarding 'deepening' of commercial ties posing a threat to academia's commitment to both basic research and the academic norm of free

disclosure. Universities, by striking deals such as the one between Novartis and Berkeley, may be behaving more and more like for-profit institutions [28].

1.6.5 Successful Collaboration Techniques

The thinking in this perspective recognizes that AII is a marriage between university and industry which is 'against nature'. It is a symbiotic relationship between two unlike organisms with vastly different characteristics and objectives. Hence, it is suggested that a very pluralistic and individually tailored approach to the practices of partnering be adopted. Establishment of new operational units and administrative structures to manage and organize research collaborations is recommended. The following traits are presented for a successful collaborative process[29]:

- Representatives from each sector should get to know each other as people
- Understand each other's mission and processes
- Must seek ways to work together
- Start to work together on common areas
- Think of partnerships and not Gifts
- Keys to collaborative success – Preparation , Contact and Follow-through
- Select a motivating problem
- Select a generalizable problem
- Create a team-based work
- Create a monitoring and redesign mechanism
- Build multiple activities
- Create personal linkages
- Create new dissemination formats
- Create new organizational arrangements
- Use IT for dissemination and memory
- To overcome the obstacles in AII

- A legal framework for the cooperation
- Include exclusivity clauses
- Minimize constraints on information.
- Vertical integration of collaboration in the partnering entities
- Promote the use of intermediaries
- Recognize the potential impediments arising out of differing cultures and negotiate the same satisfactorily, before the initiation of the partnership.

Six factors have been identified for a successful AII[30]

- Strong University research leadership
- Strong commitment from the industrial partner
- The industrial personnel should have some level of research sophistication to match that of the university – in order to facilitate transfer of K
- Extensive university support
- Extensive industry personnel involvement is setting the research agenda , progress and results

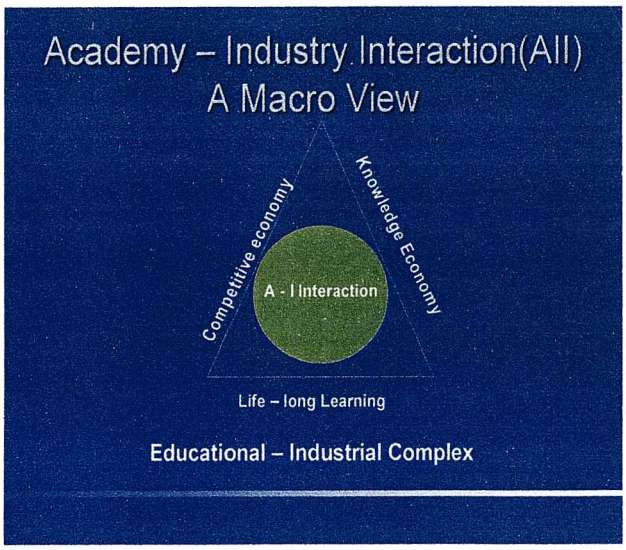
Industry partner should have internal capability to absorb the research fully and transform it into marketable products AURIL – Association for University Research and Industry Links – KT practitioners- a 'maturing' profession with 4000 practitioners. UK government has unveiled a set of model agreements designed to support University – Business collaborations and speed up IP negotiations – saves time and money for both parties involved , removes existing barriers in negotiating collaborative research agreements , especially in the case of SMEs[31]

1.6.6 Conceptual Integration of literature

We had so far explored the various streams of the existing literature underpinning our study of AII. We present a conceptual integration of the streams to gain a holistic understanding of the dimensions of AII.

Figure-2

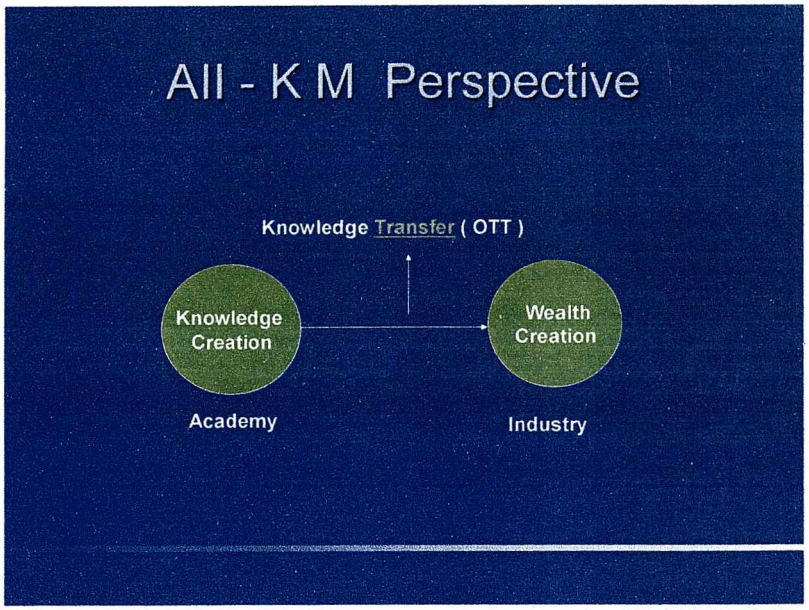
Academy–Industry Interaction – A Macro View



This framework captures the essence of AII as arising out of the demands of an increasingly competitive economy – local as well as global, the rising importance of the knowledge assets as opposed to the traditional capital assets as the mainspring of the economy and hence the felt need by the players in the economy to keep themselves updated and upgraded to remain 'productive' through Life-long continuous learning. We refer to this as the 'Educational – industrial Complex' paradigm. In fact, the demands for a vigorous AII have never before been more meaningful in India than in the prevailing milieu.

Figure – 3

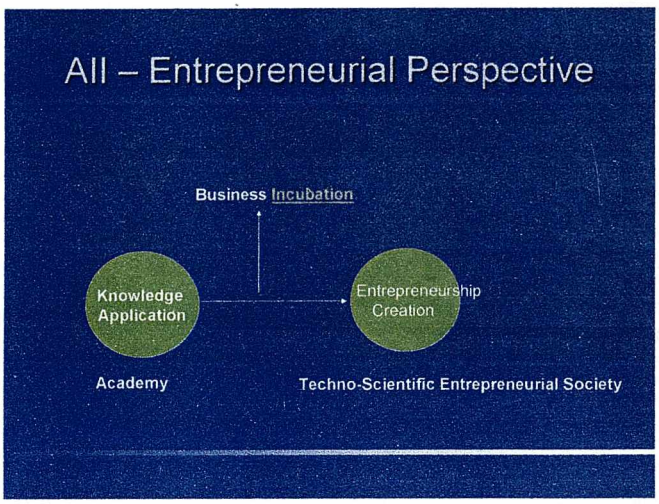
Academy Industry Interaction – a Knowledge Management Perspective



This perspective draws on the three traditional missions of an academic university – Generating new Knowledge, Transferring Knowledge to future generations and Serving the needs of industry and the community. The stock of knowledge assets within the academia is viewed as the wealth creating tools for the industry. The transfer of the Knowledge assets is sought to be carried out through various administrative mechanisms. Office of Technology Transfer (OTT) and Liaison Cells in Universities such as Institute Industry Partnership Cell are among the popular mechanisms.

Figure – 4

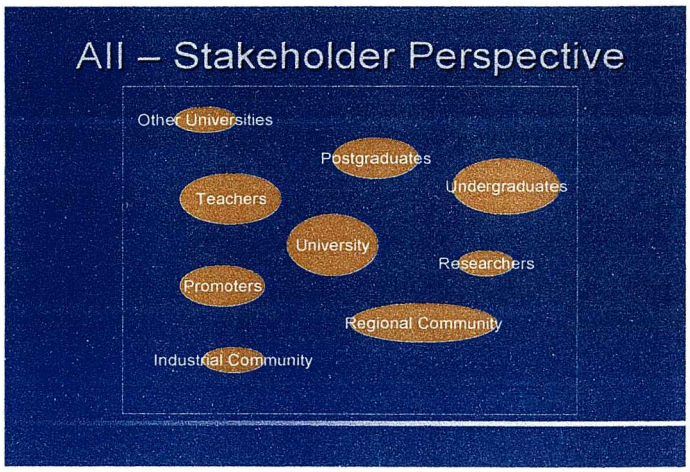
Academy Industry Interaction – an Entrepreneurial Perspective



This perspective reflects the current thinking which dominates the debate with respect to AII in the developed economy. It is gaining momentum in India too, with the resurgence of science and technology as the mainsprings of the economic growth. Incubation of different kinds is offered as the mechanism to translate Knowledge application into a viable entrepreneurial entity.

Figure – 5

Academy Industry Interaction – A Stakeholder Perspective



In a sense, the Stakeholder perspective is among the oldest and well understood. The last few decades have witnessed an expansion in the scope to include the regional community and the economy as one of the stakeholders. The widely known benefits of AII are part of this perspective.

We believe, on the basis of the survey of literature, in the Indian context there exists a yawning gap in understanding AII with respect to all the three perspectives[32]. The scanty empirical that could be claimed to have been carried out in India has been informed largely by the Stakeholder perspective[33]. One could safely conclude that AII, in the context of SMEs have not received any attention – neither empirical nor conceptual[34].

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Chapter – 3 Analyses

3.0 Interactions – Institutional Angle

The following chart presents the broad profile of the sample of institutions on three parameters viz. Location, Type of Institution and the Courses Offered.

Figure 6

Distribution of respondent institutions

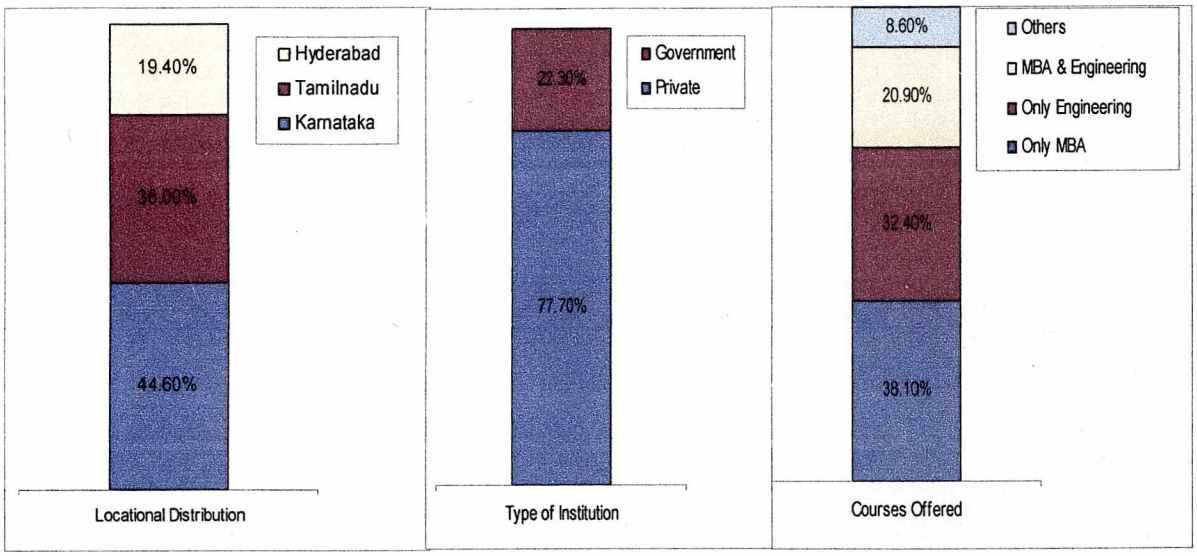
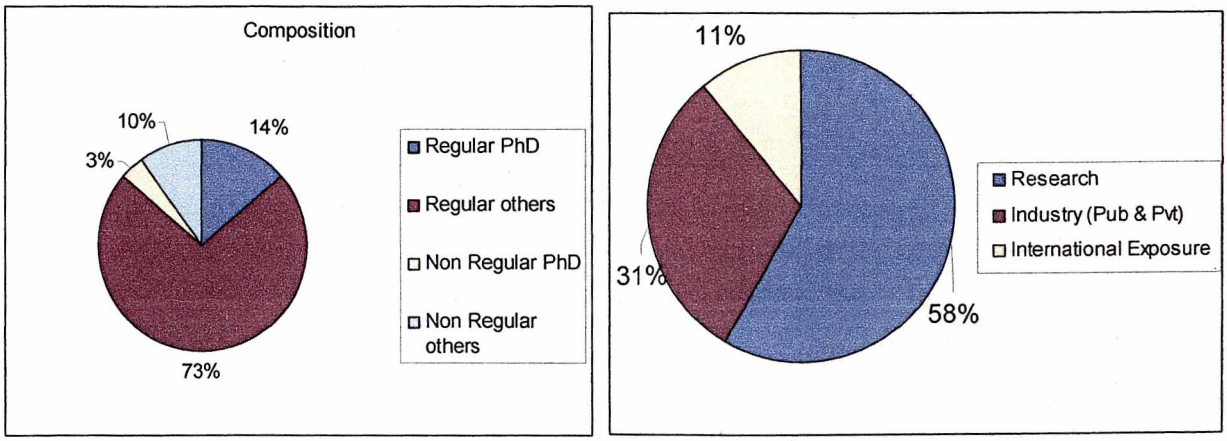


Figure – 7

Profile of Faculty



Factor Analysis of the response to 19 different types of interaction revealed the existence of Five Domains of interaction between Industry and Institutions, which could be labeled as:

Knowledge-oriented Interaction – This pertains to creation, acquisition and transfer of knowledge

Industry-oriented Interaction – This reflects the attempts on the part of the institutions to utilize the capabilities of industry

Academic-oriented Interaction – This captures the attempts by the Industry to utilize the capabilities of the Institutions

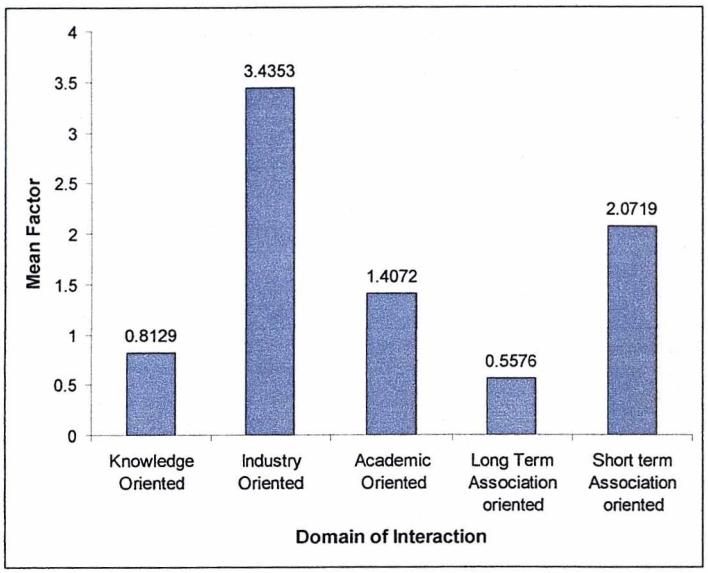
Long-term Association oriented Interaction – The types of interaction covered under this factor seem to take a long-term view of the interactions between industry and institution

Short-term association oriented Interactions – These interactions seem to be aimed at short-term gains

It is interesting to note that the intensity of the interactions varies across these domains and is captured in terms of the Factor Mean of the 'Extent of the Frequency' of Interaction. The relative positions of the five Domains of Interaction is presented below:

Figure – 8

Domains of Interaction



Contrary to what has been depicted in the Indian writing on this – knowledge creation and transfer, keeping up with theory and applications, institutions are interacting with Industry more to get the project work and placement done , get the industry to deliver guest lectures and join in workshops and seminars – a fairly clear signal of 'industry-orientation'. Shorter-term engagements with industry on MDPs, student visits, mentoring etc are the second choice of Domain of interaction. Knowledge and Academic orientation are relegated down the list. In fact, a study conducted by Profs. Madanmohan and Krishnan revealed that hardly 7% and 4% of the process and product innovations respectively had benefited significantly from academic research. That hardly 5% & 4% couldn't have been developed without substantial aid from academia. Another study by Prof. Chaudhuri and Dixit, concluded that it is 'technical services' rather than 'product or process development projects' that seem to be the need of industry.

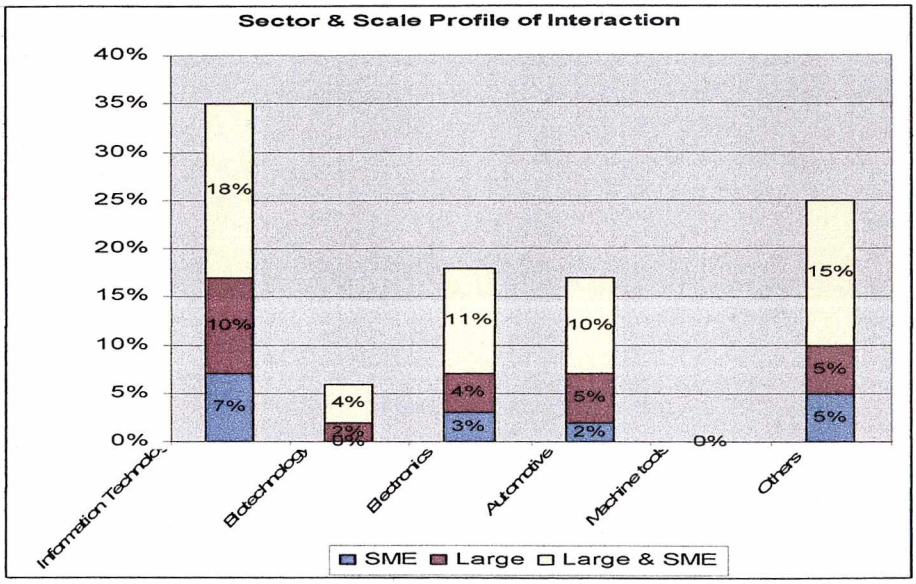
Domain of interaction – correlation with institutional characteristics and Mechanisms of Interaction

The strength of the Full-time Faculty, without PhD, has a significant correlation with 4 out of the 5 domains of interaction. In terms of faculty background – faculty with industry background have a significant correlation with both Industry oriented as well as the Academic Oriented domains of interaction. The 'Research' background of the faculty, unfortunately, does not seem to significantly influence any of the domains of interaction.

Institutions with MBA programmes and MBA & Engineering programmes seem to exhibit higher levels of interactions compared with other types of institutions. This could be attributed to the 'business-driven' nature of the MBA programmes.

Use of the Interaction Cell has a significant impact on the Industry Oriented Domain of interaction.

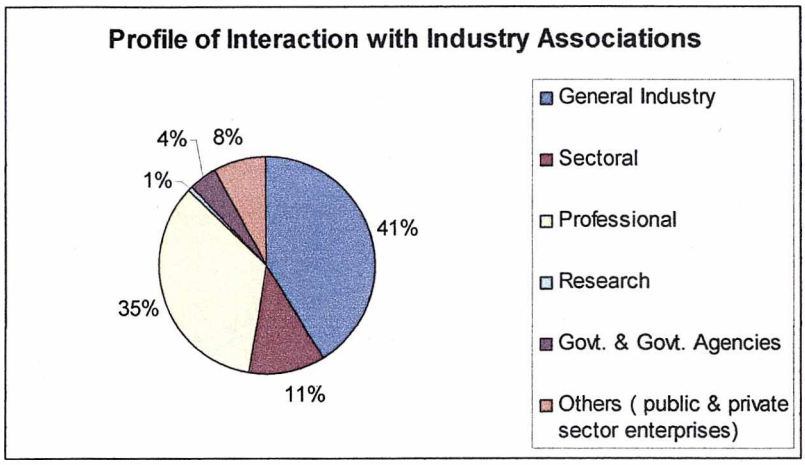
Figure – 9
Patterns of Interaction based on sector & scale



IT accounts for the largest proportion, followed by electronics and automotive. The scale-wise break up indicates encouraging interaction by the SME sector. The chart reveals that interaction has been equally active in both scales - SME & Large.

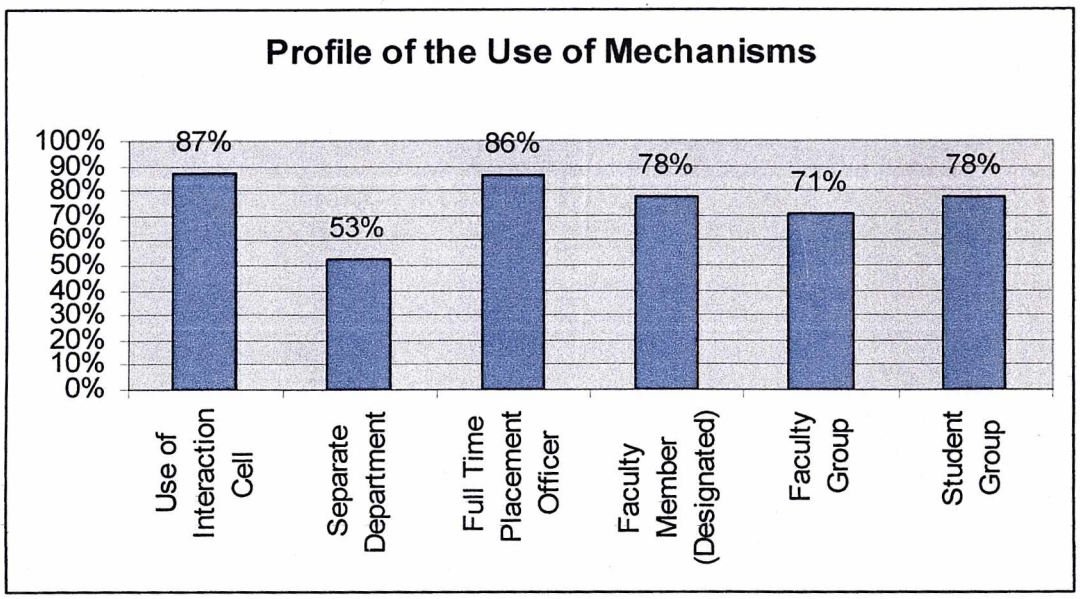
Figure – 10

Interaction with Industry Associations



From the above, it appears that institutions are most inclined to interact with General Industry Associations (41%) closely followed by the Professional bodies (35%). This could be attributed to the functional and knowledge domain of the faculty involved. At the same time, complete neglect of sectoral associations and research bodies reveals that the institutions may have to address both vision and right understanding of the philosophy of interaction.

Figure - 11



The pattern of usage of the mechanisms is fairly uniform across different types of mechanisms. However, use of Interaction Cell and Full Time Placement Officer are the most dominant mechanisms used.

Table - 11

Departmental Patterns of Interaction

	% of Interaction on a 1-5 Scale				
Department	**1**	**2**	**3**	**4**	**5**
Electronics	9%	20%	34%	20%	16%
Computer Science	6%	20%	31%	24%	19%
Mechanical	11%	15%	38%	21%	15%
Civil	16%	22%	25%	25%	13%
Electrical	13%	31%	29%	17%	10%
Marketing	10%	12%	32%	15%	32%
HRM	9%	11%	34%	20%	26%
Finance	13%	8%	34%	18%	27%

The management departments exhibit a high level of interaction with industry, perhaps due to their closer domain knowledge of business management. Among the technical departments, Civil and electrical – the two traditional streams of engineering are quite low

in their relative intensity of interaction, in comparison with electronics and computer Science. Mechanical engineering seems to be at an average level.

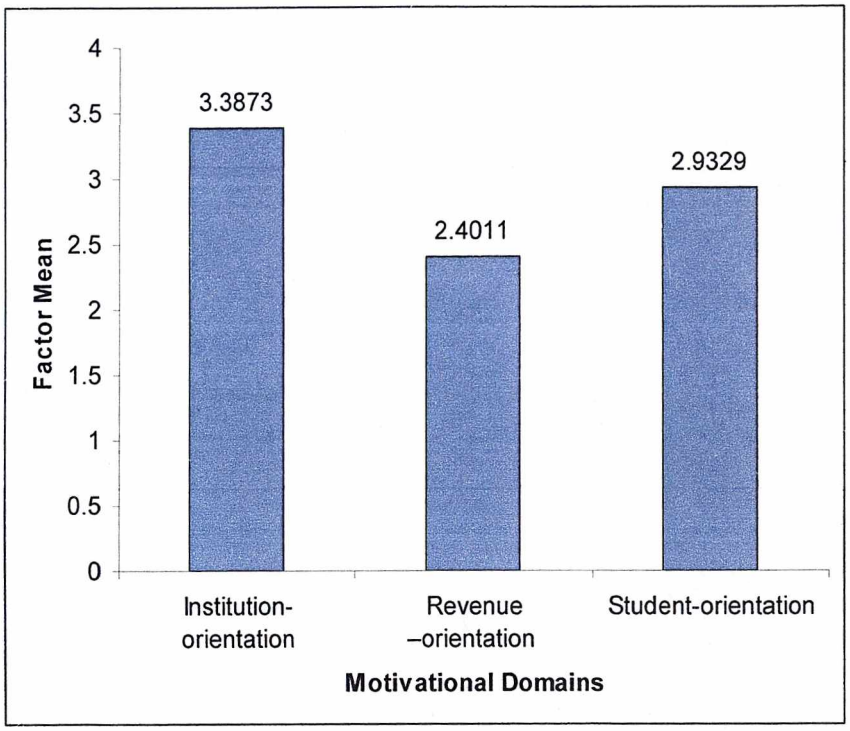
Contributory Factors of Interaction

Factor analysis of the responses to sixteen motivation-related variables revealed three underlying Domains of Motivation. These are presented below.

> ***Institution Orientation*** – The motivational elements pertain to the vision, mission and the brand image of the institution.
>
> ***Revenue Orientation*** – The sources of motivation appear to be aimed at enhancing the flow of resources
>
> ***Student Orientation*** – The motivational propellant for interaction is the interest of students

The variation in the weight of the motivating factors also provides an insight into the key drivers of institutional motivations that influence interactions. The relative weights are presented below:

Figure - 12



Institution Orientation – leadership, management, culture and climate seem to be the key motivation triggers. Student stakeholders call the shots as the next key driver. Infrastructure, Funding Schemes of Government of India and even the Knowledge –base and the Research capabilities of the institution do not seem to count for much. This closely parallels the 'Domain of interaction' dealt earlier.

Benefits of Interaction

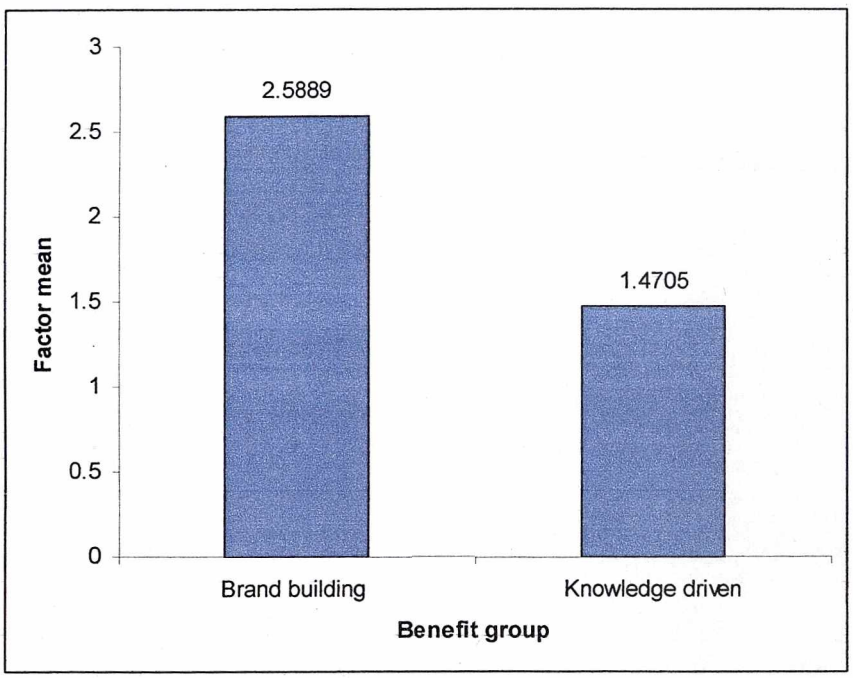
Factor analysis of the responses to eighteen variables related to the benefits derived by the institutions from their interactions with industry , uncovered two Benefit Groups:

Brand Building – This captures the benefits derived in terms of building the institutional brand and image and the attendant gains secured, including commercial.

Knowledge-driven – This reflects the benefits in the form of generation and dissemination of knowledge and building the intellectual property.

The relative standing of the two factors is presented in the chart below.

Figure - 13



It is interesting to note that institutional Brand Building is, by far, the most dominant benefit derived from the interactions. The brand equity is sought to be built through activities such as seminars, workshops, internship, exposure to faculty and outright brand improvement. This is well aligned with the motivational domain of institution-orientation presented in the previous section. While it is encouraging to note that Knowledge –driven benefit group does figure in the reckoning of the institutions, it remains a distant second.

Benefits of interaction – correlation with institutional characteristics and Mechanisms of Interaction

Almost all the mechanisms are significantly related to the Brand Building Benefit group, but Full Time Placement Officer and Interaction Cell are the most significantly used mechanisms. Understandably, Group of Faculty is the most significant mechanism used with respect to the Knowledge Driven benefit Group.

Barriers of Interaction

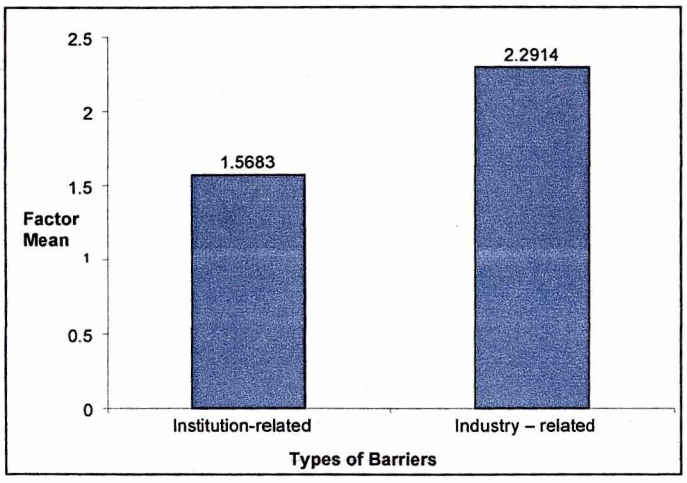
Factor analysis of responses to eleven variables which address the barriers, reveal two types of underlying barriers. These appear to hamper the types and depth of interaction with industry.

Institution-related barrier – This represents barriers arising out of the constraints in the capabilities of the faculty, institutional resources, lack of professionalism and brand image.

Industry related barrier – This represents barriers arising out of the lack of alignment of priorities, lack of continuity and response from industry.

The relative weights of the two types of barriers is presented below:

Figure – 14



A perusal of this chart indicates that institutions seem to view industry-related problems as constituting the main barrier hampering their interactions. However, to balance the attribution to external causes, it is encouraging to note that institutions do not dismiss the internal causes outright and do reckon with the same.

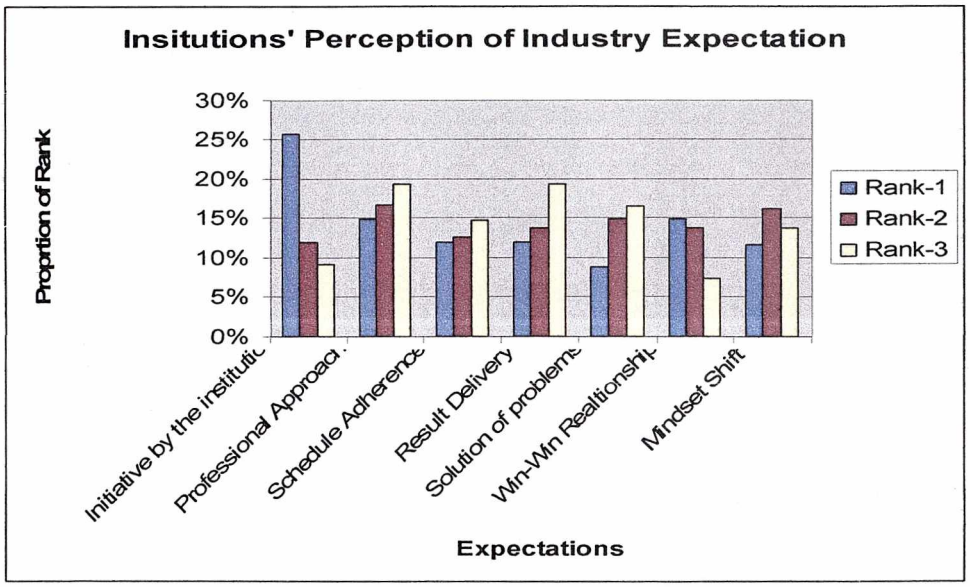
Barriers of Interaction – Correlation with Institutional Characteristics

Industry related barrier exhibits a significant variation with respect to the Types of institution – Government and Private, at the 0.05 level. No variation was seen with respect to either location or the courses offered.

Perception of Industry Expectations

This captures the perception of the institutions with regard to what Industry expects from them. The respondents had indicated their ranks for various expectations. The relative scores secured by each expectation on the first three ranks have been presented in the chart below.

Figure 15



It is interesting to note that the most important expectation of the industry as perceived by the institutions is that for any interaction to take place, initiative should be taken by the institution. Mindset has secured the highest on 2nd Rank. The least expectation of the industry, as perceived by the institution, seems to be in solving technical and managerial problem of the industry by the institution. Professional Approach and Result Delivery appear quite significant. This closely mirrors the findings of the study mentioned in section 5.1.2 wherein the 'Task Related & Business Focus' had emerged as one of the dimensions of an MDS analysis of industry respondents on the characteristics of the University System that influence industries to deal with them. It is interesting to note that 'Previous History' also was one of the significant influencers discovered by the same study- this is synonymous with 'image'.

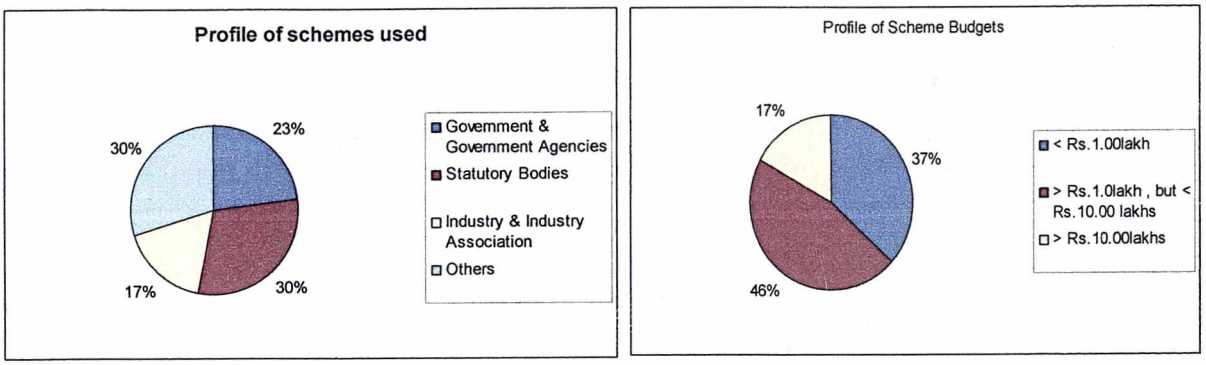
Propensity of Interaction

The respondents were presented with a battery of statements depicting typical situations involving some stimulus for interaction with industry. Using multi-item scale, their propensity to interact was calculated as a composite index. It is gratifying to note that the overall mean Propensity to Interact is quite good at 2.9 on a 5 point-scale. Analysis of the correlation of the Propensity to Interact reveals that it is independent of the location, type of institution and courses offered.

Use of Schemes to promote interaction

The use of schemes remains rather at a low level. Only 26% of the respondents said they have used the schemes that sought to promote interaction with industry – be it that of the government or other agencies. The schemes promoted by the statutory bodies such as AICTE, UGC etc. seem to be the most popular, followed by that of the Government (both central and state) and its agencies. Industry and its associations such as CII, FICCI etc do seem to attract patronage. Understandably, 83% of the schemes used are in the less than Rs.10.00lakhs category. This may point to use of schemes for short-term gains – as revealed by the patterns of interaction.

Figure 16

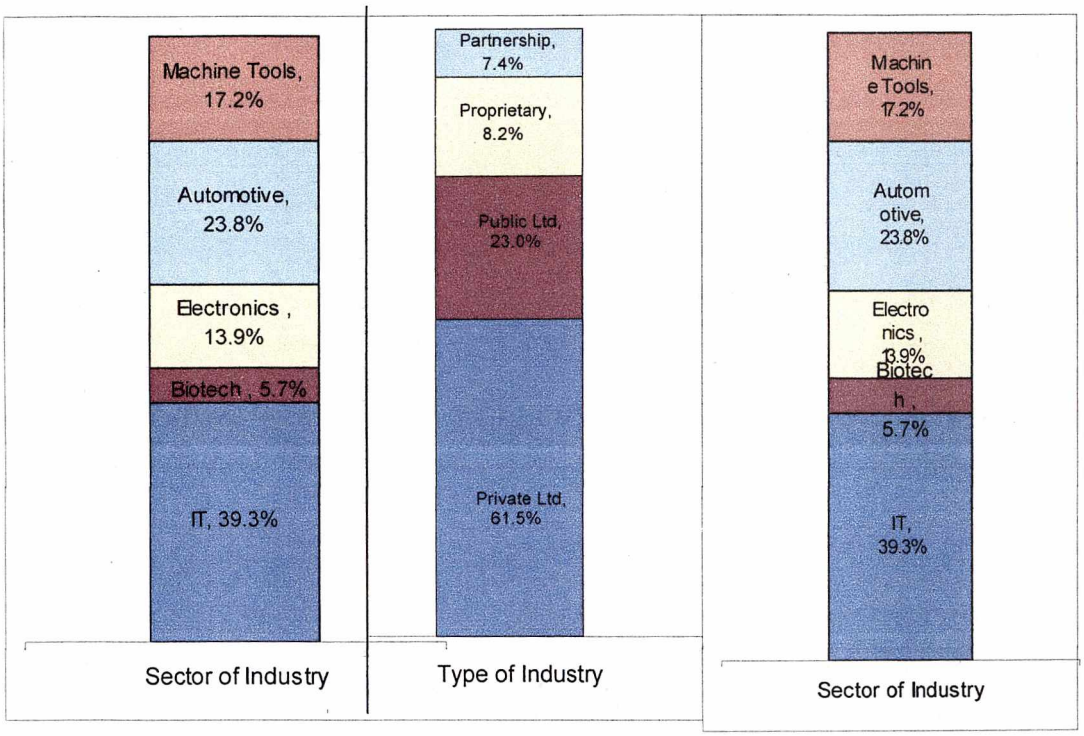


6.0 Interactions – Industry Angle

The broad profile of the sample of industry is presented in the following chart.

Figure – 17

Distribution of respondent industries



Scale Profile

In compliance with the operational definition for SME (please refer the Methodology Section vide 4.1.6), the following table presents the profile of respondent units.

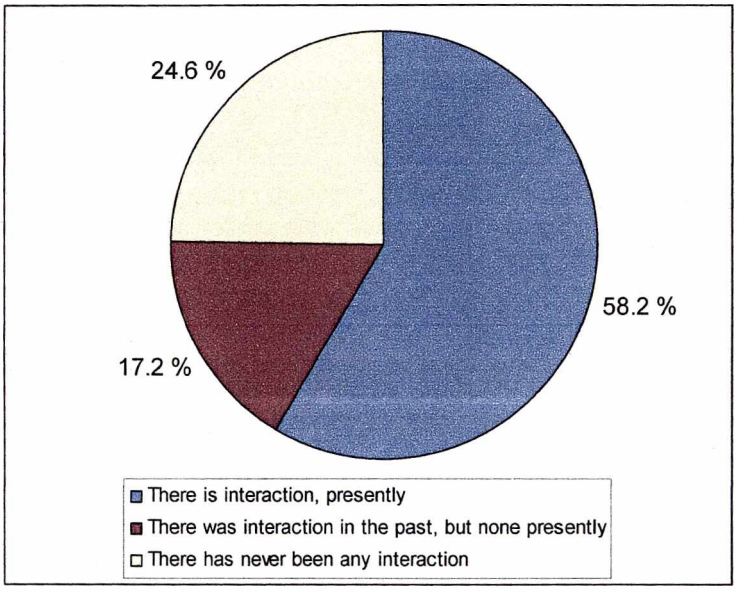
Table – 12

Distribution of respondent industries based on criteria for classification as SMEs

Satisfaction of criteria	SME	Non-SME
Plant & Machinery + Sales Turnover	74%	26%
Plant & Machinery + Employees	78%	22%
Sales Turnover + Employees	71%	29%

Figure 18

Status of interaction



6.1 Patterns of Interaction

6.1.1 Responses to nineteen variables were factor analyzed to uncover the following three Domains of Interaction.

Academia Driven Interaction – These pertain to the interactions taking place based on the needs of the faculty and the students

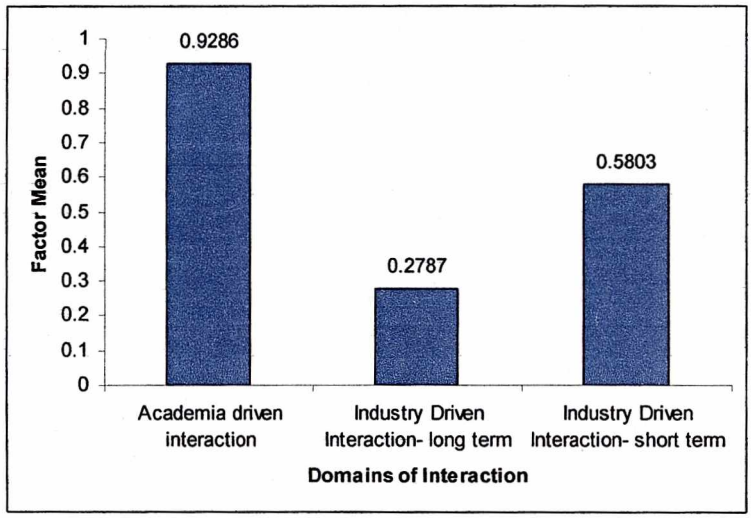
Industry- driven Interaction – Long term – This captures the willingness of industry to invest time and money in the institution, on a long term basis.

Industry- driven Interaction – Short term – This reflects the approach of the industry to have their immediate problems solved with a view to save resources

6.1.2 The relative weights of these three Domains of Interaction are presented below :

Figure – 19

Domains of Interaction of industry



As found in the analysis of institutions' responses, interaction is mainly on account of the interests of the academia which are again short-term. Industry is reluctant to commit to long-term association. Thus, the alignment between the institutional and

industry responses in our survey is noteworthy. Taken together, this is a valid representation of the current patterns of interaction between Academia and industry.

6.1.3 Domain of Interactions – Correlation with Industry Characteristics

6.1.3.1 Academia Driven Interaction is positively correlated with both Investments in plant and machinery as well as the Annual Sales Turnover at 0.01 level of significance. This may be due to the perceived potential of bigger units to support the needs of the students and faculty.

6.1.3.2 There is a significant difference in the Academia Driven Interaction depending on the geographical location of the enterprises as well as the 'Type of Enterprise'. Industry Driven Interaction – short term, exhibits significant variation with respect to the 'Type of Enterprise'. This need to be probed further to uncover the reasons. Interestingly, no significant differences were uncovered on any of the domains of interaction with respect to the 'Sector of Industry'

6.2 Sectoral Patterns of Interaction

The correlation between the Domains of Interaction and the Sectors of Interaction is presented below:

Table – 13

Correlation between domains of interaction and sector of industry

		Academia driven interaction	Industry Driven Interaction-long term	Industry Driven Interaction-short term
Sector of Industry	Information Technology	1.2176	0.3333	0.5125
	Biotechnology	1.4921	0.1429	0.1429
	Electronics	0.1429	0.5098	0.6353
	Automotive	0.6353	0.2184	0.7724
	Machine Tools	0.6349	0.0952	0.3048

IT and Biotech sectors are relatively of recent origin and hence are more driven by Academia. However, the remaining sectors are mature and exhibit a short-term, industry-driven interaction. Due to the mature characteristic of these sectors, industry is willing to invest resources, but again more on a short-term basis.

6.3 Departmental Patterns of Interaction

A correlation between the frequency of interaction in terms of the type of institution and the various functional areas in the industry is presented below.

Table – 14

Mean frequency of type of institution

Departments	Mean of institutions	Mean frequency on type of Institutions			
		NA	Technical	Management	Technical and Management
Finance / Accounts	0.35	0.10	1.67	2.00	1.33
HR/Personnel	1.48	0.06	1.89	2.67	3.59
Marketing/ Sales	0.66	0.06	2.00	2.13	2.29
Operations/ Production	0.75	0.06	3.05	1.25	2.33
Exports/ International	0.30	0.05	2.25	2.50	.67
R & D	0.84	0.05	3.42	-	3.00

HR/Personnel department seem to be interacting more as compared to other departments. This could be due to their functional nature – recruitment, training and development. R&D and Operations/Production departments exhibit a high degree of interaction with technical institutions due to the technical nature of activities.

Marketing and Exports/International present a similar pattern of interaction, equally with technical and management institutions. These share a common thread of activities which are externally oriented.

6.4 Benefits of Interaction

6.4.1 Factor analysis of the response on nineteen variables resulted in three Benefit Groups as follows:

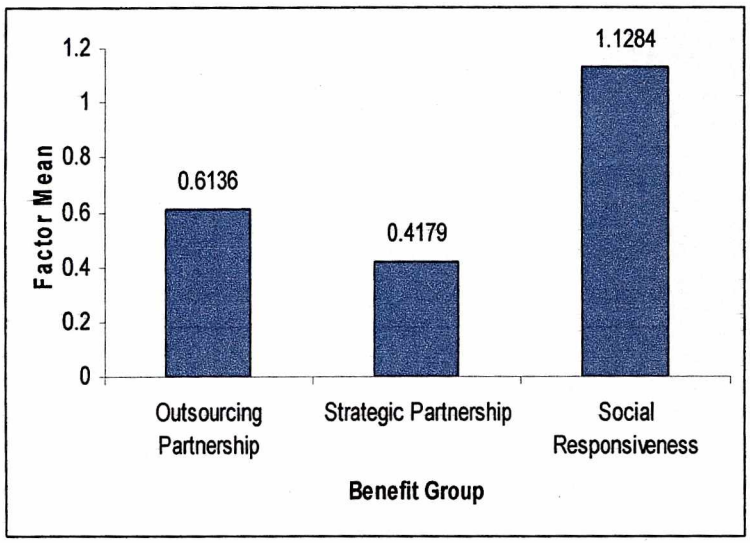
6.4.1.1 Outsourcing Partnership – Industry seeks to fulfill some of the functional needs of the business , through the institutions

6.4.1.2 Strategic Partnership – Industry seeks to forge a long-term win-win relationship with the institutions

6.4.1.3 Social Responsiveness – Industry, while seeking to fulfill the needs of the institutions, aims at achieving a social status.

6.4.2 The relative positions of the three Benefit Groups are presented in the chart below.

Figure - 20



Industry appears to stress the social responsibility towards the institutions than seeking their alliances for Outsourcing and Strategic Partnership.

6.4.3 Benefits of Interaction – Correlation with Industry Characteristics

6.4.3.1 Outsourcing Partnership is sought more by bigger units (in terms of sales turnover and investment in P&M). However, no such correlation was observed with regard to the other Benefit Groups.

6.4.3.2 Outsourcing Partnership and Social Responsiveness exhibit highly significant variations across different types of enterprises. However , no such variation was observed on any of the Benefit Groups across various 'Sectors of Industry'

6.5 Discontinuation of Interaction

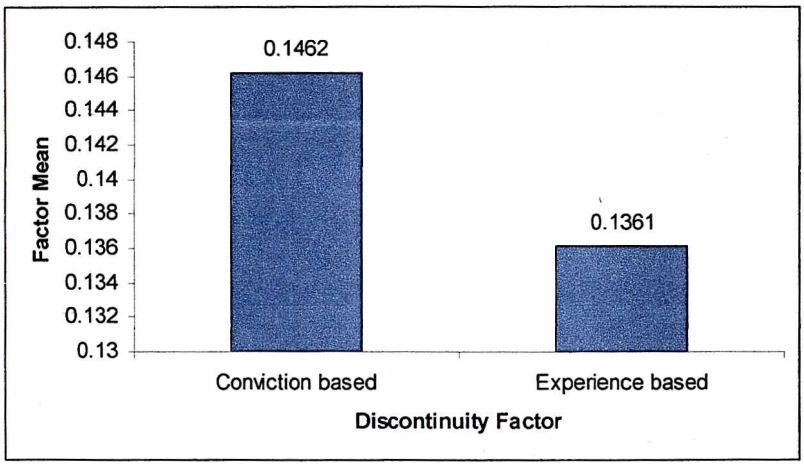
6.5.1 Factor Analysis of the responses to eleven variables revealed two underlying dimensions of the reasons as to why Industry seem to have discontinued their interactions with Institutions.

Conviction-based – The causative factors for discontentment are more rational and logical.

Experience based – This captures the causes which are more subjective and perceptual.

6.5.2 The relative weights of these two 'Discontinuity Factors' are presented in the following figure.

Figure – 21



While the absolute values of the mean are low, the relative weights indicate a marginally higher influence of Conviction based discontinuity factor.

6.6 Reasons for not initiating Interactions

6.6.1 The response to six variables related to the reasons for not initiating interaction with institutions was analyzed and the findings are presented below.

Table - 15

Mean of reasons for not initiating interaction

Reasons	Mean Importance
Institutions cannot solve industry problems	2.8
No institution worth the name in proximity	2.2
Never felt the need for interaction	3.3
Divergence of objectives	2.1
Lack of support within the firm for interaction	2.3
No initiative from institution	2.7

While the need for interaction is a fundamental requirement, lack of initiative on the part of the institutions as well as the lack of confidence in the ability of the institutions to solve the problems of industry ranked as the most important.

6.7 Propensity to Interact

6.7.1 Like in the context of Institutions, the Propensity to interact is quite encouraging at the level of 2.8 on a scale of 5 and remains independent of locations, sectors and type of industry.

6.8 Choice of the models of interaction

Table – 16

Means scores of model of Interaction

Model of Interaction	Mean score
MOU with institutions for long term association on various aspects of mutual interest	2.10
Mentoring potential entrepreneurial students by industry persons	2.10
Participating in academic activities-special lectures, syllabus up gradation, training faculty/students under a 'Revenue Model'	1.98
Consulting to establish laboratory that would be of mutual benefit	1.57
Research and development activities	1.98
Market survey and pilot study for new product launch	1.85

MOU spells out the rights and obligations and hence, the most preferred. Mentoring seems to be a naturally preferred model. R&D and looking for alternative sources of revenues through institutions seem to be the next preferred models.

We have also attempted an analysis of the preference of models in terms of the sectors as well as the types of industries. These are presented below:

Table – 17

Mean of model of interaction based on sector of Industry

Model of Interaction	Sector of industry	Mean	Type of enterprise	Mean
MOU with institutions for long term association on various aspects of mutual interest (preference)	Information Technology	2.15	Proprietary	0.80
	Biotechnology	1.71	Partnership	2.33
	Electronics	1.88	Private Limited	1.91
	Automotive	2.38	Public Limited	3.00
	Machine tools	1.90		
	Total	**2.10**	**Total**	**2.10**
Mentoring potential entrepreneurial students by industry persons (preference)	Information Technology	1.79	Proprietary	2.50
	Biotechnology	1.86	Partnership	2.78
	Electronics	2.82	Private Limited	1.91
	Automotive	2.45	Public Limited	2.25
	Machine tools	1.81		
	Total	**2.10**	**Total**	**2.10**
Participating in academic activities - special lectures, syllabus up gradation, training faculty/students under a 'Revenue Model'	Information Technology	1.90	Proprietary	1.70
	Biotechnology	2.43	Partnership	1.78
	Electronics	1.06	Private Limited	1.75
	Automotive	2.66	Public Limited	2.75
	Machine tools	1.81		
	Total	**1.98**	**Total**	**1.98**
Consulting to establish laboratory that would be of mutual benefit	Information Technology	1.10	Proprietary	1.40
	Biotechnology	3.71	Partnership	0.67
	Electronics	1.06	Private Limited	1.61
	Automotive	1.83	Public Limited	1.79
	Machine tools	1.95		
	Total	**1.57**	**Total**	**1.57**
Research and development activities	Information Technology	1.60	Proprietary	1.40
	Biotechnology	3.29	Partnership	0.89
	Electronics	1.41	Private Limited	1.89
	Automotive	2.45	Public Limited	2.79
	Machine tools	2.24		
	Total	**1.98**	**Total**	**1.98**
Market survey and pilot study for new product launch	Information Technology	1.54	Proprietary	1.30
	Biotechnology	3.00	Partnership	0.89
	Electronics	0.94	Private Limited	1.92
	Automotive	2.38	Public Limited	2.18
	Machine tools	2.19		
	Total	**1.85**	**Total**	**1.85**

Machine Tools exhibit a consistently low preference for all the models except R&D and Market Survey, where they are weak. Automotive seem to adopt a middle-of-the-road preference for all the models, with the exception of consulting for establishing laboratory. Due to the technology – orientation of Biotech sector, they have indicated a high degree of preference for Consultancy for establishing Laboratory and R&D. It is interesting to note that the electronics sector has low preference for most of the models except Mentoring which may be due to the fact that one-to-one coaching is more beneficial. While Public Limited and Private Limited companies prefer MOU, R&D and Participating in Academic activities, Proprietary and Partnership firms seem to prefer the Mentoring model.

Chapter – 4

Road Map for Industry-Institute interaction -Suggestions and Recommendations

10.1 Conclusion

10.1.1 There has been a proliferation of higher educational institutions – both technical and management. This has been fuelled by the rising demand for knowledge workers driven by liberalization, privatization and globalization (LPG), over the last decade. SMEs , in the face of LPG , had to upgrade their technologies and innovate to even survive in the increasingly liberal and competitive business environment. Hence, this study focused on interactions between technical institutions and SMEs engaged in the S&T sectors such as automotive, machine tool, electronics, Information Technology and Bio Technology (chosen for the study).

10.1.2 The thrust of both research and practice with regard to industry-institution interaction, in the Western part of the world, has been at the knowledge-intensive end of the continuum. The focus is on issues related to R&D, joint collaboration, strategic alliances intellectual property rights etc. Mechanisms used for interactions which are studied include Technology Transfer Officers (TTO), Knowledge Transfer Officers (KTO) etc. The most often used methodology is Case Research in view of the fact that the research objectives are related to understanding how? And Why? Interactions happen.

10.1.3 Most of the research and writing with respect to industry-institution interaction in India has remained qualitative and without much methodological rigor. On the one hand, institutions are presumed to be the repository of knowledge, on the other hand the thrust of most of the reporting is mainly related to the operational routines of the institutions.

10.1.4 This study has adopted the survey method, ensured a deliberate representation of the various entities, both in terms of institutions as well as industry and used sophisticated statistical techniques of analysis.

10.1.5 Institutions

10.1.5.1 From the analysis of the response on institutions, we can conclude that :

a) The interactions are predominantly short-term and oriented towards seeking support from industry for project work, placement and guest lectures.

b) The interactions are very low in the knowledge and academic oriented domains. However, interactions in this domain seem to be better with SMEs than with the larger units.

c) This pattern of interaction is reflective of the basic motivation of the institution to seek benefits in terms of building the institutional brand through short-term interactions, rather than knowledge-driven.

d) Revenue generation by leveraging in-house research capabilities and knowledge infrastructure of the institutions is a weak motivator of interactions.

e) Lack of understanding of industry needs and priorities seems to be the main hampering factor for interactions.

f) Fulltime Faculty with industry background, rather than doctoral qualification, seems to influence interactions with industry.

g) Institutions offering MBA programmes, either as stand-alone or along with engineering programmes, exhibit higher levels of interactions with industry. This could be by virtue of the business and practice orientation of the MBA curriculum.

h) Interaction cell, as a mechanism, seems to promote better interactions than other mechanisms such as Full time placement officer, Designated Faculty Members etc.

i) Institutions' understand very clearly that industry expects them to take the initiative to interact. Also, Professional Approach and Result Delivery also rank as significant expectations of industry, as perceived by the institutions.

j) Interactions with SMEs are as much as interactions with large units.

10.1.6 Industry

10.1.6.1 From the analysis of the response of the industry , we can conclude :

a) Most of the literature talk about the SME sector can manage competition through leveraging Technology and strategize their operations appropriately in terms of customer focus, resource mobilization and appropriate risk management. However, our analysis shows that generally 'interaction initiative' is mainly from the Institutions and they are more academic driven. Industry participates mainly in guest lectures, industrial visits by students, project work and similar short term activities. There is not much long term orientation in terms of building / adopting technology or product development.

b) Industry does not consider the Institutions to have enough knowledge or experience to help them on a timely basis. Industry considers 'timely response' as an important attribute for any service provider.

c) Academic oriented interactions are more predominant in the recent technology driven sectors like IT and BT. However; 'industries orientation' is more in established sectors like Automotive and Electronics.

d) It is seen that Production / Operations departments prefer to work with Technical institutions while HR / Personnel departments prefer to work with either institutions that offer Management courses or those who offer both Technical & Management courses.

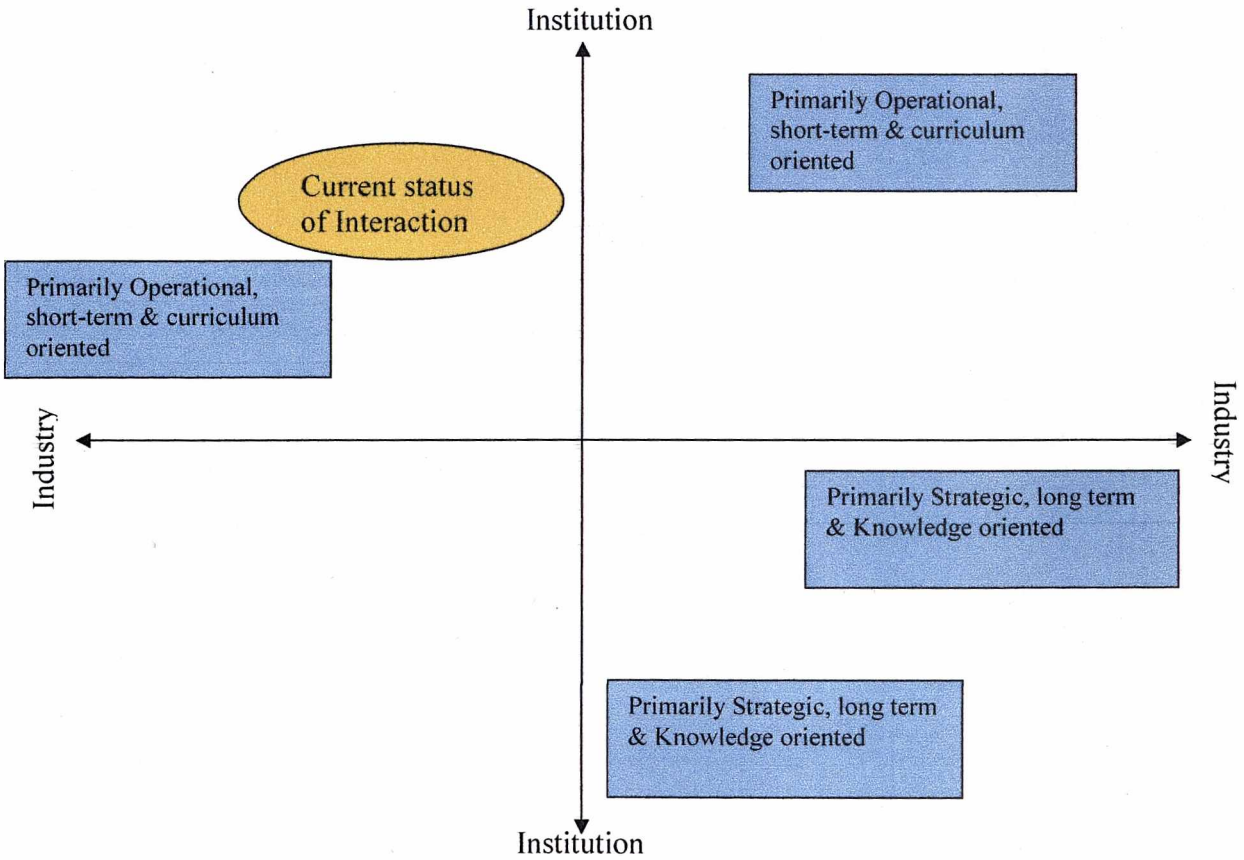
e) More than seeing the interaction with the institutions as an opportunity to 'outsource' some of the important functions based on a strong & proper understanding, industry view it as their 'social responsibility'.

f) The reasons for discontinuation of interactions by the industry wherever initiated is more based on their conviction rather than just experiential.

g) Industry prefers to work with institutions on a long term basis provided a proper Memorandum of Understanding are signed taking in to account mutual interests & time frame. Industry would also prefer to play 'mentors' role in building up students into successful entrepreneurs.

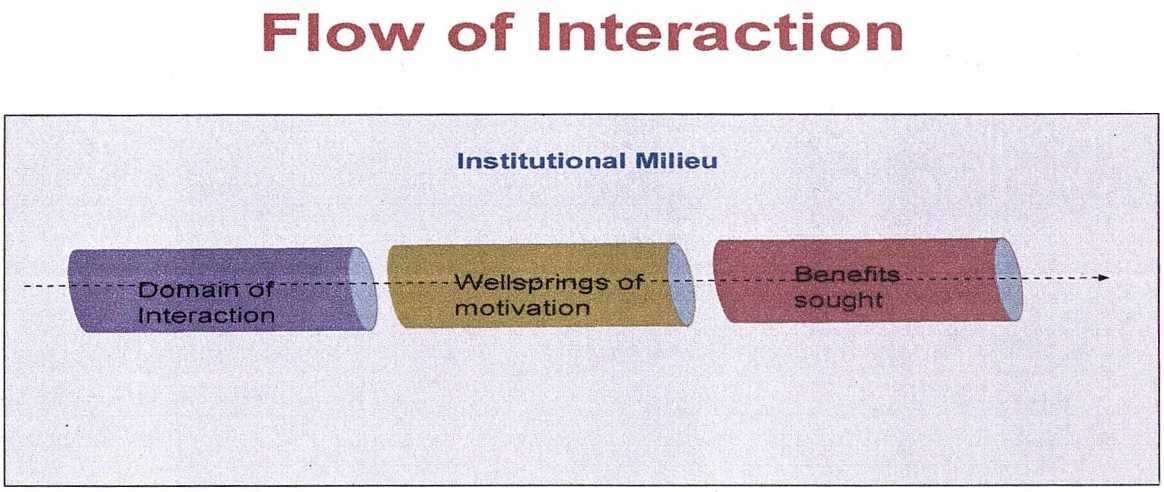
10.1.6.2 Current Status of Industry –Institute Interaction

Our conclusions with respect to the current state-of-the-art of interaction are depicted in the following schemata.



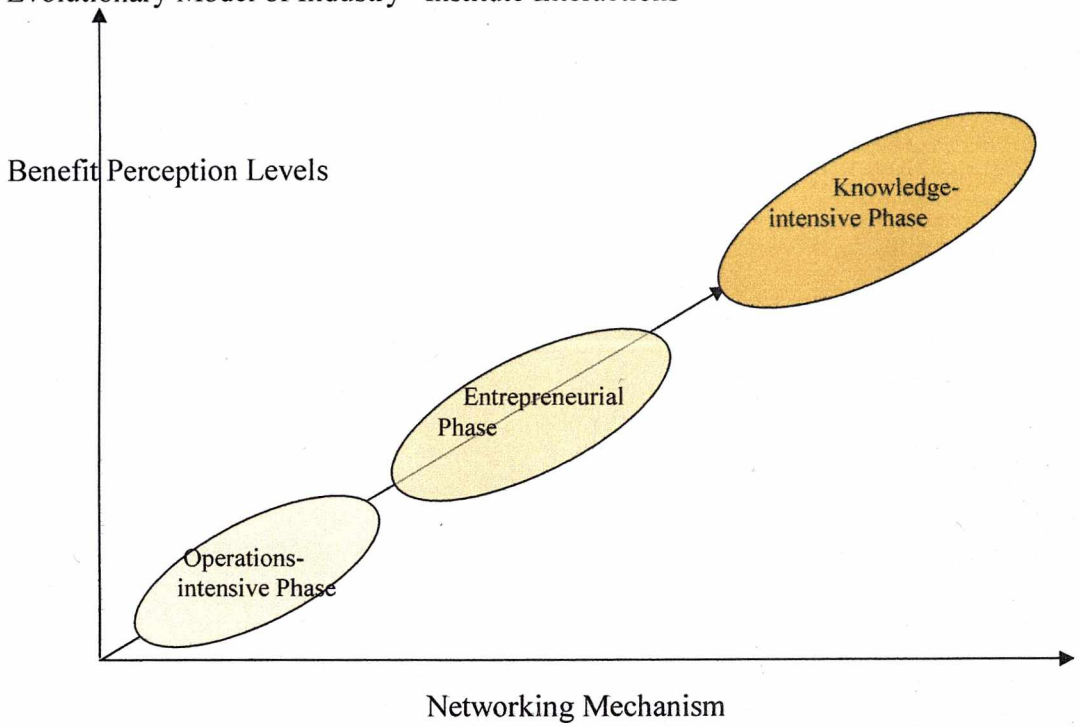
10.1.6.3 Recommendation and Road Map

1. Instead of aiming at more knowledge-intensive interactions, it is suggested that the potential of the current patterns of interaction which are more operational and short term be exploited fully. Towards this, mechanisms of interaction such as Interaction Cell, Placement Office and Designated Faculty are deployed in institutions. The channels such as Industry Association and Professional Associations, which were found to be the most active in our study, are leveraged by both the institutions and the industry. Towards achieving this, we hypothesize that an alignment of Domains of interaction, Motivations of Interactions and the perceived Benefits of Interaction be ensured in order to enable a free flow of the interactions. This is depicted in the following scheme:



2. The domains of interaction have to be enhanced progressively from the operational, routine and short-term perspective to an increasingly knowledge-intensive perspective. We suggest the following trajectory to be adopted.

Evolutionary Model of Industry –Institute Interactions



3. Evolutionary Trajectory of Interactions

A. Operations- Intensive Phase:

i. It is important that institutions should take the lead and market their competencies in a specific area(s) to SME sector. Only over time credibility could be built. It would be perhaps better to have MOU with SME industries associations like KASSIA and AIMO in Karnataka or AIMO in Karnataka, Tamilnadu, Andhra, or industry specific associations like ABLE, ACMA, etc., for specific activities which could be time bound.

ii. Institutions should make best use of schemes that are available with various statutory bodies like UGC, AICTE, etc., and facilitating government departments and agencies like DST, TIFAC, DSI, SISI, etc., to establish relationship with SME sector.

B. Entrepreneurial Phase

i. Institutions should take up some of the technical problems of SME in the S & T sector and solve them on a time bound basis to build credibility. This would help in the long run even as a revenue generation model for the faculty and institution.

ii. Institutions, with the support of state and central government agencies as well as regional communities, can build business incubators.

iii. Institutions should convince large organization to establish 'Chair' for research in specific Technology / business related areas.

C. Knowledge-Intensive Phase

i. Institutions can function as 'bridging organization' between several Central and State Government R & D establishments and SME sector for optimum utilization of the infrastructure.

ii. Patenting , establishing Technology Transfer Offices , Knowledge Transfer Offices and such mechanism can support long term strategic alliances with industry

4. Other suggestions include

- There should be a calendar –based periodic interactions between institutions and sunrise sector SMEs / Industry associations , for a period of one year which has to be reviewed, from time to time.
- Institution should look at building revenue model for consulting business
- A fixed proportion of students should be encouraged to take up internship / project work in SMEs, concerning technical / business issues SMEs in the S&T sector.
- The faculty coordinator should be exclusively for SMEs and conversant with promotional policies of the government, both state as well as the central.

- Industry and institution should jointly identify 'Interaction Champions' drawn from both camps, in order to evangelize and encourage interactions.
- SME Industry associations of specific sectors can establish common Test and Calibration facilities with subsidy support of state and central government, within the premises of the institutions.
- Institution should adopt an SME cluster and develop relevant knowledge-base in various forms – knowledge inputs, research inputs and training on specific functional / business skills , both local and global

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Appendix- 1

List of Local Project Advisory Committee (LPAC) members

Chairman

Prof. N.R. Shetty
Former Vice Chancellor
Bangalore University

Convener

M.K. Sridhar, Ph.D.,
Reader
Canara Bank School of Management Studies
Bangalore University

Members

1. Sri. Rakesh Chetal
   Advisor & Director
   NSTMIS Division
   Department of Science & Technology

2. Dr. A. N. Rai
   Principal Scientific Officer / Sc.-D
   NSTMIS Division
   Department of Science & Technology

3. Nitin Deshmukh
   Director General
   Association of Biotech Led Enterprises (ABLE)

4. Dr. Gopal P Mahapatra
   Director (Training & Organization Development)
   Oracle India Pvt. Ltd.,
   Bangalore

5. Late. H.R. Gupta
   Consultant TQM

6. Dilip Patel
   Director
   ADDON Pvt. Ltd.
   Bangalore

7. K.A. Krishnan
Executive Secretary
Karnataka Small Scale Industries Association (KASSIA)

8. Prof. M.H. Dhananjaya,
Director (Technical)
JSS Mahavidyapeetha
Mysore

9. V. Krishnan
Former General Manager (HR)
MICO

10. Dr. K. Janardhanam
Director
Canara Bank School of Management Studies
Bangalore University

11. Anant R Koppar
President and CEO
Kshema Technologies

12. Dr. M.H. Balasubramanya
Associate Professor,
Department of Management Studies,
Indian Institute of Science, Bangalore

13. Dr. Vaman Archarya
Entrepreneur, Bangalore

14. Dr. P. Narayana Reddy
Professor and Head, School of Management Studies
Chaitanya Bharathi Institute of Technology
Hyderabad

15. Prof. Rajan Mani
Chennai

16. M.V. Ravikumar
President & CEO
R.K. CONSULTANTS

17. Prof. N. Ramesh
Co-ordinator
TAPMI – CEE

Appendix 2

Proceedings of the Brain storming sessions

I. Proceedings of the Interaction Meeting held at School of Management Studies (SMS), Jawaharlal Nehru Technological University (JNTU), Hyderabad on Tuesday, the 12th October 2004

1. Dr. M.S. Bhat, Director, School of Management Studies, JNTU chaired the Interactive session.

2. Dr. P. Narayana Reddy, Professor and Head, School of Management Studies, Chaitanya Bharathi Institute of Technology, who co-ordinated with the local academia and industry at the request of Dr. M.K. Sridhar, welcomed the participants and highlighted the importance of the study. A copy of the back-ground paper was already circulated to all the participants, just before the beginning of the session.

3. Dr. M.K. Sridhar, Principal Investigator presented an over-view of the research study, highlighting the main objectives, research methodology that the team proposed to adopt, operational definitions used, and general model of the Interaction and stake-holders who would be interested in the outcome of the study, thus setting the agenda for the Interaction.

Generally, all the participants numbering over 25, were drawn uniformly from Academia, Industry, Industry Association, Consultants and Retired. Bureaucrats, very actively participated in the interaction for nearly two hours. The summary of the views given and issues raised are given below:

a. Mr. Mahesh Pande, Industrialist and Treasurer of All India Manufacturers' Organisation (AIMO), A.P Chapter, cited lack of quality in education, lack of funding for Technology Upgradation, high duty structure and severe competition as some of the reasons for retarding the growth and sustainability of SMEs.

b. Mr. Prasad Rao, a retired director of industries in the A.P . while appreciating choosing of Electronics sector emphasised the need to consider 'Hardware' industry, reasoning out that though we have lot of manpower, skills, institutional frame-work and Academic infrastructure, there are several deficiencies in Policies and Promotional methodologies.. He also said while talking about I.T, lead areas where this could be promoted also to be identified (e.g. Pune, Hyderabad, Noida, etc,). In Automotive sector, while skills are available, he said 3 or 4 major areas have to be identified and promoted. In B.T area, he said except for Banana farming, there has been no major success. He said neglect of people and areas of National & International markets are the major issues to be tackled. He also pleaded for inclusion of textiles.

c. Mr. Haridas, Entrepreneur opined that 1 year practical experience after completion of 4 years of B.E programme should be made compulsory for graduates on the lines of Medicine.

d. Dr. N.R.K Reddy, Professor and Dean, Siva Sivani Institute of Management, said that any programme should be mutually rewarding. He also felt that 4 yrs. programme is less for some one to become full-fledged engineer. He also felt that the entire faculty should work necessarily for 2 months in industry.

e. Ms. Nuzhath Jahan, Senior Consultant, Reach Management Consultants Pvt. Ltd. felt that engineering graduates do not have competencies and conceptual clarity. She also said most of them do not possess soft skills.

f. Mr. V. Bhaskar Rao, a former banker and presently HRD Professional Trainer, felt that more initiatives should come from the SME sector, as knowledge is created only in the industries and this tacit knowledge has to be brought to the academic institutions. Hence, there has to be a 'Collaborative Learning Programme'.

g. Mr. Sudharka Rao, NISIET brought out the need for developing social responsibility in SME entrepreneurs as in case of Corporate Social Responsibility (CSR).

h. Dr. Susheela, an entrepreneur and Hon. Secretary, AIMO, AP Chapter said that as such SMEs were struggling themselves to sustain the ongoing activity because of the inherent problems of small scale sector and also there is fear of the technology being copied. Hence, SMEs tend to employ only ITI / diploma holders rather than Engineering graduates. Thus, there is a remote chance of SMEs becoming training centres

i. Mr. Seshagiri Rao, Joint Secretary, AIMO felt that there is no problem of competition. He has employed and trained several graduates who have subsequently become entrepreneurs themselves and still he is able to continue his industry successfully, thus highlighting the point that the confidence of entrepreneur and the technology that matter rather than the size of the industry.

j. Prof. P Narasimha Reddy, senior academician and Principal of Sreenidhi Institute of Science and Technology brought out the following points:

1. Present day students are better compared to earlier days, because of latest technologies and faster learning.
2. Today's industry requires ready-made product in Engineering. Graduates, unlike industries of those days who took pains in training fresh graduates. While Medical colleges have practicing doctors as teachers, it is difficult to replicate that model in engineering colleges.
3. Role of teachers in enhancing level of Technical education will depend upon the type of people who join, the training given to them, understanding of type of skills that are required by the industry
4. List of possible problems / areas that could be researched / investigated need to be developed.
5. Lack of R&D activities in the industry
6. Creation of synergy between Capabilities of Tech. Institutions and needs of SMEs
7. Mutually rewarding linkages have to be established.

k. Dr. Subashini, NISIET opined that Industry associations should participate in the design and update of Syllabus of Tech. Education. Entrepreneurship should be taught as a compulsory subject to the Final year engineering students and there should be Mentors in the Technical institutions.

l. Mr. Nagasrinivasa, Srinidhi Institute of Technology suggested that department-wise relationships with specific industry have to be created identifying the strengths and weaknesses of the faculty of each of the department .He said already their institution has signed an MOU with Cherlapalli Industrial area for various activities like Industrial visits, Project work, Internship, R & D, Consultancy, etc., Meanwhile, all the industries were allowed to use the library facilities, college infrastructure for their purpose.

m. Prof. Ramaswamy Reddy (Retd) suggested that some of the old subjects could be dropped and in their place new topics could be included. He also pointed out while intelligent students were available in the rural areas; language is a major barrier as most of them have studied in local language till 12^{th} standard. He also pointed out that industries can not expect graduate engineers to perform from day one.

n. Mr. Dharmpal, Business Simulation and Corporate Consultant pointed out that Training programmes have to be initiated for the faculty in the areas of New Technology and Management. The faculty lack exposure. It is very important to train the Trainers first.

o. Mr. Mohan Kumar, AGM – Works, Fenner India Ltd. said that he has been spending some time in giving lectures in Technical institutions in the area of his specialisation. He suggested that a strong Interface mechanism has to be built between Faculty and Industry. Faculty should come forward to take up some of the SME problems as projects during vacation period and solve them to prove their credibility.

Dr. M.S. Bhat, Director, School of Management Studies, JNTU summarised aptly saying, 'No one can feel superior or inferior in the process of building relationships between

Technical institutions and SMEs. This is very much needed initiative and he assured all the support to the Research Team for any such future Interaction meets and said everyone who participated made it lively and meaningful.

Mr. M.V. Ravikumar, Principal Co-investigator while proposing a formal vote of thanks, emphasised the fact that a day has come where every one of us have to necessarily put behind the past experiences and start a fresh leaf in establishing networks to make a positive beginning in the process of establishing proper linkages between Technical Institutions and SMEs in the S & T sector and this Research study funded by Department of Science and Technology, NSTMIS division would facilitate that.

Members Present:

- Dr. M.S. Bhat
  Director, School of Management Studies
  Jawaharalal Nehru Technological University,
  Andrapradesh
- Dr. M.K. Sridhar
  Reader and Principal Investigator
  Canara Bank School of Management Studies
  Bangalore University
- Mr. M.V. Ravikumar
  Principal Co-Investigator
- Dr. P. Narayana Reddy
  Professor and Head
  School of Management Studies
  Chaitanya Bharathi Institute of Technology
- K. Venkat Reddy
  Uma Engineering works
  Hyderabad
- Dr. S.R. Reddy
  Principal, Jyothi Engineering College
  Hyderabad
- Dr. N.R.K. Reddy
  Professor and Dean
  Sivesivani Institute of Management
- V. Mohan Kumar
  AGM
  Fenner (India) Ltd
- B.S. Sudhakara Rao
  Director & Head
  NISIET
- Dr. P. Narasimha Reddy
  Principal
  SNIST
- Ms. K. Subhashini Reddy
  Vice-president
  W.O.M.E.N
- Mr. Varanasi bhaskara Rao
  HRD Professional Trainer
- Nuzhath Jahan
  Consultant,
  Reach Management consultancy
- Mir Khan
  Manager
  Reach Management
- Y. Kishan Rao
  Santhosh Chemicals
- G. Nagashwara Rao
  Tripuda Precission works

- Sri. V.M.H. Gopal
  SNIST
- K. Surya Prakash Gord
- Dr. P.R. NagaSrinivasa
  Dean III & PDTP
  SNIST
- Dr. Sindhu
  Assistant Professor
  School of Management Studies
- Dr. Subashini
  NISIET
- K. Prasad Rao
- Dr. S. Susheela
  Hon. Secretary
  AIMO, AP
- T. Haridass
- G. Seshagiri Rao
  Joint Secretary
  AIMO, AP
- Mr. Mahesh Pande
  Treasurer
  All India Manufacturers' Organisation
- Mr. Dharam Pal
  Managing Director
  SansRisk Credit Solutions Pvt Limited

II. Minutes of the Interaction Meeting held on Thursday, the 9th December 2004 at IIT-M, Chennai in connection with the Research Study on "Interaction between Technical Institutions and SMEs in the S & T Sector"

Prof. Rajan Mani, Convenor and Local co-ordinator for the study at Chennai, welcomed the guests and gave an overview of the study. Dr. Kalyana Raman, Dean, Centre for Industrial Consultancy and Sponsored Research, Indian Institute of Technology, Madras and Dr. A.N. Rai, Principal Scientific Officer, NSTMIS Division of Dept. of Science & Technology, Govt. of India, New Delhi participated as Chief guests.

In his Inaugural address, Dr. Kalyana Raman said that the time is really ripe for such a study, as it is the SME sector which is suffering a lot more than large-scale sector because of the constraints of financial resources. MOUs are being established by Large Scale Units with Technical and Management Institutions. He said that ICSR is addressing product technology issues which could be used by the 40 – 50% of the Indian population belonging to lower middle class or poor class. He also highlighted that the industries could bring with them field experience as the academicians do not have much of this. The industrialists can also become inspiring role models to the students. He said that SME entrepreneurs require

'Continuing Education' Programmes for updating their knowledge and skills. This is an area where academic institutions can contribute a lot. He cited the successful functioning of the Centre for over 3 decades. He identified the following areas for interaction between SMEs and technical institutions:

1. Continuing Education Programmes
2. Consulting and Management of Technologies
3. Bringing Industries' expertise into the Class-rooms.

In his brief address, Dr. A.N. Rai highlighted the need for the study and said that at present nearly 80% of the R & D investments are borne by Government and only 20% is borne by the private sector. Even this R & D investment is less than 2% of our GDP. He said that Ministry of Science and Technology is keen on developing independent capabilities in Technology development in the country and this can happen only by having close interaction between Technical Institutions and Industries.

Following are the other highlights of the interaction meeting which lasted for nearly 2 hours:

1. As 'Service' sector contributes more than 50% of the GDP, it may be worthwhile considering this area as one of the sectors for the purpose of Research study.
2. There are lot of small functional areas in the SMEs, like managing accounts, conducting market survey, systemising operations, etc., which could be outsourced to Institutions. The cost of such of outsourcing will not only be low, but also would give practical orientation to the students.
3. The biggest challenge for the Interaction to take place between SME sector and Technical institutions is the 'Communication Channel'. Hence, there is a pressing need to create a forum, which would ensure regular meetings between them.

4. Such regular communication could generate projects in terms of Consultancy, Continuing education, practical training for faculty members etc.,
5. One of the major problems is lack of awareness among the industry about the capabilities of the Technical institutions.
6. The interaction would be more effective if the institution can enter into MOU with the local industries associations.
7. Such interaction would give required motivation for 'entrepreneurship' among students. This also would help in EDCs already established in certain institutions to function effectively.
8. All the participants unanimously felt that there is a pressing need for such a study and the time is ripe to implement the outcome of this study at the earliest.

Dr. M.K.Sridhar, Principal Investigator summarised the discussions and proposed a formal vote of thanks.

III. Minutes of the Round Table Conference Meeting held on 11th January, 2006 Hotel Taj Residency, Bangalore in connection with the Research Study on "Interaction between Technical Institutions and SMEs in the S & T Sector"

"Knowledge needs to be shared"

Said Dr M S Thimmappa, Vice Chancellor of Bangalore University while inaugurating a round table conference on "Towards healthier interactions between industry and academia" jointly organized by Canara Bank School of Management Studies of Bangalore University and Bangalore chapter of National HRD Network on 11th January, 2006 at Hotel Taj Residency, Bangalore. He added that it is not enough to create knowledge but it must be shared and distributed to all concerned. In fact, it becomes complete and meaningful only when it is shared with others. He cited examples of success and failure stories in Bangalore University with regard to interaction between industry and academia. Sri R Srinivasan,

Consultant, was the guest of honour. He pleaded for micro and time bound action plan for bridging the gap between industry and academia.

The round table was attended by nearly sixty representatives of information technology, biotechnology, machine tools, auto components and electronic industry sectors. Principals, deans and senior faculty members of engineering and management colleges from Bangalore and outside also attended.

Prof C Balaji, HRD Officer at Sasken Communications Ltd was the moderator of the round table.

Structure of the round table

After the inauguration, the participants were rearranged around the tables to ensure that each table has similar representation of people from industry and academia. They were acknowledged for the commitment they showed in coming for the roundtable despite many other possible things. Each table had a moderator, recorder and time-keeper. Initially, few participants across the tables shared their experiences with industry or academia. Quick statements about the possible benefits of the industry-academia relationship were also shared. Then, the issue of strengthening relationship was taken up in each of the tables. The term 'relationship' was preferred over 'interaction' as it is healthier. Prof Balaji stated that the crux of the roundtable is about the gives and takes between the industry and the academia. The round table ended with each table generating four lists on the following:

i. What all can industry offer to the academia?
ii. What all can industry receive from the academia?
iii. What all can academia offer to the industry?
iv. What all can academia receive from the industry?

Benefits of interaction

The participants gave their own perception of benefits. They include talent for the Industry, wealth generation, better faculty, creation and transfer of knowledge, transparency,

development and revision of curriculum, exposure to faculty and students, seamless transition, marketability of finished products, R&D and conceptual clarity.

Development of professionalism, synchronization of objectives and interests, economic gains, developing respect for the society, development of appropriate technology, improvement in productivity, better infrastructure and reality check of products were also mentioned as benefits. In addition, motivation to work and perform, global leadership for India, better placement, infrastructure/resource sharing, possibility of winning Nobel prizes, advancement of knowledge and society, cost effective ideas, reduction in waste for the industry, sensitivity towards society, confidence in education system, reduction in training cost for industry were identified as possible ones.

Essentials of relationship

Interaction between industry and academia happens more because of relationship between them. Fundamentals of relationship are given below.

- Trust
- Mutual Benefit
- Win-win attitude
- Understanding the needs and expectations of others
- Give and take

Many a time, there exist many factors which breach the mutual trust. They include among others, not understanding the focus, greater and quick attrition after getting placements in campus recruitment, false aspirations, unwritten expectations, lack of transparency, breach of confidence, mismatch of needs, goals and activities, not honoring commitments made, not devoting enough time for building relationships, over enthusiasm initially, exploitation of weakness, not being truthful, improper rapport, selfishness, stereotype models, self ego, unclear articulation, negative attitude and too much of generalization.

Give and take in relationship

No relationship between industry and academia can be sound and lasting unless there is give and take between both the parties. In other words, it has to be two- way traffic. In this context, the participants of the round table came out with what industry and academia could offer and receive from the other.

What all can industry offer to the academia?

- Research problem
- Resources and infrastructure development
- Mentoring of students
- Opportunity to work on real projects
- Building credibility to the project
- Foresight on business angle
- Inputs for curriculum development
- Placements and careers
- Guest faculty
- Applied knowledge
- Industrial visits
- Training the teachers
- Twining programs
- Opportunity to generate revenues for institutions and faculty members
- Opportunity to use expertise and facilities
- Scholarship to students
- Case study projects
- Practical and field experience
- Sponsored projects
- Guest lectures

- Industry chairs
- Centers of excellence
- Structural inputs for enhancing soft skills / professionalism
- Contextual knowledge
- Share the best practices
- Joint research
- Industry can be gate keepers for academia
- Patent development
- Up gradation of faculty
- Out sourcing the work to students
- Make the learning curve shorter

What all can industry receives from the academia?

- Effective human resources with talents, values and ethics
- Research & development output
- New perspectives for running business
- Solutions for repetitive processes
- 'Out of box' thinking
- Current and customized knowledge
- Feed back
- Reduced hiring lost
- Problem solution
- Innovation
- Disciplined training
- Quality teaching staff (contemporary)
- Skilled craftsmen
- Joint Seminar
- Periodic evaluation of course
- Value addition
- Quality professionals

- 'Right' curriculum
- Consultancy
- Specific training
- Access to library, laboratory and R&D facilities.

What all can academia offer to the industry?

- Knowledge
- Effective and talented human resources
- Continued education
- Solutions for the problems
- Research & development
- Consulting
- Research facility
- Training/Continuing education
- Infrastructure
- Ready to use finished product
- Assistance in marketing and market research
- Window for industry to showcase
- Academic facility for children of employees
- Counseling/Mentoring
- Manage events
- Good Curriculum
- Contemporary inputs
- Soft skills
- Faculty support
- Insight into technical and managerial aspects
- Theoretical frame work
- Executive programs
- Creative ideas
- Internships

What all can academia receive from the industry?

- Effective/live projects
- Management know how and expertise
- Data or Case studies
- Processes
- Test results and shared learning
- Professionalism
- Mentoring the students
- Funding
- Scholarships
- Placement
- Knowledge application and process learning
- Consulting
- Visiting professor
- Research & Development
- In plant training
- Stipend
- Practical experience
- Conceptual clarity
- Proper direction for the shop floor experience
- Real time experience
- Joint seminars
- Career counseling from industry
- Feedback or continuous evaluation
- Consulting projects
- Testing & calibration facility
- Inputs for publishing & joint patents

TASK FORCE:

A task force with the following members voluntarily came forward to take up these issues in the days to come.

1. V L Narayana Rao, Vijaya Bank
2. Karunamoorthy, CMRIMS
3. Kiran D.M, Global Edge Software Ltd
4. Quentin
5. B.V.Krishnamurthy, Alliance Business Academy
6. Shanti Prasad, VTech Informatics
7. Dr. Sahasranam, Siddhartha, Tumkur
8. Ravikumar M.V
9. Imon Ghosh, Metro
10. Dr. S Ramesh, Mt Carmel Institute of Management
11. Wg Cdr A Raghunath, Kirloskar Group
12. Jagadeesh Bapat, Consultant
13. Sudeeptha,
14. Ramanan, Ladder Consulting
15. C Balaji, Sasken
16. M.K.Sridhar, CBSMS

The end spirit

The spirit which was evident when everybody left the venue was

- Don't wait – Let us start
- Don't postpone – Act now
- Don't expect – Let us contribute

Appendix- 3
Questionnaires used in the study

1. Institution's questionnaire

June, 2005

M.K. Sridhar, Ph.D.,
Principal Investigator & Reader
DST (NSTMIS Division) sponsored research project
Canara Bank School of Management Studies
Bangalore University
Central College Campus
Bangalore – 560 001
☎ 080-22484629 / 98452-22573.
E-mail : research_dst@yahoo.co.in

Sir/Madam,

Season's Greetings!

This is a research project on "Industry-Institute Interaction" in the states of Karnataka, Tamilnadu and the city of Hyderabad. It is sponsored by NSTMIS Division of Department of Science and Technology, Government of India. It aims at studying the present status of interaction between Technical institutions (including Management) and industrial enterprises and to make suggestions to promote the same.

Your institution has been short listed for the final study. Hence, I request you to spare your valuable time in filling up this questionnaire and provide us the necessary information. This will help you, your institution and all of us to gain from promoting productive interactions. Kindly follow the instructions furnished at appropriate places. You can use additional sheet wherever found necessary.

Thanking you for your support and cooperation

Yours truly,

(M.K.Sridhar)

Section A

This section covers some basic information about your institution and related issues. Either you have to tick (√) the appropriate answer or write briefly.

1. Name:

   Address:

   Phone no:

   Website:

   E-mail id:

2. Location of your institution

a. Karnataka ☐ b. Tamilnadu ☐ c. Hyderabad ☐

3. Your institution belongs to which geographical cluster:

a) Bangalore ☐ b) Mysore ☐ c) Mangalore ☐ c) Hubli ☐

d) Belgaum ☐ e) Chennai ☐ f) Coimbatore ☐ g) Hyderabad ☐

4. Name of the Principal / Head of the Institution:

Phone No:

E-mail ID:

5. Type of Institution:

a) Government ☐ b) Aided ☐ c) Unaided ☐ d. Autonomous and Recognized ☐

6. Year of estblishment: ☐

7. *Courses offered by your institution:*

Discipline	Level of education		Branches or specialization
	UG	PG	
Management (MBA/PGDBM)	Not applicable		
Engineering			
Others (specify)	Not applicable		

8. *Head of society/trust of your institution:*

Name:

Designation:

Industrial background: a) Yes ☐ b) No ☐

9. *Your latest accreditation and ranking:*

Details of Accreditation (like agency, year, grading)	Details of Ranking (like magazine, year, ranking)

10. *Your faculty details:*

a. Faculty strength:

Type of faculty	Number		
	With Ph.D.,	Other qualifications	Total
Full time (Regular)			
Full time (Temporary)			
Part time (Adjunct)			
Part time (Visiting)			
Total			

b. Faculty Background:

Background	Number
Research	
Industry (Public and private)	
International exposure	
Any other (specify)	
Total	

11. *Mention the number of enterprises of the specified sectors in your surroundings:*

Sector	Scale of enterprise		Number		
	SMEs	Large	Up to 10 kms	Between 10 – 20 kms	Above 20 kms
Information Technology					
Electronic					
Bio technology					
Automotive					

12. ***Did you make use of any scheme of Government or other agencies that promotes interaction with industry?***

a) Yes ☐ b) No ☐

13. ***If yes, what are the details?***

Name of Scheme	Sponsoring Agency	Year	Amount sanctioned	What was your experience with the scheme on a scale of 1-5 1= Very Good 5= Very Bad

14. ***Future plans of your institution with regard to interactions with Industry.***

Section B

In this section, interaction of your institution with industry and its various details are covered. While answering these questions, you may have to talk to other members of your institution and refer necessary records. Hence, kindly procure necessary details and answer the questions as there is only one questionnaire for each institution.

1. ***Tick the types of your interaction with industry in the last three academic years (02-03, 03-04 and 04-05. Add any other type, if not found in the list.***

Type of Interaction	Academic Years	Scale of industry		Extent of Frequency				
		Large	SME	1	2	3	4	5
Academic intervention in solving specific industry problems								
Laboratory utilization by industry								
Continuing education programme for persons from industry								
Participation of industry in Curriculum development								
Project work of students								
Placement								
Chair professor sponsorship by industry								
Sponsored Lab by industry								
Consultancy (problem solution, research etc)								
Guest lectures by industry persons								
Workshops and seminars								
Industrial visits by students								

Type of Interaction	Academic years	Scale of industry		Extent of Frequency				
		Large	SME	1	2	3	4	5
MDP / Training programmes								
Mentoring students by industry person s								
Sponsorship of programmes by industry								
Deputation of faculty to industry								
Product testing								
Product development								
Development of technology								

2. ***Mention the sectors of industry with which your institution has been interacting most frequently (sectors like electronics, IT, biotech, automotive etc. need to be mentioned).***

Academic Years	Sectors of industry	Scale of industry	
		Large	SME
2002-03			
2003-04			
2004-05			

3. ***Which is the industry associations with which your institution has been interacting more frequently in the last three academic years (02-05)? (Industry associations like CII, NASSCOM, MAIT, ACMA, ABLE etc.,)***

Name of Association	Total number of interactions

4. ***Tick the mechanisms used by your institution for interaction with industry.***

Mechanism for interaction	Most Used	Least Used	Not Used
Interaction cell			
Separate department /division / section			
Full time placement officer / PRO			
Faculty member (designated)			
Group of faculty members			
Group of students			
Any other (Specify)			

5. ***Which are the branches or functional areas of your institution that have interaction with industry? Add any other, if not found in the list.***

Branch / functional area	Scale of industry		Frequency of Interaction				
	Large	SME	1	2	3	4	5
Electronics							
Computer Sciences							
Mechanical							
Civil							
Electrical							
Marketing							
HRM							
Finance							

6. ***Which of the following factors have contributed to the interaction of your institution with industry? (You can add any other factor not found in the list)***

Factor	Importance of contribution				
	1	2	3	4	5
Initiative of individual faculty member					
Initiative of students					
Response of industry					
Vision and strategy of the institution					
Leadership and management of the institution					
Culture and climate in the institution					
Requirements of the courses					
Requirements of accreditation/ranking agencies					
Needs and problems of industry					

Factor	Importance of contribution				
	1	2	3	4	5
Personal contacts of individuals in the institution					
Brand image of the institution					
Strength and capabilities of institution					
Placement needs of the institution					
Knowledge base and research capabilities of institution					
Infrastructure and facilities in institution					
Funding schemes of Government agencies					

7. What are the benefits derived from the interaction of your institution with industry? Add any other, if not found in the list.

Benefit	Type of industry		Extent of benefit				
	Large	SME	1	2	3	4	5
Solution to problems (technical and Managerial) of industry by faculty from institutions.							
Improvement in accreditation grading or ranking of institutions.							
Organization of seminars, conferences, workshops etc. by institution and industry							

Benefit	Type of industry		Extent of benefit				
	Large	SME	1	2	3	4	5
Participation of industry representatives on the committees / councils of institutions							
Satisfaction of course requirements like assignments, internships and projects by students of institutions.							
Participation of academic representatives on the boards of industry.							
Placement of students							
Research and consultancy assignments for institutions							
Training / MDP programmes for industry							
Exchange of faculty and executives							
Development of technology and products							
Supporting programmes, equipments and infrastructure							
Research publications							
Case study development							
Generation of new and fresh ideas							
Better exposure to faculty and executives							
Improvement of brand image of institutions and industry							
Grants from Government and other agencies.							

8. ***Which of the following factors hampered the interaction of your institution with industry? Add any other, if not found in the list.***

Factor	Frequency				
	1	2	3	4	5
Divergence of objectives					
Lack of professional approach by Institutions					
Misunderstanding between institutions and industry					
Other priorities for industry					
Maintaining continuity as people change					
Resource/constraints to support linkages					
Lack of proper response from industry					
Nothing much to contribute to industry by institution					
Lack of support in institution					
Lack of brand image of institution					
Absence of schemes of Government and other agencies					

9. ***Rank the following expectations of industry which are critical for industry-institute interaction. Add any other, if not found in the list (Assign 1 for first preference, 2 for second preference and so on)***

Expectation of Industry	Rank
Initiative by the institution	
Professional by institution	
Adherence to schedules and deadlines	
Delivery of results / output	
Solution to technical and managerial problems	
Win-win relationships	
Paradigm shift in mindsets	

10. ***When do you interact with industry in your institutions?***

Statement	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
When we have shortage of faculty, we seek support from the local industries					
When we engage in the discussion on curriculum development, we invite representatives from industry					
We use only our in-house facilities to demonstrate application of technology					
We approach the local industries for student projects					
Most of the faculty have visited the local industrial estates					
Many of our faculty have contacts with the local industry					
We conduct seminars in collaboration with local industry					
As and when we need placements for students					
When we need resource persons for programmes					
We approach industry when we need support and sponsorship					

11. What are your suggestions to improve the interaction between industry and educational institutions?

Signature of Principal
(With seal)

2. Industry Questionnaire

June, 2005

M.K. Sridhar, Ph.D.,
Reader & Principal Investigator
DST (NSTMIS Division) sponsored research project
Canara Bank School of Management Studies
Bangalore University
Central College Campus
Bangalore – 560 001
☎ 080-22484629 / 98452-22573
E-mail : research_dst@yahoo.co.in

Sir/Madam,

Season's Greetings!
This is a research project on "Industry-Institute Interaction" in the states of Karnataka, Tamilnadu and the city of Hyderabad. It is sponsored by NSTMIS Division of Department of Science and Technology, Government of India. It aims at studying the present status of interaction between Technical institutions (including Management institutions) and industrial enterprises and to make suggestions to promote the same.

Your institution has been short listed for the final study. Hence, I request you to spare your valuable time in filling up this questionnaire and provide us the necessary information. This will help you, your institution and all of us gain from promoting productive interactions. Kindly follow the instructions furnished at appropriate places. You can use additional sheet wherever found necessary.

Thanking you for your support and cooperation.

Yours truly,

(M.K.Sridhar)

Section A

This section covers some basic information about your firm. Either you need to tick (√) or write brief answers.

1. ***Name of your enterprise:***

   Address:

   Phone no:

   Website:

   E-mail ID:

2. ***Location of your enterprise:***

   a) Karnataka ☐ b) Tamilnadu ☐ c) Hyderabad City ☐

3. ***Your enterprise belongs to which geographical Cluster?***

   a) Bangalore ☐ b) Mysore ☐ c) Mangalore ☐ d) Hubli ☐

   e) Belgaum ☐ f) Chennai ☐ g) Coimbatore ☐ h) Hyderabad ☐

4. ***Details of head of your enterprise:***

   Name:

   Designation:

   Phone No.:

   E-Mail ID:

   Academic background: a) Yes ☐ b) No ☐

5. ***Type of your enterprise:***

   a) Proprietary ☐ b) Partnership ☐ c) Private Limited ☐ d) Public Limited ☐

6. ***Which sector of the industry your enterprise belongs to?***

   a) Information Technology ☐ b) Biotechnology ☐ c) Electronics ☐

   d) Automotive ☐ e) Any other (specify) ☐

7. ***Are you an ancillary unit?*** a) Yes ☐ b) No ☐

8. ***Your present investment in Plant and Machinery (Rs. in lakhs)***

a) < 50 L ☐ b) 50 - 100 ☐ c) 100 – 500 L ☐

d) 500 – 1000 L ☐ e) Above 1000 L ☐

9. ***Your annual sales turnover during financial year 2004 – 05. (Rs. in lakhs)***

a) < 500 L ☐ b) 500 – 1,000 L ☐ c) 1,001 – 5,000 L ☐

d) 5,001 – 10,000 L ☐ e) > 10,000 L ☐

10. ***Year of establishment:*** ☐

11. ***Total strength of your human resources:***

Type of Human resources	Number
Managerial/Supervisors	
Skilled	
Unskilled	
TOTAL	

12. ***Mention the number of technical institutions located in your surroundings.***

Type of institution	Number		
	Up to 10 kms	10 – 20 kms	Above 20 kms
Engineering			
Management			
Post Graduate Department			

Section B

In this section, interaction of your enterprise with educational institutions and its details are covered. While answering these questions, you may have to talk to other members of your firm and refer necessary records. Hence, kindly procure necessary details and answer as there is only one questionnaire for each enterprise. In most of the cases, you nave to tick (√). You may have to write briefly in very few cases.

1. ***What is the present status of the interaction of your enterprise with educational (technical and management) institutions?***

   a) There is interaction, presently ☐

   b) There was interaction in the past, but none presently ☐

   c) There has never been any interaction ☐

2. ***What type of interaction your enterprise has been having with educational institutions during the last three years (2002-03, 2003-04 and 2004-2005)? Add any other, if not found in the list.***

Type of Interaction	Year	Type of institution		Frequency of interaction				
		Technical	Management	1	2	3	4	5
Academic intervention in solving specific industry problems								
Laboratory utilization by industry								
Continuing education programme for industry persons								
Participation of industry in Curriculum development								
Project work of students								
Placement								
Chair professor sponsorship by industry								
Sponsored Lab by industry								

Type of Interaction	Year	Type of institution		Frequency of interaction				
		Technical	Management	1	2	3	4	5
Consultancy by academics (problem solution, research etc)								
Guest lectures by industry persons								
Workshops and seminars								
Industrial visits by students								
MDP/Training programmes by institutions								
Mentoring students by industry person s								
Sponsorship of programmes by industry								
Deputation of faculty to industry								
Product testing								
Product development								
Development of technology								

3. What is the frequency of interaction of your departments/ areas with institutions? Add any other, if not found in the list.

Department	Type of institution		Frequency of interaction				
	Technical	Management	1	2	3	4	5
Finance / Accounts							
HR / Personal							
Marketing / Sales							
Operations / Production							
Exports							
R & D							

4. ***What are the benefits derived by your enterprise from interaction with institutions? Add any other benefit if not found in the list.***

Benefit	Type of Institution		Extent of benefits				
	Technical	Management	1	2	3	4	5
Technical problem solved with help of faculty from institution							
Contribution from Student Projects							
Seminars / Exhibition jointly organized or participated in							
Served as industry representatives on the institutional councils							
MDP programme							
Managerial and other problems solved with help of faculty from institutions							
Getting fresh and creative ideas							
Placement for students							
Better exposure to faculty / students							
Research / Consultancy assignments to faculty							
Improvement in image of institution							
Increase in demand for admission							
Better grading in accreditation / ranking							
Technology development / transfer							
Support for infrastructure / programmes from industry							
Project grants from government and other agencies							

6. ***What were the reasons for discontinuing your interaction with institutions? Add any other, if not found in the list. (Answer only if you have ticked answer 'B' in Question no. 1)***

Reason	Type of Institution		Degree of importance				
	Technical	Management	1	2	3	4	5
Lack of professional approach by institutions							
Misunderstanding between institutions and industry							
Maintaining continuity as people change							
Lack of resources to support linkages							
Lack of proper response from institution							
Institution could not solve the problem							
Unsuitability of Academic calendar for industry requirements							
Institutions don't have the capability							
Institutions are theoretical in solving problems							
Institutions don't understand/appreciate the time pressure of industry							
Causal/unconcerned approach of institutions							

7. ***What are the reasons for not initiating any interaction with Institutions? Add any other, if not found in the list. (Answer only if you have ticked answer 'C' in Question no. 1)***

Reason	Type of Institution		Degree of importance				
	Technical	Management	1	2	3	4	5
Lack of confidence that institutions could solve problems							
No institution worth the same proximity							
Never felt the need for interaction							
Divergence of objectives							
Lack of support within the firm for interaction							
No response from institution							

8. *Tick your answer for the following statements:*

Item Description	Strongly Disagree	Disagree	Neither Agree not Disagree	Agree	Strongly Agree
When I face a problem, I try to solve it on my own or in-house					
I generally approach a consultant or my friend when I face a problem I cannot solve on my own					
I attend academic conference whenever the opportunity arises					
I seek the help of academic experts when I find it difficult to solve a problem on my own					
I have close association with the local engineering / management colleges					
I get help from students through the projects they do in my organization					
I generally accept students who approach me with request for projects					
I like to handle classes in the engineering / management college when I get an opportunity					

Note: - The term 'Problem' in the above statements might be technical or non-technical in nature

9. ***What is your preference for a model to promote interaction with institutions? Some models are furnished below as examples. Add any other model that your have come across, if not found in the list.***

Model	Particulars of model	Preference				
		1	2	3	4	5
M.O.U with an Institution for long term association on various aspects of mutual interest						
Mentoring interested potential entrepreneurial students						
Participating in Academic activities - Special lectures, Syllabus up gradation, training faculty / students based on 'Revenue Model'						
Consulting to establish Laboratory which would be of mutual benefits						
Research and Development activities						
New Product / Service launch - Market survey, Pilot study						

10. What are your suggestions to improve the interaction between industry and educational institutions?

Signature
(With seal)

Appendix 4

Additional Tables

Factor Analysis – Domains of interaction -Rotated Component Matrix

	Component				
	1	2	3	4	5
Academic intervention in solving specific industry problems			.782		
Laboratory utilization by industry			.590		
Continuing education programme for persons of industry			.664		
Participation of industry in curriculum development			.634		
Project work of students		.804			
Placement		.688			
Chair professor sponsorship by industry					.815
Sponsored lab by industry					.741
Consultancy (problem solution, research etc.)			.507		
Guest lectures by industry persons		.847			
Participation of industry persons in workshops and seminars organised		.763			
Industry visits by students				.661	
MDP/Training programmes				.590	
Mentoring students by industry persons				.668	
Sponsorship of programmes by industry				.561	
Deputation of faculty to industry	.580				
Product testing	.792				
Product development	.731				
Technology transfer/development	.766				

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
& Rotation converged in 8 iterations.

Domain-wise Variable-wise Break-up of Scale and Frequency of Interaction

Domain Name	Code	Type of Interaction	Scale (%)			Frequency (%)				
			SME	Large	SME & Large	1	2	3	4	5
Knowledge. Oriented	V16	Deputation of faculty to industry	40.06	29.97	29.97	53.02	15.15	22.73	1.52	7.58
	V17	Product testing	41.70	30.50	27.80	59.01	14.75	11.48	3.28	11.48
	V18	Product development	42.62	36.28	21.10	62.71	22.03	6.78	1.70	6.78
	V19	Technology Transfer / Development	46.94	29.39	23.67	66.67	14.29	9.52	3.17	6.35
Industry Oriented	V5	Project work of students	15.47	18.11	66.42	3.86	6.14	17.70	18.45	53.85
	V6	Placement	9.97	26.39	63.64	4.84	13.71	18.54	21.78	41.13
	V10	Guest lectures by industry persons	15.29	20.68	64.03	1.53	16.80	24.43	29.00	28.24
	V11	Participation of industry persons in workshops and seminars organized	24.07	22.27	53.66	8.80	18.40	24.80	21.60	26.40
Academic Oriented	V1	Academic intervention in solving specific industry problems	57.14	31.35	11.51	35.30	27.06	16.46	12.94	8.24
	V2	Laboratory utilization by industry	69.11	18.23	12.66	42.47	27.40	13.70	9.59	6.84
	V3	Continuing education programme for persons from industry	63.37	17.38	19.25	28.38	28.38	17.57	17.57	8.10
	V4	Participation of industry in Curriculum development	32.85	36.21	30.94	33.71	17.44	26.74	7.00	15.11
	V9	Consultancy (problem solution, research etc)	50.64	20.09	29.27	19.32	31.82	30.68	9.09	9.09
Short term Association oriented	V12	Industrial visits by students	14.58	28.47	56.95	6.02	14.29	28.57	18.04	33.08
	V13	MDP / Training programmes	44.66	30.77	24.57	20.00	23.33	26.67	17.78	12.22
	V14	Mentoring students by industry person s	34.81	24.26	40.93	22.35	28.23	17.65	16.47	15.30
	V15	Sponsorship of programmes by industry	32.88	29.45	37.67	37.04	22.22	17.28	13.58	9.88
Long Term Association oriented	V7	Chair professor sponsorship by industry	27.04	59.12	13.84	73.47	10.20	4.08	10.21	2.04
	V8	Sponsored Lab by industry	42.76	42.76	14.48	73.47	10.20	6.12	4.08	6.13

Sectoral Pattern of Interaction

Industry Sector	SME	Large	Large & SME	Total
Information Technology	18	27	47	92 (76.00)
Bio Technology	0	4	11	15 (12.40)
Electronics	8	10	28	46 (38.00)
Automotive	4	13	25	42 (32.70)
Machine Tools	0	0	1	1 (0.80)
Others	12	14	39	65 (53.70)
Total	27 (22.30)	35 (28.90)	59 (48.80)	121 (100.00)

Contributory Factors of Interaction - Rotated Component Matrix

	Component		
	1	2	3
Initiative of students			.783
Vision and strategy of the institution	.827		
Leadership and management of the institution	.854		
Culture and climate in the institution	.670		
Requirements of the courses			.752
Requirements of accreditation/ranking agencies			.560
Needs and problems of industry		.783	
Brand image of the institution	.693		
Strength and capabilities of institution	.603		
Placement needs of the institution	.772		
Knowledge base and research capabilities of institution		.711	
Infrastructure and facilities in institution		.708	
Funding schemes of Government and other agencies		.763	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 5 iterations.

Benefits of interaction - Rotated Component Matrix

	Component	
	1	2
Improvement in accreditation grading or ranking of institutions	.671	
Organisation of seminars, conferences, workshops etc. by institution and industry	.804	
Satisfaction of course requirements like assignments, internships and projects by students of institutions	.772	
Participation of academic representatives on the boards of industry		.744
Research and consultancy assignments for institutions		.643
Exchange of faculty and executives		.858
Development of technology and products		.793
Research publications		.618
Case study development	.606	
Generation of new and fresh ideas		.603
Better exposure to faculty and executives	.731	
Improvement of brand image of institution and industry	.734	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 3 iterations.

Barriers of Interaction- Rotated Component Matrix

	Component	
	1	2
Lack of professional approach by institutions	.760	
Misunderstanding between institution and industry	.672	
Other priorities for industry		.819
Lack of continuity as people change		.704
Resource constraints to support linkages	.702	
Lack of proper response from industry		.827
Nothing much to contribute industry by institution		.576
Lack of support in institution	.756	
Lack of brand image of institution	.831	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 3 iterations.

Patterns of interaction - Rotated Factor Matrix(a)

	Factor		
	1	2	3
Academic intervention in solving specific industry problems			
Laboratory utilization by industry			.685
Continuing education programme for persons of industry			
Participation of industry in curriculum development	.645		
Project work of students	.597		
Placement	.595		
Chairprofessor sponsorship by industry		.834	
Sponsored lab by industry		.609	
Consultancy (problem solution, research etc.)	.525		.575
Guest lectures by industry persons	.781		
Participation of industry persons in workshops and seminars organised	.723		
Industry visits by students	.699		
MDP/Training programmes			.539
Mentoring students by industry persons	.593		
Sponsorship of programmes by industry	.707		
Deputation of faculty to industry		.666	
Product testing			.662
Product development			.552
Technology transfer/development			

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 15 iterations.

Domain-wise Variable-wise Break-up of Scale and Frequency of Interaction

Domain Name	Type of Interaction	Type of Institution				Extent of Frequency						Domain Mean
		NA	Technical	Management	Technical & Management	NA	1	2	3	4	5	
Academia driven Interaction	Participation of industry in Curriculum development	79.5	10.7	1.6	8.2	64.8	7.4	4.9	9.8	8.2	4.9	0.9286
	Project work of students	43.4	22.1	4.9	29.5	41.8	3.3	13.9	18.9	9.0	13.1	
	Placement	53.3	27.0	-	19.7	50.8	7.4	8.2	13.1	11.5	9.0	
	Guest lectures by industry persons	63.1	15.6	8.2	13.1	59.0	7.4	9.8	10.7	6.6	6.6	
	Workshops and seminars	68.9	14.8	2.5	13.9	64.8	6.6	4.9	9.8	9.0	4.9	
	Industrial visits by students	56.6	19.7	3.3	20.5	50.8	11.5	9.0	9.8	10.7	8.2	
	Mentoring students by industry persons	81.1	13.1	1.6	4.1	76.2	6.6	4.9	5.7	4.9	1.6	
	Sponsorship of programmes by industry	77.9	13.9	1.6	6.6	73.0	7.4	5.7	6.6	7.4	-	
Industry driven interaction – Long Term	Chair professor sponsorship by industry	91.8	4.9	1.6	1.6	86.1	7.4	2.5	3.3	-	0.8	0.2787
	Sponsored Lab by industry	94.3	4.1	-	1.6	87.7	7.4	2.5	1.6	-	0.8	
	Deputation of faculty to industry	87.7	5.7	2.5	4.1	81.1	9.0	4.1	4.1	1.6	-	
Industry driven interaction – Short Term	Laboratory utilization by industry	76.2	23.8	-	-	74.6	4.9	8.2	4.1	4.9	3.3	0.5803
	Consultancy (problem solution, research etc)	85.2	9.0	2.5	3.3	78.7	7.4	4.1	4.9	3.3	1.6	
	MDP / Training programmes	77.9	7.4	6.6	8.2	73.0	5.7	4.1	9.0	6.6	1.6	
	Product testing	82.0	16.4	-	1.6	76.2	9.0	4.9	7.4	1.6	0.8	
	Product development	85.2	13.9	-	0.8	79.5	9.0	3.3	6.6	1.6	-	
Others	Academic intervention in solving specific industry problems	72.1	18.0	3.3	6.6	69.7	9.8	6.6	10.7	1.6	1.6	
	Continuing education	70.5	14.8	5.7	9.0	68.0	5.7	9.0	7.4	5.7	4.1	

	programme for persons from industry											
.	Development of technology	90.2	7.4	-	2.5	84.4	6.6	1.6	4.1	2.5	0.8	

Benefits of interaction-Rotated Component Matrix

	Component		
	1	2	3
Solution to problems (technical and Managerial) of industry by faculty from institutions	.660		
Improvement in accreditation grading or ranking of institutions	.519	.635	
Organization of seminars, conferences, workshops etc. by institution and industry	.701		
Participation of industry representatives on committees/councils of institutions	.743		
Satisfaction of course requirements like assignments, internships and projects by students of institutions	.515		.615
Participation of academic representatives on the boards of industry		.750	
Placement of students			.806
Research and consultancy for institutions	.689		
Training/MDP programmes for industry	.712		
Exchange of faculty and executives		.855	
Development of technology and products		.492	.443
Supporting programmes, equipments and infrastructure	.634	.549	
Research publications		.793	
Case study development	.782	.413	
Generation of new and fresh ideas		.504	.468
Better exposure to faculty and executives	.546	.433	.438
Improvement of brand image of institutions and industry			.745
Grants from Government and other agencies		.683	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 6 iterations.