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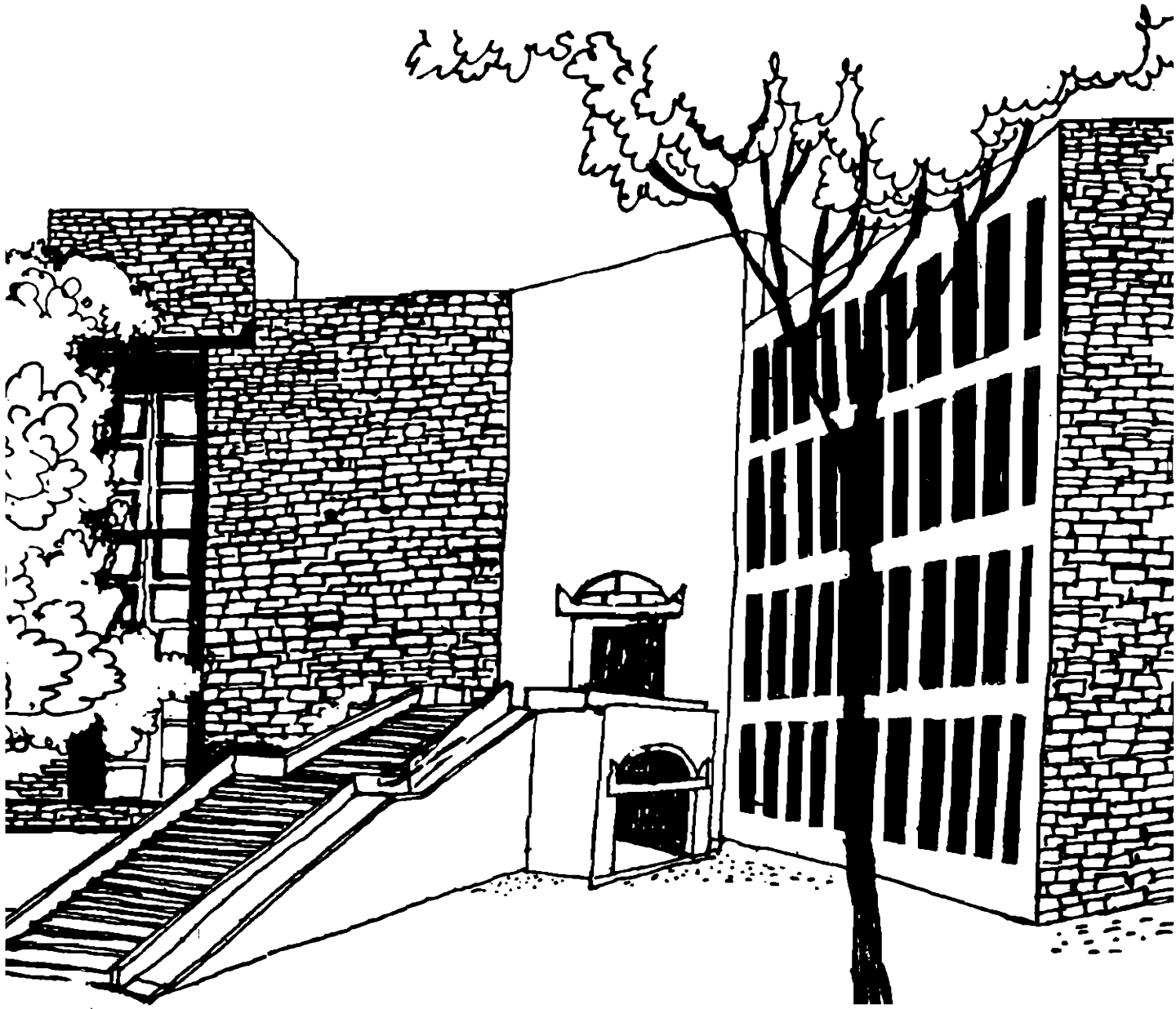

The Market for Technical Services in India - An Empirical Study

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The Market for Technical Services in India
- An Empirical Study

Considerable importance has been given by the government of India to the creation and nurturance of a strong and autonomous scientific and technological base. Towards this end, the government set up the Ministry of Scientific Research and Cultural Affairs in 1948, Council of Scientific and Industrial Research (CSIR) and the Atomic Energy Commission during the period 1948-54, Defence Research and Development Organization in 1958, Department of Science and Technology (DST), Electronics Commission and the Department of Electronics in 1971; the Biotechnology Board and Department of Biotechnology in the 80's.

Notwithstanding the significance of the investments made on scientific and technological development, it has been widely perceived that the level of utilization of research conducted at the national research laboratories has not been satisfactory.

Various studies (Alam and Langrish, 1984; Chaudhuri, 1986; Crane, 1977; Desai, 1980) attribute the following reasons to the ineffective interaction between research institutions and industry:

(a) lack of market information at the time of selection of research projects;
(b) little possibility of economic return from the technologies developed;
(c) preference of Indian firms for foreign technology;
(d) inadequate coordination between different sectors of society resulting in the failure to develop its potential for technological innovation; and
(e) lack of technical and financial resources and unsuitability of the know-how for production.

A few very successful cases of technology transfer from National Laboratories to industry have also been documented. (Chaudhuri, 1986).

With the balance of payments and fiscal crisis in the late 80's and the announcement of the New Economic Policy in mid-1991, the inadequacy of linkage between industrial organizations and research institutions has been felt at several quarters.

A number of factors determine the quality of interaction between industrial firms and technology supporting institutions (TI). The propensity of industrial organizations to seek support from TIs is likely to be determined, for example, by the government policy towards industry, regarding industrial licensing, foreign collaboration and investment, fiscal policy, trade policy; its policy for infrastructure development, nature of industry - whether it is dynamic or stagnant, nature of competition both domestic and international; company's cultural characteristics, development of related and supporting industries and level of technological sophistication of the country.

There are a number of characteristics of industrial firms that can be hypothesised to have a bearing on their desire to seek help from TIs. They are

(a) Mission and strategic objectives
(b) Competitive strategies adopted - cost leadership, differentiation or focus
(c) Technology strategy pursued by the firm
(d) Type of organization - independent, embedded or subsidiary of larger firm or a multinational company.
(e) Organizational culture
(f) Top management's background and values
(g) Nature of the product and embedded technology

The nature of the TI itself is also expected to have an influence on their interaction with industrial firms. The basic mission and objective, top management background and values, ownership, kind of

people and skills available, funding structure, kind of facility available in the TI, etc. may be expected to play an important role in TI-Firm interaction.

It is in this context that we undertook a study of the linkage between the industry and technical institutions. In this paper we present the findings of a mail survey carried to study the usage of technical services offered by the technical institutions. We received responses from 132 companies belonging to various sectors and size categories. Initially the mail survey questionnaires were sent to about 100 firms whose names had been mentioned in a variety of sources; directories of firms in different industries, lists of companies available from various institutions, lists of firms from newspapers, financial dailies, etc. After a gap of about one month we remailed questionnaires to those who had not responded. After about another month we remailed questionnaires to those who had not responded and also to another 500 additional firms. The objective was to obtain about 35 responses in each of the industrial sectors. However, as evident from the table we were able to obtain the desired response only from the auto parts sector. The response from the textiles, software, and pharmaceutical sectors have been reasonably good. However, the response from the foundry, polymers and machine tool sectors was far from satisfactory.In addition we can also mention that we received good response from the companies in the west and southern zones. Table 1 provides the distribution of the respondents across various geographical zones.

Table 1[1]
Sectorwise distribution of firms

Sector	Poly.	M/c Tool	Auto	Text.	Fdry.	SW	Phrm	Total
No.of Firms	6	10	35	25	8	27	21	132

Table 2
Zonewise distribution of firms

Zone	North	West	East	South	Central	Total
No. of Firms	28	43	5	45	2	123

The respondent's growth experience in the past is given in table 3. Most of the firms had moderate to rapid growth. But the central tendency was in favour of moderate growth.

The domestic market as perceived by the respondents was quite competitive. Forty three per cent of the surveyed firms felt that their domestic competition was quite strong while about 31 per cent felt their competition to be at a moderate level.

In contract to the domestic market competition the firms perceived their competition in the international market to be quite stiff. About 71 per cent of the firms perceived international competition to be more than moderate. About 19 per cent felt less than moderate level of competition.

Almost 35% of the firms had less than average market share in the domestic market while about 43% of firms had more than average market share in the domestic market. the rest 22% of firms had average market share. In the international market majority of the firms i.e. 89 per cent had zero or

1 Expansions of the abbreviations used in this table and subsequent tables are given at the end of the chapter.

negligible market share. Out of this about 15% firms had no export and therefore no international market share. Only 5 firms had more than average market share in the international market.

Table 3
Distribution of the firms based on sales growth during the past five years

Category	No. of Firms
Declining	3
Negligible Growth	8
Moderate Growth	64
Rapid Growth	46
Phenomenal Growth	0
Total	130

Table 4
Distribution of firms based on export sales

% of export sales	No. of firms
0 - 5	66
5 - 25	33
25 - 50	8
50 - 100	17
Total	124

Majority of the firms (53%) had less than 5% export sales whereas 80% of firms had less than 25% export sales on an aggregate basis. it is evident that the majority of the surveyed firms are weak in their international orientation. However, there are a small number of firms in the sample which had 50 to 100 per cent of their sales coming from the export market. The details are in table 4.

1. Analysis

A simple frequency analysis of the data was followed by statistical analysis to see whether the behaviour of the firms varied with the characteristics of the firms. The findings are presented in the following sections. In section 2 we present our analysis of the sources of technical services offered by various technical institutions. In section 3 we present an analysis of the usage of various technical services by the respondents. In section 4 we present an analysis of the use of training institutions. Government policies. The last section offers some comments on the findings. In each of sections 2, 3 and 4 we try to answer the following questions.

What is the aggregate behaviour?

Are there differences in the behaviour across sectors and industrial accumulation?

Are there differences across various characteristics of the firms like size, R&D intensity, technical orientation and the level of technological capability?

As we looked at the statistical tables we realised that our analysis was still at a preliminary stage and it needed further refining to draw sharper inferences. For example in the chi square tests we found that we had created too many categories and the expected cell frequencies were not as required. Hence the findings are to be treated as tentative and indicative and not as definite conclusions.

2. Usage of Sources

2.1 Ranking of Sources

Table 5 ranks the sources on the basis of the number of respondents using the sources. This gives an idea of the extent of usage of the source. Table 6 ranks the sources on the basis of the importance of the source to the users. This gives an idea of the usefulness of the sources. We then show whether the

rankings match by presenting the rank correlation. Table 6 presents the important benefits and problems faced by the most used and less used sources. Table provides an aggregate view of the sources, their perceived contribution, and important benefits and problems faced by the users.

Table 5
Ranking on the basis of usage of sources of technical services

Sources	Used by No. of firms (%)	Rank
Dept/labs	69(60%)	1
Long term suppliers	68(59%)	2
Industry associations	65(56%)	3
Long term customers	62(54%)	4
Consulting firms	53(46%)	5
Pvt. contract lab	46(40%)	6
National tech. institution	45(39%)	7
Local/ regional tech. institute	40(35%)	8
Universities	38(33%)	9
Research associations	36(31%)	10
Foreign investors	33(28%)	11
Academic associations	19(16%)	12

Table 6
Ranking of the importance of the Sources of Technical Services

Sources	Mean importance	Rank
Dept/labs	4.53	1
Foreign investors	4.33	2
Long term customers	4.11	3
Long term suppliers	3.81	4
Research associations	3.57	5
National tech. institution	3.49	6
Consulting firms	3.47	7
Industry Associations	3.43	8
Pvt. contract lab	3.25	9
Local/ regional tech. institute	3.19	10
Universities	3.13	11
Academic associations	3.00	12

From table 5 we can note that the most used sources are departmental labs, long term suppliers and industry associations. Foreign investors and licensors, and academic and research associations rank quite low in the aggregate analysis. This means that they are either offering specific services needed by few or their services are not perceived to be useful or they are not advertised sufficiently. From table 6 we can note that the services of the foreign investors are seen to be very useful. It ranks quite high. In fact the research associations also rank high. Only the academic associations rank very low in usefulness.

When ranked on the basis of usefulness the departmental lab comes on top. Followed by foreign i investors and long term customers. This made us test whether the most important source is also the most used source. The rank correlation between the two rankings is positive but quite low at 0.448. This means that there is a weak positive relation ship between the usefulness of the source and the usage of the service. This means further that there is a need to promote the useful sources and increase the usefulness of the more used sources. Table 7 presents a consolidated view of the sources.

Table 7
Sources of Technical Services: Usage, Importance, Benefits and Problems

Sources	Used by No. of firms (%)	Mean import-ance	Important benefits	Important problems
Pvt. contract lab	46(40%)	3.25	Quick (16) Solutions (20) Shares facilities (15)	High fees (19) Timeliness(16) Inadequate facilities (11)
Long term customers	62(54%)	4.11	Solutions (27) Quick (15) New pvt. devp. (27) Ideas (19)	Tech.unable to solve (13) Timeliness(10)
Long term suppliers	68(59%)	3.81	Quick (22) Solutions (37) NPD (20) Quality (17)	Timeliness(14) Confidentiality (14)
Dept/labs	69(60%)	4.53	Quick (40) Solutions (37) Production cost (31) NPD (21) Quality (23)	Inadequate facilities (23)
Foreign investors	33(28%)	4.33	Quick (19) NPD (16) Quality (11) Solutions (11)	Too far away (19) High fees (8)
National tech. institution	45(39%)	3.49	Quick (15) Solutions (13) Quality (10)	Timeliness(20)
Local/ regional tech. institute	40(35%)	3.19	Solutions (15) Quick (13) Shared facilities (13)	Timeliness(14) Inadequate facilities (10) Confidentiality (10)
Consulting firms	53(46%)	3.47	Quick (26) Solutions (31) Ideas (24)	High fees (30) Confidentiality (15) Too far away (13)

Table 7 (contd)				
Universities	38(33%)	3.13	Quick (12) Solutions (16) NPD (11) Ideas (10)	Tech. unable (10) Timeliness(14)
Industry associations	65(56%)	3.43	Quick (27) Shared facilities (23) Contacts (33) Ideas (16)	Tech. unable (15) Timeliness(12) Confidentiality (12)
Academic associations	19(16%)	3.00	Ideas (7) Solutions (6)	Timeliness(7) Tech. unable (8)
Research associations	36(31%)	3.57	Quick (13) Solutions (18) NPD (14)	High fees (10) Timeliness(11) Confidentiality (8)

Table 8
Benefits and Problems of Group of Sources of Technical Services

Sources of Technical Services	Use Rate	Important Benefits	Important Problems
Group A LTS R&DD LTC IA	 53% 60%	Quick, Solutions, NPD, Production Cost, Quality, Ideas Shared facilities contacts	Tech. unable Timeliness Confidentiality Inadequate facilities
Group B PCL NTI CF	 39% 46%	Quick, Solutions, Shared Facilities, Quality, Ideas	High fees Timeliness Inadequate facilities Too far away Confidentiality
Group C UN LRTI RA, FI	 28% 35%	Quick, Solutions, NPD, Ideas, Shared Facilities, Quality	Tech. unable Timeliness Inadequate facilities Confidentiality High fees Too far away

Table 8 groups the sources of technical services on the basis of rate of usage. The important benefits and problems have also been mentioned alongside. Group A consisting of LTS, R&DD, LTC and IA has an usage rate ranging from 53 to 60 per cent; Group B consisting of PCL, NTI and CF has a rate of use of 39 to 46 per cent and the third group - UNI, LRTI, RA and FI - has a rate of use of 28 to 35 per cent. As evident from the table there is not much difference either in the benefits firms receive from the different groups or the important problems perceived to be associated with them. It is therefore not evident why more firms seem to use Group A sources more than the other two groups. One explanation is perhaps the fact that R&D are a part of the organization and hence one would expect a greater propensity to use the same. LTS and LTC may be somewhat like part of the same

family. Over a long period of time a symbiotic relationship perhaps gets built up between the firm and LTS and LTCs. That IAs are preferred over say RAs though both are for similar services in terms of ownership needs further analysis.

2.2 Sources and Benefits

A matching of sources and benefits, and, sources and problems is presented in tables 9 and 10. The matching of source-wise usage and benefits leads to the following observations:

The prime benefits received from private consulting laboratories are quick and easy access to information and technology, solutions to specific problems, and shared facilities. From customers with long term relationship, the prime benefit is in respect of help in new product development and design, followed by solutions to specific problems. From suppliers with long term relationships, the benefits are solutions to specific problems and quick access to information and technology. The departmental laboratories within the firm not only solves specific problems but also help the firm in reducing the production and operating costs. Foreign investors and licensors have helped companies with the easy access to information and technology and helped in new product development and design. National technical institutions confer access to information and technology, help in new product development. The local research associations help in solving problems and offer facilities for sharing. Consulting firms offer quick and easy access to information and technology and solve specific problems of the clients. University and technical colleges help in solving specific problems and also provide easy access to information and technology. Industry associations provide shared facilities and easy access to information and technology. Academic associations stimulate ideas and provide specific solutions to problems. Research associations also provide specific solutions to problems and help in new product development.

Table 9
Technological Services-wise Usage of Sources

Source	Service							
	IS		PS/TS		S/T		E/T	
PCL	0	0.0	6	9.1	24	32.0	1	1.4
CWLTR	25	36.2	15	22.7	17	22.7	5	7.0
SWLTR	20	29.0	20	30.3	5	6.7	8	11.3
DLWF	10	14.5	27	40.9	33	44.0	16	22.5
FIL	13	18.8	10	15.2	13	17.3	9	12.7
NTI	11	15.9	9	13.6	21	28.0	15	21.1
LRTI	7	10.1	3	4.5	16	21.3	14	19.7
CF	13	18.8	23	34.8	7	9.3	22	31.0
UATC	6	8.7	5	7.6	5	6.7	18	25.4
IA	33	47.8	12	18.2	7	9.3	24	33.8
AA	2	2.9	1	1.5	0	0.0	10	14.1
RA	14	20.3	8	12.1	15	20.0	6	8.5
Total #	69		66		75		71	

Table 9 (contd)
Technological Services-wise Usage of Sources

Source	Service							
	ConRD		ColRd		C/MA		FFTN	
PCL	2	10.5	1	3.8	0	0.0	4	8.9
CWLTR	3	15.8	7	26.9	10	23.3	17	37.8
SWLTR	1	5.3	4	15.4	6	14.0	12	26.7
DLWF	4	21.1	7	26.9	4	9.3	2	4.4
FIL	2	10.5	9	34.6	3	7.0	7	15.6
NTI	5	26.3	4	15.4	0	0.0	1	2.2
LRTI	5	26.3	2	7.7	1	2.3	3	6.7
CF	2	10.5	3	11.5	25	58.1	9	20.0
UATC	2	10.5	6	23.1	4	9.3	3	6.7
IA	2	10.5	2	7.7	14	32.6	22	48.9
AA	2	10.5	1	3.8	7	16.3	3	6.7
RA	3	15.8	3	11.5	3	7.0	10	22.2
Total #	19		26		43		45	

From the above, it can be seen that the key benefits which the firms expect from TIs are quick and easy access to information and technology, solution to specific problems and help in new product development. If we identify two top sources for various benefits, the picture would emerge as follows:

Table 10

Benefits	Source
1. Quick and easy access to information and technology	Foreign investors and licensors, Departmental laboratories within the firm
2. Reduction and production and operating cost	Departmental laboratories within the firm
3. Solutions to specific problems	Consulting firms, suppliers with long-term relationships
4. Shared facilities	Local research institutions, private consulting laboratories
5. Stimulation of ideas	Consulting firms and customers with long term relationships
6. Help in new Product development	Foreign investors and licensors, customers with long term relationships
Improved quality and reliability	Departmental laboratories within the firm and foreign investors and licensors
8. Enhanced technical business contacts	Industry associations and customers with long term relationships

2.3 Source-wise Problems

Table 11 provide an idea of the problems faced by the users vis-a-vis various sources. With private contract laboratories, the fees are found to be too high. Nor are they able to provide timely service. The customers with long term relationships are not able to provide confidentiality and help the companies technically. Suppliers with long term relationships are not able to keep the confidentiality and respond in a timely manner. Departmental labs within the firm do not have adequate facilities.

Table 11
Sourcewise Problems

Problem	Source							
	PCL		CWLTR		SWLTR		DLWF	
FATH	19	57.6	1	2.9	1	2.7	0	0.0
TUSP	3	9.1	13	38.2	9	24.3	9	30.0
NRTM	16	48.5	10	29.4	14	37.8	6	20.0
TMFA	1	3.0	1	2.9	1	2.7	0	0.0
LPC	2	6.1	5	14.7	10	27.0	7	23.3
IPC	4	12.1	12	35.3	14	37.8	2	6.7
IF	11	33.3	9	26.5	8	21.6	23	76.7
IRORR	2	6.1	3	8.8	4	10.8	1	3.3
TFAFF	14	42.4	9	26.5	10	27.0	1	3.3
Total #	33		34		37		30	
	FIL		NTI		LRTI		CF	
FATH	8	57.1	9	27.3	7	24.1	30	71.4
TUSP	0	0.0	7	21.2	7	24.1	10	23.8
NRTM	2	14.3	20	60.6	14	48.3	10	23.8
TMFA	2	14.3	7	21.2	7	24.1	1	2.4
LPC	1	7.1	8	24.2	5	17.2	3	7.1
IPC	1	7.1	7	21.2	9	31.0	15	35.7
IF	1	7.1	5	15.2	10	34.5	10	23.8
IRORR	1	7.1	2	6.1	4	13.8	3	7.1
TFAFF	12	85.7	4	12.1	0	0.0	12	28.6
Total #	14		33		29		42	

Table 11 (contd)								
Problem	Source							
	UATC		IA		AA		RA	
FATH	2	7.4	2	5.1	1	6.7	10	37.0
TUSP	10	37.0	15	38.5	8	53.3	4	14.8
NRTM	14	51.9	12	30.8	7	46.7	11	40.7
TMFA	9	33.3	3	7.7	2	13.3	3	11.1
LPC	9	33.3	10	25.6	4	26.7	6	22.2
IPC	6	22.2	12	30.8	4	26.7	8	29.6
IF	9	33.3	11	28.2	3	20.0	2	7.4
IRORR	4	14.8	4	10.3	3	20.0	7	25.9
TFAFF	3	11.1	8	20.5	2	13.3	5	18.5
Total #	27		39		15		27	

This points to the need for building support facilities within the firm. Foreign investors and licensors charge very high fee. No significant problem is perceived by the users. National technical institutions are unable to respond in a timely manner. Not many consider that the fees are high or they are unable to maintain confidentiality. The same problems are true with local research institutions. Consulting firms also charge high fees and are not able to maintain confidentiality. Lack of responsiveness and inability to help the clients are the problems of universities and technical colleges. Same is true with industry associations. No specific problems are perceived with academic associations except their inability to help them. Research associations are not able to respond timely, but charge high price.

2.4 Testing for sectoral difference

Table 12 provides us an opportunity to see whether the perception of the usefulness of the services is different across the various sectors. It can be seen that there are no significant differences in the importance attached to the technological service institutions by the various sectors. Some difference can be noticed in the case of customers with long-term relationships, foreign investors and licensors, and academic associations. Machine tools, textiles and autoparts attach higher ;importance to learning from customers and building long-term relationships with them. The foundry sector attaches highest importance to these sources. This is because there is almost a one-to-one relationship between the foundry and the customers it serves. Academic associations are given the highest importance by machine tool industry. The textile sector does not attach even average importance to this source.

2.5 Testing for difference due to clustering

Seventy one firms (54.2%) indicated the existence of a cluster of firms in their locality while 60 firms (45.8%) indicated in the negative. Table shows the results of the tests of difference.

Table 12
Sourcewise Usage of Benefits

Benefit	Source							
	PCL		CWLTR		SWLTR		DLWF	
QEAIT	16	42.1	15	27.3	22	37.9	40	64.5
RPAOC	5	13.2	7	12.7	10	17.2	31	50.0
SSP	20	52.6	27	49.1	37	63.8	37	59.7
SF	15	39.5	13	23.6	8	13.8	6	9.7
SI	3	7.9	19	34.5	14	24.1	7	11.3
HNPD	8	21.1	27	49.1	20	34.5	21	33.9
IQAR	12	31.6	14	25.5	17	29.3	23	37.1
ET/BC	3	7.9	17	30.9	13	22.4	1	1.6
Total #	38		55		58		62	
	UATC		IA		AA		RA	
QEAIT	12	40.0	27	51.9	5	31.3	13	41.9
RPAOC	2	6.7	2	3.8	0	0.0	9	29.0
SSP	16	53.3	13	25.0	6	37.5	18	58.1
SF	8	26.7	23	44.2	3	18.8	5	16.1
SI	10	33.3	15	28.8	7	43.8	7	22.6
HNPD	11	36.7	2	3.8	4	25.0	14	45.2
IQAR	2	6.7	6	11.5	2	12.5	9	29.0
ET/BC	4	13.3	33	63.5	3	18.8	2	6.5
Total #	30		52		16		31	
	FIL		NTI		LRTI		CF	
QEAIT	19	65.5	15	37.5	13	39.4	26	54.2
RPAOC	8	27.6	1	2.5	2	6.1	5	10.4
SSP	13	44.8	13	32.5	15	45.5	31	64.6
SF	3	10.3	10	25.0	15	45.5	2	4.2
SI	4	13.8	9	22.5	6	18.2	24	50.0
HNPD	16	55.2	15	37.5	10	30.3	8	16.7
IQAR	10	34.5	10	25.0	5	15.2	9	18.8
ET/BC	7	24.1	6	15.0	4	12.1	8	16.7
Total #	29		40		33		48	

Table 13 shows that locational concentration makes a difference to the choice of national technical institutions and local regional technical institutions as source of technical services. Wherever there is a concentration, we find that the usage of national technical institutions and local regional technical

institutions is higher. This is because of the possibility of demonstration effect or bandwagon effect where if one company uses in a locality, others follow suit.

Table 13
Usage of TSI by Local Industry Accumulation

	Local	Non-Local	Chi Sq.	Sig.
PCL	25 54.3 39.7	21 45.7 39.6	0.00	0.99
CWLTR	36 58.1 57.1	26 41.9 49.1	0.76	0.38
SWLTR	35 51.5 55.6	33 48.4 62.3	0.53	0.46
DLWF	38 55.1 60.3	31 44.9 58.5	0.04	0.84
FIL	19 57.6 30.2	14 42.4 26.4	0.20	0.66
NTI	31 68.9 49.2	14 31.1 26.4	6.30	0.01
LRTI	26 65.0 41.3	14 35.0 26.4	2.81	0.09
CF	32 60.4 50.8	21 39.6 39.6	1.45	0.23
UATC	24 63.2 38.1	14 36.8 26.4	1.78	0.18
IA	34 52.3 54.0	31 47.7 58.5	0.24	0.62
AA	11 57.9 17.2	8 42.1 15.1	0.09	0.76
RA	22 61.1 34.4	14 38.9 26.4	0.86	0.35
Total	63	53		

In an overall sense, the major sources of technical services for the sample are departmental laboratories within the firm, suppliers with long term relationships, industry associations and customers with long

term relationships. It is significant to note that industry associations have emerged as one of the key sources of technical services. This is also supported by our discussions with industry associations where the industry associations have taken extra initiatives to initiate new programmes for technological upgradation, and quality improvement. The Automobile Components Manufacturers' Association, for example, has taken upon itself to drive the message of quality and export to its members. It has opened a separate technology centre called ACT to help its members. Similarly, initiatives are contemplated by the machine tool manufacturers' association.

2.6 Firm characteristics and choice of sources

2.6.1 Size and sources

The size wise distribution of the firms is given in table 14.

Table 14
Sizewise distribution of firms

Size	Large	Medium	Small	Total
No. of Firms	38	44	37	119

It can be seen that we had a reasonable distribution of the number of firms in various size categories. Table 15 provides the results of the test to see whether size of the firms has made any difference to the choices of the sources. It can be seen from the table that the size of the firm has made a difference between the choice of departmental labs, national technical institutions, consulting firms, academic and research associations. The larger companies have used departmental laboratories and national institutions. They even have used the consultancy firms more than the smaller companies. Again it is the large companies that have benefited from academic and research associations. One of the reasons for this behaviour would be the resources available with the large and medium companies to seek out and get the necessary information while the small companies have to wait will the technical institutions reached out. Given the low reachout orientations of the technical institutions, the small companies are left to fend for themselves. This was also true in the case of prototype development and training centre. The regional small units located around the centre did not utilise the centre's facilities ad they did not have the time to do so. In a discussion with the entrepreneurs, it was revealed that they expected the PDTC staff to reach them at their place. PDTC did not do so in view of its rule-bound culture.

Table 15
Usage of TSI by Size of Firms

	Large	Medium	Small	Chi Sq.	Sig.
PCL	16 36.4 41.0	14 31.8 35.0	14 31.8 43.8	0.62	0.73
CWLTR	24 40.7 61.5	18 30.5 45.0	17 28.8 53.1	2.17	0.34
SWLTR	27 42.2 69.2	21 32.8 52.5	16 25.0 50.0	3.34	0.19
DLWF	31 47.0 79.5	23 34.8 57.5	12 18.2 37.5	12.95	0.002

Table 15 (contd.)					
FIL	12 36.4 30.8	15 45.5 37.5	6 18.2 18.8	3.02	0.22
NTI	17 39.5 43.6	19 44.2 47.5	7 16.3 21.9	5.52	0.06
LRTI	17 45.9 43.6	13 35.1 32.5	7 18.9 21.9	3.75	0.15
CF	20 40.8 51.3	20 40.8 50.0	9 18.4 28.1	4.69	0.10
UATC	15 42.9 38.5	13 37.1 32.5	7 20.0 21.9	2.27	0.32
IA	22 35.5 56.4	24 38.7 60.0	16 25.8 50.0	0.73	0.69
AA	10 58.8 25.6	4 23.5 9.8	3 17.6 9.4	5.09	0.08
RA	21 63.6 53.8	7 21.2 17.1	5 15.2 15.6	17.13	0.0002
Total	39	40	32		

2.6.2 *Ownership background and choice of sources*

Table 16 provides an idea of the nature of the ownership of the sample firms.

Table 16
No. of firms by ownership

Ownership	Pvt. (DC)	Pvt. (FC)	Govt. Majority	Cooperative	Jt. Sector	Total
No. of Firms	103	20	3	1	3	130

There is a dominance of the private domestic firms. Twenty companies had foreign capital participation. Table 17 provides for the tests of difference.

Table 17
Usage of TSI by Ownership of Firms

	Pvt	PWFC	MGO	Coop	Oth	Chi Sq.	Sig.
PCL	39	3	1	0	2	6.25	0.18
	86.7	6.7	2.2	0.0	4.4		
	43.8	16.7	33.3	0.0	66.7		
CWLTR	51	7	0	0	2	6.82	0.15
	85.0	11.7	0.0	0.0	3.3		
	57.3	38.9	0.0	0.0	66.7		
SWLTR	56	9	0	0	1	7.63	0.11
	84.8	13.6	0.0	0.0	1.5		
	62.9	50.0	0.0	0.0	33.3		
DLWF	55	9	1	0	2	3.21	0.52
	82.1	13.4	1.5	0.0	3.0		
	61.8	50.0	33.3	0.0	66.7		
FIL	19	11	1	0	1	12.20	0.02
	59.4	34.4	3.1	0.0	3.1		
	21.3	61.1	33.3	0.0	33.3		
NTI	32	8	2	0	2	3.15	0.53
	72.7	18.2	4.5	0.0	4.5		
	36.0	44.4	66.7	0.0	66.7		
LRTI	30	6	1	0	2	1.94	0.75
	76.9	15.4	2.6	0.0	5.1		
	33.7	33.3	33.3	0.0	66.7		
CF	43	6	1	0	1	2.53	0.64
	84.3	11.8	2.0	0.0	2.0		
	48.3	33.3	33.3	0.0	33.3		
UATC	28	8	0	0	1	3.14	0.53
	75.7	21.6	0.0	0.0	2.7		
	31.5	44.4	0.0	0.0	33.3		
IA	52	8	0	1	3	8.15	0.09
	81.3	12.5	0.0	1.6	4.7		
	58.4	44.4	0.0	100.0	100.0		
AA	17	1	0	0	1	3.34	0.50
	89.5	5.3	0.0	0.0	5.3		
	18.9	5.6	0.0	0.0	33.3		
RA	29	4	1	1	1	2.93	0.57
	80.6	17.7	2.8	2.8	2.8		
	32.2	22.2	33.3	100.0	33.3		
Total	89	18	3	1	3		

The ownership of a firm has made a difference in the case of choice of industry associations, foreign investors and licensors, and suppliers with long term relationships. The foreign companies have used foreign investors and licensors as a source, while the Indian companies have used suppliers with long term relationships as a source. Some illustration of this find in the case of an auto lamp manufacturer who is a domestic company and has learnt a lot from the suppliers. The technology for this is closely held and reverse engineering only on the strength of a company's efforts is quite difficult. It is the supplier of the equipment who can provide certain information using which the company can reverse engineer. Today the company is setting up a glass factory to start its lamp business. Substantial part

of the technology has been supplied by the supplier and he has also been a source of problems and solutions.

2.6.3 Background of the CEO and choice of sources

Table 18 gives an idea of the background of the CEO and the tests of the difference.

Table 18
No. of firms by CEO background

CEO Background	Worker	Entrepreneur	Engineer/ Scientist	Marketing/ Finance	Other
No. of firms	1	30	68	15	16
Percentage of total	0.8	23.1	52.3	11.5	12.3

A majority of the respondents (53%) were led by persons who had an Engineer/Scientists background, which 23 per cent had general entrepreneur as CEOs. The other two categories were almost equally strong at around 12 per cent.

The test of difference given in table 18 shows that the background of chief executive has not made a difference in the choice of sources.

2.6.4 Intensity of research and the choice of sources

Tables 19 and 20 give an idea of the R&D intensity and the results of the test of difference.

Seventy two firms (59%) has R&D expenditure less than one per cent of sales while 102 firms (83.6%) had R&D expenditure less than 5% of sales. On an aggregate basis Indian firms spend less than one per cent of sales on R&D. In that context, however, it is noteworthy that 39 firms spent between 2 and 10 per cent. There were 11 %) firms which spent more than 10 per cent.

Table 19
Distribution of firms based on R&D expenditure as % of sales

R&D Expenditure as % of	No. of firms
< 1	72
2 - 5	30
5 - 10	9
> 10	11
Total	122

Table 20
Usage of TSI by R&D Spending Rate

	Low - 1	2 - 5	6 - 10	11 - High	Chi Sq.	Sig.
PCL	17 56.7 56.7	11 36.7 39.3	0 0.0 0.0	2 6.7 25.0	8.78	0.03
CWLTR	19 44.2 63.3	18 41.9 64.3	2 4.7 28.6	4 9.3 50.0	3.50	0.32
SWLTR	20 46.5 66.7	16 37.2 57.1	3 7.0 42.9	4 9.3 50.0	1.79	0.62

Table 20 (contd)						
DLWF	21 48.8 70.0	18 41.9 64.3	3 7.0 42.9	1 2.3 12.5	9.72	0.02
FIL	9 45.0 30.0	9 45.0 32.1	2 10.0 28.6	0 0.0 0.0	3.44	0.33
NTI	11 35.5 36.7	15 48.4 53.6	3 9.7 42.9	2 6.5 25.0	2.83	0.42
LRTI	13 48.1 43.3	10 37.0 35.7	2 7.4 28.6	2 7.4 25.0	1.24	0.74
CF	17 47.2 56.7	9 25.0 32.1	5 13.9 71.4	5 13.9 62.5	5.88	0.12
UATC	9 34.6 30.0	7 26.9 25.0	6 23.1 85.7	4 15.4 50.0	10.17	0.02
IA	17 40.5 56.7	17 40.5 60.7	4 9.5 57.1	4 9.5 50.0	0.31	0.96
AA	9 64.3 29.0	3 21.4 10.7	1 7.1 14.3	1 7.1 12.5	3.61	0.31
RA	12 63.2 38.7	5 26.3 17.9	1 5.3 14.3	1 5.3 12.5	4.86	0.18
Total	30	28	7	8		

The test results show that Expenditure on R&D as a percentage of sales has made a difference only in the case of choice of departmental labs. The result is mixed. The table shows that lower R&D spending is associated with use of departmental labs. So is the situation with the choice of universities and technical colleges where R & D as a percentage of sales had made a difference in the choice of this as a source. But the pattern needs further analysis.

2.6.5 *Technical training and the choice of sources*

Tables 21 and 22 provide an idea of the distribution of technical expenditure rate by the firms and the results of the tests of difference.

Eighty eight firms (70%) had technical training expenditure less than one per cent of sales which 111

Table 21
Distribution of firms based on technical training expenditure as % of sales

Technical training as % of sales	No. of firms
< 1	88
2 - 5	23
5 - 10	10
> 10	5
Total	126

firms (88%) has technical training expenditure less than 5% of sales. However, there were some firms (10) which spent between 5 and 10 per cent of sales; while 5 spent more than 10 per cent firms.

Test results show that expenditure on technical training has made a difference in the case of the choice of local regional technical institutions and departmental laboratories within the firm. The results are again mixed showing that when the technical training is low, higher is the departmental lab use and when the technical training is high, lower is the departmental lab use. Further analysis can resolve this.

Table 22
Usage of TSI by Expenditure on Technical Training

	Low - 1	2 - 5	6 - 10	11 - High	Chi Sq.	Sig.
PCL	12	6	2	1	2.15	0.54
	57.1	28.6	9.5	4.8		
	48.0	28.6	28.6	33.3		
CWLTR	17	11	3	0	5.85	0.12
	54.8	35.5	9.7	0.0		
	68.0	52.4	42.9	0.0		
SWLTR	17	11	4	1	2.04	0.56
	51.5	33.3	12.1	3.0		
	68.0	52.4	57.1	33.3		
DLWF	17	7	4	1	5.99	0.11
	58.6	24.1	13.8	3.4		
	68.0	33.3	57.1	33.3		
FIL	9	8	0	1	3.83	0.28
	50.0	44.4	0.0	5.6		
	36.0	38.1	0.0	33.3		
NTI	13	7	2	1	2.28	0.52
	56.5	30.4	8.7	4.3		
	52.0	33.3	28.6	33.3		
LRTI	12	7	0	0	7.35	0.06
	63.2	36.8	0.0	0.0		
	48.0	33.3	0.0	0.0		
CF	9	10	6	1	5.66	0.13
	334.6	38.5	23.1	3.8		
	36.0	47.6	85.7	33.3		
UATC	4	10	3	1	5.66	0.13
	22.2	55.6	16.7	5.6		
	16.0	47.6	42.9	33.3		
IA	14	11	4	3	2.46	0.48
	43.8	34.4	12.5	9.4		
	56.0	52.4	57.1	100.0		
AA	3	2	1	0	0.51	0.92
	50.0	33.3	16.7	0.0		
	11.5	9.5	14.3	0.0		
RA	9	3	1	1	3.14	0.37
	64.3	21.4	7.1	7.1		
	34.6	14.3	14.3	33.3		
Total	25	21	7	3		

2.6.6 *Strength of technical persons and choice of sources*

Another indication of the technical intensity of the firm is the strength of technical persons and engineers in the company. Tables 23 and 24 provide an idea of the distribution of the respondents in various strength categories and the results of the tests of difference.

Table 23
Distribution of firms based on total number of engineers and technicians

No. of engineers and technicians	No. of firms	Percentage
< 10	26	20.8
10 - 25	27	21.6
25 - 50	23	18.4
50 - 100	20	16.8
100 - 250	18	14.4
> 250	10	8.0
Total	125	100.0

Table 23 shows that firms having more than 100 engineers and technicians formed about 22 percent of the total and having less than 10 engineers/technicians constituted about 21 percent. The rest of the sample had more than 10. It may therefore be surmised that the sample of firms surveyed exhibited varying levels of technical capability with approximately equal number of firms concentrated at the two extremes.

It can be seen from the Table 24 that the number of engineers and technicians is positively influencing the choice of inhouse efforts, i.e. departmental laboratories within the firm for solving technical problems. The influences are significant but mixed in the case of choice of universities and technical college, national technical institutions, foreign investors and licensors as sources. The choice of consulting firms is again influenced by the number of engineers and technicians. Upto a certain level, it makes a positive influence, but beyond that, the firms seem to be preferring to do things themselves as seen from the fact that companies having more than 251 engineers and technicians have chosen to depend fully on the departmental laboratories within the firm.

Table 24
Usage of TSI by No. of Engineers & Technicians in Firm

	Low-10	11-25	26-50	51-100	101-250	251-High	Chi Sq.	Sig.
PCL	9 20.5 40.9	13 29.5 50.0	7 15.9 38.9	7 15.9 38.9	5 11.4 27.8	3 6.8 33.3	2.40	0.79
CWLTR	14 23.7 63.6	13 22.0 50.0	7 11.9 38.9	9 15.3 50.0	9 15.3 50.0	7 11.9 77.8	4.88	0.43
SWLTR	10 15.6 45.5	16 25.0 61.5	7 10.9 38.9	11 17.2 61.1	12 18.8 66.7	8 12.5 88.9	8.38	0.14
DLWF	6 9.2 27.3	15 23.1 57.7	9 13.8 50.0	13 20.0 72.2	13 20.0 72.2	9 13.8 100.0	19	0.002
FIL	4 12.5 18.2	5 15.6 19.2	6 18.8 33.3	5 15.6 27.8	7 21.9 38.9	5 15.6 55.6	6.59	0.25
NTI	3 7.0 13.6	8 18.6 30.8	12 27.9 66.7	7 16.3 38.9	10 23.3 55.6	3 7.0 33.3	14.71	0.01

Table 24 (contd)								
LRTI	3 7.7 13.6	10 25.6 38.5	8 20.5 44.4	5 12.8 27.8	9 23.1 50.0	4 10.3 44.4	7.79	0.17
CF	5 10.0 22.7	11 22.0 42.3	8 16.0 44.4	8 16.0 44.4	15 30.0 83.3	3 6.0 33.3	15.67	0.008
UATC	4 11.1 18.2	6 16.7 23.1	6 16.7 33.3	5 13.9 27.8	11 30.6 61.1	4 11.1 44.4	10.61	0.06
IA	14 22.6 63.6	14 22.6 53.8	11 17.7 61.1	8 10.1 44.4	8 10.1 44.4	7 11.3 77.8	4.44	0.49
AA	2 11.8 9.1	5 29.4 19.2	0 0.0 0.0	4 23.5 22.2	5 29.4 27.8	1 5.9 11.1	7.16	0.21
RA	4 11.8 18.2	7 20.6 26.9	4 11.8 22.2	8 23.5 44.4	9 26.5 50.0	2 5.9 22.2	7.47	0.19
Total	22	26	18	18	18	9		

This means that firms with very low or very high technological orientation do not use the consulting firms, but it is those in the middle who use the services to augment their capabilities..

2.6.7 Technology level in the domestic context and the choice of sources

One hundred and two (102) firms (78.5%) perceived their technological capabilities to be nearly the same as that of the domestic leader while only 6 firms (4.6%) rated their technological capabilities much lower that of the domestic leader. Fifty five firms (42 .9%) rated their technological capabilities as average compared to the world leader.

Table 25
Usage of TSI by Domestic Technological Leadership Level

	VL	Low	Avg	AAvg	SAL	Chi Sq.	Sig.
PCL	1 2.2 33.3	1 2.2 33.3	11 23.9 61.1	11 23.9 26.8	22 47.8 44.0	6.75	0.15
CWLTR	1 1.6 33.3	0 0.0 0.0	13 21.3 72.2	19 31.1 46.3	28 45.9 56.0	7.43	0.11
SWLTR	1 1.5 33.3	0 0.0 0.0	10 14.9 55.6	25 37.3 61.0	31 46.3 62.0	5.42	0.24
DLWF	1 1.5 33.3	1 1.5 33.3	9 13.2 50.0	24 35.3 58.5	33 48.5 66.0	3.26	0.52
FIL	1 3.1 33.3	0 0.0 0.0	4 12.5 22.2	7 21.9 17.1	20 62.5 40.0	7.53	0.11

Table 25 (contd)							
NTI	0 0.0 0.0	1 2.3 33.3	6 13.6 33.3	15 34.1 36.6	22 50.0 44.0	2.82	0.59
LRTI	0 0.0 0.0	1 2.5 33.3	5 12.5 27.8	13 32.5 31.7	21 52.5 42.0	3.31	0.51
CF	2 3.8 66.7	0 0.0 0.0	6 11.5 33.3	20 38.5 48.8	24 46.2 48.0	4.43	0.35
UATC	1 2.7 33.3	0 0.0 0.0	6 16.2 33.3	8 21.6 19.5	22 59.5 44.0	7.65	0.11
IA	1 1.6 33.3	1 1.6 33.3	13 20.3 72.2	20 31.3 48.8	29 45.3 58.0	4.11	0.39
AA	1 5.6 33.3	0 0.0 0.0	4 22.2 22.2	5 27.8 11.9	8 44.4 16.0	2.32	0.68
RA	3 8.3 100.0	2 5.6 66.7	9 25.0 50.0	7 19.4 16.7	15 41.7 30.0	15.55	0.00
Total	3	3	18	41	50		

Table 25 provides us an opportunity to see whether technological levels in the domestic context make any difference to the choice of sources. We can note from the table that it influences the choices of sources like foreign investors and licensors, universities and technical colleges, research associations and customers with long-term relationships. This shows that firms bridge the gap between themselves and the leader with the help of customers in the domestic market.

The use of research associations is influenced by the comparative technological capability in the domestic context. The zig zag pattern in the percentages across the categories does not permit us to conclude that the difference between the domestic leader and the firm gets minimised by the use of research association.

2.6.8 Technology level and the choice of sources

42 respondents (32.8%) rated their technological capabilities nearly at par with the world leader while 31 firms (24.2%) rated their technological capabilities as low when compared to the world leader. Only 11 firms (9%) rated their technological capability to be at par with the world technological leader.

The tests of difference presented in table 26 shows that higher technological capability in the international context makes a difference in the choice of foreign investment and licencors, and Universities and technical colleges as sources of technical services. In respect of other sources, this does not seem to be a differentiating factor. If we divide the sample into below average and above average comparative technological capability, we find that the percentage of users of foreign investors and licensors is more in the case of above average comparative capability and lower in the case of below comparative capability. Same is the situation with the use of University and technical colleges as sources of technical services. The chi-square test in the case of others sources does not permit us

to reject the hypothesis that there are no differences in the choice of sources across various categories of comparative capabilities.

Table 26
Usage of TSI by World Technological Leadership Level

	VL	Low	Avg	AAvg	SAL	Chi Sq.	Sig.
PCL	5 11.1 38.5	5 11.1 33.3	21 46.7 42.9	11 24.4 39.3	3 6.7 37.5	0.48	0.98
CWLTR	7 11.7 53.8	10 16.7 66.7	26 43.3 53.1	13 21.7 46.4	4 6.7 50.0	1.64	0.80
SWLTR	6 9.2 46.2	9 13.8 60.0	26 40.0 53.1	19 29.2 67.9	5 7.7 62.5	2.43	0.66
DLWF	6 8.8 46.2	10 14.7 66.7	27 39.7 55.1	21 30.9 75.0	4 5.9 50.0	4.77	0.31
FIL	0 0.0 0.0	3 9.4 20.0	14 43.8 28.6	13 40.6 46.4	2 6.3 25.0	10.22	0.04
NTI	2 4.5 15.4	6 13.6 40.0	19 43.2 38.8	15 34.1 53.6	2 4.5 25.0	6.22	0.18
LRTI	3 7.5 23.1	6 15.0 40.0	17 42.5 34.7	13 32.5 46.4	1 2.5 12.5	4.34	0.36
CF	3 5.8 23.1	6 11.5 40.0	27 51.9 55.1	12 23.1 42.9	4 7.7 50.0	4.76	0.31
UATC	1 2.7 7.7	4 10.8 26.7	16 43.2 32.7	14 37.8 50.0	2 5.4 25.0	7.96	0.09
IA	6 9.7 46.2	8 12.9 53.3	25 40.3 51.0	18 29.0 64.3	5 8.1 62.5	1.90	0.75
AA	2 11.1 15.4	3 16.7 20.0	6 33.3 12.0	5 27.8 17.9	2 11.1 25.0	1.34	0.85
RA	6 17.1 46.2	7 20.0 46.7	11 31.4 22.0	8 22.9 28.6	3 8.6 37.5	5.27	0.26
Total	13	15	49	28	8		

In sum we can say that certain firm characteristics make a difference to the choice of the sources of services. Size, technological orientation and technical capability comparable to the leaders in the

international context influences the choice of sources like national institutions, foreign investors and R&D associations.

In this section we presented an analysis of the sources of technical services and tried to see whether there is any difference in the choices of services across the sectors and firm characteristics. We also tested whether the importance of the source and the usage are correlated . We found the correlation to be low.

3. Usage of Technical Services

In this section we present an analysis of the usage of technical services. Table 27 provides a ranking of the services on the basis of the extent of usage. Table 28 provides a ranking of the sources on the basis of the importance of the services. We test whether the importance of the services is related to the usage of the services or not. Table provides an aggregate view of the usage and the importance of the services.

From the ranking of services we find that standards and testing, education and training and information services are the most used services. commercial advice, contract R&D and collaborative advice are the least used services. The usage patterns are distinctly different.

Table 27
Ranking of services on the extent of usage

Services	Used by No. of firms (%)	Rank
Standards/testing	88 (73%)	1
Education/training	81 (67%)	2
Information services	80 (61%)	3
Problem solving/trouble shooting	75 (62%)	4
Technical networks	66 (55%)	5
Comm. advice	52 (43%)	6
Collaborative R&D	30 (25%)	7
Contract R&D	24 (20%)	8

This confirms our findings from the field interviews as well. From the ranking on the basis of importance of the services we find that standards and testing, problem solving, and collaborative R&D are the important sources. The correlation coefficient of 0.548 shows a moderate correlation between usage of services and the importance of services. This shows that there is scope for improvement on both sides that is the usage of services and promoting the importance of the services. Table 30 provides aggregate information.

Table 28
Ranking of services on the basis of importance

Services	Mean Importance	Rank
Standards/ testing	3.98	1
Problem solving/ trouble shooting	3.90	2
Collaborative R&D	3.89	3
Information services	3.77	4
Technical networks	3.73	5
Education/ training	3.65	6
Comm. advice	3.53	7
Contract R&D	3.17	8

Table 29
Technological Services; Usage, Importance & Major Sources

Services	Used by No. of firms (%)	Mean Importance	Major sources used by firms
Information services	80 (61%)	3.77	LT customer (25) Indu. Asso. (33) LT supplier (20)
Problem solving/ trouble shooting	75 (62%)	3.90	LT Supplier (20) Dept./Labs (20) Consul.firms (22)
Standards/ testing	88 (73%)	3.98	Pvt. contract lab (24) Dept./lab (33) National tech. institute (21)
Education/ training	81 (67%)	3.65	Consulting firm (22) Dept/lab (16) National tech. institution (15) Ind. Asso. (24)
Contract R&D	24 (20%)	3.17	Pvt.contract lab (5) National tech. institute (5)
Collaborative R&D	30 (25%)	3.89	LT customer (7) Foreign inves. (9) Universities (6)
Comm. advice	52 (43%)	3.53	LT customer (10) Consul. firm (25) Ind. Asso. (14)
Technical networks	66 (55%)	3.73	LT Customer (17) Ind. Asso. (22) LT Supplier (12)

3.1 Services and Sources

When we match usage of services with that of the sources, we find certain interesting combinations. The matching is given in table 9. Private contract laboratories are used for standards and testing and problem solving and trouble shooting. Between the two, the preference is for using them as a source of standards and testing services. Customers with long-term relationships, on the other hand, are used most for exchange of ideas and information.; their role in problem solving and standards and testing in a less significant way. Suppliers with long-term relationships are used as sources of information, solving problems and exchanging views and ideas. Foreign investors and licensors are used as sources of information, standards and testing, and exchange of ideas. Departmental laboratories are used for standards and testing, and problem solving. National technical institutions are used for standards and testing, and contract, research and development. Local institutions on the other hand are also used for contract research and development only. Consulting firms are used for problem solving and commercial and managerial advice. Universities and technical colleges are used for education and training. Industry associations are used for exchange of information, networking, and commercial and managerial advice. Academic associations are used for commercial and managerial advice and education and training. The research organisations are used for exchanging views with technical

personnel, information services, and standards and testing. If we can identify the top two sources for each of the services, the picture would emerge as in Table 30.

Table 30
Service and Sources

Service		Top two sources
1.	Information service	Industry Organisations and Customers with long-term relationships
2.	Problem solving and trouble shooting	Departmental labs and consulting firms
3.	Standards & Testing	Pvt. Consulting labs & Departmental labs
4.	Education & Training	Industry associations and consulting firms
5.	Contract R & D	National technical institutions and local research and training institutions
6.	Collaborative R & D	Customers with long-term relationships, foreign investors and licensors, departmental labs
7.	Commercial and managerial advice	Consulting firms, Industry associations
8.	Technical networks	Industry Associations, Customers with long-term relationships

We may note from the Table 30 that the prominent sources for technical services are industry association and customers with long term relationships. The technical institutions are used for specific services like contract R & D, and collaborative R & D. It is also significant to note that the sectors being studied are having strong industry associations. The machine tool industry, for example, has an industry association which has started in 1947. Similarly, textile industry has an age old industrial association.

3.2 Testing for sectoral difference

The F-test results are presented in Table 31. Significant differences in the perceived importance of collaborative R & D and standards and testing services across sectors are observed. In respect of other services, one cannot reject the hypothesis that there are no differences in the perceived importance of technological services across sectors, i.e. these services are equally important to all the sectors. In the case of collaborative R & D where the differences are significant, we find that foundry and polymer sectors have perceived collaborative R & D to be less important than other sectors.

Table 31
The Perceived Importance of Various Technology Services Needed by Industry

Service	Total	Poly	Matls	APts	Texts	Fndrs	SftWr	Pharma	F Value	Sig.
IS	3.77	3.75	3.75	3.95	3.68	3.50	3.93	3.54	0.55	0.77
PS/TS	3.90	4.00	4.00	3.95	3.94	3.83	3.78	3.86	0.06	1.00
S/T	3.98	4.00	4.29	4.14	3.75	2.80	4.11	4.21	2.16	0.06
E/T	3.65	3.40	3.71	3.60	3.64	4.25	3.93	3.00	1.34	0.25
ConRD	3.22	0.00	4.00	3.80	2.83	2.67	4.00	3.00	0.56	0.73
ColRD	3.89	0.00	3.50	4.86	3.67	2.00	4.00	3.80	5.39	0.002
C/MA	3.53	3.50	3.83	3.29	3.60	3.67	3.40	3.56	0.26	0.95
FFTN	3.73	3.50	3.75	4.00	3.50	3.67	3.70	3.83	0.32	0.92

Table 32
Usage of Services by Industry Accumulation

	Local	Non-Local	Chi Sq.	Sig.
IS	48 60.0 73.8	32 40.0 57.1	3.75	0.05
PS/TS	38 50.7 58.5	37 49.3 66.1	0.74	0.39
S/T	51 58.0 78.5	37 42.0 66.1	2.33	0.13
E/T	44 54.3 67.7	37 45.7 66.1	0.04	0.85
ConRD	14 58.3 21.5	10 41.7 17.9	0.26	0.61
ColRD	16 53.3 24.6	14 46.7 25.0	0.002	0.96
C/MA	26 50.0 40.0	26 50.0 46.4	0.51	0.48
FFTN	34 51.5 52.3	32 48.5 57.1	0.28	0.59
Total	65	56		

Regarding standards and testing, the foundry sector has perceived it to be having less importance. This could be because it is difficult to set clear standards for the foundry output. However, it is found to be perceived as important by pharmaceuticals and autoparts where these services could make a difference in getting a customer or not getting one.

3.3 Industry accumulation and usage of services

Locational concentration of the industry has made a difference to the use of information services, and standards and testing. The cluster firms did not use the other services more than the non-cluster firms. See Table 32.

3.4 Services and firm characteristics

Tables 33 to 40 provide the results of the tests of differences in the usage of technical services by the sample firms across various characteristics of the firm. Table 46 provides data on the usage of sources. It can be seen that the most used source is standards and tests.

Table 33
Usage of Services by Size of Firm

	Large	Medium	Small	Chi Sq.	Sig.
IS	32 42.7 80.0	26 34.7 65.0	17 22.7 47.2	8.91	0.01
PS/TS	31 42.5 77.5	22 30.1 55.0	20 27.4 55.6	5.56	0.06
S/T	35 41.7 87.5	24 28.6 60.0	25 29.8 69.4	7.80	0.02
E/T	30 39.5 75.0	28 36.8 70.0	18 23.7 50.0	5.78	0.06
ConRD	10 45.5 25.0	6 27.3 15.0	6 27.3 16.7	1.48	0.48
ColRD	16 57.1 40.0	8 28.6 20.0	4 14.3 11.1	9.21	0.01
C/MA	17 34.7 42.5	16 32.7 40.0	16 32.7 44.4	0.16	0.93
FFTN	27 42.9 67.5	16 25.4 40.0	20 31.7 55.6	6.13	0.05
Total	40	40	36		

Table 33A
Usage of Services

	Used	Not Used			All
IS	80	66.1	41	33.9	121
PS/TS	75	62.0	46	38.0	121
S/T	88	72.7	33	27.3	121
E/T	81	66.9	40	33.1	121
ConRD	24	19.8	97	80.2	121
ColRD	30	24.8	91	75.2	121
C/MA	52	43.0	69	57.0	121
FFTN	66	54.5	55	45.5	121

Table 34
Usage of Services vis-a-vis Ownership Categories

	PDC	PWFC	MGO	COOP.	OTH	Chi Sq.	Sig.
IS	64 82.1 68.1	9 11.5 50.0	1 1.3 33.3	1 1.3 100.0	3 3.8 100.0	5.68	0.22
PS/TS	61 82.4 64.9	9 12.2 50.0	2 2.7 66.7	1 1.4 100.0	1 1.4 33.3	3.13	0.54
S/T	70 81.4 74.5	12 14.0 66.7	2 2.3 66.7	0 0.0 0.0	2 2.3 66.7	3.21	0.52
E/T	64 81.0 68.1	11 13.9 61.1	2 2.5 66.7	0 0.0 0.0	2 2.5 66.7	2.32	0.68
ConRD	20 87.0 21.3	2 8.7 11.1	0 0.0 0.0	0 0.0 0.0	1 4.3 33.3	2.34	0.68
ColRD	22 75.9 23.4	6 20.7 33.3	0 0.0 0.0	0 0.0 0.0	1 3.4 33.3	2.25	0.69
C/MA	42 82.4 44.7	6 11.8 33.3	1 2.0 33.3	0 0.0 0.0	2 3.9 66.7	2.35	0.68
FFTN	54 83.1 57.4	7 10.8 38.9	1 1.5 33.3	1 1.5 100.0	2 3.1 66.7	3.66	0.45
Total	94	18	3	1	3		

Table 35
Usage of Services by Background of Chief Executive

	SW	Ent	E/S	M/F	OTH	Chi Sq.	Sig.
IS	0 0.0 0.0	20 25.6 74.1	37 47.4 58.7	9 11.5 75.0	12 15.4 75.0	5.18	0.27
PS/TS	0 0.0 0.0	21 28.4 77.8	34 45.9 54.0	8 10.8 66.7	11 14.9 68.8	6.64	0.16
S/T	0 0.0 0.0	20 23.3 74.4	42 48.8 66.7	10 11.6 83.3	14 16.3 87.5	6.22	0.18
E/T	0 0.0 0.0	18 22.8 66.7	44 55.7 69.8	8 10.1 66.7	9 11.4 56.3	3.05	0.55
ConRD	0 0.0 0.0	8 33.3 29.6	12 50.0 19.0	0 0.0 0.0	4 16.7 25.0	5.07	0.28
ColRD	0 0.0 0.0	8 26.7 29.6	17 56.7 27.0	2 6.7 16.7	3 10.0 18.8	1.54	0.82
C/MA	1 2.0 100.0	14 27.5 51.9	26 51.0 41.3	4 7.8 33.3	6 11.8 37.5	2.92	0.57
FFTN	0 0.0 0.0	13 20.0 48.1	39 60.0 61.9	7 10.8 58.3	6 9.2 37.5	4.97	0.29
Total	1	27	63	12	16		

Table 36
Usage of Services R&D Spending Role

	Low - 1	2 - 5	6 - 10	11 - High	Chi Sq.	Sig.
IS	23 45.1 79.3	20 39.2 69.0	5 9.8 55.6	3 5.9 33.3	7.20	0.07
PS/TS	22 46.8 75.9	17 36.2 58.6	5 10.6 55.6	3 6.4 33.3	5.79	0.12
S/T	23 43.4 79.3	22 41.5 75.9	5 9.4 55.6	3 5.7 33.3	8.28	0.04
E/T	18 35.3 62.1	21 41.2 72.4	8 15.7 88.9	4 7.8 44.4	4.73	0.19
ConRD	8 50.0 27.6	7 43.8 24.1	0 0.0 0.0	1 6.3 11.1	3.85	0.28
ColRD	7 38.9 24.1	7 38.9 24.1	1 5.6 11.1	3 16.7 33.3	1.26	0.74
C/MA	11 32.4 37.9	13 38.2 44.8	5 14.7 55.6	5 14.7 55.6	1.40	0.71
FFTN	20 46.5 69.0	14 32.6 48.3	5 11.6 55.6	4 9.3 44.4	3.17	0.37
Total	29	29	9	9		

Table 37

Usage of Services by Expenditure on Technical Training

	Low - 1	2 - 5	6 - 10	11 - High	Chi Sq.	Sig.
IS	18 48.6 78.3	12 32.4 54.5	4 10.8 40.0	3 8.1 100.0	7.05	0.07
PS/TS	17 51.5 73.9	11 33.3 50.0	4 12.1 40.0	1 3.0 33.3	4.99	0.17
S/T	19 48.7 82.6	14 35.9 63.6	5 12.8 50.0	1 2.6 33.3	5.51	0.14
E/T	12 32.4 52.2	16 43.2 72.7	6 16.2 60.0	3 8.1 100.0	3.87	0.28
ConRD	7 77.8 30.4	2 22.2 9.1	0 0.0 0.0	0 0.0 0.0	6.99	0.07
ColRD	4 36.4 17.4	4 36.4 18.2	3 27.3 30.0	0 0.0 0.0	1.54	0.67
C/MA	9 34.6 39.1	10 38.5 45.5	4 15.4 40.0	3 11.5 100.0	4.09	0.25
FFTN	14 43.8 60.9	11 34.4 50.0	6 18.8 60.0	1 3.1 33.3	1.21	0.75
Total	23	22	10	3		

Table 38

Usage of Services by Number of Engineers and Technicians

	Low-10	11-25	26-50	51-100	101-250	251-HIGH	Chi Sq.	Sig.
IS	14 18.4 58.3	17 22.4 63.0	10 13.2 52.6	14 18.4 70.0	14 18.4 82.4	7 9.2 77.8	4.93	0.42
PS/TS	15 20.8 62.5	16 22.2 59.3	8 11.1 42.1	12 16.7 60.0	13 18.1 76.5	8 11.1 88.9	7.59	0.18
S/T	14 16.7 58.3	23 27.4 85.2	11 13.1 57.9	14 16.7 70.0	14 16.7 82.4	8 9.5 88.9	8.71	0.12
E/T	13 16.5 54.2	18 22.8 66.7	11 13.9 57.9	14 17.7 70.0	15 19.0 88.2	8 10.1 88.9	8.08	0.15
ConRD	4 17.4 16.7	5 21.7 18.5	4 17.4 21.1	4 17.4 20.0	4 17.4 23.5	2 8.7 22.2	0.38	0.96
ColRD	1 3.7 4.2	4 14.8 14.8	5 18.5 26.3	5 18.5 25.0	6 22.2 35.3	6 22.2 66.7	16.98	0.005
C/MA	12 25.0 50.0	8 16.7 29.6	4 8.3 21.1	9 18.8 45.0	11 22.9 64.7	4 8.3 44.4	9.46	0.09
FFTN	11 17.5 45.8	15 23.8 55.6	9 14.3 47.4	13 20.6 65.0	10 15.9 58.8	5 7.9 55.6	2.15	0.83
Total	24	27	19	20	17	9		

Table 39

Usage of Services by Technological Capability Gap vis-a-vis Domestic Leader

	VL	Low	Avg	AAvg	SAL	Chi Sq.	Sig.
IS	2 2.5 66.7	2 2.5 66.7	11 13.9 57.9	29 36.7 67.4	35 44.3 67.3	0.63	0.96
PS/TS	2 2.7 66.7	2 2.7 66.7	14 18.9 73.7	25 33.8 58.1	31 41.9 59.6	1.54	0.82
S/T	3 3.4 100.0	3 3.4 100.0	13 14.9 68.4	30 34.5 69.8	38 43.7 73.1	2.60	0.63
E/T	2 2.5 66.7	1 1.3 33.3	10 12.5 52.6	25 31.3 58.1	42 52.5 80.8	9.25	0.06
ConRD	0 0.0 0.0	0 0.0 0.0	4 16.7 21.1	11 45.8 25.6	9 37.5 17.3	2.59	0.63
ColRD	0 0.0 0.0	0 0.0 0.0	2 6.9 10.5	9 31.0 20.9	18 62.1 34.6	7.18	0.13
C/MA	1 2.0 33.3	1 2.0 33.3	9 17.6 47.4	19 37.3 44.2	21 41.2 40.4	0.54	0.97
FFTN	2 3.1 66.7	1 1.5 33.3	13 20.0 68.4	20 30.8 46.5	29 44.6 55.8	3.34	0.50
Total	3	3	19	43	52		

Table 40
Usage of Services by Technology Capability Gap vis-a-vis World Leader

	VL	Low	Avg	AAvg	SAL	Chi Sq.	Sig.
IS	8 10.1 61.5	11 13.9 68.8	33 41.8 64.7	21 26.6 72.4	6 7.6 66.7	0.70	0.95
PS/TS	9 12.3 69.2	12 16.4 75.0	28 38.4 54.9	18 24.7 62.1	6 8.2 66.7	2.61	0.63
S/T	12 14.0 92.3	10 11.6 62.5	36 41.9 70.6	25 29.1 86.2	3 3.5 33.3	13.22	0.01
E/T	4 5.1 30.8	8 10.1 50.0	37 46.8 72.5	23 29.1 79.3	7 8.9 77.8	12.97	0.01
ConRD	3 12.5 23.1	4 16.7 25.0	9 37.5 17.6	7 29.2 24.1	1 4.2 11.1	1.23	0.87
ColRD	1 3.4 7.7	3 10.3 18.8	11 37.9 21.6	11 37.9 37.9	3 10.3 33.3	5.70	0.22
C/MA	5 9.8 38.5	7 13.7 43.8	22 43.1 43.1	14 27.5 48.3	3 5.9 33.3	0.78	0.94
FFTN	6 9.5 46.2	9 14.3 56.3	27 42.9 52.9	14 22.2 48.3	7 11.1 77.8	2.79	0.59
Total	13	16	51	29	9		

3.5.1 Size and the use of services

Size of the firm has made a difference in the use of information services, problem solving, standard and testing, education and training, collaborative R & D and technical networks. It is the larger firms which have used these services more than small companies.

3.5.2 Ownership of firms, however, has not made any difference to the choice of services. So is the situation with the background of the chief executive.

3.5.3 R & D as a percentage of sales

Research and development expenditure as a percentage of sales has made a difference to the use of information services and standards and testing. In fact the results are interesting in the sense that the higher use is associated with lower research and development percentage. This may mean that lower the effort of the firm on its own, higher is the dependence on external source of information, testing, and problem solving. This is true with technical training as well. The use of contract R&D is associated with expenditure on technical training. Lower the technical training, higher is the usage.

3.5.4 Number of engineers and technicians and choice of services

Total number of engineers and technicians in a firm has made a difference to the use of collaborative R & D, and commercial and managerial advice. Those with lower number of technicians have made use of commercial and managerial advice as well as with higher number of technicians and engineers. This reflected a kind of 'U-curve' relationship. Collaborative R & D is used only by those firms that have higher number of technicians and engineers.

3.5.5 Technological level

The kind of 'U-curve' we talked about is also present in the associations with technological leadership. The use of collaborative R & D has directly influenced the comparative technological capability. Higher the level of comparative capability in the domestic market, higher is the use of collaborative R & D. Higher use of collaborative R&D is also associated with lower comparative capability. Those who are leaders use collaborative R&D to sustain their leadership position. Those who are not use it to bridge the gap. It is the middle companies that do not mind the gap. The U-curve however is not there with education and training. It is those companies that are technological leaders who use the education and training services. Alternatively the use of education and training services enhances the technological capabilities of the firm.

3.5.6 Technological level in the international context

Being closer to the world leader's capabilities has made a difference has made a difference in the use of standards and testing, and education and training services. Smaller the gap technological gap between the firm and the world leader, the higher is the use of education and training. It is those who have invested in education and training develop capabilities close to the world leaders.

In sum size, technical orientation, clustering of firms and technological level comparable to the leader makes a difference in the usage of services. The services in demand are education and training, testing and standards, and information services. There is limited demand for sophisticated services like collaborative R&D. This in a way reflects the short term orientation of the respondents.

4. Use of Training

Eighty six (86) firms (65%) have used formal training institutions for training their employees while 46 firms (35%) have not. Table 41 provides the details.

Table 41
Use of Vocational Institutions

Institution	Used by no. of firms	Mean contribution (perceived+actual)
Govt. vocational schools	23	3.03
Pvt. vocational schools	31	3.35
Universities	15	3.50
Industry Association	39	3.78
JV Partner	15	4.16
Buyers	4	3.50
Suppliers	17	3.78

Amongst the various institutions used by the firms for training their employees industry associations seem to be the most used with one of the higher values of 'mean contribution'. In terms of mean contribution suppliers and JV partners are relatively higher than the rest though they have been used to a lesser extent. Table 42 gives an idea of the activities carried out by the firm.

Table 42
Training activities carried out by the firm itself

Employee category:	No. of firms
Workers/operatives	45
Technical staff	31
Managerial cadre	10
All of the above	24
No employee training offered	11
Area of Training:	
Engineering/Technical	74
Others	21
Both	20
Mode of Training:	
Seminars, workshops	41
On-the-job	63
Interaction with other organisation	5
Training at collaborator's works	0

Most of the firms conducted some form of training activities for their employees. Most of the firms tended to focus on programmes for workers/operatives and technical staff. Only a few (10) organized training activities for managerial staff. On-the-job training, seminars and workshops seem to be the most used modes of training though a few used 'interaction with other organizations' in a formal manner to train their personnel. It is very surprising training at collaborator's works has not been mentioned by any of the firms.

On the whole, one can say that it is the size of the company and the international orientation that have made a difference to the choice of services and sources.

5. Conclusion

This paper presented an analysis of the usage of various sources of technical services and usage of technical services themselves. We tried to relate the usage of the services and the importance of the services, and the usage of the sources and the importance of the sources, and found that there was a weak to moderate positive link between the two. this presents scope for improvement on the sides of usefulness and usage. The most used sources were company's own labs, relation with the suppliers and industry association. The most used services are standards and testing, education and training and information services. The role played by the industry association has been appreciated. We also tried to see whether there are any differences across sectors, and firm characteristics. We found that size and technological orientation made a difference to the use of services and sources.

Abbreviations

Sector

Poly.	Polymer
M/c Tool	Machine Tools
Auto	Automobiles
Text.	Tetiles
Fdry.	Foundry
SW	Software
Phrm	Phramacuticals

Services

IS	Information Services
PS/TS	Problem solving/Trouble shooting
S/T	Standard Testing
E/T	Education Training
ConRD	Contract R&D
ColRdc	Colloborative R&D
MA	Commercial /Managerial Advice
FFTN	Facilitating Formation of Technical Networks

Source

PCL	Private Contract Laboratories
CWLTR	Customer with Long term relationship
SWLTR	Suppliers with long term relationship
DLWF	Departments/labs within your firms
FIL	Foreign Investors and licensors
NTI	National technical institutions
LRTI	Local/Regional technical Inst
CF	Consulting Firms
UATC	University and technical Colleges
IA	Industrial Associations
AA	Academic Associations
RA	Research Associations
FATH	Fees are too high
TUSP	Technically Unable to serve Purpose
NRTM	Not Responsive in Timely Manner
TMFA	Too Many Forms and approvals
LPC	Lack of personal continuity
IPC	Inadequate Protection Of Confidentiality
IF	Inadequate Facilities
IRORR	Inadequate Rules of Ownership Of research facilities
TFAFF	Too far away from firm

Benefits

QUAIT	Quick and easy access to information and technology
RPAOC	Reduced production and operating costs
SSP	Solutions to specific problems
SF	Shared facilities
SI	Stimulating Ideas
HNPD	Help new product development/ design
IQAR	Improved quality and reliability
ET/BC	Enhanced technical and Business contacts

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