A COMPARATIVE STUDY OF TECHNOLOGY AND INDUSTRY CLUSTERS OF SMEs IN INDIA

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Abstract

This paper attempts to compare the Small and Medium Enterprises (SMEs) belonging to two types of clusters [industry and technology] in India. They are compared in terms of the technological efforts, nature of competition and competitive strategy, outward orientation, research and development intensity etc. First part of the paper gives the economics of clustering and the second part analyses the inter-cluster differences, if any, between the firms belonging to 13 clusters drawn from Mumbai and Thiruvananthapuram, classified into industry and technology clusters. The analysis reveals that there are clear differences between firms in the two clusters. The firms in the technology cluster are more outward oriented and R and D intensive compared to their counterparts in industry cluster. They also differ in terms of the nature of markets they face and the type of competitors. While the firms in the technology cluster face an oligopoly market and competition from established foreign firms, those in the industry cluster face a freely competitive market and competition predominantly from established local firms. Process innovations are used by firms in the technology cluster for sustaining competitive advantage. In the case of firms in the industry cluster, productivity improvements are emphasised upon. In the multiple regression analysis, age, size, foreign equity participation, dummy for cluster, market share and the number of patents emerge as significant variables in explaining the innovative activities and competitiveness of firms.

Key words: Cluster, SME, Technology, patent, export intensity, R&D intensity

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1. Introduction

Small and Medium Enterprises (SMEs) contribute to economic growth in a significant way in both developed and developing economies. Their contributions to employment generation, regional development, Gross National Product, technological innovations etcetera are discussed widely in academic literature. Increasing liberalisation and globalisation are giving new challenges and opportunities to SMEs across the world. Without productivity improvement, innovations and technology up gradations, SMEs will find it difficult to survive and sustain their competencies. Small size, high labour intensity, technology backwardness and inward looking production have to be replaced by technology accumulation, outward orientation in production, acquiring of tacit knowledge and collective efficiency.

Small and Medium Enterprises play a vital role in the Indian economy by contributing 45% of the industrial output, 40% of exports, 42 million in employment, create one million jobs every year and produces more than 8000 quality products for the Indian and international markets. As a result, small and medium enterprises are today exposed to greater opportunities for expansion and diversification across the sectors. The SMEs in India are making remarkable progress in various Industries like Manufacturing, Precision Engineering, Food Processing, Pharmaceuticals, Textile & Garments, Retail, IT, Agro and Service sectors.

In India, due to restricted and protected policies, the SME sector did not show very substantial growth prior to 1991. But after 1991, the liberalisation policies have forced the Small and Medium enterprises to review their competitive strategies and to give emphasis on investment in research and development, technology management and joint action like collaborations and mergers etc. In this context, cluster- based SME development becomes very important. A shift in focus to clusters in explaining and analysing regional economic development has become very popular in theoretical economics literature. It points to the fact, as observed by Porter (1998), that immediate business environment outside companies play a pivotal role. Cluster-based development of SMEs help them to reap advantages of agglomeration economies like information spill overs, specialisation and division of labour, development of skilled labour markets, accumulation of various human resources, technological up gradation, cost advantages, quality improvement etc. Collective learning and efficiency do not side-line the need for competition and orientation towards innovative

activities. SMEs try to be very competitive within the cluster as the immediate business environment within the cluster necessitates adoption of competitive strategies for survival and growth.

2. Economics of clusters

The first subsection briefly explains the concept of cluster as used in various academic literatures. The second subsection then gives the theoretical and empirical studies on cluster based development of firms. In particular, studies relating to factors that contribute to efficiency and competence enhancing in cluster based development of firms are discussed. The objective of this section is to explain the economics of cluster with the help of theoretical and empirical studies.

2.1 Cluster- definitions

Clusters are defined in different ways in theoretical and empirical studies. Geographical proximity, complementarity and functionality are the three main aspects which are used to define a cluster. Clusters can be defined as 'geographic concentrations of inter connected companies and institutions in a particular field' (Porter, 1998). He continued that 'in general, industrial clusters represent geographic concentration of interconnected enterprises in a particular industry that share related production inputs, specialized labour pools, distribution and communication channels, and network association. They can be characterized as being networks of production of strongly interdependent firms (including specialized supplier), knowledge producing agents (universities, research institutes, engineering companies), bridging institutions (brokers, consultants) as well as distribution channels and customers, linked to each other in a value-adding production chain. The cluster approach focuses on the linkages and interdependence between actors in the network of production when producing products and services and creating innovations'. Alfred Marshall pointed out the advantages of having `industrial districts' in an economy to bring about rapid industrial development and economic growth. (Marshall, 1920). According to him, entrepreneurs in the industrial districts can learn easily from other enterprises, can transact intermediate goods and services with each other, can easily find workers with desired skills and can attract resources suppliers and customers. Thus, benefits that are beyond the reach of any individual firm can be reaped when there is cluster-based development of SMEs.

The definition given by Steiner and Hartmann (1998) highlights the complementarity of firms that make up a cluster. According to them, ‘ Clusters are sets of complementary firms (in production and service sectors) public, private and semi-public research and development institutions, which are inter connected by labour market and / or input-output and/ or technological links’. Elsner (2000) defined clusters as groups of firms that are functionally interconnected vertically as well as horizontally. There are many studies that look at the advantages of cluster based development of firms.

2.2 Theoretical and Empirical studies

Schmitz (1995) introduced the concept of `Collective efficiency’ in the context of clusters. He explained the concept thus: ` Collective efficiency is the competitive advantage derived from local external economies and joint action’. External economies are the out of the market rules, side effects of the economic activities of any economic agent on someone else. It can be positive or negative. Common marketing channels, presence of complementary industries, technology and knowledge spill overs, Entrepreneurial skills’ spin offs, networking among similar or complementary or allied industries are all different types of positive external economies. Small and medium enterprises that are generally small scale can achieve economies of large scale operation through external economies and collective action. This has become the theoretical basis for cluster based industrial development in both developed and developing economies.

Lorenz (1996) came out with the idea of `collective learning’ as one of the main advantages of cluster-based development strategy. ` Collective learning involves the creation and further development of a base of common or shared knowledge among individuals making up a production system which allows them to co-ordinate their actions in the resolution of technological and organisational problems they confront’. Inter firm linkages and common problem solving mechanisms will help technologically weak firms to grow in the highly competitive world. Technological capability building becomes easy for small firms in a cluster. Besides, the technologically forward companies will be able to lead other companies in the same cluster. Porter (1998) defined the new economics of competition emanating from local clusters. He refuted the common wisdom that location does not play any role in giving competitive advantage to firms. As he rightly pointed out ` the enduring competitive advantage in a global economy lie increasingly in local things- knowledge, relationship, motivation- that distant rivals cannot match’. The ways in which clusters affect

competition are explained in three distinct ways- productivity enhancement, driving the direction and pace of innovation and by stimulating the formation of new businesses.

LI and FUNG Research Centre (2006) in their industrial cluster series discussed in detail the evolution as well as the different types of clusters in China. The major types of clusters in China include self-augmented, export-oriented, high tech, resources driven and market driven clusters. Industrial clusters of the self- augmented type are owned by private individuals and are labour intensive, entrepreneurial and low technology where the skills are passed on to the next generation. In the export-oriented variety foreign direct investment also is made and the products are produced for overseas markets. High tech clusters are formed by scientists and scholars in different universities and they use modern technology in the various phases of the value chain of the product. They play a very significant role in the generation of knowledge. Resources driven clusters employ natural resources as raw materials. Furniture clusters are a classic example of this type in China. Market driven clusters came into existence as a response to the market signals. In China most of the enterprises in the various clusters are privately owned and small and medium enterprises. Government plays a very key role in fostering the various clusters through policy and incentive interventions.

Pietrobelli et al. (2004) discussed the upgrading and moving ahead in value chain of Small and Medium enterprises in the clusters in Latin America. In their study they have clearly highlighted the role of clusters as facilitating factor for division of labour and specialisation. The clusters form the breeding ground of new businesses, innovations and technology evolution.

Okada and Siddharthan (2007) analysed the differences in the cluster formation and inter cluster differences of automobile clusters in Chennai and the National capital region in India. They have looked at the role of foreign direct investment in cluster growth and development. The study also examined the inter cluster differences in the performance of firms. The study has underlined the role of industrial policies by the government for fostering SME cluster growth and has found that the productivity of firms in the cluster is higher than those that are not in a cluster.

Albeladego (2001) examined the factors that determine the competitive advantages of firms in a cluster. The following section gives a brief description of the model given in the study. He classified the factors into three major categories- country level, cluster level and

firm level. In the country level factors, he included the general intervention through macro-economic regulations and policies and SME specific interventions include financial and non-financial services.

At the cluster level, the factors are external economies, joint action, trust and connectivity. At the firm level, skills, technology efforts and learning, working conditions and physical infrastructure and machinery are included. The cluster based SME development are further elaborated in the following section on the basis of the model given by Albeladego. The external economies are the unplanned gains that occur as a consequence of the unintentional influence that firms have when they are in close proximity to each other. Creation of a pool of skilled labour, diffusion of technical know-how and shared interest of attracting foreign buyers are some of the examples of the spill overs.

Joint action represents planned gains of being in clusters. The collaborative ties between the firms help them to overcome the structural constraints in their productive, organisational and marketing functions. The horizontal and vertical linkages of firms in a cluster are given in the following chart.

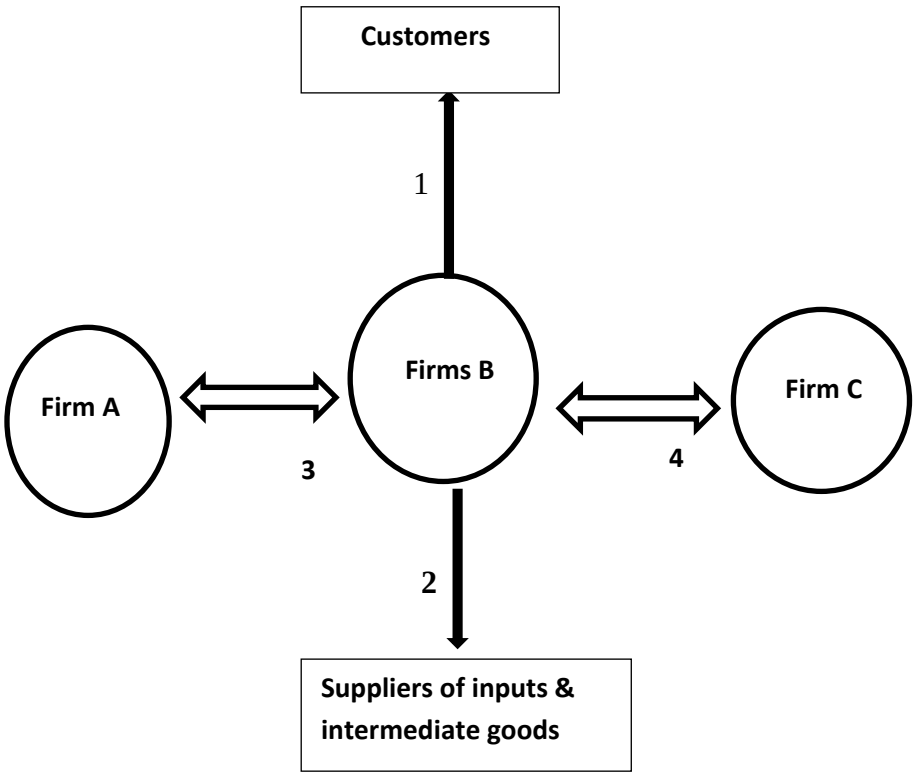

Chart 1 The dynamics of cluster based SME development
Source: developed by the researchers from the Albeladego's study

The above chart shows the ways in which an SME acquire competitive advantages in cluster based development. In a cluster there are basically two kinds of linkages. One is horizontal and the other is vertical. 1 and 2 in the diagram show vertical linkages (forward and backward). There will be firms producing intermediate goods within the cluster or may be core suppliers of raw materials in bulk. This reduces the transaction cost and also helps to access inputs at a lower cost. The suppliers approach the clusters at a competitive price for bulk supply. This enable the firms to source the inputs at a reduced rate and this will be reflected in the final output price. Price competitiveness could be achieved by firms in a cluster which otherwise would not have been the case. The customers of the products find it easier to approach a cluster for their requirements and from the demand pattern the firms come to know about the market and try to make changes in their production process or commodity mix. This gives a green signal for the formation of new businesses.

In the diagram, numbers 3 and 4 show horizontal linkages. There can be healthy competition between firms in the cluster for their products or can be cooperation between them for acquiring productivity advantages. Firms producing similar products compete each other in terms of price, quality, productivity, process technology etc. This necessitates continuous up gradation of technology and constant innovation. When the firms cooperate, there will be deliberate joint action for reaping the advantages of agglomeration economies. This results in what is known as ‘collective efficiency’. However isolated each firm is, there will be knowledge, skills, technology and information spill overs in a cluster. This is ‘collective learning’. This is very important for new firms and also for weak firms. Positive externalities like infrastructure, access to quality centres and testing labs, access to special skills employees are also other productivity enhancing factors in a cluster.

Trust and connectivity are also important. Accepted and respected common values derived from socio-cultural identities are shared by people as well as firms to achieve common interests and maximisation of community welfare. The purpose of the present study is to compare the firms in two types of SME clusters in India- industry and technology clusters. The following section gives an elaborate account of the empirical study.

3. Empirical Analysis

This section deals with the analysis of the sample data drawn from 13 clusters that are further categorised into Technology clusters and Industry clusters. The technology cluster includes

the firms in the technology parks whose products or services embody new, innovative or advanced technologies developed by the application of technical expertise. These firms leverage technology for their competitive advantage. The industry clusters include firms that belong to different lines of production but are geographically concentrated. The objective of the study is to analyse the Structure and conduct of firms, technological efforts and competitive strategies in the two types of clusters.

3.1 Sample, data and time period

The sample has been selected from 13 clusters. The clusters have been identified from the 4th census of SMEs in India. Though data have been collected from 110 firms, only 90 were taken for the study after cleaning the data. The questionnaire developed by the researcher was used for primary data collection. Personal interviews also were made to supplement the information gathered through questionnaire method. The present sample consists of 90 firms that are taken from 13 clusters. Of the total sample, 26 companies belong to technology clusters and 64 belong to industry clusters. All the companies are started by first generation entrepreneurs and the data are collected directly from the entrepreneurs. The following section analyses the structure and conduct of the firms in the two clusters.

3.2 The structure and conduct of the firms

This section analyses the structure and conduct of firms in the sample under consideration. A comparison of the firms in the technology and industry clusters in terms of the various aspects like the nature of organisation, age, size, degree of competition, types of competitors, competitive strategies, outward orientation, research and development intensity, number of patents etcetera are attempted.

Table 3.2.1 Nature of Organisation

Nature of Organisation/Cluster	Technological Cluster	Industrial Cluster	Total
Private Limited	**15(57.7)**	**24(37.5)**	**39(43.33)**
Public limited	**0**	**1(1.56)**	**2(2.22)**
Partnership	**6(23.07)**	**23(35.93)**	**28(31.11)**
Sole proprietorship	**2(7.69)**	**14(21.8)**	**16(17.77)**
Venture capital firm	**3(11.53)**	**2(3.12)**	**59(5.55)**
Total	**26 (100)**	**64 (100)**	**90**

Source: Calculated by the researcher from the data collected
Note : Figures in the brackets represent the percentages

It is clear from the table that 57.7% of firms in the technology cluster are private limited, 23.07% partnerships, 11.53% are venture capital firms and only 7.69% are sole proprietorship. 37.5% of firms in the industry cluster are private limited, 35.93% are partnerships, 21.8% sole proprietorship, 3.12% each are Venture capital firms and only 1.56% are public limited. This shows that the dominant nature of organisation of firms in the technology cluster is private limited whereas that of industry cluster is an almost equal spread between private limited and partnership types.

Table 3.2.2 Age of the Organisations

Age Group/Cluster	Technological Cluster	Industrial Cluster	Total
1-3	**3(11.53)**	**19(29.68)**	**22(24.44)**
4-7	**19(73.07)**	**20(31.25)**	**39(43.33)**
8-10	**3(11.53)**	**7(10.93)**	**10(11.11)**
>10	**1(0.38)**	**18(28.12)**	**19(21.11)**
Total	**26(100)**	**64(100)**	**90**

Source: Calculated by the researcher from the data collected
Note : Figures in the brackets represent the percentages

Majority of firms (73.7%) in the technology cluster are in the 4-7 age group. 11.53% of firms are in the 1-3 and 8-10 age groups. Only 0.38% are in the >10 age group. In the case of industry clusters, 31.25% are in the 4-7 age group, followed by 29.68 % in the 1-3 age group, 28.12% in the >10 age group and 10.93% in the 8-10 age group. The average age of firms in the technology cluster is 5.65 years and that of industry cluster is 7.89. This shows that the comparative age of firms in the technology cluster is low.

Table 3.2.3 Degree of competition in the Market

Nature of Competition	Technology Cluster	Industry Cluster	Total
Monopoly	**0**	**1(1.56)**	**1(1.11)**
Oligopoly	**12(46.15)**	**15(23.43)**	**27(30)**
Monopolistic competition	**7(26.92)**	**4(6.25)**	**11(12.22)**
Free competition	**7(26.92)**	**44(68.75)**	**51(56.66)**
Total	**26(100)**	**64(100)**	**90**

Source: Calculated by the researcher from the data collected
Note : Figures in the brackets represent the percentages

In the case of technology clusters, oligopoly is the major type of competition whereas in the case of industry clusters, free competition is the dominant market type. Nature of competition faced by the firms has very important impact on the profitability as well as the competitive strategy that they adopt. In the case of industry cluster, freedom of entry and exit of firms are very high compared to technology clusters.

Table 3.2.4 Type of Competitors

Type of Competitors/Cluster	Technology Cluster	Industry Cluster
Established local firms	**7(26.92)**	**52(81.25)**
New local firms	**5(19.23)**	**16(25)**
Established foreign firms	**16(61.54)**	**17(26.56)**
New foreign firms	**3(11.53)**	**8(12.5)**
No Competitors	**0**	**1(1.56)**

Source: Calculated by the researcher from the data collected
Note : Figures in the brackets represent the percentages

Technology and industry clusters differ in terms of the type of competitors that they confront in the market. Firms belonging to the technology clusters face competition mainly from established foreign firms, whereas firms in the industry clusters face competition mainly from established local firms. 61.54% of firms in the technology cluster face competition from established foreign firms, followed by established local firms (26.92%), new local firms (19.23%) and new foreign firms (11.53%). In the case of industry clusters 81.25% of firms face competition from established local firms, 26.56% from established foreign firms, 25% from new local firms, 12.5% from new foreign firms and 1.56% has no competitors.

Table 3.2.5 Competitive Strategy

Competitive strategy	Technology Cluster	Industry Cluster
Product differentiation	**14(53.84)**	**28(43.75)**
Cost cutting	**4(15.38)**	**19(29.69)**
Process innovations	**16(61.54)**	**20(31.25)**
Managerial improvements	**5(19.23)**	**18(28.13)**
Improving productivity	**12(46.15)**	**33(51.56)**

Source: Calculated by the researcher from the data collected
Note : Figures in the brackets represent the percentages

There is marked differences in the competitive strategies adopted by firms in the technology and industry clusters. Process innovations are the major type of competitive strategy that the

firms in the technology cluster adopt whereas the firms in the industry cluster use productivity improvements for gaining competitive edge. Product differentiation is used by firms in both the clusters. 46.15% of firms in the technology cluster employ productivity improvement measures. Cost cutting and managerial improvements are not dominant type of competitive strategies in this cluster. In the industry cluster, 31.25% adopt process innovations strategy, 29.69% cost cutting and 28.13% managerial improvements.

Table 3.2.6 Technological Problem solving methods

Methods used	Technology Cluster	Industry Cluster
In house arrangements	**22(84.61)**	**39(60.93)**
Hire external experts	**5(19.23)**	**5(7.81)**
Buy technology	**1(3.84)**	**7(10.93)**
Contractual outsourcing	**0**	**7(10.93)**
Business Collaboration	**1(3.84)**	**7(10.93)**

Source: Calculated by the researcher from the data collected
Note : Figures in the brackets represent the percentages

Technology is fast changing and continuous innovations are to be made to keep the technology up to date and also to sustain technological capability. In house arrangements are used to solve technological problems both in the technology and industry clusters. 84.61% of firms in the technology cluster and 60.93% of firms in the industry clusters use in house arrangements. 19.23% of firms in the technology cluster hire experts for technological problem solving whereas in the case of industry cluster a combination of business collaboration, contractual outsourcing and technology buying are employed.

Table 3.2.7 Outward Orientation

Exports/Cluster	Technological Cluster	Industrial Cluster	Total
Yes	**14(53.84)**	**27(42.18)**	**41(45.55)**
No	**12(46.15)**	**37(57.81)**	**49(54.44)**
Total	**26(100)**	**64(100)**	**90**

Source: Calculated by the researcher from the data collected
Note : Figures in the brackets represent the percentages

Outward orientation is expressed in this study as the percentage of firms having exports out of the total belonging to each cluster. 53.84% of firms in the technology cluster have exports whereas only 42.18% of firms in the industry cluster have exports. This clearly shows that

firms belonging to the technology cluster are more outward oriented than those in the other cluster.

Table 3.2.8 Export Intensity

Export Intensity (%)	Technology cluster	Industry Cluster	Total
<10	**3(11.54)**	**9(14.06)**	**12(13.33)**
11-20	**4(15.38)**	**6(9.37)**	**10(11.11)**
21-30	**0**	**3(4.68)**	**3(3.33)**
31-40	**1(3.85)**	**0**	**1(1.11)**
41-50	**0**	**0**	**0**
>50	**6(23.07)**	**9(14.06)**	**15(16.67)**
None	**12(46.15)**	**37(57.81)**	**49(54.44)**
Total	**26**	**64**	**90**

Source: Calculated by the researcher from the data collected
Note : Figures in the brackets represent the percentages

Export intensity is defined as the revenue from exports as percentage of sale turn over. 23.07% of firms in the technology cluster have export intensity more than 50%, 15.38% have 11-20% , 11.54% have less than 10% and 3.85% have 31-40% export intensities. In the industry cluster 14.06% have more than 50%, 14.06% have less than 10%, 9.37% have 11-20% and 4.68% have 21-30% export intensities.

The following table shows the age group wise export intensities in the two clusters. It is clear that the firms in the 1-3 & 4-7 age groups in the technology cluster are more export intensive than their older counterparts whereas the firms in the age group of 8-10 and more than 10 in the industry cluster are more export intensive.

Table 3.2.9 Age Group and export intensity of firms in the two Clusters

			Age group				
Cluster			**1-3**	**4-7**	**8-10**	**>10**	**Total**
Tech Cluster	**Percentage sales from exports**	**<10**	**1(33.3)**	**1(5.26)**	**1(33.3)**	**0**	**3**
		11-20	**0**	**3(15.79)**	**0**	**1(100)**	**4**
		31-40	**0**	**1(5.26)**	**0**	**0**	**1**
		>50	**1(33.3)**	**4(21.05)**	**1(33.3)**	**0**	**6**
		None	**1(33.3)**	**10(52.63)**	**1(33.3)**	**0**	**12**
	Total		**3**	**19**	**3**	**1**	**26**

Indus Cluster	**Percentage sales from exports**	**<10**	**1(5.26)**	**3(15)**	**1(14.28)**	**4(22.22)**	**9**
		11-20	**1(5.26)**	**3(15)**	**1(14.28)**	**1(5.55)**	**6**
		21-30	**0**	**1(5)**	**0**	**2(11.11)**	**3**
		>50	**2(10.52)**	**2(10)**	**3(42.86)**	**2(11.11)**	**9**
		None	**15(78.94)**	**11(55)**	**2(28.57)**	**9(50)**	**37**
	Total		**19**	**20**	**7**	**18**	**64**

Source: Calculated by the researcher from the data collected
Note : Figures in the brackets represent the percentages

Table 3.2.10 Research and Development intensity

R & D intensity (%)	Technology cluster	Industry Cluster	Total
0	**3(11.54)**	**40(62.5)**	**43(47.77)**
1	**2(7.69)**	**6(9.37)**	**8(8.88)**
2	**3(11.54)**	**4(6.25)**	**7(7.77)**
3	**0**	**2(3.13)**	**2(2.22)**
4	**0**	**1(1.56)**	**1(1.11)**
5	**3(11.54)**	**2(3.13)**	**5(5.55)**
>5	**15(57.69)**	**9(14.06)**	**24(26.66)**
Total	**26(100)**	**64(100)**	**90**

Source: Calculated by the researcher from the data collected
Note : Figures in the brackets represent the percentages

Research and development intensity is calculated as the research and development expenditure as percentage of sales turn over. 57.69% of firms in the technology cluster have more than 5% R& D intensity whereas 62.5% of firms belonging to the industry cluster do not have R&D expenditure. This clearly indicates that R & D intensity is high in the case of firms in the technology cluster.

Table 3.2.11 Number of Patents

Number of patents	Technology Cluster	Industry Cluster
1	**1(3.84)**	**5(7.81)**
2	**2(7.69)**	**4(6.25)**
3	**3(11.54)**	**0**
None	**21(80.76)**	**55(85.94)**
Total	**26(100)**	**64(100)**

Source: Calculated by the researcher from the data collected
Note : Figures in the brackets represent the percentages

11.54% of firms in the technology cluster have 3 patents, 7.69% have 2 patents and 3.84% have 1 patent. In the case of industry cluster, 7.81% have 1 patent and 6.25% have 2 patents. This gives an indication of the fact that the patents and R & D activity are correlated.

Table 3.2.12 Rate of growth in sales revenue in the last three years (Average)

Rate of Growth in sales revenue (%)	Technology cluster	Industry Cluster	Total
<10	**9(34.61)**	**14(21.87)**	**23(25.55)**
11-20	**9(34.61)**	**25(39.06)**	**34(37.77)**
21-30	**3(11.53)**	**14(21.87)**	**17(18.88)**
>30	**5(19.23)**	**11(17.18)**	**16(17.77)**
Total	**26(100)**	**64(100)**	**90**

Source: Calculated by the researcher from the data collected
Note : Figures in the brackets represent the percentages

34.61% of firms in the technology cluster have rate of growth in the sales revenue less than 10 and 11-20% , 19.23% have more than 30% and 11.53% have 21-30%. In the industry cluster, 39.06% have 11-20% growth rate, 21.87% have less than 10 and 21-30% growth rates in sales revenue.

The following section discusses the multiple regression analysis used in the study to understand the factors affecting the competitiveness of firms in the two clusters. This gives a general framework of examining the competitiveness of SMEs. The variables used in the model are identified from the literature review on firm growth and research and development activities.

4. Multiple Regression Analysis

A multiple regression analysis is used to find out the factors affecting the competitiveness of the firms in the study. Research and development intensity is taken as a measure of innovativeness which is used as a proxy for competitiveness of firms. The underlying assumption for such an analysis is that firms that are innovative should have greater potential for growth and are more competitive. The regression model used in the study is given in the following equation.

R and D intensity= f (size, age, export intensity, number of patents, nature of clusters, foreign equity participation, market share)

Table 4.1 Definitions and measurement of variables used in the study

Sl. No	Name of the variable	Measurement
1	Size of the firm	Number of employees
2	Age of the firm	One added to the difference between the year of establishment and the year of study
3	R& D intensity	Expenditure on R & D as percentage of sales turn over
4	Export intensity	Revenue from exports as percentage of sales turn over
5	Number of patents	Numbers are given by the respondents
6	Nature of clusters	Dummy variable 0 for industry cluster and 1 for technology cluster
7	Foreign equity participation	Dummy variable 0 for no foreign equity and 1 for foreign equity participation
8	Market share	Market share is taken as a scale variable on a scale of 0-5

Table 4.2 Result of the regression analysis for R & D as explained variable

Sl. No	Variable	Symbols	Coefficient estimates
1	Constant		4.855 (3.652)a
2	size	Size	-.225 (-1.259)c
3	Age	Age	-.071 (-1.679)c
4	Dummy for cluster	Dclus	2.821 (4.992)a
5	Percentage sales from exports	EXint	-.061 (-.629)
6	Number of patents	NUpat	-.708 (-2.718)b
7	Dummy for foreign equity participation	DFoc	-1.607 (-1.459)c
8	Market share	MKTs	.423 (2.459)b
Model Summary	**R**- 0.648, **R Square**- 0.420 **Adj. R Square**- 0.369 **Std. error of the estimate**- 2.077		
Values in the brackets are t-statistics for the coefficient estimates. a,b,c 1 percent, 5 percent and 10 percent significance level respectively			

In the model, size of the firms has a negative and statistically significant coefficient. Market share has both positive and statistically significant coefficient. This implies that firms with more market share are investing more in research and development. Number of patents shows a negative and significant coefficient. Age of the firm has negative and statistically significant coefficient. This means that research and development activity is not dependent on the experience of the firms.

Nature of clusters comes out as a significant variable affecting research and development intensity. The dummy variable for clusters is positive and highly significant. Firms in the technology cluster are more technologically active and R and D intensive compared to firms in the industry cluster.

Export intensity did not emerge significant, and therefore cannot be interpreted meaningfully. Market share shows positive and statistically significant coefficient. It may be interpreted that firm having a large market share are investing more in research and development and are more competitive.

5. Summary and Conclusions

The present study analyses the economics of cluster based SME development strategy and a comparison of industry and technology clusters in India. The literature review suggests that clustering gives lots of competitive advantages to the firms. Of the various advantages, the most important one is that clustering fosters innovative activities and technological advancements. In the study, an attempt has been made to bring forth inter-cluster differences, if any, between industry and technology clusters. The following are the major findings of the study from cross tabulation and regression analysis.

1. The dominant nature of organisation of firms in the technology cluster is private limited whereas that of industry cluster is an almost equal spread between private limited and partnership types.

2. The average age of firms in the technology cluster is 5.65 years and that of industry cluster is 7.89. This shows that the comparative age of firms in the technology cluster is low.

3. In the case of technology clusters, oligopoly is the major type of competition whereas in the case of industry clusters, free competition is the dominant market type. Nature of competition faced by the firms has very important impact on the profitability as well as the competitive strategy that they adopt. In the case of industry cluster, freedom of entry and exit of firms are very high compared to technology clusters.

4. Technology and industry clusters differ in terms of the type of competitors that they confront in the market. Firms belonging to the technology clusters face competition mainly from established foreign firms, whereas firms in the industry clusters face competition mainly from established local firms

5. There is marked differences in the competitive strategies adopted by firms in the technology and industry clusters. Process innovations are the major type of competitive strategy that the firms in the technology cluster adopt whereas the firms in the industry cluster use productivity improvements for gaining competitive edge.

6. It is clear that the firms in the 1-3 & 4-7 age groups in the technology cluster are more export intensive than their older counterparts whereas the firms in the 8-10 and more than 10 age group in the industry cluster are more export intensive.

7. R & D intensity is high in the case of firms in the technology cluster vis a vis their counterparts in the industry cluster. Number of patents is more in the case of technology cluster compared to industry cluster.

8. In the multiple regression analysis, age, size, foreign equity participation, dummy for cluster, market share and the number of patents emerge as significant variables in explaining the innovative activities and competitiveness of firms. Among the factors affecting the research and development activities of firms, nature of cluster and market share emerge as the most significant ones in this study.

The paper has important policy implications in the form of highlighting the need to distinguish the support provided to firms in different clusters. Firms in the technology cluster require more support and encouragement for innovative activities, whereas those in the

industry clusters may still be looking forward to better infrastructure, including marketing facilities. The need to support product innovations in the industry based cluster is also well highlighted by the results.

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