CHAPTER - 1

INTRODUCTION

1.1 INTRODUCTION

This thesis (Ph.D. project) is an investigation of industrial clusters in India, which are generally seen as part of both, the Small Scale Industry (SSI) sector and the Small and Medium Enterprises (SME) sector. Specifically, this thesis deals with exploring technological change and innovation in industrial clusters and the way in which technological capabilities are evolved at the level of firms and clusters. Going beyond the technology and innovation related concerns, the objective of the project is also to relate these concerns to the notion of development. This Ph.D. project is based on two case studies of industrial clusters, namely, the Metal Art-ware cluster in Moradabad, U.P. and the Textile cluster in Panipat, Haryana.

The basic focus of the thesis emerges from the assumption that the industrial clusters in developing countries, such as India, are unlikely to compete in the current era of liberalization and globalization only on the strength of the comparative cost advantage that is based on natural resource endowment, cheap labour and incidental external economies of clustering (Marshall 1962). What seems appropriate to assume that value addition through technological change and innovation is critical for their long term competitiveness and sustainability, among other cluster related factors?

This insight on the broad perspective, that clustering can further competitiveness and growth through innovation, comes from the influential writings on industrial clusters in the last two decades or so. Michael Porter (1990, 1998) showed that the competitive advantage of nations like United States of America is, in a large measure, emanating from regional and local innovation based in clusters. Literature on Industrial Districts, inspired mainly by the striking performance of industrial clusters of Third Italy, also shows how flexible specialization, termed as a strategy of permanent innovation, (Piore and Sabel 1984) is responsible for huge success and competitiveness of these clusters, known as Industrial Districts (IDs). More than a decade later, Schmitz and Nadvi (1999) resonated similar optimism on industrial clusters, in the context
of developing countries. In the special issue on ‘Clustering and Industrialization’ in the most prestigious journal ‘World Development’ they put together research studies on industrial clusters in the developing countries to examine the ability of industrial clusters to overcome growth constraints and compete in the distant markets. Schmitz and Nadvi (ibid) draw our attention to the need to go beyond the Marshallian insights touching upon external economies in the context of clusters. More specifically, relevant to present thesis, Bell and Albu (1999) advocate that research on clusters need to give explicit attention to technological dynamism and features of knowledge system underlying the dynamism of the clusters. To understand the way in which the knowledge institutions can be networked to meet the technology related needs of this cluster is of critical significance.

Several developments in recent years have reinstated role of entrepreneur in making small and medium enterprises the seedbed of innovation. Likewise research in firm theory as well as industrial clusters has highlighted the significance of the role of entrepreneur in creating and interacting with innovative networks.

From the analytical point of view it is important to recognize that the endogenous features of the cluster, such as the nature of intra-cluster networks and the features of the knowledge system of the cluster, they are not adequate to explain their dynamism in the new context of globalization. Recent literature on clusters in developing as well developed country clusters has made it amply clear that at least two more dimensions: nature of markets in which the clusters are operating; and the macro economic policy environment, have to be added to the discourse on clusters for understanding the dynamics of their functioning. It is becoming increasingly clear that the technological dynamism of clusters can not be explained without explicit reference to the nature and extent of demand pull exerted by markets. Voluminous literature on value chain analysis, in last fifteen years or so, has provided valuable insights on how integration into global value chains (GVCs) can affect the prospects of upgradation of clusters in the developing countries.

 Though most of the Indian industrial clusters dealing in the traditional product range, like Metal Art-ware cluster of Moradabad and textile cluster of Panipat, are traveling on the ‘low road’, rather than ‘high road’ of flexible specialization, technological dimensions are

---

1 World Development 27(9), 1999.
2 The low road syndrome refers to cases where clusters produce poor quality products with the help of stagnant technology and survive on the strength of low labour cost. High road syndrome, describing the industrial clusters
likely to play a significant role in their functional dynamics in the new context of liberalization and globalization. Therefore, the centuries old Marshallian agglomeration economies research needs major refurbishing to reflect the reality about these clusters in the present context. One general finding emerging clearly in the light of the empirical research (presented in Chapter 7 – Summary and Conclusions) is that the growth and dynamism in these clusters are not driven by the factors of technological change, innovation and related features. At the same time it can not be inferred that the functional dynamics in these clusters is reminiscent of the era of the 1960s and 1970s. It can be said tat the above factors are not playing a very significant role. It is realistic to argue that the clusters of the kind studied here (operating in traditional product range and with considerable export intensity) are going through a phase in which there is considerable degree of awareness with regard to need for technological knowledge and knowledge based infrastructure. In the present context, it is in this sphere that state intervention by both, local and central government agencies, is going to play a crucial role.

The section 1.2 of this chapter spells out the main objectives, scope and choice of two clusters selected in this study in the light of these initial remarks. The organization of this introductory chapter is as follows

- Main objectives, Scope and choice of two clusters
- Gaps in literature and significance of the present study
- Small scale Industry and Industrial clusters in India
- Industrial Clusters and globalization
- Changing policy scenario on Industrial Clusters
- Organization of the thesis: brief description of chapters

1.2 MAIN OBJECTIVES, SCOPE AND CHOICE OF TWO CLUSTERS

The important objective of this Ph.D. project was to be able to get some insights in the theoretical basis of dynamics of change these clusters which will be helpful in formulation of a policy framework for clusters in India. Special focus is on gaining insights for a comprehensive and holistic policy framework which will be aimed at stimulating innovation based growth and upgradation of the industrial clusters belonging to the traditional sectors, so that the small cities in developing countries, refers to cases where dynamism is promoted through innovation and efficiency enhancement. (Pyke and Sengenberger 1992). A survey of large number of industrial clusters in developing countries by Nadvi and Schmitz (1998) and Schmitz and Nadvi (1999), concluded that most of these clusters carry ‘low road’ characteristics.
and regions in which these clusters are located, can be turned into centers of balanced, equitable and sustainable development.

A major objective of the study was to review literature to develop a comprehensive conceptual and analytical framework for understanding the process of technological change and the underlying factors and processes responsible for change (or lack of change), which will be useful for studying the clusters located in the developing countries. The exercise is also meant to devise relevant hypothesis for the empirical research.

The second objective of the study is to formulate certain key issues emanating from the theoretical framework and hypotheses.

Some of the key issues concerning the nature and extent of innovation and technological change which are dealt with in this project are:

- How are these clusters surviving in the face of the heightened global competition? Have they experienced upgradation through innovation and technological change in the cluster or do they depend exclusively on low labour cost for their competitive advantage?

- What forms of changes are taking place in them; technological, organizational or market innovation? Are the changes radical or incremental? Are there significant changes in process technologies?

The key questions related to dynamics of change explored in this project are:

- Are the changes taking place in the clusters market driven, policy driven or technology driven?
- What are the main factors contributing towards technological learning and technological change?
- Are the sources of technological learning indigenous to the firms/cluster or are they exogenous?
- What are the various social and economic networks in the clusters and in what manner do they help in innovation and technological change?
- What is the general state of the technological/physical infrastructure? Are there any knowledge, financial and other institutions facilitating the process of change? Are these institutions privately run by industry trade associations - or are they public institutions?
What is the role of government in the cluster's technological change? What are the relative roles of central, state and local governments in this respect?

The third set of questions explored in this Ph.D. project relates to some key issues relating to sustainable development. They are:

- What impact does the technological change have on labour process, wage rate and employment? What is the bearing on the quantity and quality of employment generated in these clusters? Is it the low road flexible specialization syndrome?
- How does it impact on its environment?

**Scope of the Study**

Focus of this study is big industrial clusters\(^3\), belonging to traditional manufacturing sectors, which are located in non-metro cities and which have high export intensity.

Since most of the output and employment in the traditional industry is carried out in the SME clusters, for understanding the technological dynamism of SSI units in this particular segment, a cluster rather than a one single unit is a more meaningful unit. In recent years a large volume of theoretical literature in innovation studies has forcefully demonstrated that innovation is an interactive process, best studied in a network framework. To the extent that an industrial cluster is an economic and social network, it is an eminently suitable unit for understanding the process of innovation and technological change.

Since a large number of cluster development programmes have already been initiated and many are at the verge of being started, from the view point of policy making, it is worthwhile to learn about the functional dynamics of industrial clusters and explore whether, when and how clustering offers a special advantage with respect to innovative activity in the developing country clusters, and if so what form of government intervention is most suitable for promoting an innovation based sustainable development of these clusters.

There is an attempt made to go beyond the descriptive categories and develop tools; concepts and analytical framework, which can be used for understanding innovation and technological change in other industrial clusters of SSI units belonging to traditional sectors. An attempt is also made to bring to fore some policy insights emerging from the two case studies

\(^3\) Big clusters are those clusters whose annual turnover is more than Rs. 1000 crores.
which will be relevant for stimulating innovation based growth and upgradation in other industrial clusters belonging to the traditional sectors in India and in other developing countries. The inferences drawn from two case studies shed some light on some important policy related question such as: Do the clusters located in non-metro cities, and specializing in single product require specialized physical, educational and technological infrastructure? Do they require strong regional systems of innovation? In what way can innovation in these clusters be facilitated by local/regional governments? What is the relevance of the sectoral system of innovation for them? These inferences can provide significant guidelines for the formulation of comprehensive cluster based policy identification and prioritization of promotional policies for stimulating innovation based development of these cluster.

Choice of Clusters for Two Case Studies

The two clusters selected for this project are representative of a large number of big clusters, operating in the traditional manufacturing sectors with high potential for exports (See Table 1.3). These two clusters, like several other big clusters such as Knitwear cluster in Tirupur, fireworks cluster in Sivakasi, Surat diamond polishing cluster are the single most important source of employment for lakhs of persons living in and around the city and are the economic life line of the cities in which they are located. Their modernization and technological upgradation is crucial for improving the quality of employment and quality of life for lakhs of workers in the region.

Almost all the big clusters are producing either exclusively or predominantly for the export sector and are exposed to acute global competition. The contribution of traditional sector clusters in total exports is much higher than suggested by their numbers. Of the 13 big clusters belonging to the traditional sectors, all are producing at least partially for the export markets. As many as nine of them are placed in the category of high export potential, while four of them appear in the category of medium export potential. Some of the most important export items in India are produced in these clusters. In the case of one the most important export items; diamond polishing, almost the entire activity takes place in a single cluster; Surat diamond polishing cluster. The cluster which started exporting only in 1965, today exports goods worth Rs. 60,000 crores. Similarly, a significant part of export items in the Textiles and Clothing sector are manufactured in several big industrial clusters. Failure of these clusters to remain

---

4 Economic Times May 29, 2005.
competitive in the global market can have serious implications not only for the regions in which they are located, but for the macro economic stability of the country’s economy.

Selection of the clusters in small cities around Delhi was guided by two different considerations. From the academic point of view research on these small city clusters presented an exciting possibility of comparing the role of general agglomeration economies/diseconomies which the metro and mega cities experience with the sector specific economies present in these small cities. Research on these clusters was expected to throw light on the role of the regional systems of innovation and to assess how important it is for the local/regional governments to provide/facilitate specialized physical, educational and technological infrastructure.

Secondly, since these clusters are located within a manageable distance of 200 Km from New Delhi, the place from where the Ph.D. project is undertaken, from the logistics point of view these two were the most suitable clusters.

1.3 GAPS IN LITERATURE AND SIGNIFICANCE OF THE PRESENT STUDY

The moot question for the scholars and policy makers in the developing countries like India is, can the clusters of SMEs in their countries be associated with the technological dynamism and innovativeness, which is characteristically associated with the stylized form of industrial clusters in the European countries? Do they possess a latent potential, which, if exploited, can trigger off a process of innovation and technological change, turning them into centres of fast growth and sustainable development? There are serious knowledge gaps in this area. Existing literature has limited information about the dynamics of innovation and technological change in developing country clusters. Hardly any of the case studies on the developing country clusters, are exclusively devoted to the technology question, Some of the significant cluster studies identified by Albu (1997) and Bell and Albu (1999), which are discussing the technology question explicitly and at some length are: Cawthorne’s study (1990) of Tirpur knitwear cluster, Nadvi’s study of Surgical Instruments cluster of Sialkot, Sandee’s Roof Tiles cluster in Indonesia (1995), Rabellotti’s study (1995a) of Footwear cluster in Mexico and Visser’s (1999) study of Lima Garment cluster in Argentina.

These studies have little in common in terms of the conceptual and analytical frameworks and the methodology used by them. For example, Cawthorne’s study of the Tirupur

---

5 The study of Handloom and Conch Shell clusters in west Bengal by Biswas (2005) is an exception. Technological change occupies central place in this study.
knitwear cluster equates technological change with use of capital goods. Sandee's study of roof tiles cluster in Indonesia, on the other hand, pays considerable attention to the process of change and diffusion. Rabellotti attributes poor technological performance in the Mexican shoe cluster to absence of capital good industry in the cluster. Nadvi's study (1996) of surgical instruments cluster in Pakistan emphasizes the role of external sources of technology such as foreign buyers. Apart from these case studies several others like Schmitz's (1995) study of Sinon Valley Foot Wear Cluster in Brazil, Meyer Stamer's (1998) study of three Brazilian clusters in Santa Catarina, have implicit description about the dynamics of changes in products processes and organizational structures in these clusters. Nadvi's (1995) study discusses important networks and institutions which have contributed in the technological dynamism of some of the most dynamic developing country clusters.

By piecing together the evidence from various case studies, we find general lack of significant technological dynamism in majority of the developing country clusters (See Das 1995). In a survey of literature on developing country clusters, Nadvi and Schmidz (1998) observe that most of the third world clusters follow 'low-road' of flexible specialization, based on low labour cost, rather than 'high-road' of flexible specialization based on perpetual innovation, and technological change, as is the case with clusters in developing countries\(^6\). This raises serious doubts about the relevance of the model/framework used in the context of developed countries. It also strongly underlines the need for developing an analytical framework to understand the dynamics of change in the clusters located in the developing countries. Theoretical research in this respect is at a nascent stage. Bell and Albu's (1999) paper, which provides a review of existing case studies as well as a comprehensive theoretical perspective on technological learning and technological capabilities is a significant landmark in this direction.\(^7\) Paper by Knorringa and Meyer Stamer (1998) can be seen as an important step in this direction, as it discusses at length the factors which place limits to technological dynamism in non-Italianate type of clusters.

Though India has a long history of existence of industrial clusters, the serious research on industrial clusters in India is a recent phenomenon and is in a nascent stage. Research on industrial clusters is one of the areas in the study of Indian industry which has received scant

\(^6\) They found that none of the cluster in Asia (including the most dynamic Indian clusters such as Tirupur and Ludhiana knitwear clusters), except one; Daegu textile cluster in South Korea had high technology standards.

\(^7\) This Ph.D. project has borrowed extensively from the conceptual and analytical framework provided by Bell and Albu.
attention from scholars. A few case studies on Indian industrial clusters which are available, have paid very little or residual attention to the crucial importance of technical change and innovation. Very few studies have analyzed technology related issues of Indian clusters in a comprehensive manner. Most of the case studies on Indian clusters fail to give a clear account of either the level of technological upgradation or about the process of innovation in the clusters. The marginal reference that is made to the question of technology suggests negligible innovation and technological upgradation taking place in most of them. But most of the case studies don’t go into detailed analysis of reasons for lack of technological dynamism in these clusters.

Moreover, the evidence emerging from empirical research is very patchy. One possible reason for this is that the academic research on industrial clusters in India, as in several other countries, is inspired by the Industrial Districts/Flexible Specialization (ID/FS) model. It is perhaps for this reason that three successful Indian clusters, often referred to as Indian IDs in the making: Bangalore Electrical Goods cluster, Tirupur Knitwear cluster and Ludhiana Hosiery cluster have received disproportionately high share of attention. Prima facie, there is reason to believe that they are not highly representative cases for Indian clusters⁸. The Bangalore Electronics and Engineering Goods cluster is technologically one of the most dynamic SME clusters in the country.

Tirupur knitwear cluster, the cluster which has attracted more attention than any other Indian cluster in India, is one of the most dynamic among Indian clusters⁹. Though the initial study by Cawthrone (1995) reports absence of technical dynamism in subsequent studies have reported considerable level of innovation and technological change in the cluster¹⁰. High level of technological dynamism of the Hosiery cluster of Ludhiana can be attributed to specific historical reasons (Tewari 1996, 1998).

---

⁸ All the three clusters bear the label of H(high) potential for technological upgradation.
⁹ Though the cluster, located in the Coimbatore district of Tamil Nadu (TN), has been in existence for more than several decades, it shot in prominence only in the post reform period, when it emerged as one of the fastest growing export centres in the country. Today the cluster exports goods worth more than Rs.5000 crores per annum.⁹
¹⁰ The earlier UNIDO data base placed the cluster in the medium category of technological up gradation. However the subsequent studies have reported considerable level of innovation and technological change in the cluster See Nadvi 1995, Gulati 1997, Swaminathan et al. 1999, Express Textiles, October 24, 2002, Front Line November 19, 2004. Updated UNIDO database has now placed it in the H category ; the cluster with high potential for technological upgradation.
Several other case studies on Indian clusters, such as Knorringa’s study of the Foot-wear cluster in Agra (Knorringa 1998, 1999, 2005), Das’s (1996) study of Ready Made Garments cluster in Ahmedabad, and the Flooring Tile cluster in Morbi, Gujarat (1999) discuss at length the dynamics of market driven changes in product technologies.

One study that stands out in terms of significance it attaches to the process of technological change is Biswas’s (2005) study of Handloom and Conch Shell clusters in West Bengal. The study discusses various factors involved in the process of adoption of new process technologies in a cluster with pre-capitalist production organization. While bringing out the possibility of technological change in the handloom cluster, it highlights the role of merchants in promoting modern technology.

On the whole there is paucity of empirical research on developing countries’ clusters in general research and Indian clusters in particular about dynamics of technological change.

Not only is there a paucity of research about dynamics of technological change in Indian clusters, innovative activity of the Small Scale Industry (SSI) sector in India, which can be of some help, albeit indirect, in understanding the process of innovation and technological change in SME clusters, is also a fairly neglected area of research. The handful of studies, which are done in this area, concentrate mainly on the question of technical efficiency of the SSI sector vis-à-vis the Large Scale Industry (LSI) at a point of time rather than the process of technological change of the SSI units. The general impression created by some of these few studies is that by and large the SSI sector has low technical efficiency. Secondly there are not very many sectoral studies to assess the difference in technological dynamism that exists in the SSI units in different sector.

---

11 Though there are a few studies which dispel the general impression about the SSI sector by finding some positive evidence of presence of innovative activity in SSI units they are confined to one region in the country SSI units in Karnataka. They include Ramasastry and Krishnaswami (1979) study of 20 small firms in the engineering sector found them to be innovative though there was little evidence of R&D undertaken by them. Bala Subrahmaniya et al. (2002) study of 206 Karnataka SSI units reports 49% introducing technological innovation. A DST (Department of Science & Technology) study about SSI units in Karnataka reports, among other things, that 70% of units do undertake R&D activities. Few other states can boast of such conditions. Secondly, majority of the units included in these studies are located in Bangalore, which is the most important hub of technology in the country and provides a technological infrastructure which is arguably the best in the country. As a result the evidence provided by these studies can not be used to draw general inference about the SSI sector in India.
Relevance of Preset Study

Given their large number and strategic importance for employment and exports, the field of industrial clusters in India deserves much more attention from scholars than it has received so far. More specifically, there is a compelling need for in-depth case studies which are dedicated to the understanding of the process of technological change in developing country clusters. Industrial clusters in India are spread over the length and breadth of the country and belong to a very wide sectoral spectrum, ranging from handlooms to IT and Bio technology. Since each region offers its unique set of opportunities and challenges, and since each sector has its own dynamics of change, a large number of case studies of clusters belonging to different sectors and located in different regions can add to our understanding of a clear theoretical perspective which is capable of accommodating these differences. Present project, which provides a detailed case study of two Indian clusters, does expect to contribute in a large measure towards the understanding of clusters in India.

Secondly, though it has been recognized that the stylized FS/ID model can’t be very useful in the understanding of clusters in the developing countries, there is no alternative theoretical framework for understanding the dynamics of change in these clusters. There is compelling need for developing a theoretical framework which can accommodate the specific characteristics/conditions of the clusters located in developing countries, as different from clusters in the developed countries. It is expected that the present project serves as a step in that direction.

Thirdly, not only is the exercise of understanding the theoretical basis of dynamics of change in these clusters; the patterns of their growth/decay, and their up-gradation/stagnation processes, as important dimensions for policy implications. Though there are already several cluster based policy initiatives already launched by the various government agencies, most of them are still groping for the identification of the most important areas of intervention and for most effective ways of intervening. The relevance of the present study also lies in the fact that it tries to identify and prioritize the relevant areas where government intervention is needed.

\[\text{For example, SICDP which provided ‘soft’ assistance till recently, is seriously considering of providing much more ‘hard’ in the form of hardware and equipment necessary for technology improvement, standardization and testing. See}\]
1.4 SMALL SCALE INDUSTRY AND INDUSTRIAL CLUSTERS IN INDIA

A very significant part of the small scale industrial units in India are located in a very large number of SME industrial clusters, and artisanal clusters, spread all over the country. In order to understand the significance of the process of innovation and technological change in industrial clusters in India, it is important to have an idea about their contribution in the economy, and to be familiar with what ever facts are known about the existing state of technology prevailing in them. Secondly, since there is a considerable overlap between the SSI/SME sector\(^\text{13}\) and the industrial clusters in India, it is important to see the crucial role that the SSI sector plays in the Indian economy.

Small Scale Industry: Some Facts

Small Scale Industry (SSI) has been an important plank of India’s development strategy since independence. Right from the beginning of the planning process SSI and village industry were seen as important instruments in serving the objective of equitable growth. Perceived labour intensity of the SSI vis-à-vis LSI made the sector a favorite instrument for planners for achieving the objective of full employment. The sector is also expected to promote several other objectives like promotion of environmentally sustainable development through utilization of local materials and local skills, environmentally sustainable development. More importantly, SSI also plays the important role of the spatial integration and reducing inter-regional inequalities, inequalities between rural and urban spaces, and between small towns and mega cities. Not all hopes bestowed in the SSI sector have been fulfilled over time. But undoubtedly it has been playing increasingly important role in the Indian economy. This can be seen with the help of Table 1.1, which provides some quantitative dimension of the role played by the SSI sector in India.

In 2001-02 the sector accounted for 95% of all industrial units and 39.07% of value added in the manufacturing sector. Its contribution to exports was Rs.69790 crore, which has gone up to Rs.967.4 crores in 2002-03 (See Table 1.1). The share of the SSI sector in exports, which was negligible till early 1970s, and just10% in mid 1970s has grown at an impressive rate to become 34.75%in 20001-2002. The sector contributed 6.29% of the GDP. It provided

\(^{13}\) For policy purposes the SSI unit is defined on the basis of investment in plant and machinery. Till recently the limit for small unit engaged in manufacturing or production of goods was rupees one crore and for a tiny unit it was rupees twenty five lakhs. Micro Small and Medium Enterprises Development Act 2006 has raised the investment limit for SSI units to Rs. 5 crores. The manufacturing enterprises with investment more than Rs.5 crores, but not exceeding Rs.10 crores now fall under the category of medium enterprises.
employment to 19.2 millions in 2001-2002. Total employment created in the SSI sector was 28.3 millions in 2004-05. As such, SSI is the most important provider of employment in India after agriculture. Number of jobs created in the SSI sector far exceeds that of the LSI sector. More significantly, the growth rate of output in the SSI sector has been higher than that of the LSI sector in the last decade.¹⁴

**TABLE 1.1 - Performance of SSI Sector in India**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Year</th>
<th>Total SSI units (lakhs)</th>
<th>Fixed Investment (Rs. Crore)</th>
<th>Production (Rs crore)</th>
<th>Employment (lakh persons)</th>
<th>Exports (Rs. crore)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Current Prices</td>
<td>Constant Prices (1993-94)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1990-91</td>
<td>67.87</td>
<td>93555</td>
<td>78802</td>
<td>84728</td>
<td>158.34</td>
</tr>
<tr>
<td>2</td>
<td>1991-92</td>
<td>70.63</td>
<td>100351</td>
<td>80615</td>
<td>87355</td>
<td>165.99</td>
</tr>
<tr>
<td>3</td>
<td>1992-93</td>
<td>73.51</td>
<td>109623</td>
<td>84413</td>
<td>92246</td>
<td>174.84</td>
</tr>
<tr>
<td>4</td>
<td>1993-94</td>
<td>76.49</td>
<td>115795</td>
<td>98796</td>
<td>98796</td>
<td>182.64</td>
</tr>
<tr>
<td>5</td>
<td>1994-95</td>
<td>79.60</td>
<td>123790</td>
<td>122154</td>
<td>108774</td>
<td>191.40</td>
</tr>
<tr>
<td>6</td>
<td>1995-96</td>
<td>82.84</td>
<td>125750</td>
<td>147712</td>
<td>121175</td>
<td>197.93</td>
</tr>
<tr>
<td>7</td>
<td>1996-97</td>
<td>86.21</td>
<td>130560</td>
<td>167805</td>
<td>134892</td>
<td>205.86</td>
</tr>
<tr>
<td>8</td>
<td>1997-98</td>
<td>89.71</td>
<td>133242</td>
<td>187217</td>
<td>146262.9</td>
<td>213.16</td>
</tr>
<tr>
<td>9</td>
<td>1998-99</td>
<td>93.36</td>
<td>135482</td>
<td>210454</td>
<td>157525.1</td>
<td>220.55</td>
</tr>
<tr>
<td>10</td>
<td>1999-00</td>
<td>97.15</td>
<td>139982</td>
<td>233760</td>
<td>170379.2</td>
<td>229.10</td>
</tr>
<tr>
<td>11</td>
<td>2000-01</td>
<td>101.1</td>
<td>146845</td>
<td>261297</td>
<td>184401.4</td>
<td>238.73</td>
</tr>
<tr>
<td>12</td>
<td>2001-02</td>
<td>105.21</td>
<td>154349</td>
<td>282270</td>
<td>195613</td>
<td>249.33</td>
</tr>
<tr>
<td>13</td>
<td>2002-03</td>
<td>109.49</td>
<td>162317</td>
<td>311952</td>
<td>210636</td>
<td>260.21</td>
</tr>
<tr>
<td>14</td>
<td>2003-04</td>
<td>113.95</td>
<td>170219</td>
<td>357733</td>
<td>228730</td>
<td>271.42</td>
</tr>
<tr>
<td>15</td>
<td>2004-05</td>
<td>118.59</td>
<td>178699</td>
<td>418263</td>
<td>251511</td>
<td>282.57</td>
</tr>
</tbody>
</table>


Though the SSI sector has grown at an impressive rate, lack of emphasis on innovation and upgradation has lent it some worrying features. One concern about the SSI sector in India is

¹⁴ This fact is contested by Mohan (2001). According to Mohan (2001:36), if we go by the NAS (National Accounts Statistics) data, the performance of the sector would look much less impressive than suggested by SIDO data. While the SIDO data-base suggests over 10% rate of growth in value added in the SSI during 1980s and 1990s, NAS¹⁴ data shows the growth rate of the factory sector SSI to be just 6% during the period. The rate of growth of LSI at over 10% is thus 1.5 times that of the SSI. According to Mohan the deficiency in SIDO data perhaps comes from the fact that it arrives at the figure for growth rate without accounting for the mortality of the previously counted units. This contention is supported by the huge discrepancy in the number of SSI units reported in the sample survey and the Third All India Census of Small Scale Industries, both conducted by SIDO. While in the TAICSSI data number of registered SSI units is shown to be 2.30millions by the sample data shows it to be 2.67 millions. So there is reasonable ground to believe that SIDO data could be inflated. More significantly, the evidence suggests slowing down of growth rates of output as well as employment generation in the sector in the post reform period.
the quality of employment provided by the sector. Workers in most of the SSI units in the traditional sectors work in highly degraded working conditions. It is well documented that most of the employment generated in the sector is informal and casual, with no job security or any other protection of labour laws. The sector has evidence of exploitation of not only adult labour, but also child labour. The real wage in the informal sector is about half of that in the formal sector. The sector has failed to provide decent work to the majority of its workers.

Secondly, though there has been fast rate of growth of exports from the SSI sector, particularly, in the post reform period, the structure of Indian exports has remained stagnant since 1980s. Most of India's exports continue to come from labour intensive, resource based industries, requiring low levels of technology, such as textiles and clothing, footwear sports goods etc. A very substantial part of these exports comes from SSI units. If India wants to increase its share in the growing world trade in value terms the exporting units of the SSI sector must move up the value chain.

Performance of SSI in the Post Reform Period

Though the protective policies of the pre reform period have made it possible for India to create a very broad industrial base, the competitiveness of the sector is by no means assured in the changing global scenario. One important reason for this is lack of emphasis on innovation and technological change is that science and technology policies in the post-independence period did not focus on innovation policy, particularly in the manufacturing sector which should have been the biggest beneficiary of such an innovation policy. While some sectors such as steel, fertilizes and drugs and pharmaceuticals had inputs from S&T system, SSI sector did not draw the attention it deserved. The result is, as Tyabji (2000:6) puts it, 'India has learnt to do things, but it has not learned to do things better'.

Major shift in the economic policy paradigm since 1991 in the Indian economy has rekindled the debate about long term competitiveness of the manufacturing sector in general and the SSI sector in particular. Small-scale industry (SSI) is considered by many scholars to be a

---

15 For a list of references and papers describing working conditions in SSI units in the informal sector in various industries see Kashyap (1988), Sharma et al. (2005), Kurian (2005), Kantor et al. (2006), Neera Burra (1995) book on child Labour in various sectors dominated by SSI units in the unorganized sector provides a graphic picture of the appalling working conditions prevailing in traditional sector clusters like Aligarh (Locks), Khurja (Pottery), Moradabad (Brassware), Firozabad (Glass bangles) etc.

16 For detail on the structure of Indian exports see Mohan (2001).

17 In addition to protective trade policy, the government has had a whole range of promotional policies and programmes to promote and accelerate industrialization in India in the post independence period. This is particularly true of the SSI sector.
relic from the past, waiting to be swept away by the process of modernization associated with capitalist developments, which are taking place at an accelerated pace in the post reform period.

Manufacturing, the sector of the economy which is affected most by the adoption of the outward looking export promotion policy in place of inward looking industrial policy, has not shown any clear cut trends in the post reform period. The rate of growth of the sector came down in 1990s, as compared to 1980s, which is considered as a decade of mild reforms. The rate of growth of the industrial sector has picked up in post 2000 period, but the average rate is yet to touch the peak reached in eighties. More worrying is the fact that the employment elasticity of the manufacture sector has been going down consistently (Nagraj 2004, 2004a).

Also there is some evidence that that efficiency index of Indian manufacturing sector declined over the period 1991-1996. According to this study though there is some improvement since 1996, the efficiency index has not yet achieved the 1991 level. Even though it dose not necessarily suggest a fall in the technology levels of Indian industry in an absolute sense, it dose suggests a widening technological gap in many areas between India and the developed world. This is perhaps more true for the SSI segment of the Indian economy, minus a few high tech sectors. The general perception about the SSI sector in India is that it is less efficient vis-à-vis the large sector, and that it owes its survival either to the policy protection and support provided by the government. This is supported by various studies carried out in late 1980s and early 1990s.

Though the SSI sector continues to grow at an impressive rate in the post liberalization era, there is evidence that some of the momentum of the sector which was evident in 1980s has gone down in 1990s. The rate of growth of output in the sector has come down to 15.3% in 1990s, from 18.66% in 1980s. More significantly, the rate of growth of employment generated in the sector which was just 5.83% during the 80s has further come down to 4% in 1990s (Bala Subrahmanya 2004). The findings of the Third All India Census of the SSI conducted in the year 2001, are far from reassuring. The most worrying aspect of the information, provided by the third census of SSI in India is the evidence of closure of a very large number of SSI units in

---

18 For a detail account of impact of reforms on various aspects of industrialization such as productivity, employment, technology transfer etc. see various articles in Tendulkar et al. (2006).
the manufacturing sector in the post reform period\textsuperscript{21}. The evidence from the census is supported by the observations made about the SSI units in several sectors.\textsuperscript{22} Moreover, average employment per unit has come down from 6.49 to 4.6 even as per unit fixed investment has gone up from Rs.1.6 lakhs in the second census to Rs.7.11 lakhs in the third census (DC (SSI) 2004).

\textit{Industrial Cluster in India}

The defining feature of an industrial cluster is the geographical proximity of actors, engaged in the same value chain; the firms producing some or all stages of the end product, the suppliers of machinery and raw materials, the specialized service providers, including firms and institutions. An ‘Industrial cluster’ (IC) can be defined as a dense geographical concentration of firms and other institutions in a supply value chain serving the same end market. Industrial cluster broadly signifies any form of industrial organization, featuring a spatial concentration of numerous firms belonging to similar industrial branch or \textit{filiere} (Brusco 1992)\textsuperscript{23}.

As noted earlier, major boost to the idea that an industrial cluster; geographical concentration of industrial units, is an innovative organizational form, came from the seminal work of Porter (1990), in which he presented the idea of a cluster as a basis of global competitiveness of nations. According to Porter competitive advantage in global economies derives from a constellation of local factors which sustain the dynamism of leading firms.

The history of industrial clusters in India goes back to several centuries. Long before the emergence of large scale Fordist production, India used to be a producer and exporter of a large number of manufactured goods like textiles, leather goods, metal and glass works etc. Most of these goods were produced in the clusters of small workshops using crafts methods of

\textsuperscript{21}This is inferred from the Quick Estimates, Third Census of SSI in India. Though the percentage of the working units to total SE (Small Enterprises) units is roughly the same in the second and third census, there is indirect evidence that the mortality rate in the manufacturing sector may be much higher than that of the units in the service sector. While the percentage of the working units to all registered SSI units was 62.35\% as per TAICSSI (it was 62.65\% according to the second census), the share of manufacturing units to all units has come down sharply, from 96.24\% in 1988, (as per the second census) to 65.7\% in 2001 according to the third census. This implies a much higher mortality rate of the manufacturing units during this inter censual period as compared to the previous one. This can be treated as indirect evidence of growing mortality rate of the small units in the manufacturing sector.

\textsuperscript{22}Inability of footwear units in Agra to face global competition is brought out by Knorringa (1998). Coimbatore’s hand pump industry is seriously hurt by the competition from China (Pillai 2000). In a recent study (Krishna 2001) suggests that SSI units Plastics and toys sector has seen closure of a large number of units due to competition from China.

\textsuperscript{23}The term \textit{filiere} refers to channels of production and distribution, incorporating all the economic and technically inter-related operations, which feed goods directly or indirectly towards a similar end market.
production. Some of these clusters have been in existence for several centuries. Firozabad glass works cluster, for example, has had an uninterrupted history of nearly six centuries. Though over the time some of these clusters have decayed and disappeared, a large number of them have not only survived, but have grown. Several hundred new clusters have also emerged over time.

Today, there are more than 380 SME clusters and more than 2000 artisanal clusters spread all over the country. These industrial clusters are responsible for the bulk of output in the small-scale industry (SSI) in India and contribute very significantly to the country’s employment and exports (Table 1.2). UNIDO Cluster Development Programme, in which all the clusters of more than 100 registered small-scale units are (excluding household/micro units), manufacturing same or similar products are included, has identified 388 SME clusters, employing 7.5 million workers. As per the second estimate, based on the information collected through national census on small industries undertaken by the national Ministry of Small Scale Industry, there are 2,042 urban and rural industrial clusters, employing 4.39 million workers.

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>DC (SSI)</th>
<th>UNIDO</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Clusters</td>
<td>2042</td>
<td>388</td>
</tr>
<tr>
<td>No. of Units</td>
<td>1,535,357</td>
<td>490,000</td>
</tr>
<tr>
<td>Employment (No.)</td>
<td>4,392,256</td>
<td>7,500,000</td>
</tr>
<tr>
<td>Output (Rs. mn)</td>
<td>421,690.04</td>
<td>1,570,000.00</td>
</tr>
</tbody>
</table>

Source: UNIDO (2005), ‘Cluster Development in India: White Book’

Though 54% of these clusters produce goods reserved for the small-scale industry (SSI), most of them existed prior to the introduction of the reservation policy. Moreover, significant proportions of these clusters, 46% produce goods in the non-reserve category (Gulati 1997). As many as 164(45.4%) of the 358 clusters identified in the UNIDO focal point database have high export potential. Three of the fastest growing export sectors in the Indian economy, namely readymade garments, diamond polishing and IT services are all concentrated in various clusters.

Though some of the recently formed clusters belong to high tech industrial sectors like Information and Communication Technology service (ICT), bio technology and auto-parts etc., a large number of clusters belong to traditional sectors such as handicrafts, metal works and
textiles.\textsuperscript{24} Out of the estimated number of 358 urban clusters spotted by UNIDO, 131 are classified as traditional crafts' clusters. Most of them are dominated by labour intensive, low tech industry, which is the focus of this Ph.D. project. These clusters are mainly located in a large number of small towns and non-metro cities. The objective to understand the dynamics of change taking place in these clusters is likely to throw ample light on the SSI and SME sector as well.

\textit{State of Technology in Industrial Clusters in India}

Observation by Das (1995: 37), “there exists a dearth of studies focusing primarily on the whole gamut of issues on the 'actual mechanisms' involved in technology transfer, upgradation, product and process innovation and adoption in IDs of developing countries.” is particularly relevant in the case of industrial clusters in India. There is little systematic information about the technological aspects of the industrial clusters (ICs). Two important sources from where some inferences about the state of technology in Indian clusters can be drawn are; academic research on Indian industrial clusters\textsuperscript{25} carried out mostly since 1990s and the information emerging as a by-product of certain promotional programmes aimed at upgradation of industrial clusters, initiated by the government and other agencies. UNIDO Focal Point Programme in India is one of the important sources of information on clusters in India.\textsuperscript{26}

The data base of 358 SME clusters\textsuperscript{27} which was prepared by UNIDO focal point in India and published by the SSI ministry provides specifications of these clusters with respect to

\textsuperscript{24} For detail about spread of SME clusters in different sector and different regions see (Das 2005).

\textsuperscript{25} Two university based research projects by Cawthrone (1990) and by Menu Tewari (1996) were case studies of the Knitwear cluster of Tirupur and the Hosiery cluster of Ludhiana respectively. Around the same time several studies about some Gujarat clusters such as Ahmedabad RGM cluster and Morbi Ceramics cluster were carried out in the Gujarat Institute of Development Research. (See Das 1996, 1998). Economic and Political Weekly (EPW), a leading social science journal devoted considerable space to the question of the applicability of the FS/ID models in India in 1990s. A publication on flexible specialization in developed countries based on the proceedings of a seminar held in Pondicherry; 'Decentralized Production in India, Industrial Districts, Flexible Specialization and Employment' was brought out in 1998 (Cadene \textit{et al}. 1998). It had several case studies of Indian industrial clusters. Bagchi edited volume (1999) also has several papers on Indian industrial clusters. In addition some volumes of World Development (WD), specially the 1999 September issue devoted to developing countries clusters has several case studies of Indian clusters. There has been a hand full of other studies on Indian clusters.

\textsuperscript{26} The process of collection of data about industrial clusters started in late 1990s, the pioneer in the field being UNIDO sponsored report, 'Restructuring and Modernization of Small and medium Enterprise Clusters in India' (Gulati 1997). In addition to providing diagnostic and review studies of select clusters, the report presents a general review study of SME clusters in India.

\textsuperscript{27} Subsequently UNIDO focal point has come out with updated list which provides information of 388 SME clusters.
several characteristics, including the size of the clusters, their sectoral affiliation, technological upgradation and their export potential etc. (DC SSI 2003). According to this database only 57 out of 358 clusters belong to the category of high technological upgradation (Table 1.3)\(^{28}\). The database also shows that only 9 of the 33 big clusters (27.35%) have high technological upgradation. Among the big clusters belongs to traditional sector only one; Surat Diamond cluster is placed in the category of H (high technological upgradation).\(^{29}\)

There are not very many case studies of Indian clusters. Information that emerges from diagnostic studies of some clusters by UNIDO and a hand full of case studies done for academic purpose, suggests low level of technological upgradation in majority of the clusters.\(^{30}\) Most of them are traveling on the ‘low road’ of flexible specialization which is characterized, among other things, by absence of technological dynamism.

---

\(^{28}\) Though the database published in DC SSI (2003) labels clusters with H, M or L, signifying high, medium and low ‘technological upgradation’ there is no information on how were the clusters assigned their ‘technological upgradation’ label. A close inspection of the list of clusters under the category of ‘H’, signifying high ‘technological upgradation’ suggests that this epithet does not necessarily mean presence of high level of technological upgradation in the cluster. There is strong but random evidence that technology levels even in many of these 57 clusters placed in the H (high technological upgradation)’ category of clusters leaves much to be desired. For example five clusters in Eastern UP, manufacturing carpets are put in H category, signifying high level in technological upgradation. A survey of literature and discussions with some experts, including a teacher at the Indian Institute of Carpet Technology, Bhadohi, suggests that the level of technology used in the clusters, specially for dyeing and processing is very poor. However, in absence of any other comprehensive data source the information in the data base has been used to draw some very general inferences about the level of technology of the Indian industrial clusters. Subsequently updated data base of 388 SME clusters by UNIDO focal point uses the column heading ‘potential for high technological upgradation’ in place of ‘technological upgradation’

\(^{29}\) Big clusters refers to category A clusters in the UNIDO database; the cluster with an annual turnover of more than Rs. 1000 millions. For detail on big clusters see Appendix –IIa Updated database by UNIDO two more big clusters in the traditional sectors; Tirupur Knitwear cluster and the Hosier cluster of Ludhiana are placed in the H category.

\(^{30}\) Two university based research projects by Cawthrone (1990) and by Menu Tewari (1996) were case studies of the Knitwear of Tirupur and the Hosier cluster of Ludhiana respectively. Around the same time several studies about some Gujarat clusters such as Ahmedabad RGM cluster and Morbi Ceramics cluster were carried out in the Gujarat Institute of Development Research. (See Das 1996, 1998). Economic and Political Weekly (EPW), a leading social science journal devoted considerable space to the question of the applicability of the FS/ID models in India in 1990s Das (1999), Nair (1999) and others took the debate of FS model in India further. A publication on flexible specialization in developed countries based on the proceedings of a seminar held in Pondicherry; ‘Decentralized Production in India, Industrial Districts, Flexible Specialization and Employment’ edited by was brought out in 1998 (Cadene et al.198). It had several case studies of Indian industrial clusters. Bagchi (1999) edited volume also has several papers on Indian industrial clusters. In addition, some volumes of World Development (WD), specially the 1999 September issue devoted to developing countries clusters, has several case studies of Indian clusters. There has been a hand full of other studies on Indian clusters. Edited volume by Keshab Das (2005) is the first book dedicated entirely to Indian Industrial Clusters.
1.5 INDUSTRIAL CLUSTERS AND GLOBALIZATION

The present context of globalization presents enormous challenges for the small units in the manufacturing sector in the developing countries. Three paradigmatic changes which have taken place in recent decades: the shift in the country’s economic policy paradigm; the shift in the technological paradigm from electro-mechanical to ICT; and the shift in the paradigm of global production system, have presented SMEs all over the world with new opportunities, even as they have placed SMEs in the developing countries in particularly challenging position.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>State</th>
<th>Total Number of Clusters</th>
<th>Number of Clusters with High Technological Up-gradation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Andhra Pradesh</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Assam</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Bihar and Jharkhand</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>Delhi</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Gujarat</td>
<td>45</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Haryana</td>
<td>21</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Himachal Pradesh</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Jammu &amp; Kashmir</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>Karnataka</td>
<td>26</td>
<td>6</td>
</tr>
<tr>
<td>10</td>
<td>Kerala</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Maharashtra</td>
<td>66</td>
<td>13</td>
</tr>
<tr>
<td>12</td>
<td>Madhya Pradesh</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>Orissa</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>14</td>
<td>Punjab</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>Rajasthan</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>16</td>
<td>Tamil Nadu</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>17</td>
<td>Uttar Pradesh</td>
<td>41</td>
<td>11</td>
</tr>
<tr>
<td>18</td>
<td>West Bengal</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>358</strong></td>
<td><strong>57</strong></td>
</tr>
</tbody>
</table>

Source: Compiled from the database prepared by of 358 clusters UNIDO focal point published in DC (SSI) 2003

The policies of globalization and liberalization, adopted by the governments of the developing countries world over, have exposed the traditional industry in these countries to sever global competition. Today millions of SSI units in the traditional, labour intensive, low technology consumer good sectors in a large number of developing countries are engaged in fierce competition with each other. Since all of them have the advantage of very low labour cost, unless they make themselves more competitive through innovation and technological
upgradation, a large number of small units in these countries face the specter of becoming extinct.

Secondly the new global production system, in which a significant part of global production is carried out in the global value chains (GVC) rather than by stand alone firms, presents new challenges for the manufacturing sector of the developing countries. The firms in the developing countries by and large, engage only in the simple stages of manufacturing, whereas technologically challenging stages of value chain are undertaken in the developed countries. This limits the scope for up-gradation for the SMEs of the developing countries, even as it puts greater pressure on them to be globally competitive in order to be inserted in these value chains. While the immediate challenge faced by the small units in developing countries lies in surviving in the face of severe competition, in the long run, they must upgrade themselves by moving up the value chain. Enhancing skills of artisans and technicians and value addition through technological change is likely to play a crucial role in this process.

The fragmentation of global demand along with the shift in the techno-economic paradigm brought about by ICT (Information and Communication Technology) revolution, and to a lesser extent, by biotechnology, has brought about new opportunities as well as new challenges for SMEs. Technological revolution has made technological change skill/knowledge intensive rather than capital intensive. This has, at least partially neutralized the disadvantage the SMEs had vis-à-vis large enterprises in adopting technological changes. Secondly, IT revolution has turned the in built flexibility of SMEs in a big asset in the new global market paradigm. Fragmented demands, particularly in the life style based consumer goods have reduced the product life cycles and have created niche markets in which ‘new competition’ in terms of price as well as quality and delivery schedules has emerged as the prime mover of markets. Use of new IT based technologies is particularly suitable for catering to fragmented markets. IT tools allows SMEs to develop capabilities to change the characteristics of the products swiftly and deliver them at great speed. The challenge posed by ICT based technologies to SSI units in countries like India is that since IT based technologies are generic technologies their adoption has become critical for the global competitiveness even for the traditional consumer good sectors. Moreover since IT is used not only in manufacturing stages,

---

31 See Humphery and Schmitz2000 for detail on place of developing country clusters in GVCs and their prospects to upgrade by moving up the value chain.
32 For detail see section 2.3.1 in Chapter 2
but also for marketing and value chain management, certain competency in IT has become a pre
requisite for SSI units in the developing counties to be a part of global production system.

In the new context it is difficult for the manufacturing sector in the developing countries
to retain its competitive advantage on the basis of low labour cost alone. The sector must retain
its dynamic competitive advantage by upgrading itself through innovation and technological
change. Therefore in countries like India manufacturing sector in general and SSI sector in
particular must retain its dynamic competitive advantage by upgrading itself through innovation
and technological change. Or else it will either perish in the face of the global competition, or
will keep running for the race to the bottom.

The new economic policy scenario is full of challenges for the stand alone SSI units in
India, as well as small units located in industrial clusters. As the distinction between the
domestic and international markets is getting more and more blurred in this era of globalization,
SSI sector in India, like all other industries in the global world must acquire global competitions
for their survival. Today there seems to be near consensus on the view that low labour cost and
natural resource endowments alone will no be adequate for the global competitiveness of SSI
sector in India. The SSI sector must re-invent itself through considerable innovation and
 technological change if it has to survive in the new scenario. Skill up-gradation and
modernization is seen as a necessary condition for the survival of SSI by almost every body.33

1.6 CHANGING POLICY SCENARIO ON INDUSTRIAL CLUSTERS

The innovation policies in many countries are specially targeted at stimulating
innovation in the clusters of SMEs (Small and medium enterprises).34 This is a fall out of
remarkable contribution of SMEs in last quarter century in various parts of the world. The
coupling of SME clusters with innovation can be seen in the theoretical and empirical works in
a variety of discipline/sub disciplines.35 Like-wise policy makers in several countries have also

33 This realization is reflected in the policy for the SSI sector formulated by the Expert Group headed by Abid
Hussain (Hussain 1997), which places considerable emphasis on the modernization and technological
upgradation of the sector.
34 Several studies in recent past have brought out impressive contribution of the SMEs in innovative activity See
1986, Klienkechht 1993, Carlsson 1996, Acs and Audretch 1987; Cordes et al. 1999. It must be noted that the
term SME is inclusive of medium and small enterprises both in the manufacturing and services sector. The
definitions of SSI and SMEs are country specific. Some countries adopt employment criteria other adopts dual
criteria of employment and fixed investments. In some countries employment, along with sales turn over is
adopted as the criteria.
formulated their initiatives around the belief that industrial clusters can be developed as centres of fast growth, providing high-tech employment. The perception that geographical concentration of inter-linked SMEs can be linked with high technology and high growth is shaped by various events in recent economic history of the world. Remarkable success of SME clusters is North-Central Italy, Germany and other parts of Europe since 1970s has triggered off a debate about the dynamism and innovativeness of ICs, referred to as Industrial Districts (IDs) in literature. In some quarters Flexible Specialization (FS) model, (the term used for these IDs) is seen as a way out of the Fordist crisis, and a possible new stage of capitalist development. The technological and economic catching up of Japan, and to lesser extent, of South Korea in which SMEs played a crucial role, has had a profound effect on the understanding of relationship between technology and growth on the one hand and size of the firm and economic organization and growth on the other.

In India one off-shoot of new thinking on SSI policy in the era of liberalization and globalization is the newly acquired interest of policy makers in industrial clusters. Since it is increasingly recognized that clusters of small firms perhaps stand a better chance of surviving the global competition than the stand alone SSI units, one of the recent trend in the thinking of policy circles is that promotional policies should be cluster based rather than aimed at promoting individual units. The Expert Group set up by GOI to review its SSI policy emphasizes the need for cluster based policy intervention in the SSI sector. Inspired by the success of industrial clusters and by their literature, which has gone to great length to stress the great efficacy of cluster based state intervention in helping the SMEs, our own policy makers have started to pay attention to the clusters.

Since 1997 there has been a spurt in the cluster based action in India. There is a variety of CDPs (Cluster Development Programmes) under the aegis of different ministries/agencies. In 1998 the Ministry of Small Scale Industry launched a Technology Upgradation and Management Programme called UPRECH, which was renamed as Small Industry Cluster

36 A large number of initiatives by governments, both in the developed and developing countries and by international organizations like UNIDO (United Nation's Development Programme), WB (Word Bank) and OECD (Organization for Economic Co-operation and development) etc. are being launched in order to promote innovation based industrial growth. The World Bank is undertaking cluster projects in Brazil, Turkey, Morocco, Egypt and India. UNIDO's SMEs programme is increasingly building on cluster thinking. ILO's International Institute for Labor Studies has promoted the concept of industrial districts and has undertaken or sponsored several studies. Similarly, OECD in recent years has shown considerable interest in the cluster approach. (See OECD 1999).

37 See Hussain 1997
Development Programme (SICDP). As of January 2007, 86 clusters in 23 states/UTs have been taken up by SICDP in the UPTECH/SIC scheme of launched by the SSI ministry. In addition, diagnostic studies of 105 clusters is also being taken up by SICDP

In addition to Ministry of SSI, Ministry of Textiles has also introduces cluster development programmes in more than 20 textile clusters. Ministry of Commerce also has a CDP for strengthening export infrastructure in export oriented clusters. TFP (Tenth Five Year Plan) has made an allocation of Rs.675crores for the Industrial Cluster Development Scheme to be implemented by the Ministry of Commerce and Industry for creation of customized infrastructure support and common facilities, promotion of design and development and assisting appropriate technology transfer. (See Draft GoI Tenth Five Year Plan Volume II).

At present there are as many 20 agencies, including some of the state governments, which are engaged in cluster based Institutions Undertaking Cluster Development Initiatives 2005: SBI, SIDBI, SIDO, DST, TC, NSIC, NABARD, GDS, RCCI, KVIC, DC (HC), DC (HL), DIPP, Wool Board, UNIDO, ILO, and several state governments including the governments of Gujarat, Rajasthan, Madhya Pradesh, Andhra Pradesh, Kerala and Orissa,

The programmes undertaken by different agencies differ a good deal in terms of their methodologies and their objectives. Major areas of intervention in which these initiatives are engaged include provision of credit, technology, employment and infrastructure. Of the 20 agencies, just a handful of them; DC (Handicrafts), SIDBI, SIDO, Textile Committee and Gujarat GOVT have technological upgradation as a major area of intervention.

One project that is fully focused on modernization and technological upgradation is the State Bank of India (SBI) Project UPTECH. Two significant clusters covered by Project UPTECH are 'The Glass Industry in Firozabad' & 'Auto Component & Light Engineering Industry in Bangalore'. (See UNIDO2001c),

Some of the State governments have been quite proactive in this regard. Govt. of Gujarat has been a pioneer and has introduced an extensive cluster development programme, which aims at covering a large number of industrial clusters in the state. (See UNIDO 2001c)

The exercise in this section will be useful in exploring the role of the government agencies in the two case studies.
1.7 ORGANIZATION OF THE THESIS: CHAPTERIZATION

Following section of this chapter provides the broad outline of the manner in which the research work done in the Ph.D. project is organized. It provides a brief account of the contents of six chapters.

Introduction (Chapter 1)

The first part of this chapter has a detailed statement about the context and the broad objective for undertaking this Ph.D. project. It gives a brief account of the background which has SME clusters in the forefront in the academic as well as policy circles all over the world and spells out the reason for focusing on industrial clusters.

The second part of the chapter spells out specific objectives of the Ph.D. project, the scope of study and the key questions dealt with in the project. It also explains why the two clusters were chosen for the Ph.D. project.

The third part of the chapter spells out some significant gaps in the theoretical as well as empirical research with respect to understanding of innovations and technological change in industrial clusters in the developing countries and the relevance of the present Ph.D. project as an attempt to bridge some of the gaps. It also points out towards the dearth of research on Industrial clusters in India and it’s in adequacy in dealing with the issues pertaining to innovation and technological change. The inadequacy of the existing research on the SSI sector in India in providing clear insight on their level of technology and the dynamics of innovation and technological change that takes place in them is also pointed out in this chapter. The relevance of the present Ph.D project as an attempt to bridge some of the gaps is also explained in this part.

The fourth part of the chapter provides the background knowledge of the SSI sector and Indian clusters. Section gives a brief account of role played by the SSI sector in Indian economy and its problems. It discusses the performance of the sector in the post reform period. The section also provides a summary view of the clusters in India and their contribution in important macro economic variables. It also discusses the state of technology in Indian clusters.

The fifth section of this chapter discussed the opportunities and challenges faced by the SME clusters all over the world in the context of globalization.
The sixth section of the chapter provides a brief discussion about the changing policy scenario on clusters in India and recent emphasis on industrial clusters by various government agencies.

An Analytical Review of Literature (Chapter 2)

The second chapter comprises of discussion of theoretical foundation on which the hypotheses and key questions of the project are based and presents the list of hypotheses explored in this Ph.D. project. It has a detailed analytical review of existing literature in disciplines of economics, sociology, Science and Technology (S&T) Policy Studies including Innovation Studies, which tries to capture the essence of various theoretical perspectives on technological change and innovation and development in the context of Industrial Clusters, which provides the base on which various hypotheses are built.

Section 1 gives an introduction for the chapter.

Section 2 of the chapter provides the background for the theoretical core of the project. It presents a brief review of literature dealing with various dimensions of three key areas relevant for the project; innovation and technological change, development and industrial clusters. The areas of literature which have been explored for this section include Schumpeterian theory, evolutionary economics and neoclassical economics, and development economics. Section 2.2.1 deals with the existing literature in economics, particularly in economic history and growth theory, to capture the relationship between innovation, technological change and economic growth. Section 2.2.2 brings out the difference between economic growth and sustainable development, as it is highlighted in development economics and other areas in social sciences and tries to see the relation between technological change and development.

Next section contains the survey of literature on various perspectives providing theoretical/conceptual knowledge about types of innovation contributing towards economic growth. It borrows from Schumpeterian theory, evolutionary economics, economics of technological change and organization theories to identify three main types of innovations; technological, organizational and market related innovations, which are incorporated in this Ph.D. project. Need for incorporation of IT based technological change is indicated by the research on industrial economics. Insights from evolutionary economics are used to develop clarify about concepts like creation of innovation versus its diffusion and incremental versus radical change.
Section 2.3 present a critique of neo classical economics in which has little to offer in terms of process involved in bringing about technological change and which sees technological change as an instant response to market stimulus. Drawing on the insights from Schumpeterian perspective, evolutionary economics and neo classical theory, this part of the chapter identifies and elaborates on three main actors in the process; the stimulus from the market, the willing entrepreneur, and the technological capabilities to bring about the change. Section 2.3.1 conceptualizes the role of entrepreneur in innovation on the basis of Schumpeterian perspective as well as recent literature on Industrial Districts.

Using one of the core concept of evolutionary economics; technological capabilities, the concept of ‘technological capabilities of a cluster’ is developed in this chapter. Section 2.4 touches upon the technological learning perspective. Sections 2.4.2 provides details about the three components of technological capabilities; firm level capabilities, cluster level capabilities and capabilities located in intra-cluster links. Role of trust, tacit knowledge and the embeddedness of the entrepreneur are discussed in this section.

Section 2.4 surveys literature in various theoretical perspectives in different disciplines which have focus on links between clustering and innovation. It includes literature on trade theory, external/agglomeration economies, transaction cost literature, and above all literature on ID/FS models. Review of empirical research on IDs (industrial districts) in the developed countries, and literature on ICs (industrial) in the developing countries is used to explore how and to what extent the clustering may promote innovative activity in small firms located in industrial clusters.

Section 2.5 discusses literature touching upon the role of government and other institutions in the process of technological change. Section 2.5.1 touches upon briefly on various theoretical perspectives, including the systems approach. Section 2.5.2 provides a brief account of role of government in technological change, as it emerges from the empirical research, specially on industrial clusters.

Section 2.6 presents a set of hypotheses relevant to the empirical study of two clusters which are tested during the research and the key questions for which the answers are sought. While some of the hypothesis and key questions in this project are drawn directly from the existing literature, others emerge in the process of formulating a critique of existing
perspectives. Certain other hypotheses have emerged in the process of synergetic synthesis of ideas existing in diverse fields. Key concept around which the hypothesis are also highlighted.

*The Methodology and the Conceptual Base (Chapter 3)*

The chapter is divided in two main sections. The first main section (3.1) describes the methodology used in the study and the sources of data, and the techniques used. Section 3.1.1 explains the cluster approach adopted in this project. It discusses the relevance of two fields from which this project has borrowed extensively for its methodological perspective and methodological tools; Institutional Economics and Interpretive Sociology. It discusses the reasons for 'emphasis on process', which is the key point of the methodological frame used in the study. The section also contains brief discussion on relevance of quantitative versus qualitative data and gives detail of the type of data used in the study. Section 3.1.2 explains the relevance of Case Study framework adopted for this study. Section 3.1.3 spells out the study design; it discusses the sample design, process of selection of sample firms the methods used for data collection and the fieldwork challenges involved in the process of data collection. It gives a synoptic view of the questionnaire used for the firm level study.

The second main section of the chapter (section 3.2) defines / develops relevant concepts and indicators used in the study. It also describes the various new concept developed and used in the project. While some of these concepts used in this study have established definition in literature that are readily used in this study, others have evolved in the process of present research project. For example, in the existing literature the index of innovation, to be used as a quantitative category for assessing the technological dynamism; particularly for measuring the level of innovation in the SSI sector is not very adequate. The two traditional indicators of innovativeness used extensively in literature; R & D intensity (referring to the ratio of expenditure on R&D to total sales/outputs), and the number of published papers / patents, as a proxy for innovative activity, are of little use in the context of small firms in the ICs in India and other developing countries. New, suitable indicators for exploring the innovativeness of the firm as well as that of cluster have been developed during this project are described in this chapter. Similarly the concept of technological capabilities of a cluster, as different from technological capabilities of a firm, or technological capabilities of a nation, is in the process of evolution. This chapter provides detail of the exact manner in which the concept of technological capabilities of a cluster is defined and used in this project; its definition, its
components and indices used for measuring the level of different components of technological capabilities of a cluster.

In section 3.2.1 the conceptual issues involved in measurement of innovative activity and the limitations of using the conventional measures like R&D intensity in the context of SSI sector are discussed. It explains the method used in this project for measuring innovative activity. Definition of the concepts like technological change, organizational change and market based change, and their components are provided in this section. The section contains explanation of how the levels ranging from minor to significant and major, are assigned in the study to describe the level of technological changes undertaken by the cluster firms.

In section 3.2.2 the concept of 'technological capabilities of a cluster' and its various components; the firm level technological capabilities, the cluster level technological capabilities and the technological capabilities located in intra cluster links and lists out the parameters used for exploring them, is described. It spells out parameters used for exploring firm level technological capabilities and the index adopted to assign values ranging from low (L) to medium (M) to high (H) to describe the level of firm level technological capabilities.

*Innovation and Technological Change and Development: Case Study of Moradabad Metal Art-ware Cluster (Chapter 4)*

Chapter 4 presents the findings of the research with regard to Moradabad Metal Art-ware cluster. It gives an account of the nature and extent of innovation and technological change taking place in the cluster and its determinants, and the impact of changes taking place in the industry on some dimensions of economic development of the cluster. The first main section of this chapter (section 4.1) introduces the cluster; it gives the historical background of the Metal Art-ware cluster of Moradabad and the stages of development of cluster in the post independence period. It provides a brief description of the cluster, in terms of parameters such as, its market orientation, its economic performance in terms of volumes of production, exports and employment generated in them, the structure of the industry and, organizational set up of the production system and the knowledge system of the clusters, its cultural milieu of the region in which the cluster is located and the type of intra-cluster network which exist in it.

The second main section of the chapter (section 4.2) presents the findings of the research with respect to technological change /innovation taking place in the cluster. The section 4.2.1 includes a discussion of the different of technological innovation; the product innovation, the raw material innovation and process innovation. Considering the importance of role of ICT in
the modernization and up-gradation process, a special section, dealing with diffusion of IT in the cluster is included in this part of the chapter.

Section 4.2.2 presents findings about the factors which are responsible for initiated the process of technological change. The evidence about the relative role of demand pull, vis-à-vis supply push factors is presented in this section. The role played by different types of competition; in terms of price, quality and delivery in creating demand pull and the manner in which demand pull manifests itself innovation process is also reported in this section. A nuanced picture of supply push factors is presented by looking at the relative importance of different sources of technology push; availability of new technological knowledge, access to new machinery and equipment or availability of funds for introducing technological change.

The next section (section 4.2.3) reports the findings of the exploration with regard to the technological capabilities of the cluster. Three aspects of the technological capabilities of the cluster; the firm level capabilities, the cluster level capabilities and the capabilities located in intra-cluster links are discussed in this section. The presence of intra-firm technological resources is explored with the help of firm level study. The discussion of cluster level technological capabilities is carried out with reference to the following aspects; the technological infrastructure of the cluster, defined in terms of specialized knowledge/ education/ technological institutions, R&D / training, information facilities etc. The existing government facilities set up for the in the promotion of technological upgradation are seen as a part of cluster level technological capabilities and such their role in bringing about the change is also discussed in this section. The technological capabilities located in intra-cluster links are discussed with in the framework of economic and social networks present in the cluster. The role played by social factors such as trust and social capital in the promotion of innovation is also discussed at length. The role of accumulated tacit knowledge and the labour processes, as determinants of technological capabilities of the cluster, is also studied in this section. The role of entrepreneurs in determining the level of technological dynamism of the cluster is also studied in this part of the chapter. While educational levels of the entrepreneur appear in the list of determinants as a part of intra firm technological capabilities, the significance of economic background of the entrepreneurs is studied in a separate sub-section.

Next main section of the chapter (section 4.3) presents an account of various intra firm and intra cluster organizational changes which have been taking place in the cluster in the post reform period. Changes in the sub-contracting practices, in inventory management and in
quality control mechanisms are reported and the reasons for these changes are explored in this section.

Next main section of the chapter (section 4.4) presents an account of the innovations taking place in the way marketing is organized in the cluster, as well as innovation in the way marketing is promoted. This section gives an account of the extent to which market firms are entering new markets, opening new spaces; such as show rooms for displaying their products, adopting new methods, such as attending fair, net searching and starting websites for reaching new buyers and adopting new methods for advertising their products.

The last main section of the chapter (section 4.5) deals with the impact of technological and organizational changes taking place in the cluster on the key variables of development, growth being one of them. The section 4.3.1 explores the issue of global competitiveness of the industry in the cluster. Trends in the value of total output, exports, profits and rate of profit of the survey firms are studied in order to infer about the long term competitiveness of the industry. The second section studies the impact of innovations and technological change carried out in the cluster on the quality and quantity of employment being generated in the cluster. The parameters under study in this section are; trends in wage rate, trends in employment and trends in the ratio of permanent to casual workers. Impact of technological and organizational changes on gender and age composition of the employed is also studied. The last sub-section discusses the impact of technological and organizational changes on environment by finding answers to the questions; do the new technologies reduce work place pollution, or are they more polluting then the old technologies? Questions such as, has the greater insertion of the cluster firms resulted in their using clean technologies and installing ETPs (Effluent treatment plants) and other devices under the pressure from foreign buyers, and what has happen to the overall levels of pollution, as a result of various technological changes taking place in the industry are also explored in this chapter.

Innovation, Technological Change and Development: Case Study of the Textile Cluster of Panipat (Chapter 5)

Chapter 5 presents the findings of the research with regard to the Textile Cluster of Panipat. It follows the organizational pattern adopted in chapter 4.
Policy Implications and a Framework for Cluster Development (Chapter 6)

This chapter is devoted to issues pertaining to policy for industrial clusters in India. It is divided broadly in three sections. The first section presents policy related insights emerging from two case studies. It presents a critique of the macro economic policies and the SSI policy adopted by the government in the post reform period and appraises their impact on the process of technological and functional upgradation of the Indian clusters belonging to traditional sectors. Using the findings from two case studies it has tried to explain why government policies/initiatives have failed to promote an innovation based sustainable development in the traditional clusters.

The second section of this chapter brings out, in detail, the need for government support in the era of globalization. On the basis of information collected from two case studies it spells out some priority areas in which government intervention is crucial for technological and functional upgradation of the Indian clusters belonging to traditional sectors.

The third section articulates the need for a comprehensive and holistic policy for meeting the objective of sustainable development in Indian clusters belonging to traditional sectors through technological and functional upgradation. Using the conceptual and policy-related insights emerging from the two case studies, it conceptualizes a two layer framework for a cluster development policy; the national cluster development policy and local cluster development policies for individual clusters. This section also articulates the need for a technology intermediation agency within the framework of local cluster development policy. The last section of the chapter grapples with is the question of relative importance of national, regional and sectoral systems of innovation. Need for an explicit innovation policy for clusters, which brings out a synergetic relation between the national, regional and sectoral institutions is also articulated in this section.

Summary of Main Findings: A Comparative View (Chapter 7)

This chapter on summary and conclusions is constituted in terms of three main sections. The first section of the chapter is a short summary of chapter 2, which was mainly devoted to develop appropriate framework for the study. This section identifies the conceptual and theoretical streams and the leading studies in them, which were relevant for the theoretical framework. Summary of the main methodological contributions and their limitations also constitutes a part of this chapter.
The second section presents a summary of the main findings emerging from two case studies. It brings out the similarities and the differences in the nature and extent of innovation and technological change taking place in the two clusters. It presents a comparative view of the role played by intra cluster resources, external factors and the government in initiating and facilitating the process of innovation and technological change in two clusters. Further, it compares the overall impact of technological and organizational changes of the technological and organizational changes on the key variables of development; quantity and quality of employment.

In the third section of the chapter some suggestions for future research on Indian clusters arising out of this Ph.D. project.