A QUANTITATIVE ANALYSIS OF THE RELATIONSHIP BETWEEN DRIVERS OF INNOVATIVENESS AND PERFORMANCE OF MSMEs

A thesis submitted in partial fulfillment of
the requirement for the award of the degree of

MASTER OF ENGINEERING
(PRODUCTION AND INDUSTRIAL ENGINEERING)

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DECLARATION

I, **Himanshu Gupta, Registration Number - 801082011** hereby declare that the work which is being presented in this report entitled, '**A quantitative analysis of the relationship between drivers of innovativeness and performance of MSMEs**' by me in partial fulfillment of the requirements for the award of degree of Master of Engineering in Production and Industrial Engineering from MED, Thapar University is an authentic record of my own work carried under the supervision of Dr. Tarun Nanda, Assistant Professor, Mechanical Engineering Department, Thapar University, Patiala.

The matter presented in this report has not been submitted in any other University/Institute for the award of Master of Engineering or any other degree.

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This is certified that the above statement made by the candidate is correct to best of my knowledge.

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CERTIFICATE

This is to certify that the report entitled, '**A quantitative analysis of the relationship between drivers of innovativeness and performance of MSMEs**, which is submitted by Himanshu Gupta (Regd. No. 801082011), in partial fulfillment of the requirements for the award of Master of Engineering in Production and Industrial Engineering from MED, Thapar University, Patiala, is a record of candidate's own work carried out by him under my supervision. The matter embodied in this report is original and has not been submitted for the award of any other degree.

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ABSTRACT

Globalization has produced remarkable changes in business structures and organizations across the world. A key upshot of these changes has been greater synchronization of economic activities across borders leading to emergence of trans-national production systems, organized as distinct global production networks. Advent of these networks has been followed by rearranging of industrial structures, which has influenced the process of local development.

For developing country enterprises, successful entry into global networks has emerged as a key challenge. Entry into global chains promises upgradation of firm level capabilities from 'learning' through technology diffusion and exposure to international best practice systems of corporate governance. However, the ability of developing country firms to move into global chains and graduate to 'high-end' activities depends on their existing technology, as well as the support mechanism made available by national country governments. The productive entities that are mostly affected and face problems are the MSMEs. Small units are constantly struggling to survive and face pressure even in local and domestic markets. No enterprise can remain competitive without continuous technology upgradation and development. Small enterprises in developing countries largely depend on external sources like large organizations for their technology related needs. However acquiring technology from larger firms solely is not sufficient to bridge the technology deficient gap. The need of the hour is to develop technology indigenously within organizations. Firms should develop innovative capabilities for their survival and growth in the era of global competition. Technology advancement achieved through technological innovations enables firms to acquire or improve competitiveness through market orientation or quality improvement of products, among others. Technological innovation is considered to be an important strategy for technological developments in the organizations. It is with this backdrop that the present study probes the various factors influencing the tactical and technological development of organizations.

This report is divided into five main chapters, the first chapter introduces about MSMEs, the importance of MSMEs, technology, importance of technology upgradation and status of technology development in Indian MSMEs. The second chapter explores the literature regarding the various factors influencing the tactical and technological development of organizations and identifies various gaps in the present literature. The third chapter puts forward the methodology to be adopted for carrying out the research work, fourth chapter presents the findings of survey

based results, the results obtained after quantitative analysis of survey data. Four main input variables are identified viz. entrepreneur role, regulatory corroboration, technology infrastructure and linkage capability and their effect on output variables viz. innovation performance, sales performance and product performance has been determined. Classification of various organizations surveyed has been done based on their performance in each key input and output factor. Correlation between each input and output factor has been established. Principal component analysis has also been used to reduce the various key issues under each input factor. The final chapter presents the results of the analysis and also points out the various limitations in present research and scope of future work in the present topic.

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CHAPTER - I

INTRODUCTION

1.1. Preamble

The dynamic engine of a nation's economic growth is driven by a collective of micro, small and medium enterprises (MSMEs) whose activities are the spur to aggregate economic and social benefits. Several studies confirm that a nation's growth and sustenance is dictated, to a large extent, by the performance of small businesses. However, the reality is that MSMEs are constantly struggling to survive and maintain their schedule of activities. This is evident in the track record of majority of the MSMEs in the developing and transition countries: they have been unable to reap the benefits of globalization and, to add to their inadequacy, they frequently face pressure, on the local or domestic markets, from cheaper imports and foreign competition (OECD, 2004). This unfortunate predicament may be attributed to the fact that many developing countries face major challenges in suitably developing, attracting, and using modern technologies (UNIDO, 2002). It is, therefore, inevitable that a large majority of micro and small firms in countries in the Asian and Pacific region have focused on traditional industries where the activities are mostly characterized by low technological complexity and extensive use of unqualified labor (Ramanathan, 2008). Due to increased competition and rapidly advancing technologies in many industries, MSMEs are often forced to develop new products faster and more effectively. This requirement is challenging for MSMEs not only because of their limited size, but also because they have less internal resources and a more restricted competence base, which affects their ability to engage in innovative efforts (Parida *et al*., 2012).

The limited availability of technological, human, financial, and management resources on one hand, and the weaker capability and bargaining power of MSMEs on the other hand, are amongst the most crucial barriers that must be overcome when it comes to dealing with actors in their external environment, including suppliers, clients, the labor market, development agencies, and fund providers. MSMEs, especially in developing countries have been exposed to intense competition due to the accelerated process of globalization. However, globalization has also opened up new opportunities for MSMEs which brings out the need for MSMEs to develop competitiveness for their survival as well as growth (Bala Subrahmanya, 2005a).

Scientific and technological input and innovation have become the decisive factor of economic growth, they are also key elements in promoting the core competitiveness of the enterprises and an important sign indicating the level of development of a country or a region (Zhu and Lei, 2012). As companies face

pressure from increased competition, shortening product life cycles and growing product complexity, many are finding that they need to change the way they develop new technologies, products and services. As companies realize they can no longer afford to rely solely on their own R&D and need to acquire ideas from others, there has been a trend in many sectors away from a mostly closed to a more open model of innovation. Firms should develop innovative capabilities for their survival and growth. Technological advancement achieved through technological innovations enables firms to acquire or improve competitiveness through market orientation or quality improvement of products, among others (Bala Subrahmanya, 2005b).

1.2 Technology and Technology Capability

The word 'technology' comes from two Greek words 'Techne' and 'Logos'. 'Techne' means the skill or craft needed to make something and 'Logos' means discussion or knowledge of something. Technology is defined as the practical knowledge, know-how, skill and artifacts that can be used to develop a new product or service and/or a new production/delivery system (Moriarty and Kosnik, 1990). Technology is viewed as a phenomenon derived from a process of cumulative learning, with a high level of specificity and considerable costs associated with its creation and transmission (Roman *et al.,* 2011). Technology Capability is 'the entire complex of human skills (entrepreneurial, managerial and technical) needed to set up and operate industries efficiently over time' (Lall, 1992). Technological capabilities vary widely across nations depending upon a host of country specific factors. These include, *inter alia*, the nature and quality of scientific and technical institutions, expenditures incurred by the government and businesses on technological development (R&D in particular), availability of skilled manpower, prevailing intellectual property systems etc. Acquiring technological capability is a dynamic and evolutionary process and nations are classified as 'more' or 'less' technologically capable according to their stages of technological development (Jagersma, 2008).

Technological capability of developing countries is defined as the capacity of these countries to select, assimilate, adapt and improve given technologies. The various stages of building-up technological capability, or 'learning', can be described as follows.

- Learning by doing
- Learning by adapting
- Learning by design
- Learning by improved design
- Learning by setting up complete production systems
- Learning by designing new processes

Most developing countries, typically, start learning, by acquiring imported technology. Initially, they focus on optimal utilization and adaptation of both indigenously available, as well as imported technologies, for

increasing productivity. These early attempts, according to the literature on technological capability and effort, can be classified in following phases: obtaining know-how through a combination of efficient assimilation of imported techniques, quality control, improved plant layout and production practices, equipment modifications, use of different raw materials and so on. For most developing nations, acquiring know-how is a lengthy process. Know-how is followed by 'know-why' in the next stage of technological development. Acquiring know-why implies understanding the nature of the process and product technologies leading to the development of new and improved designs. In planning their technology policies, developing countries are often caught in the dilemma of 'know-how' versus 'know-why'. The choice, indeed, is not easy. Advanced know-how facilitates immediate technological improvements and higher output growth. However, know-why does not result in immediate benefits in terms of productivity gains in the short and medium terms. On the other hand, without know-why, developing countries can hardly aspire to reach advanced levels of capabilities, since it is only know-why oriented technological learning which can provide the foundation for acquiring frontier R&D capabilities (O' Regan *et al.*, 2005).

1.3 Change in the Technological Requirement

Many of the items produced in the small-scale sector are becoming redundant because of the change in tastes, preferences, and also due to emergence of new technology. The entry of foreign brands in the white goods segment has not only given consumers a wide choice of hi-tech and good quality products at competitive prices but has also given them improved after sales service. This means that the process of production has to be cost efficient and meet quality needs of the consumers. This improvement can come through the use of latest technology. Continuous upgradation of technology has become essential for survival of any manufacturing unit (Choi, 2004). Hence, the need for change in technology is more relevant for MSMEs than for large units. As a result, all over the world, large companies have been withdrawing from direct manufacturing activities and concentrating more on marketing, technology creation, diffusion and networking with MSMEs in manufacturing related activities. Thus, in the new environment, the competitiveness of large firms greatly depends on the efficiency of small firms. It should be up-to-date but at the same time it must be able to meet the needs of both traditional and new product lines. The competitiveness and efficiency of the firms largely depends upon the innovation capacity of the firms.

1.4 Technology Upgradation Needs of MSMEs

Because firms today operate in increasingly turbulent and complex environments, they need to be more proactive and innovative (Rese and Baier, 2012). With technology-based innovation playing an increasingly important role in developing global niche markets and opportunities, the old modes of technology transfer and diffusion have to evolve in new and more effective ways (Prakash and Gupta,

2008). The average success rate of innovative efforts tends to be much lower than desirable, mainly due to the high levels of risk, complexity, and uncertainty inherent in the innovation process. In addition, innovative development is usually challenging for SMEs because they are subject to the "liability of smallness," that is, SMEs generally have limited financial resources, often lack a multidisciplinary competence base, and tend to use less structured approaches to innovation. Altogether, these factors may restrict their ability to innovate and achieve competitiveness (Parida *et al.*, 2012). Thus many governments around the world are taking up various programmes to support SMEs, particularly in the field of technology development or diffusion and in their efforts to find out market opportunities and advantages. Many governments are also supporting their national R&D institutes and universities in conducting expanded activities to work with innovative SMEs and seeking international collaborations in necessary fields (Terziovoski, 2010).

1.5 Methods of Technology Upgradation

Technology upgradation would ordinarily mean induction of state-of-the art or near state-of-the-art technology. In the varying mosaic of technology obtaining in more than 7500 products in the Indian small scale sector, technology upgradation would mean a significant step up from the present technology level to a substantially higher one involving improved productivity, and/or improvement in the quality of products and/or improved environmental conditions including work environment for the unit. It would also include installation of improved packaging techniques as well as anti-pollution measures and energy conservation machinery (Ramaswamy and Gereffi, 2000).

The methods of technology upgradation for a firm are as follows:

- Internal technology acquisition (Innovation from Inside)
  - Internal R&D
  - Tacit Knowledge
- External technology acquisition (Innovation from Outside)
  - Purchasing
  - Licensing
- Combination of both external and internal
  - Reverse Engineering
  - Strategic Partnership

In order to ensure that the technology acquisition strategy pursued pays off, companies must master tactical execution. They must determine their overall priorities and evaluate their product portfolios, their competitive positions in each area, their qualities and volumes of R&D projects, and their organizational capabilities. Then they can focus on whether to develop products internally, acquire the targets, ally with them, or invest in them with an eye to future growth. A framework in this regard is presented in Figure 1.1.

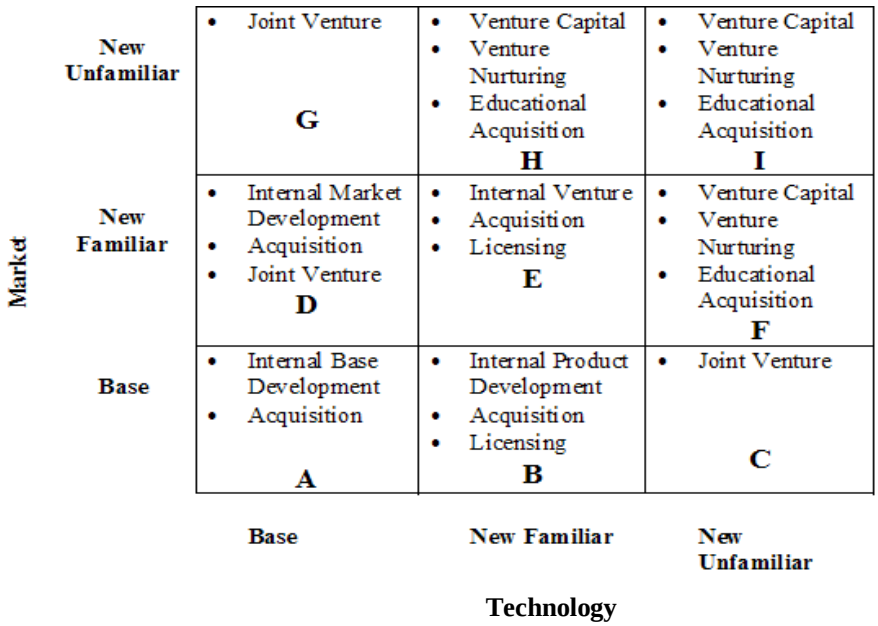

Fig. 1.1 Familiarity Matrix for Entry Stage (Roberts and Berry, 1985)

One or more of the following reasons may motivate a company to adopt an acquisition strategy:

- the desire to build a vertically integrated company
- diversification into new business areas by acquiring critical new technologies or products
- improving the company's product pipeline
- improving technical expertise and know-how or increasing the strength of professional staff (e.g., R&D team)
- expanding the company's sales force or its geographical scope

Some other terms used in the context of alliances are presented in Table 1.1

Of these methods, the method mostly used by organizations during their early stage, is technology acquisition since the development of technology generally takes longer time than acquiring and adapting already developed technology from external sources. But over a period of time, development of technology internally is beneficial as any development internally becomes the exclusive right of the company (Powell, 1998).

Table 1.1 Key terms used in Technology Acquisition (Muranishi, 2002)

Term	*Detail*
Technology Licensing	License of rights of technology in return for a license fee, milestone, or royalty. Direct acquisition of technology
Technology Access	Ability to access database of technology usually by means of licensing (not exclusively rights)
Contract Research	One company performs research on behalf of another
Collaborative Research	Co-research contract especially in early stage research
R&D Joint Ventures	Process whereby two (or more) companies combine their efforts and/or resources for R&D. Achieved by formation of a new company, in which each of the companies is nearly equal partner.
Venture Investments	Purchase of part (stock) of a R&D venture company especially for the purpose of technology acquisition.

1.6 Micro, Small and Medium Enterprises

In literature, several definitions of MSME's are given as there is no universal definition. In some countries, there are certain objective standards, which classify the units as micro, small or medium enterprises.

The technical definition varies from country to country in the Asia-Pacific region but is usually based on employment, assets, or a combination of the two. Some countries have different definitions for MSMEs in the manufacturing and services sector and may exempt firms from specialized industries or firms that have shareholdings by parent companies. Table 1.2 illustrates the range of MSME definitions in the Asia-Pacific region.

Table 1.2 MSME Definitions in Asia Pacific region (MSMED Act, 2006; Kotelnikov, 2007)

Country	*Definition of MSME*	*Measurement*
China	Varies with industry, usually less than 100 employees	Employment
Hong Kong	Manufacturing – 100 or fewer employees Other – 50 or fewer employees	Employment
Indonesia	Less than 100 employees	Employment
Japan	Wholesale – less than 100 employees or JPY 100 million assets Services – less than 100 employees or JPY 50 million assets Retail – less than 50 employees or JPY 50 million assets Other – less than 300 employees or JPY 300 million assets	Employment and Assets
Malaysia	Manufacturing – less than MYR 25 million or 150 employees Services – less than MYR 5 million or 50 employees	Shareholders, Funds and Employment
Republic of Korea	Manufacturing – less than 300 employees, or KRW 8 billion assets Wholesale – less than 100 employees or KRW 10 billion annual sales revenue	Employment, Assets and Sales Revenue
Singapore	Manufacturing – fixed assets worth SGD 15 million or less Services – less than 200 employees	Employment and Assets
Taiwan	Manufacturing – less than TWD 80 million of paid-in capital or less than 200 employees Other – less than TWD 100 million annual sales revenue or less than 50 employees	Sales Revenue and Employment
India	Fixed assets in plant and machinery upto Rs 100 million	Assets

1.6.1 MSMEs as driver of Economic Growth and Innovation

MSMEs are the driver of economic growth and innovation. Figure 1.2 describes both the reinforcing dynamics. The total number of MSMEs in an economy depends on the rate of MSME creation and rate of MSME destruction. Profitable market opportunities increase the rate of MSME creation. This increases the total number of MSMEs in the country, which increases job creation and income per capita. As people become wealthier, they increase their consumption, which in turn opens up new market opportunities that entice the creation of more MSMEs. Contrary to multinational corporations, the growth of MSMEs directly benefits the country because most MSMEs are domestic firms. This reinforcing dynamic generates economic growth. The reinforcing loop of innovation also drives economic growth. As the number of MSMEs increases, their knowledge of their product and industry increases. Their knowledge allows them to innovate on the product or process, which helps them form a competitive advantage to generate more profits. Again, market opportunity as captured by the profitability of MSMEs will encourage more people to establish their own MSMEs to capture the opportunity. In addition, the development of MSMEs can also help to achieve other development goals. MSMEs can either provide goods and services in areas critical to development, such as health and education, or provide a source of income to disadvantaged people (Kotelnikov, 2007).

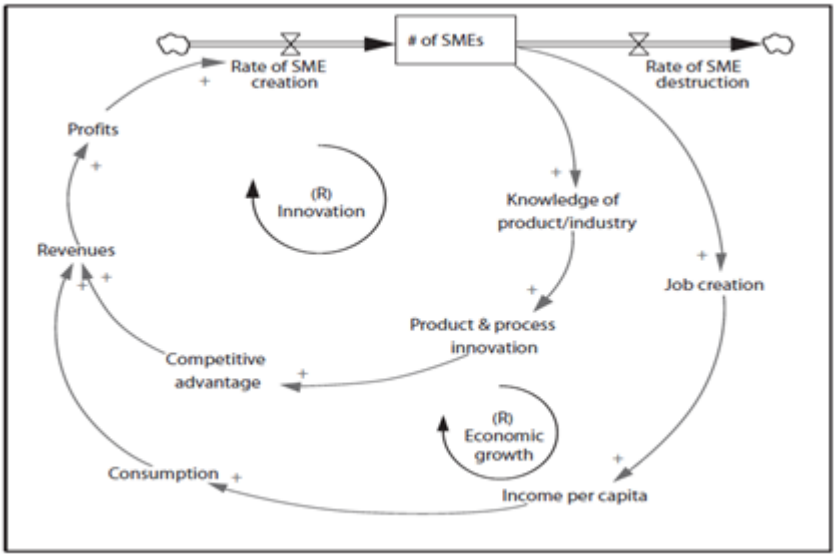

Fig.1.2 MSMEs as a Driver of Economic Growth and Innovation (Kotelnikov, 2007)

1.6.2 Role and Contribution of MSMEs in Economic Development of India

The role and importance of MSMEs has equally been felt even in countries which are classic lands of big business and industrial set-ups. Such industries are very common in Japan, U.S.A., Switzerland, Sweden

and several other countries. In an over populated and developing country, like India, the MSMEs have a vital role to play. The Government, at the centre has made a clear announcement on the importance attached to this sector of industries in its programmes and plan-outlays, from time to time for utilization of the massive manpower in both the rural and the urban areas. MSMEs play a prominent role in overall economic development of the country and contribute significantly to India's Gross Domestic Product and export earnings besides meeting the social objectives including that of providing employment opportunities to millions of people across the country, income equality, balanced regional development and creation of strong entrepreneurial base (Desai, 2006).

1.6.2.1. Expansion of MSME Sector

The MSME sector has recorded a high growth rate since independence inspite of stiff competition from the large sector and not so encouraging support from the government. This is evidenced by the number of registered units which went up from mere 16,000 units in 1950 to 36,000 units in 1961 and to 298 lakh units in 2010-2011. During the last decade alone, the MSME sector has progressed from production of simple consumer goods to the manufacture of many sophisticated and precision products like electronics control systems, micro-wave components, electro-medical equipments, T.V. sets etc. Growth and contribution of MSMEs during the period 2000-01 to 2009-10 is given in Table. 1.3 (Datt and Sundaram, 2007).

Table 1.3 Growth, Production, Employment and Export in MSME sector

Year	*No. of Units (in lakh)*	*Production (Rs. crore)*	*Employment (in lakh)*	*Export (Rs. crore)*
2000-01	101.1	2,61,297	239.1	69,796
2001-02	105.2	2,82,270	249.1	71,244
2002-03	109.5	3,11,993	260.2	86,013
2003-04	114.0	3,57,733	271.4	97,644
2004-05	118.6	4,18,263	282.6	1,24,417
2005-06	123.4	4,97,842	294.9	1,50,242
2006-07	261.0	7,09,398	594.6	1,82,538
2007-08	272.8	7,90,759	626.3	2,02,017
2008-09	285.2	8,80,805	659.4	2,18,227
2009-10	298.1	9,82,919	695.4	2,35.453

Source: Reserve Bank Of India, Handbook of Statistics on the Indian Economy, 2010-2011

Production in MSME sector during the last ten years has recorded an annual average growth rate of 8.6 percent. The share of MSME industries in the countries industrial output is around 56 percent (SIDO, 2009).

1.6.2.2 Employment Generation

Small scale industrial sector is labour-oriented and labor-intensive with relatively high labour-investment ratio. A given amount of capital invested in this sector is likely to provide more employment, at least in short run, than the same amount invested in a large industry. It is estimated that an investment of Rs.1.00 lakh, in fixed assets, in a large industry may create, on an average, employment to 2-4 persons whereas the same amount of investment made in a small-scale industry, for the same purpose, might do so for 10-12 persons. This is one of the main considerations for an overpopulated and developing country, where millions of people are either unemployed or underemployed, to utilize the possible potentiality of this sector for providing employment opportunity not only to the educated and technical manpower but also to the unlimited labour force which has been increasing, day by day, at a relatively low capital cost. Within the manufacturing sector itself, MSME sector contributes about four-fifths of manufacturing employment in India. If a big push is given to the small sector, it can become a stabilizing factor in a capital-scarce economy like India by providing a higher capital output ratio as well as a higher capital employment ratio.

1.6.2.3 Equitable Distribution of National Income

Removal of inequalities in income distribution is one of the main objectives of India's successive five year plans. MSMEs are instrumental in the equal distribution of wealth and income. The income generated in large number of MSMEs are dispersed more widely in the community and also among different geographical regions as compared to the income generated by a few large industries. In small scale industries, the industrial capital is not concentrated in a few hands rather it is widely distributed in small quantities among large number of people throughout the country. Most of the small enterprises are either proprietary or partnership concerned, hence the relationship between the workers or the employers are more harmonious. in small industry than in large industry, MSMEs encourage the distribution of national income and wealth more equally among large number of population and region of the country (Datt and Sundaram, 2007).

1.6.2.4 Contributions to Exports

About 45-50 percent of the Indian exports is being contributed by SSI Sector (SIDO, 2009). Direct exports from the MSME sector account for nearly 35 percent of total exports. Besides direct export, it is estimated that small scale industrial units contribute around 15 percent to exports indirectly. This takes place through merchant exporters, trading houses and export houses. The total export of small scale industrial products has increased from Rs. 69,796 crores in 2000-01 to Rs. 2,35,453 crores in 2009-10 (Table 1.3) which signifies a very significant increase in the total export of SMEs in this decade (Handbook of Statistics, 2012-2011).

1.6.3 Nature of MSME

In both developing and developed countries, promoting small and medium-sized enterprises is one of the most viable strategies for achieving national development goals such as economic development, strengthening the industrial base, and local production structure. There are three crucial functions of MSMEs as the engine of growth in developing countries. First, MSMEs enhance competition and entrepreneurship and therefore, have external benefits on economy wide efficiency, innovation and aggregate productivity growth. Second, MSMEs are generally more productive than Large Enterprises (LE's), but the financial market and other institutional failures and non conducive macroeconomic environmental aspects impede MSME development. Third, the expansion of MSMEs boosts employment more that LEs' growth because MSMEs are more labor-intensive.

Micro, Small and Medium Enterprises (MSMEs) play a vital role for the growth of Indian economy by contributing 45% of industrial output, 40% of exports, employing 60 million people, creating 1.3 million jobs every year and producing more than 8000 quality products for the Indian and international markets. SME's contribution towards GDP in 2011 was 17% which is expected to increase to 22% by 2012. There are approximately 30 million MSME units in India and 12 million persons are expected to join the workforce in the next 3 years. SMEs are the fountain head of several innovations in manufacturing and service sectors, the major link in the supply chain to corporate and the PSUs (SME Chamber of India, 2011).

1.7 Review of Technology Development in India

Fierce competition at both local and international level has forced the organizations to perpetually seek ways to sustain themselves. India has experienced transformation from the regime of regulated economic development to competitive regime since the liberalizations of 1991. The main thrust of this competitive regime is rapid technological developments in India. Although the change in technological pattern in Indian industry is remarkable but India is still rallying behind other developing countries in terms of growth and absorption of new technology, especially to its' Asian neighbors like China and Taiwan. The organizations in India depend on external sources for its technological requirements and often look to organizations from developed countries or other bigger organizations for acquisition of technology. This dependence on other organizations is due to the limited 'know-how' and 'know-why' competencies of organizations. This situation is even grimmer in smaller organizations. Organizations in India especially MSMEs should develop their technological and learning capabilities so that they become more innovative and less dependent on other organizations, if they have to compete at a global level.

Table 1.4 Status of Key Technology Upgradation Input Parameters

S. No.	***Parameter***	***India's Rank***	***China's / Taiwan's Rank***	***Indonesia's Rank***	***Korea's Rank***
1.	*Burden of government regulation*	96	30	44	117
2.	*Transparency of government policymaking*	58	5	87	128
3.	*Quality of overall infrastructure*	86	25	82	18
4.	*Quality of railroad infrastructure*	24	12	52	8
5.	*Quality of the educational system*	38	19	44	55
6.	*Availability of research and training services*	58	21	61	39
7.	*Extent of staff training*	63	30	52	41
9.	*No. procedures to start a business*	119	34	94	78
10.	*Cooperation in labor-employer relations*	46	17	68	140
12.	*Availability of financial services*	45	24	57	90
13.	*Easy access to loans*	35	26	16	127
15.	*Firm-level technology absorption*	41	13	54	8
16.	*Local supplier quantity*	14	5	57	25
17.	*Local supplier quality*	67	12	68	27
18.	*Production process sophistication*	44	16	56	23
19.	*Capacity for innovation*	35	15	30	20
20.	*Quality of scientific research institutions*	34	19	55	25
21.	*Company spending on R&D*	33	9	31	11
22.	*University-industry collaboration in R&D*	50	12	41	25
23.	*Availability of scientists and engineers*	21	5	45	23
24.	*Utility patents granted/million pop.*	59	1	86	5
25.	***Overall Global Competitive Index***	**56**	**13**	**46**	**24**

Source: (Global Competitiveness Report, 2011-2012)

As per the Global Competitive Report (2011-2012), India's overall Global Competitive Index is 56 out of 142 participating countries. The gap between overall Competitive Index of India and its major competitors from Asia-Pacific region like China, Korea and Indonesia has widened over the years, especially China. According to Global Competitive Report (2011-2012) this gap has increased six folds from 0.1 to 0.6 points between India and China over the last five years. This situation is mainly attributed to poor overall infrastructure in India.

Also India (35) is way behind China (15) in terms of capacity to innovate, this is mainly due to lack of company spending on R&D, lack of Industry-University Collaboration, lack of good quality research institutes, lack of availability of engineers and scientists and number of utility patents granted. In all these parameters India is rallying behind China, which has resulted in poor innovation capability in Indian industries. Korea another competitor of India is although behind in terms of government regulations, policies and cooperation in labor-employer relationship but it is still ahead of India in terms of overall Competitive Index (24) due to the same reasons as discussed above.

If the findings of Global Competitive report are to be considered as a benchmark, India needs to put emphasis on its overall infrastructure, staff training programs, Industry-University Collaborations, company's spending on R&D so as to become more competitive. Also India must improve on its technological capability competencies and firm level ability to absorb new technology and become more innovative and competitive.

1.8 Organization of the Thesis

The write up of the thesis is divided into five chapters as discussed as follows. Overall structure of thesis is presented in Figure 1.3.

- **Chapter I** highlights the importance of MSMEs and the need for technology upgradation in the manufacturing industry. It justifies the need of the present work. It highlights the aim of the research and presents the organization of thesis.
- **Chapter II** reviews in detail the previous studies to identify the factors which facilitate the technological innovations in manufacturing enterprises. The broad areas identified are entrepreneurs role, regulatory corroboration, technology infrastructure and linkage capability. The key research outputs have also been identified. The chapter also identifies the main limitations in the existing literature.
- **Chapter III** introduces overall design of the study, which includes phases of research and methodology adopted for carrying out the research work. The details of work done in each phase, tools, techniques and models used in the dissertation have also been presented in this chapter.
- **Chapter IV** presents the survey based research results conducted in various manufacturing enterprises. Descriptive and empirical analyses of data collected through the survey have been carried out to assess the status of present level of different dimensions of research problem.
- **Chapter V** covers the summary of research work, its results, conclusions, and the recommendations. The limitations along with scope for future work have also been covered in the chapter.

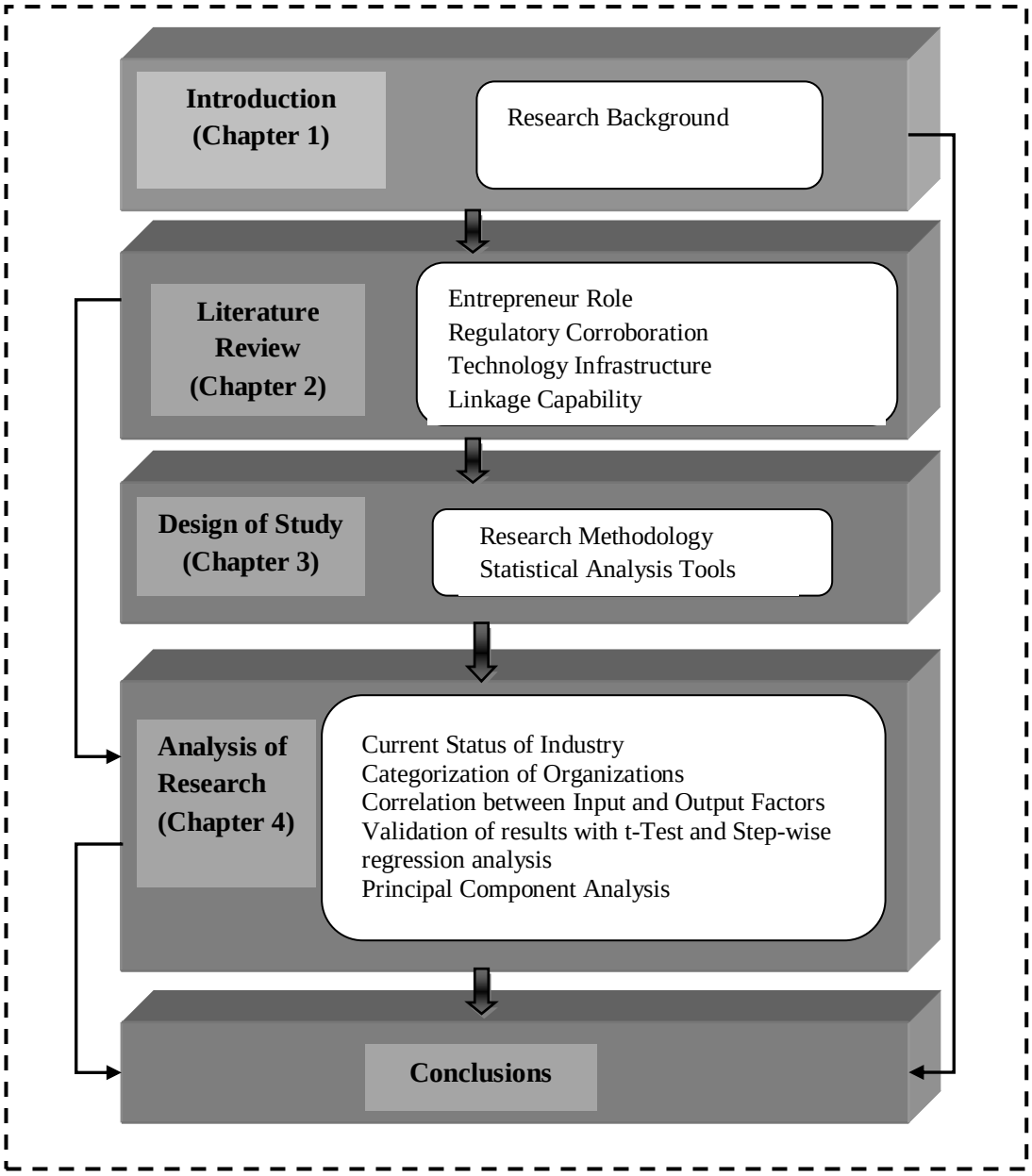

Figure 1.3 Thesis Structure

1.9 Concluding Remarks

Globalization in the broader sense of 'increasing internationalization of production, distribution and marketing of goods and services' has resulted in the opening up of markets, thus leading to intense competition. To survive/ grow in a competitive environment, a small enterprise must enhance its own competitiveness. A firm in general may adopt different methods/approaches to enhance competitiveness, such as advertising, cost cutting, network building, relationship with large firms etc. However, among all, technological innovation is considered to be an important strategy which small enterprises must adopt for

competitiveness enhancement. Among different sizes of firms, small firms are ideally suited for carrying out technological innovations due to their flexibility and willingness to adopt a new approach. The development and protection of a distinctive, innovative capability is a major determinant of the small firms' competitive success. With this, it is certain that small firms' should focus on improving their technology though innovative capability for enhancing their economic performance as a means of survival and growth. Review of the literature is the first logical step in a research effort and the next chapter is devoted to the same.

Chapter - II

LITERATURE REVIEW

2.1 Introduction

The previous chapter gave a brief overview of the need of technology upgradation in small and medium enterprises, apart from an introduction of the research problem. It is evident that research studies related to technological innovations in small enterprises have a lot of contemporary relevance in aiding the small enterprises in the developing countries to be more competitive. This chapter attempts to record in brief, the findings from literature on various aspects of technology development initiatives in the manufacturing sector and elucidates their interaction with performance enhancements.

The literature reported has been organized into the following broad headings:

- Innovation
- Entrepreneur Role
- Linkage Capabilities
- Technological Infrastructure
- Regulatory Corroboration

2.2 Innovation

The term 'Innovation' seems to be derived from the Latin novus, which means new, young or novel. For most people 'to be innovative' means to be creative and/or to make something new.

Innovation in firms has been one of the primary themes in economic research for many years. Beginning with Schumpeter's (1934) intuition on the role of the "innovative" entrepreneur, the field has considerably widened and now includes numerous different aspects. The meaning of the word 'innovation' however, has altered significantly in recent decades. This word was originally linked to the role of research and development (R&D), whereas currently, it tends to be associated with the knowledge used in the process of generating new ideas (Lasagni, 2012). Unfortunately, there is no single accepted definition of the term 'innovation'. For some people it means a new idea, for others it means an invention (a materialized new idea), for some it means a new product (a developed invention), for some others it means the act of creating a new product or process, while for others it means to create a new business. (http://en.wikipedia.org).

Innovation is the creation of the new or the re-arranging of the old in a new way. Innovation is the implementation of any new or significantly improved product (goods or services), operational processes (methods of production and service delivery), any new marketing methods (packaging, sales and

distribution methods), or new organizational or managerial methods or processes in business practices, workplace organization or external relations (Gronum *et al,* 2012*).*

2.3 Entrepreneur Role

In evolutionary economics, firms were the key actors, while the individuals were viewed as interchangeable and their actions determined by the firms they are in. However, new firms are innovative largely because they are propelled by singular individuals. One of the few economists to have recognized the profound impact of enterprising individuals was Schumpeter. Sociologists describe an agent as an individual with "transformative capacity", such that "whatever happened would not have happened had that individual not intervened". In this way, agency does not refer so much to intentions, as to capabilities (Nelson, 2000).

To be an entrepreneur means to be an agent of change. The entrepreneur and his function are not difficult to conceptualize: the defining characteristic is simply the doing of new things or the doing of things that are already being done in a new way i.e. innovation (Schumpeter, 1935). Yet, the entrepreneur was not to be confused with the inventor, for while the inventor produces ideas, the entrepreneur gets things done. In line with Schumpeter, other prominent analysts have defined entrepreneurs as individuals that create "a new market" with a "new customer". The implication of this more rigid definition is that to be in charge of a new, small business does not make one an entrepreneur. Rather, entrepreneurs are individuals that "create something new, something different: they change and transmute values" (Drucker, 1985).

It was Schumpeter (1935) who analyzed the theory of entrepreneur from a new perspective. According to him, development is the burst of economic activities. When the stationary equilibrium is disturbed, development takes place. This change or disturbance comes forth in the form of 'innovation'. For Schumpeter, the entrepreneur is an 'innovation' who is characterized by potentialities of doing new things or doing things in a new way. Entrepreneur is an economic man who tries to maximize his profits by innovations. Innovation involves problem solving and entrepreneur is a problem solver. Thus, according to Schumpeter, entrepreneur is a person who foresees the opportunity and tries to exploit by introducing a new product, a new method of production, a new market, a new source of raw materials or a new combination of factors of production. The project leader of an innovation project needs to be an entrepreneur to be able to build up a new successful business (Ottosson, 2004a).

Figure 2.1 shows in principle the importance of different "components" when making a successful innovation project. The importance of the product–i.e. the product idea/ invention/ business idea-is very small and decreasing from when the innovation project started. Often it is only a door opener to a new business and in the long run the successful product will be quite different from the initial product idea/invention. A good entrepreneur will see to it that the business is good even with a poor product idea/

invention/ business idea to start with. A good product idea/invention/business idea with a not so good entrepreneur will be a disaster. Thus, the entrepreneur is critical to success and she/he is the critical factor for a long time after the start of the project (Ottosson, 2004b).

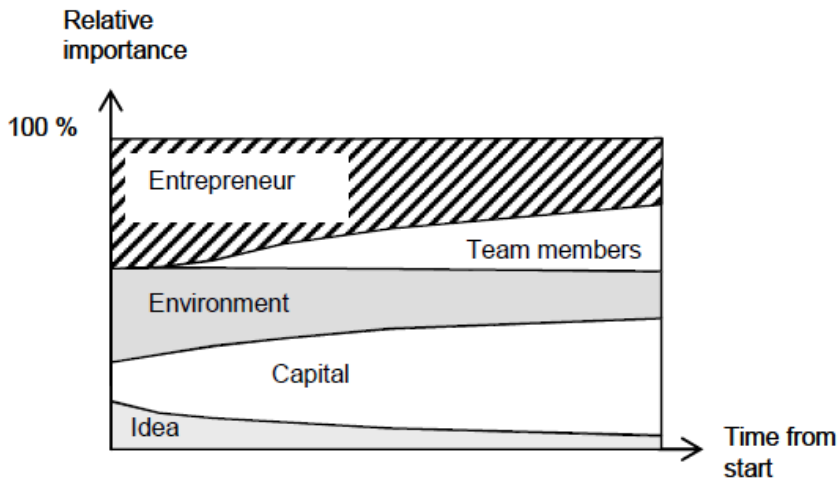

Fig. 2.1 Success Factors of an Innovation Project from the start and onwards (Ottosson, 2004a)

The positive impact of entrepreneurship arises through a number of mechanisms, such as knowledge spillovers, enhanced competition or increased diversity. Entrepreneurs are motivated by the anticipation of profits, and therefore have to be "alert" to search the market for opportunities and innovations that bring improved goods to the market place (Feldman and Audretsch, 1999).

In SMEs, the critical resources are likely to be held by the individual entrepreneurs that are reflected in their skills, knowledge, abilities, experience, and education (Edelman *et al.*, 2002). Being the key decision makers, the entrepreneurs have high influence on the formation of business strategy and are responsible to set the roadmap for their firms to move towards the set goals (Masurel *et al.*, 2003).

Engaging in entrepreneurial role involves performing activities such as developing challenging but achievable vision, formulating strategies, perceiving unmet consumer needs, scanning the environment, spotting high quality opportunities, and producing superior products or services (Chandler and Hanks, 1994). These roles require entrepreneurs' alertness, innovativeness and creativity, strong commitment and conceptual ability to seek, identify, assess, and seize opportunities and transmute them into profitable outcomes. The ability to select high quality opportunities and devise appropriate strategies to turn these opportunities into reality may have a considerable impact on venture performance (Wang and Ang, 2004). Engaging in entrepreneurial role demands entrepreneurs to continually seek out customer needs and find ways to offer their product and services in such a way that what they are offering is more attractive than others (Tracy, 2005). This requires ability to use appropriate strategies and tactics in commercializing their products or services. Entrepreneurs must also be willing to experiment different strategies in the pursuit of

profitable outcomes because it is the entrepreneur's energy, creativity, and motivation that trigger the production of superior product and services (Baum and Locke, 2004).

There is no denial to the fact that the pace and progress of an economic system largely depends on the emergence of dynamic and innovative entrepreneurs. Instead of being dependent on the government subsidies and protections they have to play the role of change agents. Their ability to innovate and take risk decides the fate and direction of a country's economy. The successful entrepreneurs of USA, Japan, Korea and other Asian tigers have proved this point. The conception and effective implementation of any individual project, irrespective of its size, largely depends on the availability and capability of innovative entrepreneurs.

There are various factors like change from present life style, childhood family environment, education, personal values, age, work history, role models and support systems, moral support network and professional support network which goes in building successful entrepreneurs (Kazmi, 1999). There are three factors that influence entrepreneurship −antecedent influences (back ground factors such as family influences and genetic factors that affect motivation, skills and knowledge), the incubator organization (the nature of the organization where the entrepreneur was employed prior to starting the business, the skills learned there) and environmental factors (economic conditions, access to venture capital, support services and role models) (Cooper (1985). A key distinguishing feature of a successful SME is a balanced alignment of the owner-entrepreneur's intention, his/ her business abilities, and environmental opportunities (Sirec and Mocnik, 2010). Entrepreneurship and innovation are fundamental drivers of economic growth and wealth creation in our economy and of a firm's long-term survival, profitability, and growth (Classen *et al.,* 2012).

2.3.1 Defining Entrepreneur and Entrepreneurship

Entrepreneurship is the process of creating something new with value by devoting the necessary time and effort, assuming the accompanying financial, psychic and social risks and receiving the resulting rewards of monetary and personal satisfaction and independence. This definition stresses four basic aspects of being an entrepreneur. First, entrepreneurship involves the creation process i.e. creating something new of value. The creation has to have value to the entrepreneur and value to the audience for which it is developed. Second, entrepreneurship requires the devotion of the necessary time and effort. Third aspect involves the rewards of being entrepreneur. The most important of these rewards is independence, followed by personal satisfaction. Fourth and final aspect of entrepreneurship is risks (Hisrich *et al.,* 2008).

There is no univocal definition of entrepreneurship as different scholars have expressed divergent views on what constitutes the concept of entrepreneurship. The description of these terms is presented in Table 2.1.

Table 2.1 Description of Entrepreneur/Entrepreneurship

S. No.	*Definition/ Description*	*Supporting Literature*
1	Entrepreneurship and the entrepreneur is the dynamic process of creating incremental wealth. This wealth is created by individuals who assume major risks in terms of equity, time, and/or career commitments to provide value for some product or service	*Ronstadt, 1988*
2	Entrepreneur was derived from the French word "entre" meaning "between" and "prendre" being the verb "to take". This means the one who takes the risk in the economy between supplier and customer. Entrepreneurship suggests innovations and risk-taking	*Woodward et al., 1994*
3	Entrepreneurship is an activity that involves discovery, evaluation, and exploitation of opportunities to introduce new goods and services, ways of organizing, markets, processes, and raw materials through organizing efforts that previously have not existed	*Shane and Venkantaraman, 2000*
4	Entrepreneurs are the people who have the ability to see and evaluate business opportunities, gather the necessary resources to take advantage of them and initiate appropriate action to ensure success. Therefore, a typical entrepreneur is a risk taker, a man who braves uncertainties, strikes out on his own and through nature with devotion to duty and singleness of purpose, somehow creates a business and industrial activity where none existed before	*Henry et al., 2005*
5	Entrepreneurs are individuals who recognize opportunities where others see chaos and confusion. This means that entrepreneurs are elements of change in the midst of economic hardship. They are aggressive catalysts for change within the market place	*Donald and Richard, 2007*
6	Entrepreneur in an economist perspective is one "who brings resources, labour, materials, and other assets into combinations that make their value greater than before".	*Hisrich et al., 2008*
7	Entrepreneurs introduce changes, innovations and a new order to a phenomenon so as to arrive at an alternative-possible end. If a good/solid entrepreneurial spirit is not cultivated by people, most of the poverty alleviation/wealth creation programmes of governments and private bodies would just be an exercise in futility.	*Ayinde, 2011*

Entrepreneurs incorporate changes in the organization through innovation, risk taking abilities and creativity and lead to development of the organization. There are certain other demographic factors of entrepreneurs like age, education, training, work experience which lead to the development of the SMEs (Islam *et al.*, 2011).

The important issues under this key area are discussed in Table 2.2.

2.4 Linkage Capabilities

Linkage capabilities are the skills needed to transmit information, skills and technology to, and receive them from, component or raw material suppliers, subcontractors, consultants, service firms, and technology institutions. Such linkages affect not only the productive efficiency of the enterprise (allowing it to specialize more fully) but also the diffusion of technology through the economy and the deepening of the industrial structure, both essential to industrial development (Lall, 1992).

Table 2.2 Key Issues in Entrepreneur Role factor

Factors	***Description***	***Supporting Literature***
Entrepreneur Education	• The educational background of the managers, business owners and entrepreneurs has been found to be an important factor explaining innovation in small businesses. Self-employed people with stronger educational backgrounds can carry out a more professional and efficient management and organization of their businesses and, in this way, can be more successful implementing innovations. • Education helps the entrepreneur to understand new information that could help him to develop higher technological capabilities. Education and literacy opens up a wide number of channels through which new technological knowledge can be obtained. Literature about the diffusion and adoption of innovations has shown that education may affect people's attitudes in favour of early adoption of new technology. • The advantage with having technical education background is that it would enable an entrepreneur to impress upon a trans-national-corporation towards forging subcontracting relationship and receive more technical assistance as compared to a non technical entrepreneur. • The educational attainment of the family CEO may influence a family firm's openness toward a diversified set of innovation related collaboration channels.	*Koellinger, 2008; Bala Subrahmanya, 2010, Classen et al., 2012, Romero and Martinez-Roman, 2012*
Entrepreneur Training	• Entrepreneur training is likely to have a more direct impact than education. Training is likely to have special effects on production capabilities. Training would presumably impart knowledge and skills that can be readily applied. • The performance of an entrepreneur is determined by a combination of motivation, entrepreneurial skills and business skills. This then would indicate that each of these would need to be covered in entrepreneurial education and training to produce the greatest probability of success. • Technical competencies are required so as to facilitate entrepreneurs in handling business related tasks which require specific expertise and also in training the employees on tasks relevant to business. Training employees internally by entrepreneur himself would reduce cost of training. • Maintaining competitiveness relies not only on job-specific training, but also on a greater degree of formal training. The advantage of formal training is the gai of accredited experience and knowledge from other sources. MSMEs that conduct management training show a statistically significant advantage in terms of both employee and turnover growth.	*Winterton, 2002; Jagersma, 2008; Ahmed and Seet, 2009; Tahir et al., 2011*
Prior Working Experience and Occupational Background	• Industry experience and work experience lead towards development of a successful entrepreneur. Many of the MSMEs and start ups which are very successful today are largely being promoted by entrepreneurs with solid work experience. • Previous experience is another conditioning factor in self employment, which can significantly influence innovation in small businesses and start-ups. Innovation, as the result of a process of knowledge accumulation, benefits from previous experience in a particular field. • Entrepreneurship is a dynamic concept and no specific personality attribute can generate success. However, the technical knowledge and skill, parental support, previous job experience may help an entrepreneur to compete successfully in the market. • The previous occupational background greatly influences the entrepreneurial venture by which the entrepreneur is able to bring all his knowledge and experience in to the new business. Work experience gives the relevant skills to identify a business opportunity and the technical capabilities to produce the product or give the identified service	*Dahlqvist et al., 2000; Romero and Martinez-Roman, 2012*

MSMEs, in general, are constrained in terms of resources such as technology, finance, marketing and human resources. The ability of MSMEs to compete in the global market depends on their access to these resources and those MSMEs that have better access to these resources are able to exhibit better innovative and economic performance. External Linkages with large enterprises (LEs) provides MSMEs better scope for accessing these resources (Kumar and Bala Subrahmanya, 2010). These partnerships are developed to create value by externally accessing and leveraging strategically critical resources to support the firm's innovation process.

Table 2.3 Classification of Linkage Capabilities (Jagersma, 2008)

Type	Capability	Definition
Learning-by doing, Simple	Local Procurement of Goods and Services	This covers all activities that involve buying, contracting, purchasing, sourcing or tendering within local environment.
	Information Exchange with Suppliers	Hand over and receive information about processes and products with suppliers and customers.
Import of technology, Search Based	Coordinated Design	Inclined to work together with another or others for a product or system design that can be plugged in, turned on, and operated with little or no additional configuring due to cooperation with each other.
Formal R&D Research-Based	Cooperative R&D	Research and development – all activities related to the evolution of new products and services inclined to work together with another or others for a common purpose.
	Licensing own Technology to others	Business arrangement in which the manufacturer grants permission of a product to manufacture that product (or make use of that proprietary material) in return for specified royalties or other payment.

A considerable share of innovating firms establishes strategic R&D links with suppliers, customers, competitors, and universities simultaneously. Companies collaborating with customers primarily search for new ideas or ways to reduce uncertainty associated with market introduction of innovations. In contrast, partnerships with suppliers generally aim at input quality improvements or cost reductions from process innovations (Classen *et al.*, 2012).

With the pace of technology development, access to knowledge and resources from outside the firm is becoming increasingly important (Edwards and Delbridge, 2001). Empirical evidence shows that large firms tend to rely more on internal factors like formal R&D and accumulated technology (Yin and Zuscovitch, 1998) while small firms rely more on external linkages with customers and suppliers for their innovations (Lee, 1995). External linkage of SMEs with LEs is an important source for transfer of technologies, leading to innovative performance of SMEs (Rothwell, 1991).

Technology acquisition in developing countries can be related to three major sources, viz., adaptive, basic or innovative research through in-house R&D efforts, arm-length purchase of designs and drawings through payments of royalty or fees and imports of capital goods with embodied technology (Narayanan and Bhat, 2009). But small firms with limited in-house resources tend to be less R&D intensive and the ability of these SMEs to innovate depends on their access to external sources of resources needed for innovations. Most innovative small firms are involved in extensive and diverse links with a variety of external sources of knowledge and expertise (Freel, 2000). Acquiring knowledge and skills through external collaboration has become an effective and efficient way towards the success of innovations for SMEs (Kaminski *et al.,* 2008). Small firms need to have radical innovations as well as a large number of minor innovations and formal and informal channels as external technical sources are of crucial importance to them. Formal channels can be of technological licensing agreement whereas informal channels include

suppliers, buyers, domestic R&D institutions or universities, government agencies and academic or technical literature (Lee, 1995).

A great variety of organizational modes can be adapted to access external sources of technology as shown in Table 2.4.

Table 2.4 Organizational Modes for Technological Collaboration (Roberts and Berry, 1985; Milson et al., 1996)

Collaboration Type	*Description/Definition*
Acquisition	A company acquires another company in order to access a technology (or technological competence) of interest.
Educational Acquisition	A company recruits experts in a certain technological discipline or acquires a smaller company, in order to obtain people familiar with a certain technological or managerial competence.
Merger	A company merges with another one that possesses a technology (or technological competence) of interest, and a new company emerges from the two existing companies.
Licensing	A company acquires a license for a specific technology.
Minor Equity	A company buys an equity in the source organization in which a technology of interest is embedded, but does not have management control.
Joint Venture	A company establishes a formal joint venture with equity involvement and a third corporation is created, with a definite objective of technological innovation.
R&D Contract	A company agrees to fund cost of R&D at a research institute or university or small innovative firm, for a definite technology.
Joint R&D	A company agrees with others to jointly carry out research and development on a definite technology (or technological discipline), with no equity involvement.
Research Funding	A company funds exploratory research at a research institute or university or small innovative firm to pursue opportunities and idea for innovation
Alliance	A company shares technological resources with other companies in order to achieve a common objective of technological innovation (without equity involvement).
Consortium	Several companies and public institutions join their efforts in order to achieve a common objective of technological innovation (without equity involvement).
Networking	A company establishes a network of relationships, in order to keep the pace in technological discipline and to capture technological opportunities and environment trends.
Outsourcing	A company externalizes technological activities and, then, simply acquires the relative output.

The important issues under this key area are discussed in Table 2.5.

2.5 Technology Infrastructure

Technology infrastructure has become critically important in a world characterized by an abundance of emerging technologies. All major technology breakthroughs require a surrounding infrastructure (Best and May, 1997). Organizational structure should be such that there are adequate funds, materials, production facilities and information support system to sustain innovation (Amabile, 1996; Ghorbani and Bagheri, 2008).

The important issues under this key area are discussed in Table 2.6.

2.6 Regulatory Corroboration

Government can create the right economic, fiscal and regulatory framework within which innovation and entrepreneurship can flourish. It can help raise the awareness of benefits of innovation, of adopting a

progressive strategic management practice and provide sufficient financial resources for efficient business support services (Beaver and Prince, 2002; Hyland and Beckett, 2005).

Government assistance offered to SMEs can basically be divided into two sub-groups: financial and technical. Financial assistance includes various forms of investment incentives and soft policy loans. It includes contributions in capital accounts and interests, financing at concession rates, guarantee concessions or tax incentives (linked to economic policies that directly support SMEs). Technical assistance consists of human resource training, export promotion initiatives, and quality and technology programs (Zeng *et al.*, 2010). Government assistance for SMEs provides potential benefits in creating employment opportunities and establishing a seedbed of growing firms as well as improving innovation and competitiveness (Johnson *et al.*, 2000).

Table 2.5 Key Issues in Linkage Capability factor

Factors	***Description***	***Supporting Literature***
Inter-firm Linkages and Subcontracting	• Inter-firm linkages involve all possible forms of economic relationships between firms to gain competitive and cooperative advantages. Inter-firm linkages can take several forms: backward, forward or horizontal. Backward linkages exist when large firms acquire goods or services from smaller firms and forward linkages occur when one firm sells goods or services to another firm mainly for distribution. Horizontal linkages involve interactions with firms of the same industry for joint ventures • Subcontracting relationship of SMEs with LEs is an important source for transfer of technologies, leading to innovative performance of SMEs. The international expansion of trans-national corporations (TNCs) to developing countries in the globalization era provides increasing opportunity of subcontracting relationships for local SMEs and an important source of technology resulting from the linkages that SMEs can forge with TNCs. • Comparison of the innovation-related characteristics of large firms with those of small firms reveals that in many cases an innovative disadvantage of large firms is an innovative advantage for small firms, and vice versa, which can make collaboration between firms of two different sizes desirable for both parties. Thus alliance between small and large firms, which characteristically possess complementary resources, can facilitate innovation success. • In subcontracting relationship, subcontractors (SMEs) deliver product or service to the contractors (LEs) as specified by the latter for their production requirements. Subcontracting firms receive assistance from the contractor and the degree of inter- firm linkages between the participating firms has to be assessed in terms of the assistance provided by the contractor to the subcontractor. • From an operational perspective, there are many forms of collaboration, ranging from one-to-one alliances through to multi-firm industrial clusters. Whilst the nature of alliances may differ, they all have to confront a number of common issues such as: *integration, organizational barriers, trust, and ongoing learning*.	*Meyanathan and Munter, 1995; King et al., 2003; Hyland and Beckett, 2005; Kumar and Bala Subrhmanya, 2010*
Collaboration between Industry and Academia	• Industry–University (I-U) alliances represent an evolving trend for the advancement of knowledge and new technologies. Collaboration between industries and universities has emerged as one of the priorities in the OECD countries and has become a trend in European innovation policy. Relationships of this type have long been considered crucial to the development of the innovation system in any country. • The collaboration of university and industry leads to mainly two types of transfers from university to industry, these are R&D results transfer and technology transfer. The R&D results transferred leads to innovative ideas in industry which leads to new product development with the help of technology transfer from university to industries. • For firms, U–I collaborations provide access to new knowledge and technologies, can solve technological problems in products and manufacturing processes, and maintain access to highly trained students, facilities and faculty members in university. • Industry-University research strategic alliance is a new pattern to convert economic growth methods as well as to implement the scientific outlook on development. Among partners external to the firm, collaboration with universities has been championed as a vital component of innovation in knowledge-intensive sectors within regions. Industry-University collaboration can stimulate learning and help drive the advancement of new technologies.	*Mansfield, 2000; Angel, 2002; D'Este and Patel, 2007; Betts and Santoro, 2011; Feng et al., 2011,*

Table 2.6 Key Issues in Technology Infrastructure factor

Factors	***Description***	***Supporting Literature***
Information and Communication Technology	• Information and Communication Technology (ICT) refers to a wide range of computerized technologies. ICT is any technology that enables communication and the electronic capturing, processing and transmission of information. These technologies include products and services such as desktop computers, laptops, handheld devices, wired or wireless intranet, business productivity software such as text editor and spread sheet, enterprise software, data storage and security, network security and so on. • Information Technology (IT) enabled operations focus and help the organizations, to transform marketing and production activities that are considered necessary to directly produce new product, improve quality and provide various channels of delivery to meet customers' expectations. Per se, it plays a vital role in the sustained growth of business organizations. • ICT in SMEs can be used as a business tool to reduce costs, create stronger links with customers, create innovations and facilitate market niche. In recent times, the current use of ICT in many organizations causes some forms of revolution in their business practices. ICT offers promising opportunities to organizations in order to meet the challenges of an ever-changing environment. ICTs have a remarkable potential to contribute to sustained competitive advantage for businesses, having been identified as key tools in management processes. • ICTs' adoption in SMEs has assisted to provide a means to access, process and distribute greater amounts of data and information quickly, in order to make thoughtful decisions. Hence, SMEs are embracing the state-of-the-art technologies to enable them penetrate into the international markets and remain competitive. • Use of ICT enables strategic management, communication, collaboration, information access, decision making, data management and knowledge management in organizations. ICT helps to increase business competitiveness and enhance enterprise performance through indirect cost savings such as labor costs and increased labor productivity and direct cost such as reduction of firm's input.	*Chahal and Kohli, 2006; Adeosun et al 2009; Maldeni and Jayasena, 2009; Ongori and Migiro, 2010; Apulu and Latham, 2011*
Project Resources	• Project resources include an array of elements: people with necessary expertise, sufficient funds, material resources, systems and processes for work, and relevant information. The physical environment or setting influences the degree to which divergent thought process is used. Divergent thinking has a broad, relaxed focus of attention that requires a sense of psychological safety and peacefulness. • Appropriate space and resources enhance organizational creativity. Resources are important not only for functional support, but also because having an adequate level of resources for the task/ project influences workers' perceptions that the project is valuable and worthy of organizational support.	*Amabile, 1996; Arad et al., 1997; Pihkala et al., 2002; Doloreux and Melancon, 2009*
Modernization and Renovation Programs	• The absence of adequate infrastructure services is one of the main problems that hinder efforts to develop technology. Innovative organizations have better systems and technology in place than their competitors. • Capability base of manufacturing firms is enhanced through internal learning, involving investments in formal R&D, experimentations, and making minor adaptations to products, processes and organizations, among others. Organizations, which are able to continually build new strategic assets faster and cheaper than those of their competitors, are able to create long-term competitive advantages. • For better technological advances, new infrastructures (mainly telecommunication), information technology, modern production systems and new strategic thinking practices are needed. Advanced equipment and resources are the most important factors to support public and private projects regarding research and development, innovation and technology modernization.	*Man et al., 2002; Sheel, 2002; Laforet and Tann, 2006; Ridley et al., 2006; Vargas and Rangel, 2007*
Financial Support to Research Initiatives	• Developing an adequate financial program that supports training and educational activities for innovation, and building a physical infrastructure for enhancing organizational capabilities are the key success factors for highly innovative companies. • Manufacturing organizations in developed countries spend substantial fraction of annual turnover on technology development. Having an innovation budget is one of the main factors that distinguish innovative firms from their less innovative counterparts. Management clearly earmarks funds for R&D activities aimed at innovations for new product and process developments. • Technology finance is clearly a necessary process, as intangible assets such as technology and knowledge have become increasingly important factors should be increasingly allocated to technology innovation-type small and medium-sized enterprises, the central axes of the knowledge-based economy, in order to strengthen their innovation capabilities when R&D investments are made primarily by large enterprises.	*, Souitaris, 2002; Huang, 2008, Lee and Lee, 2010*

A majority of enterprises rely on their own perceived skills at the time of start-up, and continue to rely on their own resources. The perception of services offered by government to small units is evaluated as insufficient by entrepreneurs. It is reported that the diverse programs created by government largely fail to be adequate for production enterprises, as policies and actions are inconsistent. As a consequence, organizations rely heavily on informal support. Governments should remove common hurdles affecting

growth-conducive environments, develop basic infrastructure, and ensure smooth functioning of its organizations (Singh *et al.*, 2008).

The important issues under this key area are discussed in Table 2.7.

Table 2.7 Key Issues in Regulatory Corroboration factor

Factors	***Description***	***Supporting Literature***
Government Policies and Procedures	• Policy restrictions and complex procedures greatly hinder the growth of small firms. Reforming the policies and simplifying regulations are thus preconditions for boosting the growth of small-scale sector. Policy makers need to understand much better the motivations and requirements that shape and drive an innovative firm. • Government can act as a facilitator of technical change and leveraging, working in collaboration with other stakeholders rather than dictating policies from above. • The government support to promote firm innovation in the form of subsidies, tax incentives, and/or loans encourages increased innovation-related activities. Governments can encourage innovation and economic growth by supporting R&D projects with the potential to generate high social rates of return. • Governments can encourage innovation by first, providing good data on scientific and technological trends, and networking, both nationally and internationally. Second, government policies have to reflect realities of the new innovation process. Third, government has to increase investments in universities and technical education, and put efforts on industrially-relevant research and training. Fourth, the government itself has to be innovative; its policies, regulations and laws need continually to be examined from the perspective of whether they support or constrain innovation. • Governments should develop policies for technological innovations, both on a global and local scale, using tools, especially geared towards improving the links between firms and research. These tools involve, creation of infrastructures for assistance and technological transfer to small units, first and foremost to technological and scientific parks and innovation service centers, linked, in an optimal situation, to research and university centers.	*Kharbanda, 2000; Hyland and Beckett, 2005, Hansen et al., 2009, Nauwelaers and Wintjes, 2010, Kang and Park, 2012*
Government Funded Programs	• Government can support programs to build infrastructure as well as incentives (such as tax incentives) and special start-up programs to develop private sector. Factors under infrastructure facilities are related to transport, market information, credit, power, water, telecom, technology upgradation and quality certification; non-infrastructure category includes interaction with government, taxation, and manpower availability. Government can assist organizations in several ways such as through collaborative training programs; R&D programs among government-funded research centers and universities for specific sectors; effective reward schemes; providing laboratories for R&D work; and funding R&D projects. • Government can provide a supportive environment conducive for growth. Business environment is assessed by the extent of delay in obtaining government permissions and clearances. Further, in a large developing country, with infrastructure being provided largely by the regional (or state) governments, there exist considerable intra-regional variations in quality and cost of infrastructure facilities. • Government can also play an important role in enabling industry to be creative through correction of market failures, providing support where benefits of creativity and design are wider than those for the firm itself, or where there are gaps in the efficient supply of finance by the market. It can provide sector specific specialist advice within the manufacturing industry and provide more financial and tax incentives. • Government takes on a dual role of investor and facilitator through industry policy by financially supporting firms' research and development and stimulating networking activities among organizations involved in the innovation process. Government support is particularly important for SMEs who face an inherent shortage of internal resources.	*Kharbanda, 2000; Hyland and Beckett 2004; Laforet and Tann, 2006; Jong and Stout, 2007; Kang and Park, 2012*
Financial Support to Research Initiatives	• Small units often face economic, institutional and legal obstacles. Such restraints include limited ability of acquiring sufficient amount of credit (including initial capital and longer term credits), inadequate infrastructure support, high transaction costs, limited managerial and technical know-how and so forth. Despite these obstacles, which are mostly interdependent, the general opinion on which supporting policies are based stems in the fact that a lack of finance makes up the principal restraint in their growth and intensification. • Government support can be categorized as *direct*, and *indirect capital investment*. *Financial direct investment* refers to the capital that the state applies to the field of science and technology. This expenditure is in the nation's financial budget. The ways in which governments fund science; in the institutions that distribute funding; and in organizations that carry out research reflects far-reaching changes in the relationship between science, industry and society.	*Garrett-Jones et al., 2005; Soderbom et al., 2006; Elaine and Derek, 2007; Jaehoon, 2010*

2.7. Theoretical Models

Rothwell (1991) explained that subcontracting manufacturing can be an important means of gaining access to new production technologies for many small firms and can enable firms to innovate products requiring

new production techniques, without having to invest initially heavily in expensive, sophisticated production equipment. The study was carried out on small and medium manufacturing organizations of United Kingdom. Most of the SMEs, which are basically subcontractors for other companies, do not perform R&D in any formal sense and much of their technology is derived from their customers. Engaging in external technical and other linkage activities can increase the technical, market and managerial know-how of the small firm and can form an important part of its overall innovatory activities.

Lee (1995) based on the study on technological acquisition strategies of small firms and innovation in the Korean electronics industry, emphasized the need of radical innovations as well as a large number of minor innovations in order to maintain technological leadership in competitive industrial markets for small firms. Small firms have formal and informal channels as external technical sources. Formal channels can be of technological licensing agreement whereas informal channels include suppliers, buyers, domestic R&D institutions or universities, government agencies and academic or technical literature. The main finding of the study was that in-house R&D and technical linkages with buyers and suppliers have stronger effects on radical innovation in a new technology setting than in a traditional technology setting. The new-technology sector includes products dealing with technologies which are in the emergent or growth stage and remain strategic values still in developed countries whereas the traditional-technology sector includes products whose technologies are in the mature stage in developed countries and are being transferred to developing countries.

De Toni and Nassimbeni (1996) in the context of the study conducted on the small firms of North East Italy, argued that the main problems related to the introduction of innovation in small firms were mainly the lack of a skilled workforce and market uncertainty. Entrepreneurs, who assessed the problems encountered by these small subcontracting firms in the introduction of innovation, concluded that the main problem was that of recruiting trained personnel. The manpower, as well as technically qualified personnel, favour employment in medium and large-sized industries where work conditions and the employment prospects are more attractive. The other issues related to innovation were financial risk linked to investments in innovation, the lack of technical know-how and the cost of innovation.

Yin and Zuscovitch (1998) in their analysis of product and process innovations, explained that even though there is no one-to-one correspondence between product innovation and major innovation on the one hand or between process innovation and minor innovation on the other, process innovation often occurs on an incremental basis while innovation that completely replaces current technology often relates to new products. The major finding of the study was that large firms tend to pursue process R&D while small firms typically try to create a `surprise' through product innovation.

Sen and Egelhoff (2000) argued that the innovation capabilities of a firm may be focused on improving existing products and processes, which are referred to as incremental innovations or developing new products and processes based on entirely different concepts and theories, which can be referred to as radical innovations. They argued that high technology firms need to possess product and process innovative capabilities as well as radical and incremental innovation emphases. But it is unlikely to find all these capabilities in the same firm and usually large firms are effective in incremental innovations, and small firms are better at radical innovations.

Bala Subrahmanya (2001) found out that technological innovations of small firms may take different forms, depending upon the intensity of innovation

- Some firms may develop new products after identifying the opportunity or need for it in the market,
- Some firms may develop a novel process of manufacturing a product that may enhance the efficiency of the production processes as well as the quality of the final product,
- Some firms may produce the existing product by using better raw materials to make it more efficient and durable and/or cost effective,
- Some firms may develop new designs/shapes/dimensions of existing products after perceiving the need for such change in the market or due to customer pressure,
- Some firms might upgrade/acquire machinery for better performance/expansion in addition to changing the designs of products as desired/provided by their large firm customers.

Hayashi (2002) argued, in the context of Indonesian metal working and machinery SMEs that inter-firm cooperation through subcontracting ties would increase productivity of SMEs. The main problems Indonesian SMEs faced were lack of technical knowledge, lack of marketing knowledge, lack of managerial knowledge and poor access to formal financial sources. It was difficult for SMEs with limited human and financial resources to acquire technology, develop markets and arrange finance by themselves. But collaborative inter-firm linkages with large enterprises helped SMEs to overcome their limitations. The results of the study indicated the positive role of vertical inter-firm cooperation, in the form of subcontracting, in improving the productivity of Indonesian SMEs.

Salavou *et al* (2003) carried out their study in 150 Greek SMEs, most of these SMEs were either food, beverages or textile industries. They developed a conceptualization which combines two broad categories of determining factors, namely internal and external. Both strategy driven characteristics, as well as competition-related factors, are expected to have a direct impact on organizational innovation, i.e. on the number of product innovations adopted. The argument behind this view is that the firm's proclivity towards product innovations is determined by both its inward and outward focus. The result indicates that market-oriented SMEs tend to be more innovative, showing higher rates of product innovation adoptions. The

findings also provide support to the argument that learning is an important antecedent to organizational innovation while technology policy does not have a significant positive effect on organizational innovation.

Bala Subrahmanya (2005a) comparing the patterns of technological innovations carried out by small engineering enterprises in Bangalore, India with that of Northeast England, UK, clearly distinguished the sources of radical and incremental innovations carried out by small enterprises. Radical innovations involving new product developments were mainly due to internal factors like self motivation, growth objective and technological capability whereas incremental innovations were mainly market driven. Changes in the market perceived by small enterprises or pressurized and supported by their large enterprise customers led to product improvements. It was the large enterprise customers, which determined the direction and trend of incremental innovations.

Hyland and Beckett (2005) identified and clarified the barriers to successful inter-firm collaboration and sub-divided these barriers into four simple categories:

1. *Integration:* Unique capabilities need to be developed and embedded in the partner's organizations and also very complex mix of intra and inter-firm processes has to be aligned and implemented for successful integration.
2. *Organizational barriers*: Firms usually restrict access to their unique practices and maintain an independent management style which causes hindrance in collaborating with other firms.
3. *Trust*: Firms generally give priority to their internal work and do not trust other organizations for their work.
4. *Ongoing Learning*: Many organization find it difficult to establish collaboration relationship with other organizations due to their ongoing practices for learning which generally find resistant with new collaborating organizations, these type of collaborations generally need time and effort to sustain.

Bala Subrahmanya (2007) highlights the need for an intervention by an external agent acting as a catalyst for promoting horizontal cooperation among SMEs, in the context of India. The role of policymakers as a facilitator of horizontal cooperation through networking among local SMEs to link up with global TNCs for the production and marketing of consumer goods is emphasized. Although the growth of the SSIs segment of the SME sector in India has slowed in terms of the number of enterprises, level of people employed and production, SSI export performance has been impressive in the globalization period. The SSI sector has grown more towards the international market than the domestic market in the globalization era. Globalization has offered new markets to SMEs primarily through two major developments: the adoption of a complex integration strategy by TNCs for their production network, and the global procurement strategies and global expansion of TNC supermarket chains. The paper prescribed a dual strategy of vertical integration of local SMEs with global TNCs for the production of intermediate goods and

horizontal cooperation through networking among local SMEs to link up with global TNCs for the production and marketing of consumer goods. The role of Indian policymakers as a facilitator in the process is emphasized. This paper throws light on recent growth performance of small-scale enterprises in India and provides insight on the emerging global opportunities to Indian SMEs, which need to be given due consideration by Indian policymakers for exploitation.

Guan *et al* (2007) investigated the effect of collaboration between industry and research institutes/universities on industrial innovation and indicated that the technology novelty of industrial innovation is positively related to the collaboration relationship, i.e. the more the collaboration, the higher the technology novelty of the innovation. However, the collaboration is less efficient in terms of economic performance indicators such as innovation sales and profit ratios, to measure innovation. They also analyzed the factors causing hindrance to successful industry-university collaboration and found that the low efficiency and difficulty of the collaboration mainly comes from the uncertainty of market perspective, difficult to commercialize and immature technology of the research results from research institutes/universities and inefficient communication of research results from research institutes.

Nanda and Singh (2009a) investigated the means with which organizations can encourage creativity in their working environment through an extensive literature review and identified the key factors that influence organizational creativity and innovation. The three major factors that enhance creativity and innovation in the work place include organizational culture and climate; individual characteristics; and the support system. 'Organization Culture and Climate' includes issues viz. supportive structure, selection process, employee empowerment, well defined goals, employee motivation, job design, tolerances for mistakes, competitiveness, balanced autonomy, celebrations and capacity for internal change. Individual characteristics include risk learning, effective leadership, personal initiative, personal idiosyncrasy and other personality constraints. 'Support System' includes project resources, reward strategy, time for innovation, processing the ideas, workplace design, effective training, open communication, problem solving teams, humorous atmosphere and socio-technical systems. The paper explained how companies can use each of these determinants to enhance innovation within workplace environment.

Nanda and Singh (2009b) conducted a study of 93 small scale cutting tool and auto-component units which highlighted the performance of Indian manufacturing organizations in different components of technology development implementation program to make significant organizational transformation from a technology dependent regime to proactive adaptation to technology innovation initiatives for affecting organizational performance improvements. The study presented the five main components comprising the technology development implementation program. These included, Manpower Competence and Management Commitment; Technology Infrastructure; Regulatory Support; Interaction with Others and

Research Outputs. Descriptive analysis was conducted to evaluate the status of each factor and to categorize industries according to their performance in different factors. The performance of industries was poorest in Technology Infrastructure.

Bala Subrahmanya *et al* (2010) studied the importance of technological innovation for SME growth in SMEs of Bangalore region and found that most of the innovative SMEs attribute the origin of their innovations to firm level technological capability, owing to internal factors such as self-motivation, technical qualification, knowledge, experience, and innovative ideas of entrepreneurs and external factors like customer requirements and demand, information provided by suppliers of equipments and materials, market opportunities, and competition. The survey was carried out on SMEs consisting of 72 auto component SMEs, 67 electronic SMEs and 75 machine tool SMEs. The data for SMEs was collected from 'Karnataka Small Scale Industries Association'. Cronbach's alpha has been used for item reliability analysis and correlation analysis has also been performed. Both 'technology push' and 'demand pull' have contributed to the emergence of innovations. They found that innovative SMEs registered higher growth in terms of sales turnover and sales growth.

Jong and Freel (2010) investigated the effect of investment in absorptive capacity of firm on innovation related collaboration between firms and concluded that absorptive capacity prevents firms from becoming locked in to a specific geography, and to too-familiar collaboration partners, running the risk of failing to recognize or master new breakthrough technologies. Specific efforts to increase absorptive capacity are beneficial to improve firms' ability to recognize, adopt and apply external knowledge from a geographically broader area. They also suggested that geographical proximity alone is not important. In addition cognitive proximity is important for innovation capability of firm, it is not necessary for firms to collaborate with geographically proximate firms to be successful, even collaborating with the firms which are at a distance but are cognitively proximate to firms can lead to successful collaboration and thus growth of firm.

Kumar and Bala Subrahmanya (2010) proposed a framework focusing on subcontracting relationship between Large Enterprises (LEs) and SMEs in terms of the assistance the later could procure from the former. The study was carried out on 81 auto component and manufacturing SMEs especially those who are subcontractor for large enterprises. ANOVA, correlation analysis and logistic regression was used for analysis of survey data. Subcontracting relationships between LEs and SMEs and the diversity of assistance transferred from one to the other and its subsequent likely outcome were discussed. It was found that SMEs receive assistance on product design, production process, organizational know-how, marketing, human resource, financial and purchase process by collaborating and subcontracting relationship with LEs and

these collaborating relationships enhance innovative performance of SMEs leading to their better economic performance.

Terziovski (2010) investigated the affect of innovation practice and its performance implications in SMEs of Australian manufacturing sector. The study was carried out on 600 manufacturing units selected from the population of 20000 manufacturing firms. Correlation analysis, regression analysis and confirmatory factor analysis were used as tools to test the research questions. The impact of innovation factors like innovation strategy, formal structure, customer and supplier relationships and innovation culture on SME performance were studied which included number of product configurations, success of new products launched, faster speed to market, reduction in waste, increased market opportunities, increased delivery-in-full-on-time, improved product innovations, and increased quality. After analysis of all these factors a significant positive impact of innovation strategy and formal structure on SME performance was found. But other factors like customer and supplier relationships were not found to affect the SME performance significantly.

Wincent *et al* (2010) provided conceptual arguments for and also the empirical evidence of the important role that different aspects of network board capital play in the innovative performance of strategic SME network members. It was found that the board members' diversity of backgrounds and education level directly facilitate network innovative performance. The effect of diversity and education was significant for the overall improvement in network member firms' innovativeness. It was concluded that having diverse boards is particularly important for incremental innovation, while board officers' education level matters most for radical innovation. According to the research, access and exposure to diverse knowledge domains enlightens organizations about new ways to solve existing problems and as such reinforces organizations' ability to refine existing products, services, or technologies—that is, to innovate incrementally, while education and ability to go beyond the mere applicability of the existing knowledge are required to morph old technologies into something radically new.

Fitjar and Rodriguez-Pose (2011) conducted a research on 436 manufacturing SMEs out of 3928 SMEs in southwest Norway region regarding how firms located at the periphery and relatively isolated regions innovate. Logit Regression was used for the purpose of analysis of results. They found that firms located at large core areas have significant advantages with respect to peripheral areas in innovation potential. But still the firms that are relatively isolated are able to innovate by building international networks and are most successful in developing new products. It was found that this tendency is most prevalent in smaller regions, firms located at these regions tend to collaborate with firms of outside region and form international networks because of the limited resources available in their region. In building these international networks, the values and attitudes of the managers play a role in determining the activities of

their companies. The companies that cooperate with a wider range of international partners tend to have managers who are open-minded about the potential of learning from foreign cultures and who are open to change and new ideas. This would ultimately helps in increasing the innovative capabilities of these firms.

Freel and Harrison (2011) investigated the effect of innovation and cooperation on small firm sector in Scotland and North England. A sample of 1347 industries was surveyed. Correlation analysis and logit regression were used to test the survey results. They investigated on two main issues: the frequency of innovation networking, and the association between firm-level innovation success and cooperation with a variety of potential network partners. With respect to the frequency of innovation networking, it was found that almost 60% of novel product innovators were engaged in at least one innovation related cooperative endeavor. Also it was concluded that innovation is primarily a process built upon internal capabilities, but even in circumstances where external know-how makes a positive contribution, firms require substantial in-house capacity in order to recognize, evaluate, negotiate, and finally adapt the technology potentially available from others. In this view, the thrust of public policy for innovation should be twofold: to develop the internal learning capabilities and absorptive capacity of firms, as a first principle; and, where necessary (as a supplementary measure), to increase the availability of external resources (including the facilitation of networks).

Lendel and Varmus (2011) proposed a model for successful implementation of innovation strategy. Research was conducted in the period from January to September 2010 in Slovak SMEs. A sample of 262 SMEs was selected for survey. Chi-square test was used to test the independence of the data and cluster analysis. To ensure their competitiveness through innovation it is necessary for organizations to implement an innovation strategy. Their proposed model of innovation strategy brings new insights primarily on analysis of internal environment and area of formulation of the strategy. The main effort of the organization should be to create an innovative corporate culture. The corporate culture significantly affects the development of organization as well as implementation of an innovative strategy. Also, creating an innovative strategy requires a change in formal structure of the organization. The successful innovative strategy will in turn ensure the development of organization through innovation.

Necadova and Scholleova (2011) in their study of 252 Czech manufacturing firms investigated the motives and barriers of innovation behavior of companies and found that non-innovating firms see lack of financial possibilities as one of the main barrier. Economic factors and market barriers were leading to non-innovative nature of organizations. The economic factors included- difficult access to external financing, economic risks and cost on R&D, insufficient flexibility of the legislature. Market barriers included- customer resistance to new products, low dynamic and innovative market, lack of information about

markets, lack of qualified workers and technical equipment (large enterprises feel it more significantly), inflexibility of business organizational structure and insufficient spaces.

Park and Ghauri (2011) in their study of 106 Korean small medium and large enterprises investigated the key factors affecting acquisition of technological capability from foreign acquiring firms by small and medium sized local firms. Correlation and regression analysis was used for analysis of survey data. They investigated several factors like human capita, intent to learn, international experience, trust, organizational culture, participation of foreign experts and reported three main findings. First, the mere possession of high quality human capital is not a sufficient condition for SMEs to absorb new technology from foreign firms. The intensity of efforts is a critical foundation for effective learning. Second, among compatible characteristics between acquiring and acquired firms, similar business background is the most important element in that it can be the primary base for knowledge acquisition. When managers have prior related knowledge, they may not need to exercise experimental ways to acquire knowledge and thus it plays a pivotal role in learning new skills. Third, collaborative support from knowledge transferors is a prerequisite to help organizations to absorb technological capabilities. In addition, such a support is particularly crucial for SMEs, as they may not own sufficient capacities to acquire new knowledge, compared to larger firms.

Roman *et al* (2011) in their study analysed the innovation capability of SMEs in Seville province of Spain by elaborating (analyzing) a model which explains in realistic manner the innovative outcomes of any type of business. They found out dimensional factors of innovation capability; these include (i) Knowledge - Incorporation of new members, learning and capacitating and R&D (ii) Human Factors - staff training and attitude, criteria for promotion, rewards and risk taking (iii) Organizational Factors - autonomy, liason/communications resources, hierarchical power and market focus. They formulated a research hypothesis that these factors (Innovation Capability) exerts a positive impact on the innovation outcomes. Other factors like contextual factors (age, size, quality standards) and environmental factors (rivalry and dynamics of competition) were also included in the hypothesis formation and are supposed to exert a positive impact on innovation outcomes. The empirical analysis was done using linear and quadratic model approach and hypotheses was validated using F- Snedecor Test. In the category of Innovation Capability all the variables were found significant w.r.t. innovation outcomes except creativity in promotion and in the category of contextual factors also all the variables were found to have positive impact on innovative outcomes except inter-business cooperation and size which were not found significant.

Tahir *et al* (2011) studied the various factors that lead to technological development of successful SMEs and concluded that there are various factors which lead to successful technological development of SMEs which include entrepreneur also. They concluded that demographic qualities of an entrepreneur like

education, training and past experience have significant positive impact on successful development of SMEs. Other factors include easy access to finance, marketing by SMEs and clustering by SMEs.

Yam *et al* (2011) in their study analyzed the sources of innovation, technological innovation capabilities and its effect on the performance of manufacturing organizations in the empirical study carried out in Hong Kong. The study explores the relationship between Regional Innovation System (RIS) and Firm's Innovation System (FIS). The different innovation capabilities of a firm were regarded as the key components of the firm's innovation system. The source of information available within a RIS includes external sources and external expert organizations. A research model was proposed indicating the relationship between Regional perspective i.e. Sources of innovation and firm perspective i.e. Technological Innovation Capabilities (TIC) and Technological Innovation Performance (TIP). The key component of TIC included – learning capability, R&D capability, resource allocation capability, manufacturing capability, marketing capability, organizational capability and strategic planning capability. The key indicator of TIP has been taken as Sales Performance of the firm. Research hypothesis indicating positive relation between Sources of Innovation and all the components of TIC were established, also these TIC components were hypothesized to have a positive impact on Sales performance of the firm. Questionnaire developed on 7 point Likert Scale was distributed among 1153 firms, of the 1153 successfully contacted firms, 202 responded to the survey for a response rate of 17.7%. The hypotheses were tested by way of structural equation modeling. The SEM results indicated that external sources have positive relationship with all the component of TIC, whereas external expert organizations don not show significant correlation with learning, manufacturing, marketing, organizational and strategic planning capability. Also only resource allocation, manufacturing and organization capabilities indicated a significant correlation with Sales performance of the firm.

Cappelen et al (2012) in their paper studied the effects of R&D tax credits on the likelihood of innovating and patenting on Norwegian firms. R&D spending in the Norwegian business sector as a share of GDP was found below OECD average. Norwegian government supplemented the policy of R&D subsidies with an R&D tax credit scheme - SkatteFUNN for small and medium sized enterprises. Three types of innovations were analyzed - a new (or improved) product for the firm, a new (or improved) product for the market, a new (or improved) production process. For the analysis, Norwegian micro data on firms included in the 2001 and 2004 innovation surveys, covering the three year periods 1999-2001 and 2002-2004 respectively was used. Stratified sampling technique was used to select sample size of 5000 firms. Econometric analysis was used to estimate the causal effect of SkatteFUNN on the probability of the various types of innovations. In the empirical analysis, a model was used in which innovations were considered as a type of output and R&D capital as one of the input factors and binary regression was used to check the effect of

independent variables on dependent variables. The results obtained indicated that Norwegian R&D tax credit scheme, SkatteFUNN affects innovation activities. Significant positive relation was found between SkatteFUNN scheme and new production processes innovation and new products innovation for firms. Firms that collaborate with other firms are found to have more successful innovations. However, the scheme did not appear to contribute significantly to innovations in the form of new products for the market or to patenting.

Huang et al (2012) in their study of 222 Taiwanese SMEs investigated the potential influence of founder's (entrepreneurs) ties and human capital on organizational innovation and organizational performance. Also business network comprising of three dimensions: supplier interaction, customer interaction and competitor interaction was also hypothesized to exert a positive outcome on organizational innovation and organizational performance. Structural Equation Modeling (SEM) was used to examine the hypothesized model's fit and the hypotheses. Confirmatory Factor Analysis (CFA) was used to test the quality and adequacy of the model and also construct validity. All the hypothesis were found true showing a positive correlation between input variables like founder's ties and human capital on organizational innovation and performance. The results of SEM clearly indicated that the business network is a mediator between founder's ties and organizational innovation together with performance. Also they are a mediator between founder's human capital and organizational innovation along with performance. According to empirical results, owners of SMEs can make use of their own ties (connections) and human capital (capabilities) in an increasingly competitive environment.

Kaiser and Kuhn (2012) studied a particular subsidized public/private research joint venture program, the 'Danish Innovation Consortia' (DIC), and its effects on the performance of the participating private sector firms. Research subsidies from government come in two main forms, tax breaks and direct subsidies for specific research projects. The data was collected from 220 firms and the information was sought for the years 1990-2007. Three variables were identified as a measure of performance, which involved patent count as a very direct measure of performance as well as employment and value added growth as more indirect measures. Econometric analysis was used to construct model and correlate the research variables. The main results of the study showed that after DIC participation i.e. RJV of organizations the number of patent applications three years after joining DIC increased by 162%. The results were more significant for smaller firms which have already filed at least one patent before joining DIC, for firms that have not filed any patent prior to joining DIC the results were less significant and for larger firms the results were not at all significant. Also the results showed that DIC members employment grew 2.5% faster in the year after DIC was joined as compared to non-participating firms. For innovative firms the corresponding effect was more than twice as large. The study didn't show any statistically significant relationship between DIC

participation and value added. The study hence concluded the governments should focus resource support to already innovative firms when it comes to subsidy schemes.

Park and Kang (2012) examined the effects of government support and inter-firm collaboration on the innovative performance of biotechnology SMEs in Korea. A hypothetical model indicating a direct positive relation with government R&D support and inter-firm collaboration on innovation performance and indirect positive relationship between government R&D support and internal R&D resource and also between internal R&D resource and innovation performance was constructed and tested using structural equation modeling. The measure of dependent variable i.e. innovation performance was taken as the total number of patent applications to the Korean Intellectual Property Organization. The data was collected from 147 SMEs over a period of 3 years. The descriptive statics showed that the frequency of collaboration between Korean SMEs and local universities and research institutes is more as compared to collaboration between SMEs and other firms. This showed that R&D is the focus of Korean SMEs for innovation and growth. Also a very high co-relation was found between internal R&D human capital (i.e. R&D workforce) and innovation performance. Also international collaboration with universities and international firms resulted in a very high correlation score with innovation performance. Government R&D support also had a very strong direct and positive effect on firms patenting outcomes. Also government R&D support showed a significant indirect positive relation with internal R&D spending and domestic collaboration thus validating the research hypothesis. Also other factors like firm's size showed a significant positive relation with innovation performance.

Romero and Roman (2012) in their study of 750 SMEs in Andalusia region of Spain explored the determinants of innovation in small businesses in their study and differentiated two types of innovations- product and process innovation. Their study mainly concentrated on three main characteristics which affect product and process innovation in small businesses; these characteristics include (i) Personal characteristics of the self employed - general business education, motivation, previous experience as an employee (ii) Organizational Characteristics - firm size, sector, dependency on specific clients and suppliers, cooperation, other managerial activities (iii) External environmental characteristics - knowledge spillovers, university system and R&D institution, regulations and public support measures. A conceptual model was developed and logistic regressions were used to test the influences of the independent variables on the dichotomous innovation variables. The empirical analysis carried out by them pointed out education of the entrepreneur as the major factor explaining the innovative behavior of entrepreneur. Previous experience as an employee was also a major determinant of innovation in small firms. Other characteristics like organizational and external environmental characteristics also showed significant positive relationship with small firm innovation.

Wu (2012) in his study theoretically argued and empirically tested the moderating effects of market competition and sectoral technological intensity on the positive and negative effects of technological collaboration on product innovation. The measure of product innovation by a firm is taken as new product sales in the past few years. Two hypothesis formed on the basis of previous literature were tested on data about the product innovation and technological collaboration of 944 firms from five manufacturing sectors in China using Poisson regression models. This analysis suggested that when the market competition is intense, firms focus on short-term benefits and adopt opportunistic behavior at the expense of collaborating firm's interest thus leading to negative impact on collaborating relations and product innovation of their own firm. Secondly, the results indicated that high-tech firms result in better cooperative relations with collaborating firms due to rapid technological development pushes thus enhancing their product innovation and ultimately negating the effect of increased market competition on technological collaboration. Moreover the findings also suggested a significant positive relationship between firm's age and size with new product sales i.e. product innovation.

Xie (2012) in an empirical study of 1206 manufacturing Chinese firms studied the effect of cooperative factors, Cooperative Innovation Effect (CIE) and innovation performance using the technique of Structural Equation Modeling (SEM). Five variables (Cooperative factors) were taken in the study viz. Basic sustaining factors which include environment and culture, the capabilities to R&D, senior leadership support, effective organizational structure. The other factors being Factors of government and policy, factors of cooperation mechanism, social network factors, Cooperative Innovation Effect. Innovation performance in the study was measured using indicators like proportion of annual turnover of new products, new products index, modified products index and patent growth rate. Research hypothesis indicating a positive relation between all the five factors and Innovation Performance was formed and tested for correlation and factor loading using SEM. The factor loading showed a value > .70 showing that the reliabilities of items are within acceptable levels, moreover all the variables showed a positive correlation with output variable thus confirming the research hypothesis.

Based on the literature review and the research models a framework establishing relationship between input factors viz. Entrepreneur Role, Technology Infrastructure, Linkage Capability, Regulatory Corroboration and research outputs viz. Sales Performance, Product Performance, Innovation Performance has been presented in figure 2.2.

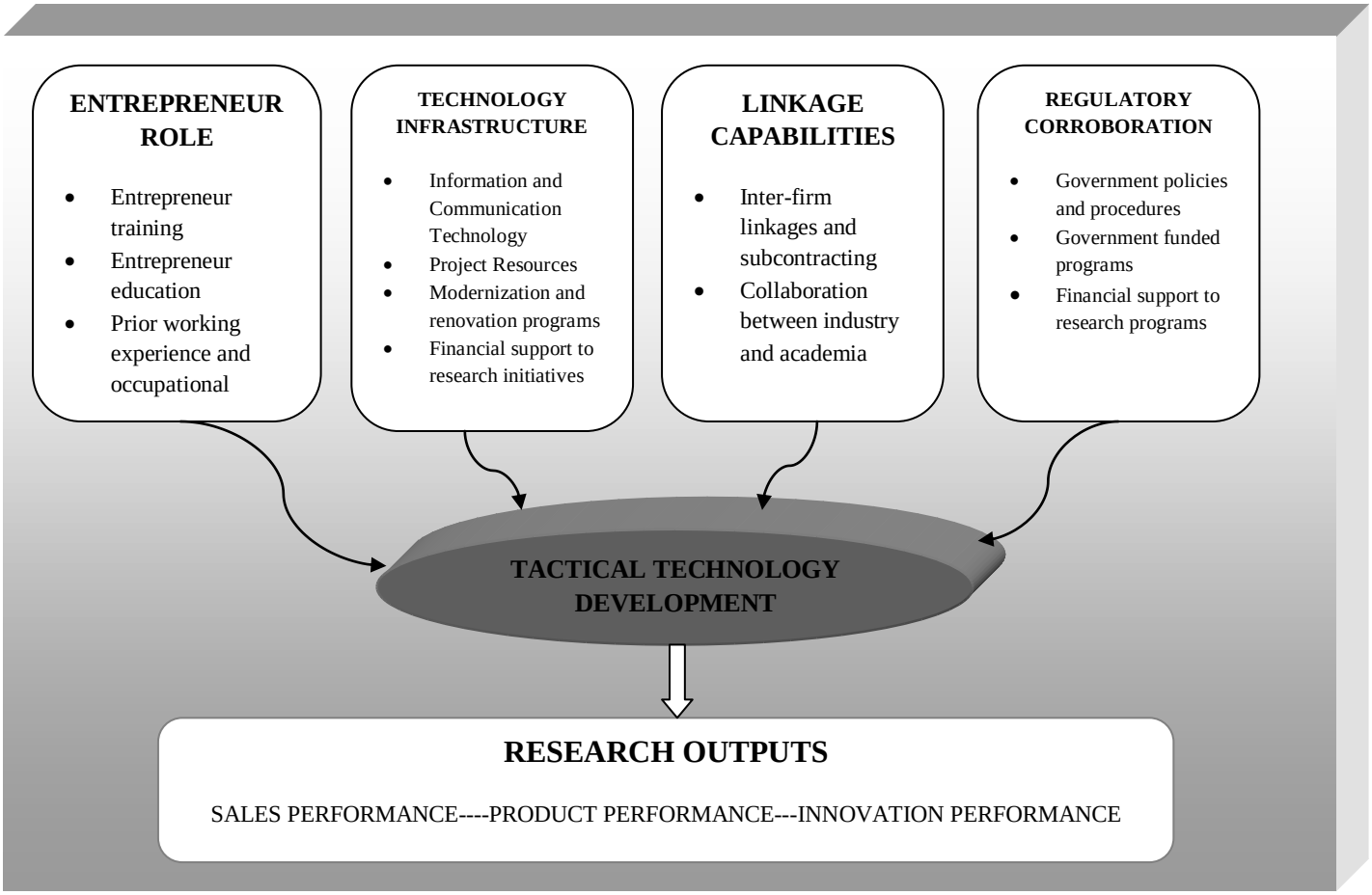

Fig. 2.2 Factors for Tactical and Technological Development of Firms

2.8 Research Hypothesis

Through extensive review of the literature several factors have appeared that are found to effect innovation efforts and performance of the firms. The broad areas identified which are of great importance in terms of their effect on firms tactical development are entrepreneur role, regulatory corroboration, technology infrastructure and linkage capability which are taken as input parameters and the various indicators of tactical development of small units are taken as sales performance, product performance and innovation performance.

In order to answer the research problem following hypotheses has been stated on the basis of inter-linkages depicted in the conceptual model.

H1: Entrepreneurs Role has a significant impact on Research Output parameters.

H1a: Entrepreneur Role has a significant impact on Innovation Performance of the manufacturing units.

H1b: Entrepreneur Role has a significant impact on Sales Performance of the manufacturing units.

H1c: Entrepreneur Role has a significant impact on Product Performance of the manufacturing units.

H2: Regulatory Corroboration significantly contributes towards firm's output performance parameters.

H2a: Regulatory Corroboration significantly contributes towards firm's Innovation performance.

H2b: Regulatory Corroboration significantly contributes towards firm's Sales performance.

H2c: Regulatory Corroboration significantly contributes towards firm's Product performance.

H3: Technology Infrastructure has significant impact on firm's output performance.

H3a: Technology Infrastructure has a significant impact on firm's Innovation performance.

H3b: Technology Infrastructure has a significant impact on firm's Sales performance.

H3c: Technology Infrastructure has a significant impact on firm's Product performance.

H4: Linkage Capability of the organizations significantly affects its output performance parameters.

H4a: Linkage Capability of the organizations significantly affects its Innovation performance.

H4b: Linkage Capability of the organizations significantly affects its Sales performance.

H4c: Linkage Capability of the organizations significantly affects its Product performance.

2.9 Limitations of Existing Approaches

An extensive review of the concepts, taxonomy and related facets of technology upgradation factors in the manufacturing organizations especially MSMEs has been carried out. The review of past literature indicates sufficient gaps for the conduct of present research work.

The main limitations in the existing approaches are as follows:

- There have been a lot of studies in the past recent time indicating why certain organizations are more technologically advanced and competitive than other organizations. These studies have tried to establish certain factors contributing to the technological innovation and upgradation of the organizations especially MSMEs. However, most of these findings focus on effect of one or two of these factors in an atomistic manner at a time. There is a lack of studies providing holistic perspective on factors contributing to technological innovation and upgardation comprehensively in an organizational setting.
- Lot of past literature is there regarding role of Information and Communication Technology in facilitating technology upgradation in an organization taking into consideration the role of web based tools like internet, intranet, broadband for communication and websites for marketing but very little or relatively no literature was found regarding use of production related tools like CAD, CAM and other modern software's for designing and new product development (which is an important indicator of innovation in an organization). Also the past literature has reported the importance of availability of finance for R&D activities in an organization but little literature has been reported on the importance for earmarking funds for implementing Information and Communication programs like ERP etc.

- There have been a lot of studies indicating the effect of demographic factors related to entrepreneur to firm's technological growth and performance. But very few studies have distinctively concentrated on effect of other factors like entrepreneur education, training and work experience on technological innovation and growth of MSMEs.
- Further, very few empirical studies and quantitative research have been reported to support the theoretical findings. There are remote cases where the relative impact of technology development initiatives on performance improvements, especially in the Indian small sector manufacturing sector have been reported.

The present research work intends to bridge the gaps in literature and practices by suggesting a systematic plan for evolving a technology development program for small scale manufacturing industry of the region.

Chapter - III

DESIGN OF THE STUDY

3.1 Introduction

This chapter introduces the overall design of the study, which includes methodology to be adopted for carrying out the research work as well as various phases of the study. The details of work to be done in each phase; the methodology adopted, statistical tools and models to be used in the work have also been described.

3.2 Objectives and Issues

The main objective of the present work is to study the factors that influence the tactical and technological development of SMEs.

Literature highlights the following areas and issues as critical to the success of the present research work:

- **Entrepreneur Role** - It comprises of the following sub-factors:
  - ✓ Entrepreneur Education
  - ✓ Entrepreneur Training
  - ✓ Prior Working Experience and Occupational Background
- **Linkage Capabilities** - It comprises of the following sub-factors:
  - ✓ Inter-firm Linkages and Subcontracting
  - ✓ Collaboration between Industry and Academia
- **Technology Infrastructure -** It comprises of the following sub-factors:
  - ✓ Information and Communication Technology
  - ✓ Project Resources
  - ✓ Modernization and Renovation Programs
  - ✓ Financial Support to Research Initiatives
- **Regulatory Corroboration -** It comprises of the following sub-factors:
  - ✓ Government Policies and Procedures
  - ✓ Government Funded Programs
  - ✓ Financial Support to Research Initiatives

3.3 Phases of Research

The present study will employ both quantitative and qualitative research approaches. The quantitative approach will utilize a series of statistical techniques. The results obtained from quantitative study and

literature review will be synthesized to develop a systematic plan using a qualitative research methods. Based on flexible systems methodology, the research work will be carried out in two phases,

Phase I : Clarifying the context

Phase II: Understanding and assessing the situation

3.4 Clarifying the Context

This phase involves extensive literature review on tactical and technological development issues of manufacturing industry with regards to entrepreneur role, investments in research function, policies, infrastructure facilities, and regulatory corroboration. Literature review regarding economic, technical, regulatory and other related issues regarding technology upgradation has also been carried out. The various factors in terms of which research output can be expressed have also been identified in this phase.

3.5 Understanding and Assessing the Situation

The study has been carried out in small scale manufacturing units dealing with cutting tool, machine tool and auto-component in Patiala region. In the research work, the questionnaire based survey research technique has been employed and questionnaire was sent to 55 small scale units in Patiala region and out of these a total of 25 fully filled and usable questionnaires were received and have been taken for analysis.

3.5.1 Research Approach

The research approach (Qualitative, Quantitative, or Mixed Methods) is decided based on interrelated levels of decisions which when made dictate the approach and the research design process. These decisions are based on which knowledge claims, strategies of inquiry, and research method used.

'A quantitative approach is one in which the investigator primarily uses post positivist claims for developing knowledge (i.e. cause and effect thinking, reduction to specific variables and hypotheses and questions, use of measurement and observation, and the test of theories), employs strategies of inquiry such as experiments and surveys, and collects data on predetermined instruments that yield statistical data'. 'A qualitative approach is one in which the inquirer often makes knowledge claims based on constructivist perspectives (i.e. multiple meaning of individual experiences, meanings socially and historically constructed, with an intent of developing a theory or pattern) or advocacy/participatory perspectives (i.e. political, issue orientated, collaborative, or charge orientated) or both. It also uses strategies of inquiry such as narratives, phenomenology's, ethnography's, grounded theory studies, or case studies. The researcher collects open-ended, emerging data with the primary intent of developing themes from the data'. 'A mixed methods approach is one in which the researcher tends to base knowledge claims on pragmatic grounds (e.g. consequence-orientated, problem-centered, and pluralistic). This approach employs strategies of inquiry that involve collecting data either simultaneously or sequentially to best understand the research

problem. The data collection also involves gathering both numeric information (e.g. on instruments) as well as text information (e.g. on interviews) so that the final database represents both quantitative and qualitative information' (Creswell, 2003).

Based on these definitions and the work of O'Leary (2004) this can be summarised as shown in Figure 3.3. Therefore, based on Figure 3.1, both Quantitative and Qualitative Research Approach would appear to be the approaches to be used in this thesis.

3.5.1.1 Quantitative Research Approach

Figure 3.2 shows the Quantitative Research Approach Model as described by Bryman and Cramer (2005). This is comprised of Theory, Hypothesis, Operationalisation of Concepts, Selection of Respondents, Survey or Experimental Design, Data Collection, Analysis and Findings. Research approaches can be categorized into two other types- survey based and non survey based. Since our study will include collecting of data from industries, so the approach to be followed in this thesis will be survey based research approach.

Fig. 3.1 Research Approach Flow Charts (O'Leary, 2004)

There are different types of survey-based research (Churchill, 1995). An overview of these is presented in Figure 3.3. Cross-sectional research is primarily used to measure the various characteristics once, whereas longitudinal research considers the measurement over time. Furthermore, cross-sectional research involves a sample of elements from the population of interest, whereas true and omnibus panels are used in longitudinal research. Even though longitudinal research could be useful in observing technological capabilities over time, there are some critical drawbacks to this method. The main disadvantage of panels is that they are non-representative. Furthermore, the agreement to participate involves a far-reaching commitment of the respondent, which is very difficult to achieve.

Instead, the use of cross-sectional research is far more useful in this study. Besides, it is also considered the most important type of survey-based research in terms of the number of times it is used as compared to other methods. First of all, cross-sectional research provides a snapshot of the variables of interest at a single point in time. Second, the sample of elements selected is considered to be representative of some known universe.

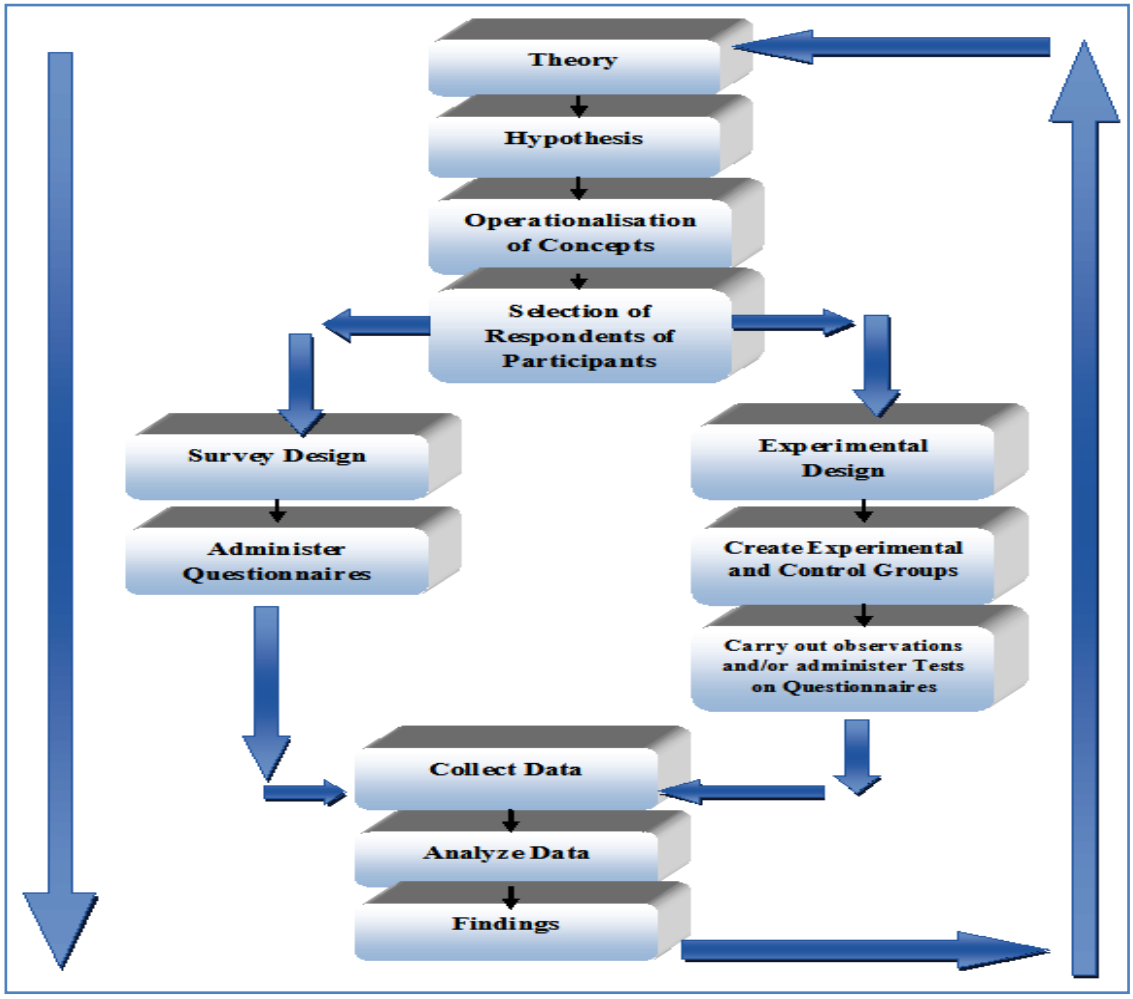

Fig. 3.2 Quantitative Research Approach Model (Bryman and Cramer, 2005)

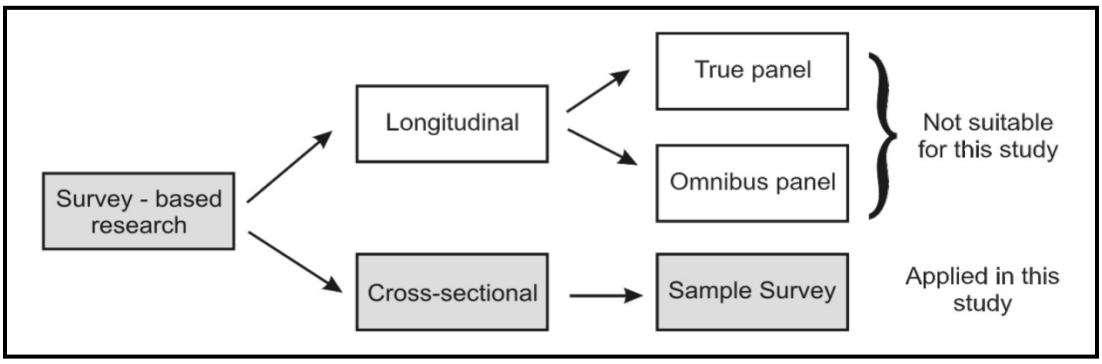

Figure 3.3 Types of Survey Based Research

Questionnaire Development: For effectively conducting the survey, the first task is to design a questionnaire. A questionnaire has been prepared through extensive literature review. A relevant and detailed questionnaire containing objective type questions with multiple choice answers pertaining to the desired conceptual framework has been designed. Information on various aspects related to this research work in the small scale manufacturing industry relating to tool and auto-component manufacturers of Patiala has been sought in it. Scale items has been used in the analysis, since the research interest is to examine the effects of independent variables on dependent variables.

Questionnaire Pre-testing and Validation: After preparing the questionnaire through extensive literature review, it has been pre-tested through peer review from academicians and practitioners from the industry. To ensure the relevance and effectiveness of the questions to the manufacturing industry, the questionnaire has been pre-tested on a representative sample of industry. The suggestion received have been incorporated to make the questionnaire more relevant to the purpose so that it may bring out key outcomes. The objective is to confirm that responses that will be obtained are based on correct interpretation of the questions. Cronbach's Alpha has been assessed for item-to-total correlation for validation (reliability testing).

3.5.2 Conceptualization and Instrument Design

With the exception of facts (like a persons age), a survey does not collect data, it creates it. The answers to the survey are a description (this is a descriptive survey) of the respondents. Conceptualisation and instrument design deals with ensuring that the concepts, in this case of technology development, are converted into questions such that relevant empirical data can be analyzed. In addition, the quality of the survey measurement is very important. Two techniques cover this, reliability and validity (Babbie, 1990).

3.5.2.1 Reliability and Validity

The quality of the survey research is established by examining the reliability and validity of the survey (Litwin, 1995).

3.5.2.1.1 Reliability

Measurement error is related to how well or badly a survey achieves its purpose in a given population. According to Litwin (1995) reliability is:

'A statistical measure of how reproducible the survey instruments data is'.

There are three types of reliability:

Test-retest reliability (or Stability Reliability) – This is the most commonly used indicator of instrument reliability. The same set of respondents are measured at two different points in time and the stability of the responses analyzed (in order to do this the survey must not be effected by time). The correlation coefficient value must be $r \geq 0.70$. This can be done for a group or an individual observer and the whole instrument can be tested (Litwin, 1995).

Alternate-form – This involves using different worded items (questions) to measure the same attribute. This is a method of getting around the practice effect, where respondent becomes familiar with the instrument and can respond with the answer they gave the last time.

Internal consistency reliability – This is applied to groups of items that measure different aspects of the same concept, not single items. It is a measure of how well the different items measure the same issue (Cronbach's Alpha) (Litwin, 1995).

The goal is to measure concepts in a way that helps us understand the world around us. As the survey is cross-sectional Test-retest can not be used, also, alternate-form requires the addition of repeat question which in this case would make the survey too long. Thus, reliability will be checked using pre-test and pilot studies and internal consistency.

3.5.2.1.2 Validity

According to Litwin (1995) validity is:

'The measure of how well the survey measures what it sets out to measure'.

Litwin (1995) explains that there are two types of validity, internal and external. External validity is concerned with how well the sample population findings apply to the entire population (generalization) and the ability of research to relate to a person's experience i.e. can they connect to it (transferability).

Internal validity is concerned with how well the study was carried out i.e. the study's design, what was and was not measured and how well it was measured. There are four types of internal validity (Litwin, 1995).

Face Validity – It is a review of items by untrained judges. It is the least scientific and considered worthless by some (Babbie, 1990; Litwin, 1995).

Content Validity – If a survey was conducted on mathematical skill and only asked about addition, the content of that survey would not be valid. This content is reviewed by people with knowledge of the research topic resulting in the identification of gaps in content.

Criterion Validity – The comparison of one instrument against another which has proven to be valid. Can be broken into two components, concurrent (measure of a variable against a gold standard) and predictive (the ability of a survey to forecast future events).

Construct Validity – This is the measure of how good a scale or survey instrument is in practical use and is based on years of experience with a survey instrument.

It is of two types, Convergent Validity and Divergent Validity.

Validity will be checked for by using content validity – using the pre-testing concept.

3.5.3 Statistical Tools

The various statistical tools used in the analysis of data are discussed in this section.

The convergent and discriminant validities of the constructs and their measures have been carried out.

Firstly, in the analysis of questionnaire, the status of all the issues under each component (input and output parameters) of tactical upgradation of the manufacturing sector has been assessed. The *Percent Points Score (P.P.S)* for each set of questions which reflect different issues under each component has been calculated. These measures reflect as to how well the area (issue) represented by that question is being looked after in the industry.

Secondly, the status of manufacturing units in different key factors has been evaluated and the manufacturing units have been classified in to different categories. The score of each unit (in terms of Percent Points Score, PPS) in individual components has been calculated from the raw score of issues under each component. The criterion reported in earlier research studies has been used to classify the industries into different categories (Nanda and Singh, 2009b).

Cronbach's Alpha Coefficient: This parameter is used for convergent validity. Convergent validity assesses the degree to which measures of the same concept (construct) are correlated. It is assessed by the correlation among items which make up the scale or instrument measuring the construct (internal consistency validity). The internal reliability of items (inter-item analysis) under each input and output parameter has been assessed by using Cronbach's alpha coefficient. The higher the score, the more reliable the generated scale is (Flynn *et al.*, 1990). Cronbach's alpha coefficient (α) is defined as per the following equations.

$$\alpha = \frac{N}{N-1}\left(1 - \frac{\sum_{i=1}^{N} \sigma_{Y_i}^2}{\sigma_X^2}\right)$$ ---------- Equation 3.1

Here, N is the number of components (items or testlets), $\boldsymbol{\sigma^2_X}$ is the variance of the observed total test scores, and $\boldsymbol{\sigma^2_Y}$ is the variance of component *i*.

Principal Component Analysis: It is a way of identifying patterns in data, and expressing the data in such a way as to highlight their similarities and differences. Since patterns in data can be hard to find in data of high dimension, where the luxury of graphical representation is not available, PCA is powerful tool for analyzing the data. The other main advantage of PCA is that once these patterns have been found in the data, the data can be compressed by reducing the number of dimensions, without much loss of information. The main objective of principal component analysis is to discover or to reduce the dimensionality of the data set and to identify new meaningful underlying variables.

t-Test Analysis: To find the relationship between key inputs and key outputs, Pearson's correlation coefficient values (r values) between various issues of inputs and the Development Indicators (output parameters) have been calculated. The correlation values obtained after this has been further validated using t-test. Pearson's correlation values and t-values (obtained from t-test) has been worked out to ascertain significant issues and factors contributing to the success of tactical upgradation program in industry. The t-values obtained (from t-test) can also be worked out through empirical expression indicated in Equation 3.3.

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \geq t_{n-2} \text{ (from't' Tables)}$$ ---------- Equation 3.2

Here, '***n*-2**' represents degrees of freedom (df) for a particular test, '**r**' represents Pearson's correlation coefficient between a particular input issue and an output parameter, '$\mathbf{t_{n-2}}$' is the $t_{critical}$ value from statistical't' tables for (**n–2**) degrees of freedom.

Regression Analysis: Further, step-wise linear regression analysis has been performed taking into account a set of all independent variables and each dependent variable individually. This technique can identify a set of variables which conjointly contribute significantly towards the criterion variable. The notations employed in this test include: β= Regression Coefficient (Beta Coefficient), R= Multiple Correlation Coefficient.

3.5.4 Analysis of Survey

The analysis of questionnaire has been carried out from the following view points:

- To review the status of each factor influencing the tactical and technological development of SMEs.
- To assess the overall standing of each manufacturing organization in various factors for tactical and technological development, leading to classification of organizations into various categories ranging from very good to very poor.
- To evaluate contributions of technology input factors towards achieving tactical and technological development of SMEs.

3.6 Concluding Remarks

The methodology to be adopted for the study along with the step-by-step approach to be employed for the research has been elaborated in this chapter. Descriptive and empirical analysis will be used to yield rich data for statistical analysis. The learning issues from the literature review and results of questionnaire based survey will be synthesized to develop a systematic plan for tactical technological development of small and medium enterprises.

CHAPTER - IV

SURVEY BASED RESEARCH RESULTS

4.1 General

This chapter presents the analysis and major findings of survey based research data. The survey explores the factors affecting the tactical and technological development of cutting tool industry in the region.

4.2 Survey Methodology

For conducting the survey, the questionnaire based technique has been used. A relevant and comprehensive questionnaire seeking information on various aspects of tactical technology upgradation in the small units has been specifically designed. For effectively conducting the survey, the questionnaire has been designed through an extensive literature review and validated through peer review from academicians, consultants and practitioners from industry. To ensure the relevance and effectiveness of questions to the manufacturing industry, the questionnaire has been pre-tested on a representative sample of industry. The feedback received has been incorporated to make the questionnaire more relevant for the purpose.

The present work considers five key areas (components) for overall assessment of various factors affecting the tactical and technological development of cutting tool industry. These include

- Entrepreneur Role
- Linkage Capabilities
- Technological Infrastructure
- Regulatory Corroboration
- Research Output Functions

4.2.1 Industrial Units Surveyed

Small scale cutting tool manufacturing organizations in Patiala (Punjab, India) have been included in the survey. The main products of cutting tool industry in the region include metal slitting saws, slotting cutters, side and face cutters, shank type milling cutters, reamers, gear hobs, milling cutters, broaches, harvester blades, jack plane blades etc.

A total of 55 cutting tool units were selected from the list of registered units provided by the office of District Industrial Centre, Patiala. Only those units with their minimum annual turnover of 10 lakh rupees were selected for the survey. 55 questionnaires were distributed among these industries by making personal visits to the industrial units and having discussions with proprietors and senior executives. A total of 25

units (details of units in Appendix IV) responded to the questionnaire. This constituted a response rate of 45.45%.

4.3 Analysis of Questionnaire

The analysis of questionnaire has been carried out to assess the following:

1. Status of each issue under input factors contributing to tactical technology development in the industrial units surveyed.
2. Classification of industrial units in various Tactical technology aspects.
3. Correlation among various input factors and key output factors contributing towards the tactical development of small scale units.

4.4 Status of Input and Output Parameters

The present work considers four key inputs and three output performance parameters for the overall assessment of development initiatives in the small scale sector. The input issues include '*Entrepreneurial Role'*, '*Linkage Capability'*, '*Regulatory Corroboration'* to support development efforts of the industry and '*Technology Infrastructure'*. The key outputs include *'Product Performance'*, *'Sales Performance'*, and *'Innovation Performance'*. The various issues under key output are being collectively referred to as '*Research Output Parameters'*.

The issues under each input factor viz. Entrepreneur Role, Linkage Capability, Regulatory Corroboration and Technology Infrastructure comprises of responses of few questions combined. The scores indicated under each issue in Tables 4.1 to 4.4 consist of average (rounded off) of the responses of these questions. The details of questions under each issue have been discussed in Appendix I.

4.4.1 Status of Entrepreneur Role

This section discusses the status of '*Entrepreneur Role'* issues in the manufacturing sector. The questions in questionnaire for this component aim at collecting information on the following:

i) Education level of the entrepreneur, technical skills and competencies of the entrepreneur and proficiency of the entrepreneur to make decisions regarding the routine activities and technology up gradation initiatives of the organization.

ii) Tacit and technological knowledge and skills achieved through prior working experience and utilization of this knowledge in formal business planning, obtaining finance for the organization and alertness to new technology development opportunities present in the market.

The response to individual issues on this component is presented in Table 4.1.

The educational background of the managers, business owners and entrepreneurs has been found to be an important factor explaining innovation in small businesses. Self-employed people with stronger educational

backgrounds can carry out a more professional and efficient management and organization of their businesses and, in this way, can be more successful in implementing innovations (Bala Subrahmanya, 2010, Classen *et al*., 2012, Romero and Martinez-Roman, 2012). The education level of the entrepreneur (employer) in the region is fairly good (PPS=71.20), indicating that the most of the organizations (52%) are being run by entrepreneurs having either a post graduate or engineering degree, 44% organizations are run by entrepreneurs having either diploma or normal graduation degree.

Table 4.1 Evaluation *of Entrepreneur Role Issues*

S. No.	Topics in the Component	No. of Responses (N)	No. of Units Scoring					Total Point Score (TPS)^	Percent Point Score (PPS) $\frac{TPS}{5 * N}100$	Central Tendency (CT) TPS/N
			1 (W_1)	2 (W_2)	3 (W_3)	4 (W_4)	5 (W_5)			
1	Education level of the entrepreneur	25	0	1	11	11	2	89	**71.20**	3.56
2	Effective decisions pertaining to business activities and taking decisions related to cost, raw material etc.	25	0	0	14	11	0	86	**68.80**	3.44
3	Awareness regarding government benefits to SMEs	25	2	6	5	8	4	81	**64.80**	3.24
4	Technical competencies of entrepreneur like competency in operating all machines, quality control tools etc.	25	1	0	15	8	1	83	**66.40**	3.32
5	Entrepreneur training	25	0	0	1	19	5	104	**83.20**	4.16
6	Strategic decision making in identifying the right kind of business and market	25	0	0	12	11	2	90	**72.00**	3.60
7	Tacit knowledge obtained through prior work experience	25	0	1	5	17	2	95	**76.00**	3.80
8	Alertness and formal business planning of different management areas like finance, H.R, logistics etc.	25	0	1	8	10	6	96	**76.80**	3.84
9	Easy access to finance and loans (knowledge about various financial schemes and procedures to be followed)	25	1	0	6	12	6	97	**77.60**	3.88
10	Ease of collaboration with other firms especially large enterprises due to entrepreneurs contacts	25	2	6	13	3	1	70	**56.00**	2.80
11	Ability to seize opportunities from market and using appropriate strategies in commercializing product	25	0	4	14	6	1	79	**63.20**	3.16
12	Awareness about new production technologies, machines, equipments etc.	25	0	3	5	16	1	90	**72.00**	3.60
	Overall Average (Out of 5.00)									**3.53**
^ Total Point Score (TPS) = $1\times W_1+2\times W_2+3\times W_3+4\times W_4+5\times W_5$										

The results show that entrepreneurs in the manufacturing organizations are able to make (PPS=68.80) effective decisions regarding routine activities, regarding implementation of new ideas i.e. product-process innovations etc. Entrepreneurs at quite good number of units (44%) are able to effectively take decisions regarding to business activities due to their higher education background.

The results (PPS=64.80) shows that fairly large number of units (48%) believe that lack of formal educational background of the entrepreneurs is generally the main reason for lack of awareness towards various government schemes and programs.

Technical competencies are required so as to facilitate entrepreneurs in handling business related tasks which require specific expertise and also training of employees on tasks relevant to business. A good number of entrepreneurs (PPS=66.40) are equipped with technical competencies (ability to handle all equipments and machinery in including CNCs, competencies in quality control tools etc.) required to handle their businesses effectively. At 60% of the units, entrepreneurs are well equipped with the technical competencies required to handle their businesses, only 4% of the units don't have entrepreneurs with necessary technical competencies.

Literature reveals that training employees internally by the entrepreneur himself after receiving training on new techniques and equipments helps in reducing the cost of training for the organizations. The cutting tool industry in the region shows a very high rating in this regard (PPS=83.20). In most of the units, training to employees is provided to a large extent internally by the entrepreneur himself.

Technical training received by the entrepreneurs has been helpful in making the strategic decisions effectively which include identifying the right kind of business, market and technology for firm's products and also decisions pertaining to appropriate selection of manpower and materials. The cutting tool sector in the region has shown a good rating (PPS=72.00) with regards to this. A fairly large number of units (44%) have been able to make the strategic decisions effectively to a large extent. About one tenth of the units have been extremely effective in this context.

A large part of the relevant knowledge for innovation is of tacit and unspoken nature and derives from experience, the entrepreneur of the manufacturing organizations have shown a very high rating with this regard (PPS=76.00). Entrepreneurs at a fairly good number of units (68%) have been found to obtain the tacit knowledge from previous work experience in some large organizations or other small units to a large extent.

Alertness to new business opportunities and formal business planning are quite important functions for innovation related activities. The cutting tool industry in the region has been found to show a good rating (PPS=76.80) in this regard. Entrepreneurs at fairly good number of units (about 64%) have been found to be alert in identifying new business activities to a large extent.

Entrepreneurs with prior work experience are generally found to have better access to finance and loans and knowledge about various financial schemes and procedures to be followed to obtain them. The cutting tool industry has shown a fairly good rating (PPS=77.60) with regards to this issue. Entrepreneurs at a good

number of units (72%) have been found to have better access to finance and loans to a large extent because of their prior work experience.

Literature reveals that prior work experience of entrepreneur is generally helpful in collaboration with other firms. However, the cutting tool sector in the region has shown a relatively poor rating (PPS=56.00) with regards to this. Only 12% of the units have been found to collaborate with other organizations which is not encouraging.

Organizations have been able to show only a fair rating (PPS=63.20) in their ability to seize market opportunities and use appropriate strategies in commercializing their products as a result of entrepreneurs prior experience. There are only few units (28%) which have been performing these functions effectively to a large extent.

Entrepreneurs prior work experience also leads to awareness about new production technologies (machine, equipments, tooling etc). The cutting tool sector has shown a fairly good rating (PPS=72.00) in this regard. A fair number of units (64%) have been found to have proper awareness regarding new production technologies to a large extent due to entrepreneur's prior experience.

The average score of this aspect is 3.53 (out of 5.00) as shown in Figure 4.1. The analysis of this component reveals that effective decision making pertaining to business activities, awareness regarding government benefits, technical competencies, working in collaboration with others and ability to seize opportunities from the market are some areas which need improvement.

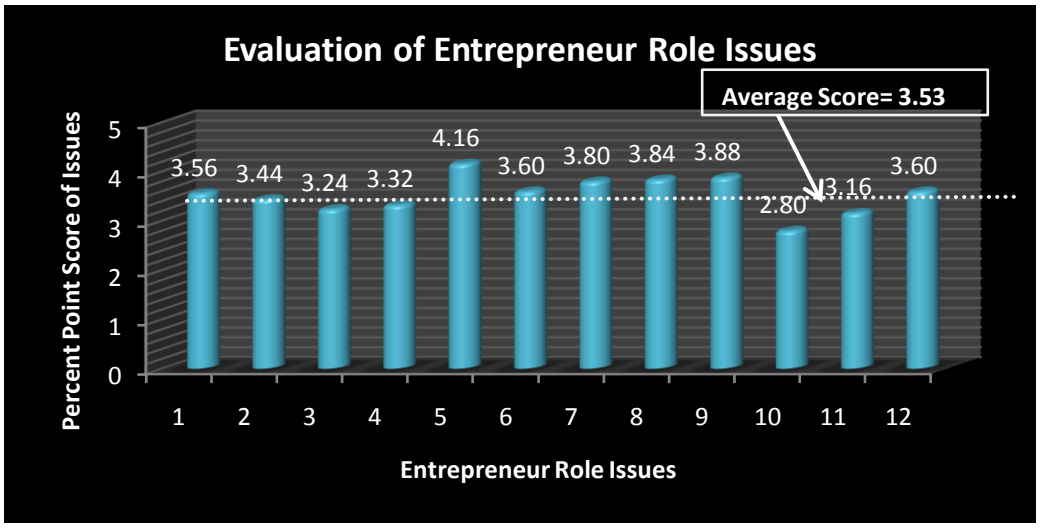

Fig. 4.1 Performance regarding Entrepreneur Role Issues

4.4.2 Status of Regulatory Corroboration

This section discusses the role of government in supporting the small scale industry in its tactical technology development efforts. The keys and statements on government support aim at collecting information on the following:

i) Availability and cost of electric power, condition of transportation infrastructure, government policies regarding subsidies etc.

ii) Status of government funding for research initiatives, programs for technology awareness, availability of government laboratories for research projects, assistance in acquiring latest technologies, sponsoring employee development programs, credit linked scheme by government, assistance in acquiring quality certifications, assistance on marketing and exposure to international market, providing subsidized information and consultancy for research work.

iii) Awareness of industry regarding government subsidiaries for small scale sector, assistance from these government organizations.

The response to various issues on this component is presented in Table 4.2.

Table 4.2 Evaluation of Regulatory Corroboration Issues

S. No.	Topics in the Component	No. of Responses (N)	No. of Units Scoring					Total Point Score (TPS)^	Percent Point Score (PPS) $\frac{TPS}{5 * N}100$	Central Tendency (CT) TPS/N
			1 (W_1)	2 (W_2)	3 (W_3)	4 (W_4)	5 (W_5)			
1	Government initiatives and assistance in acquiring latest technology, quality certification and marketing assistance	25	9	15	1	0	0	42	**33.60**	1.68
2	Availability of electricity to the industrial units	25	0	1	23	1	0	75	**60.00**	3.00
3	Availability of rail-road infrastructure in the region	25	0	3	22	0	0	72	**57.60**	2.88
4	Government policies and measures to support innovation initiatives in small units	25	2	21	2	0	0	50	**40.00**	2.00
5	Allocating funds for R&D related activities in small units	25	17	8	0	0	0	33	**26.40**	1.32
6	Employee training at government institutes like mini tool rooms	25	6	12	7	0	0	51	**40.80**	2.04
7	Subsidized information regarding latest trends and technologies and consultancy for research work	25	9	14	2	0	0	43	**34.40**	1.72
	Overall Average (Out of 5.00)									**2.10**
^ Total Point Score (TPS) = $1\times W_1+2\times W_2+3\times W_3+4\times W_4+5\times W_5$										

The analysis of data reveals that government initiatives and assistance being provided to the small scale sector is quite poor (PPS=33.60). Most of the units (96%) have found government initiatives and assistance inadequate and have not benefited from government support. There are only about 4% units which have been moderately benefited through government initiatives.

Availability and cost of electric power in the region also show a relatively low rating (PPS=60.00). Most of the organizations (92%) consider unreliable supply of power (too many cuts and that too unplanned) as a major factor causing poor performance of the industrial sector in the region.

Good transportation infrastructure plays a vital role in increasing competitiveness of the manufacturing sector. Government is performing relatively poorly (PPS=57.60) in providing proper rail-road infrastructure for the development of industrial sector. Most of the organizations (88%) do not consider the current condition of rail-road infrastructure in the region as supportive for development of industrial sector.

Policy restrictions and complex procedures greatly hinder the growth of small firms (Nauwelaers and Wintjes, 2010, Kang and Park, 2012). The survey results show that cutting tool sector in the region shows a very poor rating (PPS=40.00) with regards to support received from government policies and measures. Most of the organizations (88%) have termed government measures and assistance as inadequate and ineffective.

Small scale industrial sector needs active support from government with regards to sponsoring funds for development activities, loans at low interest rates, assistance in import of technologies, favorable excise duties etc. However, majority of the organizations consider lack for government support to be the most significant factor in lowering the performance. Government has failed miserably (PPS= 26.40) in providing funds to the industry for innovation initiatives. Majority of the units (68%) do not receive any financial grant from government which is discouraging.

Government aid in terms of providing training to employees of small units at government training centers and skill development centers is paramount for development of small units in other developed nations. But the analysis of the result in the small sector units of the region reveal the inability of government (PPS=40.80) in providing necessary skill development training to employees and employers of small units. Most of the units (about 72%) have either not received any training at government institutes or have received only to a small extent.

Similarly, the cutting sector shows very poor rating (PPS=34.40) in terms of free or subsidized information/consultancy received from the government. Most of the units (92%) have not received this type of government support.

The average score of this aspect is 2.10 (out of 5.00) as shown in Figure 4.2. Lack of initiatives by government for development work, no or very less allocation of funds by government for R&D, very few employee training centers and lack of subsidized information/consultancy services by the government for research initiatives are critical factors which need immediate attention for technology developments in the small scale manufacturing sector.

4.4.3 Status of Technology Infrastructure

The keys and statements on this component contained in the questionnaire aim at collecting information on the following:

i) Availability of financial support for developmental work, specific earmarking of funds for research activities, sources of funds, investments in research function as a proportion of annual turnover.

ii) Availability of infrastructural facilities to carry out technology development work and the role of modernization and renovation programs.

iii) Use of Information and Communication technology for the development initiatives, use of computers, internet and intranet for routine work and marketing, modern softwares for designing work.

The response to various issues of this component is presented in Table 4.3.

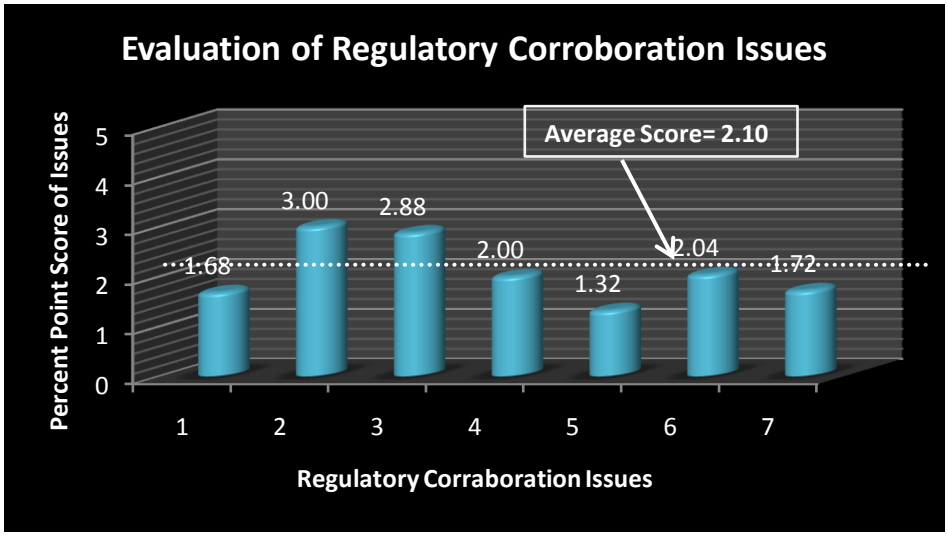

Fig. 4.2 Performance regarding Regulatory Corroboration Issues

Bar coding and RFID techniques are an important means for effective management of products. These techniques are extensively used in nations like China, Taiwan etc. However, the small scale sector in the region is lacking badly (PPS=20.00) in the implementation of these techniques. None of the organizations that were surveyed were found to be using these techniques which is very discouraging.

Use of computers for office work also leads to effective management of routine activities and obtaining and maintaining correct information regarding products on shop floor. The small scale sector shows a relatively good rating (PPS=69.60) in terms of use of computers for routine work. A large number of organizations (48%) use computers to a large extent. However, there are a few (4%) organizations which do not use computer at all for their routine work.

The use of internet for routine activities and marketing generally provide a means to access, process and distribute greater amounts of data and information quickly, in order to make thoughtful decisions. The

cutting tool units are not showing relatively good rating (PPS=60.80) with regards to this issue. Only a few units (24%) use internet and intranet facilities to a large extent at their end. Most of the units (64%) use these facilities only moderately.

The industrial sector shows a relatively poor rating (PPS=54.40) with regards to use of design and production related softwares. There are only few units (24%) which are using these softwares extensively. This issue needs attention, as the use of these tools can lead to product related improvements and innovations.

Table 4.3 Evaluation of Technology Infrastructure Issues

S. No.	Topics in the Component	No. of Responses (N)	No. of Units Scoring					Total Point Score (TPS)^	Percent Point Score (PPS) $\frac{TPS}{5 * N} 100$	Central Tendency (CT) TPS/N
			1 (W_1)	2 (W_2)	3 (W_3)	4 (W_4)	5 (W_5)			
1	Bar Coding and RFID techniques for automatic collection of information	25	25	0	0	0	0	25	**20.00**	1.00
2	Use of computers for routine work	25	1	2	8	12	2	87	**69.60**	3.48
3	Use of internet for marketing and promoting products	25	2	1	16	6	0	76	**60.80**	3.04
4	Designing and production related softwares for product improvement	25	2	6	14	3	0	68	**54.40**	2.72
5	Investment on Information and Communication technology infrastructure	25	2	0	0	23	0	94	**75.20**	3.76
6	Appropriate resources like expert employees, state of art equipments etc. for technology upgradation	25	0	2	21	2	0	75	**60.00**	3.00
7	Proportion of annual turnover for technology upgradation	25	12	11	1	1	0	41	**32.80**	1.64
8	Role of organization like skill agencies, technology centers, financial institutions for enhancing SME resources	25	1	22	2	0	0	51	**40.80**	2.04
9	Modernization and renovation programs for technology upgradation	25	0	16	9	0	0	59	**47.20**	2.36
10	Allocation of funds for R&D Infrastructure	25	11	14	0	0	0	39	**31.20**	1.56
	Overall Average (Out of 5.00)									**2.46**
^ Total Point Score (TPS) = $1\times W_1+2\times W_2+3\times W_3+4\times W_4+5\times W_5$										

Information and communication technology has a significant impact on SME operations and is claimed to be crucial for the survival and growth of economies in general. Analysis of the survey indicates a relatively good rating (PPS=75.20) with regards to investment in ICT infrastructure by small units. Most of the units (92%) have increased their investment in ICT related infrastructure in past few years.

Appropriate resources enhance organizational creativity and also provide functional support for technology upgradation related activities of organizations. The industrial units in the region have shown a relatively poor rating (PPS=60.00) with regards to availability of appropriate resources for technology upgradation at small units. Most of the units (84%) have these resources only to a moderate extent.

The manufacturing organizations are performing very badly (PPS=32.80) in terms of allocation of funds for technology upgaradation activities. Most of the units (48%) either do not allocate funds for technology upgradation activities or allocate less than 0.5% of their annual turnover for such initiatives. The remaining (44%) units allocate only 0.5-1.0% of annual turnover for technology upgradation which is far below compared to global standards.

Lack of modernization and renovation programs (PPS=47.20) is an important aspect preventing the development in this industrial sector. Most of the organizations (64%) lack in the undertaking of modernization and renovation programmes at their units.

The condition of small scale units with regards to allocation of funds for R&D is quite poor (PPS=31.20). A large number of units (44%) do not earmark any budget for R&D related activities. The remaining organizations (56%) club the R&D budget with other development activities.

The average score of this aspect is 2.46 (out of 5.00) as shown in Figure 4.3. The survival of industry is not feasible in the absence of research and development initiatives and for that infrastructure and financial support is needed. The critical analysis of various issues related to 'Technology Infrastructure' component reveals that most of the issues and concerns of this component have shown a very low rating. Substantial improvements need to be affected in the following issues: increasing the proportion of annual turnover for technology upgradation, modernization and renovation programmes and earmarking separate budget for R&D activities.

4.4.4 Status of Linkage Capability

This section presents the status of linkage capability aspect of manufacturing organizations with other small units, large enterprises and the academia etc.

The keys and statements on linkage capability aim at collecting information on the following:

i) Product and production related assistance through collaboration with small units and large enterprises, benefits obtained through subcontracting.
ii) Industry–Institute collaborations on research and development for solving technology related problems.
iii) Cooperative and Contract based research with universities, university labs and infrastructure for testing and inspection etc.

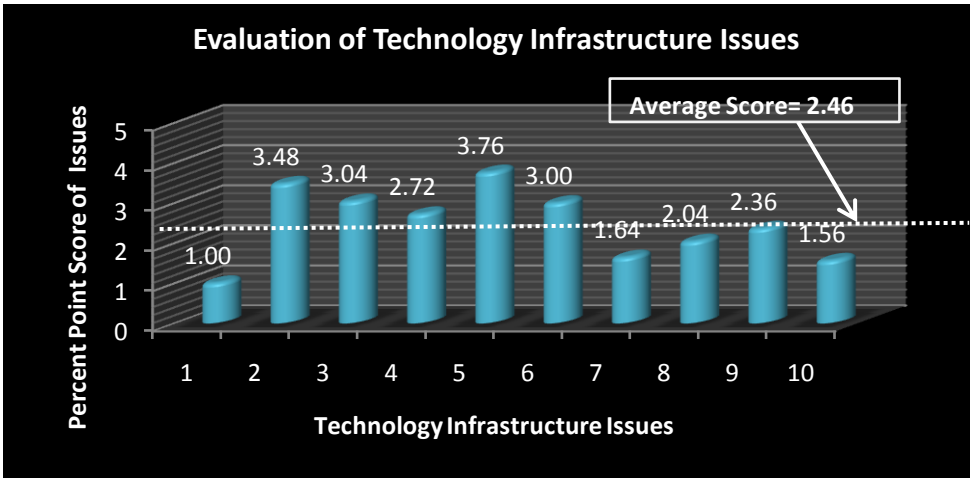

Fig. 4.3 Performance regarding Technology Infrastructure Issues

The response to various issues on this component is presented in Table 4.4.

Linkages capability affect not only the productive efficiency of the enterprise (allowing it to specialize more fully) but also the diffusion of technology through the economy and the deepening of the industrial structure, both essential to industrial development (Lall, 1992). The survey results poor rating (PPS=36.80) for benefits obtained through collaboration with small units. Most of the units (76%) obtain positive results to a small extent through collaboration. Some of the units (20%) do not receive any positive result through collaboration.

Subcontracting relationship of SMEs with LEs is an important source for transfer of technologies, leading to innovative performance of SMEs. However, the survey results indicate a very poor status (PPS=34.40) of small units in terms of forging subcontracting relations with large enterprises and obtaining benefits through such collaborations. Most of the units (56%) have received benefits only to a very small extent by forging such relations. A large fraction (36%) of the units either have not received any benefit through these collaboration or do not have subcontracting relationships with any large enterprise.

Cooperative research i.e. joint R&D projects undertaken involving direct interactions between academic-industrial personnel for mutual learning and knowledge sharing on a specific topic in developed nations. But Indian small scale sector has been found to be very poor (PPS=29.60) in this regard. Most of the units (52%) are not involved in any type of cooperative research with universities.

Contract based research is also very poor (PPS=32.00) in Indian small scale units. A large number of units (40%) are not involved in any type contract based research with universities. Most of the units (60%) are involved in contract based research to a very small extent.

Manufacturing organizations are not collaborating much with external research institutes and universities. This is in accordance with the results obtained from survey showing very poor rating (PPS=31.2). A large number of units (44%) either do not collaborate with academic institutes or do not obtain positive results

through collaboration and most of the units (56%) obtain positive results to a small extent only through collaboration. These issues need critical and thorough investigation and there is need to focus on industry-university collaboration.

The status of technology transfer from academia to industry is extremely poor (PPS=20) indicating that there is no technology transfer from academia to industry in the region.

University labs can be an important source for testing and inspection related activities for small units as such units are unable to procure costly equipments themselves. However, the results indicate a very poor status (PPS=48.00) of small scale units in this regard. Most of the units use lab facilities at technical institutes only to a small extent.

Table 4.4 Evaluation of Linkage Capability Issues

S. No.	Topics in the Component	No. of Responses (N)	No. of Units Scoring					Total Point Score (TPS)^	Percent Point Score (PPS) $\frac{TPS}{5 * N}100$	Central Tendency (CT) TPS/N
			1 (W_1)	2 (W_2)	3 (W_3)	4 (W_4)	5 (W_5)			
1	Industry-industry alliance in recent past	25	7	15	2	1	0	47	**37.60**	1.88
2	Benefits obtained through collaborations with small units	25	5	19	1	0	0	46	**36.80**	1.84
3	Subcontracting benefits with large enterprises	25	9	14	2	0	0	43	**34.40**	1.72
4	Cooperative research with institutes for joint R&D projects	25	13	12	0	0	0	37	**29.60**	1.48
5	Contract based research with institutes	25	10	15	0	0	0	40	**32.00**	1.60
6	Industry-academia alliance in recent past	25	11	14	0	0	0	39	**31.20**	1.56
7	Technology transfer from academia to industry with positive results	25	25	0	0	0	0	25	**20.00**	1.00
8	University labs for testing and inspection	25	4	9	11	0	1	60	**48.00**	2.40
9	Expert lectures and training programmes by academicians	25	8	14	3	0	0	45	**36.00**	1.80
10	Combined supervision of thesis	25	20	5	0	0	0	30	**24.00**	1.20
	Overall Average (Out of 5.00)									**1.65**
^ Total Point Score (TPS) = $1\times W_1+2\times W_2+3\times W_3+4\times W_4+5\times W_5$										

Academic institutes can be an important source of state-of-the-art technical know-how for industrial sector through expert lectures and training programs organized by faculty of these institutes. Most of the units (88%) have rarely benefited from this.

Combined supervision of thesis by universities and industries also shows an extremely poor rating (PPS=24.00). Most of the organizations (80%) are not involved in collective guidance of thesis with universities.

The overall score of this aspect is 1.65 (out of 5.00) as depicted in Figure 4.4. This factor needs immediate attention from the industries and mainly by government. The government should encourage the collaboration between industry-industry through promoting cluster development programmes to build strong linkages between industries for exchange of technological knowhow and resources. Also emphasis must be given to promote linkage of industries with universities for technology transfer related results and combined research based activities.

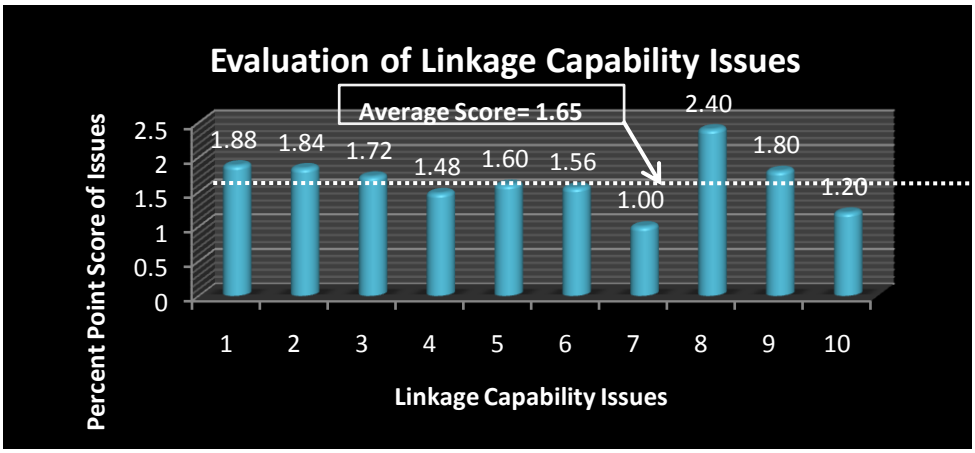

Fig. 4.4 Performance regarding Linkage Capability Issues

4.4.5 Status of Research Output

The keys and statements pertaining to research output issues aim at collecting information on the following:

i) Response of manufacturing sector to increased competition situation through increase in product mix, improvement in product features, proportion of new products introduced.

ii) Increase in market share, penetration into new markets, improvement in sales of products.

iii) Status regarding improvement in technical characteristics of the product through improved technology development initiatives, improvement in quality levels of the products and lowering of product cost through effective use of technology.

The response to various issues on this aspect is presented in Table 4.5.

The manufacturing units have shown a relatively poor rating (PPS=55.20) with regards to increase in product mix and product variants. Only a few units (16%) have been able to increase their product mix appreciably over last 3-5 years. About 40% units have been able to make these changes only to a small extent.

Improvement in existing products is an important indicator of the innovation activities of the organizations. The surveyed units have shown a relatively better rating (PPS=63.20) in making improvement in the existing product features. About one-third of the units have shown improvement in existing product

features to a large extent. There are only few units (16%) which have shown such improvements only to a small extent.

One of the important indicators of product innovation is proportion of new products introduced as a percentage of total products. This issue has shown an extremely poor rating (PPS=26.40). Most of the units (72%) either have not introduced any new products or the proportion of new products has been less than 5% (of the total product range).

Table 4.5 Evaluation of Research Output Issues

S. No.	Q. No.	Topics in the Component	No. of Responses (N)	No. of Units Scoring					Total Point Score (TPS)^	Percent Point Score (PPS) $\frac{TPS}{5*N}100$	Central Tendency (CT) TPS/N
				1 (W_1)	2 (W_2)	3 (W_3)	4 (W_4)	5 (W_5)			
1	G1	Increase in product mix and product variants over past few years	25	0	10	11	4	0	69	**55.20**	2.76
2	G2	Improvement in existing product features due to technology upgradation initiatives	25	0	4	13	8	0	79	**63.20**	3.16
3	G3	Proportion of new products as a percentage of all products	25	18	6	1	0	0	33	**26.40**	1.32
4	G4	Changes made in products features in response to market demands	25	1	0	7	15	2	92	**73.60**	3.68
5	H1	Proportion of sales improvement as a percentage of total sales due to new products	25	1	8	14	2	0	67	**53.60**	2.68
6	H2	Increase in market share because of new products	25	0	9	15	1	0	67	**53.60**	2.68
7	H3	Penetration into new markets	25	1	10	11	3	0	66	**52.80**	2.64
8	H4	Increase in profit margins of the firms	25	2	6	11	6	0	71	**56.80**	2.84
9	H5	Retention of existing customers/market	25	0	1	9	12	3	92	**73.60**	3.68
10	H6	Improvement in sales over past three years	25	0	1	10	13	1	89	**71.20**	3.56
11	I1, I4	Improvement in quality level of the products	25	0	0	15	10	0	85	**68.00**	3.40
12	I2, I7	High cost/benefit ratio of company's products as compared to competitors	25	0	0	13	11	1	88	**70.40**	3.52
13	I3	Improvement in product life cycle of the products	25	0	3	11	11	0	83	**66.40**	3.32
14	I5	Improvement in technical characteristics (performance) of products	25	0	5	17	3	0	73	**58.40**	2.92
15	I6	Lowering of cost of product due to technology upgradation changes	25	0	9	14	2	0	68	**54.40**	2.72
Overall Average (Out of 5.00)											**2.99**
^ Total Point Score (TPS) = $1\times W_1+2\times W_2+3\times W_3+4\times W_4+5\times W_5$											

The manufacturing units have shown relatively good response (PPS=73.60) to changes demanded in product features due to market or customer needs. Most of the units (60%) incorporated changes in their

products due to market demands to a large extent. Only few units (4%) do not responded to requirement of changes due to market needs.

The proportion of sales improvement as a percentage of total sales as a result of improved or new products has shown relatively a poor rating (PPS=53.60). About one-third of the units (32%) have improved their sales upto 1-5% only due to improved/new products. There are only a few units (8%) who have improved their sales by 10-15% over the past three years by introducing new/improved products.

The increase in market share of organizations over the past 3-5 years of innovative outcome also shows a relatively low (PPS=53.60). Many of the units (36%) have increased their market share to a small extent only over the past 3-5 years. Only about 4% units have increased their market share to a large extent.

Penetration of the manufacturing units into new markets is also relatively poor (PPS=52.80). Only some of the units (12%) have penetrated into new markets to a large extent over the past few years. Many of the units (40%) have penetrated into new markets to a small extent only.

The profit margins of the cutting tool units in the region have increased only marginally (PPS=56.80) over the past few years. Only about one forth (24%) of the units have been able to increase their profit margins to a large extent. Most of the units (44%) have been able to increase their profit margins only marginally.

Manufacturing units have shown a good rating (PPS=73.60) in terms of retention of existing customers. Most of the units (48%) have been able to retain their customers to a large extent whereas 12% units have been able to retain their customers to an extremely large extent. Only a few units (4%) have not been able to retain their existing customers.

The sales of the firms products have shown a relatively good improvement (PPS=71.20). Most of the units (52%) have shown improvement in the sales of their products. Only a few units (4%) have shown improvement in sales only to a small extent. Further, the firms have also shown a relatively fair improvement (PPS=68.00) in quality level of their products. Most of the units (60%) have shown improvement in quality levels to a marginal extent.

Manufacturing organizations have been able to provide relatively good (PPS=70.40) cost/benefit ratio to their customers over the past few years. Many of the units (44%) have been able to provide products with more features at a lesser cost to their customers to a large extent as compared to their competitors.

Organizations have shown a relatively fair rating (PPS=66.40) in terms of improvement in the product life of their products. Most of the units (44%) have shown improvement in the product life of their products to a large extent.

Improvement in technical characteristics of the products have shown a relatively poor rating (PPS=58.40). Most of the units (68%) have shown only marginal improvement in the technical characteristics of their products. There are only a few units (12%) who have shown improvement to a large extent.

The cost of production has increased over the past few years due to increase in the cost of raw materials, labor cost, power cost etc. This fact is validated by the survey results showing a poor rating (PPS=54.40) in terms of lowering of production costs. Only a few units (8%) have been able to reduce the production costs to a large extent. However most of the units (56%) have not been able to reduce the cost of production to an appreciable extent.

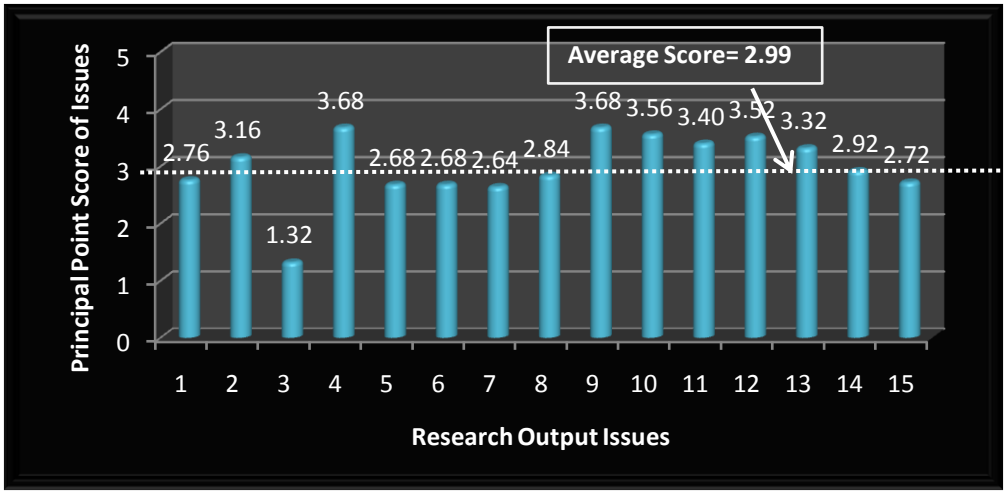

Fig. 4.5 Issue wise Performance regarding Research Output Issues

The overall score of this aspect is 2.99 (out of 5.00) as depicted in Figure 4.5. The analysis reveals that some issues need critical attention such as proportion of new product introduced as a percentage of total products, improvement in technical characteristics of the products, lowering in the cost of production and penetration into new markets.

4.5 Classification of Manufacturing Organizations

The purpose of this section is to evaluate the performance of manufacturing organizations in different factors of tactical technology development and thus to classify them into different categories. The overall standing of various units in different components has been assessed. The score of each organization (in terms of percent points scored, PPS) in individual components of '*Entrepreneur Role, 'Technology Infrastructure', 'Regulatory Corroboration, 'Linkage Capability', and 'Research Output'* has been calculated from the raw score of issues under each component.

While deciding upon the choice carrying highest marks in each issue, the levels achievable by small scale manufacturing industry in India have been taken into consideration. Requirements for highest score are

definitely less than those for large enterprise or small units in developed nations. Thus, a score close to 100% (PPS≈100.00) obtained by an organization has been graded as *Very Good* only and not *Excellent*. Further, the organizations score just 20% marks (PPS= 20) in a component if all responses to various issues of that component fall at the lowest choice and score 100% marks if all responses correspond to the best choice. The criterion used to classify the industries into different categories is presented in Table 4.6. Table 4.7 presents the performance rating of organizations in various factors of tactical technology development.

Table 4.6 Criteria for Classification of Industries

Category	Range of Percent Score	Inference	Grading
1	25 - 35	Industry at the lowest stage. Nearly all responses to the lowest choice box on an average.	***Very Poor***
2	36 - 55	Industry at a poor stage. Nearly all responses to the third or fourth choice on an average.	***Poor***
3	56 - 75	Nearly all responses to the second or third choice on an average.	***Fair***
4	76 - 90	Industry at a good stage. Nearly all responses to the first and second choice on an average.	***Good***
5	91 - 100	Industry at the highest stage. Nearly all responses to the highest choice box on an average.	***Very Good***

(Nanda and Singh, 2009b)

The industry wise performance in *'Entrepreneur Role'* component is presented in Figure 4.6. The classification of units in this component is presented in Figure 4.7.

The performance of organizations in '*Entrepreneur Role'* component is good with an average score of 70.6%. More than three fourth (84%) of the units fall in '*Fair'* category in this component. 12% of units are at a '*Good'* level and 4% of units even lie in '*Very Good'* level. None of the units lie in '*Poor'* or '*Very Poor*' category.

The manufacturing units can make use of entrepreneur's higher education level, technical skills, work experience and links for the development and growth of the industrial units. The units which are lying in '*Fair*' category must tap the potential of entrepreneur at their firm to become more competitive.

Table 4.7 Percent Point Score of Organizations in various tactical technology development **factors**

Range of PPS → / Aspect ↓	20-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	71-75	76-80	81-85	86-90	91-95	96-100
	Number of Units in a given PPS Range														
Entrepreneur Role	--	--	--	--	--	--	5	1	5	10	3	--	--	1	--
Regulatory Corroboration	--	4	6	8	6	1	--	--	--	--	--	--	--	--	--
Technology Infrastructure	--	1	1	3	11	5	4	--	--	--	--	--	--	--	--
Linkage Capability	9	5	8	3	--	--	--	--	--	--	--	--	--	--	--
Research Outputs	--	--	--	--	3	5	5	5	4	2	1	--	--	--	--

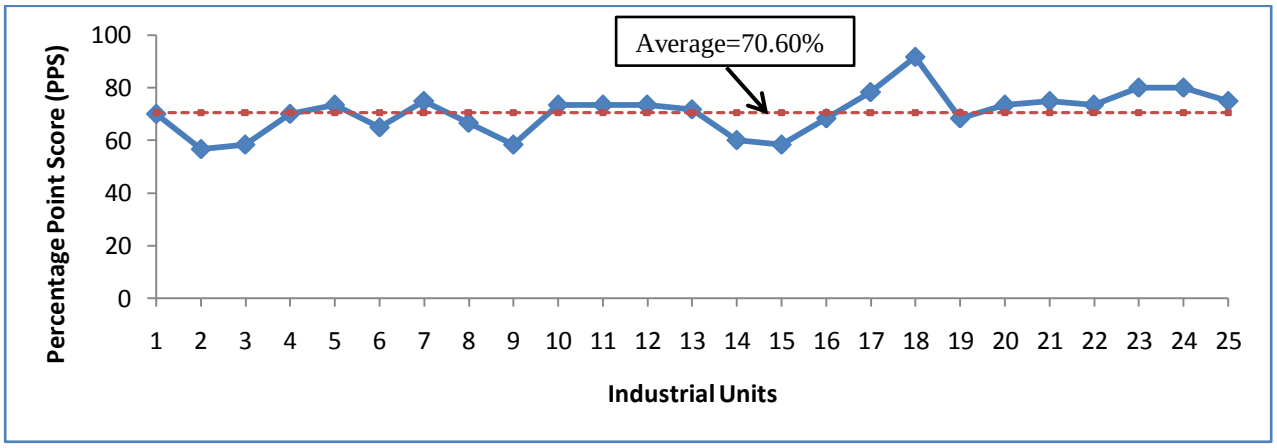

Fig. 4.6 Performance of Units in Entrepreneur Role Component

Percent Point Score (PPS)	Category	Number of Units in the Range	Proportion of Units in the Range (%)
20-35	Very Poor	-	-
36-55	Poor	-	-
56-75	Fair	21	**84**
76-90	Good	3	**12**
91-100	Very Good	1	**4**

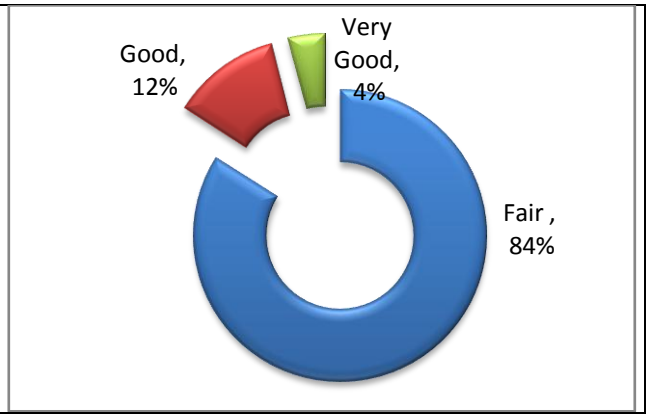

Fig. 4.7 Classification of Units in Entrepreneur Role Component

The performance of industrial units in '*Regulatory Corroboration'* component is presented in Figure 4.8. The classification of units in this component is presented in Figure 4.9. This component has shown very

poor status with an average score of 41.83%. Around one fifth (16%) of the units are at *'Very Poor'* level and 84% units are at a '*Poor'* level which is disappointing. None of the units are in '*Fair*' category in this component.

Government needs to increase the awareness about its various programs for technology development, tax benefits, subsidies and marketing assistance effectively to small scale units. The results indicate that gsmall scale units are generally unaware of the schemes available for their upliftment; the government need to thrust upon creating awareness among small scale units and also reduce paper work and bureaucratic hurdles so that these schemes have far reaching benefits to small units.

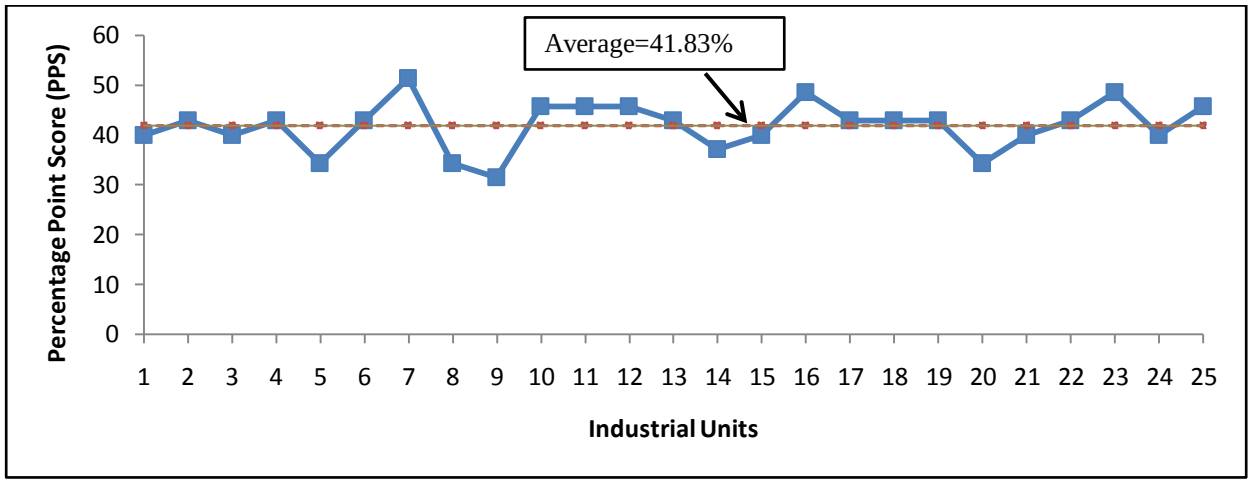

Fig. 4.8 Performance of Units in Regulatory Corroboration Component

Percent Point Score (PPS)	Category	Number of Units in the Range	Proportion of Units in the Range (%)
20-35	Very Poor	4	**16**
36-55	Poor	21	**84**
56-75	Fair	-	-
76-90	Good	-	-
91-100	Very Good	-	-

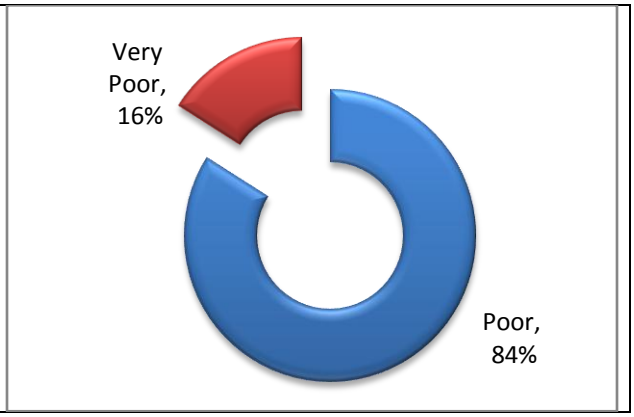

Fig. 4.9 Classification of Units in Regulatory Corroboration

The industry wise performance in '*Technology Infrastructure'* component is presented in Figure 4.10 and classification of units is presented in Figure 4.11.

The average score of units in the component, '*Technology Infrastructure'* is 49.20%. 4% of the units are at *'Very Poor'* level and 80% are at '*Poor'* level. Only few units (16%) are at fair level.

The above data indicates the poor state of cutting tool industry in the region. These industries do not have state of the art equipments for carrying out product-process innovation and technology development related activities. The emphasis needs to done on recruiting the people with required expertise and also procuring the most modern equipment to grow vertically as well as horizontally.

The industry wise performance in '*Linkage Capability'* component is presented in Figure 4.12. The classification of units in this component is presented in Figure 4.13.

The average score of organizations in this component is worst and is 32.80%. The results show that more than half of the units (56%) are at '*Very Poor*' level and rest (44%) are at '*Poor*' level.

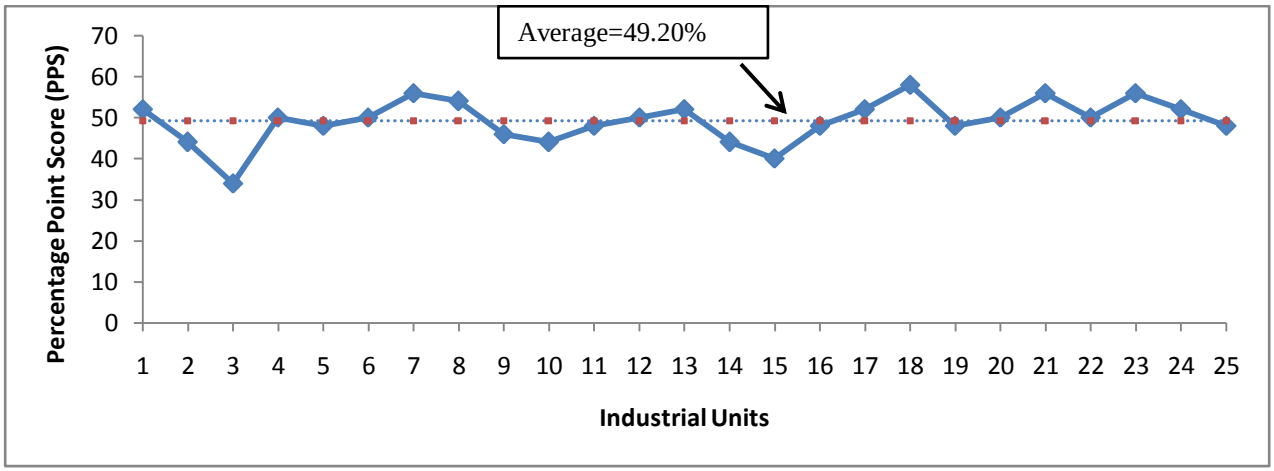

Fig. 4.10 Performance of Units in Technology Infrastructure Component

Percent Points Scored (PPS)	Category	Number of Units in the Range	Proportion of units in the range (%)
20-35	Very Poor	1	**4**
36-55	Poor	20	**80**
56-75	Fair	4	**16**
76-90	Good	-	**-**
91-100	Very Good	–	**–**

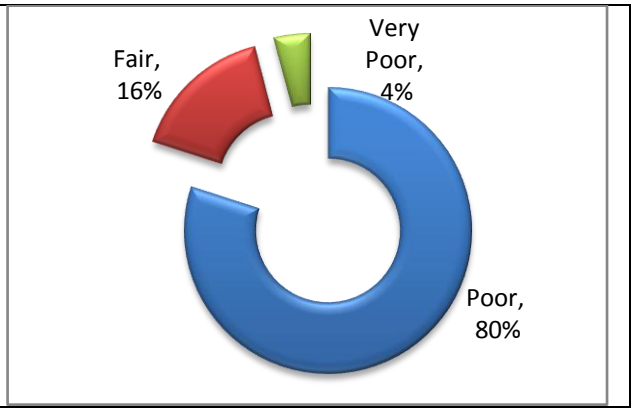

Fig. 4.11 Classification of Units in Technology Infrastructure Component

The small units need to collaborate with other small units, large enterprises and/or region academic institutes to work on a common platform so as to utilize each other's resources for the technology upgaradation and development related issues. Government can encourage them to work on a common platform by promoting its cluster development scheme at a large scale for the betterment of the small units.

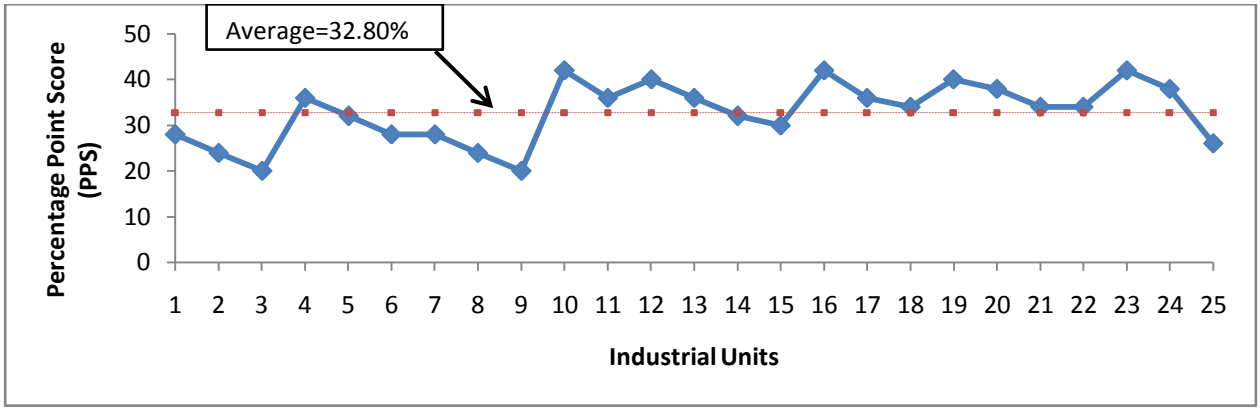

Fig. 4.12 Performance of Units in Linkage Capability Component

Percent Point Score (PPS)	Category	Number of Units in the Range	Proportion of Units in the Range (%)
20-35	Very Poor	14	**56**
36-55	Poor	11	**44**
56-75	Fair	-	-
76-90	Good	-	-
91-100	Very Good	-	-

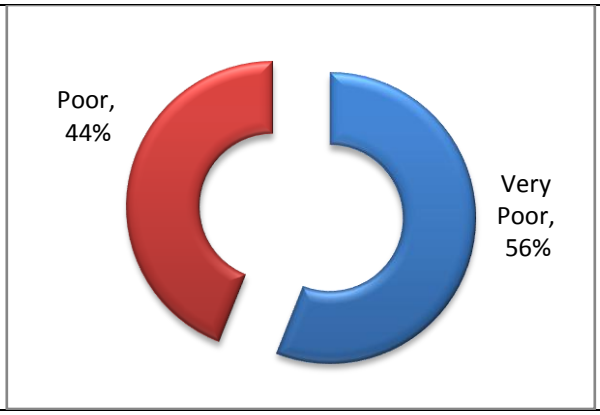

Fig. 4.13 Classification of Units in Linkage Capability Component

The industry wise performance in *'Research Output'* component is presented in Figure 4.14. The classification of units in this component is presented in Figure 4.15.

The average score of organizations in '*Research Output'* is 59.84%. About two third (64%) of the units are at *'Fair'* level. Around one third (32%) of the units are in '*Poor'* category. There are only 4% units which are at *'Good'* level.

The manufacturing units need to penetrate into new markets to increase their market share and sales. The quality of the products need to be improved and cost be reduced to retain existing customers and increase profit margins.

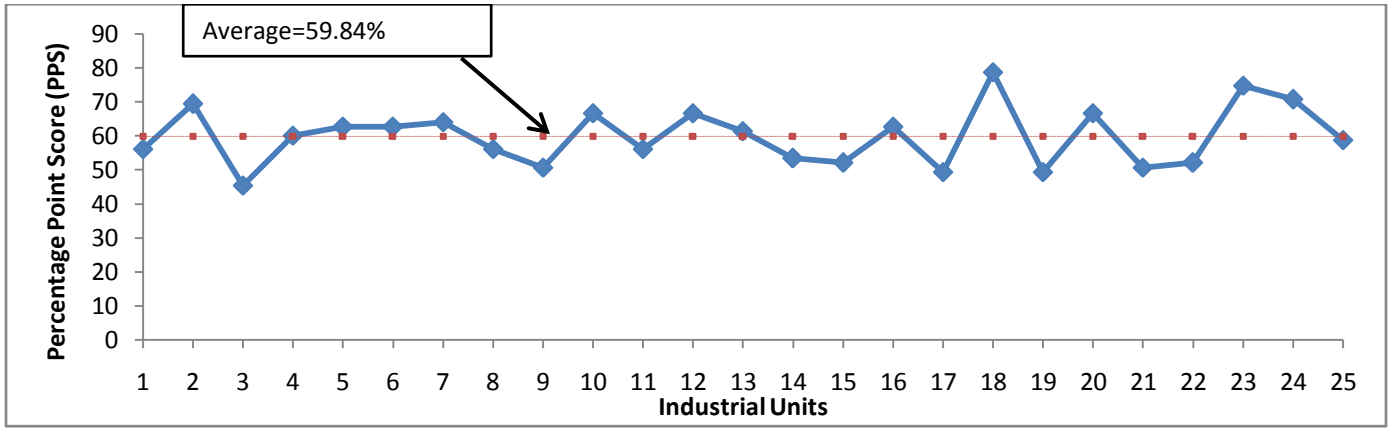

Fig. 4.14 Performance of Units in Research Output Component

Percent Point Score (PPS)	Category	Number of Units in the Range	Proportion of Units in the Range (%)
25-35	Very Poor	-	-
36-55	Poor	8	32
56-75	Fair	16	64
76-90	Good	1	4
91-100	Very Good	–	–

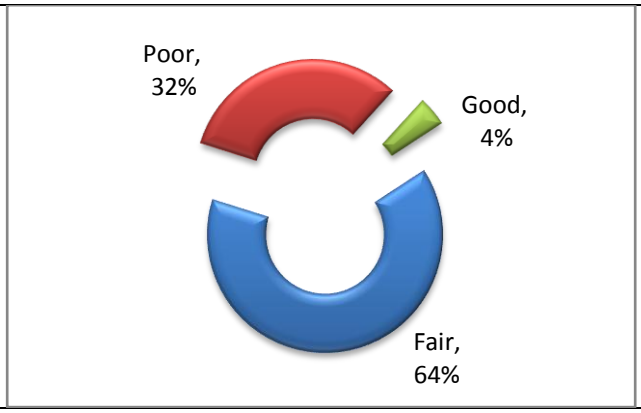

Fig. 4.15 Classification of Units in Research Output

4.6 Contributions of Technology Upgradation factors in achieving Performance Improvements

From the literature findings, four input factors (I1, I2, I3, I4) and three output parameters (Z1, Z2, Z3) have been identified as significant in analyzing the factors affecting the tactical and technological development of small units. These input and output parameters are presented in Table 4.8.

Table 4.8 Input and Output Parameters

Input Factors	Output Parameters
I1. Entrepreneur Role	**Z1. Innovation Performance**
I2. Regulatory Corroboration	**Z2. Sales Performance**
I3. Technology Infrastructure	**Z3. Product Performance**
I4. Linkage Capability	

The internal reliability of items under each input parameter (inter-item analysis) has been assessed by using Cronbach's alpha co-efficient, as recommended for empirical research in operations management (Flynn et al., 1990). Cronbach's alpha coefficient measures the extent to which a set of variables are consistent in what they are intended to measure (internal cohesiveness of items of a construct). Cronbach's alpha values calculated for various categories are greater than 0.7, which is considered adequate for exploratory work (Hair et al., 1998). This also indicates high reliability of data collected through the 'Questionnaire'. Cronbach's alpha values calculated for various input parameters are presented in Table 4.9.

The detailed description of issues (statements/ items) related to these parameters is listed in Table 4.10.

Table 4.9 Cronbach's Alpha values for all key parameters

Key Parameters		Cronbach's Alpha Value
Entrepreneur Role	I1	0.853
Regulatory Corroboration	I2	0.720
Technology Infrastructure	I3	0.873
Linkage Capability	I4	0.934
Innovation Performance	Z1	0.708
Sales Performance	Z2	0.812
Product Performance	Z3	0.814

4.7 Principal Component Analysis

Principal Component Analysis (PCA) has been performed with all the input and output research constraints considered in the present research problem. The aim has been to identify the attributes which emerge as most relevant in defining the variable. The components are extracted based on eigen value greater than 1 to reduce the dimensionality of the variables.

In '*Entrepreneur Role*' input factor, three components have been extracted based on eigen value greater than 1. Although there were five components having eigen value greater than 1, but based on the Scree Plot (as shown in Appendix V) only three most significant components have been extracted. The first component explains most of the total variance (34.91%), and related items have high loads on the component itself, highlighting their relative importance. The first component consists of six issues which include effective decision making pertaining to business activity, tacit knowledge through work experience, alertness and formal business planning, ease of collaboration, ability to seize opportunities from market and awareness about new production technologies.

Table 4.10 Issues regarding Input and Output Performance Parameters

KEY INPUTS	*KEY OUTPUTS*
I1. ENTREPRENEUR ROLE E1. Education level of the entrepreneur E2. Effective decisions pertaining to business activities and taking decisions related to cost, raw material etc. E3. Awareness Regarding Government benefits to SMEs E4. Technical competencies of entrepreneur like competency in operating all machines, quality control tools etc. E5. Entrepreneur Training E6. Strategic decision making in identifying the right kind of business and market E7. Tacit knowledge obtained through work experience E8. Alertness and formal business planning of different management areas like finance, H.R, logistics etc. E9. Easy access to finance and loans (knowledge about various financial schemes and procedures to be followed) E10. Ease of collaboration with other firms especially large enterprises E11. Ability to seize opportunities from market and using appropriate strategies in commercializing product E12. Awareness about new production technologies, machines, equipments etc **I2. REGUATORY CORROBORATION**. R1. Government initiatives and assistance in acquiring latest technology, quality certification and marketing assistance R2. Availability of electricity to the industrial units R3. Availability of rail-road infrastructure in the region R4. Government policies and measures to support innovation initiatives in small units R5. Allocating funds for R&D related activities in small units R6. Employee training at government institutes like tool rooms R7. Subsidized information regarding latest trends and technologies and consultancy for research work **I3. TECHNOLOGY INFRASTRUCTURE** T1. Bar Coding and RFID techniques for automatic collection of information T2. Use of computers for routine work T3. Use of internet for marketing and promoting products T4. Designing and production related softwares for product improvement T5. Investment on Information and Communication technology infrastructure T6. Appropriate resources like expert employees, state of art equipments etc. for technology upgradation T7. Proportion of annual turnover for technology upgradation T8. Role of organization like skill agencies, technology centers, financial institutions for enhancing SME resources T9. Modernization and renovation programme for technology upgradation T10. Allocation of funds for R&D Infrastructure **I4. LINKAGE CAPABILITIES** L1. Industry-industry alliance in recent past L2. Benefits through collaborations with small units L3. Subcontracting benefits with large enterprises L4. Cooperative research with institutes for joint R&D projects L5. Contract based research with institutes L6. Industry-academia alliance with positive results L7. Technology transfer from academia to industry L8. University labs for testing and inspection L9. Expert lectures and training programmes by academicians L10. Combined supervision of thesis	**Z1. INNOVATION PERFORMANCE** I1. Increase in product mix and product variants over past few years I2. Improvement in existing product features due to technology upgradation initiatives I3. Proportion of new products as a percentage of all products I4. Changes made in product features in response to market demands **Z2. SALES PERFORMANCE** S1. Proportion of sales improvement as a percentage of total sales due to new products S2. Increase in market share because of new products S3. Penetration into new markets S4. Increase in profit margins S5. Retention of existing customers/market S6. Improvement in sales over past three years **Z3.PRODUCT PERFORMANCE** P1. Improvement in quality level of the products P2. High cost/benefit ratio of company's products as compared to competitors P3. Improvement in product life cycle of the products P4. Improvement in technical characteristics (performance) of products P5. Lowering of cost of product due to technology upgradation changes

Table 4.11 Principal Component Analysis of issues under Entrepreneur Role

Components	Eigen Value	Percentage of Variance	Cumulative Percentage
1	**4.19**	34.91	34.91
2	**1.88**	15.63	50.54
3	**1.20**	10.03	60.58
4	1.12	9.33	69.91
5	1.04	8.70	78.61
6	0.73	6.12	84.74
7	0.58	4.88	89.62
8	0.42	3.55	93.17
9	0.35	2.94	96.12
10	0.24	2.03	98.16
11	0.15	1.31	99.47
12	0.06	0.52	100.00

The second component explains 15.63% of the total variance. It consists of two key issues i.e. strategic decision making and easy access to finance and loans.

The third component has a percentage variance of 10.03. It emphasizes on two key issues including technical competencies of entrepreneur and entrepreneur training.

Table 4.12 Rotated Component Matrix of issues under Entrepreneur Role

Issues under Entrepreneur Role	Component		
	1	2	3
• Education level of the entrepreneur	0.479	0.354	-0.455
• Effective decisions pertaining to business activities and taking decisions related to cost, raw material etc.	**0.682**	0.297	0.191
• Awareness Regarding Government benefits to SMEs	0.221	-0.601	0.083
• Technical competencies of entrepreneur like competency in operating all machines, quality control tools etc.	0.394	-0.068	**0.510**
• Entrepreneur Training	0.145	0.245	**0.813**
• Strategic decision making in identifying the right kind of business and market	0.254	**0.745**	-0.013
• Tacit knowledge obtained through prior work experience	**0.672**	-0.273	0.288
• Alertness and formal business planning of different management areas like finance, H.R, logistics etc.	**0.636**	0.504	0.032
• Easy access to finance and loans (knowledge about various financial schemes and procedures to be followed)	-0.001	**0.676**	0.192
• Ease of collaboration with other firms especially large enterprises	**0.780**	0.074	0.222
• Ability to seize opportunities from market and using appropriate strategies in commercializing product	**0.865**	0.034	-0.113
• Awareness about new production technologies, machines, equipments etc.	**0.830**	-0.136	0.159

Issues under '*Regulatory Corroboration*' input factor are also extracted into three component based on the Eigen value calculated. The first component explains most of the variance (37.32%) and can be interpreted to consist of two main issues viz. government initiatives and assistance and employee training at government institutes. The second component explaining 22.56% of variance is explained through availability of electricity, government policies and measures and free or subsidized information/consultancy for research work. The third component (percentage of variance=15.53) is the outcome of one issue only i.e. allocating funds for carrying out R&D work.

Table 4.13 Principal Component Analysis of issues under Regulatory Corroboration

Components	Eigen Value	Percentage of Variance	Cumulative Percentage
1	**2.61**	37.33	37.33
2	**1.58**	22.56	59.88
3	**1.09**	15.53	75.42
4	0.62	8.85	84.27
5	0.49	7.09	91.36
6	0.43	6.14	97.51
7	0.17	2.49	100

Table 4.14 Rotated Component Matrix of issues under Regulatory Corroboration

Issues under Regulatory Corroboration	Component		
	1	2	3
• Government initiatives and assistance in acquiring latest technology, quality certification and marketing assistance	**0.890**	0.146	0.007
• Availability of electricity to the industrial units	0.136	**0.846**	-0.011
• Availability of rail-road infrastructure in the region	-0.297	-0.241	-0.684
• Government policies and measures to support innovation initiatives in small units	-0.339	**0.624**	0.467
• Allocating funds for R&D related activities in small units	0.008	-0.001	**0.897**
• Employee training at government institutes like tool rooms	**0.902**	0.091	0.191
• Subsidized information regarding latest trends and technologies and consultancy for research work	0.261	**0.800**	0.154

The results reveal that dimensions of '*Technology Infrastructure*' can be compressed to three components which collectively explain 67.13 % of the variance. The items that should be combined in first component are, use of computers for routine work, use of internet, designing and production related softwares and investment in ICT infrastructure.

Appropriate resources for technology upgradation, and allocation of funds for R&D are the issues related to the second component. The third component comprises of role of organization for enhancing SME resources, and modernization and renovation programmes as the two key issues.

'*Linkage Capability'* factor can also be compressed to three components which explains 71.19% of the total variance. The first component (with variance of 41.96%) consists of industry-institute alliance in recent past, subcontracting benefits with large enterprises, cooperative research with institutess and industry academia alliance in recent past. Contract based research with institutes and expert lectures and training programs by academicians are the issues under second component. The third component (variance=12.24%) consists of benefits through collaboration with small units, university lab for testing and inspection and combined supervision of thesis.

Table 4.15 Principal Component Analysis of issues under Technology Infrastructure

Components	Eigen Value	Percentage of Variance	Cumulative Percentage
1	**3.48**	34.85	34.85
2	**1.85**	18.47	53.32
3	**1.38**	13.81	67.13
4	0.96	9.65	76.78
5	0.80	8.04	84.82
6	0.57	5.76	90.58
7	0.42	4.24	94.82
8	0.24	2.44	97.26
9	0.16	1.61	98.87
10	0.11	1.13	100

Table 4.16 Rotated Component Matrix of issues under Technology Infrastructure

Issues under Technology Infrastructure	Component		
	1	2	3
• Bar Coding and RFID techniques for automatic collection of information	0.394	-0.507	0.379
• Use of computers for routine work	**0.836**	-0.053	0.247
• Use of internet for marketing and promoting products	**0.852**	0.201	0.076
• Designing and production related softwares for product improvement	**0.815**	0.169	-0.030
• Investment on Information and Communication technology infrastructure	**0.506**	0.145	-0.619
• Appropriate resources like expert employees, state of art equipments etc. for technology upgradation	0.216	**0.853**	0.242
• Proportion of annual turnover for technology upgradation	-0.724	0.097	-0.111
• Role of organization like skill agencies, technology centers, financial institutions for enhancing SME resources	0.342	0.130	**0.517**
• Modernization and renovation programmes	0.150	0.254	**0.807**
• Allocation of funds for R&D Infrastructure	0.051	**0.864**	0.107

Table 4.17 Principal Component Analysis of issues under Linkage Capability

Components	Eigen Value	Percentage of Variance	Cumulative Percentage
1	**4.19**	41.96	41.96
2	**1.70**	17.00	58.96
3	**1.22**	12.24	71.19
4	0.96	9.59	80.79
5	0.68	6.83	87.62
6	0.52	5.25	92.87
7	0.28	2.87	95.75
8	0.23	2.32	98.07
9	0.12	1.28	99.35
10	0.06	0.65	100

Table 4.18 Rotated Component Matrix of issues under Linkage Capability

Issues under Linkage Capability	Component		
	1	2	3
• Industry-industry alliance in recent past	**0.841**	0.142	-0.007
• Benefits through collaborations with small units	0.489	-0.478	**0.601**
• Subcontracting benefits with large enterprises	**0.889**	0.103	0.054
• Cooperative research with institutes for joint R&D projects	**0.915**	0.162	0.004
• Contract based research with institutes	0.299	**0.706**	-0.067
• Industry-academia alliance in recent past	**0.830**	0.401	0.122
• Technology transfer from academia to industry with positive reslts	0.243	0.066	-0.552
• University labs for testing and inspection	0.518	0.011	**0.648**
• Expert lectures and training programmes by academicians	0.143	**0.839**	0.156
• Combined supervision of thesis	0.079	0.236	**0.745**

4.8.1 Association between Input and Output Performance Parameters

In this section the contribution of each input factor towards enhancing each output factor has been evaluated. For this, Pearson's correlation coefficient values (r values) between each input factor and the output parameters have been calculated. The correlation values obtained have been further validated using statistical tools like t-Test and multiple regression analysis.

Pearson's correlations and significance levels (p-values) for pairs of interrelationships of various input and output factors are depicted in Table 4.11.

t-values can also be worked out through the empirical expression provided in equation 4.1.

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \geq t_{n-2} \text{ (from't' Tables Appendix III)} \quad \text{---------- Equation 4.1}$$

where, '*n*-2' represents degrees of freedom (df) for a particular test, 'r' represents Pearson's correlation coefficient between a particular input and output parameter, t_{n-2} is the $t_{critical}$ value from statistical 't' tables (as shown in Appendix III) corresponding to (n – 2) degrees of freedom.

4.8.2 Correlation Analysis

The correlation matrix depicting the association between independent and dependent research constructs has been prepared and presented in the Table 4.19.

Table 4.19 Correlation Analysis between Input Factors and Output Parameters

DEPENDENT VARIABLES ⟹ / INDEPENDENT VARIABLES ⇓			Innovation Performance	Sales Performance	Product Performance	Overall Research Output
			Z1	Z2	Z3	Z
Entrepreneur Role	I1	r	0.488*	0.478*	0.645**	0.610**
		t	2.68*	2.61*	4.04**	3.69**
		p	0.013	0.016	0.000	0.001
Regulatory Corroboration	I2	r	0.088	.145	0.463*	0.249
		t	0.42	0.70	2.51*	1.23
		p	0.674	0.488	0.020	0.230
Technology Infrastructure	I3	r	0.399*	0.595**	0.394*	0.540**
		t	2.09*	3.55**	2.07*	3.08**
		p	0.048	0.002	0.049	0.005
Linkage Capability	I4	r	0.335	0.343	0.523**	0.452*
		t	1.71	1.75	2.94**	2.43*
		p	0.101	0.094	0.007	0.023

**** Correlation significant at 0.05 level (2-tailed) ** Correlation significant at 0.01 level (2-tailed)***

The input parameter, '*Entrepreneur Role*' (I1) has shown a significant correlation with all the research output parameters. It shows a significant association (r=0.488; p=0.013) with '*Innovation Performance*' (Z1); affects significantly (r=0.478; p=0.016), the '*Sales Performance*' (Z2); and also contributes very effectively (r=0.645; p=0.000) towards '*Product Performance*' (Z3). As a result, the '*Entrepreneur Role*' (I1) parameter shows a very significant correlation (r=0.610; p=0.001) with '*Overall Research Output*' (Z). *Thus the hypotheses H1, H1a, H1b and H1c all are accepted*.

The input factors, '*Regulatory Corroboration*' (I2) and '*Linkage Capability*' (I4) have not contributed very effectively towards the output parameters. These input factors have shown a significant association

(r=0.463; p=0.020 and r=0.523; p=0.007 respectively) only with the '*Product Performance*' (Z3) output. *Thus the hypotheses H2c, H4 and H4c are accepted whereas hypotheses H2, H2a, H2b, H4a and H4b are rejected.*

The input parameter, '*Technology Infrastructure*' (I3) has also shown a significant correlation towards all the research output parameters. It significantly contributes (r=0.399; p=0.048) towards '*Innovation Performance*' (Z1); significantly affects (r=0.595; p=0.002) the '*Sales Performance*' (Z2); and also contributes effectively towards (r=0.394; p=0.049) '*Product Performance*' (Z3). As a result, the '*Technology Infrastructure*' (I3) parameters shows a significant correlation (r=0.540; p=0.005) with '*Overall Research Output*' (Z). *Thus the hypotheses H3, H3a, H3b, and H3c all are accepted.*

4.8.3 Regression Analysis

Table 4.20 shows the regression analysis with the dependent variable as '*Innovation Performance*' (Z1) and four input factors as independent variables. The results indicate that, '*Entrepreneur Role*' (I1) and '*Technology Infrastructure*' (I3) together can predict 17.6% of the variance in '*Innovation Performance*' (Z1) variable, the other input variables will add little to the variance.

Table 4.20. Regression analysis for Innovation Performance

Dependent Variable			**R**	**R Square**	**Adjusted R Square**	**F Probability**
Innovation Performance (Z1)			0.494	0.244	0.176	0.046
S. No	**Independent Variable(s)**	**B**	**β**	**Standard Error**	**t-value**	**Significance**
1	**Entrepreneur Role (I1)**	0.662	0.411	0.420	1.577	0.129
2	**Technology Infrastructure (I3)**	0.203	0.110	0.481	0.422	0.677

Table 4.21 shows the regression analysis with the dependent variable as '*Sales Performance*' (Z2) and the four input factors as independent variables. The results indicate that, '*Entrepreneur Role*' (I1) and '*Technology Infrastructure*' (I3) together can predict 30.3% of the variance in '*Sales Performance*' (Z2) variable, the other input variables will add little to the variance.

Table 4.22 shows the regression analysis with the dependent variable as '*Product Performance*' (Z3) and four input factors as independent variables. The results indicate that, '*Entrepreneur Role*' (I1), '*Regulatory* Corroboration' (I2) and '*Linkage Capability*' (I4) together can predict 46.6% of the variance in '*Product Performance*' (Z3) variable, the other input variables will add little to the variance.

Table 4.21 Regression analysis for Sales Performance

Dependent Variable			R	R Square	Adjusted R Square	F Probability
Sales Performance (Z2)			0.601	0.362	0.303	0.007
S. No	**Independent Variable(s)**	**B**	**β**	**Standard Error**	**t-value**	**Significance**
1	**Entrepreneur Role (I1)**	0.192	0.117	0.394	0.489	0.630
2	**Technology Infrastructure (I3)**	0.968	0.513	0.451	2.143	0.043

Table 4.22 Regression analysis for Product Performance

Dependent Variable			R	R Square	Adjusted R Square	F Probability
Product Performance (Z3)			0.730	0.533	0.466	0.001
S. No	**Independent Variable(s)**	**B**	**β**	**Standard Error**	**t-value**	**Significance**
1	**Entrepreneur Role(I1)**	0.672	0.513	0.213	3.157	0.005
2	**Regulatory Corroboration(I2)**	0.500	0.221	0.417	1.199	0.244
3	**Linkage Capability(I4)**	0.206	0.190	0.210	0.978	0.339

4.8.4 Result Discussion

Literature reveals that entrepreneurs incorporate changes in the organization through innovation, risk taking abilities and creativity and lead to development of the organization. There are certain demographic factors of the entrepreneur like age, education, training, work experience which lead to the development of the organization (Islam *et al.*, 2011). The correlation analysis of '*Entrepreneur Role*' factor validates the above facts. Entrepreneur Role shows a significant positive correlation with Sales Performance (Z2) (r=0.478; p=0.016); Product Performance (Z3) (r=0.645; p=0.000); and Innovation Performance (Z1) (r=0.488; p=0.013). Entrepreneur Role input factor consists of three main sub factors viz. Entrepreneur Education, Entrepreneur Training, and Prior work experience of the entrepreneur. The education background of the managers and entrepreneur is an important factor explaining innovation in small business, education helps entrepreneur to understand new information that could help him to develop higher technological capabilities. It is crucial for entrepreneurs to have *know how* (technical skill) and *know that* (knowledge) as well as the ability to obtain *know how* in handling their business. Similarly industry experience and work experience lead towards development of successful entrepreneurs (Hisrich *et al.*, 2008; Classen *et al.*, 2012). All these three factors combined together lead to growth of organization and enhancement in

innovation related activities of the organization which is evident from the correlation analysis which shows a significant correlation with all the three research output parameters.

Linkage Capability according to literature involves following activities: local procurement of goods and services, information exchange with suppliers, import of technology, cooperative R&D, licensing own technology to others and lending own machinery and equipments for training or production related activities to collaborating organization. Such linkages affect not only productive efficiency of the enterprise but also diffusion of technology thus enabling the organizations to specialize more fully in their products and producing products with better features and quality (Lall, 1992; Kumar and Bala Subrahmanya, 2010). Survey result also shows that '*Linkage Capability*' (I4) has significant positive relation with '*Product Performance*' (Z3) (r=0.523; 0.007)). Partnerships with suppliers or larger firms generally lead at significant quality improvements or cost reductions due to process innovations (Classen *et al.,* 2012).

Technology infrastructure is necessary in any organizational structure to sustain and carry out innovation related activities (Ghorbani and Bagheri, 2008). '*Technology Infrastructure*' (I3) consisting of ICT, project resources, renovation programs and financial support to research initiatives shows a significant positive correlation (r=0.399; p=0.048)) with '*Innovation Performance*' (Z1). ICTs' in SMEs can be used as a business tool to reduce costs, create stronger links with customers, create innovations and gather relevant data to produce new or improved products. People with necessary expertise, sufficient funds to carry out research and use of modern equipments also supplement the innovation related activities of the organizations (Doloreaux and Melancon, 2009). '*Technology Infrastructure*' (I3) has also been found to be having a significant positive effect on '*Sales Performance*' (Z2) (r=0.595; p=0.002). Information Technology enabled operations focus helps the organizations, to transform marketing and production activities that are necessary to directly produce new products and meet customer needs. Also, use of state of the art infrastructure leads to better quality products with enhanced products thus attracting more customers and enhancing sales of the organization directly (Chahal and Kohli, 2006). '*Technology Infrastructure*' (I3) also shows significant positive correlation with '*Product Performance*' (Z3) (r=0.394; p=0.049).

Regulatory Corroboration i.e. government support for SMEs provides potential benefits in providing sufficient financial resources for efficient business support services. Financial assistance generally includes various forms of investment incentives and soft policy loans. Financial incentives and assistance is necessary for small organizations generally facing financial crunch to produce new products or products with enhanced features. Government support in the form of assistance in procuring imported machinery and assistance in getting various quality certifications also leads to small organizations eventually producing better quality products and staying afloat in competitive environment (Kang and Park, 2012). Survey result

also showed a significant relation between '*Regulatory Corroboration*' (I2) and '*Product Performance*' (Z3) (r=0.463; p=0.02) thus confirming with the findings in the literature.

The analysis of results show that the two input factors viz. '*Entrepreneur Role*' (I1) and '*Technology Infrastructure*' (I3) that are internal to manufacturing units have shown significant positive correlation with all the three output factors viz. '*Innovation Performance*' (Z1), '*Sales Performance*' (Z2) and '*Product Performance*' (Z3) as well as with '*Overall Research Outputs*'. Whereas other input factors viz. '*Regulatory Corroboration*' (I2) and '*Linkage Capability*' (I4) have shown significant correlation with one output parameter only i.e. '*Product Performance*' (Z3). This is due to the fact that these two input parameters are dependent on external agents like government/or and other small units to form linkage. '*Entrepreneur Role*' (I1) and '*Technology Infrastructure*' (I3) are totally dependent on manufacturing units themselves and due to these factors significantly affect all the output parameters. The descriptive analysis shows that entrepreneur's education level, ability to seize opportunities from market, strategic decision making and awareness about new production technologies and equipments are the key issues yielding a good percent point score indicating manufacturing unit's good state in these issues. As a result, they are able to make proper investment in technology infrastructure like ICT, people with necessary expertise, proper machinery etc which also show a fair percent point score and hence significant affect on '*Product Performance*' of the manufacturing units.

4.9. Chapter Summary

The chapter describes the quantitative analysis performed on the data using various statistical tools. Status of key input and output performance parameters has been determined. Further, all the manufacturing units surveyed have been classified as very good, good, poor etc based on their status in key issues. Significance and correlation of input parameters with output parameters have been found out through step-wise regression analysis and Pearson's correlation analysis. Principal Component analysis has been used to reduce various key issues under each input parameter to few important components.

CHAPTER - V

RESULTS AND CONCLUSIONS

5.1 Introduction

This chapter covers the summary of the research work, its results, conclusions, and the recommendations. The chapter also lists various areas which can be taken up for further research. The summary of the research covers the methodology adopted, salient features, and tools and techniques used in the work. Further, the results of the survey and the inferences drawn from them along with the major learning's have been presented. Based on the results and the findings, conclusions have been drawn and recommendations have been made. The limitations along with the scope for future work are covered in the subsequent sections of the chapter.

5.2 Results and Major Findings

The main results of the present research work have been derived from the descriptive and empirical analyses of primary data collected though questionnaire based survey. The major findings are presented as follows:

Entrepreneur Role Issues

- The education level of the entrepreneur (employer) is fairly good (PPS=71.20), indicating that most of the organizations (52%) are being run by entrepreneur's having either post graduate or engineering degree. 44% organizations are run by entrepreneurs having either diploma or normal graduation degree.
- The higher education background of entrepreneurs have enabled them to take decisions regarding routine activities, implementation of new ideas i.e. product and process innovation effectively (PPS=68.80).
- Entrepreneurs at 60% of the units are well equipped with the technical competencies required to handle their businesses. Only 4% units don't have entrepreneurs with necessary technical competencies.
- Entrepreneurs at 44% of the units are able to take their decisions regarding market and technology effectively due to their technical knowledge and entrepreneurs at 76% of the units provide training internally to their employees thus reducing the cost of training.
- Entrepreneurs at a fairly good number of units (about 64%) have been found to be alert in identifying new business activities to a large extent.
- Entrepreneurs with prior working experience have generally better access to finance and loans and knowledge about various financial schemes (PPS=77.60). Entrepreneurs at 68% of the units have been

found to obtain the necessary knowledge for innovation related activities from their prior work experience.

- Entrepreneurs at a good number of units (72%) have been found to have better access to finance and loans to a large extent because of their prior work experience.
- Prior work experience has been found to be moderately helpful in collaboration with other firms (PPS=56.00). Entrepreneurs at 40% of the units have been found to be alert in identifying new business activities to an extremely large extent due to their experience or technical know-how.
- Entrepreneurs prior work experience has also led to awareness about new production technologies (machine, equipments, tooling etc). The cutting tool sector has shown a fairly good rating (PPS=72.00) in this regard. A fair number of units (64%) have been found to have proper awareness regarding new production technologies to a large extent due to prior experience.
- The average score of this aspect is 3.53 (out of 5.00). The analysis of this component reveals that effective decision making pertaining to business activities, awareness regarding government benefits, technical competencies, working in collaboration with others and ability to seize opportunities from the market are some areas which need improvement.

Regulatory Corroboration Issues

- Government has failed to provide assistance to small scale organizations effectively. Most of the units (96%) have found government initiatives and assistance inadequate and have not benefited from government support. There are only about 4% units which have been moderately benefited through government initiatives.
- Most of the organizations (92%) consider unreliable supply of power (too many cuts and that too unplanned) as a major factor causing poor performance of the industrial sector in the region.
- Most of the organizations (88%) do not consider the current condition of rail-road infrastructure in the region as supportive for development of industrial sector.
- Cutting tool sector shows a very poor rating (PPS=40.00) with regards to support received from government policies and measures. Most of the organizations (88%) have termed government measures and assistance as inadequate and ineffective.
- Only a small number of units (48%) have been able to get training for their employees at government training centre's and institutes
- Most of the organizations (92%) have not received free or subsidized information/consultancy for innovation related activities from the government.

- The average score of this aspect is 2.10 (out of 5.00). Lack of initiatives by government for development work, no or very less allocation of funds by government for R&D, very few employee training centers and lack of subsidized information/consultancy services by the government for research initiatives are critical factors which need immediate attention for technology development in the small scale manufacturing sector.

Technology Infrastructure Issues

- None of the organizations that were surveyed were found to be using Bar Coding and RFID techniques for management of their products.
- A good number of the organizations (PPS=69.60; 48%) have been found to be using computers for routine work and maintaining correct information regarding products on shop floor.
- Most of the units (64%) have been found to be using internet and intranet facilities only moderately at their organizations.
- The small scale organizations have shown poor rating (PPS=54.40) regarding use of production related softwares, only few units (24%) are using these type of softwares extensively.
- Most of the units (92%) have increased their investment in ICT related infrastructure over the past few years.
- The manufacturing organizations are fairing badly (PPS=32.80) in terms of allocation of funds for technology upgaradation activities. Most of the units (48%) either do not allocate funds for technology upgradation or allocate less than 0.5% of annual turnover for technology upgradation.
- Many of the units surveyed (44%) do not earmark any budget for R&D related activities.
- Most of the organizations (64%) lack in the undertaking of modernization and renovation programmes at their units.
- The average score of this aspect is 2.46 (out of 5.00). The survival of industry is not feasible in the absence of research and development initiatives and for that infrastructure and financial support are needed. The critical analysis of various issues related to 'Technology Infrastructure' component reveals that most of the issues and concerns of this component have shown very low rating.

Linkage Capability Issues

- Most of the industrial units (88%) collaborate only to a small extent with other industrial units.
- Most of the units (76%) have obtained positive results only to a small extent through collaborations.

- The manufacturing organizations show a poor rating (PPS=34.40) in terms of collaborating with large organizations and forming subcontracting relationships. 36 % of the industrial units surveyed do not form any kind of subcontracting relationship with large organizations.
- The manufacturing organizations surveyed have shown a poor rating in both contract based research (PPS=32.00) and cooperative research (PPS=29.60) involving academic institutes. 52% of the organizations are not involved in any type of cooperative research and 40% of the organizations are not involved in any contract based research with the academic institutes.
- Manufacturing organizations have shown a poor rating (PPS=31.20) in terms of collaborating with academic institutes and universities. A large number of units (44%) either do not collaborate with academic institutes or do not obtain positive results through collaboration and most of the units (56%) obtain positive results to a small extent only through collaboration.
- The status of technology transfer from academia to industry is extremely poor (PPS=20.00) indicating that there is no technology transfer from academia to industry.
- Only 44% of the units use university labs and testing facilities that too to a very small extent.
- Most of the organizations (80%) are not involved in collective guidance of thesis with universities showing poor collaboration of industries with local academic institutes and universities.
- The overall score of this aspect is 1.65 (out of 5.00). This factor needs immediate attention from the industries and mainly by government. The government should encourage the collaboration between industry-industry through promoting cluster development programmes to build strong linkages between industries for exchange of technological knowhow and resources. Also emphasis must be given to promote linkage of industries with universities for technology transfer related results and combined research based activities.

Research Output Issues

- Only a few units (16%) have been able to increase their product mix appreciably over the last 3-5 years.
- Manufacturing organizations have shown a better rating (PPS=63.20) towards improvement in product features over past 3-5 years. About one-third of the units have shown improvement in existing product features to a large extent. There are only few units (16%) which have shown such improvements only to a small extent.
- Most of the units (72%) either have not introduced any new products or the proportion of new products has been less than 5% (of the total product range).

- The manufacturing units have shown relatively good response (PPS=73.60) to changes demanded in product features due to market or customer needs. Most of the units (60%) incorporated changes in their products due to market demands to a large extent.
- About one-third of the units (32%) have improved their sales upto 1-5% only due to improved/new products. There are only a few units (8%) who have improved their sales by 10-15% over the past three years by introducing new/improved products.
- Penetration into new markets by the manufacturing organizations is quite on a lower side. Only some of the units (12%) have penetrated into new markets to a large extent over the past few years. Many of the units (40%) have penetrated into new markets to a small extent only.
- Only 24% of the units have been able to increase their profit margins to a large extent in past few years.
- Manufacturing units have shown good rating (PPS=73.60) in terms of retention of existing customers. Only 4% units have not been able to retain their existing customers.
- A fairly large number of units (52%) have shown improvement in the sales of their products.
- Quality level of the products has increased considerably. Most of the units (60%) have shown improvement in the quality level of their products to a marginal extent.
- Quite a good number of units (44%) have shown improvement in the product life of their products to a large extent.
- Most of the units (68%) have shown only a marginal improvement in the technical characteristics of their products. Only a few units (12%) showed improvement to a large extent.
- Only a few units (8%) have been able to reduce the cost of production to an appreciable extent.
- The overall score of this aspect is 2.99 (out of 5.00). The analysis reveals that some issues need critical attention such as proportion of new product introduced as a percentage of total products, improvement in technical characteristics of the products, lowering the cost of production and penetration into new markets.

Status of Manufacturing Units

- The performance of organizations in '*Entrepreneur Role'* component is good with an average score of 70.6%. More than three fourth (84%) of the units fall in '*Fair'* category in this component.
- The performance of industrial units in '*Regulatory Corroboration*' is very poor with average score of 41.83%. Most of the units (84%) are at '*Poor*' level in this component.
- The industrial units have shown poor performance in '*Technology Infrastructure*' issue with average score of 49.20 %. 80% of the units are at '*Poor*' level in this component.

- The industrial units have shown worst performance in '*Linkage Capability*' component. More than half of the units (56%) are at '*Very Poor*' level and rest of the units (44%) are at '*Poor*' level.
- The performance of organizations in 'Research Output' issues is relatively fair with average score of 59.84%. About two third (64%) of the units are at *'Fair'* level.

Results of Principal Component Analysis

- The twelve issues under '*Entrepreneur Role*' factor have been extracted into three main components. The first component consists of six issues which include effective decision making pertaining to business activity, tacit knowledge through work experience, alertness and formal business planning, ease of collaboration, ability to seize opportunities from market and awareness about new production technologies. The second component consists of two key issues i.e. strategic decision making and easy access to finance and loans. The third component emphasizes on two key issues which include technical competencies of the entrepreneur, and entrepreneur training.
- Principal component analysis extracted three main components from seven key issues of '*Regulatory Corroboration*' input factor. First component can be interpreted to consist of two main issues viz. government initiatives and assistance and employee training at government institutes. Second component is explained through availability of electricity, government policies and measures, and free or subsidized information/consultancy for research work. The third component is the outcome of one issue only i.e. allocating funds for carrying out R&D work.
- *'Technology Infrastructure*' factor can also be extracted into three main components. The first component consists of four items i.e. use of computers for routine work, use of internet, designing and production related softwares and investment in ICT infrastructure. Appropriate resources for technology upgradation, and allocation of funds for R&D are the issues related to second component. The third component comprises of role of organization for enhancing SME resources, and modernization and renovation programs as the two key issues.
- Dimensions of '*Linkage capability*' input factor can also be compressed into three main components. The first component consists of industry-institute alliance in recent past, subcontracting benefits with large enterprises, cooperative research with institutes and industry academia alliance in recent past. Contract based research with institutes and expert lectures, and training programs by academicians are the issues under second component. The third component consists of benefits through collaboration with small units, university labs for testing and inspection, and combined supervision of thesis.

Results of Correlation Analysis

- '*Entrepreneur Role*' (I1) has shown a significant correlation with all the research output parameters. It shows a significant association (r=0.488; p=0.013) with '*Innovation Performance*' (Z1); affects significantly (r=0.478; p=0.016), the '*Sales Performance*' (Z2); and also contributes very effectively (r=0.645; p=0.000) towards '*Product Performance*' (Z3). As a result, the '*Entrepreneur Role*' (I1) parameter shows a very significant correlation (r=0.610; p=0.001) with '*Overall Research Output*' (Z).
- '*Regulatory Corroboration*' (I2) has shown significant association (r=0.463; p=0.02) with '*Product Performance*' (Z3) only.
- The input parameter, '*Technology Infrastructure*' (I3) has also shown a significant correlation towards all the research output parameters. It significantly contributes (r=0.399; p=0.048) towards '*Innovation Performance*' (Z1); significantly affects (r=0.595; p=0.002) the '*Sales Performance*' (Z2); and also contributes effectively towards (r=0.394; p=0.005) '*Product Performance*' (Z3). As a result, the '*Technology Infrastructure*' (I3) parameters shows a significant correlation (r=0.540; p=0.005) with '*Overall Research Output*' (Z).
- '*Linkage Capability*' (I4) has shown significant positive correlation (r=0.523; p=0.007) with '*Product Performance*' (Z3) only.

Results of Regression Analysis

- *'Entrepreneur Role*' and '*Technology Infrastructure*' explain 17.6% variance in '*Innovation Performance*'.
- 30.3% of variance in '*Sales Performance*' can be predicted by input variables viz. '*Entrepreneur Role*' and '*Technology Infrastructure*'.
- 46.6% of the variance in '*Product Performance*' can be predicted from the combination of three input factors viz. '*Entrepreneur Role*', '*Regulatory Corroboration*' and '*Linkage Capability*'.

5.3 Major Discussions

- Though innovation occurs in many guises, firms play a leading role in creating innovation and translating it into useful applications for market. Innovation in firms takes place when knowledge is commercialized, for example in the form of new products, services, processes, or business models.
- MSMEe depend on their ability to be innovative for sustaining competitiveness. MSMEs in the region need to focus on developing new products faster and more effectively to sustain increased competition and compete with rapid advancing technologies in many industries.

- The entrepreneur acts as a breakthrough innovator and entrepreneurship is an activity that carries out new combinations of resources for the creation of innovation. The higher education background of the entrepreneurs has been instrumental in innovation related activities and growth of firms in the region, more and more entrepreneurs should emphasize on increasing their education level so as to facilitate their other competencies like ease of strategic decision making which has been evident as per the results obtained through descriptive analysis of the issues.
- Entrepreneur's training has a more direct impact than education. Training has special effects on production capabilities and it imparts knowledge and skills that can be readily applied. The descriptive analysis indicates that entrepreneur's with necessary and good technical competencies are able to make strategic decisions in identifying the right kind of business and market for their products an also in imparting training to their employees on their own because of indispensible technical abilities thus saving cost of training employees to some extent. Thus entrepreneurs of small scale units of the region should focus their energy in further enhancing their technical competencies so as to take their organizations to a more advanced stage.
- Previous work experience is one of the important conditioning factor which significantly influences innovation in small businesses. Entrepreneur brings all his knowledge, expertise and contacts from previous work experience to propel his current venture. However, entrepreneurs of the region are lacking in contacts with large enterprises and hence have failed to form collaborations with large enterprises for technology related resource sharing which needs to be addressed for betterment of the manufacturing units of the region.
- In SMEs, the critical resources are likely to be held by the individual entrepreneurs that are reflected in their skills, knowledge, abilities, experience, and education. Being the key decision makers, the entrepreneurs have high influence on the formation of business strategy and are responsible to set the roadmap for their firms to move towards the set goals. The overall education level of entrepreneurs in the region is quite good and instrumental in managing their firms but few entrepreneurs who lack in their education level should also try to upgrade their education level so as to further enhance their managerial skills and abilities which can help them in better understanding of government policies and offers beneficial for their units.
- In order to meet the challenges of continuous innovation in technology-based industries, a technology firm needs to focus on developing its in-house Research and Development (R&D) activities and applications, specifically through the development of new products. Thus, R&D activities are regarded as a determinant of innovation. Furthermore, R&D activities may also increase the value of a firm,

especially in terms of a firm's products or process development by increasing a better understanding on how and where to innovate amongst technology-based firms.

- Government initiatives and assistance to MSMEs of the region in acquiring latest technology, quality certification and marketing assistance has been largely ineffective. Government has failed to extend the benefits of policies and initiatives formed under MSMED Act 2006 to small scale sector of the region mainly due to inefficient staff at district level. Stricter norms with deadlines for reaching required population of industries in the region should be set by government for officers at DIC's so as to ensure that benefits of the various schemes reach the MSMEs for their betterment and upgadation.
- Erratic power supply and inappropriate rail-road infrastructure are also a source of concern for small scale units of the region. Good transport infrastructure is vital for increasing the competitiveness of the organizations but the infrastructure in the region is not supportive for the development of units. Government should put efforts to improve transport infrastructure of the region and also to provide better and regular power supply at subsidized rates. Efforts should be made to set electric sub-stations near industrial centers to ensure regular supply of power to the industrial units of the region.
- Policy restrictions and complex procedures greatly hinder the growth of small firms. Bureaucratic hurdles along with the lackluster attitude of the government towards small units has led to the downfall of small units. Multiple taxes imposed by government should be relaxed and government should offer tax break to industries of the region (like adopted in other states) to help prevent them from falling sick and ultimately failing.
- R&D initiatives at the small units is one of the important feature of innovation activities at the small unit. But, small sector has been performing extremely poorly in R&D activities mainly due to lack of financial sources and expert manpower. Government should assist small scale firms by providing collaborative training for R&D with universities or at government funded research centers, government should provide laboratories for R&D work and also should provide funding for R&D projects and infrastructure development at small units.
- Government should promote innovation by providing data on scientific and technological trends, and networking, both nationally and internationally. But, the government has failed miserably in terms of providing free or subsidized information/consultancy for research work at small units. Special seminars should be held or regular magazines (technical journals) concerning the latest trends and technologies being adopted by MSMEs of developed nations should be published and distributed free of cost among small units for their knowledge enhancement.

- Bar Code and RFID techniques are not being used by any of the small units of the region which is very discouraging. Small units should start using these techniques for effective management of their products on the shop floor and to keep track of all the products.
- Design and production related softwares for CAD etc are an important source to facilitate the product related innovation activities (minor modification in design of products). However, most of the small scale units in the region are not using these softwares and also do not have trained professionals to operate these softwares thus acting as a hindrance to innovation related activities. Small units should purchase these softwares and try to incorporate changes in their product designs for enhanced product performance.
- The absence of adequate infrastructure services is one of the main problems that hinder efforts to develop technology. Innovative organizations have better systems and technology in place than their competitors. Small scale units need to set aside some proportion of their annual turnover for technology upgradation activities like purchase of modern machinery and equipments so as preclude their technology from becoming obsolete.
- Small scale units need to forge separate R&D division to ensure a dedicated workforce excogitating and innovating new and better products on a regular basis. They should allocate separate funding from total profit for procuring R&D infrastructure and setting R&D labs at their end.
- The status of small firms' linkage with other units of region is appalling. Small firms need to constitute inter-firm linkages with small units to gain competitive and cooperative advantage, sharing of resources, staff training, to take expert opinion from other in case of major problem, also, small firms can join hands to procure raw material jointly in bulk quantity from a major supplier located outstation at competitive prices and also to show their grudges against government policies on a common platform.
- The ability of MSMEs to compete in the global market place depends on their access to resources and those MSMEs that have better access to these resources are able to exhibit better innovative and economic performance. External Linkages with large enterprises (LEs) provides MSMEs better scope for accessing these resources. External linkage of MSMEs with LEs is an important source for transfer of technologies, technical guidance and human and financial capita leading to innovative performance of MSMEs.
- The collaboration of university and industry leads to mainly two types of transfers from university to industry, these are R&D results transfer and technology transfer. The R&D results transferred leads to innovative ideas in industry which leads to new product development with the help of technology transfer from university to industries. However, educational institutes of the region have failed to

understand the technology related needs of small units. Regional institutes should render their labs to small units for carrying out research or testing, also they should deliver expert lectures and conduct seminars regarding latest technology in their field to enrich small units about latest happenings and trends being followed in other countries.

5.4. Scope of future work

The study has presented the findings with regards to technology development of cutting tool industry in the region. However, during the course of this study a number of areas have come up which necessitates further research. The scope for future work has been presented as follows:

- The study has been limited only to small units of the region. However, the study of medium and large enterprises could also conduce some more beneficial results.
- This research ends with a number of interrelationships found out between input and output factors reflecting the technology upgradation process in a small number of companies. The study is therefore exploratory in its nature and the phenomena and interrelations that have been found out through empirical analysis of the sample companies need a complementary validation from studies in a larger number of companies.
- The present study has been limited to the analysis of certain input characteristics of the manufacturing units with regards to research parameters, but the study can be further broadened by taking into consideration other factors like age of the firms, type of firms like service and processing.
- The present study has been limited to quantitative analysis only, whereas a qualitative modeling of the research parameters will yield better result and understanding of the issues under consideration.
- The present study focuses on factors impacting technology upgradation of the small units in the region whereas the study of barriers impairing technology development and upgradation initiatives needs to be taken into due consideration.

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APPENDIX – I

Questions under Linkage Capability Issues

Issues under Linkage Capability	*Questions under each issue*
• Industry- Industry alliance in recent past	A3
• Benefits obtained through collaborations with small units	A4, A5, A6, A7, A8
• Subcontracting benefits with large enterprises	A9
• Cooperative research with institutes for joint R&D projects	A10a
• Contract based research with institutes	A10b
• Industry-academia alliance in recent past	A11
• Technology transfer from academia to industry with positive results	A12
• University labs for testing and inspection	A13a
• Expert lectures and training programmes by academicians	A13b
• Combined supervision of thesis	A13d

Questions under Regulatory Corroboration Issues

Issues under Regulatory Corroboration	*Questions under each issue*
• Government initiatives and assistance	B10b, B13, B15, B16, B17, B18, B19, B20
• Availability of electricity	B7, B8, B12
• Availability of rail-road infrastructure	B5, B6
• Government policies and measures	B1, B2, B3, B4, B9
• Allocating funds for R&D	B10a
• Employee training at government institutes	B10h
• Subsidized information and consultancy for research work	B22

Questions under Entrepreneur Role Issues

Issues under Entrepreneur Role	*Questions under each issue*
• Education level of the entrepreneur	C1, C2
• Effective decisions pertaining to business activities and taking decisions related to cost, raw material etc.	C3, C4, C5, C6, C7, C9
• Awareness Regarding Government benefits to SMEs	C8
• Technical competencies of entrepreneur like competency in operating all machines, quality control tools etc.	C10
• Entrepreneur Training	C11, C12, C13
• Strategic decision making in identifying the right kind of business and market	C14
• Tacit knowledge through work experience	C15
• Alertness and formal business planning of different management areas like finance, H.R, logistics etc.	C18a, C18b
• Easy access to finance and loans (knowledge about various financial schemes and procedures to be followed)	C18c
• Ease of collaboration with other firms especially large enterprises	C18d
• Ability to seize opportunities from market and using appropriate strategies in commercializing product	C18e, C18f
• Awareness about new production technologies, machines, equipments etc.	C18g

Questions under Technology Infrastructure Issues

Issues under Technology Infrastructure	*Questions under each issue*
• Bar Coding and RFID techniques for automatic collection of information	D1, D2f, D6f
• Use of computers for routine work	D2a, D6a
• Use of internet for marketing and promoting products	D2b, D2c, D2d, D4, D5, D6b, D6d, D7
• Designing and production related softwares for product improvement	D2e, D6c
• Investment on Information and Communication technology infrastructure	D3
• Appropriate resources like expert employees, state of art equipments etc. for technology upgradation	D8, D9
• Proportion of annual turnover for technology upgradation	D10
• Role of organization like skill agencies, technology centers, financial institutions for enhancing SME resources	D11
• Modernization and renovation programs	D12
• Allocation of funds for R&D infrastructure	D13, D14, D15

APPENDIX – II

Principal Components under Entrepreneur Role

Principal Components	*Issues*
Component 1	• Effective decisions pertaining to business activities and taking decisions related to cost, raw material etc. • Tacit knowledge through work experience • Alertness and formal business planning of different management areas like finance, H.R, logistics etc. • Ease of collaboration with other firms especially large enterprises • Ability to seize opportunities from market and using appropriate strategies in commercializing product • Awareness about new production technologies, machines, equipments etc.
Component 2	• Strategic decision making in identifying the right kind of business and market • Easy access to finance and loans (knowledge about various financial schemes and procedures to be followed)
Component 3	• Technical competencies of entrepreneur like competency in operating all machines, quality control tools etc. • Entrepreneur Training

Principal Components under Regulatory Corroboration

Principal Components	*Issues*
Component 1	• Government initiatives and assistance in acquiring latest technology, quality certification and marketing assistance • Employee training at government institutes like tool rooms
Component 2	• Availability of electricity to the industrial units • Government policies and measures to support innovation initiatives in small units • Subsidized information regarding latest trends and technologies and consultancy for research work
Component 3	• Allocating funds for R&D related activities in small units

Principal Components under Technology Infrastructure

Principal Components	***Issues***
Component 1	• Use of computers for routine work • Use of internet for marketing and promoting products • Designing and production related softwares for product improvement • Investment on Information and Communication technology infrastructure
Component 2	• Appropriate resources like expert employees, state of art equipments etc. for technology upgradation • Allocation of funds for R&D Infrastructure
Component 3	• Role of organization like skill agencies, technology centers, financial institutions for enhancing SME resources • Modernization and renovation programmes

Principal Components under Linkage Capability

Principal Components	***Issues***
Component 1	• Industry-industry alliance in recent past • Subcontracting benefits with large enterprises • Cooperative research with institutes for joint R&D projects • Industry-academia alliance in recent past
Component 2	• Contract based research with institutes • Expert lectures and training programmes by academicians
Component 3	• Benefits through collaborations with small units • University labs for testing and inspection • Combined supervision of thesis

APPENDIX – III

t critical value Distribution table

t Distribution						
	α					
Degrees of freedom	.005 (one tail) .01 (two tails)	.01 (one tail) .02 (two tails)	.025 (one tail) .05 (two tails)	.05 (one tail) .10 (two tails)	.10 (one tail) .20 (two tails)	.25 (one tail) .50 (two tails)
1	63.657	31.821	12.706	6.314	3.078	1.000
2	9.925	6.965	4.303	2.920	1.886	.816
3	5.841	4.541	3.182	2.353	1.638	765
4	4.604	3.747	2.776	2.132	1.533	741
5	4.032	3.365	2.571	2.015	1.476	727
6	3.707	3.143	2.447	1.943	1.440	.718
7	3.500	2.998	2.365	1.895	1.415	.711
8	3.355	2.896	2.306	1.860	1.397	.706
9	3.250	2.821	2.262	1.833	1.383	.703
10	3.169	2.764	2.228	1.812	1.372	.700
11	3.106	2.718	2.201	1.796	1.363	.697
12	3.054	2.681	2.179	1.782	1.356	.696
13	3.012	2.650	2.160	1.771	1.350	.694
14	2.977	2.625	2.145	1.761	1.345	.692
15	2.947	2.602	2.132	1.753	1.341	.691
16	2.921	2.584	2.120	1.746	1.337	.690
17	2.898	2.567	2.110	1.740	1.333	.689
18	2.878	2.552	2.101	1.734	1.330	.688
19	2.861	2.540	2.093	1.729	1.328	.688
20	2.845	2.528	2.086	1.725	1.325	.687
21	2.831	2.518	2.080	1.721	1.323	.686
22	2.819	2.508	2.074	1.717	1.321	.686
23	2.807	2.500	2.069	1.714	1.320	.685
24	2.797	2.492	2.064	1.711	1.318	.685
25	2.787	2.485	2.060	1.708	1.316	.684
26	2.779	2.479	2.056	1.706	1.315	.684
27	2.771	2.473	2.052	1.703	1.314	.684
28	2.763	2.467	2.048	1.701	1.313	.683
29	2.756	2.462	2.045	1.699	1.311	.683
Large (z)	2.575	2.327	1.960	1.645	1.282	.675

APPENDIX-IV

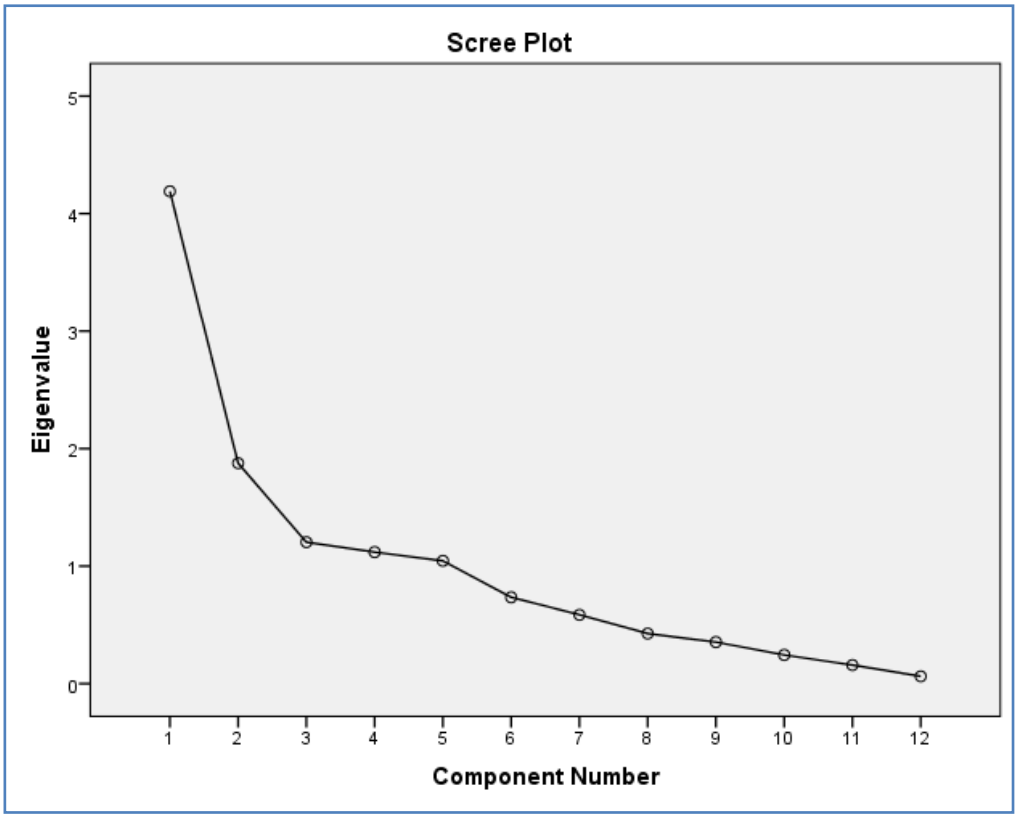
Details of Respondents to the Questionnaires

S. No.	Name of Organization	Address	Designation of Respondent	Year of Inception	Main Products
1.	Aro Tech Industries	D-9, Focal Point, Patiala	Proprietor PN Aggarwal 3291462 (O)	2003	*Master Gears, Gear Shaper Cutters, Straight and Spiral Bevel Cutter Blades*
2.	Bhaskar Cutting Tools	D-76, Focal Point, Patiala	Proprieter Bhushan Aggarwal	2009	*Milling Cutters, Piper Cutters*
3.	Canon Tools Company	D-149, Focal Point, Patiala	Proprietor V.S. Arora	1996	*Gear Hobs, Gear Shaper Cutters, Milling Cutters, Dies and Moulds*
4.	Eskay Tool Industries	D-228, Focal Point, Patiala	Proprieter Avtar Singh	2001	*Hobs and Gear Cutters*
5.	Ferro Tech. Tools	C-134, Focal Point, Patiala	Proprietor R.K. Singla 3293454 (O)	2005	*Reamers, End Mill Cutters, Dovetail Cutters, Slitting Saw, Side and Face Cutters*
6.	Ganesh Corporation	D-91, Focal Point, Patiala	Proprieter Ashwani Kumar	1997	*Cutting Tools*
7.	Global Enterprise	C-6, Focal Point, Patiala	Proprietor Sunil K. Sood 2232856 (O)	1995	*Gear Hobs, Gear Shaper Cutters, Milling Cutters, Dies and Moulds*
8.	Jeewandeep Tools	D-110, Focal Point, Patiala	Proprietor Navdeep Gupta 2233915 (O)	1997	*Shank Type Tools,Reamers, End Mill Cutters*
9.	Jyoti Tools	A-18, Industrial Area, Sirhind Road, Patiala	Proprieter Harsh Kumar Mittal	1985	*Form Tools, Gear Hob, Reamer, Centre Drill, Slotting Cutter,T-slot*
10.	Kapson India	D-99, Focal Point, Patiala	Partner Sanjay Kapoor 2216950(O)	1999	*Master Gears Worm, Gear Hobs, Involute Gear Hobs, Gear Shaper Cutters, Gear Shaving Cutters, Involute Gear Cutters*
11.	K.Vee Tools	Sirhind Road, Patiala	Proprieter K.L. Verma		*H.S.S Milling Cutters*
12.	Lalson Tool Corporation	D-277, Focal Point, Patiala	Owner Amit Singla	2002	*H.S.S Cutting Tools*
13.	Module Tools	D-268, Focal Point, Patiala	Proprietor Mitilesh Aggarwal 9988319017(M)	2006	*Hobs, Gear Shaving Cutters, Master Gears, Gear Shaper Cutters*
14.	Perfect Engg. Tools	D-16, Focal Point, Patiala	Proprietor Dilbagh Singh, 5001314 (O)	1994	*Reamers, End Mill Cutters, Dovetail Cutters*
15.	Precision Machines	D-136, Focal Point, Patiala	Proprietor Tejinder Jeet 5003287 (O),	2007	*Shank Type Tools, , Involute Gear Cutters, End Mill Cutters*
16.	P.S. Tools	D-207, Focal Point, Patiala	Proprieter, Neeraj Singla, 9216292234	2012	*Cutting Tools*
17.	R.J. Tools	D -8, Focal Point, Patiala	Partner Mukesh Gupta 2232423 (O)	2003	*Reamers, End Mill Cutters, Dovetail Cutters*
18.	Shakti Tool Industries	D-291, Focal Point, Patiala	Partner Surinder Kumar	2005	*Reamers, End Mill Cutters, Dovetail Cutters*

S. No.	Name of Organization	Address	Designation of Respondent	Year of Inception	Main Products
19.	Shaktiman Tech Tools	D-205, Focal Point, Patiala	Proprieter Gurvinder Singh		*Broaches*
20.	Star Auto Industries	D-57, Focal Point, Patiala	Partner Pritpal Dhiman 5000883 (O)	2004	*End Mill Cutters, Slot Drills, Counter Bore, Convex cutter, Face cutter, Angle cutter*
21.	Super Hobs and Broaches Pvt. Ltd.	B - 22, Focal Point, Patiala	Director Narain Nath, 2232772 (O)	1999	*End Mill Cutters, Side and Face Cutters, Slotting Saw*
22.	Surya Tools Industries	D-97, Focal Point, Patiala	Proprietor Naresh Goyal 3294307 (O)	1998	*Side and Face Cutters, Slotting Saw, End Mill Cutters*
23.	United Broach Company	D-220, Focal Point, Patiala	Proprietor Joginder Singh	2006	*Involute Gear Cutters ,Shank Type Tools, End Mill Cutters,*
24.	Versa Agro Industries	D-33, Focal Point, Patiala	Partner Rahul Tayal	1999	*Cutting Tools*
25.	V.V. Industries	D-86, Focal Point, Patiala	Proprieter Neeraj	2012	*Cutting Tool*

APPENDIX – V

Scree Plot for Entrepreneur Role factor



Department of Mechanical Engineering
Thapar University, Patiala

To,

Subject: **Request for filling up the Questionnaire**

Dear Sir,

We are submitting the enclosed questionnaire for seeking your expert views on our research topic. This study is a part of our M.E thesis research work at Thapar University, Patiala, Punjab.

The questionnaire has been specially designed to collect information regarding various aspects related to the tactical development of Small Scale Industry (SSI), by assessing the problems related to this industry (particularly cutting tool, hand tool, machine tool and auto component) and evaluating its technology capabilities.

This questionnaire is divided into three sections. The first section seeks general information regarding the organization, its products etc. The second section attempts to collect information regarding the various factors influencing the technology capability and technological development of small units. The third section is designed to collect information regarding the problems related to SSIs. Most of the questions are of multiple choice types. Kindly tick[✓] against the most appropriate choice for your company.

We assure the confidentiality of the response provided by you. We hope that the details provided by you will be instrumental in developing strategies for enhancing the technology capability for small scale sector and for solving technology related problems. We shall remain grateful to you for your help and cooperation in this regard.

Thanking you in anticipation and hoping for a prompt response.

With Regards

Himanshu Gupta, Manjeet Kharb, Navdeep Singh
M.E- Production & Industrial Engineering
Thapar University, Patiala

SECTION-I

Name of the Organization					
Address					
Name of the Respondent					
Designation of the Respondent					
E-mail Address					
Phone Number(s)					
Fax No.					
Type of Organization	**Cutting Tool Manufacturer**				
	Machine Tool				
	Hand Tool				
	Any Other (please specify)				
Main Products					
Year of Inception					
Annual Turnover					
Number of Employees	**<10**	**10-99**	**100-199**	**200-499**	**>500**
Market Share (in your product range sector)	**<1%**	**1-3%**	**3-5%**	**5-10%**	**>10%**

	Name: Designation:
(Signature of the Respondent)	

SECTION-II
A. LINKAGE CAPABILITIES

A.1.What is the motivation of carrying out R&D activities at your organization?

Motivation	Degree of Importance				
	To an extremely large extent	**To a large extent**	**To a moderate extent**	**To a small extent**	**Not at all**
To reduce product price (*by improving efficiency of production resources to reduce costs*)					
To improve existing products or introduce new products (*to increase market share by being first-to-the-market*)					
To tap government benefits (*we just show that R&D initiatives are being undertaken to avail government subsidies and other benefits*)					
To solve our maintenance related problems (*Fire Fighting*)					

A.2. During the last 3-5 years, how important have been the following information sources for innovation activities at your organization?

Information Source	Degree of Importance				
	Very High	**High**	**Medium**	**Low**	**Not Relevant**
Market Sources • Suppliers of equipment, material etc • Clients or customers • Competitors • Consultants, Labs, Private R&D Institutes					
Institutional Sources • Universities • Government Departments (*Service Institutes*) • Public research institutes					
Other Sources • Conferences • Journals/ Publications • Product Reviews (*of new and improved products in various media*)					
Internal • Learning by doing. Depend on our own in-house knowledge and experience.					

A.3.Has your organization worked in association or collaboration with some other industry in the past 3-5 years?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

A.4.Marketing and promotion of products is very essential for small organizations to manifest their products in the market. Has the association of your organization with other industrial units been helpful in promotion through a common platform (*viz. sales promotion and public relation activities)*?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

A.5.Has your association/collaboration with other industrial units been helpful to reduce risks, costs and knowledge requirements associated with innovation, thereby enabling your organization to improve innovative performance in terms of product or process development and improvement?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

A.6.Have other industrial units (*in lieu of your association with them*) been able to support your organization in terms of knowledge sharing and training of employees?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

A.7.Has your association/collaboration with other industrial units been able to garner support for your organization in terms of infrastructure development and proprietary technology?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

A.8.If you have been working in collaboration with other industrial units, what types of benefits have been achieved with regards to the following?

Benefits obtained through Collaboration with other industrial units	Benefits obtained by your unit				
	Very High	High	Medium	Low	Not Relevant
Access to new production technologies (*knowledge about new production processes or improvements in the existing processes*) or collaborating firm provides proprietary technology/ machinery and equipments					
Access to new product designs and detailed specifications and/or knowledge about better materials					
Improvement in marketing function (*common sales promotion programmes, combined participation in international trade fairs and exhibitions etc*.)					
Collaboration just means coming together on a common platform (*in the form of association*) to express grudges against government policies or to put demands before the government					
Collaborating firm provides feedback on the quality and performance of our products					
Collaborating firm is helpful in getting preferential pricing of our products and has helped in avoiding delayed receipts of payments from customers					
Sharing of resources and specialized technology infrastructure available with the collaborating industry					

A.9. If you have been acting as a subcontractor to a large scale enterprise (*Trans National Corporation*) what type of benefits have been achieved with regards to the following?

Benefits obtained through subcontracting	Benefits				
	Very High	High	Medium	Low	Not Relevant
Product related assistance (*LEs provide detailed specifications and designs of the product, feedback on product performance and quality*)					
Production process related assistance (*assistance on new manufacturing practices of international standards, specific machinery, equipments, raw materials, advice on raw material procurement, selection of machinery and special processes*)					
Organizational know-how (*assistance on modern management techniques, advice on inventory management, quality control techniques and human resource management*), help in increasing market knowledge (*includes information about competitors activities*)					
Marketing assistance (*LEs promote and recommend our products to other LEs; they also help us in getting international exposure*)					
Human resource assistance (*LEs provide training to the employees of subcontractors, follow practice of swapping of personnel with the subcontractors*)					
Financial assistance (*LEs provide financial support for working capital requirements or in implementation of new projects etc*)					
Material testing related assistance (*LEs provide access to modern testing equipments like XRD, Spectroscopy, micro-hardness testing, UTM etc which small units are unable to afford*)					

A.10.In University-Industry Collaborations (UIC), there are two broad categories of linkage viz. Cooperative Research or Contract based Research. Which of the two types has been more prevalent for your organization while collaborating with academic (*technical*) institutes?

Types of University-Industry Collaboration	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Cooperative Research (*joint R&D projects are undertaken involving direct interactions between academic-industrial personnel for mutual learning and knowledge sharing on a specific topic*)					
Contract based Research (*research projects are outsourced by industry to technical institutes with least direct interaction between academic-industrial personnel*)					

A.11.Has your organization been involved in any University-Industry collaboration in the past 3-5 years (*do you obtain any type of support from regional academic institutes*)?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

A.12.Has the collaboration with universities and research institutes been helpful in technology transfer (*R&D results transfer*) from academia to industry leading to innovative ideas and new product development?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

A.13.Small units collaborate with academia for various means. For what purpose(s) does your organization associate/collaborate with regional academic institutes?

Purpose of interacting with Academic Institutes	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Inspection, Testing and/or Material Characterization (*Profile Measurements, Metallurgical Examinations, Surface Assessment, Tests for Strength, Toughness, other Metrological applications*)					
Expert Lectures/Short Term Programmes pertaining to various Quality Tools, Scientific Management Principles and Maintenance Practices (*5s, FMEA, 7QC Tools, TPM, 6 sigma etc.*)					
Industrial Consultancy (*pertaining to problems being faced in final products either because of wrong raw material or improper process etc.*)					
Combined Supervision of dissertations on topics of industrial relevance (*B.E Projects, M.E Thesis, Student Internship viz. Project Semester Training etc.*)					
Start-up (*forming start-up based on university's patent and research results*)					

B.REGULATORY CORROBORATION

B.1.Has the government policy of providing tax benefits to SSIs to undertake R&D work been beneficial to your organization?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

B.2.Has the government policy of providing price preference to the items manufactured by SSIs been helpful in the development of your organization?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

B.3.Has the government been encouraging and helpful in innovative efforts of SMEs by providing good and up to date data on scientific and technological trends, both nationally and internationally?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

B.4.Recently MSME (*Ministry of Micro, Small and Medium Enterprises*) in association with SEBI (*Security and Exchange Board of India*) has granted permission to BSE and NSE stock exchanges to launch a SME Exchange to offer a platform to small and medium companies to raise capital. Would this initiative by MSME be beneficial for small enterprises in raising capital and improving their financial situation?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

B.5.Are you satisfied with the condition of rail-road infrastructure present in the region for the development of industrial sector?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

B.6.Do you consider bad condition of rail and road infrastructure in the region as the main factor deteriorating the performance of small scale sector?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

B.7.Do you consider unreliable supply of power (*too many cuts and that too unplanned*) as a major factor causing poor performance in your industrial sector?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

B.8.How do you rate the power tariff charged from industrial sector in your region as compared to other states?

a) Extremely High b) Reasonably High c) Comparable d) Relatively Low e) Extremely Low

B.9.On an overall basis has the government been successful in providing support to your industrial sector in terms of financial support and other policy measures?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

B.10.Literature reveals that in developed and emerging economies the governments introduce several initiatives and policy measures for supporting small units. Which of the following government initiatives have been more effective for your industry?

Government Initiatives	Please tick in this column if an option is not applicable to your industry	Effectiveness of a given factor				
		To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Allocating funds to small units for R&D initiatives for development of product/process technologies						
Giving tax cuts and benefits to firms which undertake R&D work						
Reserving certain products of small scale sector for exclusive purchase by government departments and/or other public sector undertakings						
Giving price preference to small units by government departments i.e. purchasing some products from small units even when they are being offered at 15% higher rate than alternate sources						
Reserving items for exclusive manufacturing by small scale sector						
Providing government labs for developmental projects at subsidized rates						
Providing help to industry in acquiring imported technologies, machinery and equipments etc. (*providing assistance in purchase/custom free import*)						
Training to employees of SMEs at MSME Tool Rooms and Training Centres						
Legal framework i.e. protection of intellectual property, enforcement of laws on anti-competitive and unfair trade practices that hurt SMEs						
Building Networks i.e. Cluster Development Programmes, Collaborative research and technology transfers between public and private institutions						
Provision of business support services i.e. counseling, consulting and competence development through functional workshops and related activities						
Creating an openness to transnationalization i.e. promoting successful firms as role models for other units to create awareness of international business opportunities						
Assistance pertaining to participation in trade fairs, exhibitions etc by providing small scale organizations with necessary space and money for stalls, for setting up permanent exhibition-cum-convention centers and organizing international trade fairs						
Forcing implementation of international quality standards (viz. ISI quality standard etc.)						

B.11.There must be some organizations which are more competitive than you and have grown at a faster rate than your organization due to support received by the government in the past 3-5 years. What kind of support by the government has been behind their success?

a) Information dissemination i.e. providing information on tax rules, regulations and new/latest technology available.
b) Provision of business support services i.e. counseling, consulting and competence development through functional workshops and related activities.
c) Building Networks i.e. cluster development programmes, collaborative research and technology transfers between public and private institutions.
d) Financial assistance and incentives i.e. export marketing funds, giving price preference to SME products and easy access to loans.
e) Legal framework i.e. protection of intellectual property, enforcement of laws on anti-competitive and unfair trade practices that hurt SMEs.

B.12.Have the government departments been supportive in terms of easy clearance of power/water connections and clearance from pollution control boards?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

B.13.Has the state government's initiative to provide financial assistance (*upto 50% of total cost*) to Entrepreneurship Development Institutes (EDIs) like Regional Centre for Entrepreneurship Development (RCED), Chandigarh been helpful (*directly or indirectly*) for the development or your organization in terms of training and know-how to carry out research in your field?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

B.14.Under MSMED act 2006 and 11th Five Year Plan government has started various schemes under its NMCP (*National Manufacturing Competitiveness Programme*) for the upliftment of small scale manufacturing sector. Which among the following schemes started by the government under the above mentioned plan are you fully aware of?

Schemes	**Please tick Yes if you are aware of scheme**	
	Yes	**No**
Market Development Assistance (MDA) scheme [*assistance on marketing and exposure to international markets by providing opportunity to small units to participate in international trade fairs under MSME India stall for exhibiting their products*]		
Micro and Small Enterprise Cluster Development Programme (MSE-CDP) [*setting up common facilities for capacity building, skill development, export promotion, exposure visits etc. for small units*]		
Credit Linked Capital Subsidy Scheme (CLCSS) [*government provides for 15% capital subsidy on institutional finance availed by small units for induction of well-established and improved technology in approved sub-sectors/products*]		
Technology Upgradation and Quality Certification Support to SMEs (TEQUP) [*for obtaining quality certification and reimbursement of 75% of cost for acquiring quality certification*]		
Design Clinic Scheme (DESIGN) [*to bring design expertise on a common platform and to provide expert advice, training and solutions on real time design problems, resulting in continuous improvement of products*]		
Scheme for setting Mini Tool Rooms and Indo-German Tool Rooms [*for setting tool rooms for providing training to employees of small units and others*]		
Entrepreneurship Development Training Programme (EDP)/Skill Development Training Programme (SDP) and Vocational Training Programmes through Udyami Mitras		
Lean Manufacturing Programme [*for SMEs to assist SMEs in reducing their costs through proper management, better space utilization, scientific inventory management or through Lean Manufacturing Consultants where SMEs will be paid Rs 2 lakh per year for consultancy related fees apart from Rs 8 lakhs for implementation charges*]		

B.15.The government has TEQUP programme (*Technology UIpgradation and Quality Certification Support*) for small units. Through this, the government provides financial support (*upto 75% of fee*) in obtaining quality certification by small units. Have you utilized this government scheme?

a) Yes, we have obtained quality certification in our unit through this scheme
b) We are aware of this scheme but have obtained Quality Certification through our own funds
c) We were not aware of this scheme but we have obtained Quality Certification through our own funds
d) We were neither aware of this scheme nor we have obtained Quality Certification on our own

B.16.Government has formulated the Design Clinic Scheme (DESIGN) to bring design expertise of manufacturing sector to a common platform. In this regard institutes like Central Institute of Tool Design have been opened to render help to small units. Have these institutes been effective in improving your performance?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

B.17.Indo-German Tool Rooms have been set up to assist small units in adopting new technologies like NC etc. Have these institutes been effective in fulfilling their tasks?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

B.18.Several training programmes have been set up by the government to support the small scale sector. Examples include EDP (*Entrepreneurship Development Training Programme*), SDP (*Skill Development Training Programme*), ESDP (*Entrepreneurship and Skill Development Training Programme*), VT (*Vocation Training Programmes*) etc. Have these programmes been effective in training and development of workforce of small units?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

B.19.The government has been providing assistance to small units to market and promote their products at international and national level by providing space at subsidized rates under MSME India stall to exhibit their products under Market Development Assistance Scheme (MDA). Has this scheme been helpful in increasing the competitiveness of your organization?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

B.20.Under the Credit Linked Capital Subsidy Scheme (CLCSS), government provides for 15% capital subsidy on institutional finance availed by small units for induction of well-established and improved technology in approved sub-sectors/products. Has this scheme been instrumental for the technology development initiatives of your organization?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

B.21.MSME has so many programmes for SMEs but their benefits don't reach the industrial units. What have been the main reasons because of which your unit has not been able to obtain this support?

a) Lack of awareness about various government schemes
b) Lack of initiative on our part (*because of heavy routine schedule*) to apply for such schemes
c) Too much paper work and bureaucratic hurdles are involved in obtaining these schemes
d) These schemes have a great face value but at the ground level they are totally non-effective
e) The initial investment required in utilizing these schemes or the guarantee/collateral requirements involved in these schemes are very forbidding

B.22.Has the government support in terms of free or subsidized information advice or consultancy to carry out research been helpful for your firm?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

C.ENTREPRENEUR ROLE

C.1 At your organization who is responsible for taking the major decisions pertaining to day to day working activities?

a) Owner (*i.e. entrepreneur*) only **b) Entrepreneur and his family members**
c) Entrepreneur with the help of in charge of each section **d) Supervisors/ heads of independent sections**
e) Varies with time and with type of decisions

C.2 Indicate the education level of the entrepreneur (*owner*) of your firm.

a) Post Graduate (i.e. M.B.A, M.Tech etc) **b) Engineering Graduate (B.Tech)** **c) Diploma Holder**

d) Normal Graduate (B.A, B.Com etc) **e) ITI or other Apprenticeship Program** **f) Not even graduate**

C.3. For which of the following areas/activities do you think that good educational background of the entrepreneur is important for a small unit?

Business Activities	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Making decisions regarding routine activities on the shop floor					
Making decisions regarding implementation of new ideas for product-process improvements and/or innovative projects for new product development					
Getting orders from large scale manufacturing organizations or collaborating with them for technology upgradation (*for communicating effectively with other units especially LEs)*					
Obtaining benefits of various government schemes for small unit (*obtaining funds through various government schemes, training at various centres or support for promotion etc*)					

C.4.In some small units, the employees/staff members are better educated than the entrepreneur. However, most of the decisions pertaining to working of the unit are taken by the entrepreneur himself. Does the entrepreneur's lack of formal education results in ineffective or wrong decision making adding to problems of small units?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

C.5.Has your good educational background (*owner/decision maker*) helped you to develop higher technological capabilities by opening up new channels for obtaining technological knowledge and thus changing your attitude in favor of early adoption of new technology?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

C.6.Has the technical educational background of the owner/entrepreneur enabled you to impress upon TNC's/ large enterprises towards forging relationships with your unit?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

C.7.Has your good educational background been helpful in taking decisions related to production and maintenance problems or understanding better the customer specifications and other requirements?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

C.8.Generally small units are not aware of various policies by the government for small scale manufacturing sector. Does this situation arise due to lack of formal education of entrepreneur?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

C.9.Higher level of formal education helps the entrepreneur in identifying the right kind of business, market and taking product decisions related to cost, raw material procurement and selection of appropriate technology and manpower. To what an extent do you agree with this statement in the context of your organization?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

C.10.What type of technical competencies is the entrepreneur (*owner/main decision makers*) at your organization equipped with?

Technical Competencies	Extent of Competency				
	Very High	High	Medium	Low	Not at all
Professionally trained to operate all machines including CNC's					
Training in product designing for product improvement/ new product development					
Training in Quality Control Tools (*e.g. 7QC Tools, Control Charts, Acceptance Sampling, Process Capability Analysis etc*)					
Training in minor maintenance related issues and troubleshooting of machines on shop floor					
Trained in shop floor management techniques like 5s, Kaizen, 3Gs etc.					

C.11.After the entrepreneur receives training, does he impart the same learning to employees also? (*Does the entrepreneur share his competencies with his employees*?)

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

C.12.Training employees internally by the entrepreneur himself would reduce the cost of training. Has training of employees by the owner/entrepreneur himself helped in reducing the cost of training at your organization?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

C.13.On what basis does the entrepreneur/ owner of your firm receives training?

a) Follows a fixed schedule of receiving training i.e. either quarterly or on six months basis

b) Generally receives training on the procurement of new equipment

c) Receives training when a special training program is organized by some agency in an upcoming area

d) When some other collaborating organization provides training on related technology products

e) Only when government organizes some compulsory training programmes

C.14.Has the technical trainings received by the entrepreneur/owner been helpful in taking the following strategic decisions effectively related to your organization?

Decisions	Extent of Competency				
	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Identifying the right kind of business for your organization					
Identifying the right kind of market and technology for your organization					
Decisions related to raw material procurement and cost					
Decisions related to selection of appropriate manpower					
Decisions related to appropriate training programmes and schedule for your employees					
Decisions related to supplier/vendor selection					
Decisions related to supply chain management i.e. storage of raw materials and finished components and supply of finished components according to schedule given by OEM					

C.15.A large part of the relevant knowledge for innovation is of a tacit and unspoken nature and derives from experience. Has the experience and tacit knowledge obtained by you from previous work been helpful in the innovation related activities of your organization?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

C.16.What was the previous professional experience of the entrepreneur before starting this unit (*or becoming the head of this unit*)?

a) More than 10 years b) 5-10 years c) 3-5 years d) 1-3 years e) Less than 1 year

C.17.Where did you have this prior professional experience before heading this small unit?

a) At a large scale manufacturing organization
b) At a medium scale manufacturing organization
c) At another small unit
d) At our own unit starting at the lowest hierarchical level
e) Did not have any prior experience

C.18.To what an extent has your prior work experience helped you in the following activities at your own unit?

Characteristics	Degree of Help				
	Very High	**High**	**Medium**	**Low**	**Not at all**
Alertness and identification of new business opportunities and new markets					
Formal business planning of the different management areas (*finance, marketing, logistic, H.R etc*)					
Better access to finance and loans (*knowledge about various financial schemes and procedure to be followed to obtain them*)					
Ease of collaborating with other firms and institutes for training of our employees or getting orders from LEs					
Ability to seize opportunities from market and transmute them into profitable outcomes					
Ability to use appropriate strategies and tactics in commercializing our products					
Awareness about new production technologies (*machines, equipments etc*)					

D.TECHNOLOGY INFRASTRUCTURE

D.1.Have you been using the Bar Coding and RFID system for automatic collection of information for easier planning and efficient management by allowing management to fix bottlenecks at your organization?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

D.2.Organizations can use Information and Communication Technology (ICT) in several forms. These forms are listed below. To what an extent is each form being utilized at your firm?

ICT Sources	Degree of Use				
	To an extremely large extent	**To a large extent**	**To a moderate extent**	**To a small extent**	**Not at all**
Use of computers for routine work (*MS office etc*)					
Use of internet and intranet for effective communication (*email etc*)					
Use of internet for marketing our products (*through website*) and also for e-selling					
Use of internet to learn latest know-how and modern methods followed by competitors in other developed countries					
Use of designing and production related softwares like Auto CAD, PRO-E etc					
Automated system to collect information on shop floor using Bar Codes and RFID					
Enterprise Resource Planning (ERP) software for automating the facility of finance/accounting, manufacturing, sales and service, customer relationship management etc.					

D.3.Has your spending on technology infrastructure (*related to Information and Communication technology*) increased over the past 3-5 years?

a) Increased to a large extent b) Increased considerably c) Decreased to some extent d) Decreased to a large extent e) No investment is made in this regard

D.4.Has the use of ICT by your organization led to effective flow of data within your organization (*effective data management and knowledge management*) thereby assisting your organization to obtain information at any given time which in turn help in reaching the desired targets?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

D.5.SMEs which are having stronger links with their clients and subcontractors are generally found to be more enriched in terms of knowledge, resources and other facilities thus enhancing their chances to be more competitive and innovative. Has the use of ICT at your organization enabled you to become digitally networked and thus creating stronger links between your organization and your clients?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

D.6.In which of the following functions has the use of ICT at your organization been effective. (*Please tick against 'Not Relevant' if a particular function is not applicable at your unit*)?

Functions performed by ICT	Not Relevant	Degree of Effectiveness				
		To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Use of computers (*MS office etc*) for general routine work						
Use of intranet and internet for communication (*email etc*)						
Use of computers for drafting and designing of parts, components and products using Auto CAD, PRO-E etc.						
For e-marketing and e-selling of products						
For quality control work (*control charts etc*) or inventory management or Enterprise Resource Planning						
For automated systems using Bar Codes/RFID etc						

D.7.E-marketing and e-selling is the most modern and cheapest means used nowadays by small units to promote and sell their products easily and also to make their presence felt at the domestic as well as international market. Has the use of ICT for engaging in e-commerce been helpful for your organization in terms of promotion and sales?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

D.8.MSMEs generally lack in availability of appropriate resources required for technology up gradation. Please indicate the status regarding availability of following resources at your unit.

Project Resources	Extent of Availability				
	Very High	High	Medium	Low	Not at all
Employees with necessary expertise to carry out R&D work (*adequate technical and scientific manpower*)					
Availability of finance for routine activities					
Availability of finance for research and technology development activities					
Availability of appropriate raw material at reasonable rates					
State of the art production equipment, workstations, machining centers, CNC m/c's, tooling, Robots etc.					
Availability of relevant information and latest know how related to your products form market					

D.9.Literature reveals that performance of small manufacturing units in the area of technological innovations is poor because of a lack of resources. Employees in small units are occupied in finding additional resources and not with actually developing improved or new products. Is this situation faced by your employees?

a) Always b) Usually c) Sometimes d) Rarely e) Never

D.10.What fraction of your annual turnover is spent on research initiatives for technology upgradation at your unit?

a) Less than 0.5% b) 0.5-1% c) 1-3% d) 3-5% e) More than 5%

D.11.Which among the following organizations have been helpful in enhancing the resources and competencies that fuel innovative capabilities and dynamics for your organization?

Organizations	Degree of Effectiveness				
	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Skills Agencies (*MSME Training institutes, Central Institute of Hand Tools, Jalandhar etc*)					
Technology Centers (*Technology Incubation Centres*)					
Public Research Institutes (*CSIR, Central Institute of Tool Design, DRDO etc*)					
Higher Education Sector (*Universities and Technical institutes*)					
Financial Institutions, Banks etc.					

D.12.Modernization and renovation programmes are the backbone of any organization to become competitive. Which among the following programmes have been effective in enhancing the capability base of your organization? (*Please indicate 'Not Relevant' against the activity which you do not undertake*)

Programmes	Not Relevant	Degree of Effectiveness				
		To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Investment in formal R&D (*setting up R&D labs, modern state of art equipments for R&D work*)						
Investment in marketing, setting separate sales force for marketing and promotion						
Effective implementation of Lean Manufacturing Programme in your organization- proper inventory management, waste reduction, cycle time reduction etc.						
Use of new metrological equipments for inspection and testing						

D.13.Is there a separate allocation of budget for R&D initiatives and new product development projects at your unit?

a) Separate fund is earmarked for R&D in the budget **b) Clubbed with other development activities**
c) Some earmarking is done subject to availability **d) No specific consideration**

D.14.Has the allocation of separate budget for R&D by your organization been instrumental in enhancing the innovative efforts of your organization through new product/process development? (*Please write 'Not Relevant', if you do not earmark separate budget for research and innovation initiatives*)

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

D.15.Has higher spending on R&D heightened the level of research activity within your organization and also been helpful in building specialized scientific and technical expertise as a result?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

E.INVESTMENT CAPABILITY

E.1.Has the total investment in tangible assets (*new machines, equipment, tooling etc*.) in past 3-5 years contributed to the growth of your company?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

E.2.Have you been able to continuously improve your company's tangible assets (*new machines, equipment, tooling etc*.) to sort out problems related to existing technology?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

E.3. Are your tangible assets (*machinery and equipment*) sufficient and capable for higher output and/or effective utilization of resources like labour, materials etc?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

E.4.Does your organization have state of the art production machinery, tooling and equipment in your field of technology?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

E.5.Have you been more effective than your competitors because of the availability of better production technology (*machines, equipment, tools etc*.) as compared to them?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

E.6.Has the total investment in intangible assets (*patents, databases, knowledge and increasing the know-how and skill of labour force, research and development initiatives*) in past 3-5 years contributed to the growth of your firm?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

E.7.Does your organization use intellectual property (*patents etc.)* as a strategic tool for gaining competitiveness in the market?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

E.8.Does your organization investment significantly to upgrade the skill levels of employees through training or other learning initiatives?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

E.9.Does the organization provide any formal training to employees to enhance their creativity skills, innovation skills and education levels?

a) Proper formal training (*at OEMs or other large scale manufacturing organizations*) just after induction into our unit
b) Training during orientation period by senior executives of the organization
c) On the job training where employees are believed to learn through experience
d) Some training is provided but without any explicit form or schedule
e) **No training at all**

E.10.Are the employees and workforce level people encouraged to undertake R&D work/innovative work?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

E.11.Do you take sufficient measures to extract and put to use the tactical knowledge contained in the minds of the workforce level employees (*Tactical knowledge means skills and understanding about the process and product which the worker has gained through his experience with the production process, products etc., however this knowledge is not codified and is not available explicitly in a written form.*)?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

E.12.Whenever your organization comes up with a new concept or a new design for a product or an improved production process, does the organization apply for a patent to safeguard this intellectual property?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

E.13. Do you undertake inhouse research and innovation initiatives for process improvements on a continuous basis?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

E.14. Has the management clearly earmarked funds for R&D activities aimed at innovations for new product and process developments?

a) Clearly earmarked specifically for process-product improvements in the form of clearly defined projects
b) Clearly earmarked specifically for process-product improvements but not in the form of defined projects
c) Clubbed with other developmental activities
d) Some earmarking is done subject to availability
e) **No earmarking for R&D activities**

E.15. The investments in R&D, as a percentage of total sales revenue is

a) Less than 0.5 % b) Between 1-3% c) Between 3-5% d) Between 5-8% e) More than 8%

E.16. It has been seen that firms with separate research facilities are more innovative than others. What type of an organization exists for R&D work at your end?

a) R&D exists as a separate department
b) Teams are formed by top management for specific R&D projects
c) Design/ Engineering department/ some specific individuals are responsible for R&D initiatives
d) All R&D work and related activities are subcontracted to firms/consultants
e) **No clear structure of R&D department or for its activities**

E.17.Have the in house research and innovation initiatives taken by you for process improvements been effective in improving your performance?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

E.18. Do you have adequate strength of technical staff and managers etc. to undertake research and innovation initiatives (*in addition to their routine production and other responsibilities*)?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

E.19. For what purpose Research and Development activities are used in the organization

Activities	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
To develop new processes and/or improve the existing processes					
To develop new products and/or improve the attributes/features of existing products					
To solve maintenance related problems					
To improve product quality by suggesting new materials etc					

F.PRODUCTION CAPABILITY

Quality Management

Effective quality management depends upon some key components which include good leadership, customer focus, effective planning, process management, and effective human resource management.

The following questions inquire about the status of these components in your organization:

F.1.Leadership

	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Senior Managers actively encourage change and implement a culture of trust, involvement and commitment in moving towards 'Best Practice'					
There is a high degree of unity of purpose throughout our site, and we have eliminated barriers between individuals and/or departments					
We proactively pursue continuous improvement 'Fire Prevention' rather than reacting to crisis 'Fire-Fighting'					
Ideas from production operators are actively used in assisting management (*using tactical knowledge for innovation and improvements*)					

F.2.Human Resource Management

	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
The concept of 'internal customer' (*i.e., the next person or the process down the line and including all employees*) is well understood at our site					
We have an organization-wide training and development process, including career path planning, for all our employees					
Our site has effective 'top–down' and 'bottom–up' communication processes (*two way communication*)					
Employee flexibility, multi-skilling and training are actively used to support improved performance					
All employees believe that quality is their responsibility (*Everyone is responsible for Quality*)					

F.3. Process Management

	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
A large percent of the equipment or processes on the shop floor are currently under statistical quality control (*we extensively use control charts, acceptance sampling etc. to control our processes*)					
Training in basic statistical techniques (*use of control charts etc.)* in the organization as a whole is undertaken on a regular basis					
Training in advanced statistical techniques (*such as design of experiments and regression analysis*) in the organization as whole is undertaken on a regular basis					
We work closely with our suppliers to improve each other's processes					
Our suppliers have an effective system for measuring the quality of materials they send to us					
We have well established methods to measure the quality of our products and services					
We have side-wise standardized and documented operating procedures					

F.4. Customer Focus

	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
We know the current and future requirements (*both in terms of volume and product characteristics) of our external customers (either through effective demand forecasting or because we receive customer orders fairly in advance*)					
These customer requirements are effectively disseminated and understood throughout the workforce					
We have an effective process for resolving external customers' complaints					
We have a good system to collect customer feedback and we try to learn from it (*Customer complaints are used as a method to initiate improvements in our current processes*)					
We systematically and regularly measure external customer satisfaction					

F.5. Planning

	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
We have a vision & mission statement which has been communicated throughout the company and is supported by our employees					
We have a comprehensive and structured planning process which regularly sets and reviews short and long-term goals					
Our plans regarding quality assurance focus on achievement of 'Best Practice'. We have a broad array of activities which collectively create the overall quality plan and numerous specialized plans. We have clearly defined procedures needed to communicate these plans to all concerned					
We do careful identification, measurement and analysis of cost as a function of time in tracking the impact of an effective quality control system					
We have a written statement of strategy covering all manufacturing operations which is clearly articulated and agreed to by our senior managers					
A large proportion of our quality costs comprise of Prevention costs. Prevention costs include cost in quality planning, quality training, supplier reviews/survey etc.					

F.6. Has your organization established specific policies and procedures to ensure that those who have been assigned responsibility for quality control system have sufficient and appropriate experience and ability?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

F.7. What type of an organization structure exists at your organization for quality improvement?

	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Quality Circles					
Quality Project Teams or Kaizen Teams or Product Development Teams					
No formal structure exists. Owner and employees meet informally whenever a quality related issue arises					

F.8. Have you been able to sustain companywide quality control (*manufacturing quality control*) which involves operational techniques and activities aimed both at monitoring a process and at eliminating causes of unsatisfactory performance at relevant stages of the quality loop in order to result in economic effectiveness?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

F.9. How do you work with process and quality improvement programs?

a) No specific quality improvement activity has been conducted during the last few years

b) Quality improvement activities have received increased importance, but are still scarce

c) A few employees specifically work on identification and improvement of key quality issues

d) Continuous quality improvement activities are an important part of the corporate strategy-several employees participate

e) Quality has a central role in the improvement programs. Such programs are an inherent feature of our organization for several years. All employees participate in these programs.

F.10. Which quality tool have you been using on shop floor for continuous quality improvement?

	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Histograms, Bar Charts, Pie Charts etc.					
Pareto Diagrams/ Pareto Charts (*based on 80/20 rule*)					
Flow Charts					
Cause and Effect Diagrams/ Fishbone Diagrams/ Ishikawa Diagrams					
Scatter Diagrams					
Control Charts, Run Charts					
New Quality Tools viz. Force Field Analysis, Matrix Diagrams, Fault Tree Analysis etc. (*New 7 QC Tools*)					

G.INNOVATION PERFORMANCE

G.1. Have you been able to enlarge your 'product mix' and 'product variants' from each product line in the past 3-5 years?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

G.2. Has your company been able to improve its existing products over the last three years because of the technology capability building initiatives?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

G.3. Number of commercialized new products as percentage of all products in company per year during the past 3-5 years.

a) <5% b) 5-10% c) 10-15% d) 15-20% e) >20%

G.4. In the recent past, have you introduced rapid changes in features of the product in response to the market demand.

a) Significantly more than the competitors

b) Slightly more than the competitors

c) Almost at par with the competitors

d) Less than the competitors

e) Not many changes worth mentioning

G.5. How many patents have been obtained (applied for) by your organization in the last

Period	Number	
	Obtained	Applied for
15 Years		
10 Years		
5 Years		

H.SALES PERFORMANCE

H.1. Sales due to improved products and/or technologically new products as a percentage of total sales during the past three years has been

a) <1% b) 1-5% c) 5-10% d) 10-15% e) >15%

H.2. Has your company been able to increase its market share over the last 3-5 years because of the introduction of new products?
a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

H.3. Has your company been able to penetrate into new markets because of the new or improved products in recent past?
a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

H.4. Have your profits (*or profit margins*) in the last few years gone up
a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

H.5. Have you succeeded in retaining the existing customers/markets (market share) with you in the last few years?
a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

H.6. Has the sale of your firm's products increased in the last 3-5 years?
a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

I.PRODUCT PERFORMANCE

I.1. Have you been able to continuously improve the quality level of your products in the recent past to meet competition?
a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

I.2. Compared with your competitors, are your products appropriately priced? In other words, do your products offer a high cost/benefit ratio?
a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

I.3. Have you been successful in increasing the product life of your products in the market in the recent past (*last 3-5 years*)? (*Have you been able to make your products more reliable and durable because of innovation initiatives*?)
a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

I.4. Have the technology capability building initiatives taken by your organization (*in the last 3-5 years*) resulted in improvement of product quality to meet the changing taste of the customers?
a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

I.5. Have you been able to continuously improve the technical characteristics (*performance*) associated with your products as compared to your competitors because of your technology capability building initiatives (*over the last 3-5 years*)?
a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

I.6. Have the technology capability initiatives taken at your organization contributing in lowering the cost of production operations and product price?
a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

I.7. Do the products (*of same class and same price range*) made by your company have features and quality
a) Extremely better than your competitors b) Marginally better c) Almost at par d) Slightly below e) Appreciably below

PROBLEMS RELATED TO SMEs

J. LACK OF PROPER HUMAN RESOURCE MANAGEMENT

J.1. Does your organization use specific human resource management (HRM) practices for recruitment of employees? (*Do you conduct a thorough job analysis to identify the tasks and responsibilities that need to be performed for various jobs at your unit and then predict the personal characteristics and behaviours that are needed for specific recruitment position*)?
a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

J.2. Does your organization use strategic human resource management (HRM) practices such as formal employee participation programs, team based problem solving and/or other socialization programs for development of your employees?
a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

J.3. Does your organization provide motivation to the employees in terms of reward/recognition and other incentives to cultivate the habit among employees to reduce scrap rate and increase productivity?
a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

J.4. In case, the company makes profits as a result of innovative efforts of employees, how are their contributions recognized?
a) Recognition Through appreciation letter b) Promotion in designation c) Increment in salary d) Fixed monetary reward
e) Share in profits made on account of innovation f) No recognition or reward

J.5. Is your organization able to recruit technical workforce and employees of high quality (*skilled, technically qualified, experienced*)?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

J.6. What proportion of your total workforce is technically qualified (*means at given designations, they have appropriate technical qualification*)?

a) Less than 5% b) 5-10% c) 10-30% d) 30-50% e) more than 50%

J.7. What are the main reasons because of which small firms (*especially yours company*) are not able to recruit employees of requisite quality (*education and experience*)?

Reason/Factor	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Small firm are not able to pay salaries/perks etc. comparable to what are available in large counterparts					
Skilled and educated candidates are more willing to join large scale organization because of better career growth and opportunities					
Small firm by themselves do not recruit graduate because they feel that they cannot utilize graduate skills					

J.8. Do you have adequate strength of technical staff and managers etc. to undertake research and innovation initiatives (*in addition to their routine production assignments and other responsibilities*)?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

J.9. Do you follow a systematic formal recruitment procedure (*i.e. means vacancies are advertised properly at a specific time and in formal channels; application are sought in proper format, trained staff or external agency conducts interviews etc.*)?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

J.10. If your organization suffers a loss (*unnecessary waste scraps etc.is produce*) because of negligence on the part of an employee/worker, what action(s) is generally taken?

Aspect	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Someone from the management side will give counseling, No strict action					
A written warning is issued if someone repeat mistakes too often					
Non-paid leaves (*Employee/worker not allow to come in organization for a period of time say one or two days*)					
Some deduction from the salary					

J.11. What type of an action does the management take in case an project failure occurs?

Actions	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Strict action against members of the project team					
Enquires the reasons for project failure					
Advises to learn lessons from current failures					
Does a thorough analysis, pin points the root causes and plans a future course of action by consensus					

J.12. Do you partner with any training institution, large scale manufacturing firm, university and/or private agency for delivery of training opportunities to your employees?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

J.13. Research reveals that it is difficult to retain skilled and experienced staff in small firms. In the light of this, please specify up to what an extent the following reasons affect your organization in retaining skilled staff?

Actions	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Unreasonable low remuneration system (*Unsatisfactory pay and/or hikes*)					
Lack of training and career development opportunities on a long term basis					
Staff cannot see long term business for the unit i.e. job security					

K. LACK OF FINANCIAL PLANNING

K.1. Does your organization have sufficient credit for meeting requirements of routine operations?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

K.2. To meet your financial requirements for routine and important work, do you have to take loans at high interest rates?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

K.3. Do you follow some defined financial strategy or plan for effective financial management?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

K.4. Before investing in any new project, does your organization calculate the exact amount of money and time with respect to different activities in the project?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

K.5. Before investing in any project (*new order or new product*) does your organization have clear vision about the exact amount of money you are going to invest internally with self-capital and how much you have to take loan from external sources (*banks, private agencies etc.*)?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

K.6. Does your organization have a clear profit-distribution strategy i.e. if you get high profit from market, does your organization pre-plan as to how and where to invest these profits *(viz. increase core competitiveness by introducing new products or purchase new machinery/technology, increase employee welfare etc*.)?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

K.7. Does your organization have sufficient channels (*finance agencies and loan guarantee institutions*) to get short/long term finance loans?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

K.8. How does your unit manage when your incomes drop suddenly and your organization runs out of money?

Options	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Cut down in salary and incentives of employees					
Spend out savings from previous projects/profits					
Borrow money from relative or any private finance institution					
Take a bank loan from any nationalized bank					
We have never face this problem					

L. LACK OF PLANNING AND DECISION MAKING

L.1. Which of the following strategy/philosophy does your organization follow in order to compete in market place?

Strategy	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
'Competition through Efficiency' (*We try to obtain the market allowed margins of profit by making more efficient use of our available production resources. For this, cost cutting techniques and operations management techniques are utilized*)					
'Competition through Innovation' (*We disrupt the market place through the introduction of improved products or new technology products. For this innovation management techniques are used for becoming 'first-to-the-market'*)					

L.2. Literature reveals that owners running a small scale organization take most of the decision by themselves and are preoccupied with the routine production and maintenance related issues. In the light of this statement, please specify, do you get sufficient time to brainstorm with your employees regarding research initiatives and for product and process improvements?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

L.3. Does your organization have a separate planning & strategy making team (*or all the decisions related to product features and specifications are taken by one or two persons especially the owner manager of your organization*)?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

L.4. Before doing any project/business (*or making changes in the existing products etc.*), does your organization follow a systematic approach towards activities like analysis of own potential (*availability of funds, available human resource, labour utilization etc.*) by considering all participant objects affecting the business, and then make a real and relevant objective?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

L.5. Does your organization plan in advance according to the market situation (*like size of demand, intensity of competition and company ability*) so that you can get best result with your limited resources?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

L.6. Does your organization make use of production planning activities and tools (*like demand forecasting, master production scheduling, material requirement planning, inventory control etc.*)?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

M. LACK OF ENTREPRENEURSHIP AND MANAGERIAL SKILL

M.1. Literature reveals that entrepreneurs of small unit take most of the decisions independently without thorough discussion with their employees/workforce people. What is the reason for this in your organization?

Aspect	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Entrepreneurs are too busy with production issues and other routine problems. As a result they do not get time to discuss the decision with employees					
The entrepreneur feels that their fellow college/employees are not capable enough to contribute effectively in decision making					

M.2. Decision making in small and medium enterprises is generally very risky. In the light of this, please respond to the following options as per your organization perspective.

Aspect	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
The decision making is risky because it has been imposed on one or two persons (*owner/CEO*) which leads them into long working hours in an atmosphere of constant pressure. As a result they may take wrong decisions which further main cause failure of business					
The decision making is risky because of lack of mutual discussion between different department (*HR, Finance, and Marketing etc.*) before taking the decision. Decisions are not based on a systematic or holistic approach					

M.3. As per your organization perspective, what are the main reasons because of which small firm manager do not attend management training at regional institutes, other large enterprise or government centers (*MSME Tool Rooms, CSIR, Central Institute of Tool Design, DRDO etc.*).

Aspect	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
The training/educational institute are not effective in imparting training					
Training and educational courses are not accurately planned and marketed					
Time and location does not suit/match us					
Price is unaffordable (*cost of training is too high*)					
Manager think that no outsider can be expected to really understand the training need of a specific small firm					

N. LACK OF MARKETING RESEARCH

N.1. Does your organization give equal importance to the marketing function (*product planning and development, standardization, grading, packaging, branding, sale promotion, storage and warehousing etc.*) as you give to other functions such as accounting, production, training programs etc.?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

N.2. Do you have up-to-date knowledge regarding your product (*position of your product with respect to your competitors*) and prevailing trend in the market?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

N.3. Do you gather data and record then analyses the facts about problems which are affecting the sales of your product?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

N.4. To meet increase competition of globalization, you must have made changes in your marketing strategy in the last few years. Which of the following options accurately represent the change adapted at your firm?

Strategy	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Unrelated Diversification (*you started extending your business activities to other manufacturing areas and products*)					
Focalization & Concentration (*you started concentrating on your main activities or products by eliminating one or more business activities which are not directly linked with your core business*)					
Relative Diversification (*by increasing the existing features or introducing new ones*)					
Internationalization (*By expending your business from one country to another or into new domestic markets by exploring marketing activities*)					

N.5. Up to what extent, does your organization consider the following primary sources of information to gather and record data from market to know the performance of your product?

Primary Sources	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Customers (*feedback regarding price, performance, quality of product*)					
Dealers (*regarding marketing policies of competitor, customer feedback from dealers*)					
Salesman (*buying habits and preference of customers, customers complaints and compliments*)					
Trade fares, exhibitions etc. (*where competitor's products are exhibited*)					

N.6. Does your organization use market segmentation strategy (*dividing the total market into different segments or homogeneous groups of people/customers on basis of economic status, education qualifications, preference etc*.)?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

N.7. Does your organization have formal marketing network (*media campaign, dedicated sales force etc*.) or you have to totally depend on personal effort and resources (*pay extra commission to dealers for selling efforts*) to increase your sales?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

N.8. Up to what extent does your organization use the following secondary sources of information to get market related information (*regarding new product, new technology etc*.)?

Secondary Sources	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Press (*Newspapers, Magazines, Bulletins*)					
Publication (*Journals, Periodicals*)					
Government Sources and International Agencies (*various government bodies like SISI, DIC etc. provide information; or Report or surveys conducted by government*)					
Private Concerns (*Research institutes like Indian Institute of Foreign Trade, National Council of Applied Economic Research etc.*)					

N.9.There are various pricing policies which can be extremely useful in small units for effective control of sales and profit. Please specify up to what an extent these pricing policies are used at your unit?

Pricing Policies	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Competitive Pricing (*you have a direct competitor in market and you charge price with respect to your competitor*)					
Skimming the Cream Price (*Here you charge high price in the initial stages of your product*)					
Penetration Pricing (*you charge price below than competitor but want to have more share in market by selling more units*)					

N.10. To fulfill the need of different market segments (*different group of people*), does your organization use the market mix strategy? Up to what an extent are you able to control effectively the four 'P's (*Product, Price, Place and Promotion*)?

Strategy related to Four 'P's	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Product: Making suitable changes in features, design, variety and/or quality to meet expectations of different customers					
Price: Keeping flexibility in product price, payment period, allowances etc. according to economics status of different customers					
Place: Increasing distribution channels. Quick and efficient transportation channels etc.					
Promotion: Increasing the advertising, publicity and increasing personal sales effort etc.					

N.11. Is your organization able to grab market opportunities by providing adequate distribution channels or make the product available to target customers at the right time and at the right place? Please indicate your performance in these physical distribution activities:

Aspect	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
You are able to provide the product at right time to the customer					
You are able to provide the product at right place where the customer desires					
You are able to provide the product at the right price as the customer desires					

O. INFRASTRUCTURE INABILITY

O.1. As the purchasing capacity of SMEs is low in quantity so they cannot purchase raw material from major source/suppliers. They have to purchase material from local suppliers at high prices (*local supplier have become empowered*). To what an extent have you faced this problem?

a) To an extremely large extent b) To a large extent c) To a moderate extent d) To a small extent e) Not at all

O.2. Small firms generally face quality related problems in their product because of improper raw materials. In this content, please respond to the following.

Aspect	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
We have thorough knowledge (*composition, properties etc.*) required for our parts, components and products					
Our policy is to use cheap materials which are easily available					
Though we have complete knowledge about the best materials for our product but these are not used because of their very high prices					
We generally suffer because of our ill planning. We are unable to procure the material at right time and right place					
Though we have complete knowledge about the right type of material and they are also available at appropriate prices but procuring material from suppliers is the problem (*may be because of our small quantities of order*)					
The requisite material is not available locally. We have to procure either from other state or have to import. As a result material cost become very high because of the high excise/custom duty					
We don't carry out the required R&D for finding out the best material for product. We simply copy and follow our competitors					

P. LACK OF PROPER INVENTORY MANAGEMENT

P.1. Does your organization keep records of income and expenditure? Please tick at the relevant option which accurately describes your firm.

Option	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
Yes, we keep record of everything, including all revenue and expenditure					
Yes, we keep record of everything, but not all revenue and expenditure entered					
No we don't keep records of everything, but we know in general how much money is received and spent during a given period, say a month					
We neither keep records of everything nor we know					

P.2. As the research revealed that there are three common inventory management systems which are being used in small firm as given below. Please specify which of the following systems are used in your organization?

Inventory systems	To an extremely large extent	To a large extent	To a moderate extent	To a small extent	Not at all
The Eyeball System (*a key manager stands in the middle of the store or manufacturing area and look around to record the item which are out of stock*)					
Reserve Stock System (*in this a bag of reserved stocks is kept aside. This bag is placed at rear of the stock area. The reserved items from bag are used when stocks from open area have been consumed and then reorder is immediately placed*)					
Perpetual System (*this include manual card-oriented or any computer operated system. In this system an automatically order is placed when supplies fall below a prescribed level)*					