Thesis Report

on

Attributes and Components for the Strategic Development of Manufacturing Sector in the Region

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DECLARATION

I, **Ramandeep Singh Saini** hereby declare that the work which is being presented in this thesis report entitled, **'Attributes and Components for the Strategic Development of Manufacturing Sector in the Region'** by me in partial fulfilment of the requirements for the award of degree of Master of Engineering in Production and Industrial Engineering from MED, Thapar University, Patiala 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.

Ramandeep Singh
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Date 15/07/2011

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

(Dr. Tarun Nanda)
(Supervisor)

CERTIFICATE

This is to certify that the thesis report entitled, **'Attributes and Components for the Strategic Development of Manufacturing Sector in the Region',** which is submitted by Ramandeep Singh Saini (800982022), in the partial fulfilment of the requirement for the award of M.E (Master in 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 thesis report is original and has not been submitted for the award of any other degree.

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ABSTRACT

In today's competitive business environment, global competition forces companies to perpetually seek ways of improving their products and services. The pressure on organizations to adapt to new technologies and external threats requires resourcefulness, creativity and innovation. The fierce competition situation arising out of globalization and liberalization is forcing the organization across the globe to realize that their survival is not feasible in the absence of R&D and innovation practices. Markets have become more open, competitive and the customers more demanding. To stay close to the customers is essential for sustained growth and continuity of business. Without continuous technology upgradation, no enterprise can ever remain competitive. The external acquisition of technology in the initial stages may be desirable or even necessary in the high technology areas, but no industry can prosper in the long run unless it builds up a self reliant base for carrying out indigenization of process and product technologies. In most developing countries like India, small scale enterprises are still relying heavily on external acquisition of technology. The over dependence of the Indian firms on external technology acquisition has rendered their available technologies and skills inefficient and outdated. They should start managing innovation in research and development activities to develop cutting edge technologies and products. The present work presents the various dimensions and determinants for strategic development of small scale enterprises.

The literature on various aspects of technology development initiatives required to become competitive has been explored in detail. Empirical analysis of the survey data has been done to explores the status of development initiatives and resulting performance improvements in the industrial sector in the region. The main factors affecting the performance of small units have been evaluated. Classification of manufacturing units has been done based upon the status of their performance in each of the key input and output parameters. The analysis also establishes the relationship of key input factors with output performance parameters. Further, the associations between various input and output dimensions have been established using Pearson's correlation and step-wise regression analysis. Principal component analysis has been performed to discover and reduce the dimensionality of the data set and to identify new meaningful underlying variables.

The learning issues of survey have been synthesized to bring out a systematic implementation plan for effectively managing the different strategic measures in manufacturing organizations. For this, a qualitative modeling technique has been applied using options field methodology (OFM), options profile methodology (OPM), analytic hierarchy process (AHP) and fuzzy set theory (FST). Various profiles for course of actions planned for strategic development have been developed and include; technology based approach, competence development based approach, innovative culture based approach, and mixed approach. The order of implementing various strategies for successfully achieving technology development at tactical and strategic level in regional context has been highlighted.

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Chapter - I

INTRODUCTION

1.1 General

In the post-liberalization era, Indian firms have been under tremendous pressure to improve their competitiveness (Kiran and Jain, 2010; Mohammad *et al.*, 2010). The advent of liberalization, privatization and globalization has brought forth profound economic, social, environmental and technological pressures on organizations. Markets have become more open, competitive and the customers more demanding (Gottardi, 2000).

In this growing internationalization, some of the principal drivers, such as liberalization and globalization, are rooted in political and economic evolutions, and technological innovations. Even domestically oriented organizations need to operate internationally in order to guarantee their competitiveness and viability (Maeseneire and Claeys, 2011). Globalization has caused significant changes in the business environment with the emergence of global market opportunities and threats. Firms have been forced to respond quickly and focus on corporate strategies in terms of improving their organizational competencies and global perspective. They should continually build a new set of differentiated skills, complementary assets and routines that provide the basis for firm's competitive capacity and sustainable advantage in a particular business (Chaiprasit and Swierczek, 2011).

Global competitiveness has forced companies to initiate effective steps to improve overall productivity and efficiency. Productivity growth depends on the implementation of new technology and development of new innovation products (Kiran and Jain, 2010).

1.2 Change through Innovation

Innovation is the engine of change and in today's fiercely competitive environment, resisting change is dangerous. Change, while it brings uncertainty and risk, also creates opportunity (Ahmed, 1998a; Jarratt, 1999; Williams, 2001; Wong and He, 2003; Carayannis and Provance, 2008). Innovation helps the organization to deal with the turbulence of external environment and, therefore, is one of the key drivers of long-term success in business, particularly in dynamic markets (Jimenez and Valle, 2010). Successful organizations are those that continually adapt their structures, strategies, systems, products and cultures (Waterman, 1988; Syrett and Lamoniman, 1997).

Innovation is described as a pervasive attitude that allows business to see beyond the present and create the future. There is no escape from the reality that organizations must continuously innovate in order to survive, especially in this era of rapidly changing market conditions (Lei *et al.*, 1999). Innovation fuels organizational growth, drives future success and is the engine that allows businesses to sustain their viability in a global economy (Lin and Chen, 2007; Morques and Ferrerra, 2009).

Innovation is a management discipline; it focuses on the organization's mission, searches for unique opportunities, determines whether they fit the organization's strategic direction, define the measure for success and continually reassesses opportunities (Lin and Chen, 2007). Innovation results in generation and implementation of new or improved processes, services, products, production methods or single actions aimed at increasing the competitiveness of an enterprise (Forsman, 2011).

1.3 Innovation for Technology Development

The general issue of what technology is, has received a great deal of attention over the years. The review of literature reveals that definitions of technology vary from much bounded definitions (which include only physical hardware) to very open definitions (that include software, brain ware, organizational aspects of technology and even human skills). Since it is difficult in practice to separate technology from the organization and the employees, generally an open definition of technology is chosen in academic writings. Thus, technology is defined as the system of hardware, human beings, and organizational aspects that are used in the operations of firms. This includes process technology and even technologies used for, say, production planning, order fulfillment, and other management related activities (Drejer, 2000).

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 (Moriarity *et al.*, 1990).

Technology, in broader sense, makes us able to change raw material into finished products required by the market and supply it to the market. It comprises the entire notion of techniques as well as the medical, agricultural, management, and other fields with their total hardware and software contents (Zhao and Reisman, 1992). It is the scientific, engineering and managerial knowledge which makes possible the conception, design, development, production, and distribution of goods and services (Gibson, 1976). It is the totality of means employed to provide objects necessary for human sustainability and comfort (Martino, 1983). The atmosphere for creative application of technology is critical to the economic growth, national security, and social stability (Ramo, 1989).

Technological change is the social and economic process through which an invention becomes a novel technology, and then diffuses within an industry. Technological change and the substitution of old products by new ones are common events in every industry, but these events have significant strategic and competitive implications for firms (Schiavone, 2011).

Table 1.1 depicts the various methods which firms can utilize for "technology upgradation"

Sr. NO.	Methods of Technology Upgradation	Mode
1.	Internal technology acquisition (Innovation from Inside)	*Internal R&D*
		Tacit Knowledge
2.	External technology acquisition (Innovation from Outside)	*Purchasing*
		Licensing
3.	Combination of both external and internal	*Reverse Engineering*
		Strategic Partnership

Table 1.1: Methods of Technology Upgradation

Internal technology acquisition is the result of technology development efforts that are initiated and controlled by the company itself. Internal acquisition requires the existence of a technological capability in the company which capability could vary from one expert that understands technological application well enough to manage a project conducted by an outside research and development (R&D) group to a full blown R&D department. It also includes the less well-known process of seizing tacit knowledge (understanding and codifying knowledge that already exists inside the company, but is not well enough understood or widely used).

External technology acquisition is the process of acquiring technology developed by others for use in the company External acquisition can take the form of licensing, purchasing equipment with embedded technology, investment in a joint venture which has a technology development purpose, or even the acquisition of a company that has the desired technology (Dixit, 2010).

1.4 Technology Upgradation in Indian manufacturing sector

Global competition and liberalization of industrial policies has reinforced the need for technology upgradation to attain international level of competitiveness and to be able to offer contemporary levels of technology.

The present day knowledge economy demands knowledge-intensive enterprises. According to the Global Competitiveness Report, 2010-2011, published by World Economic Forum (WEF), India ranks at 51 out of 139 nations on Overall Global Competitiveness Index.

The status of Indian manufacturing industry vis-à-vis industry in other developed and emerging economies in various areas which affect technology innovation capability is presented in Table 1.2.

Sr. No.		Rank (139 Countries)								
		India	*China*	*Taiwan*	*S. Korea*	*Japan*	*U.S.*	*Hongkong*	Singapore	Thailand
1.	**Global Competitive Index**	51	27	13	22	06	04	11	03	38
2.	**Organizational Culture**									
	Extent of Staff Training	59	57	31	42	06	10	27	04	62
	Hiring and Firing Practices for Labour	89	62	26	115	121	06	01	02	31
	Quality of Educational System	39	53	17	57	35	26	25	01	66
	Utility Patent per million	59	51	01	05	02	03	22	11	65
	Availability of Scientific and Technical Manpower	15	35	08	23	02	04	64	10	40
3.	**Resource Support**									
	Technical Readiness (Adoption of Existing Technologies)	86	78	20	19	28	17	05	11	68
	Local availability of specialized Research and Training Services	51	50	21	39	13	10	15	19	69
	Production Process Sophistication	43	55	16	23	01	11	33	14	60
	Private sector Spending on R&D	37	22	09	12	03	06	36	08	48
4.	**Government Support**									
	Transparency of Government Policy Making	42	38	07	111	48	41	02	01	63
	Burden of Government Regulations	95	21	30	108	70	49	02	01	42
	Wastefulness of Government Spending	57	35	39	71	91	68	11	01	45
	Quality of Railroad Infrastructure	23	27	08	10	03	18	02	06	57
	Quality of Electric Supply	110	52	24	19	05	23	01	09	42
	Quality of Overall Infrastructure (Transport & Communication)	91	72	19	12	15	23	02	03	46
5.	**External Capacity Building**									
	University-Industry Research Collaboration	58	25	12	23	19	01	26	06	42
	Quality of Scientific Institutes	30	39	17	25	15	04	35	11	59

Table 1.2: Technology Innovation Capability of Indian Industry

1.5 Small-and-Medium Size Enterprises

Small scale enterprises have been an important engine for the development of local economies and communities (Tambunan, 2008). SMEs bring greater vitality to market, provide more job-opportunities and promote technology innovation and economic stability (Dia and Zhang, 2009). The success and vitality of SMEs are recognized as important elements in measuring an economy's progress and future development (Tsai and Kuo, 2011).

As industrial globalization becomes an increasingly important trend, the role of SMEs is changing. Small enterprises in India, with their dynamism, flexibility and innovation drive are increasingly focusing on improved production methods, penetictive strategies and modern scientific and management capabilities to sustain and strengthen their operations (Kharbanda, 2001). SMEs enhance competition and hence have external benefits on economy wide efficiency, innovation and aggregate production growth (Tambunan, 2008). SME development fosters employment, economic growth and technological advances. Not surprisingly, small firm development has become a central goal in economic policies (Maeseneire and Claeys, 2011).

In most developing countries, small and medium enterprises (SMEs) constitute the bulk of the industrial base and contribute significantly to their exports as well as to their GDP. For instance, India has nearly three million SMEs, which account for almost 50 per cent of industrial output and 42 per cent of India's total exports. It is the most important employment-generating sector and is an effective tool for promotion of balanced regional development. These account for 50% of private sector employment and 30–40% of value-addition in manufacturing.

1.6 Research Problem

Successful innovation occurs when an invention, related to a product, service or a process in some part of the organization's value chain, is joined with a business design, which in turn is implemented with discipline and skill through innovation management. Successful innovation management requires developing a strategic approach to innovation. The present research work has been carried out for the small scale sector in the region. It aims to investigate the nature of technological innovation processes in the small scale sector by identifying the key inputs and outputs of a strategic development program, determining their status in the industrial sector and determining the key input parameters which make a significant contribution to performance improvements.

1.7 Organization of the Thesis

The write up of the thesis is divided into six chapters as discussed as follows. The overall structure of thesis is presented in Figure 1.2.

- **Chapter I** justifies the need of present work. It underlines the aim of research problem and covers the organization of thesis.
- **Chapter II** reviews in detail the previous studies in the field to identify the factors which facilitate technological improvements in manufacturing enterprises. It identifies the key inputs and outputs issues affecting the research problem. The chapter identifies the main limitations in the existing academic writings.
- **Chapter III** introduces overall design of the study. It explains the methodology adopted for carrying out the research work. The details of work done in each phase of research, the tools and techniques used have been presented.
- **Chapter IV** presents the results of detailed survey conducted in various manufacturing enterprises. Descriptive and empirical analysis of data has been carried out to assess the status of present level of different dimensions of the research problem.
- **Chapter V** presents a synthesis of learning issues and outcomes of survey and their utilization through a qualitative model to evolve a strategic development program for small scale industry.
- **Chapter VI** 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 subsequent sections of this chapter.

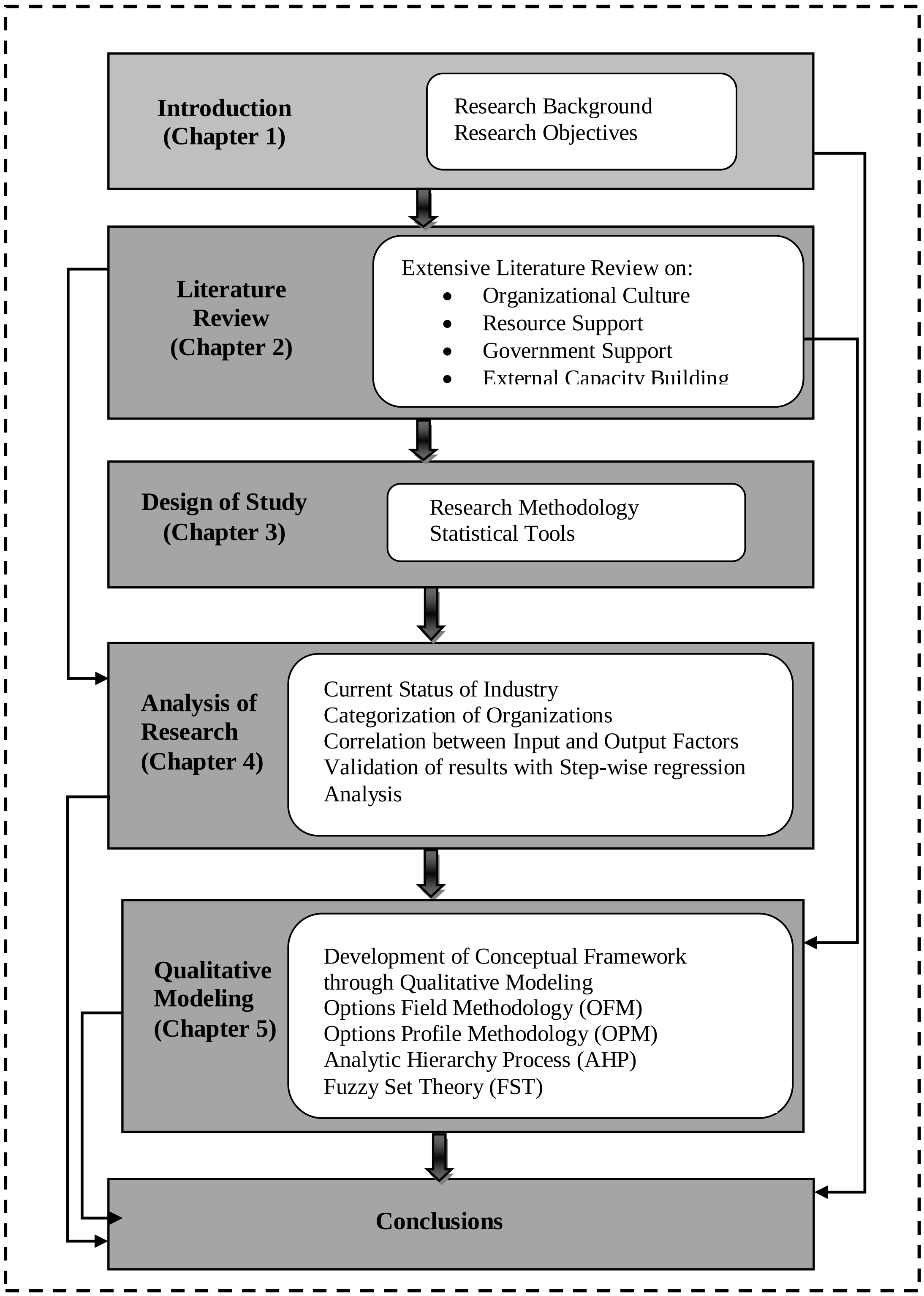


Figure 1.1 Thesis Structure

1.8 Concluding Remarks

Encouraging innovation in small enterprises has been at the heart of policy incentives owing to the important role that small enterprises play in economic development. Despite their important role, innovation in small and medium enterprises has received only scant attention (Forsman, 2011).

The ability to innovate is increasingly viewed as the single most important factor in developing and sustaining competitive advantage. It is no longer adequate to do things better; it's about "doing new and better things". Effective innovation incorporation resulting in increased competitiveness involves systematic planning and intervention programs, rather than relying solely on natural progression on "innovation under the gun". Organizations are left with no choice but to upgrade the existing systems, products and technologies for their survival (Barton 1991; Martins and Terblanche, 2003; Yang, 2007).

An organized attempt has been made to make the present study exhaustive, intensive and broad based as possible.

Review of 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

This chapter is an attempt to record in brief what has been reported in research literature on various aspects of strategic development initiatives required to become competitive.

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

- Organizational Culture
- Resource Support
- Government Support
- External Capacity Building

Based on the description of all related concepts and models proposed by the researchers related to the research topic, a conceptual framework has been developed and explained in the chapter.

2.2 Organizational Culture

Culture may be defined as ``the way we do things around here" or ``the way we think about things around here". In general, learning definitions of culture deal primarily with the way we act or the way we think. Organizational culture forms an integral part of general functioning of an organization. A strong culture provides shared values that ensure that everyone in the organization is on the same track. Organizational culture fills the gap between what is formally announced and what actually takes place. The key feature is that culture is taught to new members as the correct way to behave, thus perpetuating organizational survival and growth (Martins and Terblanche, 2003).

Corporate culture has received much attention in the last two decades due to its effects and potential impact on organizational success (Rashid *et al.*, 2003). Top management support and availability of competent manpower is critical to the success of indigenous technology development initiatives of an organization. Thus, organizational culture and climate is an integral

Table 2.1 Major Findings of Literature on Organizational Cultural Issues

Factors	***Key Issues***	***Supportive Literature***
Skilled Workforce	Firms which strive to be first-to-market with new products require a workforce that is adaptable, skilled, and educated. Innovative firms encourage their employees to work in various departments in order to gain a well founded experience which helps them to appreciate the problems of different parts of the organization, and to become better managers of the multifaceted innovation process. Small firms often rely on their own experiential know-how, and train up their own operative and intermediate level skills. The firms generally remain insular and autonomous and fail to recognize the underlying or latent skill deficiencies. Smaller companies often do not have the capacity to undertake skills forecasting and strategic analysis. The main barriers to skills development include cultural, financial, access & provision and awareness barriers.	Gupta and Singhal, 1993; *Baldwin and Da Pont, 1996;* Lange *et al.*, 2000; Taxell, 2009
Employee Education	Employee education increases the formation of new ventures, the likelihood of developing new products, and increases the sales growth rates of emerging firms. High-performing organizations spend more time on education and training – not just on technical, task-related skills, but also on communication and team skills. Education is linked to higher entrepreneurial performance and productivity. Organizational learning is the process by which firms develop new knowledge and insights from the common experiences of people in the organization, and has the potential to influence behaviors and improve the firm's performance.	Charney and Libecap, 2000; Keogh and Stewart, 2000; Lange et al., 2000, 2002; Indarti and Langenberg, 2004; Carmen, 2008; Dickson et al., 2008; Yang et al, 2009; Jimenez and Valle, 2010.
Training	Training greatly compresses the time to acquire skills over earlier methods, such as apprenticeship. It achieves this condensation through a process involving careful analysis of job requirements, determination of skill needs, specification of objectives, and design, delivery and evaluation of an instructional program. Innovative organizations continually educate and train their employees in various skills, matching employee's professional career goals with organization's needs. Innovative firms empower their employees more, study the marketplace regularly and provide more training to their managers than in less innovative organizations. Innovators and advanced technology users train their workers in response to skill shortages. They provide training when introducing new technologies and prefer training that is highly firm-specific. SMEs prefer to external recruitment of experienced staff rather than training the staff internally. Training in such organizations is usually adhoc. Maintaining competitiveness relies not only on job-specific training or on-the-job training, but also on a greater degree of formal training. The advantage of formal training is the gain of accredited experience from other sources.	Bessant, 1993; Locke and Kirkpatrick, 1995; Samaha, 1996; Arad *et al.*, 1997; Holbeche, 1998; Barnett and Storey, 2000; Georgellis *et al.*, 2000; James and Roffe, 2000; Beaver and Prince, 2002; Salavou *et al.*, 2004; Goncalo and Staw, 2006. Laforet and Tann, 2006; Abor and Quartey, 2010
Personality Traits	Innovative organizations make strategic choices with regard to their human resources. Personality traits for innovation include broad interests, attraction to complexity, high energy, independence of judgment, intuition, self-confidence, and ability to accommodate opposites. Persistence, curiosity, intellectual honesty, internal locus of control (reflective/introspective), diversity, risk taking and strong desire to fulfill goals are also required for innovation Small units find themselves competing against the employees' packages offered by larger organizations, including salary and bonus, perks and other non-financial rewards. In addition to this, the career options offered by large established firms might be seen as more stable and progressive than the relatively risky option of working for a small firm	Amabile, 1988; Woodman and Schoenfeldt, 1990; Herbig and Palumbo, 1996; Bresnahan, 1997; Brand 1998; Gardenswartz and Rowe, 1998; McFadzean, 1998; Keogh and Stewart, 2000; Pihkala *et al.*, 2002; Martins and Terblanche, 2003; Dubina; 2005, Nanda and Singh, 2009

Factors	*Key Issues*	*Supportive Literature*
Reward Management	Employee reward systems include such practices as providing freedom for creativity, financial rewards, promotions, and other forms of recognition. Their very existence can galvanize employee contributions. Innovation based organizations know how to manage, motivate and reward employees. These organizations rely heavily on personalized intrinsic rewards whereas less innovative organizations tend to place almost exclusive emphasis on extrinsic rewards. Innovative organizations allow their employees time to think creatively, to experiment and to engage in their own research projects. Time pressure is a real barrier to creativity. Empowering to innovate is one of the most effective ways to mobilize the energies of employees to be creative. Top management prescribes a set of strategic goals, but allows personnel great freedom within the context of goals. Innovative organizations allow employees with some personal discretion to suggest that they are valued for their contributions. Long - term incentive plans, team based rewards and security benefits also have a positive effect on employee creativity.	Badawy, 1978; Robert, 1988; Mumford and Gustafron, 1988; Gupta *et al.*, 1991; Plunkett, 1990; Rehfeld, 1990; Shalley, 1995; Judge *et al.*, 1997; Ahmed, 1998b; Koning, 1998; McFadzean, 1998; Andriopoulos, 2001; Martins and Terblanche, 2003; Morris, 2005; Kiran and Jain, 2010; Zhou et al., 2011
Risk Taking and Strategic Direction	Innovative firms have appropriate systems and procedures, which emphasize that creative effort is a top priority within the company. Too many management controls inhibit risk taking and consequently creativity. There should be freedom to experiment, to do things and fail, to challenge the status quo, discussion of dumb ideas, and no punishment for mistakes. Rigid and punishing norms promote conformity and restrict creativity. It is important that a balance be reached in the degree to which risk taking is allowed. This is achieved by spelling out expected results, assigning responsibility of monitoring and measuring risk taking to someone, creating a tolerant atmosphere in which mistakes are accepted as part of taking the initiative, regarding mistakes as learning experiences, and assuming that there is a fair chance of risks being successful. Innovative organizations actively celebrate success and recount stories of success throughout the organization to motivate, direct and guide actions. These stories are used to illustrate and demonstrate the potential for action and the type of behaviour that is expected of employees.	Morgan, 1991; Anderson *et al.*, 1992; Amabile *et al.*, 1996; Jones and McFadzean, 1997; Judge *et al.*, 1997; Amabile, 1998; Ahmed, 1998a; 1998b; Martins and Terblanche, 2003; Brennan and Dooley, 2005; Mishra and Srinivasan, 2008

component of any technology development program. The important issues under this component are discussed as follows:

Innovative organizations have a significant approach towards manpower development in order to achieve long term organizational goals (Kim and Choi, 1997). The types of skills and education needed by different firms vary systematically. SMEs are more heavily reliant on skills. In short, SMEs need to have stocks of skilled and educated labour. However, in the earlier stages of development, the greatest demand will be for skilled rather than for highly educated labour. SMEs in developing economies are generally not well positioned to make up any deficiencies themselves to obtain the skills. Firm owners and managers generally lack enough knowledge to make properly informed investment decisions about training and skill acquisition; they have not yet learned to learn. Lack of adequate skills is a major constraint to SMEs (Tambunan, 2008).

Organizational learning is a basis for gaining a sustainable competitive advantage and a key variable in the enhancement of organizational performance. Firms that are able to learn stand a better chance of sensing events and trends in the marketplace. As a consequence, learning organizations are usually more flexible and faster to respond to new challenges than competitors which enable firms to maintain long-term competitive advantages (Jimenez and Valle, 2010).

Organizational learning allows the development, acquisition, transformation and exploitation of new knowledge that enhances organizational innovation. As such learning is viewed as a dynamic process in the sense that each component of learning process will reinforce the others without predominance of one on the other or unidirectional causal links (Therin and Dalglish, 2004).

Although innovation is often seen as a technological breakthrough, it is also very much the art of an individual who has triumphed over the status quo. This triumph requires personal initiative. Although there appears to be general agreement that personality is related to creativity, attempts to try and use this inventory type of approach in an organizational setting as predictor of creative accomplishments is not always correct. Nevertheless it does highlight the need to focus on individual actors, and to try and nurture such characteristics or at least bring them out, if necessary, in an organizational setting (Nanda and Singh, 2009).

The values and beliefs of management are reflected in the type of people that are appointed. When human resource is competitive, it can push the boundaries of technical competence into the area of unknown or the new. Human resource is critical to economic growth and entrepreneurial opportunities. Human resource consists of knowledge, skills, talent and experience used to provide value to the firm (Javalgi and Todd, 2010).

Reward management is a key function in modern enterprises, playing an important role in attracting, retaining and motivating employees. Utilitarianism emphasises extrinsic incentives such as monetary compensation to motivate the innovative behavior of employees. In contrast, romanticism views creativity as self motivated psychological behaviour that is typically sparked by intrinsic spiritual rewards. Utilitarianism provides the foundation for early behaviourist arguments that suggest that people’s behaviours are driveable and changeable and that extrinsic rewards can bring expected behaviours and performance. Extrinsic rewards and resource investment have been seen as necessary to motivate employee creativity, especially in formalised task. Literature reveals that performance-linked salary increases and monetary rewards positively influence innovative behaviour and results. Long-term incentive plans, team-based rewards, and security benefits are also empirically shown to have a positive effect on employee creativity (Zhou *et al.*, 2011).

Intrinsic rewards are based on internal feelings of accomplishment by the recipient and include increased autonomy and improved opportunities for personal and professional growth. Granting individuals the freedom to create and innovate is an important human resource management practice in successful organizations. Innovative organizations rely heavily on personalized intrinsic rewards whereas less innovative organizations tend to place almost exclusive emphasis on extrinsic awards (Plunkett, 1990; Ahmed, 1998b; Morris, 2005).

Managerial behavior and the operating philosophy of firm's executive level characterize entrepreneurial orientation, enabling entry into new markets. Three dimensions most frequently used to describe entrepreneurial orientation are innovativeness, proactiveness, and risk taking. Top management is the primary force driving the creation of values and beliefs that members of that firm adhere to (Javalgi and Todd, 2010). Some of the significant findings on this input factor are presented in Table 2.1

2.3 Resource Support

Resource support is an important cornerstone for successful product development in small and medium enterprises. Resources include tangible as well as intangible assets viz skills, knowledge, and links with other firms. Resources encompass three general capital resource categories: physical, human, and organizational. Physical capital resources encompass physical technology, property, plant, equipment, and access to raw materials. Human capital resources include the "training, experience, judgment, intelligence, relationships, and insight of individual managers and workers in a firm". Organizational capital resources involve the firm's reporting structure, planning processes, control and coordination systems, and information relations among workers within the firm, between firms, and within the business environment (Javalgi and Todd, 2010).

Building a physical infrastructure for enhancing organizational capabilities and developing an adequate financial programme that supports training and educational activities for innovation are the key success factors for highly innovative companies (Smilor et al, 1988). The physical environment or setting can influence 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 (Smilor et al, 1988; Odette et al, 2006; Ridley et al, 2006).

Capital is a necessary component for innovation but is not in itself sufficient. Not only the quantity of financial support important, it is the efficient usage of funds that is important in R&D spending. The real issue for businesses looking for competitive advantages from innovation should not be how much they spend on R&D, but how effectively they spend it. Capital simply cannot buy effective innovation. Innovation can lead to higher performance, but the process is not automatic and it does not necessarily require above average levels of investment. There is no silver bullet, and just throwing money at the problem is not the answer (Herbig and Palumbo, 1996).

Table 2.2 Major Findings of Literature on Resource Support Issues

Factors	***Issues***	***Supportive Literature***
Infrastructure Services	Organizational structure should be such that there are adequate funds, materials, production facilities and information support system to sustain innovation. There is a threshold of sufficiency and when resources are added above this threshold, creativity is not enhanced. Below this threshold, a restriction of resources also limits creativity since employees are more occupied with finding additional resources and not with actually developing new products or services.	Amabile *et al.*, 1996; Ahmed, 1998; Ghorbani and Bagheri, 2008
Financial Support	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. Higher R&D spending heightens the level of research activity within a firm and builds specialized scientific and technical expertise as a result. The tangible outcome of this is the ability to develop several significant product technologies. SMEs engaged in the innovation process have different and special financing requirements that arise because of the need for seed capital and development capital.	Charles and Burton, 1995; Cook and Nixson, 2000; Parthasarthy and Hammond, 2002; Souitaris, 2002; Huang, 2008; Abor and Quartey, 2010

2.4 Government Support

Governments have been imploring enterprises of all kinds to embrace innovation as a matter of survival in the globalized, knowledge economy. Government cannot make small organizations innovate. Businesses and the entrepreneurs that drive them must want to innovate to pursue growth and to exploit new market opportunities. However, government can create the right economic, fiscal and regulatory framework within which innovation and entrepreneurship can flourish (Beaver and Prince, 2002; Hyland and Beckett, 2005).

Table 2.3 Major Findings of Literature on Government Support Issues

Factors	***Issues***	***Supportive Literature***
Public Policies	Governments can encourage innovation by providing good data on scientific and technological trends. It has to increase investments in universities and technical education, and put efforts on industrially-relevant research and training. Public policies focusing on improving human capital, upgrading technology availability, labor market reforms, and deregulation of financial markets are important to support growth. Government should concentrate on quality strategy development, goal stretching, continuous improvement, and concurrent engineering programmes contributing to the creation of innovation context.	Kharbanda, 2000; Beaver and Prince, 2002; Bossink, 2002; Hyland and Beckett, 2005; Acs and Szerb, 2007; Gupta, 2009
Support Programs	Support programs can be broadly divided into five aspects: financial and credit assistance; technical and training assistance; extension and advisory services; marketing and market research; and infrastructure support. 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. Problems faced by small units are numerous. They experience delays in getting credit sanctioned from banks, getting tax-and-duty benefits, obtaining temporary and permanent registration, clearances for exports, permission for expansion and diversification, power and water connections, and clearance from pollution control boards. Small units often face economic, institutional and legal obstacles. Such restraints include limited ability of acquiring sufficient amount of credit, inadequate infrastructure support, high transaction costs, limited managerial and technical know-how and so forth. 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. In indirect capital investment, the state adopts preferential policies for small scale sector, through reducing tax, to encourage them to speed up technological development and new product development.	Thomas, 1993; Breif and Motowidlo, 1996; Abdullah, 1999; Sheel, 2002; Rolfo and Calabrese, 2003; Hyland and Beckett 2004; Garrett-Jones *et al.*, 2005; Soderbom *et al.*, 2006; Elaine and Derek 2007; Massa and Testa, 2008;Tambunan, 2008; Zhang and Dai, 2009; Jaehoon, 2010

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 (Henrik *et al.*, 2009; Zeng *et al.*, 2010).

Government should formulate various policies which should be meant to provide various incentives (sales-tax and entry-tax exemptions) and establishment of technology parks, and habitat centers to provide world-class facilities for the industry players. Besides, the central and state governments have attempted to improve physical infrastructure like roads, highways, mass-transit systems, power, water, housing, and national and international airports (Lahiri and Kedia, 2011).

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).

Increase in technological innovation demands that government should enhance spending on R&D. In some developed economies, government supports investments in more formalized creative activities such as R&D. The government also supports R&D through targeted expenditure and collaborative research programs. The government plays an important role in financial markets, particularly in helping small firms. At the aggregate level, ensuring a stable macro environment has helped in keeping interest rates relatively low and stable over recent years. At the business level, government works in partnership with the private sector to ensure adequate funding, for example by providing guarantees on loans or venture funding (Liyanage, 2003).

2.5 External Capacity Building

Inter-organizational collaboration, which has been introduced as an important innovation catalyst, emphasizes interaction-oriented capabilities for ensuring success in innovation development. Innovation capacity of enterprises can be incrementally or radically increased through participation in collaborative networks (Forsman, 2011).

In various countries numerous experimental projects have been started at local and national level to set up centers for technological transfer and foster firms in making use of the scientific and technical services offered by these centers and universities. In more advanced countries, this has led to the creation of a vast structure of technological services and brokerage that mainly involves three types of protagonist: the producers of innovation (universities and research centers); the collective economic organizations (chambers of commerce, industrial associations); and the autonomous institutions created specifically for dealing with technological transfer (agencies, information centers, incubators) (Justman and Teubal, 1996).

Table 2.4 Major Findings of Literature on External Capability Building Issues

Factors	***Issues***	***Supportive Literature***
Industrial Collaborations	Organizations need a culture that supports collaboration and a systematic approach for managing innovation. Through collaborations, a company can improve its exploration and exploitation capabilities and consequently improve its innovative capacity. Co-operations are characterized by intensive knowledge exchange and learning processes basically by the combination of complementary assets as well as the realization of synergies. 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. Relationship benefits sought by small firms collaborating with larger partners can be classified as cost, service, image and flexibility benefits. Such collaborations can provide resources, in the form finance and expertise, as well as future sales and international opportunities.	Moorman *et al.*, 1992; Dyer and Sing, 1998; Christensen and Overdorf, 2000; Mitra, 2000; Roy, 2000; Rycroft and Kaash, 2002; Terziovski, 2003; Hyland and Beckett, 2005;; George *et al.*, 2002; Frishammar and Horte, 2005; Capaldo, 2007; Kelly, 2007; Singh *et al.*, 2008; Forsman, 2011
Industry-Institute Bonding	By collaborating with universities, firms may reduce uncertainty inherent from the innovation process, as well as expand their markets, increase access to new or complementary resources, keep up with evolution of scientific knowledge, and create new technological learning options on future technologies. Early access to technological knowledge, risk reduction, access to unique research skills and cost reduction through delegation of selected activities, especially in the field of basic research are other factors. On university side, the motivation for collaboration is enhancement of teaching followed by financial resources and reputation enhancement. Access to empirical data from industry is also a strong motivation source.	Meyer-Krahmer and Schmoch, 1998;Hagedoorn et al., 2000; George et al., 2002; Gulbrandsen and Smeby, 2005
Other Alliances	Collaboration with higher education institutions, R&D agencies, and R&D laboratories allows firms to expand their range of expertise, develop specialist products, and achieve various other corporate objectives. Low frequency of public-private research collaboration is the result of a lack of proper mechanisms, such as, simple information channels, to ensure that firms know the benefits of collaboration, guidelines for organizing collaborative projects, public co-funding, and mechanisms for solving conflicts between public and private actors.	Kitson *et al.*, 2001; Drejer and Jorgensen, 2005

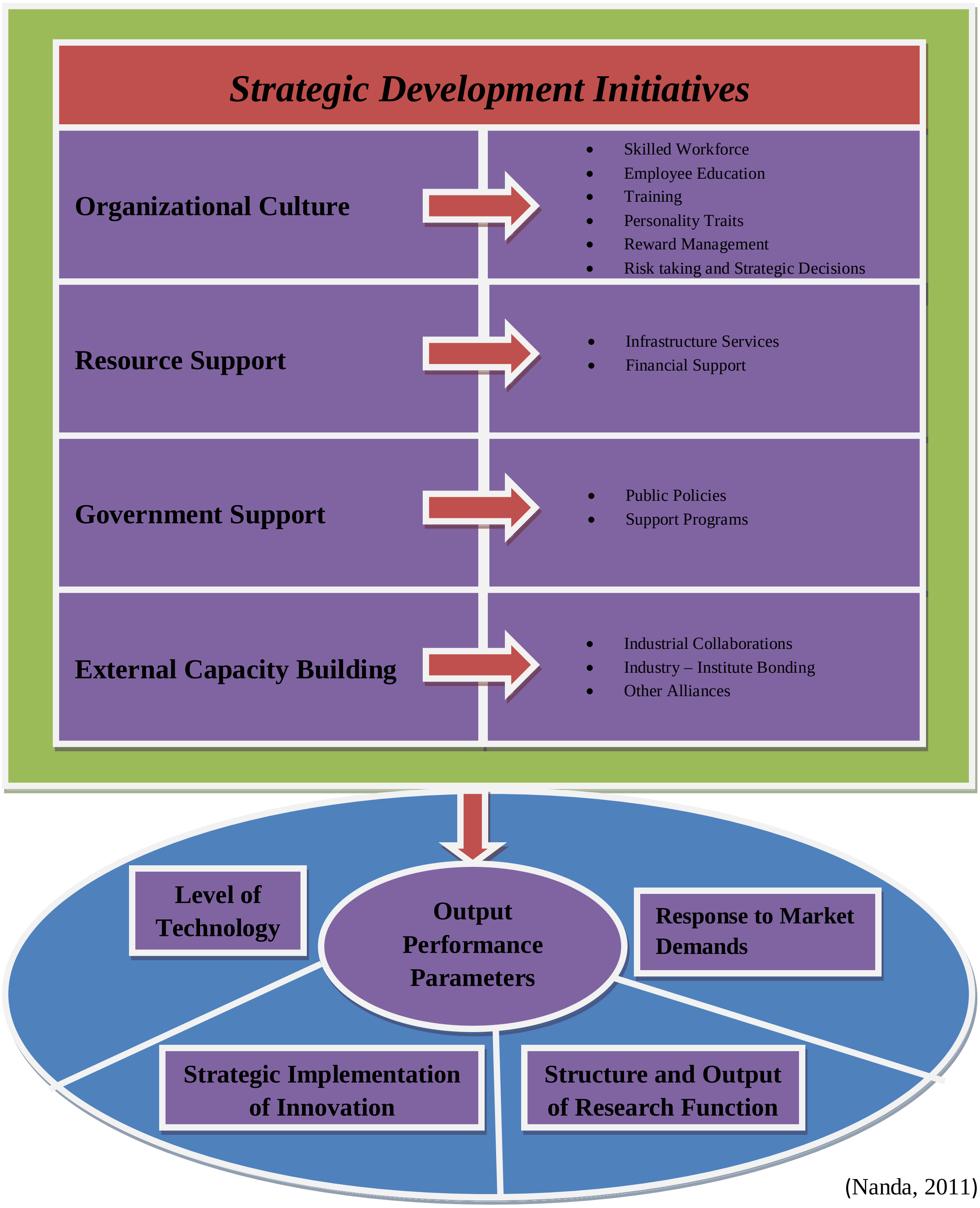
Collaboration is one strategy for acquiring and exploiting a firm's technology base as firms have to externalize their technology sourcing to deal with market uncertainties. Collaboration is a means to benefit from complementarities among firms. R&D collaborations are typically established to mutually profit from each other's resources and resource complementarities. Central to such efforts are the characteristics of the shared resources, which influence the coordination, integration and appropriation of the relevant resources. For example, in particular for knowledge as a resource, imitability plays an important role, also in relation to appropriability Furthermore, as mutual learning is a main driver for the development of knowledge and technology within collaborations; knowledge complexity as well as teachability affect the ease with which knowledge is successfully shared. Collaborations help to access skills and to transfer complex and tacit knowledge, with an important role for appropriability and protection of intellectual property. Furthermore, to benefit from increasing returns, explicitness is an important knowledge characteristic due to the inter-dependencies and cumulativeness of knowledge (Bogers, 2011).

Firms with high level of international links exhibit above average levels of local networking with respect to research collaborations and inter-industry links. The most difficult problem for innovative business is that of managing its relationship with larger firms. These may involve a variety of measures such as licensing agreements, long-term contracts, joint ventures or other arrangements to enable the emerging enterprise to develop, produce and sell its products (Keeble *et al.,* 1997).

Industrial-academic collaboration is an efficient way to accelerate and diversify the progression of novel technological solutions, educate new multidisciplinary professionals, and incubate new businesses. The need for industry-institute bonding can be summarized as follows:

- Knowledge which is generated through research work at university level lies unused in dissertations in the libraries. To pull out this unused knowledge.
- In universities research work goes on and on haphazardly without any specific direction. To give a specific direction.
- To avoid re-inventing and repetition of research work.
- To get fresh & pure knowledge directly from universities for industries.
- To reduce the time for research at the industrial level.

The various issues and dimensions as reported in literature for the strategic development of an enterprise have been presented in Figure 2.1:



(Nanda, 2011)

Figure 2.1 Determinants for Strategic Development of Firms

2.6 Theoretical Models

Some of the important theoretical models for strategic development of SMEs are presented as follows:

Thomas and Tymon (1993) have found that there are four elements of intrinsic motivation consisting of feelings of meaningfulness, progress, choice, and competence. The study showed that feeling of meaningfulness occurs when individuals are progressing on a path that they believe is worth their time and energy. The feeling of progress involves a person's sense that a task is moving forward and that their activities are really accomplishing something. The feeling of choice occurs when individuals feel free to choose activities that make sense to them and are able to perform them in ways that seem appropriate. The final component of intrinsic motivation, the feeling of competence, involves whether the individuals feel skillful in performing the task activities that they have chosen.

Storey (1994) developed a model which identified the key components important in analyzing the growth of SMEs: the characteristics of entrepreneurs; the characteristics of SMEs; and the type of strategy associated with growth. Characteristics of entrepreneurs included age, gender, education and former work experience as its dimensions. Characteristics of the SMEs included origin of enterprise, length of time in operation, size of enterprise and capital source. It was found that age and previous experience had no significant relationship with business success. Surprisingly entrepreneur with university education were significantly less successful than those with elementary and senior high school. Also origin of enterprise, length of time in operation, size of enterprise showed no significant relationship with business success. The findings also suggested that entrepreneurs who took advantage of family investment were significantly more successful than those with other sources of capital.

Lange *et al* (2000) identified and clarified the barriers to skills development in SMEs and sub-divided these barriers into four simplified categories. *Cultural barriers* which include primarily attitude towards skills development, *Financial barriers* which refer to those barriers which are directly related to the cost or perceived cost of training and learning, *Access and provision barriers* which refer to problem which either prevents interested parties from accessing skills development opportunities or manifest themselves in the lack of suitable provision of learning and *Awareness barriers* which related to the knowledge of learning opportunities.

Castka (2001) presented a 'team development model' which has three dimensions namely organization, team and individual member. For these three dimensions, there are three primary tasks: purpose, partnership and process. In order to maintain alignment among the dimensions, the development of a team has been considered in view of this model. The work has considered teamwork as a prerequisite to face a turbulent environment and discusses the many obstacles to its successful implementation. The role of factors like group culture, knowledge and skills, needs of the individual, measure of performance, defined focus and organizational impact in successful implementation of high performance teams has been discussed.

Rashid *et al* (2003) established a theoretical framework on the relationship between corporate culture, organizational commitment and financial performance. The authors observed a significant relationship between corporate culture and organizational commitment. In an entrepreneurial and competitive culture, a continuance type of commitment is recommended for the organization to succeed. It has also been suggested that affectively-committed employees contribute more to organizational success than continuance or normative committed employees. Also the corporate culture and organizational commitments have an impact on performance. The findings also suggest the contingent relationship that has to be considered in developing appropriate management development programmers' in the organization.

Salavou *et al* (2003) 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.

Narayana (2004) focused on analysis of quality and cost of infrastructure facilities and business environment, and their impact on competitiveness of India's Small-Scale Industries (SSIs). Infrastructure facilities include transport, market information, credit, power, water, telecom, technology upgradation and quality certification. Quality of business environment is indicated by duration of delay in obtaining government's permissions and clearances. Study reflects that infrastructure facilities positively affect the quality of business environment.

Bozic and Radas (2005) proposed a conceptual model aimed at establishing the determinant factors of innovation effects. The ownership structure, the proportion of highly educated employees, market orientation, strategic and managerial changes, marketing strategy and market scope were the factors included. Increased market share, improved product quality, reduced material cost per unit of product, improved ecological, safety and health aspects were considered as innovation effects. The results reveal that strategic and managerial changes fail to strongly impact innovation effects while ownership structure influences it positively. The proportion of highly educated employees also proved to be a significant variable, with a higher number of highly educated employees positively relating only to quality improvement and negatively to the reduction of costs and environmental impacts. The most significant predictor of positive innovation effects was market orientation index.

Raymond and Croteau (2006) proposed a model which included advanced manufacturing systems (AMS) along with products, markets, and networks as the four components for strategic development of SMEs. These four elements were considered as theoretical attributes that should reach a level of internal coherence among them, corresponding to a specific configuration. It has been found that successful implementation of AMS is bound to take added importance for many SMEs in terms of survival, growth, and competitiveness.

Tsai *et al* (2007) formulated a framework which indicates that pay policy and innovation strategy has a combined effect on performance of technology-based service firms. The study highlighted characteristic of the industry also effect the relationship between combination of pay and innovation strategy with firm performance. The results indicated that in IC design services firms innovation strategy combined with high pay exhibited a positive effect, but in software services firms and information system integration services firms, they did not.

Kak (2008) examined the relationship of core competence with competitive advantage and competitiveness in terms of corporate success. The results revealed that core competence has not been fully introduced in most of the organizations. The organizations that are in the process of introducing this concept need to implement it faster for better corporate performance. The process of technology acquisition, assimilation and implementation processes are aided by core competence for improved organizational performance. It has been found that competence at the level of technology is the strongest predictor for generation of sustainable competitive advantage and achieving profitability. Competitive advantage, in terms of customer value, coordination of functions, capacity utilization, economies of scale and scope, and time advantage, has been found statistically as the strongest predictor for achieving corporate success in terms of growth.

Singh *et al* (2008) have showed that SMEs face many constraints due to lack of resources and poor innovative capabilities. For sustaining their competitiveness, they have to benchmark their assets, processes and performance with respect to best in the industry. There is also a need for developing a framework for quantifying the competitiveness by adopting a holistic approach. Major problems are related with knowledge loss, product design and development capability, training infrastructure and networking.

Xu *et al* (2008) have found that innovative capabilities of firms can be enhanced in a business network characterized by frequent and diversified interactions, as well as collaborative interdependencies among network members. Partnerships between SMEs and large firm partners help SMEs pioneer innovation. By sharing technological resources, SMEs can further develop their core competencies and increase their opportunities to innovate. In addition, with partnerships SMEs can gain access to new and diverse ideas and have greater opportunities to learn and increase their R&D knowledge.

Campos *et al* (2009) constructed a model which explains the technology strategy process, suggests actions in top-down order that the firm carries out to protect its profits, and also a feedback circuit to reconfigure its objectives/strategies. The model shows that technology strategy process compromises of four stages i.e. dynamic, formulation, implementation and evaluation. Initially, the firm must recognize the dynamics of the context in which it operates, so that it knows the different kinds of strategies that are undertaken. The next step is the change of structure in order to implement the strategies. Finally the firm must find a mechanism to protect the profits. It has been examined that for the successful management of the firm, a trade-off between the uncertainty of technology and the potential strategic benefits of technology is necessary.

Morques and Ferreira (2009) developed a model which consisted of five dimensions: the firm, the entrepreneur, the firm’s external business environment, the firm’s innovative capacity and the firm’s performance. The first three dimensions are the input dimensions which are further made up of certain internal variables. Size, age, level of training, sector of activity and life cycle are the internal variables for first dimension; age and entrepreurship for second; whereas partnership/cooperation and openness to external environment are the variables for the third. The results showed that firm's size, firm's life cycle, entrepreurship and partnership agreement with other firms has a positive influence on the firm's innovative capacity. Finally, it was checked whether a firm's innovative capacity has an influence on its performance or not. The results showed that greater a firm's innovative capacity, the better is its performance. Finally, the dimension of innovative capacity that most influenced the firm's performance has been process innovation.

Nanda and Singh (2009a) investigated the means with which organizations can encourage creativity in their working environment and identified the key factors that influence organizational creativity and innovation. The three major factors that enhance creativity and innovation in the workplace include organizational culture and climate; individual characteristics; and the support system. The paper explained how companies can use each of these determinants to enhance innovation within workplace environments.

Nanda and Singh (2009b) found that technology development (RD) initiatives have become mandatory for the industrial growth, customer needs and strategic direction, thereby leading to improving the product and technology portfolio. The study highlighted the performance of Indian manufacturing organizations in different components of technology development implementation program to make a significant organizational transformation from a technology-dependent regime to a proactive adaptation of technology innovation initiatives for affecting organizational performance improvements.

Alpkan *et al* (2010) identified the effect of organizational support factors and human capital on the innovation performance of firms. It has been found that (among the individual effects of the dimensions of organizational support) management support for idea development and tolerance for risk taking exerts positive effects on innovative performance. Availability of a performance based reward system and free time have no impact on innovativeness, while work discretion has a negative one. As for the role of human capital, it is found to be an important driver of innovative performance especially when the organizational support is limited.

Kiran and Jain (2010) undertook a research study with the objective to study the technology management strategies used by manufacturing units in the state of Punjab. The study highlighted the extent of use of Intellectual Property Rights by Punjab Manufacturing sector and to recommend the factors for developing an IPR culture in the region.

Singh *et al* (2010) developed a framework and investigated the relationship between business environment (viz. business cost, market pressure and constraints) and strategies like competitive priorities, competency and investment in different areas so that the performance/competitiveness of a firm can increase. The results revealed that cost reduction, quality improvement, and delivery in time have emerged as major challenges for SSIs. Market research, welfare of employees, and research and development have been major areas of investment. Use of information technology, training of employees, and research and development have a significant relationship with performance.

Adobor (2011) developed a framework for understanding the relationship between embedded industry conditions and alliance formation. The work summarized that contextual and situational factors increase convergence expectations. In turn, convergence expectations increase institutional trust, non-relational cooperation, cultural and structural embeddedness, while reducing transaction costs. Collectively, these conditions ensure that alliances are formed in the industry.

Gotham *et al* (2011) proposed a model of technology transfer which suggests that the innovation process begins with the development of a new innovation, including an initial evaluation and subsequent effectiveness and efficacy research to ensure that it improves outcomes, experience, or services. Next, the innovation goes through translation, where the essential elements and relevance of the innovation are explained and the innovation is packaged to facilitate its spread. In dissemination, awareness about the innovation is promoted through a variety of activities with the goal of encouraging its adoption. Adoption is not a single decision but a process of deciding to use the innovation. The final phase, implementation, is the incorporation of the innovation into routine practice in real-world settings.

Kock and Ellstrom (2011) established an analytic framework named ‘the learning triangle’. The corners of the learning triangle denote relationships between the learning environment of a firm, the strategy for competence development and perceived learning outcomes. A main assumption behind the framework is that the learning outcomes of a competence development effort are assumed to be dependent on the character of the learning environment; the strategy for competence development used; and the interaction between these two factors.

2.7 Gaps in the literature

This chapter has presented the findings from literature on various key input factors required for strategic development of small scale industrial sector. The review of past literature indicates sufficient gaps for the conduct of proposed research work. The following limitations may be noted:

- There is extensive literature available which brings forth the key parameters to be considered for promoting technological improvements in the industrial sector. However most of the writings do not cover the various factors together and thus fail to compare their relative importance in achieving the overall objective of strategic development in the industrial sector.
- There is a lack of academic writings (both theoretical models as well as quantitative research) on the role of government as a facilitator of technical change in the industrial sector.
- Very limited literature based on quantitative research (based on actual data from industry) or empirical studies is available to prove the effectiveness of various factors in an organizational setting. In the few (primary data based studies) such studies available in literature, all manufacturing units have been treated alike, irrespective of specific requirements of various sectors. Sector wise analysis has not been conducted for appropriate dealing with varying requirements of different sectors.

The present research work intends to bridge the gaps in literature and practices by suggesting a systematic plan for evolving a strategic development program for SMEs in the region.

Chapter - III

DESIGN OF THE STUDY

3.1 Introduction

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

3.2 Objective and Issues

The main objective of the present work is to develop a systematic plan for strategic development of industrial sector in the region.

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

- **Organizational Culture.** It comprises of the following sub-factors:
  - ✓ Skilled Workforce
  - ✓ Employee Education
  - ✓ Training
  - ✓ Personality Traits
  - ✓ Reward Management
  - ✓ Risk Taking and Strategic Direction
- **Resource Support**. It comprises of the following sub-factors:
  - ✓ Infrastructure Services
  - ✓ Financial Support
- **Government Support**. It comprises of the following sub-factors:
  - ✓ Public Policy
  - ✓ Support Programs
- **External Capacity Building**. It comprises of the following sub-factors:
  - ✓ Industrial Collaboration
  - ✓ Industry-Institute Bonding
  - ✓ Other Alliances

3.3 Phases of Research

The present study employed both quantitative and qualitative research approachesThe quantitative approach utilizes a series of statistical techniques including correlation and factor analysis. The results obtained from quantitative study and literature review have been synthesized to develop a systematic plan using a qualitative research method. Based on the flexible system methodology, the research work has been carried out in three phases:

Phase I : Clarifying the context

Phase II : Understanding and assessing the situation

Phase III : Evolving a management process

3.4 Clarifying the context

In this phase, the need and scope of the research work is established. An extensive literature review is carried out to clarify the context. In this phase, literature on strategic development initiatives with regard to organizational culture, infrastructure facilities, government support etc has been carried out for the manufacturing sector with focus on SMEs.

3.5 Understanding and assessing the situation

The study has been carried out in small scale manufacturing organizations in the region to assess the status of key input initiatives and resulting performance improvements through a survey based research. The questionnaire survey technique has been employed.

3.5.1 Sampling and Data Collection

The quantitative analysis has been performed on the data gathered from the questionnaire survey conducted during 2009 as part of a prior study (Dixit and Nanda, 2010).

3.5.2 Statistical Tools

The various statistical tools and techniques employed in the research work are discussed as follows:

Firstly, in the analysis of questionnaire, the status of all the issues under each component (input and output parameters) of strategic development of the manufacturing sector is assessed. The percent points score (P.P.S) for each set of questions which reflect different issues under each component are 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 is evaluated and the manufacturing units are classified into 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 is used to classify the industries into different categories (Singh, 1993; Nanda and Singh, 2009). Analysis of Variance has been applied to compare the means of output variables according to category distribution of each input parameter. ANOVAs and p-values have been calculated for finding a mean difference between the groups.

An assessment of association of various input factors with output parameters has been presented in the study.

Correlation Analysis*:* To find the relationship between various key inputs and key outputs, Pearson's correlation analysis has been performed to identify the strong and statistically significant relationships between the factors within the independent and dependent constructs. In doing so, a correlation matrix has first been generated for the entire set of factors. The matrix has then been examined to uncover statistically significant correlations between factors within the relevant constructs. It should be noted that a two-tailed test was used, to provide a measure for establishing statistical significance of correlation coefficients, since the direction of the relationships between the factors were already determined which can either be positive or negative.

Step-wise Regression Analysis: For closer examination of relationships between individual dimensions of dependent variable with the independent variables, the step-wise regression analysis has been done. Stepwise regression can be achieved either by trying out one independent variable at a time and including it in the regression model if it is statistically significant, or by including all potential independent variables in the model and eliminating those that are not statistically significant, or by a combination of both methods. The notations employed in this test include: β= Regression Coefficient (Beta Coefficient), R= Correlation Coefficient.

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 a powerful tool for analyzing 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.

3.6 Evolving a Management Process

The inferences drawn from the literature survey and survey results shall be used to design a model for strategic development of SMEs in the region. Qualitative modeling will be used in this study which involves deriving expert opinion and using this along with findings of previous phases in a structured manner. Four main techniques for modeling of the research problem will be used in the present work. These include Options Field Methodology (OFM) and Options Profile Methodology (OPM) developed by Warfield (1979, 1982, 1990), Analytic Hierarchy Process (AHP) developed by Saaty (1980, 1986, 1990) and Fuzzy Set Theory (FST) methodology developed by Zadeh (1965).

Options Field Methodology (OFM) and Options Profile Methodology (OPM) provide a means for thorough development of the design situation and the design target description. The Options Field Methodology generates a list of options as a solution to the present research problem using modified idea writing. It organizes the Options Field displaying the clusters, dimensions and options in an orderly manner.

The next technique used in qualitative modeling will be Options Profile Methodology (OPM). Here, various courses of actions (Profiles) of the design would be developed. These profiles can be employed to achieve overall objective of the research problem. The main steps in OPM are developing various courses of actions (Profiles) as a solution to the problem and allocating various options to these alternate profiles.

The completed options profiles represent alternative approaches and courses of action to be adopted in each approach.

The next step in modeling will be the use of Analytic Hierarchy Process (AHP). This process decides the various sub-objectives (under the main objective) of the research problem. These are also referred to as ‘features of design’. Further in this step the relative weightage of these sub-objectives using paired comparison will be performed.

Finally, Fuzzy Set Theory (FST) technique will be employed. This approach quantifies (from the qualitative feedback provided by experts) the contribution of each profile towards each objective.

The main steps in this approach include developing ‘Position Matrices’ to quantify the contribution of each profile to each objective, making ‘Weighted Position Matrices’ to ascertain the effectiveness of each profile for the fulfillment of goals and making ‘Dominance Matrices’ to find out the best course of action (profile) under optimistic, pessimistic and realistic scenario.
Finally, a conceptual framework will be developed to represent the linkage between essential components of a ‘Strategic Development Program’ for SMEs. The framework shall elaborate on their relative contribution in meeting the overall research objective.

3.7 Chapter Summary

The methodology adopted for the study along with the step-by-step approach employed for the research has been elaborated in this chapter. Empirical studies will be used to yield rich data for statistical analysis that can be used for drawing relevant inferences. The critical learning issues from the survey shall be synthesized to develop a systematic plan and evolve a management process. In view of the insights gained from this synthesis and the literature available, actions for implementation in the manufacturing industry will be recommended.

Chapter - IV
Analysis of Survey

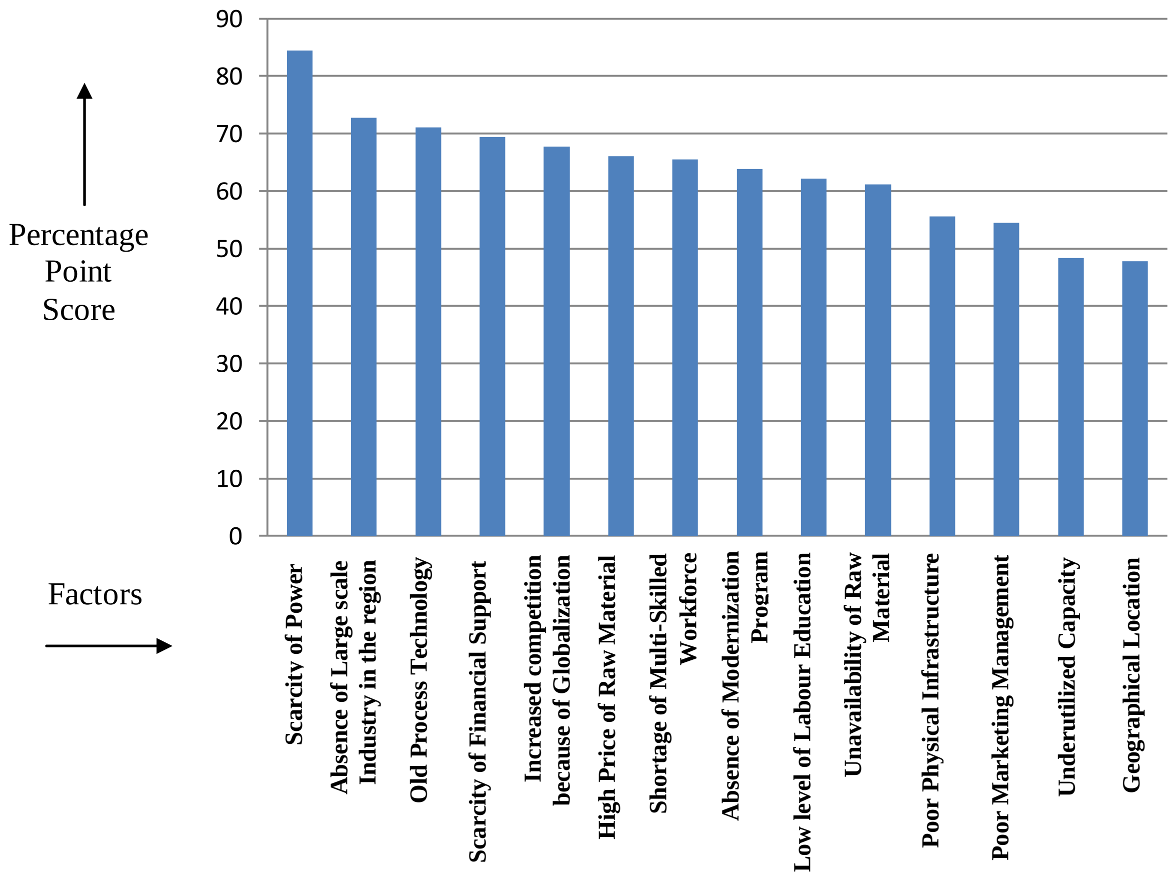
4.1 General

This chapter presents the analysis and major findings of survey based research data. The survey explores the status of development initiatives and resulting performance improvements in the industrial sector in the region. The main factors affecting the performance of small units have been evaluated. The analysis also establishes the relationship of key input factors with output performance parameters.

4.2 Barriers to Performance Enhancement

The relative severity of various possible barriers to performance enhancement has been presented in this section. Dixit and Nanda (2010) identified fourteen potential factors in literature which are impairing the performance of small scale sector.

Figure 4.1 Relative score of the Barriers to Performance Enhancement



The relative score of these factors is summarized in Appendix I and depicted in Figure 4.1. The most severe barrier has been found to be scarcity of power with a scoring of 84.44%. The firms are receiving electricity for only one third of a full day. The high cost involved in power generating system (DG sets) forbids them to use alternate source of electricity.

Other severe barriers include absence of large scale industry in the region and use of old process technology. Old process technology usually results in high frequency of breakdown or maintenance requirements. The presence of large organizations can provide support in the form of finance and expertise, as well as future sales and international opportunities. Small scale sector in the region has been suffering because of absence of large scale manufacturing organization.

Scarcity of financial support for development projects, increase in competition because of globalization high prices of raw material and shortage of multi-skilled workforce are also important barriers to growth. Technology development initiatives require huge capital investment there is a huge risk associated.

Absence of modernization programs, low level of technology know-how and education of employees and unavailability of raw are factors in the next range of scores.

4.3 Status of Input and Output Parameters

The present work considers four key inputs and four output performance parameters for the overall assessment of development initiatives in the small scale sector. The input issues include '*Organizational Culture'* issues, '*Resource Support'* facilities for research function, '*Government Support'* to support development efforts of the industry and '*External Capacity Building'*. The key outputs include *'Level of Technology'*, *'Strategic Implementation of Innovation'*, *'Structure of output of R&D Function'* and *'Response to Market Demands'*. The various issues under key output are being collectively referred to as '*Output Performance Parameters'*.

4.3.1 Status of Organizational Culture

Organizational culture has a potential impact on the firm's success. Early development of an entrepreneurial culture positively influences a firm's international intent, allowing a firm to be more capable and willing to pursue international opportunities. This section discusses the status of *'Organizational Culture'* issues in the manufacturing sector and presented in Appendix II.

There is a strong association between high performing, internationally diversified firms and top management team characteristics such as flexibility, tolerance for change and acceptance of uncertainty (Javalgi and Todd, 2010). As reported by Dixit and Nanda (2010) reaction of top management to project failure secures good status (PPS-0.83) in the small scale sector in the region. There are only a very few organizations (2%) which take strict action against members of the project team when a failure occurs.

Manufacturing organizations in the region have performed very poorly in providing training to employees. Innovative organizations rely heavily on proper training to enhance creativity and innovation skills of employees but industrial sector in the region has shown an unreasonably low rating (PPS-0.33) in this issue.

4.3.2 Status of Resource Support

In order to enhance efficiency and productivity, innovative organizations undertake measures to modernize and upgrade machinery, equipment and operations. Firm specific resources result in a sustainable competitive advantage, creating resources that are valuable, rare, inimitable, and non-substitutable (Muhammad *et al.,* 2010). The score of various key issues is presented in Appendix III.

Small scale sector in the region clearly lacks in in-house research infrastructure (PPS-0.35). State of the art production machinery and equipment is also not available in majority (63%) of the industrial units and thus a very low (PPS-0.36) rating has been shown in this issue. In most of the organizations, only a very small portion of the annual turnover is spent on development initiatives.

4.3.3 Status of Government Support

Manufacturing competitiveness is increasingly defined by skill, advanced technology, and high quality output. Policy-makers from governments, industrial development corporations, and international organizations, are recommending a shift away from labour-intensive manufacturing towards skill-intensive manufacturing, where high value-added products provide competitive edge. Governments play a vital role in economy and industrialization in the country. The response to key issues on this component is presented in Appendix IV.

The results show that government has failed in ensuring supply of reliable and uninterrupted power supply. There are considerably high number of units (62%) which consider unavailability of electricity to be most significant hurdle in their performance. Further, the government has performed poorly in providing funding to small units for research initiatives.

4.3.4 Status of External Capacity Building

Innovative organizations choose to maintain their competencies only in selected core technologies and obtain additional capabilities through partnerships and alliances with other companies, government laboratories, universities and R&D organizations. Collaboration is a means to benefit from complementarities among firms. It also helps to access skills and to transfer complex and tacit knowledge, with an important role for appropriability and protection of intellectual property (Justman and Teubal 1996).

As most SMEs lack financial resources, the best way is to enter into linkages and partnerships with other enterprises, academia and/or R&D institutions. In various countries numerous experimental projects have been started at local and national level to set up centres for technological transfer and foster firms in making use of the scientific and technical services offered by these centers and institutes (Kharbanda, 2001).

The results show that though he entrepreneurs are aware of the benefits of industry-institute interaction, actual collaboration have not yielded positive results (PPS-0.39). also the performance of industry in developing technology in collaboration with other knowledge generators viz. R&D institutes, other industries etc has been poor (PPS-0.33).

4.3.5 Status of Output Performance Parameters

The relative score of various issues are presented in Appendix VI. In order to have long term gains, organizations in developed economies work with specific product innovation strategies like practicing '*Risky Research',* developing a *'Market Niche'*, using *'Imitation for Creation'* etc. As shown in the results, the use and effectiveness of these strategies is low in industrial units in the region.

In majority of the units, the structure of research function is not clearly defined (PPS-0.41). The performance of industry has not been very good as far as increase in product mix and adding new features to the existing products is concerned.

The industrial sector in the region is aware of the benefits of in-house technology development programs (PPS-0.91) but, a lot needs to be done on the practical front. At present, not even one tenth of the units are employing latest technology to produce products. Further majority of the units do not follow and practice a well defined research policy.

The results reveal that industrial units are using the research function for firefighting of production problems and not for technology upgradation.

4.4 Status of Manufacturing Units

This section presents the status of performance of manufacturing organizations in each of the key input and output parameters. The criterion as developed by Singh, 1993 and further used by Nanda and Singh, 2009 has been used for classification of manufacturing units. The PPS score obtained by organizations in various research constructs is shown in Table 4.1.

Table 4.1 Performance Rating of Units in Key Parameters

Range of PPS → / Aspect ↓	25-30	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														
Input variables															
Organizational Culture	--	--	--	1	6	3	12	9	3	11	--	--	--	--	--
Resource Support	--	3	14	3	10	3	5	4	--	1	2	--	--	--	--
Policy Environment	2	--	5	2	9	13	6	1	2	1	1	1	1	1	--
Alliance with External Organizations	1	--	--	--	1	8	6	10	9	4	5	1	--	--	--
Output variables															
Level of Technology	1	--	5	--	12	--	--	16	--	7	--	--	4	--	--
Strategic Implementation of Innovation	--	3	3	4	8	14	4	7	1	--	1	--	--	--	--
Structure and Output of R&D Function	2	5	6	6	7	3	1	4	5	3	--	--	3	--	--
Response to Market Demands	--	--	1	--	2	--	6	8	11	7	--	6	4	--	--

The performance and classification of units in *'Organizational Culture'* component is depicted in Figure 4.2 and Figure 4.3 respectively.

Figure 4.2 Performance of units in Organizational Culture component

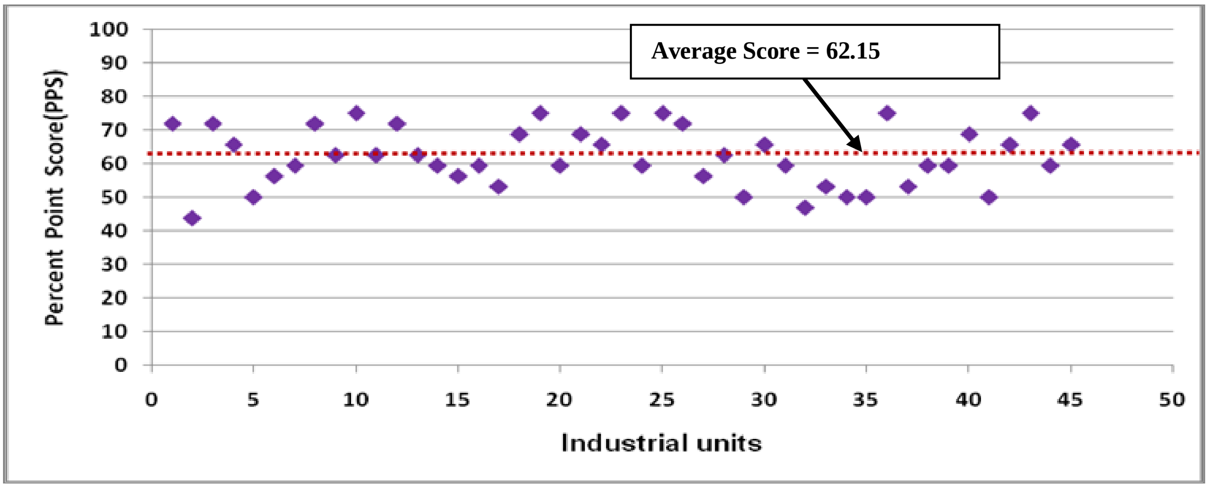
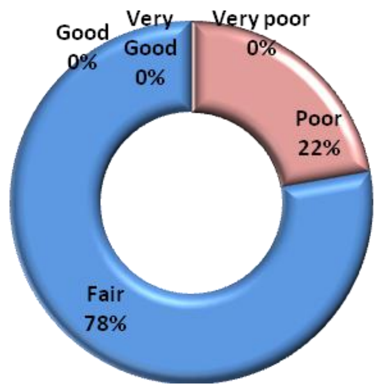


Figure 4.3 Classification of Units in Organizational Culture component

Percent Points Scored (PPS)	Category	Number of Units in the Range	Persentage of Units in the range (%)
25-35	Very poor	-	-
36-55	Poor	10	22
56-75	Fair	35	78
76-90	Good	-	-
91-100	Very Good	-	-



The performance and classification of units in '*Resource Support'* component is depicted in Figure 4.4 and Figure 4.5 respectively.

Figure 4.4 Performance of Units in Resource Support component

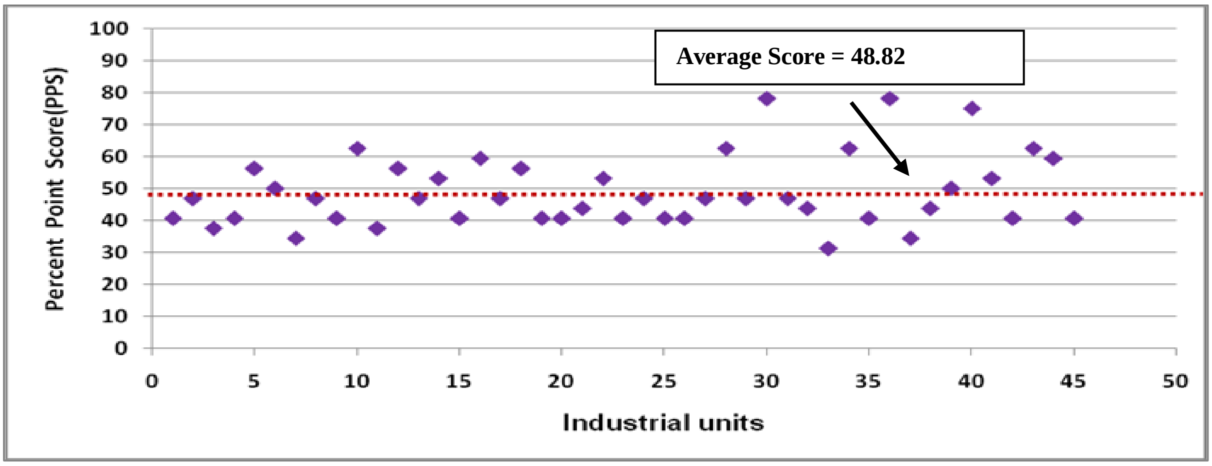
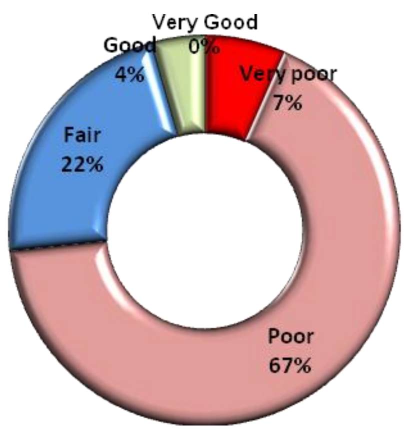


Figure 4.5 Classification of Units in Resource Support component

Percent Points Scored (PPS)	Category	Number of Units in the Range	Percentage of Units in the range (%)
25-35	Very poor	3	7
36-55	Poor	30	67
56-75	Fair	10	22
76-90	Good	2	4
91-100	Very Good	-	-



The performance and classification of units in '*Government Support'* component is depicted in Figure 4.6 and Figure 4.7 respectively.

Figure 4.6 Performance of Units in Government Support component

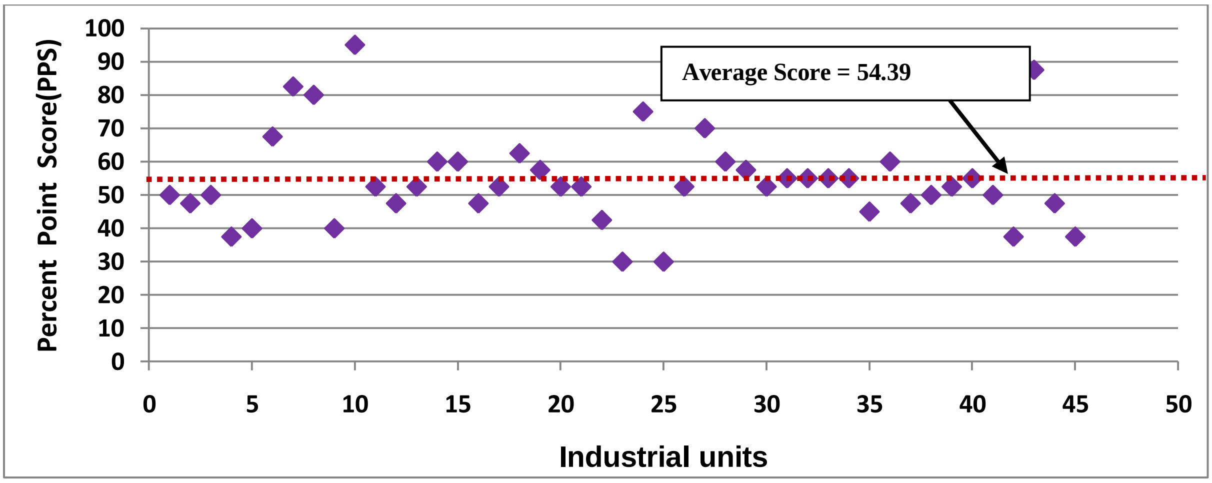
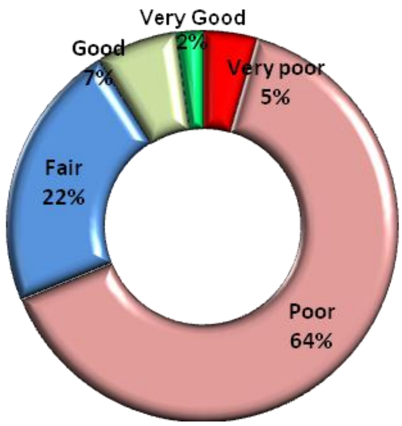


Figure 4.7 Classification of Units in Government Support component

Percent Points Scored (PPS)	Category	Number of Units in the Range	Percentage of Units in the range (%)
25-35	Very poor	2	5
36-55	Poor	29	64
56-75	Fair	10	22
76-90	Good	3	7
91-100	Very Good	1	2



The performance and classification of units in '*External Capacity Building'* component is depicted in Figure 4.8 and Figure 4.9 respectively.

Figure 4.8 Performance of Units in External Capacity Building component

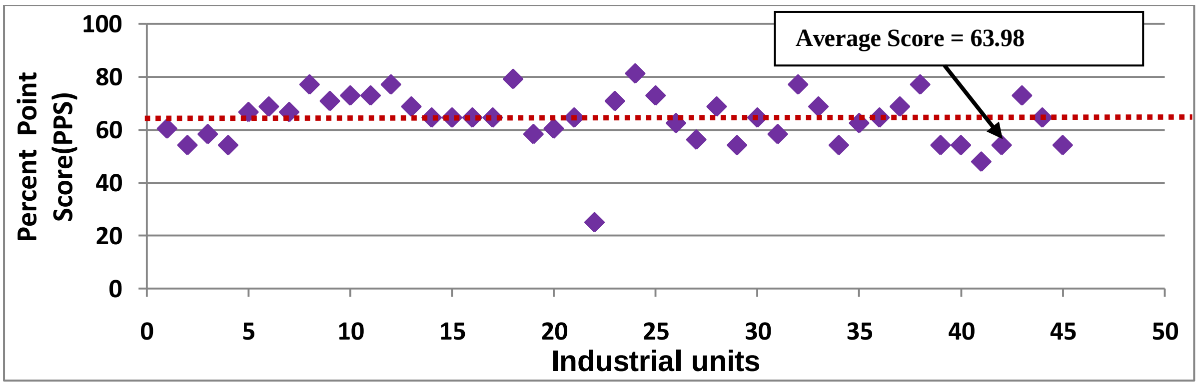
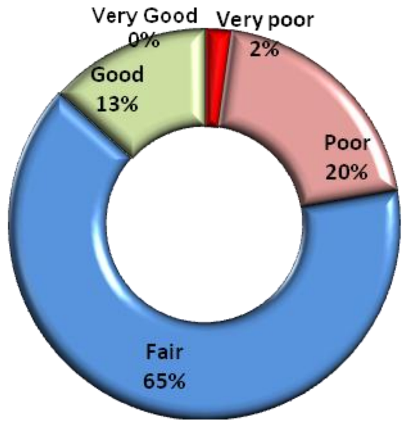


Figure 4.9 Classification of Units in External Capacity Building component

Percent Points Scored (PPS)	Category	Number of Units in the Range	Percentage of Units in the range (%)
25-35	Very poor	1	2
36-55	Poor	9	20
56-75	Fair	29	65
76-90	Good	6	13
91-100	Very Good	-	-



The performance and classification of units in *'Level of Technology'* component is presented in Figure 4.10 and Figure 4.11. The average score of organizations in '*Level of Technology'* is 59.72%. More than one third of the units are at *a 'Poor'* level in managing this component.

Figure 4.10 Performance of Units in Level of Technology

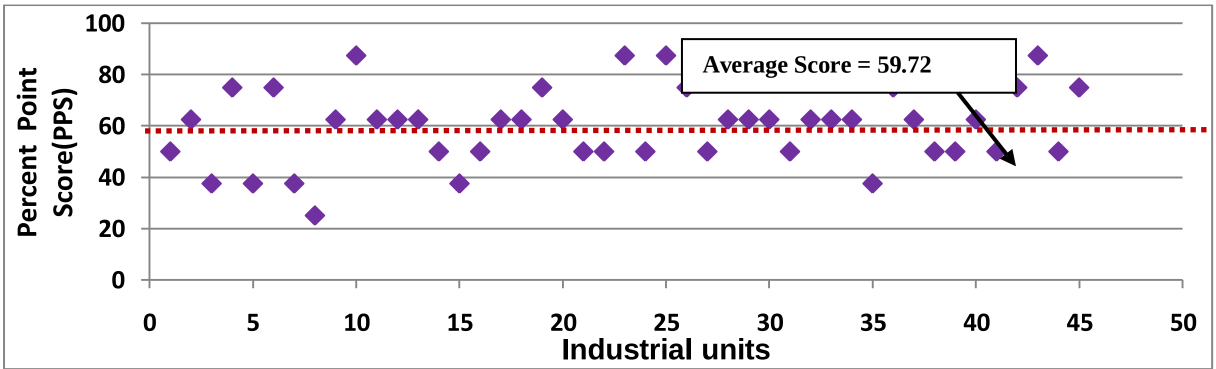
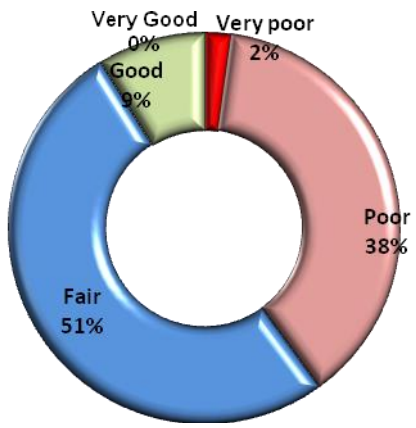


Figure 4.11 Classification of Units in Level of Technology

Percent Points Scored (PPS)	Category	Number of Units in the Range	Percentage of Units in the range (%)
25-35	Very poor	1	2
36-55	Poor	17	38
56-75	Fair	23	51
76-90	Good	4	9
91-100	Very Good	-	-



The performance and classification of units in *'Strategic Implementation of Innovation'* component is presented in Figure 4.12 and Figure 4.13 respectively.

The average score of organizations in '*Strategic Implementation of Innovation'* is 53.78%. Nearly three fourth of the units are at a 'Po*or'* level which discouraging.

In order to improve performance in this component, firm's should develop and practice various strategies for effective implementation of innovation. Research initiatives should be based on specific product innovation strategies. This can be achieved by developing a detailed corporate strategy as well as a balanced approach to short and long-term objectives.

Figure 4.12 Performance of Units in Strategic Implementation of Innovation

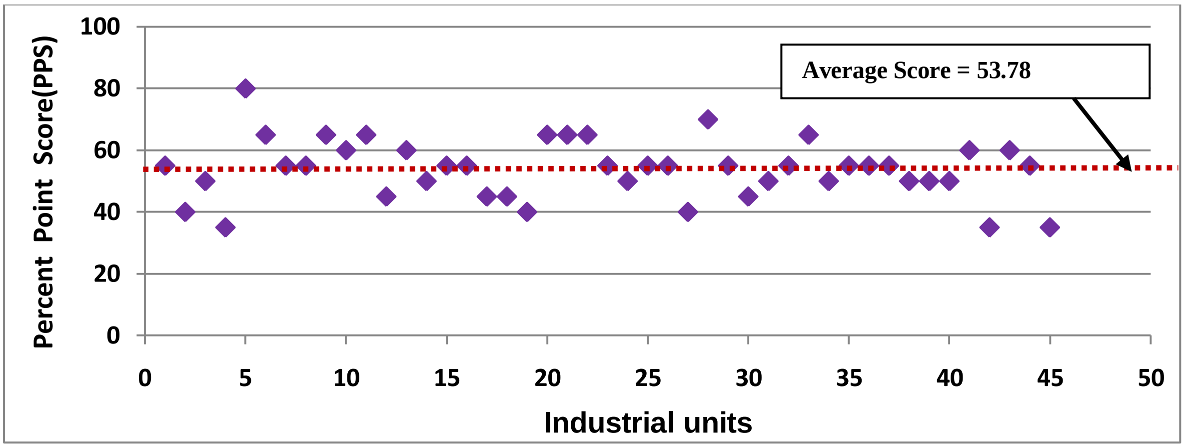
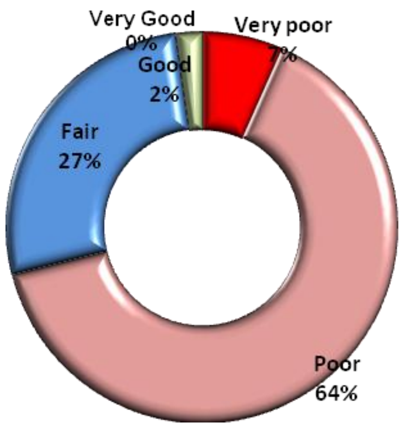


Figure 4.13 Classification of Units in Strategic Implementation of Innovation

Percent Points Scored (PPS)	Category	Number of Units in the Range	Percentage of Units in the range (%)
25-35	Very poor	3	7
36-55	Poor	29	64
56-75	Fair	12	27
76-90	Good	1	2
91-100	Very Good	-	-



The performance and classification of units in *'Structure and Output of R&D Function'* component is presented in Figure 4.14 and Figure 4.15 respectively.

The average score of organizations in '*Structure and Output of R&D Function'* component is 53.89%. Nearly two third of the units are at a 'Poor' level.

The manufacturing units can enhance performance in this component by establishing research function as a separate division and having clear procedures and defined policies. The structure of R&D function is not clearly defined in small scale units in the region.

Figure 4.14 Performance of Units in Structure and Output of R&D Function

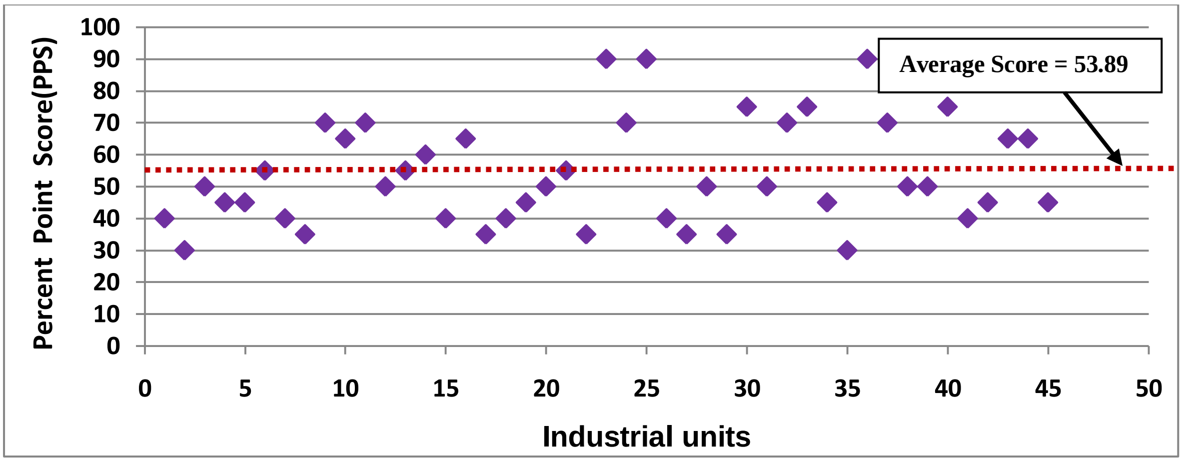
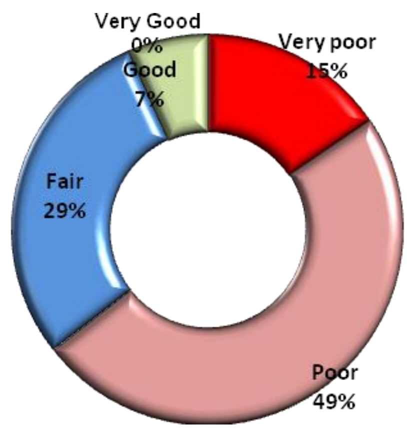


Figure 4.15 Classification of Units in Structure and Output of R&D Function

Percent Points Scored (PPS)	Category	Number of Units in the Range	Percentage of Units in the range (%)
25-35	Very poor	7	16
36-55	Poor	22	49
56-75	Fair	13	29
76-90	Good	3	7
91-100	Very Good	-	-



The performance and classification of units in *'Response to Market Demands'* component is presented in Figure 4.16 and Figure 4.17 respectively.

The average score of organizations in '*Response to Market Demands'* is 68.75%. The results show only about one fifth units (22%) which are at a *'Good'* level in responding to the needs of marketplace.

Figure 4.16 Performance of Units in Response to Market Demands

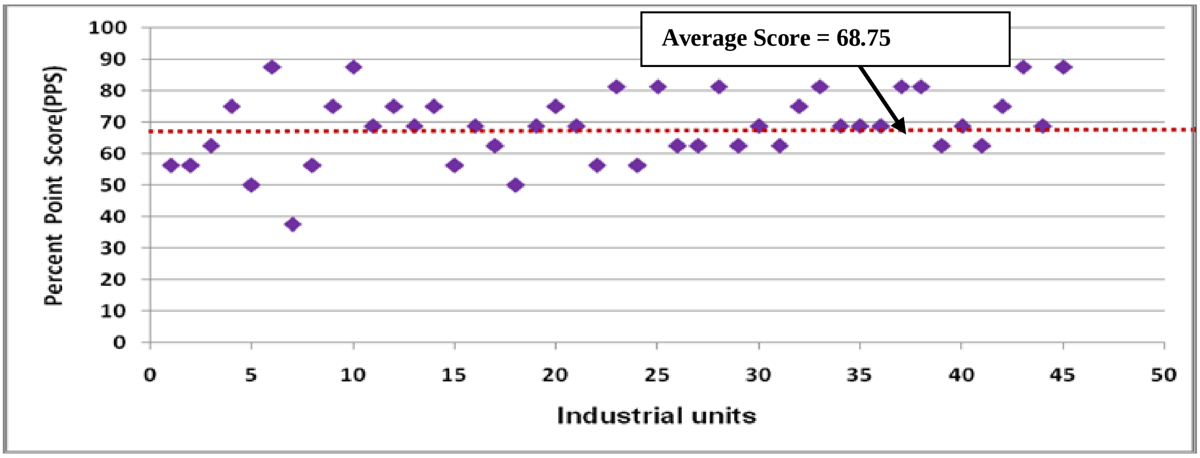
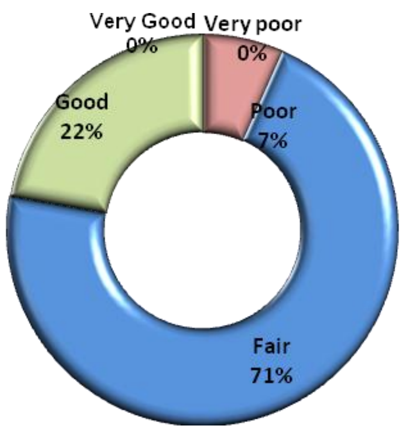


Figure 4.17 Classification of Units in Response to Market Demands

Percent Points Scored (PPS)	Category	Number of Units in the Range	Percentage of Units in the range (%)
25-35	Very poor	-	-
36-55	Poor	3	7
56-75	Fair	32	71
76-90	Good	10	22
91-100	Very Good	-	-



4.4.1 Mean distribution of output variables for different categories

The objective of this part of analysis is to compare the mean distribution of output variables according to category distribution of input parameters. The statistical significance of the difference in means of output variables according to group has been determined using ANOVA.

Mean, standard deviation, ANOVA's value and p-value have been calculated separately for output variables according to category distribution of each input parameter. A significance level of 95% has been considered and therefore p value less than 0.05 shows a significance difference between the means of output variables.

Table 4.2 shows the distribution of means of output variables according to 'Poor' and 'Fair' category of 'Organizational Culture' input parameter. The results show that there is not any statistical significance of the difference in means of any of the output variables according to category distribution of this input factor.

Table 4.2 Mean distribution of Output Performance Parameter according to category distribution of Organizational Culture Component

Category	N	Z1	Z2	Z3	Z4	Z
Poor	10	56.25±10.6	56.00±11.0	47.50±17.5	66.87±10.2	52.79±10.2
Fair	35	60.71±15.8	53.14±9.2	55.71±15.8	69.28±11.6	55.46±8.5
ANOVAs, p-value		0.702, 0.407	0.684, 0.413	2.011, 0.163	0.353, 0.555	0.766, 0.386

The distribution of means of output variables according to the four categories of 'Resource Support' component is shown in Table 4.3. The comparison of mean scores among groups reveals that the output variable, '*Structure and Output of R&D Function'* shows a statistical significance difference (ANOVA = 3.267; p = 0.031).

Table 4.3 Mean distribution of Output Performance Parameter according to category distribution of Resource Support Component

Category	N	Z1	Z2	Z3	Z4	Z
V' poor	3	54.16±14.4	58.33±5.8	61.67±18.9	66.67±25.2	57.35±14.2
Poor	30	58.75±15.1	52.50±9.4	50.33±15.9	68.33±9.6	53.23±8.2
Fair	10	62.50±15.6	57.00±11.10	56.50±11.8	70.62±13.2	57.35±7.4
Good	2	68.75±8.8	50.00±7.1	82.50±10.6	68.75±0.00	63.23±6.2
ANOVAs, p-value		0.531, 0.663	0.873, 0.463	3.267, 0.031	0.133, 0.940	1.432,0.247

The mean distribution of output variables according to category distribution of Government Support component is shown in Table 4.4. The results show that *'Level of Technology'* (ANOVA = 3.905; p = 0.009) and '*Structure and Output of R&D Functions'* (ANOVA = 3.410; p = 0.017) has a statistical significant difference in the means.

Table 4.4 Mean distribution of Output Performance Parameter according to category distribution of Government Support Component

Category	N	Z1	Z2	Z3	Z4	Z
V' poor	2	87.5±0.00	55.00±0.00	90.00±0.00	81.25±0.00	72.05±0.00
Poor	29	55.75±10.8	53.62±10.5	52.41±13.9	68.75±8.7	54.15±6.5
Fair	10	60.00±12.9	52.50±9.8	52.00±17.5	66.87±11.8	53.52±8.9
Good	3	50.00±33.0	56.66±2.9	46.67±16.1	60.41±25.2	50.49±14.9
Very good	1	87.50±-	60.00±-	65.00±-	87.50±-	67.65±-
ANOVAs, p-value		3.905, 0.009	0.211, 0.931	3.410, 0.017	1.956, 0.120	3.638, 0.013

Table 4.5 shows the distribution of means of output variables according to category distribution of 'External Capacity Building' component. Results reveal that the second output variable '*Strategic Implementation of Innovation'* has a significant difference (ANOVA = 4.905; p = 0.005) in the means according to categories of this input parameter

Table 4.5 Mean distribution of Output Performance Parameter according to category distribution of External Capacity Building Component

Category	N	Z1	Z2	Z3	Z4	Z
V' poor	1	50.00±-	65.00±-	35.00±-	56.25±-	48.52±-
Poor	9	63.89±9.8	45.56±9.5	45.56±12.6	68.75±9.4	50.49±4.9
Fair	29	60.34±16.0	56.72±8.8	57.4±16.9	69.8±11.6	57.09±9.1
Good	6	52.08±14.6	50.00±4.5	52.50±14.7	65.62±13.0	51.72±7.2
ANOVAs, p-value		0.925, 0.437	4.905, 0.005	1.780, 0.166	0.641, 0.493	2.072, 0.119

4.5 Association between Input and Output Performance Parameters

In this part of analysis, the impact of development initiatives in achieving performance improvements in the industry have been evaluated. Pearson's correlation analysis has been performed to identify the association between input factors and output parameters. Pearson's correlation coefficient values (r values) have been calculated and further validated using Step-wise regression analysis.

4.5.1 Correlation Analysis

The correlation matrix depicting the association between independent and dependent variables has been established and presented in the Table 4.6.

The results show that '*Organizational Culture*' (I1) is significantly correlated with the level of technology (Z1; r= 0.389) at a significance level of 0.01. It has also been found that at a significance level of 0.05, organizational culture (I1) significantly influences structure and output of research function (Z3; r= 0.332) and response to market demands (Z4; r= 0.303).

'Resource Support' (I2) is the next key input parameter for successful implementation of technology upgradation initiatives of industry. A significant correlation (r= 0.316; p<= 0.05) has been exhibited between resource support (I2) issues and strategic implementation of innovation (Z2).

Table 4.6 Correlation Matrix of Input and Output Variables

	I1	I2	I3	I4	Z1	Z2	Z3	Z4	Z
I1	---	0.166	0.099	0.156	**0.389****	0.106	**0.332***	**0.303***	0.296*
I2		---	0.241	-0.047	0.13	**0.316***	0.246	0.046	0.195
I3			---	0.314*	**0.296***	0.113	-0.093	**0.322***	0.073
I4				---	0.091	**0.363***	**0.415****	0.209	0.373*
Z1					---	-0.164	0.462**	0.662**	0.619**
Z2						---	0.212	0.02	0.426**
Z3							---	0.496**	0.887**
Z4								---	0.735**
Z									---

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The third key input parameter for successful implementation of technology upgradation initiatives in small scale industry is *'Government Support'* (I3). This input parameter has established a significant positive association with level of technology (Z1; r= 0.296) and response to market demands (Z4; r= 0.322)

'External Capacity Building' (I4) has shown a significant association with strategic implementation of innovation (Z2; r= 0.363) and structure and output of research function (Z3; r= 0.415).

4.5.2 Step-wise Regression Analysis

Table 4.7 shows the regression analysis (step-wise method) with the dependent variable as *'Level of Technology'* and four input factors as independent. The results indicate that, 'Organizational Culture' and 'Government Support' are significant (13.1% of the variance in Level of Technology can be predicted from these variables), but the other variables will add a little to the prediction of level of technology.

Table 4.7 Regression Analysis for Level of Technology

Dependent Variable			R	R Square	Adjusted R Square	F Probability
Level of Technological			0.389	0.151	0.131	0.008
Sr. No.	Independent Variable(s)	B	Beta	Standard Error	t - value	Significance
1.	**Organizational Culture**	0.657	0.389	0.237	2.768	0.008
2.	**Government Support**	0.292	0.267	0.118	2.479	.016

Table 4.8 Regression Analysis for Strategic Implementation of Innovation

Dependent Variable			R	R Square	Adjusted R Square	F Probability
Strategic Implementation of Innovation			0.373	0.139	0.119	0.012
Sr. No.	Independent Variable(s)	B	Beta	Standard Error	t - value	Significance
1.	**Resource Support**	0.217	0.256	0.082	2.652	0.019
2.	**External Capacity Building**	0.313	0.373	0.119	2.636	0.012

Table 4.8 shows that the multiple correlation coefficient (R), using these four independent variables in stepwise method, is 0.373 (R^2 = 0.139) and the adjusted R^2 is 0.119, meaning that 11.9% of the variance in strategic implementation of innovation strategies can be predicted

from input variables viz. 'Resource Support' and 'External Capacity Building'. The other variables (Z1 and Z2) will always add a little to the prediction of strategic implementation of innovation.

Table 4.9 shows the regression analysis with the dependent variable as *'Structure and Output of Research Function'*. 15.3% of the variance in Structure and Output of Research Function can be predicted from these two significant variables combined.

Table 4.9 Regression Analysis for Structure and Output of Research Function

Dependent Variable			R	R Square	Adjusted R Square	F Probability
Structure and Output of Research Function			0.415	0.172	0.153	0.005
Sr. No.	Independent Variable(s)	B	Beta	Standard Error	t - value	Significance
1.	**Organizational Culture**	0.461	0.339	0.263	2.097	0.010
2.	**External Capacity Building**	0.670	0.415	0.224	2.987	0.005

Table 4.10 shows the regression analysis with the dependent variable as *'Response to Market Demands'*. The result shows that 22.9% of the variance in 'Response to Market Demands' can be predicted from the two significant variables combined. 'Organizational Culture' and 'Government Support' are significant, but the other variables will always add a little to the prediction of response to market demands.

Table 4.10 Regression Analysis for Response to Market Demands

Dependent Variable			R	R Square	Adjusted R Square	F Probability
Response to Market Demands			0.547	0.299	0.229	0.006
Sr. No.	Independent Variable(s)	B	Beta	Standard Error	t - value	Significance
1.	**Organizational Culture**	.207	.214	.132	1.570	.049
2.	**Government Support**	.372	.444	.120	3.116	.003

4.6 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 the 'Organizational Culture' input factor only three issues are extracted using the principal component analysis. The first component, in particular, explains most of the total variance (37.106%), and related items have high loads on the component itself, highlighting their relative importance. The items that should be combined in first component are availability of multi skilled labour, training provided to employees and awareness regarding importance of in-house R&D (as shown in Table 4.12).

Table 4.11 Principal Component Analysis of issues under Organizational Culture

Components	Eigenvalue	% of Variance	Cumulative %
1	**2.969**	37.106	37.106
2	**1.712**	21.395	58.501
3	**1.102**	13.777	72.279
4	.945	11.816	84.095
5	.595	7.439	91.534
6	.307	3.834	95.368
7	.246	3.070	98.438
8	.125	1.562	100.000

The second component (Percentage of Variance = 21.4) emphasizes the issues related to reward schemes to recognize contributions of employees and reaction of top management to project failures. The third component (Percentage of Variance = 13.78) can be interpreted to be comprising of availability of technical manpower and undertaking R&D work for technology development.

Table4.12 Component Matrix (I1)

Issues under Input Factors	Component		
	1	2	3
• Availability of multi-skilled workforce	**.818**	-.304	-.134
• Level of labor education	-.165	-.758	-.204
• Training provided to employees	**.854**	-.322	-.219
• Awareness regarding importance of in-house R&D	**.615**	-.588	-.098
• Availability of scientific and technical manpower	-.348	-.184	**.856**
• Undertaking R&D work for technology development	-.831	-.064	**.638**
• Reward schemes to recognize contributions	-.021	**.634**	-.341
• Reaction of top management to project failure	-.593	**.793**	-.342

Further the analysis extracted three components among the eight items of ‘Resource Support’ input parameter which explain 74.45% of the total variance. The first component can be interpreted from availability of dedicated labs for R&D, advance production facilities and use of software packages.

Table 4.13 Principal Component Analysis of issues under Resource Support

Component	Eigenvalue	% of Variance	Cumulative %
1	**2.839**	35.483	35.483
2	**1.846**	23.078	58.560
3	**1.271**	15.889	74.450
4	.920	11.500	85.950
5	.484	6.051	92.000
6	.276	3.455	95.455
7	.198	2.470	97.925
8	.166	2.075	100.000

Allocation of funds, proportion of annual turnover as R&D funding and financial support to industry combined make the second component whereas modernization & renovation programs reflects the third component of this input variable.

Table 4.14 Component Matrix (I2)

Issues under Input Factors	Component		
	1	2	3
• Financial support to industry	-.617	**.549**	-.384
• Modernization & renovation programs	-.659	-.477	**.715**
• Availability of dedicated labs for R&D	**.423**	-.840	-.053
• Advanced production facilities	**.777**	-.404	-.193
• Use of software packages	**.712**	-.019	-.558
• Allocation of funds	-.732	**.458**	-.224
• Proportion of annual turnover as R&D funding	-.067	**.605**	-.0157
• Source of financial support	-.441	-.238	-.470

‘Government Support’ factor can also be compressed to three components by combining awareness programs for technology upgradation, funding for employee training programs and motivation through reward schemes into the first component. Cost and availability of raw material, transportation infrastructure and capital subsidy schemes constitute the second component. Funding for R&D activities reflects the third component of this input parameter.

Table 4.15 Principal Component Analysis of issues under Government Support

Component	Eigenvalue	% of Variance	Cumulative %
1	**4.258**	42.583	42.583
2	**1.583**	15.827	58.410
3	**1.368**	13.678	72.089
4	.933	9.331	81.420
5	.638	6.377	87.798
6	.539	5.389	93.186
7	.277	2.766	95.953
8	.199	1.990	97.943
9	.152	1.521	99.464
10	.054	.536	100.000

Table 4.16 Component Matrix (I3)

Issues under Input Factors	Component		
	1	2	3
• Cost and availability of raw material	-.736	**.415**	-.180
• Availability of electricity	**.433**	-.201	-.755
• Transportation infrastructure	-.324	**.662**	-.305
• Capital subsidy schemes	-.136	**.684**	-.030
• Funding for R&D activities	-.490	-.500	**.802**
• Motivation through reward schemes	**.766**	-.105	-.442
• Awareness programs for technology upgradation	**.874**	-.121	-.078
• Availability of labs for R&D work	-.713	-.225	-.572
• Support in acquiring imported technology	-.781	-.272	-.753
• Funding for employee training programs	**.835**	-.253	-.629

The results reveal that dimensions of external capacity building can be compressed to four components which collectively explain 70.413% of the variance. The items that should be combined in first component are awareness of industry-institute interaction and use of institute labs for research. Academia for preparing road maps, expert lectures by academicians and collective guidance for dissertations are the items related to the second component.

Table 4.17 Principal Component Analysis of issues under External Capacity Building

Component	Eigenvalue	% of Variance	Cumulative %
1	**3.627**	30.225	30.225
2	**1.994**	16.618	46.843
3	**1.510**	12.582	59.425
4	**1.319**	10.989	70.413
5	.953	7.941	78.354
6	.782	6.520	84.875
7	.506	4.217	89.092
8	.454	3.780	92.872
9	.377	3.140	96.012
10	.222	1.849	97.861
11	.178	1.485	99.346
12	.078	.654	100.000

Table 4.18 Component Matrix (I4)

Issues under Input Factors	Component			
	1	2	3	4
• Technology from within the country	-.542	-.003	-.562	-.240
• Technology developed through alliances	-.234	-.324	**.741**	-.159
• Awareness of industry-institute interaction	**.520**	-.485	-.184	-.288
• Industry-institute alliance with positive results	-.586	-.565	**.230**	-.322
• Academia for preparing road maps	-.388	**.689**	-.111	-.385
• Expert lecture by academicians	-.427	**.639**	-.006	-.173
• Training through short term courses	**.550**	-.405	-.115	-.445
• Combined teams for R&D	**.762**	-.112	-.383	-.391
• Institute labs for analysis	**.568**	-.133	-.273	-.598
• Collective guidance for thesis	-.742	**.589**	-.143	-.153
• Awareness regarding government subsidiaries	-.385	-.004	-.502	**.552**
• Assistance from government organizations	-.654	-.326	-.194	**.727**

The third component comprises of combining technology development through alliance and industry institute interaction with positive results. Awareness regarding government subsidiaries and assistance from these government organizations can be combined to form the fourth component.

4.7 Chapter Summary

The chapter describes the quantitative analysis performed on the data using various statistical tools. Status o key input and output performance parameters have been determined. Further, manufacturing units have been classified into different categories based on their status in key parameters. Principal component analysis, correlation and regression analysis have been performed to identify input parameters contributing significantly towards output performance parameters.

Chapter - V

Qualitative Modeling

5.1 Introduction

This chapter presents the inferences drawn from earlier phases of work in the form of learning issues and their utilization through a qualitative model to evolve a strategic development program for manufacturing sector in the region. The main techniques used for modeling have been Option Field Methodology (OFM), Option Profile Methodology (OPM), Analytic Hierarchy Process (AHP) and Fuzzy Set Theory (FST). An implementation plan has been developed under various conditions of optimism.

5.2 Synthesis of Learning Issues

The outcomes of previous phases (survey based empirical study and literature review) have been synthesized and presented in the form of learning issues in this section. These learning issues have been utilized to develop various options and courses of actions for qualitative modeling. The various issues are presented as follows:

1. Innovation helps the company to deal with the turbulence of external environment and, therefore, is one of the key drivers of long term success in business, particularly in dynamic markets.
2. In order to be considered highly innovative, a firm would usually need a history of successful new product launches to warrant such a reputation.

2a. Three dimensions most frequently used to describe entrepreneurial orientation are innovativeness, proactiveness, and risk taking. Innovativeness refers to supporting creativity, introducing new products and services and developing new processes whereas Proactiveness refers to opportunity seeking that involves, for example, introducing new products, services and processes ahead of the competition and Risk taking, deals with a tendency to take bold actions, such as entering into new foreign markets

3. With decreasing trade barriers and opening up of economies to global competition, most enterprises have realized that organizational survival and prosperity depends on newer business models necessitating lower cost structures, enhanced quality of market offerings, reduced time to market, and greater customer responsiveness.

3a. Early development of an entrepreneurial culture positively influences a firm's international intent, allowing a firm to be more capable and willing to pursue international opportunities.

4. The process of innovation in small organizations tends to leave too much to chance. Majority of the units adopt an unsystematic approach towards product innovations. They are less effective when it comes to planning and implementing innovation, or to establishing formal research groups, or to allocating specific individuals to work exclusively on developing innovations.
5. Innovation is an expensive and risky activity, with positive outcomes on firm performances but also with negative outcomes, such as increased exposure to market risk, increased costs, employee dissatisfaction or unwarranted changes.
6. Technology development and management capability are the two factors that firms need to put more efforts in order to specialize in their technology efficiency and stimulate economic growth.
7. Managerial behavior and the operating philosophy of the firm's executive level characterize entrepreneurial orientation, enabling entry into new markets.
8. SMEs have been affected by lack of skills in several key areas such as advanced qualifications in science, engineering and technology, and mathematics. Such shortfall results in the dependence of enterprises on external sources of knowledge and expertise.
9. Every stakeholder of the business, such as managers, supervisors, workers or even the business owners must take the initiative to participate and create the knowledge-sharing environment.
10. Organizational learning and its output, organizational knowledge, are antecedents of innovation. Learning plays a key role in enabling companies to achieve speed and flexibility within the innovation process.
11. Organizational learning composes four sub processes. First is Knowledge acquisition, which is used by companies for obtaining new information and knowledge. Second sub-process is Knowledge distribution, the process by which employees share information within the firm. Next sub-process is Knowledge interpretation, which happens when individuals give meaning and transform information into new common knowledge. The last step is Organizational memory, in which storing the information and knowledge for future use has been done.

12. Firms with a higher degree of human capital developed through access to employees with higher education and expansive personal experience achieve higher performance.
13. Formal training to enhance innovation skills of employees has emerged as one of the lowest concerns for the organizations in the region. The units remain insular and autonomous and fail to recognize the underlying or latent skill deficiencies.
14. Employee training in small units has usually been adhoc and underlines poor attitude towards learning. Organizations rely on their own experiential know-how, and train up their own operative and intermediate level skills.
15. Reward management is a key function in modern enterprises, playing an important role in attracting, retaining and motivating employees. Rewarding divergent thinking results in higher levels of creativity.
16. Formation of combined project teams (with members from industry and institutes) to work on research projects has also been considered significant in increasing technological capabilities of small units.
17. Small organizations have lacked in access to well researched database, whether it pertains to market intelligence or technology. There is need to provide this information proactively on a regular basis through a dynamic portal. There should be provision for small units to become members and obtain value added services on supply databases, market intelligence, technology providers and linkages with relevant institutions.
18. Lack of knowledge of employees regarding government (capital grant) schemes for small sector is also a major problem. Employees should submit proposals to obtain funds through these schemes for in-house research initiatives.
19. Organizations have also shown lack of competitiveness when it comes to financial analysis or adopting a defined financial strategy.
20. Technology infrastructure and resources are important not only for functional support but also because having an adequate level of resources for the research project influences workers perception that the project is valuable and worthy of organizational support.
21. Government should formulate policies that are meant to provide various incentives like sales-tax and entry-tax exemptions promoting in-house technological innovation efforts.
22. Governments should attempt to improve physical infrastructure like roads, highways, mass-transit systems, power, water, housing, and national and international airports.

23. Technological competence of a firm is not only to be given precedence but needs to be developed network competence to link with other alliances.
24. Collaborations help to access skills and to transfer complex and tacit knowledge, with an important role for appropriability and protection of intellectual property. Collaboration is a means to benefit from complementarities among firms.
25. Active participation by a few organizations in international events like trade fairs, exhibitions etc has significantly contributed to their exports and turnover. The main objective of participation is to exhibit company's products, learn about latest developments in the field and develop business contacts.
26. Organizations maintain interaction with external environments owing to their dependence on critical resources that are needed for performance and survival.
27. Inter-organizational collaboration, which has been introduced as an important innovation catalyst, emphasizes interaction-oriented capabilities for ensuring success in innovation development. Innovation capacity of enterprises can be incrementally or radically increased through participation in collaborative networks.
28. Technological innovation capabilities can be enhanced by developing the firm's ability in concept generation, product development, production, technology acquisition, leadership, resource provision, and system and tool provision.
29. The innovation process begins with the development of a new innovation, including an initial evaluation and subsequent effectiveness and efficacy research to ensure that it improves outcomes, experience, or services.
30. There are a few organizations which have been working with specific product innovation strategies and have been extremely successful.

5.3 Methodology of Modeling

The analysis of survey data has revealed a number of shortcomings in the working and systems of manufacturing organizations. A number of solutions have also been suggested. It is however difficult to implement all the suggestions. Therefore a need is felt for a methodology which generates alternate solutions to the problem and helps in choosing a set of most effective solutions. To meet this objective, a qualitative model has been developed in the present work using Options Field Methodology, Options Profile Methodology, Analytic Hierarchy Process, and Fuzzy Set Theory. A brief description of techniques used in modeling is presented in Appendix - XIII and discussed in the subsequent sections.

5.3.1 Options Field Methodology

The completed options field is a polystructure. Its construction begins with the generation and classification of a set of options. This set may be generated using modified idea writing in response to a carefully formulated triggering question. This question defines the context and must, therefore, reflect substantial insight into the design situation. The question must be neither too broad nor too narrow. It must stimulate creative and productive responses that do not stray from the research topic under consideration.

Once a set is developed, the initial structuring begins. The initial structuring is for placing the options into categories. Theory of dimensionality is used for placing the options into categories. Options field is a triply structured-quad. Its structure incorporates three distinct relationships described as '*membership in a dimension*' for classifying the options into dimensions, '*interdependence*' for classifying dimensions into interdependent clusters and 'time preference relationship' for relating dimensions to each other in clusters

After placing them into categories, the options are displayed as sets, arrayed vertically in anticipation of developing a name for each category that is placed at the head of the appropriate column of options.

After the set of categories has been achieved, it is reasonable to believe that learning has occurred. At this point, it is appropriate to ask whether every category should be taken as a dimension of the design. The criteria for making this decision is to ask whether some option(s) in that category really must be specified in order to provide adequate definition of alternative represented by choosing one or more options from each dimension, or whether any particular category is not essential to the definition of the target.

Once the group has settled on the dimensions of the target, a second structuring occurs. Now the set of dimensions is structured. The relationship used is 'independent of'. Two dimensions are defined to be independent if a choice of one or more options in one of the dimensions does not rule out any choices in the other dimension. If two dimensions are interdependent, the choice of options in one may be restricted by the choice of options in the other. Following this structuring, there is a defined set of clusters, each cluster consisting of a set of dimensions, and each dimension consisting of a set of similar options.

Now the third structuring begins. This structuring takes clusters as elements to be structured. The structuring relationship involves the sequence in which choices of options should be made. A suitable relationship is 'should be considered first in making choices of options'.

In next step, structuring is carried out separately for each cluster and initial decision-making sequence among dimensions in each cluster is defined.

It is then appropriate to organize the options field by placing dimensions in the order determined with name of each dimension heading a list of options therein and with the cluster clearly identified.

5.3.2 Options Profile Methodology

The next technique used in qualitative modeling is Options Profile Methodology (OPM). It comprises of the following main steps:

a) Deciding various courses of actions (profiles) of the design. These profiles represent alternative approaches which can be employed to meet various dimensions of the research problem.
b) Assigning options from options fields to profiles. This step involves generation of complete options profiles by deriving options from each cluster.

Options Profile is the visual representation of an alternative consisting of a set of chosen options with at least one option coming from each dimension in the options field. Each option that has been selected is designated by a line drawn from the bullet in front of it down to the tie line. In applications, it is common to construct several options profiles for a given options field. Each options profile represents one design alternative. In choosing options, choices are made in the sequence determined in formulating the way the options field is represented.

5.3.3 Analytic Hierarchy Process

The next technique used in qualitative modeling is Analytic Hierarchy Process (AHP). This technique provides a comprehensive and rational framework for structuring a decision problem, for representing and quantifying its elements, for relating those elements to overall goals, and for evaluating alternative solutions (Saaty 1980; Saaty and Vergas, 1982; Saaty and Kearns, 1985; Saaty, 1990). AHP decomposes the decision problem into a hierarchy of more easily comprehended sub-problems, each of which can be analyzed independently. The elements of hierarchy can relate to various aspects that apply to the decision at hand. Once the hierarchy is built, the decision makers systematically evaluate its various elements by comparing them to one another, two at a time. In making the comparisons, the decision makers can use concrete data about the elements, or they can use their judgments about the elements' relative meaning and importance. It is the essence of AHP that human judgments and not just the underlying information can be used in performing the evaluations. AHP converts these evaluations to numerical values that can be processed and compared over entire range of the problem. Finally, numerical priorities are calculated for each of the decision alternatives. The numerical rankings represent the alternatives' relative ability to achieve the decision goal.

The main steps involved in Analytic Hierarchy Process are as follows:

a) *Decide the 'Features of Design'*: Decompose the decision problem into a hierarchy of several sub-problems (alternatives or criteria or features of design) which can be evaluated independently.

b) *Develop the 'Pairwise Comparison Matrix'*: Suppose we get 'f' alternatives or features of design from the previous step. It is these alternatives whose relative importance to achieve the decision goal is to be determined using the AHP technique. In this step, a 'pairwise comparison matrix' is developed. It is a matrix of dimensions 'f x f'. The various alternatives or criteria are compared to each other in pairs and the subjective assessments are recorded in the matrix. The number (numerical rating) in the i_{th} row and the j_{th} column of this matrix gives the relative importance of i_{th} alternative as compared with j_{th} alternative. For example, in Table 5.1, 'a_{12}' is the numerical rating assigned to alternative 1 when compared to alternative 2. To complete the matrix, '$(f^2$-f)/ 2' values are needed. The assessor gives values (in cells) only in the upper part of the matrix (above the diagonal). The cells on the diagonal are assigned a value equal to 1, and values in cells under the diagonal are reciprocal of values filled in corresponding cells in upper part of the matrix.

   In the matrix, one begins with an element on the left and compares how much more important it is than an element on top. When compared with itself, the numerical rating provided is one. When compared with another element, if it is more important than the other element, an integer value is used. If, however, it is less important, then reciprocal of the previous integer value is used. In either case, reciprocal value is entered in the transpose position of the matrix. Thus, only 'f (f-1)/2' judgments are considered. The scale used for pair wise comparisons in AHP is presented in Table 5.2.

Table 5.1 Pairwise Comparison Matrix

Alternatives (Features of Design)	1	2	…….	f
1	**1**	$\mathbf{a_{12}}$	…….	$\mathbf{a_{1f}}$
2	$\mathbf{a_{21}}$	**1**	…….	$\mathbf{a_{2f}}$
.	.	.	…….	.
.	.	.	…….	.
.	.	.	…….	.
.	.	.	…….	.
f	$\mathbf{a_{f1}}$	$\mathbf{a_{f2}}$	…….	**1**

Table 5.2 Scale for Pairwise Comparison

Judgment of Preference (Definition)	**Explanation**	**Intensity of Importance (Numerical Rating)**
Equal Importance	Two elements contribute equally to the objective	***1***
Moderate Importance	Experience and judgment slightly favour one element over another	***3***
Strong Importance	Experience and judgment strongly favour one element over another	***5***
Very Strong Importance	One element is favoured very strongly over another; its dominance is demonstrated in practice	***7***
Extreme Importance	The evidence favouring one element over another is of the highest possible order of affirmation	***9***
Intensities of **2, **4**, **6**, and **8** can be used to express intermediate values*		

c) *Determine weights of each alternative:* Obtain weightage (relative importance to achieve the decision goal) of each alternative by using the following steps:

- Compute the sum of each column of ‘pairwise comparison matrix’ and divide each cell value in respective columns by the corresponding column sum. The resulting matrix is termed as ‘normalized comparison matrix’.

- Compute the average value of each row of the 'normalized comparison matrix'. These average values are the resulting weights of various alternatives or features of the design problem (e.g. the average of first row is the resulting weightage of the first alternative).

d) *Check consistency of results:* An index of consistency, called *'Consistency Ratio'* is calculated to check if numerical and transitive consistency has been maintained. The results can be used to seek additional information and re-examine the data used in constructing the scale in order to improve consistency. This step begins with calculation of a parameter called 'Consistency Index' (C.I).

$C.I = (X_{max} – n) / (n-1)$ ------------- (Equation 5.1)

In equation 6.1, n is the number of elements being compared; X_{max} is the largest eigen value (it is the sum of products of each column sum (of 'paired comparison matrix') and respective row weights (of 'normalized comparison matrix').

'Consistency Ratio' (C.R) is obtained by the following equation.

$C.R = C.I / N$ ------------ (Equation 5.2)

In equation 5.2, N is the random consistency number. Its value depends on the size of matrix (number of alternatives under consideration). Table 5.3 provides values of random consistency number (N).

Table 5.3 Value of Random Consistency Number

Size of Matrix	1	2	3	4	5	6	7	8	9	10
Random Consistency Number	**0.00**	**0.00**	**0.58**	**0.90**	**1.12**	**1.24**	**1.32**	**1.41**	**1.45**	**1.49**

The value of 'Consistency Ratio' (C.R) should be less than 10% to be acceptable. If the value is not within this range, participants should study the problem and revise their judgment (Saaty and Kearns, 1985).

5.3.4 Fuzzy Set Theory

The next technique used in qualitative modeling is Fuzzy Set Theory (FST). This technique has been used to quantify the contribution of each profile (course of action) towards various objectives (features of design) and to rank the profiles under different situations.

FST approach has successfully been applied to system analysis problems, decision theory, man-machine systems, modeling of industrial processes etc. In the present research work, it has been used for the purpose of ranking of options profiles in an integrated form with Analytical Hierarchy Process.

In order to represent the views of each of the interest group, a position matrix is prepared from the responses of all the experts in the group by giving numerical values to the qualitative assessment. Average value of each element representing the group response is worked out by multiplying membership function value of each alternative as given by the respondents with assigned weight (eigen vector weight as determined by AHP).This way some of the bias in the matrix is eliminated. The weighted matrices for each of the interest groups are thus, prepared. There are three ways to aggregate the weighted matrix viz. optimistic, average and pessimistic aggregation. The highest value among various group responses represents the optimistic value, the lowest value represents the pessimistic value and the average of all the values represents the average value.

Dominance Matrix (D) of dimensions 'n x n' is prepared to display the dominance structure between all possible pairs of options. The element 'd_{ij}' is the number of features for which membership value of option 'j' dominates or is greater than option 'i'. A dash is entered for the diagonal 'd_{ij}' element. If the K_{th} column is summed, the total number of dominances of option K over all options is obtained. Similarly, if the K_{th} row is summed, the number of times the K_{th} option is being dominated by all other options is determined. Outcomes that are more favorable have higher column sums and lower row sums. As in case of weighted position matrices, three dominance matrices namely optimistic dominance matrix, pessimistic dominance matrix and mean dominance matrix are prepared. The ranks of options are normally decided by examining the ranks obtained from extent of dominance and also extent of being dominated by other options. Although any of the optimistic, pessimistic and average approaches can be used but there are shortcomings in each. The best course of action for a decision maker in such a situation may be to use the Hadley's criteria of cautious optimism (Hadley, 1967). The decision maker may choose different coefficients of optimism (α). If 'A' is the dominance weight of the option as determined from optimistic matrix and 'B' that of the pessimistic dominance matrix, the weight of option according to Hadley's criterion is determined by the relationship:

$$W = \alpha \times A + (1-\alpha) \times B \qquad \text{------------} \quad \text{(Equation 5.3)}$$

Since the process of choosing the coefficient of optimism (α) in Hadley criterion of 'Cautious Optimism' is a judgment based approach, ranks of options from the dominance matrix are considered on the basis of dominance and ignoring the considerations of being dominated.

5.4 OFM based Modeling

The learning issues as given in section 5.2 have been analyzed and restructured to convert them into options of the Options Field Methodology (OFM). These options have been presented in appendix (Appendix – VII) and displayed in the completed options profiles in Appendix - XIII.

5.4.1 Putting the Options into Categories

The options were then put into various categories and the categories were named. The categories are:

- Develop long term focus within the organization.
- Generate necessary training and development programs.
- Enhance organizational consciousness about innovation.
- Maintain good interpersonal relationship among employees.
- Develop in-house research and development capabilities.
- Ensure continuous efforts on process and product improvements.
- Enrich job responsibility and empowerment.
- Develop network competence to link with other alliances.
- Set modest challenges and innovation performance targets.
- Motivate formal learning i.e. learning during working hours.
- Allocate funds for various technological activities.
- Keep developing new products and raising quality levels.

5.4.2 Dimensions of the Design

The above categories were scrutinized to include them or exclude any of them for the design. All of these have been included and considered as dimensions of the design.

5.4.3 Clusters of the Design

The dimensions were put into broader categories called clusters. Eight main clusters have been identified in the present work through clustering of dimensions. These clusters are presented in the next section and shown in Appendix - XIII.

5.4.4 Sequencing of Clusters

Following the clustering of dimensions, the clusters were put into sequence as per the importance of an area. The sequencing of dimensions within clusters was then carried out. The resultant clusters with sequenced dimensions are given below:

1. **Establishing a Technology Platform**
    a. Develop in-house research and development capabilities.
    b. Allocate funds for various technological activities.
    c. Develop network competence to link with other alliances.
2. **Developing Human Resources**
    a. Generate necessary training and development programs.
    b. Enrich job responsibility and empowerment.
    c. Motivate formal learning i.e. learning during working hours.
    d. Maintain good interpersonal relationship among employees.
3. **Extensive Market Research**
    a. Ensure continuous efforts on process and product improvements.
    b. Keep developing new products and raising quality.
4. **Indicate Strategic Aims**
    a. Develop long term focus within organization.
    b. Set modest challenges and innovation performance targets.
    c. Enhance organizational consciousness about innovation.

5.5 OPM based Modeling

Various profiles or courses of actions planned to achieve different dimensions of research problem at tactical and strategic level, for the purpose of this study are delineated as follows:

1) **Technology based approach (T_{ba}):** This approach focuses on building an adequate research infrastructure for product and process development. The course of action is based on the following:
   - Providing adequate financial support to the research function.
   - Providing resources (latest production machines, materials, time etc.) for project work.
   - Providing adequate management support and commitment to utilize resources effectively for technology development initiatives.
   - Forging a mutually reinforcing relationship with other manufacturing enterprises, technical universities, R&D institutes for co-developing advanced futuristic technologies.

2) **Competence Development based approach (C_{ba}):** This approach focuses on the ability of individual employees to perform his/her her job on a regular basis as well as their ability to change with the development of the organization. The course of action is based on the following:
   - Enhancing the technical know-how, managerial and production skillfulness of employees for faster technology commercialization.
   - Providing adequate learning and training opportunities to employees for their skill enhancement.

3) **Innovative Culture based approach (I_{ba}):** This approach focuses on building a conducive and supportive internal environment to encourage successful creation and implementation of novel ideas. The course of action is based on the following:
   - Provide strategic solutions to achieve innovation performance targets.
   - Promote the transfer of new innovations and technologies from research to practice.
   - Provide an environment within the organizations conductive to technology innovation.
4) **Mixed approach (M_a):** This approach uses a mix of features of the above profiles. It strategically utilizes the key elements of different profiles to implement required options to meet an objective.

After deciding upon various profiles, the next task has been to find out the options from each cluster contributing to each profile. The completed ‘options field’ has been displayed in Appendix - XIII. A tie line has been drawn on the bottom. Each option contributing to a profile has been joined to the tie line through its bullet.

5.6 AHP based Modeling

The next step in modeling is the use of Analytic Hierarchy Process (AHP). Here, the decision problem (main objective of research problem) is decomposed into a hierarchy of sub-problems (sub-objectives or goals) by the experts. The sub-objectives formulated by the panel are as follows:

Goal A. To develop a detailed corporate strategy as well as a balanced approach to short and long-term objectives.

Goal B. To create a learning environment to enhance skills of employees for faster technology development.

Goal C. To develop firm's ability in concept generation and product development to facilitate technology upgradation initiatives of industry.

Goal D. To create an enabling environment in the whole industrial sector and society for strategic development.

Analytic Hierarchy Process (AHP) has been employed to decide the relative weightage of these sub-objectives in achieving the overall objective of technology development in the industry. Paired comparison method of AHP has been applied to find the weightage of each goal.

Three respondents participated in the process and compared each goal with another, independently. The respondents included an industrial expert, an academic expert and the researcher himself.

Table 5.4 Weights of various sub-objectives using AHP

Respondents ⇨ **Objectives ⇩**	**Researcher**	**Industrial Expert**	**Academic Expert**
Goal A. To develop a detailed corporate strategy as well as a balanced approach to short and long-term objectives.	**0.12**	**0.16**	**0.14**
Goal B. To create a learning environment to enhance skills of employees for faster technology development.	**0.56**	**0.46**	**0.45**
Goal C. To develop firm's ability in concept generation and product development to facilitate technology upgradation initiative of industry	**0.26**	**0.28**	**0.25**
Goal D. To create an enabling environment in the whole industrial sector and society for strategic development.	**0.05**	**0.10**	**0.06**

The ‘pairwise comparison matrices’, ‘normalized comparison matrices’, and values of eigen vector, consistency index, consistency ratio obtained against values filled by each respondent are provided in Appendix - VIII. The numerical ratings given by respondents were quite consistent and consistency ratio (C.I) was found well within permissible limits (less than 10%) in each case. The resulting weights of different goals as decided by various respondents using AHP is shown in Table 5.4.

The results reveal that to achieve the overall objective of strategic development, it is most important to create a learning environment to enhance skills of employees for faster technology development (sub-objective B). Learning plays a key role in enabling companies to achieve speed and flexibility within the innovation process. Industrial units should create and maintain a learning environment by keeping knowledge and skills of employees up to date. Training and education programs should be operated extensively to identify strategies to face the competition.

The next criterion in order of importance is to develop firm’s ability in concept generation and product development to (sub-objective C).

Sub-objective A and D have been found to be less important to achieve the overall objective of strategic development of the industrial sector in the region.

5.7 FST based Modeling

After determining the weights of various sub-objectives, the next step was to make position matrices. In these matrices, the qualitative value of contribution of each profile or approach to each of the three capabilities was to be decided. This exercise was done by each of the three participants independently. The position matrices along with the weights determined earlier are given in Appendix – IX.

From the position matrices, weighted position matrices were determined. This has also been done individually for the matrix from each respondent. The weight of the objective as determined earlier was multiplied by value of each position of the position matrix and weighted values were obtained. Appendix – X shows the weighted position matrices.

From these weighted position matrices, optimistic, average and pessimistic weighted position matrices were made using Fuzzy Set Theory. For optimistic matrix, the highest value of each position was selected, for pessimistic the lowest values and for average matrix, the average values were selected. Tables 5.5 to 5.7 show these values.

Based on above optimistic, pessimistic and average weighted position matrices, other matrices have been computed at various degrees of optimism (80%, 60%, 40% and 20%) and tabulated in Appendix – XI.

Table 5.5 Optimistic Weighted Position Matrix

Profile ⇨ Objectives ⇩	**Technology based Approach**	**Competence Development based Approach**	**Innovative Culture based Approach**	**Mixed Approach**
Goal **A**	0.048	0.080	0.080	0.080
Goal **B**	0.322	0.504	0.168	0.322
Goal **C**	0.084	0.130	0.252	0.175
Goal **D**	0.050	0.030	0.070	0.070

Table 5.6 Pessimistic Weighted Position Matrix

Profile ⇨ Objectives ⇩	**Technology based Approach**	**Competence Development based Approach**	**Innovative Culture based Approach**	**Mixed Approach**
Goal **A**	0.036	0.042	0.036	0.060
Goal **B**	0.168	0.315	0.135	0.225
Goal **C**	0.075	0.084	0.225	0.130
Goal **D**	0.015	0.015	0.025	0.025

Table 5.7 Average Weighted Position Matrix

Profile ⇨ Objectives ⇩	**Technology based Approach**	**Competence Development based Approach**	**Innovative Culture based Approach**	**Mixed Approach**
Goal **A**	0.042	0.061	0.062	0.070
Goal **B**	0.238	0.411	0.147	0.276
Goal **C**	0.079	0.113	0.237	0.148
Goal **D**	0.028	0.021	0.042	0.042

Table 5.8 present the preferred strategies for achieving various sub-objectives (goals) under specific levels of optimism situation.

Table 5.8 Preferred Strategies under Cautious Optimism for achieving various Goals

Objectives ⇩	**Optimistic**	**80% Optimistic**	**60% Optimistic**	**40% Optimistic**	**20% Optimistic**	**Pessimistic**	**Average**
Goal **A**	M_a- I_{ba}-C_{ba}-T_{ba}	M_a- C_{ba}-I_{ba}-T_{ba}	M_a- C_{ba}-I_{ba}-T_{ba}	M_a- C_{ba}-I_{ba}-T_{ba}	M_a- C_{ba}-I_{ba}-T_{ba}	M_a- C_{ba}-I_{ba}-T_{ba}	M_a- I_{ba}-C_{ba}-T_{ba}
Goal **B**	C_{ba}-M_a -T_{ba}- I_{ba}	C_{ba}-M_a -T_{ba}- I_{ba}	C_{ba}-M_a -T_{ba}- I_{ba}	C_{ba}-M_a -T_{ba}- I_{ba}	C_{ba}-M_a -T_{ba}- I_{ba}	C_{ba}-M_a -T_{ba}- I_{ba}	C_{ba}-M_a -T_{ba}- I_{ba}
Goal **C**	I_{ba} -M_a-C_{ba}-T_{ba}	I_{ba} -M_a-C_{ba}-T_{ba}	I_{ba} -M_a-C_{ba}-T_{ba}	I_{ba} -M_a-C_{ba}-T_{ba}	I_{ba} -M_a-C_{ba}-T_{ba}	I_{ba} -M_a-C_{ba}-T_{ba}	I_{ba} -M_a-C_{ba}-T_{ba}
Goal **D**	M_a- I_{ba} -T_{ba}-C_{ba}	M_a- I_{ba} -T_{ba}-C_{ba}	M_a- I_{ba} -T_{ba}-C_{ba}	M_a- I_{ba} -T_{ba}-C_{ba}	M_a- I_{ba} -T_{ba}-C_{ba}	M_a- I_{ba} -T_{ba}-C_{ba}	M_a- I_{ba} -T_{ba}-C_{ba}

The following observations have been outlined from Table 5.8.

- ‘Innovative Culture based approach’ (I_{ba}) primarily influence the development of a detailed corporate strategy as well as a balanced approach to short and long-term objectives (Goal A). Innovation helps the company to deal with the turbulence of external environment and, therefore, is one of the key drivers of long term success in business, particularly in dynamic markets.
- ‘Competence Development based approach’ (C_{ba}) and ‘Technology based approach’ (T_{ba}) are the preferred strategies to create a learning environment to enhance skills of employees for faster technology development (Goal B).
- To develop firm’s ability in concept generation and product development to facilitate technology upgradation initiative of industry (Goal C) ‘Innovative Culture based approach’ (I_{ba}) is the most preferred strategy. The innovation process begins with the development of a new innovation, including an initial evaluation and subsequent effectiveness and efficacy research to ensure that it improves outcomes, experience, or services.
- Creating an enabling environment in the whole industrial sector and society for strategic development (Goal D) can be facilitating by using mixed strategic approach. All the approaches have their significant contribution in achieving the overall objective.

Following this, dominance matrices were prepared under different situations of optimism. In these matrices, the dominance of each course of action over the others has been tabulated. In Table 5.9 to Table 5.12, cell value denotes number of times, the domination of a profile written on the top, over a profile written on the left. The column sum depicts the number by which the profile dominates all other profiles.

Table 5.9 Dominance Matrix under Pure Optimistic Situation

Profiles ⇨ ⇩	**Technology based Approach**	**Competence Development based Approach**	**Innovative Culture based Approach**	**Mixed Approach**
T_{ba}	--	4	3	3
C_{ba}	0	--	2	2
I_{ba}	1	1	--	1
M_a	0	1	0	--
Column Sum	1	*6*	*5*	*6*
RANK	**IV**	**I**	**III**	**I**

Table 5.10 Dominance Matrix under Pure Pessimistic Situation

Profiles ⇨ ⇩	**Technology based Approach**	**Competence Development based Approach**	**Innovative Culture based Approach**	**Mixed Approach**
T_{ba}	--	4	2	4
C_{ba}	0	--	2	3
I_{ba}	1	2	--	2
M_a	0	1	1	--
Column Sum	1	*7*	*5*	*9*
RANK	**IV**	**II**	**III**	**I**

Table 5.11 Dominance Matrix under Average Optimistic Situation

Profiles ⇨ ⇩	**Technology based Approach**	**Competence Development based Approach**	**Innovative Culture based Approach**	**Mixed Approach**
$\mathbf{T_{ba}}$	--	3	3	4
$\mathbf{C_{ba}}$	1	--	3	3
$\mathbf{I_{ba}}$	1	1	--	2
$\mathbf{M_{a}}$	0	1	1	--
Column Sum	2	*5*	*7*	*9*
RANK	**IV**	**III**	**II**	**I**

Dominance matrices for various degrees of optimism (80%, 60%, 40% and 20%) have been compiled in Appendix – XII. The results of these dominance matrices have been summarized in Table 5.12.

In the present work, a cautious approach with high degree of optimism has been considered as most appropriate. Thus, dominance matrix with 80% degree of optimism has been considered as providing the most realistic industrial situation in the region (*highlighted in Table 5.12*). This dominance matrix has been used to identify preferred strategies for meeting the overall objective of strategic development program in small scale sector.

Table 5.12 Compiled outcomes of various Dominance Matrices

Degree of Optimism ⇨ Profile ⇩	**Optimistic**	**80% Optimistic**	**60% Optimistic**	**40% Optimistic**	**20% Optimistic**	**Pessimistic**	**Average**
	Rank under various degrees of Optimism						
$\mathbf{T_{ba}}$	IV	**IV**	IV	IV	IV	IV	IV
$\mathbf{C_{ba}}$	I	**II**	II	II	II	II	III
$\mathbf{I_{ba}}$	III	**II**	II	II	II	III	II
$\mathbf{M_{a}}$	I	**I**	I	I	I	I	I

5.8 Preferred Approaches for Strategic Development of Small Scale Sector

Results of qualitative modeling have clearly depicted that more or less, all the approaches like optimistic, average, pessimistic and Hadley's cautious optimism have brought out the following as the preferred strategies for strategic development of manufacturing units of the region. To sum up, the following three strategies in order of their importance have emerged to be significant in meeting the overall objective of the present research problem.

1. Mixed Approach
2. Competence Development based approach
3. Innovative Culture based Approach

The results of qualitative modeling clearly show that for strategic development of the industrial sector, the most preferred strategy is 'mixed approach'. This strategy has also emerged as the most preferred profile to meet two out of the four sub-objectives (Goal A and Goal D) of the research problem. For the remaining two criteria (Goal B and Goal C), 'mixed strategy' is ranked second.

'Mixed Approach' signifies that to meet the overall objective, a judicious mix of several courses of actions is required. Managing the effective implementation of strategic development program from a current state to a desired future condition is a complex process. The various goals and objectives must be fully understood and integrated into the strategic and business plans of the organization. To enhance the probability of success through such initiatives, a structured approach has to be employed. For this, performance evaluation is based on multiple inputs and multiple outputs. Since evaluation involves multiple inputs and outputs, it is a multi-criteria decision problem. Pure strategies can be effective in meeting individual criterion, but the overall objective needs elements of various profiles and hence the 'mixed approach'.

'Competence Development based approach' and 'Innovative Culture based approach' have emerged as the second most preferred strategies for meeting the overall research objective. 'Competence development based approach' is the most preferred profile to create a learning environment to enhance skills of employees for faster technology development (Goal B) and second most preferred profile to develop a detailed corporate strategy as well as a balanced approach to short and long-term objectives (Goal A). To develop firm's ability in concept generation and product (Goal C) 'Innovative Culture based approach' has shown maximum contribution. Further, it is also the most important strategy combined with 'Mixed Approach' to create an enabling environment in the whole industrial sector and society for strategic development (Goal D).

'Competence development based approach' focuses on the ability of the individual employee to perform his/her her job on a regular basis as well as their ability to change with the development of the organization. It stresses on having adequate learning and training opportunities to employees for their skill enhancement. Creating and maintaining a learning environment by keeping knowledge and skills of employees up to date is an important element of this approach. It also focuses on developing multi-skilled workforce through job rotation programs to perform varied tasks. Employees should be encouraged to work in various divisions in order to gain a well founded experience and to appreciate problems of different parts of the organization.

'Innovative Culture based approach' focuses on building a conducive and supportive internal environment to encourage successful creation and implementation of novel ideas. It stresses on the need of an environment within the organizations conductive to technological innovations. Providing strategic solutions to achieve innovation performance targets is also an important constituent of this strategy. This approach emphasizes on the need of promoting the transfer of new innovations and technologies from research to practice.

5.9 Development of a Conceptual Framework

Based on the literature review, survey results and outcomes of qualitative modeling, a conceptual framework has been developed and presented in Appendix – XIV.

The framework depicts the main objective of research problem decomposed into a hierarchy of sub-objectives or goals. The relative weightage of these sub-objectives in achieving the overall research objective has been presented in the model. For this, the sub-objectives have been shown in varying intensity of color, where darkness of color represents higher weightage of a sub-objective. The framework presents the different profiles which can be used to meet various dimensions of the research problem. The model depicts relative contribution of each profile in meeting different sub-objectives and also the overall objective under the realistic situation (of high degree of optimism, 80%).

The conceptual framework indicates that to meet the overall objective of technology development in small scale sector, the 'mixed approach' shows maximum contribution and hence is the most preferred strategy.

5.10 Chapter Summary

This chapter presents a synthesis of learning issues of all previous of the research work. The outcomes have been utilized through a qualitative model to evolve a strategic development program for small scale industry. The findings of qualitative modeling are in the context of small manufacturing units of the region, yet their implications and suggested management approaches are generic and can also be applied to industrial units in other parts of the state.

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Chapter - VI

Conclusions

6.1 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 method 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 learnings 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.

6.2 Results and Major Findings

The various results have been derived on the basis of quantitative analyses performed on the data. The main findings are presented as follows:

General Areas

- High cost of electricity to run production operations smoothly, absence of large scale manufacturing industry in the region and old process technology used in the manufacturing units are the most significant factors deteriorating the performance of small scale industries.
- Increase in competition because of globalization and liberalization, scarcity of funds for development projects, shortage of multi-skilled workforce and high price of raw material are also significant factors deteriorating performance enhancement of manufacturing units.

Organizational Culture Issues

- In majority of the units, managerial behavior has been supportive in situations of project failures. However, a few organizations (2%) take strict action against members of project team if a failure occurs.
- Manufacturing units in the region have good reward schemes for employees based upon their contribution towards innovation. Rewards are provided in the form of an increment in salary or a share in profits made on account of innovation.

- Education level in majority (63 percent) of the units is between fair to good. However, one fourth (24 percent) of units have considered poor education level of employees to be a serious concern.
- Industrial units have been affected by lack of availability of skilled workforce. Majority of the units do not have technical and scientific staff in required numbers.
- Majority of the units do not have adequate training facilities to enhance innovation skills of employees. Only 2% units in the region provide formal training to their employees.

Resource Support Issues

- Small scale sector in the region lacks in in-house research infrastructure. Only 2% of the units have dedicated laboratories for their research function.
- In majority of the industrial units (63%) state of art production machinery and equipments are not available.
- In majority of the organizations, only a very small portion (less than 0.5 percent) of the annual turnover is spent on development initiatives.
- Absence of modernization and renovation programs is another aspect preventing development. Only one fifth (20%) of the units regularly implement modernization and renovation measures.

Government Support Issues

- Government is spending losufficientt of funds for developing overall rail-road infrastructure every year. 31% of the units are completely satisfied with the available transport infrastructure.
- Majority of the units (62%) are not satisfied with the availability of electricity. Government has failed in ensuring supply of reliable and uninterrupted power supply.
- Majority of the units (65%) do not recieve any funds from government for their research initiatives.
- Government has to make improvements (PPS= 57.60) in its policies to ensure availability of raw materials at appropriate prices. Majority of the units have considered raw material prices to be high and significant in impairing their performance.

External Capacity Building Issues

- Majority of the units (62 %) have been dependent on large scale manufacturing industry in the country for process technology needs.
- The industry has obtained an extremely poor rating in interacting with academic institutions. Most of the organizations (89%) have not experienced any affirmative results through industry-institute interactions.

Concerning Output Performance Parameters

- In majority of the units, the structure of research function is not clearly defined
- The performance of industry has not been very good as far as increase in product mix and adding new features to the existing products is concerned.
- The industrial sector in the region is aware of the benefits of in-house technology development programs but at present, not even one tenth of the units are employing latest technology to produce products.
- The response of industry in utilizing *'Risky Research'* and '*Imitation for Creation'* strategies is low.

Status of Manufacturing Units

- The performance of organizations in *'Organizational Culture'* issues is moderate. More than one fifth (22%) units fall in *'poor'* category in this component.
- *'Resource Support'* issue has shown the worst performance. 7% of the units are at *'Very Poor'* level and 67% units are at a *'Poor'* level.
- In *'Government Support'* issue, 5% units are at *'Very Poor'* level and 64% are at *Poor'* level.
- As far as industry wise performance in *'External Capacity Building'* is concerned, 2 percent units are at a *'very poor'* level. Most of the units are in the *'Fair'*.
- More than one third of the units are at *a 'Poor'* level in managing *'Level of Technology'* component.
- In *'Strategic Implementation of Innovation'* issue 7% units are at *'Very Poor'* level and nearly three fourth of the units are at a 'Po*or'* level. Around 2% fall in *'Good'* category.
- '*Structure and Output of R&D Function'* issue has shown moderate performance with average score of 53.89%. About half of the units are in *'Poor'* category. 29% are at *'Fairly well'* level and only 7% are at *'Good'* level.

- In *'Response to Market Demands'* issue, 7% are at *a 'Poor'* level and most of the units (71%) *'Fair'* category. About one fifth units (22%) are at a *'Good'* level.

Concerning Mean distribution of output variables for different categories

- The comparison of mean scores among groups reveals that the output variable, '*Structure and Output of R&D Function'* shows a statistical significance difference according to the four categories of 'Resource Support' component.
- *'Level of Technology'* and '*Structure and Output of R&D Functions'* has a statistical significant difference in the means according to category distribution of 'Government Support' component.
- According to category distribution of 'External Capacity Building' component, output variable '*Strategic Implementation of Innovation'* has a significant difference in the means according to categories of this input parameter.

Results of Correlation Analysis

- '*Organizational Culture*' (I1) is significantly correlated with the level of technology (Z1), structure and output of research function (Z3) and response to market demands (Z4).
- A significant correlation has been exhibited between 'Resource Support' (I2) issues and strategic implementation of innovation (Z2).
- *'Government Support'* (I3) has established a significant positive association with level of technology (Z1) and response to market demands (Z4).
- *'External Capacity Building'* (I4) has shown a significant association with strategic implementation of innovation (Z2) and structure and output of research function (Z3).

Results of Regression Analysis

- 13.1% of the variance in 'Level of Technology' can be predicted from 'Organizational Culture' and 'Government Support'.
- 11.9% of the variance in 'Strategic Implementation of Innovation' strategies can be predicted from input variables viz. 'Resource Support' and 'External Capacity Building'.
- 15.3% of the variance in Structure and Output of Research Function can be predicted from 'Organizational Culture' and 'Government Support' combined.
- 22.9% of the variance in 'Response to Market Demands' can be predicted from 'Organizational Culture' and 'Government Support'.

Results of Principal Component Analysis

- The eight issues under ‘Organizational Culture’ input factor can be related three issues by combining availability of multi skilled labour, training provided to employees and awareness regarding importance of in-house R&D in to first component; reward schemes to recognize contributions of employees and reaction of top management to project failures into second component and the third component can be interpreted to be comprising of availability of technical manpower and undertaking R&D work for technology development.
- Principal component analysis extracted three components among the eight items of ‘Resource Support’. The first component can be interpreted from availability of dedicated labs for R&D, advance production facilities and use of software packages. Allocation of funds, proportion of annual turnover as R&D funding and financial support to industry combined make the second component whereas modernization & renovation programs reflects the third component of this input variable.
- ‘Government Support’ factor can also be compressed to three components by combining awareness programs for technology upgradation, funding for employee training programs and motivation through reward schemes into the first component. Cost and availability of raw material, transportation infrastructure and capital subsidy schemes constitute the second component. Funding for R&D activities reflects the third component of this input parameter.
- Dimensions of ‘External Capacity Building’ can be compressed into four components. The items that should be combined in first component are awareness of industry-institute interaction and use of institute labs for research. Academia for preparing road maps, expert lectures by academicians and collective guidance for dissertations are the items related to the second component. The third component comprises of combining the issues of technology development through alliance and industry institute interaction with positive results. Awareness regarding government subsidiaries and assistance from these government organizations can be combined to form the fourth component.

Results of Qualitative Modeling

- ‘Mixed approach’ is the most preferred strategy to facilitate technology upgradation in the industrial sector. ‘Competence development based approach’ and ‘Innovative

Culture based approach' have emerged as the second most preferred strategies for meeting the overall research objective.

- 'Mixed approach' has also emerged as the most preferred profile to develop a detailed corporate strategy as well as a balanced approach to short and long-term objectives (Goal A).
- To create a learning environment to enhance skills of employees for faster technology development (Goal B), the 'Competence development based approach' is the most preferred profile.
- To develop firm's ability in concept generation and product development to facilitate technology upgradation initiative of industry (Goal C) 'Innovative Culture based approach' has shown maximum contribution
- 'Innovative Culture based approach' and 'Mixed approach' are the most preferred strategies to create an enabling environment in the whole industrial sector and society for strategic development (Goal D).

6.3 Limitations of the Study

The main limitations of the study are as follows:

- The study has been limited to only small units of the region.
- The manufacturing organizations in the study have been treated alike, irrespective of the specific requirements of various sectors.
- No mathematical models or quantitative relationship has been derived to calculate the contribution of various profiles in achieving different sub-objectives and the overall objective.

6.4 Scope of Future Work

- The item measures identified for various constructs have been considered to be of equal importance in the study, however in actual situation, some item measures may be more important than the others. The study can be extended by attaching appropriate weights to these item measures through qualitative techniques.

- The present study has taken into consideration the manufacturing industry only and can be extended to other categories of industry. Also, it can be carried out for large scale manufacturing sector.

The present research is aimed at developing an insight into the prevalent development initiatives adopted in the manufacturing industry for realizing sustainable growth Without doubt the most innovative companies of the future will be dominated by those that do not simply focus energies upon product and technical innovation, but those who manage to build enduring environments of human communities striving towards innovation through the creation of appropriate cultures and climate.

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APPENDIX - I

Barriers to Performance Enhancement

S. No	Aspect	Percent Point Score (PPS)
1	Poor Marketing Management	**54.44**
2	Geographical Location	**47.78**
3	Poor Physical Infrastructure	**55.56**
4	Increased Competition because of Globalization	**67.78**
5	Absence of Large Scale Industry in Region	**72.78**
6	Absence of Modernization Programs	**63.89**
7	Underutilized Capacity	**48.33**
8	Low Level of Labour Education	**62.22**
9	Scarcity of Financial Support	**69.44**
10	Old Process Technology	**71.11**
11	Shortage of Multi-Skilled Workforce	**65.56**
12	Scarcity of Power	**84.44**
13	High Price of Raw Material	**66.11**
14	Unavailability of Raw Material	**61.11**

APPENDIX - II

Evaluation of Organizational Culture Issues

S No	Aspect	Percent Point Score (PPS)
1	Awareness regarding importance of in-house R&D	**76.67**
2	Level of labor education	**62.78**
3	Training provided to employees	**33.33**
4	Reward schemes to recognize contributions	**72.22**
5	Reaction of top management to project failure	**82.78**
6	Availability of scientific and technical manpower	**52.78**
7	Undertaking R&D work for technology development	**57.22**
8	Availability of multi-skilled workforce	**59.44**

APPENDIX - III

Evaluation of Resource Support Issues

S. No	**Aspect**	**Percent Point Score (PPS)**
1	Source of financial support	**73.89**
2	Use of software packages	**45.56**
3	Availability of dedicated labs for R&D	**35.00**
4	Financial support to industry	**55.56**
5	Proportion of annual turnover as R&D funding	**37.78**
6	Modernization & renovation programs	**61.11**
7	Advanced production facilities	**36.11**
8	Allocation of funds	**45.56**

APPENDIX - IV

Evaluation of Government Support Issues

S. No	Aspect	Percent Point Score (PPS)
1	Funding for R&D activities	**42.22**
2	Cost and availability of raw material	**58.89**
3	Availability of electricity	**40.56**
4	Transportation infrastructure	**69.44**
5	Motivation through reward schemes	**53.33**
6	Funding for employee training programs	**52.22**
7	Availability of labs for R&D work	**56.67**
8	Support in acquiring imported technology	**55.56**
9	Awareness programs for technology upgradation	**57.78**
10	Capital subsidy schemes	**57.22**

APPENDIX - V

Evaluation of External Capacity Building Issues

S. No	**Aspect**	**Percent Point Score (PPS)**
1	Awareness regarding government subsidiaries	**70.00**
2	Assistance from government organizations	**49.44**
3	Awareness of industry-institute interaction	**76.11**
4	Industry-institute alliance with positive results	**39.44**
5	Academia for preparing road maps	**61.11**
6	Expert lecture by academicians	**71.67**
7	Training through short term courses	**78.89**
8	Combined teams for R&D	**77.22**
9	Institute labs for analysis	**73.89**
10	Collective guidance for thesis	**53.89**
11	Technology from within the country	**82.22**
12	Technology developed through alliances	**33.89**

APPENDIX – VI

Evaluation of Research Output Issues

S. No.	Aspect	Percent Point Score (PPS)
1	‘Risky Research’ practice	46.11
2	‘Imitation for Creation’ strategy	38.89
3	Structure of research function	40.56
4	Maintenance related problems through R&D	62.78
5	Developing new process through in-house research	65.56
6	Technology developed through indigenous R&D	46.67
7	R&D for developing new products	62.22
8	Collecting information for customer needs	55.00
9	Importance of technology up gradation for growth	91.11
10	Increase in product mix	66.67
11	Improvement in product quality	63.33
12	Establishment of research policy	46.11
13	Means of technology up gradation	68.89
14	Level of process technology in use	56.67
15	Drawbacks of technology acquisition	68.33
16	Modifications in product features	53.89

APPENDIX - VII

OPTIONS GENERATED BY OPTIONS FIELD METHODOLOGY

- Adopt knowledge-friendly organizational culture.
- Encourage employees to get involved in knowledge related process activities.
- Enhance employees' capability to participate in collaborative work.
- Implement an incentive scheme to encourage knowledge sharing amongst work colleagues.
- Adopt 'performance-linked salary increases and monetary reward' system.
- Implement long-term incentive plans (e.g. stock options), team-based rewards (e.g. profit-sharing plans), and security benefits to have a positive effect on employee creativity.
- Adopt effective career planning measure for employees.
- Attempt to minimize dependence and work towards greater control of resources.
- Make the customers aware of a product existence.
- Operate internationally in order to guarantee competitiveness and viability.
- Enable technology to facilitate the process activities.
- Interest the customers in order to get their attention to the products, their features, their benefits.
- Promote the transfer of new innovations, knowledge, technologies, practices, and/or skills from one setting to another (i.e., from research to practice).
- Implement strategies with available social resources (education, health, and welfare), current technologies, future markets, and socio-economic environment to improve technology efficiency.
- Motivate individuals to acquire existing knowledge and to share this knowledge within the organization.
- Enhance capacity of the firm to absorb new ideas, that is, the firm's ability to understand, assimilate and apply the new external knowledge to commercial ends.
- Allow the development, acquisition, transformation and exploitation of new knowledge that enhances organizational innovation.

- Add features to current product range regularly.
- Encourage individuals capabilities by allowing employees to work on projects of their choice.
- Implement improvement and guidance-oriented performance communication and feedback.
- Use latest technology in products and processes to compete effectively.
- Provide training resources and comprehensive learning opportunities.
- Adopt plans for career development with job rotation and multiple channels.
- Establish R&D collaborations to mutually profit from each other's resources and resource complementarities.
- Improve ability to anticipate consumer needs, and responding to them better than competitors.
- Try to give tailor made solutions to the customer.
- Got ideas from the customers and improve internal processes and product features in response.
- Develop in-house research and development capabilities.
- Carry out continuous improvements in all technological related activities and components.
- Improve ways of working, working environment and safety, which leads to employees' satisfaction.
- Bring innovativeness in design to develop new products.
- Develop a shared understanding of the threats and opportunities that innovation provides.
- Gain a better understanding of consumers in different product categories and markets.
- Adopt a definite structure in which every part of the organization works together to drive innovation forward.
- Focus on formal education and training programs for employees at all levels.
- Encourage leaders to facilitate a culture where experimentation and creativity flourish.
- Implement strategies for competence development that are related to characteristics of firm's learning environment.
- Align the attitude of employees toward objective of new technology.

- Exploit new products and market opportunities better than non-innovative companies.
- Develop firm's ability in concept generation, product development, production, technology acquisition, leadership, resource provision, and system and tool provision.

APPENDIX - VIII

AHP WEIGHT MATRICES

Position Matrix Respondent – Researcher

A) Pairwise comparison Matrix

Criteria (Alternative)	A	B	C	D
A	1	1/5	1/3	3
B	5	1	3	7
C	3	1/3	1	5
D	1/3	1/7	1/5	1
Sum of Column	9.33	1.68	4.53	16

B) Normalized Comparison Matrix

Criteria (Alternative)	A	B	C	D	WEIGHTS
A	0.10	0.12	0.07	0.19	0.12
B	0.54	0.59	0.66	0.44	0.56
C	0.32	0.20	0.22	0.31	0.26
D	0.04	0.08	0.04	0.06	0.05

C) Consistency Ratio

Maximum Eigen Vector **(X_{max})** = 4.038

Consistency Index **(C.I)** = 0.013

Consistency Ratio **(C.R)** **= 1.41%**

AHP WEIGHT MATRICES

Position Matrix Respondent – Industry Expert

A) Pairwise comparison Matrix

Criteria (Alternative)	A	B	C	D
A	1	1/3	1/2	2
B	3	1	2	4
C	2	1/2	1	3
D	1/2	1/4	1/3	1
Sum of Column	6.5	2.08	3.83	10

B) Normalized Comparison Matrix

Criteria (Alternative)	A	B	C	D	WEIGHTS
A	0.15	0.16	0.13	0.2	0.16
B	0.46	0.48	0.52	0.4	0.46
C	0.31	0.24	0.26	0.3	0.28
D	0.08	0.12	0.09	0.1	0.10

C) Consistency Ratio

Maximum Eigen Vector **(X_{max})** = 4.069

Consistency Index **(C.I)** = 0.023

Consistency Ratio **(C.R)** **= 2.56%**

AHP WEIGHT MATRICES

Position Matrix Respondent – Academic Expert

A) Pairwise comparison Matrix

Criteria (Alternative)	A	B	C	D
A	1	1/4	1/2	3
B	4	1	2	5
C	2	1/2	1	4
D	1/3	1/5	1/4	1
Sum of Column	7.33	2.95	3.75	13

B) Normalized Comparison Matrix

Criteria (Alternative)	A	B	C	D	WEIGHTS
A	0.14	0.08	0.13	0.23	0.14
B	0.55	0.34	0.53	0.38	0.45
C	0.27	0.17	0.27	0.31	0.25
D	0.04	0.07	0.07	0.08	0.06

C) Consistency Ratio

Maximum Eigen Vector **(X_{max})** = 4.071

Consistency Index **(C.I)** = 0.024

Consistency Ratio **(C.R)** **= 2.63%**

APPENDIX – IX

POSITION MATRICES

Position Matrix: Respondent-Researcher

Profile ⇨ Objectives ⇩	Technology based Approach	Competence Development based Approach	Innovative Culture based Approach	Mixed Approach	Weight (as determined by AHP)
Goal A	0.3	0.5	0.3	0.5	0.12
Goal B	0.3	0.9	0.3	0.5	0.56
Goal C	0.3	0.5	0.9	0.5	0.26
Goal D	0.3	0.3	0.5	0.5	0.05

Position Matrix: Respondent-Industrial Expert

Profile ⇨ Objectives ⇩	Technology based Approach	Competence Development based Approach	Innovative Culture based Approach	Mixed Approach	Weight (as determined by AHP)
Goal A	0.3	0.5	0.5	0.5	0.16
Goal B	0.7	0.9	0.3	0.7	0.46
Goal C	0.3	0.3	0.9	0.5	0.28
Goal D	0.5	0.3	0.7	0.7	0.10

Position Matrix: Respondent-Academic Expert

Profile ⇨ Objectives ⇩	Technology based Approach	Competence Development based Approach	Innovative Culture based Approach	Mixed Approach	Weight (as determined by AHP)
Goal A	0.3	0.3	0.5	0.5	0.14
Goal B	0.5	0.7	0.3	0.5	0.45
Goal C	0.3	0.5	0.9	0.7	0.25
Goal D	0.3	0.3	0.5	0.5	0.06

APPENDIX – X

WEIGHTED POSITION MATRICES

Weighted Position Matrix: Respondent-Researcher

Profile ⇨ Objectives ⇩	Technology based Approach	Competence Development based Approach	Innovative Culture based Approach	Mixed Approach
Goal A	0.036	0.060	0.036	0.060
Goal B	0.168	0.504	0.168	0.280
Goal C	0.078	0.130	0.234	0.130
Goal D	0.015	0.015	0.025	0.025

Weighted Position Matrix: Respondent-Industrial Expert

Profile ⇨ Objectives ⇩	Technology based Approach	Competence Development based Approach	Innovative Culture based Approach	Mixed Approach
Goal A	0.048	0.080	0.080	0.080
Goal B	0.322	0.414	0.138	0.322
Goal C	0.084	0.084	0.252	0.140
Goal D	0.050	0.030	0.070	0.070

Weighted Position Matrix: Respondent-Academic Expert

Profile ⇨ Objectives ⇩	Technology based Approach	Competence Development based Approach	Innovative Culture based Approach	Mixed Approach
Goal A	0.042	0.042	0.070	0.070
Goal B	0.225	0.315	0.135	0.225
Goal C	0.075	0.125	0.225	0.175
Goal D	0.018	0.018	0.030	0.030

APPENDIX – XI

HADLEY'S MATRICES OF CAUTION OPTIMISM

Hadley's Matrix – 80% Optimism

Profile ⇨ Objectives ⇩	Technology based Approach	Competence Development based Approach	Innovative Culture based Approach	Mixed Approach
Goal **A**	0.046	0.072	0.071	0.076
Goal **B**	0.291	0.466	0.161	0.303
Goal **C**	0.082	0.121	0.247	0.166
Goal **D**	0.043	0.027	0.061	0.061

Hadley's Matrix – 60% Optimism

Profile ⇨ Objectives ⇩	Technology based Approach	Competence Development based Approach	Innovative Culture based Approach	Mixed Approach
Goal **A**	0.043	0.065	0.062	0.072
Goal **B**	0.260	0.428	0.155	0.283
Goal **C**	0.080	0.112	0.241	0.157
Goal **D**	0.036	0.024	0.052	0.052

Hadley's Matrix – 40% Optimism

Profile ⇨ Objectives ⇩	Technology based Approach	Competence Development based Approach	Innovative Culture based Approach	Mixed Approach
Goal **A**	0.041	0.057	0.054	0.068
Goal **B**	0.230	0.391	0.148	0.264
Goal **C**	0.079	0.102	0.236	0.148
Goal **D**	0.029	0.021	0.043	0.043

Hadley's Matrix – 20% Optimism

Profile ⇨ Objectives ⇩	Technology based Approach	Competence Development based Approach	Innovative Culture based Approach	Mixed Approach
Goal **A**	0.038	0.050	0.045	0.064
Goal **B**	0.199	0.353	0.142	0.244
Goal **C**	0.077	0.093	0.230	0.139
Goal **D**	0.022	0.018	0.034	0.034

APPENDIX – XII

HADLEY'S DOMINANCE MATRICES

Dominance Matrix – Hadley's 80% Optimism

Profiles ⇨ ⇩	**Technology based Approach**	**Competence Development based Approach**	**Innovative Culture based Approach**	**Mixed Approach**
$\mathbf{T_{ba}}$	--	3	3	4
$\mathbf{C_{ba}}$	1	--	2	3
$\mathbf{I_{ba}}$	1	2	--	2
$\mathbf{M_{a}}$	0	1	1	--
Column Sum	2	*6*	*6*	*9*
RANK	**IV**	**II**	**II**	**I**

Dominance Matrix – Hadley's 60% Optimism

Profiles ⇨ ⇩	**Technology based Approach**	**Competence Development based Approach**	**Innovative Culture based Approach**	**Mixed Approach**
$\mathbf{T_{ba}}$	--	3	3	4
$\mathbf{C_{ba}}$	1	--	2	3
$\mathbf{I_{ba}}$	1	2	--	2
$\mathbf{M_{a}}$	0	1	1	--
Column Sum	2	*6*	*6*	*9*
RANK	**IV**	**II**	**II**	**I**

Dominance Matrix – Hadley's 40% Optimism

Profiles ⇨ ⇩	**Technology based Approach**	**Competence Development based Approach**	**Innovative Culture based Approach**	**Mixed Approach**
T_{ba}	--	3	3	4
C_{ba}	1	--	2	3
I_{ba}	1	2	--	2
M_{a}	0	1	1	--
Column Sum	2	*6*	*6*	*9*
RANK	**IV**	**II**	**II**	**I**

Dominance Matrix – Hadley's 20% Optimism

Profiles ⇨ ⇩	**Technology based Approach**	**Competence Development based Approach**	**Innovative Culture based Approach**	**Mixed Approach**
T_{ba}	--	3	3	4
C_{ba}	1	--	2	3
I_{ba}	1	2	--	2
M_{a}	0	1	1	--
Column Sum	2	*6*	*6*	*9*
RANK	**IV**	**II**	**II**	**I**

Appendix – XIII

Options Field

Establishing Technology Platform

- Enable technology to facilitate the process activities.
- Attempt to minimize dependence and work towards greater control of resources.
- Adopt 'performance-linked salary increases and monetary reward' system.
- Implement an incentive scheme to encourage knowledge sharing amongst work colleagues.
- Implement long-term incentive plans (e.g. stock options), team-based rewards (e.g. profit-sharing plans), and security benefits to have a positive effect on employee creativity.
- Implement improvement and guidance-oriented performance communication and feedback.
- Establish R&D collaborations to mutually profit from each other's resources and resource complementarities.
- Encourage leaders to facilitate a culture where experimentation and creativity flourish.
- Develop in-house research and development capabilities.
- Carry out continuous improvements in all technological related activities and components.

Developing Human Resources

- Enhance employees' capability to participate in collaborative work.
- Encourage employees to get involved in knowledge related process activities.
- Motivate individuals to acquire existing knowledge and to share this knowledge within the organization.
- Provide training resources and comprehensive learning opportunities.
- Adopt plans for career development with job rotation and multiple channels.
- Encourage individual capabilities by allowing employees to work on projects of their choice.
- Improve ways of working, working environment and safety, which leads to employees' satisfaction.
- Focus on formal education and training programs for employees at all levels.
- Implement strategies for competence development that are related to characteristics of firm's learning environment.
- Adopt effective career planning measures for employees.
- Align the attitude of employees toward objective of new technology.

Extensive Market Research

- Operate internationally in order to guarantee competitiveness and viability.
- Use latest technology in products and processes to compete effectively.
- Make the customers aware of a product existence.
- Interest the customers in order to get their attention to the products, their features, their benefits.
- Improve ability to anticipate consumer needs, and responding to them better than the competitors.
- Try to give tailor made solutions to the customer.
- Bring innovativeness in design to develop new products.
- Got ideas from the customers and improve internal processes and product features in responce.
- Gain a better understanding of consumers in different product categories and markets.
- Add features to current product range regularly.
- Exploit new products and market opportunities better than non-innovative companies.

Indicate Strategic Aims

- Adopt knowledge-friendly organizational culture.
- Implement strategies with available social resources (education, health, and welfare), current technologies, future markets, and socio-economic environment to improve technology efficiency.
- Promote the transfer of new innovations, knowledge, technologies, practices, and/or skills from one setting to another (i.e., from research to practice).
- Enhance capacity of the firm to absorb new ideas, that is, the firm's ability to understand, assimilate and apply the new external knowledge to commercial ends.
- Allow the development, acquisition, transformation and exploitation of new knowledge that enhances organizational innovation.
- Develop firm's ability in concept generation, product development, production, technology acquisition, leadership and resource provision.
- Develop a shared understanding of the threats and opportunities that innovation provides.
- Adopt a definite structure in which every part of the organization works together to drive innovation forward.

Legend

Technology based Approach

Competence Development based Approach

Innovative Culture based Approach

Mixed Approach

Appendix – XIV

Strategic Development Program for Industrial Sector in the Region