THE ROLE OF PROCESS INNOVATION IN ATTAINING STRATEGIC TECHNOLOGICAL CAPABILITY

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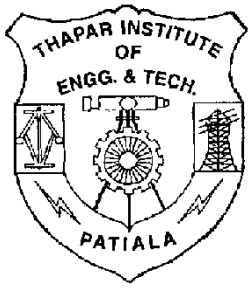

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ABSTRACT

The world is moving from an era of separate national economies to a networked global economy. The society is steadily shifting to a fast track of economic and industrial development. The advent of liberalization, privatization and globalization has brought forth profound economic, social, environmental and technological pressures on the organizations. Markets have become more open, competitive and the customers more demanding. In order to address the top competitive issues facing the industry, successful firms across the world are continuously making efforts to keep pace with new technologies. Continuous up gradation of technology has become essential for the survival of any manufacturing unit. Without continuous technology up gradation no enterprise can ever remain competitive.

The objective of the present work is to analyze the technology development capabilities of small scale manufacturing industry especially the auto component industry in the state of Punjab. The following issues explored include. Present status and future scope of R&D capabilities of small scale manufacturing industry regarding infrastructure facilities, investments from government and academic institutes, reasons for low performance of small scale industry in the area of technology development, correlation between organizational characteristics with individual and group characteristics to enhance organizational creativity.

The present research work is divided into three phases. The first phase consists of extensive literature survey to determine the essential elements of technology development programme. The literature reveals that to assess the status of technology development efforts of an organization, there are four key elements or areas which have to be taken care of. These include manpower for creative input, infrastructure facilities for experimentation and testing, government support to the technology development efforts and interaction of the organization with external agencies to generate innovation. The chapter also reviews the conditions that encourage creativity culture at the firm level. The second phase presents a detailed survey conducted for small scale manufacturing units in the northern region of India covering the

major cities in the state of Punjab. The survey explores the present status of R&D capabilities of the auto component industry with regards to R&D policies, infrastructural facilities, investments in R&D, organization for R&D, support from government and academic institutes etc. and the reasons for the low performance of small scale sector in the area of technological innovations. The final phase comprises of a case study. The general objective of building this case study is to prove that organizational characteristics have a significant relationship with individual and group characteristics. The work has been carried out at "Preetika Industries Private Limited, Mohali". This particular study is aimed to explore the effect of organizational climate on the employee's creativity. The study has used the analysis of variance (ANOVA) technique in an attempt to prove that both individual and group characteristics are significantly related to organizational climate.

CONTENTS

CHAPTER - 1

INTRODUCTION

1.1 GENERAL

The world is moving from an era of separate national economies to a networked global economy. The society is steadily shifting to a fast track of economic and industrial development. The advent of liberalization, privatization and globalization has brought forth profound economic, social, environmental and technological pressures on the organizations. Markets have become more open, competitive and the customers more demanding. Competition is fierce in all aspects of business such as technology, cost, product quality and services. (Gottardi. 2000)

1.2 TECHNOLOGY UP GRADATION

In this modern age, technology is the most important resource to any nation. It is the main driver of a nation's economic development (Beets 1994). It is commonly accepted that the most important strategies for industrialization and economic development of developing countries lie in the development of industrial technology (Choi 1989). In order to address the top competitive issues facing the industry, successful firms across the world are continuously making efforts to keep pace with new technologies. Continuous up gradation of technology has become essential for the survival of any manufacturing unit. Without continuous technology up gradation no enterprise can ever remain competitive. (Cecile Patris 2003)

Technology up gradation can be achieved through creativity and innovation efforts by the organization. The largest and the most successful companies in the world today recognize that innovation and change are essential ingredients in the recipe for success. The following quotes from the CEOs of the top three corporations in the world on fortune magazine's 1995 ranking of firms establish the importance of innovative efforts (Fisher 1995).

"*If you think you are going to be successful running your business in the next ten years the way you did in the last ten years, you are out of your mind. To succeed, you have to disturb the present". (Roerto Goizueta, Coca-Cola)*

"I am convinced that if the rate of change inside the institution is less than the rate of change outside, the end is in sight. The only question is the timing of the end". (Jack Welch, General Electric)

"Swim upstream. Go the other way. Ignore the conventional wisdom. If everyone else is doing it one way, there is a good chance you can find your niche by going in exactly the opposite direction". (Sam Walton, Wal Mart Stores).

The reasons, because of which innovative efforts have become mandatory for survival, are

a) What used to work doesn't work anymore.
b) Customers are increasingly demanding innovation.
c) Competitors are getting increasingly better at copying past innovation.
d) Superior long-term financial performance is associated with innovation.

Customer's needs and expectations become increasingly sophisticated as they experience new ideas in the world around them everyday. Customers today know from experience that someone will come up someday with just the new concept they are looking for. When that happens, they have no strong need to be loyal to their old product. If you can't innovate and someone else can, why should the customer stay with you? Today customers are experiencing innovation all around them and have, therefore, come, to expect further innovation. (Deming, 1993)

These formidable changes have forced the organization around the world to adopt innovative and state of art strategies to suitably address the all-important issues of organizational survival, growth and excellence. Thus the organizations are left with no choice but to upgrade the existing systems, products, and technologies. (Barton, 1991)

1.3 MODES OF TECHNOLOGY UP GRADATION

Technological developments in the area of both product and process technologies are taking place at a very fast pace. While the nature of competition among the firms is highly dependent on industry structure, at a high level of abstraction, there are two ways of competition among the firms. The first way is through the optimization of productive resources in order to gain the market allowed margins of profit. In a way this is "Competition through Efficiency". A second way is to disrupt the market through the introduction of new technology products, which gives to the innovative firm a temporary absolute advantage over the other firms. This is "Competition through Innovation" (Conceica. et. al. 2002). For "Competition through Innovation", there are two options:

i. Technology Acquisition, in which technology is acquired from an external source (source outside the organization) with in the country or abroad. This is "Innovation from Outside" or "Technology Transfer".

ii. Technology Development, in which technology is indigenously developed by the organization through in house R&D. This is "Innovation from Within".

1.3.1 INNOVATION FROM OUTSIDE

"Innovation from outside" or "technology acquisition" is the process of acquiring technology developed by a source external to the company and implementing it in the company. Technology acquisition can be viewed as a process during which technology is carried across the boundary of two entities. These entities can be two companies or countries Technology acquisition is helpful for the organization and countries, which don't have capabilities to develop technologies of their own. Moreover, the increased level of specialization has made technology acquisition the ultimate solution in some cases. India has been acquiring technologies from other nations from the time of independence. India established steel plants and heavy industry with the help of Russia, U.K. and Germany. Even now, Israel technologically aids major

defence projects. The technology for Metro Rail, New Delhi was acquired from South Korea. There are different modes of technology acquisition or technology transfer. A broad classification is

a) Purchasing.
b) Licensing.
c) Joint Venture.

Fig 1.1 Types of Technology Acquisition

a) **Purchasing:** A common and efficient method of technology acquisition is purchasing the technology. This normally involves buying a machinery or equipment with the embedded technology. This is the quickest form of technology transfer because the technology is readily available for use. It is of low risk because the equipment that has proved to work well is purchased. In addition, technology is received from a specialized person in the field. For example, a manufacturing plant making pistons for automobiles wants to incorporate closer tolerances. The obvious answer to this problem would be to purchase a CNC machine from a specialized CNC machine's manufacturer.

However, great care must be taken whether it is feasible to blend the new technology with the existing system or not. The cost of training staff to run the new equipment and disruption in work for some time must be taken into account. The major problem is of maintenance of equipment. Many organization face problems when a breakdown occurs in exported equipment. To avail the full advantage of equipment, organizations have to hire expert maintenance personnel, which adds to their costs.

In some cases, the cost of purchasing a technology is definitely lesser than developing a technology. This is generally when the companies from which one is buying the technology, is in the business of providing machines containing the technology. In such cases, the cost of developing that technology is spread over several customers.

b) **Licensing**: Licensing is similar to purchasing but involves an ongoing relationship between the buyer and the provider rather than a one-time purchase. In purchasing, the company pays for technology in one or very few payments. In licensing, the payments are made in relation to the sales which the acquiring company makes using the technology. In other words, the company has to share its profits with the technology provider.

   In licensing and purchasing, the acquiring company will not be the only one, which is using the technology. It will not have the exclusivity advantage of the technology. This gives them lesser benefits as expected from the technology.

c) **Joint Venture**: A joint venture with the technology provider is another form of technology acquisition. This is a partnership between a company with the technology and a company with the market access. In a joint venture, usually a new company is created. Each of the partners has shares in the company in the proportion to the contribution to the new company. The major difference between licensing and joint venture is that in the latter, both the partners make joint decision about production and marketing. The costs involved are maximum in this type. Joint ventures have the constraints that the partners may not agree on one issue, or the other. The disagreement may even lead to failure of the joint venture or

break up between the two partners.

There are many successful joint ventures in India like Hero Honda, Maruti Udyog Limited, and Bajaj Kawasaki etc. The Indian industry has also witnessed some failures eg. TVS and Suzuki, Kinetic and Honda etc.

In addition to purchasing, licensing, and joint venture there can be some other forms of technology acquisition like acquiring the whole company, which has a novel technology. This can happen when one company has technological innovation that is impairing other company's business. The second company negotiates to purchase the entire company e.g. Bill Gate's Microsoft purchased and acquired Sabeer Bhatia's "Hot mail".

The option of technology acquisition suffers from some major limitations. These have been discussed as follows.

i. *Non-Exclusivity* - When a company buys technology from an external source, it is not the only one to have that technology. There are other companies in the market, which are using that technology, and there may be potential buyers of that technology also. Although the new technology helps the organization but it does not provide an exclusive edge to the company over its competitors.

ii. *Problem of Adaptation* - The technologies available for acquisition are not tailor made for acquiring company's application. The acquiring company has to adapt the technology and make changes in its system according to that technology. This may include purchasing new machinery, educating and training employees etc.

iii. *Old Technology* - The technologies which are available for acquisition are most of the times not state of the art. The provider company generally sells off technologies, which are no longer useful to it, or when some advanced technology has been developed by it.

iv. *Difference of Culture* - There are some basic causes of technology transfer failures when technology is transferred from one country to another. The technology, designed for one country is according to skill of manpower and level of automation culture existing there. It becomes very difficult to blend that acquired technology into the system of the other country.

v. *Problem of Maintenance* - The acquiring company knows only about the surface details of the purchased technology i.e. how to use it. It knows only about the macro details of the acquired technology. There are many inherent features in the technology which are not known to the acquiring company. Whenever a failure occurs, it becomes difficult to fix the problem and expert personnel have to be hired for rectification. This adds to cost.

vi. *Recurring Expenditures* – Whenever technology is purchased, most generally it is in the form of agreement or license. High expenses are involved in the renewal of such license or agreement.

In the light of above-mentioned limitations of technology acquisition, it is better to develop technology through indigenous R&D activities.

1.3.2 INNOVATION FROM INSIDE

The process of developing technology by a company on its own using its R&D and internal resources is called "Technology Development" or "Innovation from Inside". This is the best option for technological growth of the company. Technology development is similar to building a house according to one's own requirements and designing it in such a manner that gives full satisfaction, Technology transfer is more likely buying an already built older house or going in a rented house. Because internal personnel are more aware of company's motives and resources, the developed technology satisfies company's needs perfectly.

The greatest advantage that indigenous technology gives is the competitive edge over others because it is not available to other companies in the market. There are many examples in this regard. Nokia Corporation developed the technology of internal antennas in the mobile phones, which no other company had at that time. This made Nokia the most popular brand in the mobile market.

An indigenously developed technology is the exclusive property of the company and it strengthens the company internally. Most of the IT and biotechnology firms are growing in India because of their self developed technology.

1.4 STATUS OF TECHNOLOGY DEVELOPMENT IN INDIA

The status of Indian manufacturing industry with regards to their technology development efforts through indigenous research is not very encouraging.

According to Global Competitiveness Report 2004 published by World Economic Forum, India ranks at 64 out of 102 nations on technology index as compared with 59 out of 80 in 2002. The paradox is very stark, on one hand India has developed nuclear capabilities and has shown a lot of strength in the area of satellite communication, missile technology etc. but performs badly in the export performance. India ranks 31st in the export performance among exporting countries in the world. India's share in the world market is just 0.34% out of which 64.55% is to developing countries (Economic Survey 2004-2005).

The number of patents obtained by the Indian firms is almost negligible when comparing with the developed countries of the world. The record of Indian private sector firms in the introduction of new products and processes that come out with indigenous research is very poor. India does not figure in the first 25 core technology innovating economies (Global Compitiveness Report, 2004).

The investments in R&D are very low, ranging between 0.2-0.5% of the total turnover as compared to 2.5-18 % in case of organizations across the globe. The total investment in R&D in U.S is about 80 times, in Japan about 45 times, in France and Germany about 20 times, in South Korea about two times as compared to what is in India. Many companies in the world (IBM, SONY) have annual R&D expenditure that exceeds the total R&D expenditure of India as a whole.

The pattern of technology funding by Indian government, does not reflect priorities inferred from economic development and growth objectives. An analysis of R&D expenditure in India shows that funding for technology in specific sectors is not in consonance with the size of domestic or global market of different sectors.

The GDP for the year 2004-2005 was 1430.5 thousand crores. The total development money allocated for all different sectors i.e. agriculture and allied services, rural development, energy (coal, petroleum, non conventional resources), industries (small scale, medium and large scale industries), transportation (railway), communication, science and technology, social services (education, medical facilities etc.) was 162947.24 crore i.e. only 11.4 % of GDP was used for development of different sectors. The spending in agriculture and allied services was 2.8%, rural development was 4.3%, energy was 28.7%, transportation was 18.4%, and social service was 23.3%. Spending in industrial development was just 5.1% from which 4.2% was invested in large and medium scale industries and only 0.9% in small-scale industries. Science and technology received 3.5% of the developmental money.

In India too much of R&D efforts are invested in public sector. Over 80% of the funding for R&D comes from the government and almost all of this is invested in government run organizations. Only less than 20% of R&D funding comes from private run organizations. According to global competitiveness report 1999, India stands at number 39 on private sector spending on R&D among 52 developed and emerging economies.

India stands at number 27 on the number of research institutes. India as a whole is in an advantageous position by way of having an extraordinary large pool of trained scientific and technological manpower, reputedly the third largest in the world. The quality of technical education available to a small sector of students is also high with the IIT's being of international standard as far as education standard is concerned. But almost 30% of the better graduates from IIT's eventually go abroad, a trend, which is at variance with many other Asian countries such as Taiwan and Korea etc.

According to Global Competitiveness Report 1999, India stands at number 49 on the number of research collaborations between industry and academic institutes. All high technology businesses across the globe have academic ties wherever they are located. This type of industry institute interaction is missing in India.

1.5 SMALL SCALE MANUFACTURING INDUSTRY IN NORTH INDIA

The small scale industrial sector has emerged as a dynamic and vibrant sector of economy. Small scale industries are undertaking having investments in fixed assets in plant and machinery whether held on ownership terms or by lease or by hire purchase not exceeding Rs. 1 crore. In India, the small scale industry assumes special significance because of its employment potential. It also serves as a useful ancillary to large industrial units. Another major advantage of this industry (SSMI) is its very low capital output and capital labour ratio. This means that capital investments required per unit of output and per unit of input is very low. This is of particular importance to labour abundant and capital scarce economy like India. It has been estimated that the turnover to capital invested is approximately 4.62. SSMI contributes almost 40% of the gross industrial value added in the Indian economy. It plays a major role in India's present export performance. About 45% of Indian exports are contributed by SSM sector.

The number of small scale units has increased from an estimated 0.87 million units in the year 1980-81 to over 3 million in the year 2000. In north India, Punjab is one of the major industrial states. Ludhiana has a concentration of small scale units numbering to 40,860 with total annual production of Rs. 3499.29 crores. Jalandhar and Amritsar follow with 26,898 and 26,687 units respectively. There are five major industries in the state viz. cycle parts, auto parts, machine tools, sewing machines and hosiery.

Though there have been a striking increase in the number of SSMIs, industrial sickness in this sector has assumed very serious proportions. Many causes endogenous and exogenous accounts for their sickness. Among these are long standing shortage of raw material and power, lack of space for expansion, shortage of finance, under utilization of capacity, apathy of management towards timely modernization and renovation programs, product and market diversification and technological obsolescence. The absence of state of the art technology which alone can ensure high quality, high productivity and competitiveness is one of the major handicaps of SSMI. To overcome this, the

SSMI needs to foster an innovative culture in the organization which would lead to technology development.

1.6 OBJECTIVES OF THE STUDY

The objective of the present work is to analyze the technology development capabilities of small scale manufacturing industry especially the auto component industry in the state of Punjab. The following issues will be explored.

i. Present status and future scope of R&D capabilities of small scale manufacturing industry regarding infrastructure facilities, investments, support from government and academic institutes.
ii. Reasons for low performance of small scale industry in the area of technology development.
iii. Correlation between organizational characteristics with individual and group characteristics to enhance organizational creativity.

CHAPTER - 2
LITERATURE SURVEY

2.1 INTRODUCTION

An extensive literature survey has been carried out to determine the essential elements of a technology development program. The literature reveals that to assess the status of technology development efforts of an organization, there are four key elements or areas which have to be taken care of. These include manpower for creative input, infrastructure facilities for experimentation and testing, government support to the technology development efforts and interaction of the organization with external agencies to generate innovation. The following sections present a detailed review on all these four components of technology development program. The chapter also reviews the conditions that encourage creativity culture at the firm level.

2.2 MANPOWER

Manpower aspect can support technology development program when organization have adequate multi skilled labour with sound technical knowledge, by building effective training program for improving employee skills, encouragement from top management to work creatively, effective reward strategy and maintaining good relation ship with the employee.

Arif Hassan et. al. (2006) state that successful organizations in today's business environment are those who manage their human resources well. This includes effective manpower planning, recruitment and selection process, realistic performance plans, effective learning system providing ample learning opportunities with the help of training, performance guidance and other mechanisms such as mentoring. It also consists of mechanism to inculcate sense of pride in work, high degree of organization commitment, introduction of organizational development systems such as personal growth labs, creativity workshops, quality circles, Kaizen team building exercises etc.

Singh (2003) conducted a survey of 84 Indian firms representing major domestic business sectors ranging from automobiles and auto components to cement engineering, iron and steel, financial services etc. and found the organization performance is directly linked with the performance of the workforce available in the organization.

Hollbeche (1998) did a survey and found that organizations perform better when they make investments in training their employees to broaden their skills.

Sandberg (2000) states that emphasis on human resource development results into several positive individuals and organizational outcomes such as higher performance. The author states that by training employees, quality individuals are built who help the organization in problem solving and achieving competitive advantage.

Brian et. al. (2001) ranked organizations on "High Performance Work Index" (HPWI) and compared their HR system and practices. The HPWI index included the organization system of building and maintaining a stock of talented human capital through:

1 Linking its selection and promotion decision

2 Developing strategies that provide timely and effective support for the skills demanded by the firm, and

3 Enacting compensation and performance management policies that attract, retain, and motivate high performance employees.

Barney J.B. (1991) conducted a study and concluded that the organizations having positive social interaction culture where both management and employees socialize and interact frequently with each other are in a better position of solving problem.

Osman et. al. (1999) suggest that in order to achieve long term organizational gains, a significant approach for manpower development should be there. Manpower can support technological innovation to achieve high performance and technology innovation could serve as an effective ingredient to sustain competency.

Zhongming W. (2005) suggests that employee training has a direct and positive effect upon technological innovation in firms. In order to achieve long term gains, a variety of practices are required for facilitating employee's high performance, intrinsic motivation, teamwork and attitude. He adds that enhancing cross functional and cross cultural competencies should be enhanced in order to achieve high compatibility among work teams and technology innovation.

Salleh Yahya et. al. (2002) conducted a survey which reveals that in order to be a high performance organization, the focus should be on employee development i.e. training, performance appraisal, reward and compensation.

Jack Mc Gourthy et. al. (1996) state that technological advances are fundamental to business growth and competitive advantage and one way of achieving this is through employee development i.e. helping people to develop as innovators. Highly innovative companies have reward strategies that encourage the employees to work creatively. Managers tie performance reviews, career progression and promotion to successful innovation

John W. Koning (1998) suggests that in order to increase employee's creativity and innovation skills, appropriate recognition and reward for their creative work should be provided.

Lanchaster (1994) states that employees cannot be treated as commodities to be hired and discarded depending on short range whims of the organization. They are to be nurtured and developed. Good people can fix the poor policies, procedure and rules but it is never the other way around.

Huselid et. al. (1998) conducted a survey and state that 90 percent of the organizations expect their employees to help them in their development. The survey reveals that high fliers would leave if they do not broaden the skills of their employees. The authors therefore states that organization likewise view investment in human resource development to be most important.

Losey (1999) reports that organizations always seek help from the workforce and must build effective training programs for improving employee's skills in order to develop employee competencies and to enable them to respond quickly and flexibly to business needs.

Mozammel Huq (2003) states that an important prerequisite of technology capability building is developing the labour force which can select, install, maintain, assimilate, design and even create the technology.

Arvind Singhal (1989) states that successful companies create competitive advantage in the market place through innovation and creativity. Such companies are innovative and creative not by accident but these companies manage their human resources effectively to create and build new product and services. The author argues that people are the most vital resource of an creative organization.

S.K. Gupta (2000) defines that over time, the individual role has been changed in the organization. The author states that to foster innovation, human resource planners should consciously recruit people with variety of professional skills. i.e. people with different personnel characteristics, knowledge, expertise, and skills.

Badawy (1999) states that recognizing individual and team accomplishment with awards encourages innovation. The author defines that salary raise and financial benefits play an important role in motivating the creative individuals.

Rehfeld (1998) sates that in order to be a creative organization, companies should employ people with right skill-mix i.e. individual with both technical and interpersonal skills.

Ulrich D. (2002) states that an enterprise wishing to embrace innovation as a source of competitive advantage must emphasize on improving individual creativity and skills.

2.3 INFRASTRUCTURE

In today's business environment organizations must build infrastructure to support technology development programs. Organizations must allocate funds for R&D, should support modernization and renovation programs, build dedicated laboratories for experimentation, modern production systems for carrying out production, and must have latest softwares for modeling and analysis.

Carlos Sheel (2002) states that for technological advances new infrastructures, mainly telecommunication, information technology, new strategic thinking practices are needed for hypercompetitive environment.

Smilor et al. (1988) argues that infrastructure (i.e. advanced equipments and resources) is one of the most important factors which is to be employed to support public and private projects regarding research and development, innovation and technology modernization.

Monge et. al. (1995) suggest that employees will be more creative when they have a shared commitment to their projects and when they have adequate resources to conduct their work.

Amabile (1996) proposes that to enhance employee's creativity, organization structure should be such that it should have adequate funds, materials, facilities, and information support system to support innovation and technological advancement.

Mathews (2001) states that a key success factor for technological innovation systems is through developing adequate financial program that supports training and educational programs for innovation, and building physical infrastructure for enhancing organizational capabilities.

Jack Mc Gourthy et. al. (1996) claim that highly innovative companies put processes in place readily to accommodate new ideas. To accommodate new ideas there should be adequate funds to support innovation.

Garavan et. al.(2000) advocates that for overall management of R&D, the business unit must make adequate arrangement of funds before starting of the project so that during development stage there is no shortage of funds.

Charles E. et. al (1999) conducted a survey and state that money that a company spends for R&D and the amount allocated to central research are a measure of a corporation's commitment to R&D.

William L. Miller (1995) states that new innovation system includes process capability and architecture development. Process capability is defined as the people with knowledge, tools, technology, and the process that organizations practice where as architecture constitute the physical infrastructure i.e. modern production facilities and systems.

Arad et. al (1998) argues that resources are important not only for functional support, but also because having an adequate level of resources for the task/project influences workers' perceptions that the project is valuable and worthy of organizational support.

Gryskiewicz (1989) states that infrastructure includes sufficient funds, materials, system and processes for work etc. which is important to increase employee creativity and skills and lack of project resources constrains employee's creativity.

E.C Martin et. al. (2003) propose that innovation and creativity of the workforce is enhanced by having appropriate resources as by having adequate resources the idea generation of employees increases and contributes to new technological advancements.

2.4 GOVERNMENT SUPPORT

Government can help industries by providing raw material at cheaper prices, building infrastructure for transportation, funding R&D activities, providing monetary rewards for better performance, providing government labs for experimentation, sponsoring training programs, providing assistance in

acquiring modern technologies, organizing seminars for awareness regarding technology development programs etc.

Seoyong Kim (2001) determines new roles of government in supporting learning, innovation and building competitiveness. The author states that government should act as a facilitator of technical change and leveraging, working collaboration with other stakeholders rather than dictating policies from above.

Carlos Sheel (2002) argues that government should support programs to build infrastructure as well as incentives (such as tax incentives) and special start up programs in order to develop private sector.

Shantha Liyanage (2003) states that increase in technological innovation demands that government should increase spending on R&D, as now it is an important factor for economic and social development.

Thomas (1993) states that government can support organizations by providing funds for developmental activities at low rates of interest and by building laboratories for carrying out R&D work.

Afuah (1998) argues that government policies play, an important role in development of the industrial units. The author states that government policies in most countries assist organization to innovate through funding, assistance, consultancy, and other policies.

Little (2001) considers the impact of government policy intervention on various attributes of innovation for small and medium enterprises i.e. vision and strategy, managing for the competency base, creativity and idea management, culture and climate intelligence, and organizational process.

Pawl W. Hyland (2004) states that government policies in major developed countries play an important role in developing new inventions. The government can help organizations by providing funds for R&D projects, by rewarding the organizations performing well, and by providing laboratories for carrying out R&D work.

Brief A.P. (1996) states that government policies should be such that they support technological innovation as they are the important for social and

economic growth of the nation. Government must increase funding for R&D projects for achieving technological advancement in the country.

DTI Economic Paper (2005) states that government plays an important role in enabling industries to be creative. The government can support in many drivers of creativity. The government intervention can generate more economic benefits than market alone can provide.

2.5 INTERACTION

Interacting with external organizations, academic institutes and R&D agencies is important. Interaction helps in acquiring technology from abroad, building technology by collaboration, solving R&D problems. The organizations can utilize academic laboratories for experimentation, academician can provide training to employees of the organization etc.

Thomas (1993) states that the universities and private research laboratories which are engaged in the supply of scientific, technological and market knowledge can be sources of taking competitive advantage, if these resources are carefully managed and applied.

J. David Roessener (1995) conducted a survey which revealed that many of the largest federal laboratories are engaged in developing new advanced technologies and are trying to inform companies for the technical expertise and technology that could be potential commercial knowledge. Moreover, the companies look for external sources of technical knowledge and technology as their internal R&D budgets shorten and competition pressure increases. The author advocates interaction of companies with federal laboratories to achieve success in technology driven environment.

Arther N. Chaster (2000) states that the companies are feeling the pressure of shifting markets because of globalization. The companies have to make improvements in internal strategies and should start interacting with external organizations i.e. universities and private research laboratories for building the cutting edge technologies.

Kling et. al. (2000) states that organizations should start building social interaction culture for building and adapting new technologies. The author

argues that organizations must interact with universities and R&D institutes in order to know about the new technologies in the market and to build the same.

Shalley (1995) defines that traditionally innovation and technology development were considered an issue pertaining to companies strictly focused on search for excellence and technology leadership but now it not the same. Organizations have to contact external organization in order to develop new technologies.

Easterby et. al (1998) state that in order to increase organization's R&D performance and effectiveness, organizations must interact with the external R&D laboratories. This interaction calls for clear communication so that problem of the industry is clearly defined and full involvement of the external laboratory is achieved.

K.C. Chan et al. (1994) claims that there are many works by academics and research practitioners that can be utilized by the organizations in order to develop new technologies. The author states that organizations are implementing strategies that are build up by academicians or research practitioners. There is a symbolic relation between academia and industry.

Gwynne (2001) states that nowadays in designing the curriculum of the institutes, business focus has been adopted as it was considered that the core knowledge base in technology management program differ from the process adopted at industry. The author presents various examples such as Microsoft, IBM, Intel etc. who have achieved great success by interacting with institutes.

Mallick et. al (2000) explains that in developing new technology, organizational and institutional theories contribute to some essential knowledge, these theories are fully relevant to development and use of technology in knowledge intensive industry.

Cook P. (2001) suggests that in order to achieve the goal of improving industrial infrastructure, to provide support and incentives for the firm to learn, innovate and lead to world class competitiveness the organization have to interact with external organization.

Seyong Kim (2001) explains that there are so many strategies for by which technological innovation comes into picture but collaborative R&D may well be thought as one of those strategy categories, this mode is catching up with policy trend more than any other development tactics. Today every organization tends to accept the mode of joint venture with other external organization for technological development.

Carlos Scheel (2002) defines that some worldwide organization and individuals dedicated to industrial development agree that one of the main producers of wealth and prosperity of industrialized countries has been existence of well coordinated and sustainable system that support interaction other organization and forming networks, capable of converting technological innovation assets into building new technology.

Vittoria Chiesa et. al. (2000) states that in order of converting new ideas into technological breakthrough there must have an inter-industry collaboration, this is because R&D carried out within the industry includes activities of different nature. Author defines managerial studies have shown positive relation between building inter-industry relation and doing effective R&D in building new technological advances.

Patric S. Poon et. al. (2003) explains that for developing new technology, it requires whole range new skills and dynamic competencies. These competencies are often renewed in the process of managing innovation through organizational changes within and outside the firm. Authors defines that technological solution are often costly and results are unpredictable, so there has to be collaboration with other R&D institutes for developing and implementing new technologies.

2.6 ROLE OF R&D

This section examines the role of R&D functions in the organization.

William L. Miller (1995) states that improving the effectiveness of innovation requires R&D management to resolve the dilemma of risk management through discovery of competitive capabilities for unclear stakeholder requirements. The author defines a broader view of innovation system i.e.

Fourth generation R&D which states that there should be no isolation between the groups and there must be overlap between the groups. The overlaps create more effective concurrent learning that shortens innovation cycle time, lessens risk and cuts costs. The author also identifies new role of R&D i.e. R&D is acting beyond just providing technical support, R&D has a responsibility for identifying latent customer requirements that create business opportunities enabled by technology developing the architecture for new application new concepts responding to mutual discovery of unperceived needs.

David A. Nadler (1998) has identified eight primary forces that lead to in house R&D. These are impact of technology on time and skills, increased competition, oversupply, globalism, increased diversity of worker and work location, and increased customer expectation.

Ferdinando Chiaromonto (1997) states the main objectives of the organizations in today's competitive environment are design, development, and implementation of activities needed to fulfill technological innovations.

Jack Mc. Gourthy (1996) states that R&D function should be customer driven and market focused. The author believes that technological advances are fundamental for business growth and competitive advantage. By coupling R&D with the business units, organizations are in a better position to generate ideas for technological innovation and can achieve better competitive edge.

James W. Tipping et. al. (1995) argue that technology development can be derived by performing adequate R&D efforts.

Arthur N. Chaster (1999) states that the companies are feeling pressure because of shifting markets, globalization, changing national priorities, accelerating technological changes. The author states that corporate strategies have been changing both internally and externally. Internally, R&D is highly visible on corporate income statement therefore enhancing R&D productivity or R&D effectiveness have gained the status of survival tactics for R&D community whereas externally R&D is only one facet of an integrated business approach.

W. David Sheasley (1999) states that market competition is keen and advancing the pace of technology development that provides competitive edge and produces major rewards. The management has to employ strategies for enhancing R&D productivity in order to achieve long term gains.

Charles E. Bosomworth et. al.(1995) derive a positive correlation between investments in central research and long term corporate sales growth. They argue that the money that companies spend for R&D and the amount allocated to central research are measures of an organization commitment toward R&D.

Glorianna et. al. (2003) explain business success in general is increasingly tied to development and implementation of right technology. Author define the mission of corporate R&D is development of technologies that may impact several business or have long term time horizon and which have the promise of significant competitive advantage.

Ted M. Foster (1996) defines that the mission of today's organization is to identify, develop and implement innovative technologies in a cost effective and timely manner to create new business or provide competitive advantage in existing ones with ultimate objective of profitably growing the organization. Author believes that only the creation of new business competitive advantage for quantum business growth justifies the existence of a corporate R&D centre.

Vittorio Chiesa (1999) conducted a survey and analyzed that top executives of technology driven organization ranked the international management of R&D and technology as a top priority in their agenda. To become part of the development system firms are forced to disperse their R&D units to access such knowledge that accumulates locally. This means to spread technical capabilities around the world and put up global R&D organization in order to address top competitive issue.

2.7 CREATIVITY CULTURE

There are numerous factors which support creativity and innovation within firms. Figure 2.1 suggests some major factors that contribute to a creativity culture. These range from individual skills, (including motivation and knowledge) to group features, (such as communication, team building etc.) to organizational characteristics (viz. culture, reward, strategy etc.). Thus organizational creativity comes from creative behavior. Creative behavior is a composite of individual characteristics, group characteristics and organizational characteristics.

2.8 ORGANIZATIONAL CHARACTERISTICS:

Organizational characteristics comprise of the following factors.

1. **Supportive Structure:** Organization structure relates to organization's ability to adapt and innovate. Organizational structure that provides a mechanism for developing new ideas enhances creativity and innovation in the organization. The structure seems to emphasize certain values which have an influence on the promotion or restriction of creativity and innovation in organizations. Generally it has been seen that innovation is enhanced by organic structure rather than mechanistic structure i.e. innovation is increased by highly participative structure and culture. A flat structure, autonomy and work teams will promote innovation, whereas specialization, formalization, standardization and centralization will inhibit innovation (E. C. Martin et. al., 2003).

Fig 2.1 Organizational Creativity

Values like flexibility, freedom and cooperative teamwork will promote creativity and innovation. On the other hand, values like rigidity, control, predictability, stability and order (mostly associated with hierarchical structures) will hinder creativity (Shattow, 1996).

The literature reveals that the degree to which employees have authority to participate in decision making in solving problems determines the level of empowerment, which is positively related to the level of creativity and innovation in an organization (Wayne Morris , 2005). Further supportive supervision is positively related to employee creativity (Oldham, 1996). R&D scientist's creativity is significantly related to the extent to which supervisors are empathic and attempt to understand employees' feelings (Stahl and Koser, 1978). Health care professionals seem to be most creative when their supervisors provide high levels of social support (West, 1989).

It has long been believed that organizational structures relate to organization's abilities to innovate and adapt to the environment (Burns and Stalker, 1961). Organizational structures that provide a mechanism for developing and sharing new ideas facilitate creativity. Again, as with culture, structure may not be a fruitful focus of short-term training interventions (Amabile et al., 1996).

To encourage creativity within their working environments organizations need to develop what Brand (1998) defines as an ``innovative'' (divergent and learning) and ``supportive'' (empowering and caring) culture. ``Controlling'' (convergent and efficiency conscious) and ``directive'' cultures (profit more important than people) hinder creativity in the working

environment. Kay's (1989) study in a high tech industry generates similar findings. He proposes that to succeed in the present competitive enviorment, a company needs a set of principles based upon a common set of values, an organizational culture that provide the desired guidance. Every employee needs to understand and apply core principles and values which apply to everyone in the organization.

Organizational culture has an influence on the organizational structure and operational systems in an organization. The structure seems to emphasize certain values which have an influence on the promotion or restriction of creativity and innovation in organizations (Armstrong, 1995). Organizational structure is concerned to a large extent with "atmosphere" or "mood" (Morgan, 1991).A "working atmosphere" favorable to creativity and innovation requires participation and freedom of expression, but also demands performance standards (Bower, 1995).

2. **Adequate Resources for Experimentation:** There should be adequate resources in the organization to promote a creativity culture. The resources include laboratories for experimentation, modern production systems, funds for carrying out projects etc. It has been seen that resources are important not only for functional support, but also because having an adequate level of resources for the task/project influences workers' perceptions that the project is valuable and worthy of organizational support (Arad et. al., 1998). Researchers have always related infrastructure positively with organization creativity. So in order to build organization culture that stimulates creativity and innovation, availability of adequate infrastructure is important (E. C. Martin et. al., 2003).

Gryskiewicz notes that resources include an array of elements: adequate time for developing novel work, people with necessary expertise, sufficient funds, material resources, systems and processes for work, relevant information, and the availability of training. Lack of project resources can constrain employee's creativity (Grysklewicz, 1998).

Amabile points out that managers must decide on the funding, people, and other resources that a team legitimately requires to complete a project. She suggests that there is a ``threshold of sufficiency'', and when resources are added above this threshold, creativity is not enhanced. Below the threshold, a restriction of resources can limit creativity since employees will be more occupied with finding additional resources and not with actually developing new products or services (Ambile, 1998). Employee's perceptions of the adequacy of resources may have an effect on their beliefs about the intrinsic value of the projects that they have undertaken (Ambile et. al., 1998)

Carlos states that for better technological advances new infrastructures, mainly telecommunication, information technology, modern production systems, new strategic thinking practices are needed for hypercompetitive environment (Carlos Sheel, 2002).

Amabile explains that to enhance employee's creativity, organizational structure should be such that it should have adequate funds, materials, facilities, and information support system to support innovation and technological advancement (Amabile, 1996).

Mathews states that the key success factor for technological innovation systems is through developing adequate financial program, that supports training and educational programs for innovation, and building physical infrastructure for enhancing organizational capabilities (Mathews , 2001).

Charles and others conducted a survey and conclude that the money a company spends on R&D and the amount allocated to central research are a measure of corporation's commitment to R&D. The authors state that research is done on building new technologies which are often a source of competitive advantage (Charles E. et. al, 1999).

3. **Recruitment and Selection Process**: Competent staff is one of the major factors that will enhance organizational creativity and innovation. Recruitment, selection, appointment and maintaining employees are an important part of promoting a culture of creativity and innovation in an organization. The values and beliefs of management are reflected in the type

of people that are appointed. Apart from personality traits like intelligence, knowledge, risk taking, inquisitiveness and energy, a value like diversity is of utmost importance in the appointment of creative and innovative people. Appointing people of diverse backgrounds should lead to richer ideas and processes that should stimulate creativity and innovation (E. C. Martin et. al., 2003).

Organizational creativity also requires companies to make strategic choices with regard to their human resources. Creative organizations must explicitly strive towards the attraction, development and retention of creative talent, if they want to remain competitive (Cook, 1998). Organizations need to attract and develop their intellectual capital. The organizations should hire people who are knowledgeable, intelligent, creative in their thinking process and willing to work tenaciously to attain their goals (Brand, 1998). In general, creative organizations should focus on employing people with broader interests, who are eager to learn and prepared to take some risk. Creative organizations can develop and train such individuals only when senior management provides sufficient resources and training, encouragement for developing new ideas, time to work on pet projects and/or financial support (Jones, 1997).

It has been seen that if the staff of the organization is competitive, the organization is in better position in generating better ideas in order to address the top competitive issues. By having a competitive staff, the organization can rely on them and can push the boundaries of there technical competence into the areas of unknown or the new – to come up with creative and innovative ideas (Elspeth Mc Fadzean , 1998).

4. Reward Strategy: Rewarding individuals for their contributions to the organization is widely used by corporations. However, while recognition can take many forms there is a common distinction: rewards can be either extrinsic or intrinsic. Extrinsic rewards are things such as pay hikes, bonuses and shares and stock options. Intrinsic rewards are those that are based on internal feelings of accomplishment by the recipient. Personnel should also be

rewarded for risk taking, experimenting and generating ideas. Intrinsic rewards like increased autonomy and improved opportunities for personal and professional growth may support the innovation process. If creative behavior is rewarded, it will become the general, dominant way of behaving with employees. The problem is that many organizations hope that personnel will think more creatively and take risks, but they are rewarded for well-proven, trusted methods and fault-free work (E. C. Martin et. al., 2003). Management should be sensitive to methods of reward and recognition which will inspire personnel in their specific organization to be more innovative. Bonuses and pay-for-performance plans can even be problematic when people believe that every move they make is going to affect their compensation. In those situations, people tend to get risk averse (Arad et. al. , 1998). Of course, people need to feel that they're being compensated fairly. Rewards do matter to enhance organizational creativity but they must be appropriate and each person will decide what appropriate is for him.

Organizations that aim to support the value of creativity within their environments should consistently reward creativity, but at the same time they should avoid using money to ``bribe'' people to come up with innovative ideas. Financial rewards can have a negative effect on creativity, especially when employees perceive the financial incentive as a means of being bribed or controlled (Wayne Morris, 2005).

Innovative companies appear to rely heavily on personalized intrinsic awards, both for individuals as well as groups. Less innovative companies tend to place almost exclusive emphasis on extrinsic awards. It appears that when individuals are motivated more by intrinsic desires than extrinsic desires then there is greater creative thought and action. Nevertheless, it has to be stated that extrinsic rewards have to be present at a base level in order to ensure that individuals are atleast comfortable with their salary. Beyond the base salary thresholds it appears that innovation is primarily driven by self-esteem level rather than external monetary rewards. It appears that extrinsic rewards often yield only temporary compliance. Extrinsic rewards promote competitive behaviors which disrupt workplace relationships, inhibit openness

and learning, discourage risk-taking, and can effectively undermine interest in work itself. When extrinsic rewards are used, individuals tend to channel their energies in trying to get the extrinsic reward rather than unleash their creative potential (Pevaiz K. Ahmed, 1998).

Several companies have created in-house reward system that motivates employees to achieve goals of innovation, productivity and profitability. In companies where innovation is the driving force, an effective reward system motivates employees to take risk, develop successful new products and generate more new product ideas. Employee reward system should include such practices as providing freedom for creativity, financial rewards, promotion and other recognition (Arvind Singhal, 1989).

5. Freedom in work: The organizations that provide freedom to employees in their work and decision making promote innovation and influence a creativity culture in the organization. Freedom as a core value in stimulating creativity and innovation is manifested in autonomy, empowerment and decision making. This implies that personnel are free to achieve their goals in an automatic and creative way within guidelines. Personnel therefore have the freedom to do their work and determine procedures as they see fit within the guidelines provided (Elspeth Mc Fadzean, 1998). Management should believe in personnel and should encourage them to be more creative by allowing freedom. In other words, empowering them instead of controlling them (E. C. Martin et. al, 2003). The degree to which employees have freedom and authority to participate in decision making in solving problems determines the level of empowerment, which is positively related to the level of creativity and innovation in an organization (Wayne Morris, 2005). The speed of decision making can also promote or inhibit creativity and innovation. Cultural norms which lead to quick decision making promote the implementation of innovation (Scott w., 1998).

Empowering people to innovate is one of the most effective ways for leaders to mobilize the energies of people to be creative. Combined with leadership support and commitment, empowerment gives people freedom to take

responsibility for innovation. Empowerment in the presence of strong cultures that guide actions and behavior produces both energy and enthusiasm for consistent work towards an innovative goal. Employees themselves are able to devise ways that allow them to innovate and accomplish their tasks. The only serious problem with empowerment occurs when it is provided in an organization without a strong value system capable of driving activities in a unified and aligned manner to the super-ordinate goals of the organization. In these conditions, empowerment is little less than abdication of responsibility, and when responsibility and power is pushed downwards (Pervaiz K. Ahmed, 1998).

6. Clear Goals: In order to build an innovative culture in the organization, there must be clarity of goals that have to be achieved. It is also important that employees should understand the vision and mission and the gap between the current situation and the vision and mission to be able to act creatively and innovatively (E. C. Martin et. al, 2003). The vision and mission of an innovative organization are also customer and market oriented, focusing on solving customer's problems among other things. In fact, results shows that creative people are more likely to take the initiative when goals are clearly defined. Organizational goals and objectives reflect the priorities and values of organizations and as a result may promote or hinder innovation. It appears that reflecting the value of purposefulness in the goals and objectives of organizations has an influence on creativity and innovation (Elspeth Mc Fadzean , 1998).

Managers should encourage "visioning". Creative thinkers look into the future and visualize where they would like to be in five or ten year's time. This can be applied to the company as a whole or to a department or section or to products, services, procedures and processes (VanGundy, 1988). This is evidenced by the fact that the best performing companies had a clear set of guiding beliefs for their group activities (Peters and Waterman, 1982).

Vision is a transcendent goal that represents shared values, has moral overtones, and provides meaning; it reflects what the organization's future

could and should be (Cook , 1998). A mission appears to provide two major influences on the organization's functioning. First, a mission provides purpose and meaning, and a host of non-economic reasons why the organization's work is important. Second, a sense of mission defines the appropriate course of action for the organization and its members. Both of these factors reflect and amplify the key values of the organization (Pervaiz K Ahmed, 1998).

7. Risk Taking: Taking risks and experimenting are behaviors that are associated with creativity and innovation. A culture in which too many management controls are applied will inhibit risk taking and consequently creativity. Risk can be defined as the extent to which there is uncertainty about whether potentially significant and/or disappointing outcomes of decision will be realized (Elspeth Mc Fadzean , 1998). Simply stated, to engage in a creative effort is not a risk free proposition. Consequently, new ideas can pose a risk to an employee because they represent disturbances in routines, relationships, power balances, and job security. The assumption that risks may be taken as long as they do not harm the organization will not encourage personnel to be creative and innovative by experimenting and taking risks. It is important that a balance should be reached in the degree to which risk taking is allowed. This can be achieved by spelling out expected results, assigning the responsibility of monitoring and measuring risk taking to someone in the organization, 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 (E. C. Martin et. al., 2003).

Employees need to know the level of risks that they can take safely. This helps them to define the space within which they are allowed to act in an empowered manner, and the occasions when they need to approach organizational ratification for engaging in actions. For example, employees need to understand how much time they can spend on their pet projects, and how much effort they need to ensure that their "routine" operations are not made sub-optimal. They need also to understand the penalties if

inefficiencies creep into aspects of their task. In this way, understanding of risk provides clear definition of the priority and space for innovative actions. Without knowing that risk tolerance exists within the organization, employees tend not to be willing to try and innovate, or engage in activities that are a departure from tradition. The best way for leaders to define the action space, is not to be so precise as to discourage innovation, but to stipulate a broad direction which is consistent and clear. This means that as leaders they must be capable of accepting ambiguity, and able to place trust in employee's ability to stretch out to goals rather than prescribe details of specific actions which stifle smother creative actions.

Arvind Singhal states that developing innovative products is a risk taking venture. Innovative companies realize that to succeed time, money and talent need to be invested in the culture. One can't win if he does not play. Innovative companies accept the failure as a price of playing the game. Senior management encourages individual's initiatives and risk taking (Arvind Singhal, 1989).

Todd argues that an employee's willingness to take risk is an important antecedent of creative effort. Creative efforts implies personnel risk, as they are ideas or behaviors that are not within the normal range of work (Todd, 2004).

8. Design of the workplace: Workplace design is also an important factor that promotes a creativity culture in the organization. The design of workplace can enhance the physical environment to enhance innovation. Design of the workplace should be such that there should be adequate space for discussion between the individuals and groups. Workplace should be designed in such a way that, all the places where individual or groups meet must be equipped with modern facilities for discussion i.e. computers must be installed at the places, there should be provision of boards and modern information systems such internet, electronic mails etc. If an individual or group generates a new idea he/they should be able explain to others.

2.9 INDIVIDUAL CHARACTERISTICS

Individual characteristics comprise of the following factors.

1. Handling of Mistakes: The culture of the organization should be such that there must be tolerance for failures. It has been estimated that on an average 70 to 80% of the times innovative projects lead to a failure. The organization culture should be such that they must recognize the cause of failure and should not discourage it. The logic is to institutionalize an effective method for maintaining organizational memory (Wayne Morris, 2005).

Employees can only be encouraged to think creatively if they are not afraid of criticism or punishment. For example, if a project fails and the champion is in fear of losing his job then he will never take the risk of thinking creatively again (Anderson et. al., 1992)

The way in which mistakes are handled in organizations will determine whether personnel feel free to act creatively and innovatively. Mistakes can be ignored, covered up, used to punish someone or perceived as a learning opportunity. Tolerance of mistakes is an essential element in the development of an organizational culture that promotes creativity and innovation (Pervez K. Ahmed, 1998). Successful organizations reward success and acknowledge or celebrate failures, for example, by creating opportunities to openly discuss and learn from mistakes. An organizational culture in which personnel are encouraged to generate new ideas, without being harmed, and where the focus is on what is supported instead of on what is not viable, should encourage creativity and innovation.

2. Effective leadership: Effective leadership is a critical factor to enhance organizational creativity. In fact, without effective leadership very few other factors will work for success of creativity in an organization. Leaders have a big part to play in enhancing organizational creativity. It is the task of organizational leaders to provide the culture and climate that nurtures and acknowledges innovation at every level (E. C. Martin et. al, 2003). While individuals should take responsibility for their own areas, a leader has a big

impact on the organization dynamics and environment that individuals operate in and it can become increasingly frustrating for someone to be inspired and creative when their leader isn't supportive.

Leadership is the key to success with regards to creativity in the workplace. The leader sets the vision, goals and culture that all must live and breathe. Creation of a culture that allows and enhances innovation is the key to re-invention and it is not effective when the leadership is not effective.

Employee perceptions of supervisory encouragement are significantly related to creativity (Gryskiewicz et. al, 1989). Supervisors provide encouragement of creativity by valuing individual's contributions and showing confidence in the work group (Amabile et al., 1996). Leader behaviors that foster follower's self-efficacy lead to higher levels of follower's creativity (Redmond et al., 1993).

There is a consensus that a democratic, participative leadership style is conducive to creativity, whereas more autocratic styles are likely to diminish it (Nystro EM, 1979). Leaders must effectively communicate a vision conducive to creativity through any available formal and informal channel of communication and constantly encourage employees to think and act beyond current wisdom (Cook, 1998). In other words, the leader must abide by all aspects of vision concerning creativity in the organization, even in informal settings, because every action is observed and interpreted by subordinates.

Over the years, scholars have proposed a number of elements that leaders must possess in order to develop the conditions upon which organizational creativity can flourish. A leader should possess the ability to constitute effective work groups which reflect a diversity of skills and consist of individuals who trust and communicate well with each other, challenge each other's ideas in constructive ways and are mutually supportive. Leaders should also be in a position to balance employee's freedom and responsibility, without domination or control, while at the same time they have to show concern for employee's feelings and needs, generously recognize creative work and encourage employees to voice their own concerns, provide feedback, and facilitate skill development (Amabile, 1996).

In order to build a successful and sustainable culture of innovation, leadership needs to accomplish two broad tasks. First, leaders need to be acutely sensitive to their environment and aware of the impact that they themselves have on those around them. This sensitivity enables them to provide an important human perspective to the task at hand and is critical because it is only within this awareness that the leader can begin to bridge the gap between "leader speak" and the real world of organizational culture. The second factor is the ability of leaders to accept and deal with ambiguity. Innovation cannot occur without ambiguity, and organizations and individuals that are not able to tolerate ambiguity in the work place environment and relationships reproduce only routine actions (Elspeth Mc Fadzean , 1998). Innovative structures for example cannot have all attendant problems worked out in advance. Leaders need to build a deep appreciation of this fact, otherwise there will be a tendency to create cultures of blame. Tolerance of ambiguity allows space for risk taking, and exploration of alternative solution spaces which do not always produce business results. This hedges against constant deployment of tried and tested routines for all occasions (Pervez Ahmed, 1998).

3. **Motivation of the Staff:** Motivated staff is essential in order to create a culture that supports creativity. It is said, "No Motivation No Creativity". Firms that develop a work environment which motivates their employees to engage in a behavior consistent with this goal will only succeed. These organizations will be able to recognize and solve contemporary problems and bring solutions to the marketplace sooner than their competitors who fail to develop such an environment (Houschild et. al., 2001). Since productive knowledge in organizations is ultimately a product of human mind, it cannot be manipulated like sophisticated machines, fancy systems, or efficient controls. Organizations that desire to use knowledge in their products, processes, and services, have to know how to engage the human mind in their operations.

Every organization has some sources i.e. making the work attractive, making it challenging from where employee motivation sprouts etc. It may depend on how management loads these sources with the factors that energize, direct, and maintain appropriate work behavior in them. Because the presence of these factors will cause motivation in employees, we call them the antecedents of motivation. Their successful connection with the employees will excite and energize them rather than create or recognize a need-deficit and then fulfill it, or simply fulfilling a preexisting need. In fact, the presence of these antecedents will give the employees what is needed to motivate them to innovate. Employee motivation can be achieved by the presence of the right antecedents. If they connect with the employees, i.e. if employees find them exciting, they get motivated. In the alternative, they do not (Strempel, 2003).

Intrinsic motivation is a key driver of creativity (Baron and Harrington, 1981). In fact extrinsic interventions such as rewards and evaluations appear to adversely affect innovation motivation because they appear to redirect attention from "experimenting" to following rules or technicalities of performing a specific task.

4. Time: According to Gustafson, one of the most important resources which leaders may allocate to foster creativity is time (Gustafson, 1988). Productivity goals undermine creativity (Shalley, 1995). Time pressure has been identified as a real barrier to creativity. An organizational culture that promotes creativity and innovation should allow employees time to think creatively and experiment. In organizations where creativity and innovation are encouraged, personnel are, for example, allowed to spend 15 percent of their time on generating new ideas and working on their favorite projects (Wayne Morris, 2005). Emphasis on productivity and downsizing, which leads to more pressure on employees to work harder, is not conducive to creativity and innovation in organizations. It has been seen that, people are least creative when they are fighting the clock (A. D. Amar, 2004). Anderson conducted a survey and defines that, kind of time- pressure hangover exists,

when people are working under great pressure. Their creativity goes down not only on that day but the next two days as well. Time pressure stifles creativity because people can't deeply engage with the problem. Creativity requires an incubation period. People need time to soak in the problem and let the ideas bubble up (Anderson et al, 1993). Amabile argues that the two main resources that affect creativity are time and money. She stresses explicitly the importance of the quantity of time and money that should be given to employees, since they can either support or constrain creativity. For instance, when managers do not allow time for proper experimentation, they are unwittingly standing in the way of the creative process (Amabile, 1998).

5. **Effective Processing of Ideas:** The organizations must build a culture in which effective processing of ideas is done. Every idea must properly be judged in order to check its effectiveness. The merit and demerits of the idea must be clearly defined (Strempel, 2003).

The organization should build a culture where ideas come from every corner of the organization i.e. every employee must contribute in idea generation. The evaluation of the ideas must be done to identify innovative refinements to existing ideas and to make sure that certain new ideas did not repeat mistakes made in the past. This type of processing helps the organization to enhance organizational creativity and increase a participative climate in the organization (Cook, 1998). Fair evaluation of ideas will also support and encourage creativity. Evaluating creative ideas in a way that optimizes creativity is delicate. Amabile's review of the effects of evaluation suggests that both favorable and unfavorable evaluation of creative performance can harm creativity (Ambile, et. al, 1996). Yet some studies have found a positive relationship between expected evaluation and creative performance (Shalley, 1995). Positive and negative performance feedbacks are extrinsic consequences for one's efforts and can undermine one's sense of self-determination (Deci and Ryan, 1995). Evaluation of creative performance should be fair and supportive, and should be chiefly informational. Such

feedback provides an opportunity to revise one's creative ideas without making criticism or praise salient (Oldham and Cummings, 1996).

6. **Effective Training Program for Continuous Learning:** Improving the employee's creativity is important if the organization has to compete successfully in global competitive environment. For developing and implementing new technologies, there must be an effective training program. There are a variety of training programs for improving employee's knowledge and skills. Organizational culture that supports a continuous learning orientation should encourage creativity and innovation. By focusing on being inquisitive, encouraging personnel to talk to one another (e.g. to clients within and outside the organization to learn from them), keeping knowledge and skills up to date and learning creative thinking skills, a learning culture can be created and maintained (Elspeth Mc Fadzean, 1998). Creativity training assigns a central role to deferred judgment and focuses on the use of checklists and forced relationships. Studies evaluating creative training find that trained subjects perform better than untrained subjects at using the instructions to defer judgment and there is a moderate to large effect on creativity.

Creativity training involves both individual and group problem-solving techniques. The term brainstorming is normally associated with the group training variation of creative problem solving, but the technique is effective for independent individuals as well. The program teaches participants to use a five- stage approach to problem solving, Fact Finding, Problem Finding, Idea Finding, Solution Finding, and Acceptance Finding over a series of several sessions (Scott W., 2001). The Productive Thinking Program and the Purdue Creative Thinking Program are designed for use with schoolchildren. The Productive Thinking Program presents subjects with several instructional units consisting of a mystery story that leads them through problem solving using various techniques. The Purdue Creative Thinking Program uses a series of tape-recorded presentations and narratives integrated with creative problem- solving exercises. The presentations contain instructions and

persuasive statements on creative thinking, followed by stories about famous leaders, inventors, and discoverers. The creativity exercises allow subjects to practice, improving their fluency, flexibility, and originality in writing and drawing (Wayne Morris 2005).

Self-statement creativity training teaches participants to use self-instruction statements believed to enhance creative performance. The self- instructional techniques that assist in the development of self-control can also increase creativity. The self-statements used in this form of creativity training encourages participants to engage in a controlled regression to playful modes of thinking and attend to their ongoing streams of thought, becoming more aware of their internal monologue and sensory imagery. The training is accomplished by means of group discussion, modeling, and rehearsal. Participants are instructed to say these statements to themselves before and during problem solving. Subjects in the training group have reported to demonstrate significant increases in flexibility and originality on standard creativity tests, while subjects in the control group do not improve (Scott William, 2001).

Synectics is a creative problem-solving method that is guided by two principles; make the strange familiar (through metaphors and analogies) and make the familiar strange (by finding new ways of viewing a problem). Like brainstorming, synectics uses deferment of judgment. However, unlike brainstorming, it puts emotions and non- rationality to greater use. Group members take turns serving as the group leader. The leader's role is to cultivate member’s creativity and avoid directing the group towards one problem solution (E. C. Martin et. al.,2003).

Object stimulation is an idea generation technique that can be used to explore the problem space as well as to enhance solution development. The technique encourages participants to view the situation from a different perspective by using unrelated stimuli. The group members are asked to develop a list of objects that are completely unrelated to the problem. Each individual then needs to select one object and describe it in detail. The group uses each description as a stimulus to generate new and novel ideas. The

facilitator writes each idea down. This process continues until each group member has described an object or until each object has been described. The objects that are chosen can range from garden tools to animals to organizations to pictures. This technique requires more imagination than any other technique and may therefore cause some discomfort to some team members who feel that it may be "a waste of time". In fact, research has shown that Object Stimulation is a more powerful tool in terms of creativity (McFadzean, 1996).

Metaphors can be used to create a fantasy situation so that a new perspective of the problem can be gained. There are different types of metaphors that can be used for problem solving and opportunity finding. These include metaphors of nature, vehicle metaphors, creational metaphors, the journey metaphors and so on. The group members are asked to write a brief statement of the problem. The facilitator asks the group to select a metaphor category or he or she can stipulate the category to the group. Each individual then needs to describe the situation using the metaphor category. The facilitator needs to stipulate whether the description should be of the present situation or the ideal situation. Using the descriptions developed by each team member, the participants can generate new ideas. Again, this method requires some imagination by the group. The development of metaphors, however, may be difficult for some people and will require practice. Nevertheless, once it has been mastered the results produced can be very creative (Scott W., 2001).

Wishful thinking is a technique that forces participants to look at a "perfect future". By using this method, group members are allowed to develop a goal that can be attained. Moreover, it can increase their motivation and help to change their perspective. The group members are asked to write a brief statement of the problem. The facilitator tells the group to assume that everything is possible. Each individual then needs to develop some fantasy statements about the future using terms such as: *In the future, it would be nice if the organization did… What really needs to happen to be a great company is… If I were in charge of this situation I would do….* The group

members need to examine each fantasy statement and develop ideas on how these can be achieved. The new ideas that have been developed need to be explored and linked back to the present problem situation. This can be achieved by using statements such as: Although this is difficult to achieve, it might be possible to do that if we… This is not an easy technique because some of the fantasies can be difficult to develop into practical solutions. The group, therefore, must be very patient and enthusiastic about the process. Again, in order to be effective in using the technique, both the group and the facilitator should be experienced at using this type of CPS method. Moreover, the participants and the facilitator should have worked together before and should have developed a high degree of trust. If the technique is used properly, a number of different perspectives can be produced (Wayne Morris 2005).

Rich pictures is another technique that can help participants look at problems from a totally different perspective. It can change the patterns of thinking within the group. The group members are asked to write a brief statement of the problem. The facilitator then asks each individual to draw two pictures. The pictures may be a metaphor of the situation e.g. a vehicle or an animal. The first drawing would be a picture of how each participant would like to see the situation in the future. The second picture would be a drawing of how the participants see the present situation. Each participant is asked to describe the picture of the present first. Not only should he or she describe the picture but a description should also be given of the properties of the objects drawn and why they have been drawn that way. Next, a description of the picture of the future should be given. Again, the properties and the relationships of the objects should be described. From the descriptions given by the participants new ideas can then be generated. Rich pictures is a useful technique because the group can very quickly see what each member’s perception is of the problem and how he or she would like to see the future. Moreover, a picture can show a vast amount of information such as patterns, relationships and properties very effectively. It can be easily shared with the other group members and it allows all the participants to see the problem in its entirety

at a single glance. This method can also be used as a quick icebreaker at the beginning of a session. The group, however, needs to be aware of its effectiveness before participating as many people feel inhibited and embarrassed about their lack of drawing skills. The facilitator needs to explain to the group that the picture does not have to be a work-of-art as long as it makes sense to its creator and can be easily described to the group. The facilitator needs to be skilled at teasing information out of the participants while they describe their picture. There are times when information is not communicated because the facilitator has failed to ask the correct questions.

2.10 GROUP CHARACTERISTICS

The group characteristics comprise of following factors.

1. **Open Communication**: An organizational culture that supports open and transparent communication, based on trust will have positive influence in promoting innovation and creativity in the organization. An open-door communication policy, including open communication between individuals, teams and departments to gain new perspectives, is therefore necessary to create a culture supportive of creativity and innovation (Scott William, 2001). The open flow of communication is crucial for encouraging creativity in social settings and, thus, norms that promote open information exchange should facilitate creative performance (Amabile, 1988).

It has been seen that lack of open communication between the work groups and the organization is a major backlog in organization creativity. Earlier there was lack of information system in the organization, but nowadays because of technological advancement there is electronic mail, electronic news feeds and intranet facilities which have enhanced the organization information system (Arif Hassan et. al, 2006). Effective communication determines the personnel's understanding of the vision, mission and values of the organization and how these can be transformed into measurable individual and team goals and objectives (E. C. Martin et. al., 2003).

In order to build culture that support innovation, open communication is very important and it can be achieved by building strong relationship between the management and the employees (Wayne Morris, 2005).

2. Creative Problem Solving Teams: Creative problem solving teams that can work together and develop trust for one another must be formed (McFadzean, 1996). Problem solving teams will be more effective if the participants have the same goals and are supported by a trained facilitator (Briggs et. al,, 1996). Group members who share goal congruence will work towards their objectives together rather than working with hidden agendas and conflicting interests, which will ultimately reduce the efficiency of the group. In addition, the group will work more effectively together if it is supported by a competent facilitator. The facilitator helps the group to reach its objectives and can help the group to look at the situation from different perspectives by using a variety of creative problem solving techniques (McFadzean and Nelson, 1998).

Kling and Anderson explored the literature related to ``innovation in working groups''. They identified that the following factors promote innovation in a group environment:

1. A democratic, collaborative leadership style that encourages and motivates group members.
2. Cohesiveness between team members - A heterogeneous team is an advantage for idea generation to avoid ``group think'' and a homogeneous team for smooth implementation.
3. Group longevity - short-lived groups have been found to be more creative.
4. Group structure - a more organic structure is preferred to adapt to new problems.

They also highlight that groups are more willing to take risks than individuals, which can be advantageous if innovation is being inhibited by too much caution (Kling and Anderson, 1995).

West describes the innovation process at the group level. He lists the following facilitators of group innovation:

1. A Vision – a group should have a clear focus or goal that is negotiated and shared by the group, valued within the group, and is accepted as attainable.
2. Participative safety–The group works in non-threatening environment that allows motivated involvement in decision making by the group participants.
3. Climate for Excellence -The group members expect and welcome critical evaluation and appraisal of quality.
4. The company provides practical support for innovation.

Company vision and climate for excellence drive ``quality of innovation'', whereas participative safety and company support drive ``quantity of innovation''. All four factors need to be at a high level for the group to produce a large number of high quality ideas. West reports that large teams (more than 12 people) are less creative due to problems with communication and team co-ordination, whereas very small teams (03 or less) suffer from lack of diversity in idea generation (West, 1990).

Cooperative teams are identified by some authors as having an influence on the degree to which creativity and innovation take place in organizations. Well-established work teams which allow for diversity and individual talents that complement one another should promote creativity and innovation (Arad et al., 1997). Cross-functional teams which encourage social and technical interaction between developers and implementers can improve and promote creativity and innovation (Shattow, 1996). Another important aspect is that team members should be able to trust and respect one another, understand one another's perspectives and style of functioning, solve differences of opinion, communicate effectively, be open to new ideas and question new ideas (Elspeth Mc Fadzean, 1998). Such effective teamwork is partly based on team member’s skills and abilities and partly on the shared values within the group (e.g. values about shared trust and solving differences).

Managers can influence creativity in the way they design work groups. Work groups conducive to creativity have diversely skilled members, an openness to new ideas, high levels of interpersonnel trust, commitment to the work, and communication where members constructively challenge each other's ideas (Martins, 1996).

3. Cross-Functional Teams: **Cross functional teams comprise of members of different departments and disciplines brought together under one manager to make development decisions and enlist support for them throughout the organization. Cross-functional teams can also be defined as a group of people with clear purpose representing a variety of functions or disciplines whose combined efforts are necessary for achieving the team's purpose. The team may be permanent or adhoc and may include vendors and customers as appropriate. Glenn L. Taylor (1995) states that "Cross functional teams have considerable currency now as a logical means to generate more creative, less problem riddled solution, faster. By cutting across functions and assembling all the employees working on the same project onto a team, companies hope to reduce disputes among functions, pre-empt problems and unleash the energy and effort.**

The cross functional teams are used extensively and successfully in every aspect of industrial R&D. Despite little formal training, both the team members and their sponsors find that the team's output usually meets, and often exceeds expectations, where as knowledge of important goals, clean

communication and supportive management are key factors leading to team's success.

According to a survey conducted by Taylor of 100 odd companies, almost half of the companies are found to have 10 to 25 teams. Typical size of team is about 9-10 people. All teams consist of technical professionals, half also include technician and about half include managers as members. To develop an effective cross functional team three important items are required viz. clear goals, communication and customer involvement, and team structure and selection (Glenn L. Taylor , 1995).

David Wilemeon. (1998) defines that cross-functional teams are very important to build new products. He states that new products are occurring in speed, quality and efficiency, and even more is being demanded. The author states that companies are creating environments that are more likely to support authentic teamwork. It is noted that the goal is to get everyone focused on the business as a system in which functions are seamless. Organizations will increasingly demand people who think more broadly and thrive on change, who manage process instead of people and who cherish team work as never before.

CHAPTER - 3

SURVEY FOR TECHNOLOGY DEVELOPMENT STATUS

3.1 INTRODUCTION

This chapter presents a detailed survey conducted for small scale manufacturing units in the northern region of India covering the major cities in the state of Punjab. The survey explores the present status of R&D capabilities of the auto component industry with regards to R&D policies, infrastructural facilities, investments in R&D, organization for R&D, support from government and academic institutes etc. and the reasons for the low performance of small scale sector in the area of technological innovations.

3.2 METHODOLOGY

For survey, firstly a questionnaire was designed which seeks information on the status of technology development and its various aspects in the Indian industry. A simple, relevant and a comprehensive questionnaire has been designed that covers all the aspects of technology development through indigenous R&D. The questionnaire is divided into two sections. Section 1 seeks information on the general aspects of the industrial units. Section 2 seeks information on R&D policies, infrastructural facilities, investments in R&D, organization for R&D, support from government, academic institutes etc. The technology development process is considered to be dependent on four main factors viz. manpower, technology infrastructure, government support and interaction.

3.3 RESPONSE FROM THE INDUSTRY

A lot of effort was made to get maximum response from the industry. Most of the data has been collected by making personnel visits. The questionnaire was sent to 102 small scale manufacturing units. The response of the industry is presented in Table 3.1 A total of 42 industries out of 102 responded to the questionnaire.

Table3.1 Response of the Industry

S.No.	**Classification**	**Questionnaire sent to**	Response	
		No. of Companies	Number	**Percentage**
1.	Auto Components Industry	102	42	41

3.4 PURPOSE OF ANALYSIS

The analysis of the response has been carried out from the following view points.

1. To determine the percentage of companies which have certain departments and facilities for technology development or have conducted some programmes for the same.
2. To assess the main factors impairing the performance of the small scale manufacturing industry.
3. To assess the overall standing of each company, leading to categorization or classification of companies into very good, good, fair, poor and very poor classes.
4. To assess as to how each aspect as represented by a group of questions is being looked after in industry.

3.5 STATUS OF VARIOUS FACILITIES, DEPARTMENTS AND PROGRAMS

In this section, information concerned with the existence of departments, policies, facilities and running of programmes for technology development through indigenous research in various companies has been compiled. Table 3.2 shows the status of various companies in this regard. A department entrusted with the task of research and development (R&D) exists in 56% of the industries. A well defined R&D policy exists in only about one tenth of the industries. 50% of the industries have a proper marketing department to know about the customer requirements. State of the art infrastructural facilities for R&D are available in less than one tenth of the industries. About 44% of the industries provide formal training to the employees to enhance creativity and innovation skills for effective technology development.

Table 3.2 Existence of Department, Facilities, and Programmes

		Type of Industry
		Auto Component (In percentage)
1.	R&D Department	56
2.	R&D Policy	11
3.	Marketing Department	50
4.	Infrastructure facilities	9
5.	Formal Employee Training	44

3.6 FACTORS AFFECTING PERFORMANCE OF MANUFACTURING SECTOR

Section 2 of the questionnaire contains a question (Q. No. 16) seeking information regarding factors considered responsible for causing downfall of the small scale manufacturing industry (SSMI) in India. The information has been tabulated and presented in Table 3.3 and Fig. 3.1. Table 3.3 shows the scores achieved by different organizations in different factors. The number of companies scoring 4, 3, 2 and 1 on a 4 point scale has been shown and total points secured by all the 42 companies in every factor has been calculated and its percentage score based on the calculation has been tabulated in the last column of the table.

The analysis reveals that lack of government support to the small scale industry in the area of technology development and the use of old process technology by the industry are the prime reasons causing sickness. This fact also justifies the need of carrying out the present research work. Absence of large scale manufacturing industry in the state of Punjab is also a major reason causing downfall of SSMI. Shortage and cost of power, high prices of raw materials, inability to reduce the cost of manufacturing, absence of modernization programs, unorganized structure of the industry are some other major problems. Lack of financial support to R&D activities, shortage of raw material, competition from other countries like China etc. and underutilization of capacity are also considered as important reasons needing

attention. However, poor technical know how of workers, non availability of multi skilled labour, poor marketing management, poor infrastructure of rail and road transportation and geographical location are not considered as significant factors for poor performance of small scale sector in this part of India.

Table 3.3 Factors affecting SSMI

		No. of Companies Scoring Points					
		4	3	2	1		
1.	Shortage of Raw Material	11	8	8	13	97	60
2.	High Prices of Raw Material	11	13	10	6	109	68
3.	Shortage and Cost of Power	13	13	8	6	105	71
4.	Non Availability of Multi Skilled Labour	2	12	12	13	114	52
5.	Old Process Technology	16	10	10	4	117	73
6.	Shortage of finance	8	13	9	9	99	62
7.	Poor technical know how of workers	5	8	13	14	84	53
8.	Under utilization of capacity	5	13	14	13	91	57
9.	Absence of modernization programmes	8	16	8	7	106	66
10.	Absence of large scale industry	16	9	10	5	115	72
11.	Competition from other countries	8	12	8	12	96	60
12.	Poor transportation infrastructure	4	2	8	25	67	42
13.	Geographical location	0	4	7	28	56	35
14.	Poor marketing management	3	3	13	20	70	44
15	Lack of government support	17	10	8	4	120	75
16.	Unorganized sector	10	11	11	8	104	65
17.	Inability to reduce cost of manufacturing	12	11	11	7	107	67

3.7 CLASSIFICATION OF COMPANIES

The technology development process is considered to be dependent on four main factors viz. manpower, technology infrastructure, government

support and interaction. Total score of each company in the individual component of manpower, infrastructure, government support and interaction has been calculated from the raw scores. The total score of each company is divided by its maximum possible score to arrive at the percentage score of each company in each component as well as in all components take together. While deciding upon the choice carrying highest marks in each question, the levels achievable by small scale manufacturing industry in India were taken into consideration. Thus, a score close to 100

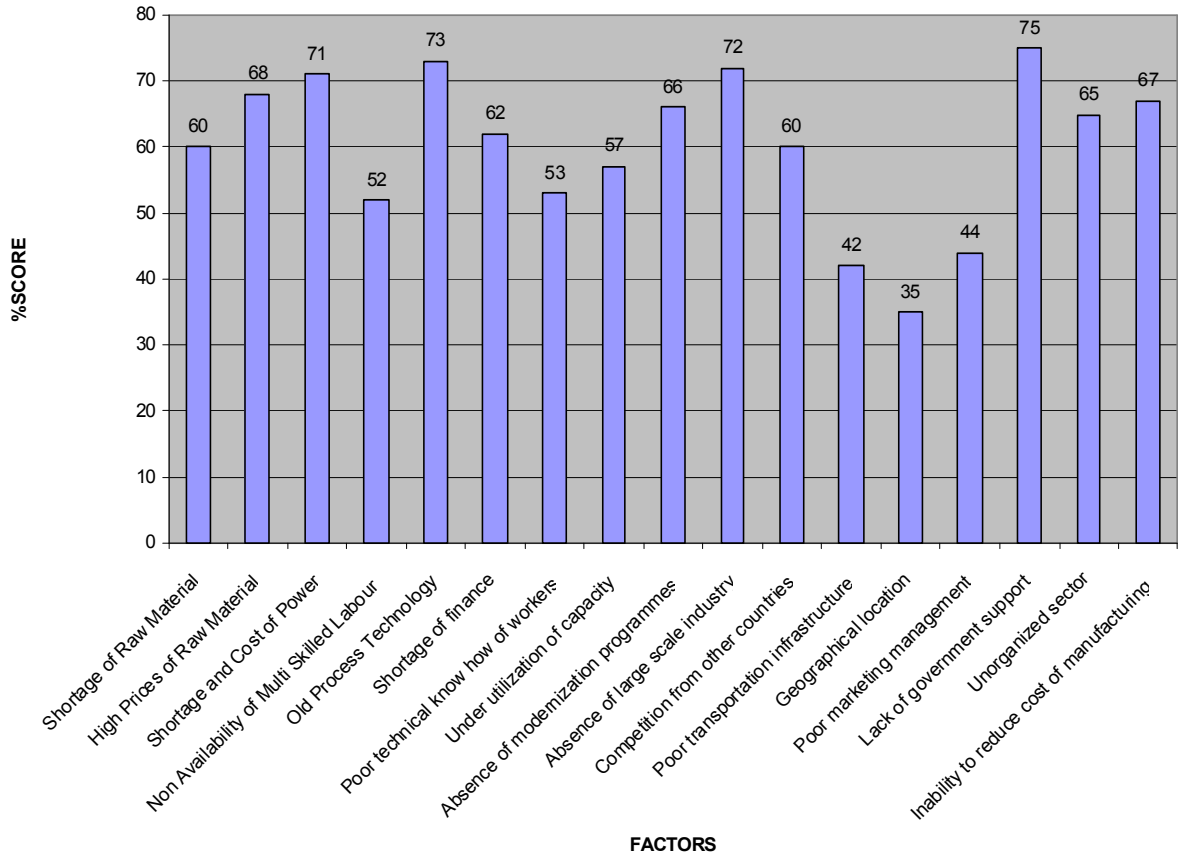


Fig. 3.1 Factors Affecting SSMI

will only be considered very good. Further, a company will score just 25% marks if all its answers to various questions fall at the lowest preferred choice and will get 100% marks if all the boxes ticked are of the highest score i.e. best choice. Table 3.4 presents the criteria used in classification of companies. Table 3.5 presents the range of percentage scores achieved by

companies and table 3.6 shows the classification of companies in each component.

i) According to the Table 3.4 and 3.5 performance of the companies is worst in Technology Infrastructure where the average score is only 50%.A total of 71% companies fall in poor and very poor range. 29% of the companies are doing fairly well and only 1% of the companies are at good level in this component. The percentage score achieved by different organizations in infrastructure component is depicted in Fig. 3.2 a.

Table 3.4 Criteria for Classification of Companies

Category No.	% Score	Inference	Grading
1	25 - 35	Industry at lowest stage. Nearly all responses to the lowest preferred choice on an average.	Very Poor
2	36 - 55	Industry at poor stage. Nearly all responses to the third or fourth proffered choice on an average	Poor
3	56 - 75	Nearly all responses to second or third choice on an average.	Fair
4	76 - 90	Industry at good stage. Nearly all responses to the first and second preferred choice on an average	Good
5	91 - 100	Industry at the highest stage. Nearly all responses to the highest choice on an average.	Very Good

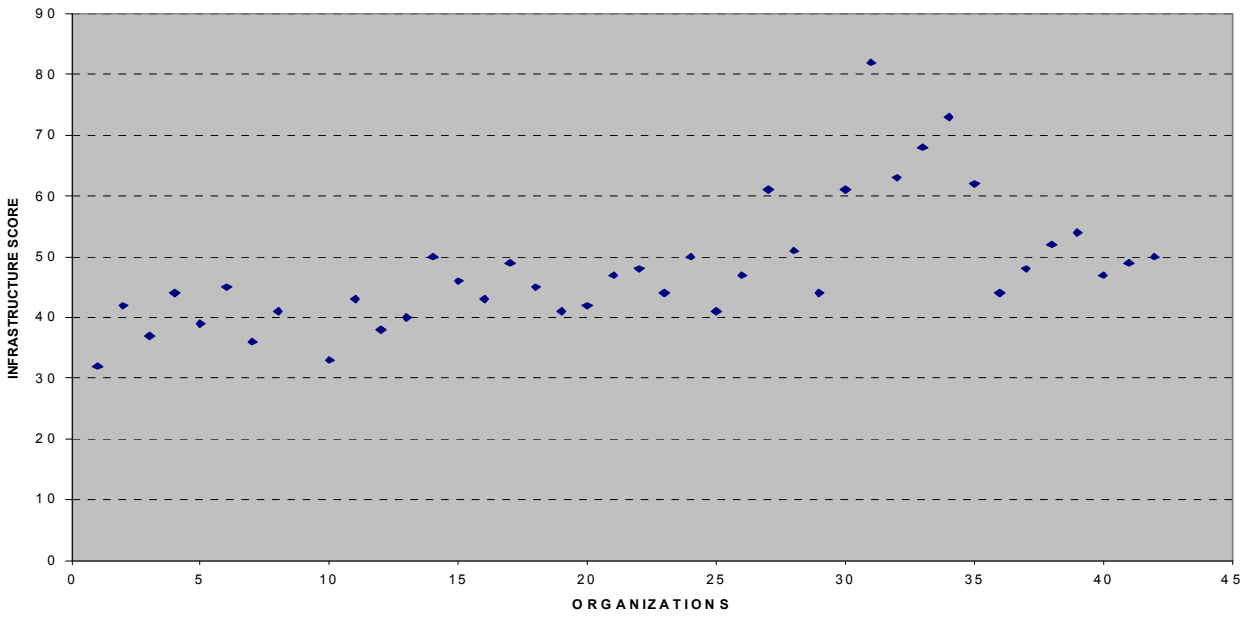


Fig. 3.2a Level of Technology Infrastructure in Different Organizations

Table 3.5 Range of Percentage Score of Companies

	Number of Companies				
	Manpower *	**Infrastructure ***	**Govt. Support ***	**Interaction*** **	
25-30			1	1	
31-35			1	4	
36-40	1		1	1	
41-45	3	3	3	2	3
46-50	2	7	4	7	7
51-55	6	9	4	2	9
56-60	9	13	6	8	13
61-65	11	8	7	4	8
66-70	4	2	4	3	2
71-75	5		7	8	
76-80			2	2	

81-85			1	1	
86-90				1	
91-95					
96-100					
Average	59%	50%	60%	58%	
SD	6.8	7.2	4.2	5.5	

*38 industries out of 42 had responded ** 40 industries out of 42 had responded*** 41 industries out of 42 had responded

ii) The next critical area is interaction which has an average score of 58%. Only 5% of the companies are at a good level as far as interaction with external agents viz. academic institutes, R&D institutes etc. is concerned. A little more than half of the companies are managing this resource well. More than 40% of the companies fall in very poor and poor range The percentage scored achieved by different companies in this component is depicted in Fig. 3.2b

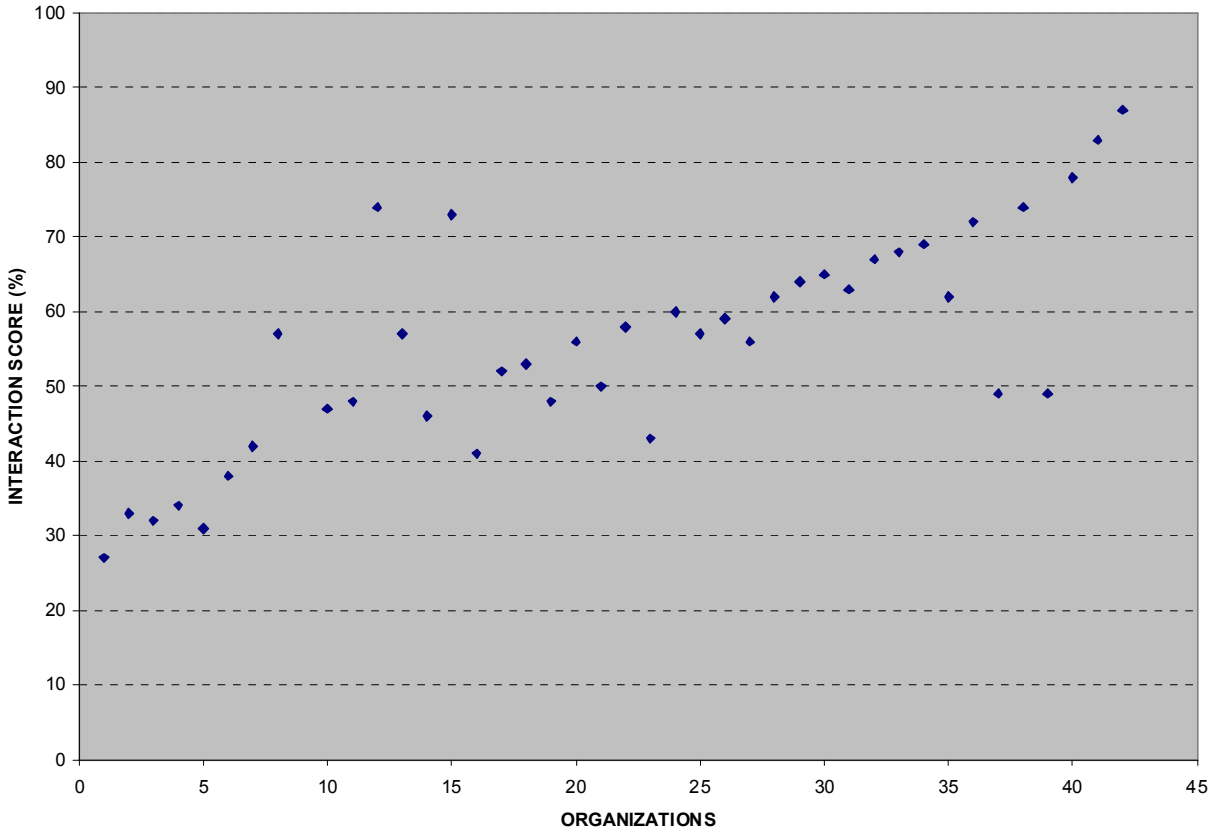


Fig. 3.2b Level of Interaction in Different Organizations

Table3.6 Classification of Companies

		Percentage of companies under				
		V. Good	Good	Fair	Poor	V. Poor
1	Manpower	-	-	69	31	-
2	Infrastructure	-	1	29	67	4
3	Govt. Support	-	3.8	59.5	30.4	6
4	Interaction	-	5	55	29	12
5	Overall	-	-	54	46	-

iii) The component of Manpower has received an average score of 59% .

About one third of the industries (31%) adopt those measures for management of manpower which render them a poor scorer. The remaining companies (69%) are at a fairly good level. The percentage score of different units in manpower is depicted in Fig. 3.2 c.

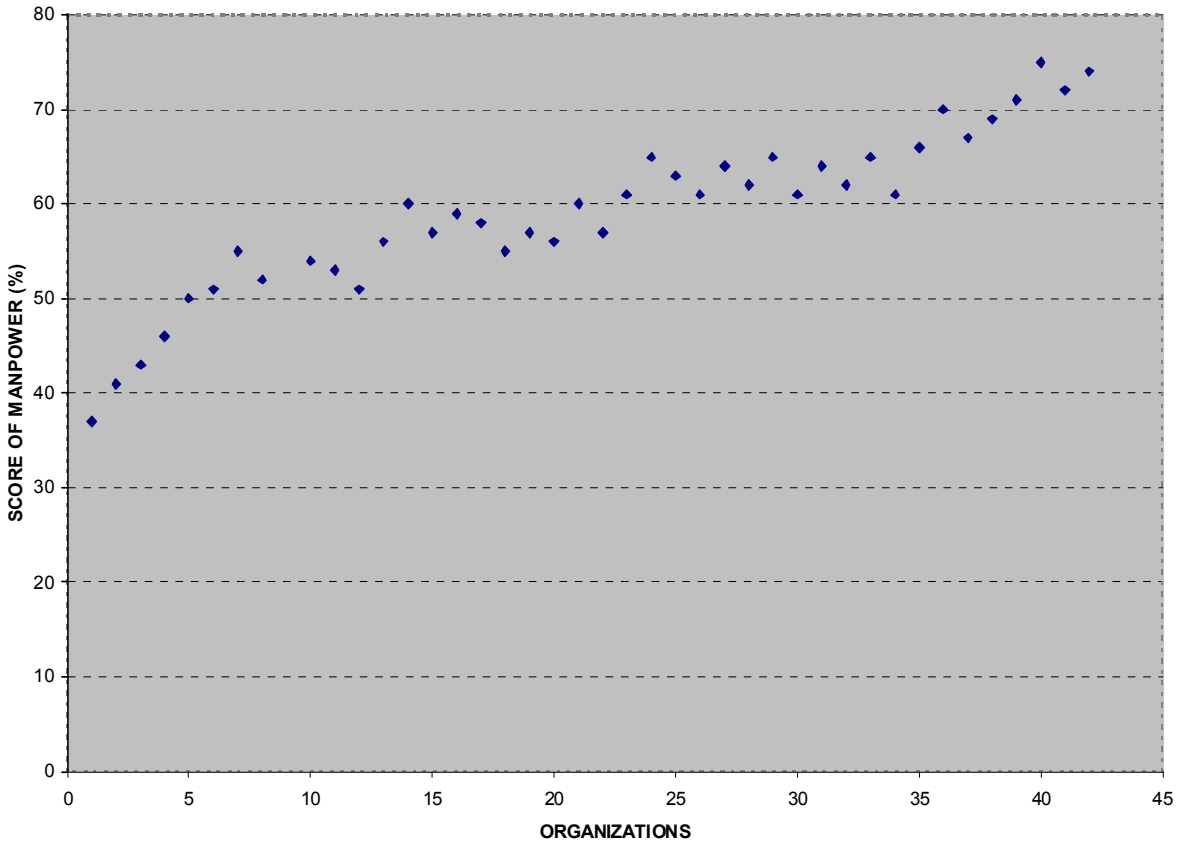


Fig. 3.2 c Level of Manpower in Different Organizations

iv) Government Support is also a very important factor and has received an average score of 60%. Only 3.8% of the organizations are managing this resource well and more than 30% of the companies are performing badly. A very large proportion of the units (about 60%) are doing fairly well in seeking government support for developmental activities. The percentage score of different units in this component is depicted in Fig. 3.2 d.

From the above analysis it can be concluded that out of the four main components required for technology development, infrastructure is the most

critical area which requires more attention followed by manpower, interaction and government support

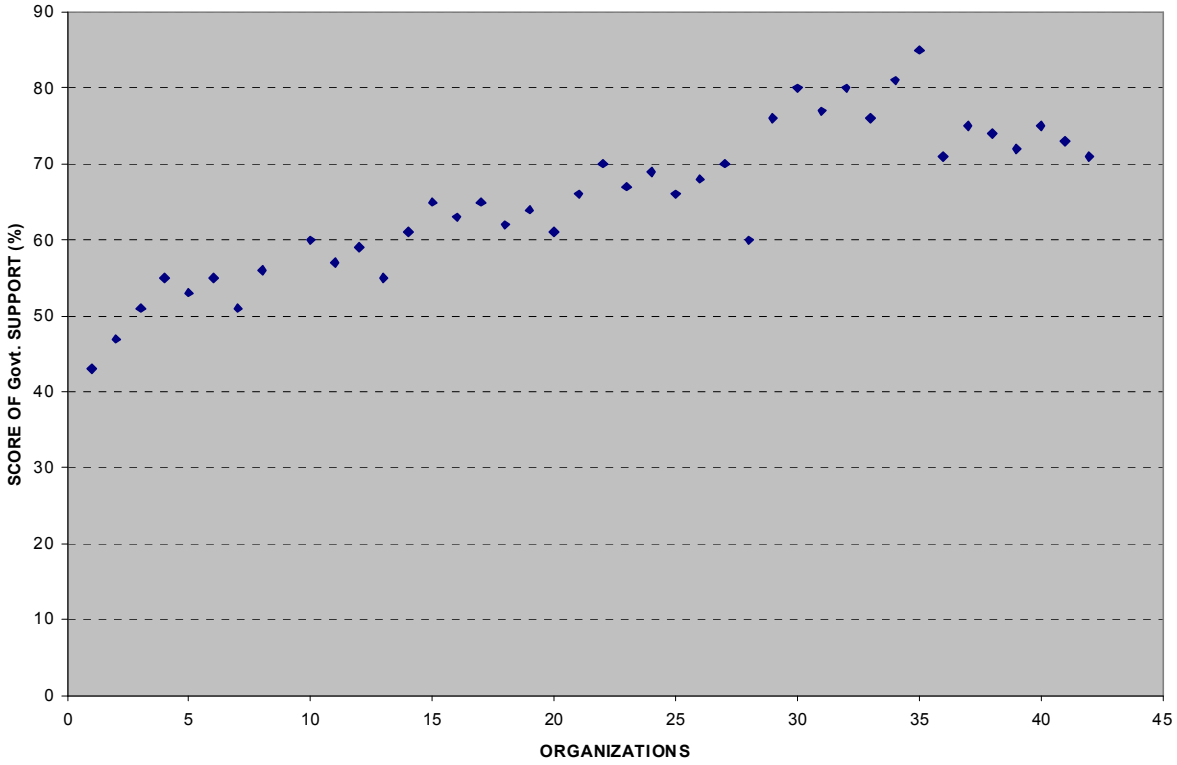


Fig. 3.2 d Level of Government Support in Different Organizations

3.8 STATUS OF VARIOUS COMPONENTS OF TECHNOLOGY UPGRADATION

From the file of raw data, the sum of scores of each component of technology development is calculated. The score has been divided by the maximum possible score the question could have got. This has been done separately for each component. Table 3.7, 3.8, 3.9, 3.10 gives a brief description of the area represented by each question on manpower, Infrastructure, government support, and interaction respectively. The average score of each question reflects as to how an area represented by a question is being looked after by the industry. The results are discussed below.

The grand average of score of manpower, infrastructure, government support, and interaction are 2.40, 1.94, 2.46 and 2.34 respectively as depicted by figure 3.3a, 3.3b, 3.3c, 3.3d.

3.8.1 Manpower

This section discusses the status of manpower aspect which is an important component of the technology development process in any organization. The results of the analysis are discussed below. The response to individual questions on this component is presented in Table 3.7.

In slightly more than 34% of the organizations, non availability of multi skilled labour is causing downfall in the technology development efforts. In nearly half the units, education level of the workers is not up to proper standards. Technical know how of the workers is reported to be extremely well and helpful in R&D initiatives in 35% of the industries. However, 14% of the industries report it to be at a poor level. For the remaining industries (51%), the level of the workers is between fair to good.

About 60% of the responding industries do not provide any formal training to the employees to enhance their creativity and innovation skills. Less than 5% of the organizations are providing formal training to the employees.

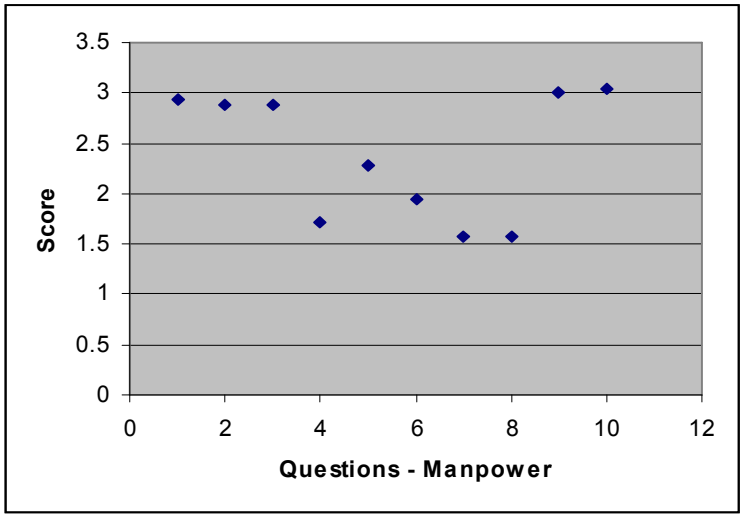
The organizations are not having adequate technical and scientific manpower to carry out R&D work. More than 59% of the units lack in the R&D initiatives because of non availability of scientific and technical manpower in sufficient number.

Majority of the organizations properly recognize the contributions of the employees in case the company makes profits because of their innovative efforts. More than 91% of the companies either give a fixed monetary reward, an increment in salary or a share in the profits made on account of innovation and majority of the units the management’s role has been supportive in case an R&D project fails. In more than 70% of the organizations the employees are advised to learn lessons from current failures to improve for future and are encouraged to continue with the R&D efforts.

3.8.2 Infrastructure

This section presents the status of financial support provided by the organizations to their R&D function and the availability of technology infrastructure for R&D work. One the major cause of sickness in small scale sector is non availability of funds for development

activities. About 22% of the industries face acute shortage of funds for developmental work and treat it as the most significant reason for downfall of Indian industry and less than 60% of the organizations have reasonable amount of financial support for developmental activities.



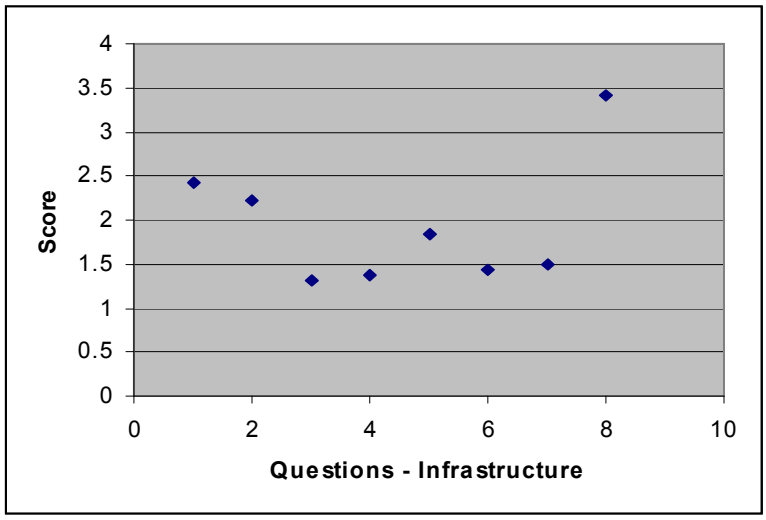
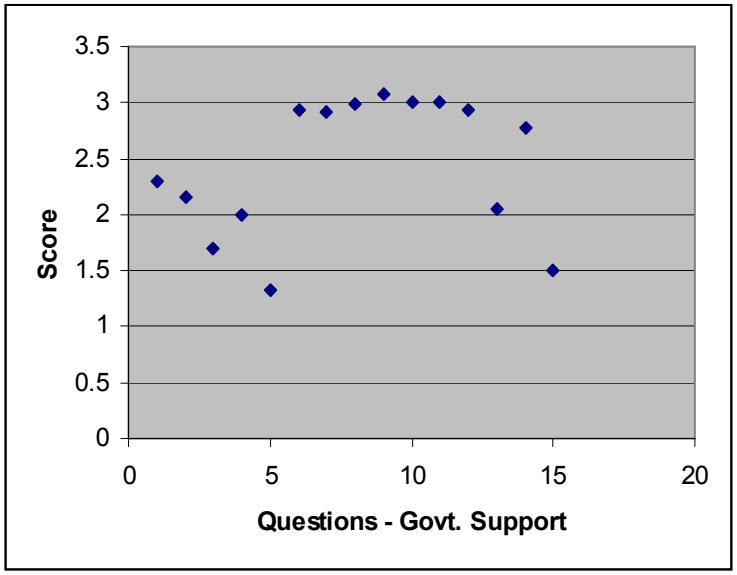


Fig. 3.3a Score of Manpower

Fig 3.3b Score of Infrastructure



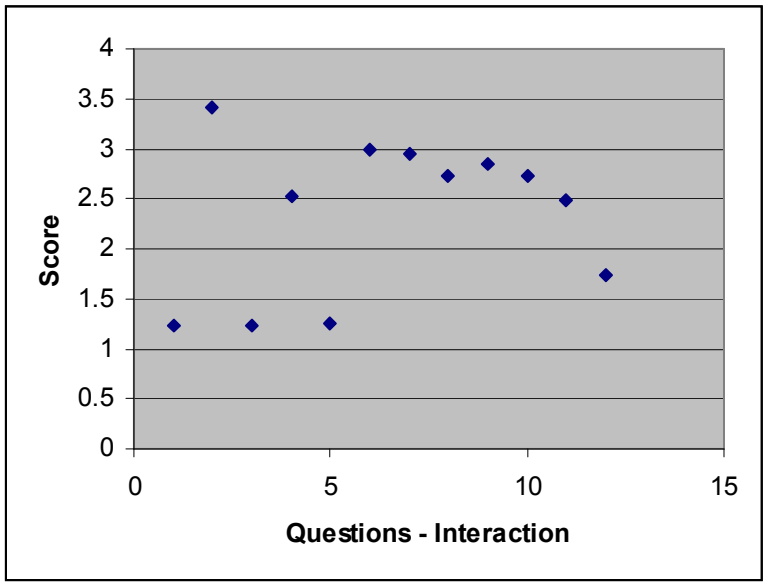


Fig 3.3c Score of Govt. Support

Fig 3.3d Score of Interaction

Table 3.7 Score of Various Questions – Manpower

	Q. No.			No. of Companies Scoring					
	In Questionnaire			1	2	3	4	Total	
1	16d	Non availability of multiskilled Labour	40	2	12	12	14	118	2.93

2.	16g	Education level of workers	40	5	8	13	14	116	2.89
3.	16g	Technical know how of workers	40	5	8	13	14	116	2.89
4.	28	Formal training to employees to enhance innovation skills	42	28	0	12	2	72	1.72
5.	35	Awareness of significance of technology up gradation	42	11	10	11	10	104	2.28
6.	36	Adequate scientific and technical manpower	42	17	14	8	3	82	1.94
7.	37	Encouragement to undertake R&D work	42	24	12	5	1	66	1.57
8.	37	Encouragement to obtain patents	42	24	12	5	1	66	1.57
9.	39	Reward scheme for innovative effort	42	1	1	38	2	126	3.00
10.	40	Reactions to R&D project failure	42	3	0	31	8	128	3.04
		Overall average							2.40

More than 75% of the organizations do not clearly earmark funds for R&D activities. In 6% of the organizations some earmarking is done subject to availability of funds and only 1% of the organization have earmarked funds for development activities

More than 60% of the companies spend less than 0.5% of their annual turnover on R&D and about 23% of the industries spend between 0.5–2.5% of their annual turnover on R&D. The number of units whose spending compares the global standards is less than 4%.

The absence of modernization and renovation programmes is an important factor preventing the development of this class of industry. About 27% of the units consider this factor most significant in causing sickness in the small

scale industry. Another 61% of the industries feel that this factor is important. However about 13% of the industries regularly implement modernization and renovation programmes and consider this factor as least significant in impairing performance of the auto components industry.

The response to individual questions on this component is presented in the Table 3.8.

Table 3.8 Score of Various Questions – Infrastructure

	Q. No.			No. of Companies Scoring					
	In Questionnaire			1	2	3	4	Total	
1	16f	Funds for R&D activities	40	9	14	9	8	96	2.43
2.	16i	Modernization and renovation program	40	11	15	10	5	89	2.23
3.	27a	Dedicated labs for experimentation and analysis	40	32	4	3	1	52	1.31
4.	27b	Sate of the art production facilities	41	31	6	4	0	56	1.37
5.	27c	Latest software for modeling and simulation	41	19	12	7	3	75	1.84
6.	29	Earmarking funds for R&D activities	42	33	3	4	2	60	1.43
7.	30	Investments in R&D as a fraction of annual turnover	40	26	9	3	2	60	1.49
8.	31	Main source of funds for R&D	42	8	4	6	28	144	3.42
		Overall average							1.94

In about 74% of the organizations the state of the art production equipment is not available. Only less than 11% of the industries have such facilities at an acceptable level. For carrying R&D work there must be dedicated

laboratories with facilities for experimentation and subsequent analysis. More than 80% of the industries do not have these facilities at all. Only 11% of the organizations have such facilities at an acceptable level. Only 1% of the industries have proper R&D infrastructure for experimentation, testing etc.
The average score of this aspect is 1.94 (out of 4) which is very discouraging. Industry must understand that its survival is not feasible in the absence of R&D practices and for that technology infrastructure is needed.

3.8.3 Government Support

This section discusses the role of government in supporting small scale industry in the region in the technology development efforts.
More than one fourth of the organizations feel that the cost of raw material is exceptionally high. Another 34% of the organizations consider raw material prices to be very high affecting industry performance. However the remaining organizations do not consider raw material prices to be a significant factor impairing small scale sector's performance.
Shortage and cost of power is a major problem impairing the performance of small scale industry. More than 65% of the organizations feel, shortage as one the major cause which is affecting the small scale sector whereas less than 30% industries are not facing any problem as far as availability and cost of power is concerned.
Good transport infrastructure plays a vital role in increasing competitiveness of any manufacturing industry. More than 85% of the units feel, government is performing fairly well as far as maintaining rail and road infrastructure in the region.
Government has failed miserably in providing funds to the industry for R&D activities. 80% of the industries do not receive any financial help from the government for R&D. For 13% of the organizations government is only a minor source of R&D funds. There are only 7% units which consider government as the major or main source of funds for R&D related work.
About 57% of the organizations strongly urge that government should suitably reward the entrepreneurs who are making contributions in the field

of technology development. However 19% of the units consider reward schemes to be of no use.

More than 50% of the organizations feel that government should organize seminars for awareness on technology development, 25% feel that it is significant where as remaining do not consider such a support of government to be worthwhile.

A little more than half (54%) of the industries want the government to provide its laboratories for developmental projects on subsidized rates to the industry. Another 13% of the units believe that even if government laboratories are provided occasionally to the industry for R&D related work, the industry would be greatly benefited.

The response to individual question is shown in table 3.9.

Table 3.9 Score of Various Questions – Government Support

	Q. No.			No. of Companies Scoring					
	In Questionnaire			1	2	3	4	Total	
1	16d	Raw material prices	40	10	14	10	6	92	2.29
2.	16c	Shortage and cost of power	40	13	13	8	6	86	2.16
3.	16i	Transportation infrastructure	42	24	12	2	4	71	1.69
4.	16o	Policies regarding subsidies	39	17	10	8	4	78	1.99
5.	31a	Funding for R&D activities	42	33	6	1	2	56	1.33
6.	41a	Funding related to R&D performance	42	8	7	7	20	123	2.94
7.	41b	Funding related to annual turnover	41	10	4	6	21	119	2.91
8.	41c	Reward schemes of R&D initiatives	42	8	4	10	20	126	2.99
9.	41d	Organizing seminar for technology awareness	42	6	5	11	20	129	3.07

10	41e	Providing labs for R&D projects	41	8	5	6	22	123	3.00
11	41f	Assistance in acquiring imported technologies	42	8	5	7	21	126	3.00
12	41g	Sponsoring employee training program	42	9	5	7	21	123	2.94
13	48	Assistance from Govt. subsidiaries	42	27	0	0	15	86	2.05
14	49	Aware regarding Govt. subsidiaries	42	9	7	10	16	117	2.78
15	51	Assistance from Govt. run organizations	40	28	5	6	1	60	1.51
		Overall average							2.44

3.8.4 Interaction

This section presents the level of interaction of the industry with external agencies viz. academic institutes, R&D agencies etc. for technology development.

Small Scale manufacturing industry is largely dependent on external help for its process and product technology needs. The dependency of Indian firms is mainly on the national firms for providing new technologies. Nearly 83% of the industries buy almost all technology from other Indian firms.

Small scale manufacturing Industry in India is not working much in collaboration with external R&D institutes and agencies. 87% of the units have never worked in collaboration with external agencies. 7% of the units have partially developed some technologies through collaborations. In only less than 2% of the units, most of the product and process technologies have been developed through collaborations. There are 4% units who completely depend upon collaborations for their technology needs.

One other major mean of technology up gradation is through interaction with academic institutes. 60% of the units suggest that experts from academia can prepare roadmaps for making R&D an integral part of firm's working which definitely or to a large extent would be helpful. A little less than one

third of the units feel this activity to be helpful only to a small extent and the remaining one fifth consider this activity to be useless.

Another option in industry-institute interaction is that industry personnel can be trained at the institute laboratories. More than 30 % of the organizations feel that this activity is significant.

40% of the industries feel that combined supervision of M.E, Ph.D dissertations by industry and institute personnel on industry oriented problem would definitely or to a large extent help the small scale industry. However the remaining 60% of the industries do not consider this activity to be very useful.

The response to individual questions on this aspect is presented in Table 3.10

Table 3.10 Score of Various Questions – Interaction

	Q. No.			No. of Companies Scoring					
	In Questionnaire			1	2	3	4	Total	
1	21a	Technology acquired from abroad	42	34	5	2	1	52	1.24
2.	21b	Technology from within the country	42	5	2	5	30	143	3.41
3.	21c	Technology developed in collaboration	42	36	3	1	2	52	1.23
4.	42	Interaction with academic institutes	42	12	8	10	12	106	2.52
5.	43	Industry institute tie on R&D	42	35	3	3	1	53	1.25

6.	44a	Academia for preparing the road maps	42	7	11	9	5	126	2.99
7.	44b	Expert lectures from academicians	42	6	9	8	19	124	2.95
8.	44c	Training through S.T. courses	42	6	12	10	14	114	2.72
9.	44d	Combined teams for R&D	41	6	9	11	15	117	2.85
10	44e	Institute laboratories for analysis	42	7	11	11	13	115	2.73
11.	44f	Combined supervision of dissertation	42	8	17	5	12	104	2.48
12.	46	Collaboration with R&D institutes	42	26	6	3	7	73	1.73
		Overall average							2.34

Another means of industry-institute collaboration is formation of R&D teams comprising of members from industry and academic institutes to work mutually on R&D projects by sharing their specialized knowledge. Nearly two third of the industries consider this activity to be definitely helpful to a large extent in technology development. 22% industries consider this option to be beneficial only to a small extent whereas 15% treat this activity to be of no use.

Small scale industries can't afford to have state of the art infrastructure facilities for R&D. The survey revealed in an earlier section that about 90% of the industries do not have state of the art laboratories for experimentation and analysis. In the light of this fact, industry should utilize laboratories of regional academic institutes for testing, experimentation and subsequent analysis. More than 58% of the units consider this alternative to be helpful definitely or to a large extent in increasing technological capabilities of

industry. 27% of the industries feel that regional academic institutes can be of help to a small extent in this regard.16% of the units do not want to consider this alternative.

CHAPTER - 4
ORGANIZATIONAL CLIMATE FOR CREATIVITY - A CASE STUDY

4.1 GENERAL

The general objective of building this case study is to prove that organizational characteristics have a significant relationship with individual and group characteristics. The various factors discussed in the preceding chapters on how to develop an organizational climate that fosters creativity are being used here. The work has been carried out at "Preetika Industries Private Limited, Mohali". This small scale unit stated in the year 1974 has an annual turnover of 62 crores. The main products of the unit are brake housing, silencer etc. which are supplied to Mahindra & Mahindra, Ashoka Leyland, Tafe, Swaraj Majda and Eicher.

There are four main department viz. Production, Quality, Tool Room and Administration with a total employee strength of 150.

4.2 METHODOLOGY

This particular study is aimed to explore the effect of organizational climate on the employee's creativity. The study has used the analysis of variance (ANOVA) technique in an attempt to prove that both individual and group characteristics are significantly related to organizational climate.

The case study has been built at "Preetika Industries Pvt. Ltd., Mohali". To examine the organizational climate, the KEYS build by Amabile (Amabile, 1996) have been used. The KEYS have been attached in Appendix I. These keys are specially designed to judge the organizational climate. The KEYS have been filled by 41 employees at the said industry.

4.3 HYPOTHESES DEVELOPMENT

The literature survey suggests that employee creativity is positively related to organizational climate. It follows that:

H1. Organizational factors have a significant relationship on individual and group characteristics.

4.4 DATA COLLECTION

The sample used in this study is made up of the employees at "Preetika Industries Pvt. Ltd., Mohali". This method gave a high internal representativity, since we were able to ensure that the information supplied by the firm is correct. The employees included in the sample were given the questionnaire after a detailed explanation about the research objective. The employees were asked to respond to the questions, valuing aspects related to their job experience.

4.5 PROCEDURE

The keys in the questionnaire divided into three broad categories viz. organizational characteristics, individual characteristics and group characteristics. All keys under organizational characteristics have been grouped together in Table 4.1. Organizational characteristics comprise of keys (1,4,5,8,10,12,14,16,17,18,22, 25,29,31,33,34,37,38,39, 41,42,48,49,55,56,60,61,62,64,65,70,76). All keys under individual characteristics have been grouped in Table 4.2. Individual characteristics comprise of keys (2,3,7,9,11,13,21,30,35,36,43,44,46,47,51,52,53,54,59,63,68,69,73,74,75, 77) and group characteristics have been grouped in Table 4.3. Group characteristics comprise of keys (6,15,19,20,24,26,28,32,40,50,57,58,66,67,71,72). Each of the characteristic viz. organizational characteristics, individual characteristics and group characteristics are then further subdivided into different factors. Organizational characteristics have been subdivided into five factors viz.

culture, rewards, resources, freedom & risk taking and structure. Individual characteristics have been subdivided into four factors viz. leadership, motivation, training program, time. Group characteristics have been subdivided into three factors viz. communication, team building and problem solving approach. A total of 41 employees participated in this research program. Each employee was given a separate questionnaire and responded to each 77 keys/statements.

From the file of raw data, the sum of scores of each key was calculated. The score was divided by the maximum possible score each key could achieve. This was done separately for each key. Table 4.1, 4.2, 4.3 gives the description of the score achieved by each key used under each characteristic.

Table 4.1 Score of Keys in Organizational Factors

key Q[a]	Culture	Reward	Resources	Freedom & Risk Taking	Structure
1.				**1**	
4.					**0.31**
5.					**0.5**
8.	**0.625**				
10.	**0.25**				
12.	**0.5**				
14.					**0.56**
16.		**0.87**			
17.					**0.60**
18.	**1**				
22.		**0.68**			
23	**0.68**				
25			**0.625**		
27	**0.87**				
29					**0.68**
31			**0.815**		

33		**0.75**			
34		**0.75**			
37				**0.75**	
38				**0.625**	
39					**0.75**
41				**0.68**	
42				**0.68**	
45			**0.87**		
48				**0.625**	
49		**0.68**			
55				**0.75**	
56			**0.75**		
60		**0.5**			
61				**0.56**	
62			**0.625**		
64					**0.81**
65	**0.43**				
70				**1**	
76				**0**	
Q[a] text of question is attached in appendix I					

Table 4.2 Score of Keys in Individual Factors

Key Q[a]	**Leadership**	**Motivation**	**Training Program**	**Time**
2		**0.625**		
3				**0.43**
7		**0.68**		
9			**0.75**	
11				**0.625**
13			**0.81**	
21	**0.68**			
30				**0.37**
35				**0.625**
36	**0.47**			
43		**0.75**		
44		**0.81**		

46		**0.56**		
47	**0.625**			
51				**0.68**
52		**0.625**		
53	**0.81**			
54	**0.75**			
59	**0.75**			
63				**0.56**
68		**0.68**		
69	**0.43**			
73			**0.68**	
74		**0.75**		
75		**0.56**		
77	**0.68**			
Q[a] text of question is attached in appendix I				

Table 4.3 Score of Keys in Group Factors

Key Q[a]	Communication	Team Building	Problem Solving Approach
6		**0.625**	
15		**0.68**	
19			**0.81**
20	**0.53**		
24	**0.68**		
26			**0.5**
28		**0.81**	
32	**0.43**		
40		**0.87**	

50			**0.625**
57		**0.75**	
58	**0.5**		
66	**0.75**		
67		**0.93**	
71			**0.81**
72			**0.68**
Q[a] text of question is attached in appendix I			

After tabulating the data in tables a correlation matrix was obtained to judge the relationship between organization characteristic and individual/group characteristic. The factors pertaining to individual and group characteristics have been combined together in the correlation table. The results are shown in Table 4.4.

4.6 RESULTS & DISCUSSION

The results obtained from the correlation matrix are being discussed here.

The results show that leadership factor has a very significant relation with organizational structure and strategy employed in the organization though the relation with reward, resources and culture of the organization is not very significant.

Motivation of the employees is an important factor in a creative organization. The results show that culture of an organization plays an important role in motivating employees. When the organization provides adequate resources to the employees, their motivation levels are high. Structure and strategy also play a very significant role in motivating employees to work creatively.

Table 4.4 Correlation Matrix

Individual and Group Factors	**Organizational Factors**				
	Culture	Reward	Resources	Strategy	Structure
Leadership	**-0.135**	**0.034**	**0.052**	**0.262**	**0.357**
Motivation	**0.349**	**0.04**	**0.194**	**0.204**	**0.191**

Knowledge	**0.115**	**0.29**	**0.309**	**-0.14**	**0.211**
Time	**-0.236**	**0.239**	**0.151**	**0.114**	**0.52**
Communication	**0.034**	**0.49**	**0.42**	**0.121**	**0.309**
Team Building	**0.174**	**-0.06**	**-0.126**	**0.380**	**0.109**
Problem Solving Approach	**-0.009**	**0.32**	**0.34**	**0.52**	**0.342**

Table 4.5 Results of the ANOVA Test

a) SUMMARY

Groups	Count (N)	Sum (∑X)	Average (¯X)	Variance (σ)
Column 1	7	0.292	0.041714	0.038047
Column 2	7	0.975	0.139286	0.052746
Column 3	7	1.34	0.191429	0.034997
Column 4	7	1.461	0.208714	0.044561
Column 5	7	2.039	0.291286	0.018208

b) ANOVA TABLE

Source of Variation	Sum of Squares (SS)	Degree of Freedom (df)	Mean Squares (MS)	F_{calc}	F_{crit}
Between Groups	0.237777	4	0.059444	1.576288	2.689632
Within Groups	1.131347	30	0.037712		
Total	1.369125	34			

Continuous improvement of knowledge of employees is another very important factor which supports building up a creative climate in the organization. Culture in which the employees operate has a very significant relation in improving their knowledge base. Reward strategy of the organization also helps the employee in fully exploiting their knowledge base. The results show that the employees can capitalize their knowledge when they are given adequate resources. Also timely training to the employees to broaden their skills helps in broadening their knowledge base.

Effective communication is important in developing a creativity culture in the organization. The results suggest that a supportive structure plays an important role in improving communication in the organization. Availability of adequate resources viz. internet facilities etc also has a very significant effect in improving communication process in the organization. The results also reveal that even the reward schemes encourage communication in the organization.

Employees need time to work creatively. The results reveal that a supportive structure is also important in providing time to work creatively.

It has been seen that team building is very important to support a creative climate in the organization. The results show that the strategy adopted and the culture employed in the organization has very significant relation with team building whereas reward schemes have a negative effect on team building.

The results suggest that suitable reward schemes, adequate resources and supportive structure have a very significant relation with problem solving.

After obtaining the correlation matrix and discussing its results, ANOVA (Analysis of Variance) test was performed on the data to check again whether the organizational characteristics are significantly related to individual and group characteristics or not. The findings of the results are presented in Table 4.5. As from the results the calculated value of F is less than the table value (F_{crit}), therefore hypothesis is accepted.

The result supports the hypothesis H1 which states that "organization factors have a significant relation with individual and group Performance".

CHAPTER – 5

CONCLUSIONS AND RECOMMENDATIONS

The present study has been conducted with an objective to analyze various aspects of the working of small scale industry with regard to various functional elements of technology development. By conducting a survey through a specially designed questionnaire, status of various industrial units

with regard to technology development and the status of various resources of manpower, infrastructure, government support and interaction has been brought to light. A case situation has been represented to show the relationship between various factors needed to build a culture in the organization conducive to for creativity and innovation.

5.1 RESUTS OF THE SURVEY

a) General Areas

i. The response has been about 41%.

ii. Special departments aiming at technology development eg. R&D departments, Marketing Departments etc. exists in about half of the industries.

iii. State of art infrastructure facilities, proper R&D policy is nearly absent in the industry.

iv. Use of old process technology and lack of government support are the major factors causing sickness in the small scale units.

v. Nearly half of the companies fall in poor category with respect to technology development.

vi. In case of manpower, nearly one third of the companies fall in poor class. Infrastructure has two third of the companies in poor class and about 4% in very poor class. In government support, 30% of the companies are in poor class and another 6% in very poor. Interaction component has 29% companies in poor category and another 12 % in very poor category.

b) Manpower

vii. Technical know how of workers, their education levels are not major problems as far as technology development is concerned.

viii. Only very few industries are providing formal training to employees to enhance their innovation skills.

ix. More than half of the industries do not have the adequate scientific and technical manpower to carry out R&D work.

x. Majority of the organizations properly recognize the contribution of the employees in case the organization makes profits because of their innovation efforts.

xi. In case of an R&D profit failure, majority of the organizations don't discourage R&D initiatives but direct the employees to learn from current failures.

c) Infrastructure

i. Non availability of funds for developmental activities is a major problem faced by small scale units.

ii. In majority of the organizations, there is no clear earmarking of funds for R&D activities.

iii. The investments in R&D by the companies is very low. There are less than five units whose spending compares global standards.

iv. Absence of modernization and renovation programs is also an important factor causing sickness in this class of industry.

v. In majority of the organizations, state of the art production equipment is not available.

vi. Only very few organizations have a proper R&D infrastructure for experimentation, testing and subsequent analysis.

d) Government Support

i. Shortage and cost of power is a major problem impairing the performance of small scale industry.

ii. The condition of rail and road transport is to the satisfaction of industry.

iii. Government has failed in providing funds to the industry for R&D activities. Majority of the industries don't receive any financial help from the government for R&D related work.

1 Interaction

i. Majority of the small scale units purchase technology from other (bigger) Indian firms.

ii. Majority of the organizations have never worked in collaboration with external agencies for technology development.
iii. A very few firms have experienced industry-institute ties to solve technology related problems.

5.2 RESULTS OF THE CASE STUDY

The results obtained from the correlation table and ANOVA analyses are discussed below.

i. Leadership factor has a very strong correlation with organizational structure as well as strategy adopted in the organization.
ii. Motivation of employees is strongly correlated to structure, strategy and adequate resources available in the organization.
iii. The knowledge base of the employees can be fully exploited provided, a suitable reward system exists, and timely training is provided to employees.
iv. Communication system in the organization can be improved by having a suitable structure, reward schemes and adequate resources viz. internet facilities etc.
v. A supportive structure is very important in providing time to employees to work creatively.
vi. Team building greatly enhances innovation. It is strongly correlated to structure and culture prevailing in the organization.
vii. The results suggest that suitable rewrd schemes, adequate resources and a supportive structure have a significant relation with problem solving.
viii. The organizational characteristics are significantly related to individual and group characteristics as was sated by Amabile (1996).

5.3 LIMITATION OF THE STUDY

I. The study has been limited to auto component engineering industry of specified regions.

II. The study involved all the resources viz. manpower, infrastructure, government support and interaction. Because of this the domain of the study became very large and involved varied areas. Because of the multifacet areas included, the study has been restricted to analysis of resources. Implementation of the suggestion has not be carried out.

5.4 SCOPE OF FUTURE WORK

a. The work can be extended to other sectors of small scale industry viz. cutting tool, machine tool, hand tool etc.
b. The work can be extended for medium and large scale industries.

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APPENDIX II

QUESTIONNAIRE

This questionnaire has been specially designed to collect information regarding the organizational attitude towards creativity. The aim of this study is to check whether organization supports the employees to work creatively, and to build a culture of an organization that will support creativity.

The questionnaire is divided into two sections; section 1 solicits the general information regarding the employee and section 2 consists of keys specially designed to collect the information from the employee regarding the organizational climate. The each question has two options kindly encircle [O] the appropriate option.

We assure the confidentiality of the information provided by you. It is hoped that the results of the study and the analysis being carried out by us will help the small scale industry of Punjab in building a organizational climate that will support creativity.

SECTION 1

General information about the employee

Name of the employee	
Name of the organization	
Designation of the Respondent	
E-mail Address	

Phone Number	
Working experience	

KEYS

(1) I have the freedom to decide how I am going to carry out my projects.

YES NO

(2) I feel that I am working on important projects.

YES NO

(3) I have too much to do in too little time.

YES NO

(4) This organization is strictly controlled by upper management.

YES NO

(5) My area of this organization is innovative.

YES NO

(6) My co-workers and I make a good team.

YES NO

(7) The tasks in my work are challenging.

YES NO

(8) In this organization, there is a lively and active ow of ideas.

YES NO

(9) My supervisor clearly sets overall goals for me.

YES NO

(10) There is much emphasis in this organization on doing things the way we have always done them.

YES NO

(11) I have sufficient time to do my project(s).

YES NO

(12) I feel considerable pressure to meet someone else's specifications in how I do my work. YES NO

(13) Overall, this organization is effective.
YES NO

(14) Overall, the people in this organization have a shared "vision" of where we are going and what we are trying to do.
YES NO

(15) There is a feeling of trust among the people I work with most closely.
YES NO

(16) People in this organization are very concerned about protecting their territory.
YES NO

(17) There are too many distractions from project work in this organization.
YES NO

(18) New ideas are encouraged in this organization.
YES NO

(19) Within my work group, we challenge one another's ideas in a constructive way.
YES NO

(20) There is destructive competition within this organization.
YES NO

(21) My supervisor has poor interpersonal skills.
YES NO

(22) Performance evaluation in this organization is fair.
YES NO

(23) I do not have the freedom to decide what project(s) I am going to do.
YES NO

(24) People in my work group are open to new ideas.
YES NO

(25) The facilities I need for my work are readily available to me.
YES NO

(26) My supervisor serves as a good work model.
YES NO

(27) In this organization, top management expects that people will do creative work.
YES NO

(28) In my work group, people are willing to help one another.
YES NO

(29) Procedures and structures are too formal in this organization. _____

YES NO

(30) There are unrealistic expectations for what people can achieve in this organization.

YES NO

(31) Generally, I can get the resources I need for my work. _____

YES NO

(32) My supervisor's expectations for my project(s) are unclear. _____

YES NO

(33) People are quite concerned about negative criticism of their work in this organization.

YES NO

(34) People are recognized for creative work in this organization.

YES NO

(35) The tasks in my work bring out the best in me.

YES NO

(36) My supervisor plans poorly.

YES NO

(37) The organization has an urgent need for successful completion of the work I am now doing. YES NO

(38) People in this organization feel pressure to produce anything acceptable, even if quality is lacking.

YES NO

(39) There is an open atmosphere in this organization.

YES NO

(40) There is a good blend of skills in my work group.

YES NO

(41) Ideas are judged fairly in this organization.

YES NO

(42) Top management does not want to take risks in this organization.

YES NO

(43) In my daily work environment, I feel a sense of control over my own work and my own ideas. YES NO

(44) Failure is acceptable in this organization, if the effort on the project was good.

YES NO

(45) The budget for my project(s) is generally adequate.

YES NO

(46) My area of this organization is creative. _____

YES NO

(47) My area of this organization is productive. _____

YES NO

(48) People are encouraged to solve problems creatively in this organization. _____

YES NO

(49) People are rewarded for creative work in this organization. _____

YES NO

(50) My supervisor supports my work group within the organization. _____

YES NO

(51) Overall, my current wok environment is conducive to my own creativity. _____

YES NO

(52) I feel challenged by the work I am currently doing. _____

YES NO

(53) My area of this organization is effective. _____

YES NO

(54) A great deal of creativity is called for in my daily work. _____

YES NO

(55) People in this organization can express unusual ideas without fear of being called _____

stupid. YES NO

(56) I can get all the data I need to carry out my project(s) successfully. _____

YES NO

(57) The people in my work group are committed to our work.

YES NO

_____

(58) My supervisor does not communicate well with our work group. _____

YES NO

(59) I get constructive feedback about my work. _____

YES NO

(60) This organization has a good mechanism for encouraging and developing creative

ideas. YES NO

(61) People are encouraged to take risks in this organization. _____

YES NO

(62) I have trouble getting the materials I need to do my work. _____

YES NO

(63) I feel that top management is enthusiastic about my project(s). _____

YES NO

(64) Overall, this organization is productive. _____

YES NO

(65) People are too critical of new ideas in this organization. _____

YES NO

(66) There is free and open communication within my work group. _____

YES NO

(67) My supervisor shows confidence in our work group. _____

YES NO

(68) Overall, my current work environment is conducive to the creativity of my work group. _____

YES NO

(69) I feel a sense of time pressure in my work.

YES NO _____

(70) Overall, this organization is efficient.

YES NO

(71) My supervisor values individual contributions to projects.

YES NO

(72) My supervisor is open to new idea.

YES NO

(73) My area of this organization is efficient.

YES NO

(74) The information I need for my work is easily obtainable.

YES NO

(75) I believe that I am currently very creative in my work. _____

YES NO

(76) Other areas of the organization hinder my project(s). _____

YES NO

(77) Destructive criticism is a problem in this organization.

YES NO