DEVELOPMENT OF A MODEL FOR FOSTERING INNOVATION CULTURE IN SMALL SCALE AUTOPARTS MANUFACTURING INDUSTRY OF PUNJAB

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BY

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Dedicated

to

my

Loving Family

CERTIFICATE

Certified that the thesis entitled, "**DEVELOPMENT OF A MODEL FOR FOSTERING INNOVATION CULTURE IN SMALL SCALE AUTOPARTS MANUFACTURING INDUSTRY OF PUNJAB**", being submitted by Balwinder Singh Sangha (Registration No. 90610504), School of Behavioural Sciences and Business Studies, Thapar University, Patiala in fulfillment of the requirements for the award of the degree of **DOCTOR OF PHILOSOPHY**, is a record of bonafide research work carried out by him under our guidance and supervision. The matter presented in this Thesis has not been submitted in part or full to any other University or Institute for the award of any degree.

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ABSTRACT

Innovation is the key driver for sustainable growth of an organization. It is a dynamic process of continual improvement. A strong innovative culture sets a conducive environment for innovation to strive and thrive. The present study is an attempt to analyze the status of Innovation Culture among Small Scale Autoparts Manufacturing Industry (SSAMI) of Punjab and to develop a model for fostering innovation culture in these organizations. The research work has been carried out in four phases. The first phase comprised of an identification of determinants and assessment of innovative culture among small scale units. The second phase was targeted to study the role and contribution of various agencies in developing innovative culture. The third phase of the work was focused to quantify the status of innovation culture in each individual respondent organization as well as to assess the overall status among the autoparts manufacturing sector. This phase also included the analysis of national system of innovation and assessment of the impact of various elements of this system on innovativeness of the manufacturing industry. The fourth phase of research work presents the development of a model for which the qualitative modeling technique has been applied using factor loading analysis. The sample of the study consisted of 110 Small Scale Organizations engaged in the autoparts industry. Data was collected from primary as well as secondary sources. The findings of the present study indicated that 44% of the respondent organizations were engaged in processing unit; 42% in product manufacturing whereas 14% were service providers in the auto manufacturing sector. The organizations were also classified for their innovation capability. The status of innovation culture among small scale autoparts manufacturing industry of Punjab revealed that the overall level of innovation culture is 34% against the optimal and achievable level of 50% to 75% in the present scene of autoparts manufacturing sector of India. Majority (65%) of the small scale autoparts manufacturing industry of Punjab fall under Type III classification, which indicated that the industry know the need but not aware how to change. About 18% of the industry falls under category of Type II i.e. they know the need and have some ability to generate and absorb technology. About 17% of the units were falling in Type IV category i.e. the lowest category of innovation capability, which meant that they didn't know the need and how to change. It is surprising to note that no unit belongs to highest level of Type I category i.e. capable to generate and absorb technology. Further, no unit was found to be product innovator. The findings on the role and contribution of industry support institutions in fostering innovative

culture revealed that 80% component of the services provided by these institutions is on skill training pertaining to CAD/CAM, CNC Programming, CNC Machining, White light scanning, 3D modeling, Rapid prototyping, Testing, Calibration, Non-destructive Testing including Industrial Radiography, Gauge validation, high end Heat treatment facility of Vacuum hardening and Material improvement Cryogenic process technology. Some path breaking technological innovations have been introduced by these institutions. These highly interactive, self-reliant institutes are the virtual In-house R&D to SSAMI. Sustainability of these institutes for more than two decades reflects their relevance to SMEs of the State. All the institutes are growing over time significantly. An increasing trend in revenue generation of these institutes, as shown by the Compound Growth Rate (CGR) values depicted, Central Tool Room, Ludhiana, at a very good level of 11.7 ($p<0.01$) of CGR and the remaining five institutes are also registering significant growth ($p<0.05$). Knowledge accumulations in the institutes also offer a platform for exchange of ideas which further facilitate the process of open innovation. The speedy and efficient dissemination of technical know-how by these institutes have brought creativity and innovativeness among SSAMIs of the region. The results on the basis of secondary data on national innovation policy indicated that innovation dimensions in the country are improving and are on the rise. India occupies second position after China in Global Competitiveness Ranking (Deloitte and CoC, 2010). India has declared 2010-2020 as 'the Decade of Innovation' (Ministry of Science & Technology, India, 2013). The results of the factor analysis indicated that support for capacity building; monitoring aspects and cultural aspects were the significant predictors of innovation score. The element of education, science and technology environment, markets and quality of networking has been found major influencing factors toward capacity building for innovation of organizations. Financial infrastructure and government incentives were found supportive for enhancing innovation capacity of the organizations under the monitoring aspect. Cultural aspects i.e. desire to learn, openness and trust, has also been found contributing towards innovation culture in the organizations. The study provides a valuable insight regarding existing status of innovation among small scale autoparts manufacturing industry of Punjab. The model developed in the study can be used for self-assessment of innovation culture in an organization.

LIST OF ABBREVIATIONS

ACMA	Automotive Component Manufacturers Association of India
ACT	ACMA Centre for Technology
ANOVA	Analysis of variance
BIS	Bureau of Indian Standards
CAD	Computer Aided Drafting
CAM	Computer Aided Manufacturing
CEO	Chief Executive Officer
CGR	Compound Growth Rate
CICU	Chamber of Industrial & Commercial Undertakings.
CIHT	Central Institute for Hand Tools Technology, Jalandhar
CIPET	Central Institute for Plastics Engineering and Technology, Amritsar
CNC	Computer Numerical Controlled
CNC CMM	Computer Numerical Control Coordinate Measuring Machine
CSIO	Central Scientific Instruments Organization
CSIR	Council for Scientific and Industrial Research
CT	Central Tendency
CTR	Central Tool Room, Ludhiana
DI&C	Director Industries & Commerce, Punjab
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GDP	Gross Domestic Product
GOI	Government of India
HR	Human Resources
HSS	High Speed Steel
IAHT	Institute for Autoparts & Hand Tools Technology, Ludhiana
IMTT	Institute for Machine Tools Technology, Batala.
IPR	Intellectual Property Rights
ISO	International Organization for Standardization
ISO	International Standard Organization
ISRO	Indian Space and Research Organization
JFT	Jig Fixture Tools
JIS	Japanese Institute of Standardization

JV	Joint Venture
MACE	Maruti Centre for Excellence
MNC	Multi National Company
MNC	Multinational Corporations
MoMSME	Ministry of Micro, Small and Medium Enterprises
MPI	Magnetic Particle Inspection
MSME	Medium, Small and Micro Enterprises
MSMEDI	Medium, Small and Micro Enterprises Development Institute
NABL	National Accreditation Board for Testing and Calibration Labs
NCAER	National Council of Applied Economic Research
NDT	Non-Destructive Testing
NGO	Non-Government Organizations
NIF	National Innovation Foundation
NInc	National Innovation Council
NIQR	National Institution for Quality and Reliability
NMCC	National Manufacturing Competitiveness Council.
NPC	National Productivity Council
NSI	National System of Innovation
OECD	Organization for Economic Cooperation and Development
OEM	Original Equipment Manufacturer
PMRY	Prime Minister RozgarYozna
PPS	Percent Point Score
QCC	Quality Control Circle
R&D	Research and Development Centre for Bicycle & Sewing Machines, Ludhiana
R&D	Research and Development
RIS	Regional Innovation Systems
RPT	Rapid Prototyping
SD	Standard Deviation
SIDO	Small Industries Development Organization
SME s	Small and Medium Enterprises
SPM	Special Purchase Machine
SSAMI	Small Scale Autoparts Manufacturing Industry
SSI	Small Scale Industry
TPS	Total Points Scored

TQM	Total Quality Management
UNIDO	United Nations Industrial Development Organization
WTO	World Trade Organization

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CHAPTER – I

INTRODUCTION

1.1 General

Innovation has been the major strategic tool used by global organizations for dominating the global markets. Innovation as a process, which was earlier visible only in the big organizations, who serve high-end markets, has now become a basic necessity in every organization and in all parts of their value chain. In the 21st century, the nature of innovation has changed; it has become faster, more open and collaborative. The outdated concepts around tightly controlled intellectual property are giving way to a more enlightened emphasis on sharing intellectual capital (Bontis, 2001; Leinter, 2011). Innovation has become one of the major factors propelling economic growth and enhancing social benefits in a number of countries. Innovation needs to be built into the culture of an organization to enable it gain sustainability by involving and inspiring every process associated with the organization.

Globalization has made it necessary to project innovative capabilities of nations, regions, industries and firms. Innovation has become a major tool in the race to create jobs and increase incomes. Innovation should not be accidental. Many companies do it by accident; that is why, they hope someone will come up with an idea for a product or service and then it would capitalize on it. At a time when companies need to generate more ideas than ever before and turn these into viable products and services before competition can catch up, the accidental approach is no longer enough. Business needs a sustainable, repeatable approach to creativity and innovation. For an innovation to be successful there must be a system of idea generation, evaluation, environment for incubation of the idea and finally development of the product. If culture of an organization is not innovative, an effective change process can bring about innovative culture in the organization. The organizations need to focus for developing a favorable environment for development and growth of innovation (Tucker, 2002).

Innovation is about an organized search for changes and monitoring resources for innovative opportunity both within and outside the enterprise. The ultimate objective of innovation is not to establish technological superiority but to maximize the returns on constrained resources by improving products and processes and creating a market for it. Innovation is the key to any organization's sustainability in this competitive business environment, where continuous metamorphosis of strategies, designs, products and deliveries are essential. Innovation or innovative thinking is probably the most influential factor that helps in ensuring the organization's future.Organization culture appears to have an influence on the degree to which creativity and innovation are stimulated in an organization. There are three known characteristics, which support creativity and innovation within firms. Creativity in an organization comes from creative behavior, which is a composite of individual characteristics, internal characteristics and external characteristics (Arad *et al.,* 1997).

Innovation has also been described as unpredictable, intrinsically a contradiction, offering significant improvement to business. It can dramatically enhance competitive advantage and can create sustainable growth. It manifests that positioning innovation as a core value or business model is a high-reward, high-risk proposition. Creating an innovation culture may require a different approach to leadership as well as a different way of thinking. One way to conceptualize the leadership of innovation is to think of oneself as a single ecosystem, operating inside of a larger ecosystem. Organizational ecosystem is made up of complex relationships, connections and networks whereas individual ecosystem operates inside of relationships and networks.A foundational element of innovation is always risk and failure how they are perceived, how they are contextualized in systems, how they are viewed culturally. Innovative leaders are required to evaluate and judge their organization's risk culture and how it supports innovation or otherwise (Doss, 2014).

1.2 Defining Innovation

Innovation is all about ideas which work better. The various definitions given by different authors describe it in different ways. Schumpeter (1950) defined innovation as 'to create or use something new.' This simultaneously goes with loss of old products and processes and termed this phenomenon as creative destruction.As per guidelines set up by Oslo Manual OECD; (2005), Innovation is invention and commercialization of new or significant improvement of existing products and services. The minimum requirement for an innovation is that the product, process, marketing method or organizational method, must be new or significantly improved to the firm.

According to Abernathy and Clark (1985), incremental innovations build on and reinforce the applicability of existing knowledge while radical innovations destroy the value of an existing knowledge base. Gatignon *et al.,* (2004) define incremental innovations as involving improving and exploiting an existing technological trajectory whereas radical innovations disrupting an existing technological trajectory.

Open innovation is defined as the use of purposive inflows and outflows of knowledge to accelerate internal innovation and to expand the markets for external use of innovation, whereas the phenomenon by which large firms discover, develop and commercialize technologies internally is identified as closed innovation (Chesbrough*et al.,* 2006). Innovation is often given complex definitions. The simple one is "new ideas that work"(Geoff Mulgan, 2006).National Innovation Act of India define 'Innovation' as a process for incremental or significant technical advancement or change which provides encashment of measurable economic value and shall include introducing new or improved goods or services; implementing new or improved operational as well as managerial process (DST, 2008). Innovation, whether small or incremental, large or disruptive, open or closed is all about change.

1.3 Need for Developing Innovation Culture

An innovative culture is an important determinant of any organization. Creating any change in an organization is difficult but for achieving sustainability, innovation is required. A strong innovative culture helps the organization work well and comfortably with internal and external resources, and it relies on strong networks to bring better innovation to market in record time. Such a culture leads to fast paced innovations which become a key driver for growth and induce more risk taking, encourage new experimentation, and learning from failure (Gassmann, 2006; Dombrowski *et al.,* 2007).

The culture of an organization has a direct bearing on its sustainability, innovativeness and performance and it plays an important role in making an innovation successful. It is difficult to change organizational culture (Tucker, 2002). One way of changing culture could be to identify elements of innovative culture and adopt these elements through process of organization change. The elements of innovative mission and vision statement, democratic communication, safe spaces, flexibility, collaboration, boundary spanning, incentives and leadership enable any organization to support and sustain the innovative environment (Dombrowski *et al.*, 2007).

A strong innovation culture has its roots in diversification, open communication, networking, collaboration, risk taking, commitment, failures and self-initiated activity. Commitment to innovations is a critical step in the innovation process. The development of a sustainable culture that expects and encourages innovation at every level and function of the organization actually undergirds each element of the innovation framework. The entire process of innovation is heavily dependent upon culture. Creating an innovation-friendly culture means moving steadily toward comprehensive changes that make the organization viable and competitive.Creating an innovative culture is totally knotted with creating a learning culture. Therefore, an effective learning as well as constant refining and improvement of activities is required in any organization.

1.4 Innovation:A Continuous Process

Innovation is a continuous process of creating new ideas and accumulation of knowledge within an enterprise. This accumulation of knowledge can be built up by interaction with external sources, which are often located in the regional innovation system comprising of markets, research organizations, education system, and network of industry support institutions along with financial, physical and cultural set up. Small and medium enterprises (SMEs) lose the competitive edge for lack of innovative activities required to keep pace with customer end requirements.The capability of a firm to be innovative, is closely related to its structural, human and intellectual capital (Subramaniam and Youndit, 2005;Leinter, 2011).

Generally the business opportunities are few.A quick identification for their leverage can only be possible if the innovation idea pipeline of the organization is full. An organization that is in a position to keep its idea pipeline running and continuously full will be able to develop new reserve of innovations. A robust innovation process needs to be in place and for this to happen, an organization needs to inculcate an innovative culture. Competition drives business and organizations need to be alert and continually keep innovating new product or a new service to meet market requirements. Businesses need Idea Management Cell for bringing better products and services to market more quickly and more effectively. The Managers heading Innovation Management Cells need to work for bringing frequent andcontinuous change within the organization. The managers are also required to recognize their people's innate capacity to adopt and innovate.

1.5 Innovation and Evolution of Industry

The process of Innovation has been around us for a long time. In fact it's a part of the evolution process itself. In some ways, at the dawn of the human civilization the ability to create and control fire was a massive innovation, which transformed human beings to social creatures. This probably happened, as most innovations do, because one individual chooses to look at a problem differently than everyone else.

The relationship between innovation and the evolution of industries is at the core of the work of Schumpeter (1939) and is one of the major Schumpeterian legacies. It is a central theme in the Schumpeterian approach to economic dynamics, as well in evolutionary and neoclassical theories. For him, innovation was very closely linked to the emergence, growth and decline of industries. Standard economic analysts claim that demand provides incentives to innovation during industry evolution. The size, growth, structure and composition of demand, differentiation and market segmentation affect innovation in various ways in different stages of the evolution of an industry.

1.6 Status of Innovation in India and Support Structure

National Innovation Foundation (NIF) is a major organization working to promote innovation at the grass root level. NIF has been providing support for R & D, filing patents and IPR issues and enabling green grass root innovators to build linkages with formal science and technological experts. Kumar (2001a) argued that the substantial investments made by the government in building the National Innovation System (NIS) over the past 50 years helped in improving the overall competitiveness of the Indian I.T. industry. Kumar and Joseph (2004) pointed out that the NIS of India evolved as an outcome to government policies and has been instrumental in facilitating India's IT success story.

Innovation in India could be seen in three distinct phases of Infrastructure building up phase (1947-60), Re-orientation phase (1960-80) and Market orientation phase (1990's on wards). The Post liberalization Era of Indian Economy after the year 1991 brings in the reality of intensified competition in the country.Thus Indian Innovation System can be viewed as a system that is presently going through an evolution phase(Gupta and Dutta 2005).

Indian innovation system is continuously adapting itself to the newer ways of conducting R&D and funding the same.In order to have impressive innovation output a very close interaction of S&T frame work of the country with user industry and innovators is required. Dobson (2010) has predicted China and India to be economic powerhouses of the world by year 2030. According to Dobson, India will come into its own, making major strides in modernizing its vast rural population, vanquishing illiteracy and emerging as an innovative manufacturing power house. At present, India is aspiring to achieve a faster, sustainable and inclusive growth, where Science and Technology frame work of the country will play a pivotal role. Government of India has taken some initiatives directing towards promotion of innovations in manufacturing sector and formed a National Innovation Act(DST, 2008). The Ministry of Science and Technologyhas introduced Science, Technology and Innovation Policy STI in year 2013 and has declared 2010 to 2020 as the Decade of Innovation for the country. These initiatives by the government will help in building up a Robust National Innovation System in the country.

1.7 The Scenario of Innovation in Manufacturing Sector of Punjab

Medium, Small and Micro Enterprises (MSME's)are the engine of growth. The total number of MSME's in India has risen from 105.21 lakh units in 2001-01 to a level of 467.56 lakh units in 2012-13. Out of these, 94.94% units are engaged in micro sector, 4.89% in small sector and 0.17% in medium sector. The deployment of manpower within MSMEs has risen from 249.33 lakh persons in 2001-02 to a level of 1061.52 lakh persons in 2012-13 (MSME Report, 2014). The investment limit for micro sector engaged in manufacturing is Rs.25 lakh and for unit engaged as a service enterprise is Rs.10 lakh. The investment limit for small sector engaged in manufacturing is Rs.5 crore and for unit engaged as a service enterprise is Rs.2 crore (MSMED Act, 2006). The automotive manufacturing is a sunrise sectorinIndia.There is a well-knit and progressive Automotive Component Manufacturers Association ACMA in India. A total number of 524 members of this Association have adopted the ISO 9000 Quality Management Systems, 342 are complying with the requirements of TS 16949 quality management system, 81 are QS 9000 certified and 154 are complying with ISO 14001 environment system requirements (ACMA Report, 2009-10).

Punjab, though not highly industrialized, has a presence of 1,62,000 small and medium enterprises in the areas of cutting tools, machine tool, knitting, cycle parts and sports goods (DI&C, 2009). However, with the exception of auto parts industry, most of the other industry is in unorganized sector.The autoparts cluster of Punjab is one of the declared clusters by the Government of India.According to a report by Entrepreneurship Development Institute of India EDII (2009) onAutoparts Cluster Development Project; there are about 1350 Small Scale Autoparts Manufacturing Industry SSAMIs in Punjab which are engageddirectly or indirectly to the automobile sector. The autoparts industry units are the suppliers to large automobile manufacturers like, Mahindra & Mahindra, Swaraj Mazda and Maruti-Suzuki. The product range of these suppliers includes assembly parts for transmission, steering, engine, electrical, suspension, braking, chassis and gear-train.In the recent past, many Medium and Large autoparts manufacturers from Punjab have graduated to Tier I and Tier II suppliers to Indian OEMs. Majority of small scale auto parts manufacturers are direct or indirect vendors to these tier-I and tier-II firms. At present, the autoparts industry of Punjab accounts for nearly 10% of production and about 12% of export of auto components from India.

The entrepreneurs of Punjab auto cluster are known for their low cost and low tech innovations. This capability is well acknowledged by the Indian original equipment manufacturers OEMs and exporters, who are depending heavily on this cluster in meeting ‘high mix’ ‘low volume’ product range.Small Scale autoparts manufacturing industry of Punjab received a great deal of help from OEMs and different governmental agencies in becoming innovative and productive. This has helped themto withstand competition and achieve levels for sustainable growth. The innovation culture existing within the enterprises can be synergized with the presence of an effective system of innovation in the context of Punjab.

1.8 Need for the study

India is emerging as a global outsourcing hub ofautomobile industry. In order to increase and sustain global market share the country need to enhance its competiveness. Manufacturing competitiveness can be achieved in an enabling environment for carrying out consistent and systematic technological advancements.Such an environment requires an effective national innovation system in place. Punjab, a northern state of India, though not highly industrialized, has a large number of small scale units in the areas of cutting tools, machine tool, knitting, cycle parts, autoparts and sports goods.At present, the autoparts industry of Punjab accounts for nearly 10% of production and about 12% of export of auto components from India. A few sectoral studies have been conducted in the manufacturing sector of India butno such study has been conducted in Punjab. Hence, a workable theoretical frame work for systematic study on small scale autoparts manufacturing sector of Punjab is attempted to understand the status of innovation culture and to know influence of national innovation system in enhancing innovativeness and competitiveness of this sector.

1.9 Statement of the Problem

The present study aims at identification of various determinants of innovation culture and evaluation of the status of innovation among small scale autoparts industry of Punjab.The study also focuses on the influence of national innovation system and role of industry support institutionson innovativeness and competitiveness of industry for developing a model for fostering innovation culture in small scale autoparts manufacturing industry of Punjab. Hence, the study has been titled as "**Development of a Model for Fostering Innovation Culture in Small Scale Autoparts Manufacturing Industry of Punjab**".

1.10 Objectives of the Study

The present study has been planned with the following objectives:

1. To identify the elements of innovation culture in small scale autoparts manufacturing industries small scale autoparts manufacturing industry of Punjab.
2. To evaluate the innovation culture in small scale autoparts manufacturing industry.
3. To study the role and contribution of various agencies in developing innovation culture.
4. To study the National System of Innovation (NSI) of India and other leading countries for the purpose of Bench Marking.
5. To evolve a model for fostering innovation culture in small scale autoparts manufacturing industries of Punjab.

1.11 Document Structure

The thesis consists of seven Chapters and four Annexures. The first Chapter highlights the concept of innovation, related issues and need to develop a model for fostering innovation culture in SSAMI of Punjab. The second Chapter covers the extensive review of literature to find out various issues related to research. The third Chapter deals with the research design and methodology adopted for carrying out the study. The statistical techniques used for data analysis have also been detailed in this Chapter. The fourth Chapter depicts the results of the study on determinants of innovation culture, evaluation of the status of innovation culture, measure of variation in the status of innovation culture in individual units and study of the elements of national system of innovation and its impact on small scale autoparts manufacturing industry of Punjab. The fifth Chapter focuses on role and contribution of industry support institutions in fostering innovative culture among SMEs. This also covers the role of agencies in developing innovativeness among autoparts manufacturing sector of Punjab. The sixth Chapter is about developing a model for fostering innovation culture among SSAMI's of Punjab. This model was developed using Factor Loading Analysis and Regression Analysis Technique. The seventh Chapter summarizes the results and conclusion of the research work.

1.12 Summary of the chapter

The current chapter deals with concept of innovation, related issues and need for taking up the study. This chapter presents a scenario of innovation among small scale autoparts manufacturing sector of Punjab. It can be inferred that the small scale autoparts industry is a vibrant sector of economy of India and National Innovation System can give impetus for the sustainable growth of small scale autoparts manufacturing industry of Punjab.

CHAPTER – II

REVIEW OF LITERATURE

The outcome of a research work becomes more meaningful when relevant literature is reviewed and analyzed. This chapter gives an overview of the findings and their recordings in brief, from extensive literature on various aspects of innovation culture and various elements of National Innovation System. A systematic review of various concepts, elements and parameters influencing organization culture has been taken up. The interrelating issues, regulatory initiatives and role of support institutions and agencies have also been studied to know the gaps for improvement in the existing approach and practices and to draw directions for future research in the area of innovation.

2.1 Innovation and Innovation Systems

Schumpeter (1950) defined innovation as ‘to create or use something new’. This simultaneously goes with loss of old products and processes and termed this phenomenon as creative destruction. As per guidelines set up by Oslo Manual OECD/Eurostat, (2005), innovation is invention and commercialization of new or significant improvement of existing products and services. The minimum requirement for an innovation is that the product, process, marketing method or organizational method must be new or significantly improved to the firm. Innovation activities are all scientific, technological, organizational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations. These activities also include R&D that is not directly related to the development of a specific innovation (OECD/Eurostat, 2005).

Innovations usually do not take place in a static environment. These are rather a result of a dynamic process involving interplay of several firm’s internal and external factors. R&D may constitute a major though not exclusive part of the innovation process. The innovation process encompasses several systematic steps such as requirement analysis, idea generation, project planning, product development and marketing (Verworn and Herstatt, 2000). The individual steps may overlap each other and in a simplified process be categorized into three broad phases (Tiwari *et al.*, 2007).

National Innovation Act of India 2008 defines innovation as a process for incremental or significant technical advancement or change which provides encashment of measurable economic value and shall include introducing new or improved goods or services; implementing new or improved operational as well as managerial process (DST, 2008).

Ettlie (1999) suggested that disruptive or new to the word innovations are only 6% to 10% of all projects labeled innovation. Most of the time innovations are of incremental type and are targeted to enhance productivity and competitiveness. Adoption of Total Quality Management led Japanese manufacturers to achieve significant gains in the form of improved quality and productivity through sustained incremental change. Recent trends of deploying Lean Practices is also a type of continuous innovations in manufacturing and services (Bessant, 2003). These continuous innovations are termed as incremental type innovations.

The phenomenon by which large firms discover, develop and commercialize technologies internally, is identified as closed innovation model (Chesbrough, 2003). On the other hand open innovation is defined as the use of purposive inflows and outflows of knowledge to accelerate internal innovation and to expand the markets for external use of innovation, respectively (Chesbrough *et al*, 2006). It thus comprises both outside-in and inside-out movements of technologies and ideas, and is also referred as Technology Acquisition and Technology Exploitation (Lichtenthaler, 2008). Companies can no longer keep their own innovations secret unto themselves; the key to success is creating, in effect, an open platform around your innovations so your customers, your employees and even your competitors can build upon it, because only by that building will create an ongoing, evolving community of users, doers and creators (Rothenberg, 2003).

External networking is an important aspect associated with open innovation (Chesbrough *et al*, 2006) and includes all activities required to acquire and maintain connections with external sources of individuals and organizations. Formal and informal networks help firms to fill in specific knowledge needs quickly without any major investments. The crux of open innovation is in the background that organizations cannot conduct all Research and Development (R&D) activities in-house, but have to depend on external knowledge sources which can be licensed or bought (Gassmann, 2006).

The incremental innovations build on and reinforce the applicability of existing knowledge while radical innovations destroy the value of an existing knowledge base (Abernathy and Clark, 1985). Gatigon *et al.,* (2004) define incremental innovations as involving improving and exploiting an existing technological trajectory whereas radical innovations disrupting an existing technological trajectory. Innovation is fundamentally a learning process. Such learning, by doing, by using, by observing from, and sharing with others, depends upon the accumulation and development of relevant knowledge of a very wide variety.

Innovation systems are country, region or industry specific elements which support developing and successfully marketing new products and services. Freeman (1987) defined National Innovation System (NIS) as the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies. According to Lundvall (1992), the elements and relationships which interact in the production, diffusion and use of new and economically useful knowledge, and are either located within or rooted inside the borders of a nation and constitute the national innovation system. Nelson (1993) defined the national innovation system as a set of institutions, whose interactions determine the innovative performance of national firms. Patel and Pavitt (1994) defined national innovation system as the national institutions, their incentive structure and their competencies, that determine the rate and direction of technological learning, or the volume and composition of change generating activities, in a country.

National Innovation System can also be defined as a set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provide the framework within which Governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills and artifacts which define new technologies (Metcalfe, 1995). NIS can be hardly regarded in isolation in today’s globalizing world (Ernst, 1999).

The National Innovation System at regional level is referred as the Regional Innovation System (RIS) which is defined as the localized network of actors and institutions in the public and private sectors whose activities and interactions generate, import, modify and diffuse new technologies (Cooke 1998, 2000).

At present, India is aspiring to achieve a faster, sustainable and inclusive growth, where Science and Technology frame work of the country will play a pivotal role in giving new dimensions to National Innovation System. National Manufacturing Competitiveness Council (NMCC) was set up in 2004 with the goal to enhance competitiveness of manufacturing sector and to identify sub sectors which have to potential for global competitiveness. NMCC formulated a National Strategy for Manufacturing in 2006 which is working towards the import of advanced technologies, prototype development and design innovations (NMCC, 2006).

The Government of India has taken some strong initiatives towards promotion of innovations in manufacturing sector and formed a National Innovation Act 2008. The main aim of this Act is to facilitate public, private or public-private partnership initiatives for building an innovation support system; to evolve a national integrated science and technology plan; and to codify and consolidate the law of confidentiality for protecting confidential information, trade secrets and innovations (DST, 2008).

The Government of India introduced Science, Technology and Innovation Policy (STI) in the year 2013 and Ministry of Science and Technology has declared 2010 to 2020 as the Decade of Innovation for the country. The policy makers in the government are trying hard to give new dimensions to the National Innovation System of the country. The goal of the STI Policy is to map India among the top five global scientific powers by 2020. And to realize this goal; the government policies are aimed at establishing world class R&D infrastructure to gain global leadership in some select frontier areas of science; facilitating enhanced private sector participation in R&D; seeding S&T based high-risk innovations and fostering cost effective innovations across various technology domains. These new policy initiatives are triggering changes in the mindset to adopt value system to recognize, respect and reward performances. The aim is to create wealth of knowledge from S&T initiatives for creating a robust National Innovation System of the country (Ministry of Science & Technology, 2013).

2.2 Innovation and Role of Clusters

Clusters are a geographically proximate group of interconnected companies and associated institutions in a particular field linked by commonalities and complementarities. Clusters encompass an array of linked industries and other entities important to competition including governmental and other institutions such as universities, standard setting agencies, think tanks, vocational training providers and trade associations. According to Porter (1998); Clusters are geographic concentrations of interconnected companies or institutions in a particular field. Industrial clusters or districts existing within the region could provide important inputs as sources of innovative ideas as well as of technical information and skilled manpower. Linkages or networks with elements of such clusters could eventually prove crucial in the success of innovations.

Geographically bounded concentration of similar, related or complementary businesses, with active channels for business transactions, communications and dialogue, that share specialized infrastructure, labour markets and services, and that are faced with common opportunities and threats(Rosenfeld 1997). Regional clustering has been used to describe industrial districts of small crafts firms, high technology centers, agglomerations of financial and business service firms in cities, company towns, and large branch plants and their supply chains. Clusters at least must be characterized along relevant dimensions if appropriate policies are to be devised. These include density, breadth, depth, activity base, growth potential and innovative capacity. (Enright 1998 & OECD 2007).As per UNIDO, the definition of cluster is concentration of micro, small and medium enterprises in a given geographical location producing same or a similar type of products or services and these enterprises face similar type of opportunities and threats. The cluster is known by the name of the product being produced by principal firms and the place they are located in. The concept of Industrial District or Cluster has been mooted by a number of researchers who observed the productivity raising benefits to small industrial units positioned in an industrial network or cluster (Sforzi, 1990; Pyke *et al.*, 1990, 1992; Brass *et al.*, 2004).

As innovation is multi-faceted and difficult for individual firms to exploit (Bessant, 2004), clusters can provide a mechanism to manage the process more effectively as geographically concentrated firms, that are linked or networked to various degrees are said to help drive innovation and the creation, diffusion, application and commercialization of new knowledge (OECD, 2007).Watson (2011) maintains that there are few economic development policies as popular as clusters, given it is difficult to find a country, region, or even a city that is not trying to develop a network of complementary and competitive firms. He points out the appeal of clusters from a political perspective, given the global economic crisis has highlighted the need for innovation in order to diversify economies and create jobs. Thus, industry clusters reportedly have a dual purpose. One being to enhance the competitiveness of the SMEs that comprise them, by utilizing the advantages generated by business cooperation and agglomeration economies and the other to build or revitalize certain regions.

Connell *et al.,* (2014) maintain that industry clusters can play a key role for the growth of established and new starts up enterprises. Collaboration, knowledge sharing among member firms can result in positive outcomes and innovations. If the cluster is facilitated appropriately and knowledge sharing is nurtured, an industry cluster can be considered as an antidote for knowledge sharing and collaborative innovations.

The clusters in the Indian context can be defined as sectoral and geographical concentration of enterprises, in particular Small and Medium Enterprises (SME), faced with common opportunities and threats which can give rise to external economies; e.g. specialized suppliers of raw materials, components and machinery; sector specific skills etc. It favour emergence of specialized technical, administrative and financial services and create a conducive ground for the development of inter-firm cooperation and specialization as well as of cooperation among public and private local institutions to promote local production, innovation and collective learning (MSME, 2009).

The planners and policy makers in government realized the necessity of human development along with giving incentives and facilities for establishing enterprises and as a result entrepreneurship development in India started. Small Industry Extension and Training Institute (SIET), later known as National Institute of Small Industry Extension Training(NISIET) was started in Hyderabad with support from Harvard University to do pioneering work in entrepreneurship development in India (Sinha 1983). The structure and the name of this apex organization were changed to National Institute of Micro, Small and Medium Enterprises (ni-msme) from April, 2007 (www.msme.org). At present, there are different Entrepreneur Development Programmes (EDPs) being run by the Government through MSME Centres with an active support of Small Industrial Development Bank of India (SIDBI). There is another popular entrepreneur development scheme namely; *Prime Minister Rozgar Zogna* (PMRY) running very successfully through District Industries Centres (DIC's) since year 1993 in collaboration with Nationalized Banks. These EDP's have helped in establishing a network of first generation entrepreneurs throughout India and are contributing towards its growing economy.

The Government of India initiated the Cluster Development Programmes in year 1997 through Small Industry Development Organisation (SIDO), a wing of Ministry of Small & Medium Enterprises, to cater the needs to different sectors in the country. In this cluster approach, the technological inputs required by the sector are met through hardware part of scheme by setting up common facilities. The programme of training and capacity building is included as a software part of this scheme. In cluster approach, the common facility so created can be used by the stakeholder industrial units. These units also get the advantage of cost sharing, provision of markets and knowledge sharing. It is estimated that there are about 2000 rural and artisan based clusters exist in India and these clusters contribute up to 60 percent of India's exports in manufacturing sector. The MSME clusters in India also have significant contribution in generation of employment throughout the country (www.dcmsme.gov.in).According to CII (2009), there are 10 locations in the country identified as Autoparts Cluster. These are located at New Capital Region-NCR-Delhi, Noida-Ghaziabad-Faridabad-Gurgaon, Jamshedpur, Chennai-Bangalore-Hasur, Pitampur, Haridwar-Pantnagar, Rajkot, Mumbai-Pune-Nasik-Aurangabad, Hyderabad and Ludhiana-Jalandhar-Phagwara. The Ministry of MSME, Government of India (2007) has taken-up state-wise cluster development programme under UPTECH/SICDP scheme in four states of Punjab, Haryana, Tamil Nadu and Jharkhand.

The autoparts cluster of Punjab is spread over Ludhiana, Jalandhar and Phagwara and is one of the declared clusters by the Govt. of India. There are about 1350 enterprises engaged directly or indirectly in autoparts manufacturing activities in this cluster. This has been reported by Entrepreneurship Development Institute of India in their report on 'Autoparts Cluster Development Project' (EDII, 2009).

2.3 Networking and Innovation

The concept of absorptive capacity was first defined by Cohen and Levinthal (1990) as a firm's "ability to recognize the value of new information, assimilate it, and apply it to commercial ends". The ability to search for appropriate partners and to utilize external, innovation-relevant knowledge depends on the absorptive capacity of a firm. The higher the absorptive capacity, the more firms are able to seek out co-operation partners and to cooperate within network relations, not only within their regional environment, but on an international scale (Cohen and Levinthal, 1990).

Studies on technological change emphasize that innovation i.e. the development of new products, process and organization, is basically an interactive process. The process of innovation cannot fit into the boundaries of a single firm. Firms can now innovate only within an intensive web of interactions with other firms, consumers, research institutions, etc. i.e. they can be innovative, and, thus competitive only if they can form and be part of innovation networks (Lundvall 1988 and Smith 1995).

During the recent years, networking research has dealt particularly with the relevance of systematic learning in the innovation process (Cimoli and Dosi, 1996). It is argued that knowledge can only be acquired by systematic learning and forgetting. Learning within enterprises can be implemented at different levels (Reid and Garnsey, 1998). According to Lundvall (1988); learning by interacting between customers and producers, competitors and other enterprises as well as research establishments, substantially affects innovation activity and ability of a firm. The importance of interacting in innovation processes makes it clear that networking is an essential means of knowledge exchange and learning. Networks bring actors, resources and activities together and are thereby to be regarded as a system.

Kaschatzky (2002) reported that the advantages of networks lie in the acquisition of complementary resources, which an individual actor does not have at his own disposal. Thus external effects can be realized by networking, which are particularly pronounced if the individual network participants are connected by horizontal, less-hierarchical and trusting relationships. According to this view, innovations can be implemented more effectively by co-operation between different actors.

External networking is an important aspect associated with open innovation and includes all activities required to acquire and maintain connections with external sources of individuals and organizations(Chesbrough *et al.*, 2006).Networks in the shape of formal or informal allow firms to fill in specific knowledge needs quickly without any major investments. The crux of open innovation is in the background that organizations can not conduct all R&D

activities in-house, but have to depend on external knowledge sources which can be licensed or bought (Gassmann, 2006). Porter's (2003) definition of innovation includes improvements in technology and better methods of doing things. Information is a major factor in the process and may be a resource that is not available to competitors, or something that is interpreted in new ways. This is where knowledge clusters can play an important role. Porter states that innovation can result from organizational learning as well as research and development, but that it always involves investment in developing skills and knowledge and sometimes physical assets and marketing efforts as well.

The use of external networks to extend a firm's knowledge base calls for regular contacts with other parties i.e. relations with universities, suppliers and knowledge institutes. This also includes both formal and informal contacts. The role of proximity and of particular geographical level varies between the different types of knowledge bases and sources. There is now enormous evidence on the contribution of universities, public research organization, the military, other public actors and financial organizations such as venture capital in the generation and diffusion of technological advances in industries. Their roles, however, have been shown to be quite different in different industries (Levin *et al* 1987; Cohen *et al* 2002). Moodysson *et al.,* (2008) stated that analytical knowledge is often drawn from international sources whereas synthetic knowledge is more often acquired locally.

There is another line of thinking that the knowledge exchange between firms and universities and research organizations need to overcome more cognitive and relational distance and is thus eased by face-to-face interaction and geographic proximity(Kaufmann and Todtling 2001). As a consequence such relations can often be found at the regional level (Keeble and Wilkinson 2000; Fritsch 2001; Todtling *et al.,* 2006; Trippl, *et al*., 2009). Informal and untraded relationships and knowledge spillovers from the movement of employees within the cluster are often based on a common cultural background, trust and face-to-face interactions (Storper, 1997). Knowledge exchange with customers and suppliers are characterized by cognitive and relational proximity and shaped by existing, and often be found at an international level (Todtling *et al.,* 2006; Cappellin and Wink 2009). Business is frequently reliant on networks and networking within and between firms that belong to clusters, to support knowledge sharing and spillovers and to encourage the deliberate learning transferred from interaction with supporting institutions (Hilliard and Jacobsen, 2011).

It has been argued that using external networks alone without investing internal factors, will not lead to better innovative performance (Freel 2003; Oerlemans, *et al.*, 1998). Firms however also require internal capacity to identify and absorb externally generated knowledge. Such an absorptive capacity as stated by Cohen and Levinthal (1990) and by Zahra and George (2002) depend upon several factors such as knowledge of each individual working for the firm's diversity of knowledge and communication process within the firm.

The ability to absorb new knowledge depends on what has been learned before i.e. knowledge processes are cumulative. Internal and external knowledge consequently have to be regarded as complements rather than substitutes in the innovation process. The importance of networking and cooperation with external parties in several survey results indicate that for small organizations with limited resources such as SME's, the use of external skills and knowledge is essential for achieving innovation and competitiveness, especially in more challenging and dynamic areas (Mckinsey Global Survey 2010; DHK Innovation Report 2010). Lamblin and Siweris (2013) addressing weaknesses in networking and cooperation with external partners reported that successful innovation is dependent on the identification cultivation and maintenance of good linkages between different actors in the global value chain and as open innovation becomes more embedded in SME business strategies. This demands a change for cluster policies for more structured formed of cooperation including the creation or appointment of a legal entity for cluster management, and the creation of ongoing facilitation of business networks for more informal forms of cooperation.

2.4 Innovation: Role of Small & Medium Enterprises

Small & Medium Enterprises provide a strong base for innovation in manufacturing sectors. Empirical studies have shown that SMEs contributed to the main innovations of the 20th century (Rothwell and Zegveld, 1982; Oakey *et al.*, 1988). Small firms usually have good internal communications and many have a dynamic and entrepreneurial management style (Rothwell, 1994). The average capability of technical people is higher in small firms and that innovations in these firms can be less expensive. SMEs absorb technologies and improve their productivity more effectively and efficiently and innovations contribute to their growth (Cooper, 1964; Vossen, 1998; Bala Subrahmanya 2011). The main barriers to innovation faced by MSMEs include; shortage of financial resources; sophisticated innovation management skills, insufficient marketing of innovation; lack of internal research capabilities and weaknesses in networking and co-operation with external partners (Lamblin and Siweris 2013).

The role of small enterprises is very important in modern day economies as these can give variety and reasonably competitive products to meet growing demand. In developed OECD countries, about 60% of GDP is attributed to small enterprises i.e. the enterprises with a maximum of 50 employees. Small enterprises are critically important for employment generation. Small scale sector in India is quite large and is a major contributor to its economy. Government of India passed a bill in year 2006 as Micro, Small and Medium Enterprises Development Act, (2006);which defines a small enterprise in manufacturing sector, where investment in Plant and Machinery is more than Rs. 25 lakh does not exceed Rs. five crores and this upper limit for units engaged in service centre is Rs. two crores. Business Today (2006) reported that the small scale sector in India accounts for 38.55% of its industrial production; 34.4% in exports; 5.81% to its GDP and is the source of employment for 29.5 million people in India.

The Government has also set up a regulatory agency, SMERA, Small & Medium Enterprises Rating Agency to rate instruments of firms belonging to this segment. Further, the Government of India is also planning to have an exclusive stock exchange to meet requirements of SME sector. The Small Industries Development Bank of India has been assigned an active role for providing a supportive structure to SME sector.

2.5 Innovation: Technological Transfer

Innovation is necessary to remain competitive. Nobel Prize winner in Economics, Robert Solow (1987), is of the view that technological innovation is the ultimate source of productivity and growth. It is the only proven way for economies to consistently go ahead (Senor and Singer, 2010). Technological innovations promote the economic competitiveness of the whole country (Ciemleja and Lace, 2008). Innovation and competitiveness have a dynamic and mutual relationship. By virtue of its relationship with competitiveness, innovation emerges as a major factor promoting competitiveness and economic growth. Innovation can be a critical driver of increasing productivity and competitiveness. Thus innovation is the necessary core competence to remain competitive in the global landscape.

However, empirical studies show that the net benefits the host country can enjoy from FDI depend on host country characteristics, such as industry and the policy environment (Blomstrom and Kokko 1998). This also depends upon the level of human capital stock of the host country; (Borensztein *et al*. 1998; Noorbakhsh *et al*., 2001). The absorptive capacity of domestic firms matters a lot for a successful diffusion of technical know-how in the field; (Kinoshita, 2001). In the case of the hi-tech knowledge intensive sector, innovation is the key to competitive success, knowledge is a key asset and learning is a key process. Innovation as a key factor in competitiveness is particularly important in a knowledge-based economy, since hi-tech firms may more readily exchange tacit creative knowledge with each other and with university research laboratories and public or private research institutes as well as with the local or regional innovation support infrastructure (Smith 1997). The recent studies also showed that innovative activities by the domestic firms are essential to build its technological capabilities in order to become competitive in the International markets (Ozelik and Tamaz, 2004).

The conventional technological transfer modes of collaboration i.e. acquisitions, joint ventures, know how transfers are no doubt very quick but are very costly. These are found to be a stop gap arrangement only for the initial stages of development of a nation. The Governments of Developing Countries and Least Developing Countries all over the world are introducing lucrative policies to attract foreign capital. It is assumed that with FDI, the subsequent diffusion of technology shall take place automatically through demonstrative effects & spillovers. Lenger and Taymaz (2006) reflected through their findings the importance of tactiness of knowledge and confirm the technology cannot be easily transferred through passive mechanisms of technology acquisitions, joint ventures and reverse engineering. The Foreign Direct Investment mode has been considered as an important channel for transfer of technology to developing countries.

2.6 Innovation: Organization Culture

Effective innovation efforts usually begin by intentionally setting the conditions and culture for success of any organization. The creation of a culture that is supportive of continuous innovation within the organization underlies all other elements of the innovation process. Organizational culture has been studied extensively by various researchers. Schein (1985) defined culture as the shared values, beliefs and practices of the people in the organization.

Barney (1986) described organizational culture as a complex set of values, beliefs, assumptions and symbols that define the way in which a firm conducts its business.

Organization culture is an important determinant of sustained innovativeness and financial performance. Organization culture appears to have an influence on the degree to which creativity and innovation are stimulated in an organization. There are three known characteristics, which support creativity and innovation within firms. Creativity in an organization comes from creative behavior, which is a composite of organizational characteristics, individual characteristics and group characteristics.

Organizational characteristics comprises elements of supportive structure, project resources, selection process, reward strategy, employee empowerment, well defined goals, workplace design, tolerance for mistakes, training programs, communication, team building, and problem solving approaches, etc(West, 1990; Anderson *et al*, 1992;Taylor, 1995; Ambile *et al*, 1996; Martins, 1996; Ahmed, 1998; Brand 1998; Fadzean, 1998; Gryskiewicz *et al*, 1998; Scott, 2001; Martin *et al.*, 2003). Similarly, individual characteristics include the elements of risk taking, effective leadership, motivation to the staff, time for innovation, and processing of ideas (Barron *et al*, 1991; Anderson *et al*, 1992; Ambile et al, 1996; Ahmed, 1998; Ambile, 1998; Cook, 1998; Fadzean, 1998; Singh, 2003). Group characteristics include the elements of training programmes, communication, team building and problem solving approaches (Taylor, 1995; Martins, 1996; Fadzean, 1998; Martein *et al.*, 2003).

Organizational structure relates to organization's ability to innovate and adapt to the environment. It provides a mechanism for creativity through development and sharing new ideas (Burns *et al.*, 1961). Organizational structure is concerned to a large extent with atmosphere or mood (Morgan, 1991). Innovation is enhanced by organic structure rather than mechanistic structure. The promoting factors for creating innovative culture in an organization are structure, autonomy and work teams, whereas specialization, formalization, standardization and centralization inhibit innovation (Martin *et al*, 2003). Values like flexibility, freedom and cooperative teamwork promote creativity but values like rigidity, control, predictability, stability and order hinder creativity (Shattow, 1996). The empowerment of the employees in decision making and solving problems also determines the creativity and innovation in an organization, (Morris, 2005).

Resources comprise elements of adequate time for developing novel work, skilled manpower, sufficient funds, material resources, systems and processes for work, relevant information and provision of trainings. Lack of project resources can constrain employee's creativity, organizational structure should be such that it provides adequate funds, materials, facilities and information support system to support innovation and technological advancements (Amabile *et al.*, 1996). Resources are important not only for functional support, but also because having an adequate level of resources for the task influences worker's perceptions that the project is valuable and worthy of organization support (Arad *et al.*, 1998).

Innovative organizations believe in recruiting, developing and nurturing the right people Recruitment and retention of employees is an important part of promoting a culture of creativity and innovation in an organization. Apart from personality traits like intelligence, knowledge, risk taking, inquisitiveness and energy, a value like diversity is of utmost importance. People of diverse backgrounds should lead to richer ideas and processes that should stimulate creativity and innovation (Ahmed, 1998a; Martin *et al*, 2003; Harney and Dundon, 2006; Paauwe and Boselie, 2005; Nunes *et al.*, 2006). Since innovation is viewed as the ongoing pursuit and harnessing of new and unique knowledge, skills and abilities of a firm's employee i.e. its human capital, are important elements in innovation. Agile, well-informed and trained individuals are fundamental for innovation and form the basis for the creation, integration and transfer of knowledge within a firm (Hayton, 2003: Laursen and Fooss, 2003; Shrader and Siegel, 2007). Thereby, creativity, teamwork capacity, flexibility, motivation, learning capacity and education are regarded as important features of human capital which positively influence innovativeness and performance of firms (Bassi and Van Burren, 1999). Leitner (2011) also reported a positive association between human capital and product innovativeness. Firms, that have strength in both human and structural capital, have a higher likelihood to be highly innovative.

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 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 (Martin *et al*, 2003). Though it is easy to appreciate the important role culture plays in making an innovation successful, it is difficult to change culture. One way of changing culture could be to identify elements of innovation culture and then adopting the ones relevant to a given organization. Eight elements of organizational innovative culture i.e. innovative mission and vision statement; democratic communication; self-spaces; flexibility; collaboration; boundary spanning; incentives; and leadership (Dombrowski *et al.*, 2007).

The culture of the organization should be such that there is tolerance for failures. Failure is recognized and is taken as a learning experience rather than directing the employees to discontinue the innovative practices (Morris, 2005). An organization culture in which personnel are encouraged to generate new ideas, without being harmed, and where the focus is on what is supported instead of what is not viable, encourage creativity and innovation (Ahmed, 1998).

Most of the organizations follow reward systems to motivate employees for achieving goals of innovation, productivity and profitability. This policy helps in motivating employees to take risks, generate new ideas, experiment and develop new products or process. The reward system include such practices as providing freedom for creativity, financial rewards, promotions, and other forms of recognition such as peer recognition, letter of appreciation or plaque etc (Badawy, 1978; Robert, 1988; Gupta *et al.*, 1991; Koning, 1998; Kiran and Jain, 2010). These types of reward initiatives induce creative behaviour in the individual and also contribute towards creating a culture.

Extrinsic rewards play an important role, especially in situations where an innovator might become dissatisfied if not adequately compensated. However, simply raising an employee's salary rarely makes him more innovative. The main purpose of pay hikes in innovative organizations is to reward creative performers just enough that they continue to excel, but not so excessively that the raise ceases to motivate. Some innovation based organizations have different pay raise policies for performers and non-performers (Business Week, 1987; Herbig and Palumbo, 1996).

Intrinsic rewards include increased autonomy and improved opportunities for personal and professional growth. Innovation based organizations know how to manage, motivate and reward employees. These organizations rely heavily on personalized intrinsic rewards whereas less innovative organizations tend to place almost exclusive emphasis on extrinsic awards (Plunkett, 1990; Ahmed, 1998b; Morris, 2005).

McKinsey 7S Model which was created in early 1980s by the consulting firm McKinsey & Company is an effective management tool in managing a successful change process in an organization. This also aids change process to meet the objectives of organization successfully. The model is based around 7 Key elements of any organization which are interrelated and aligned synergetically. These elements are split into two groups as hard and soft. The hard elements are those that can be seen physically and are quite tangible, whereas, the soft are more intangible and can't be seen. The elements of strategy, structure and systems are grouped as hard elements; whereas, the shared values, skills, staff and style are grouped as soft elements. All these elements are interrelated and the core element for successful application of this model is the element of shared values. The right balance of all the above identified seven elements result into right type of the organization culture. The framework can be used to identify the gaps and the elements creating imbalance in the alignment across the seven elements of organization structure. A successful alignment helps organizations to improve their performance and getting desired results.

The process of innovation is all about bringing a change in products and processes of an organization in order to stay innovative by bringing new products. The progressive and innovative organizations must focus and manage the required organization change process. Schein (2013) describes four categories of culture: Macrocultures referring to nations, occupations that exist globally; Organization Cultures; Subcultures pertaining to groups within organizations, and Microcultures relating to microsystems with or within organizations. He identifies three levels of culture: artifacts i.e. visible, espoused beliefs and values which may appear through survey and basic underlying assumptions i.e. the unconscious taken for granted beliefs and values which are not visible. The latest being the more important since as he puts it;'human minds need cognitive stability and any challenge of a basic assumption will release anxiety and defensiveness'. Many change programs fail for that very reason. Aligning subculture, in an organization, he identifies three important levels i.e. operators, engineers and executives. The first level i.e. operators, refers to human interaction, high levels of communication, trust and teamwork. The second level i.e. engineers responsible for elegant solution, abstract solutions to problems and automation systems. The third level i.e. executives responsible for financial focus, lone hero, sense of rightness and omniscience. He is also of the firm view that in any organization, the alignment between these three subcultures is critical. Many problems that are attributed to bureaucracy, environmental factors or personality conflicts among managers are in fact the result of the lack of alignment between these subcultures. Further, Schein has suggested a conceptual model for managing the culture change in an organization. The change creates learning anxiety i.e. leaving what we know to something we don't know. This learning anxiety can be fueled by fear of loss of power & position, fear of temporary incompetence, fear of subsequent punishment, fear of loss of personal identity and fear of loss of group membership. Higher the learning anxiety, the stronger is the defensiveness and resistance to change process in an organization.

2.7 Markets and Innovation

Innovation is a key driver for adoption of new products or processes based on customer needs and requirements to increase competitiveness and overall profitability (Mone *et al.*, 1998; Zahra *et al.*, 1999). The study conducted by Zenger and Hesterly (1997) has focused on the need to meet customer demands in shorter product cycles using flexible manufacturing systems. Firms manifest their market orientation through the success of new innovations. A firm's innovativeness represents the degree to which the firm generates new, timely and creative product/service introductions using the accumulative knowledge of customers, competitors and technologies. Thus market orientation is viewed as a pre-requisite to the formulation of the effective competitive response to product and process innovation. (Deshpande *et al,* 1993; Jaworkshi and Kohli, 1996; Varadarjan and Jayachandran, 1999; Mavondo *et al.,* 2005).

Technological changes and demanding customers are creating a more knowledge intensive, turbulent, complex and uncertain environment (Singh *et al.*, 2008; Muhammad *et al*, 2010). The competitiveness of an organization is dependent on its ability to provide goods and services more efficiently than others involved in the market place. The intense competition requires that organizations excel simultaneously in several areas without trade-off, including innovativeness and responsiveness to their customers. Therefore, organizations should develop core competencies, which give them a competitive edge over others. Organizations,

which are able to continually build new strategies, assert faster and cheaper than those of their competitors, create long-term competitive advantages (Ajitabh and Momaya, 2004).
The use of external networks to extend a firm's knowledge base has been related to successful innovation (Rothwell, 1977, 1991; Hoffman *et al*, 1998; Romijn and Albaladejo, 2002; Freel, 2000, 2003). The external information does not only come from suppliers or competitors, but also from customers. Markets, therefore, is a critical element of innovation as it enables firms to better understand customer needs (Kim *et al* 1993;Hadjimanolis, 2000; De Jong & Vermeulen, 2006). Market orientation is an important antecedent to product innovation, process innovation and administrative innovation (Mavando *et al.*, 2005).

Appiah-Adu and Singh (1998) reported a strong positive link between innovation and customer orientation, implying that small firms must use customer-based knowledge to develop products and services through a customer pull approach. Dejong and Vermeulen (2006) also hold the view that doing market research among customers proved to be a significant factor as their findings indicated that the new industry products are not delivered by suppliers, but instead through analysis of unsatisfied needs of customers.

Consumer behavior plays a significant role in affecting the innovation process. The knowledge and mental frame work of consumers now greatly affects product and the process innovations. In market segment of semiconductors and computers, public procurement has been found important for innovation in early stages of industries (Malerba, 1985). For computers experimental customers have been major actors in the emergent phase of the industry (Bresnahan and Malerba, 1999). Consumer as a co-inventor has been identified in information technology as user involvement has been key factor in the development and modification of products and applications and he has brought the major advances and development in the IT industry (Bresnahan and Greenstein, 2001). As reported by Malerba and Orsenigo (2002); in pharmaceuticals sector; the demand channeled through agencies, physicians and the health system has played a significant role developing new drugs. Von Hippel (1988) reported that in instrumentation and machine tools, lead users have played a major role in innovation. Harhoff *et al.*, (2003) stated that innovators sometimes reveal the information inside a community intentionally to induce interest and to get suggestions and improvements from outside sources.

2.8 Innovation: Role of Education and Training

The knowledge, skills and abilities of firm's employees i.e. its human capital, are important elements in innovation. Well-informed and trained individuals are fundamental for innovation and form the basis for the creation, integration and transfer of knowledge within a firm (Hayton, 2003; Laursen and Foss, 2003; Shrader and Siegel, 2007). Knowledge and skills of employers are often regarded a pre-condition for highly innovative performance (Roper, 1997; Hoffman *et al.*, 1998; Freel, 2000). The presence of formal education and training programmers to keep up the knowledge and skill level may enhance product innovation in small firms (Romijn and Albaladejo, 2002).

Well educated people adaptmore rapidly to technological changes and assure economic adaptiveness and growth of productivity in the long run (Carmen, 2008).Employee education increases the formation of new ventures, the likelihood of developing new products, and increases the sales growth rates of emerging firms (Charney and Libecap, 2000; Indarti and Langenberg, 2004).

The educated workers provide the flexibility needed to switch production between sectors and branches, and to restore external balance through innovation, retraining and relocation. This adaptability is essential for keeping labour and capital employed and maintaining competitiveness (Booth and Snower, 1996; Godfrey and Peter, 1997).

The entrepreneurial performance and productivity of a firm are strongly linked to education (Keogh and Stewart, 2000; Lange *et al,* 2000; Dickson *et al,* 2008). Education and training systems transmit knowledge and skill that directly affects the pace of technological developments. Studies on evaluation of creative trainings indicate that trained subjects perform better than untrained subjects at using instructions for their performance (Rose and Lin, 1984; McFadzean, 1998).

The organizations upgrade the knowledge and skills of their employees in firm specific technologies or systems for sustaining the innovativeness (Barnett and Storey, 2000; Georgellis, *et al,* 2000; Beaver and Prince, 2002; Salavou, *et al,* 2004; Laforet and Tann, 2006).

2.9 Innovation: Role of Science & Technology

According to Scott *et al.*, (2000), the determinants of National Innovative Capacity include an appropriate infrastructure, industrial clusters and a strong link between the two. The infrastructure includes the nation's science and technology policy, the mechanisms for supporting the basic research and higher education as well as the cumulative stock of software or technological knowledge. Porter (1990) also articulated that competitive advantage of a nation relies on four factors. First is the context for strategy and rivalry. This needs a local context that encourages innovation related investment and a spirited competition. Second is an appropriate input condition, including high quality human resources, capital, research and information infrastructures. Third is the presence of support industries, including suppliers. And finally the demand conditions must exist. They must be sophisticated and demanding local customers that anticipate needs elsewhere.

The national and sectoral institutions play an important role. The major point here is that innovative activities in industries are shaped by institutions, which include standards, regulations, norms, routines, common habits, established practices, rules, and so on (Edquist, 1997). There is now enormous evidence on the contributions of universities, public research organizations, the military, other public actors and financial organizations (such as venture capital) in the generation and diffusion of technological advance in industries. Their roles, however, has been shown to be quite different in different industries (Levin *et al.*, 1987; Cohen *et al*. 2002).

Many researchers treat R&D expenditure as a factor contributing towards innovation (Pakes and Grillches, 1984; Hall *et at.*, 1986; Ace and Audrestsch, 1987). Grillches (1990) stated that R&D expenditure is a significant predictor of innovation output and patents as a data source of innovations.

Indian Innovation System is presently going through an evolution phase and is continuously adapting itself to the newer ways of conducting R&D and funding the same. Kharbanda (2001) has reported through few case studies that enterprises in India are entering into clusters and gearing up to face the challenges of globalization and increased international competition, by facilitating innovations in small-and medium scale enterprises through linkages with R&D institutions. The Government of India has taken major science and technology initiatives by establishing central and state R&D institutes. These institutes are assisting for solving technological problems and for applied R&D work required to undertake incremental innovations among the small scale auto industry. Roy, *et al.*, (2002) reported that regional specialization for technological innovation has become institutionalized in India and they highlighted the adoption of strategy initiative for technological innovation through the CSIR; R&D Laboratories in India.

The recently introduced India's Science & Technology Innovation Policy, 2013 also aims seeding the science and S&T based high risk innovations as well as inclusion of private sector participation in R&D (Ministry of Science & Technology, 2013).

2.10 Innovation: Role of Financial Infrastructure

Financial means in the form of raising equity, funding through venture capital and easy credit loan facility from banks are the key resources in carrying out innovative activities in the small scale industries. The lack of financial resources, inadequacy of management and marketing, lack of skilled workers, weakness in external information and difficulties in coping with government regulations are the factors that limit the competitiveness of small firms. Most of these constraints are inter dependent and are due to lack of financial resources that ultimately restrict their growth (Rothwell, 1991; Freel, 2000; Jaehoon*et al*, 2010).

In some developed economies, government supports investment in more formalized innovative activities. The state government adopts preferential policies for small scale sector, through reducing tax, to encourage them for soft loans and technological upgradation. Tax policies that encourage enterprises to invest in technological innovations play a significant role (Massa and Testa, 2008; Zhang and Dai, 2009).

2.11 Innovation: Role of Physical Infrastructure

Infrastructure is generally defined as the physical framework of facilities through which goods and services are provided to the public. World Development Report (1994) divides infrastructure stock into physical infrastructure and social infrastructure. Physical infrastructure includes services such as electricity, transport, roads, water system, communications, irrigation etc, while latter includes education and health facilities.

Punjab is considered as one of the best states in India in terms of rail, road and transport network as per National Council of Applied Economic Research (NCAER, 2007). Poor infrastructure, of power, is a major constraint on competitiveness of Small Scale Industries (SSIs), who cannot afford in house captive power. According to report of Planning Commission (2011), Government of India in the Twelfth Plan has given major thrust on accelerating the pace of investment in infrastructure, as this is a critical factor for sustaining and accelerating growth.

2.12 Innovation: Role of various Agencies and Industry support Institutions

Innovation is fundamentally a learning process. Such learning, by doing, by using, by observing from, and sharing with others, depends upon the accumulation and development of relevant knowledge of a very wide variety.

The role of different institutions, some of them national, other sectoral, has been recognized as relevant. The major point here is that innovative activities in industries are shaped by institutions, which include standards, regulations, norms, routines, common habits, established practices, rules, and so on (Edquist, 1997). There is now enormous evidence on the contributions of universities, public research organizations, the military, other public actors and financial organizations such as venture capital, in the generation and diffusion of technological advance in industries. Their roles, however, has been shown to be quite different in different industries (Levin *et al*, 1987; Cohen *et al*, 2002).

A sectoral system of innovation and production encompasses new and established products for specific uses and the set of agents carrying out market and non-market interactions for the creation, production, and sale of their products (Malerba, 2002). Industries have been interpreted as systems, in which actors are related and interact in various ways (formal as well as informal relationships, market and non-market interactions, and so on) and are strongly influenced by their competences, learning processes, the knowledge base of sectors and the institutions. In this frame, the notion of sectoral systems of innovation is a useful tool for examining innovation in a sector (Malerba, 2004).

Roy *e tal.,* (2002) reported that in India, particularly, regional specialization for technological innovation efforts has become institutionalized and highlights the adoption of strategy initiative for technological innovation through the CSIR; R & D Laboratories in India. A sectoral system of innovation and production has been successfully adopted by CSIR (Council for Scientific and Industrial Research), ISRO (Indian Space and Research Organization) and CSIO (Central Scientific Instruments Organization) in the area of Scientific Instruments. Kharbanda (2001) has shown, through a few case studies that how enterprises in India are gearing up to face the challenges of globalization and increased international competition, by facilitating innovations in small-and medium scale enterprises through linkages with R&D Institutions.

The Government of India has also set up the National Manufacturing Competitiveness Council (NMCC) which is an interdisciplinary autonomous body to serve as a policy forum of creditable and coherent policy initiatives required to make domestic industry competitive. According to one of important recommendations of NMCC, the Government of India is taking up the issue of up-grading and increasing training institutions with various state Governments to meet requirements of skilled and semi-skilled work force. Similarly, acting on another recommendation of NMCC; the Government is also encouraging private partnership in the management of industrial training institutes in various states.

National Manufacturing Competitiveness Council (NMCC) was set up in 2004 under the initiative of Ministry of Medium, Small and Micro Enterprises (MoMSME). National Innovation Council (NIC) is another wing of NMPC and is spear heading formation of industry innovation clusters across the country. First innovation cluster under NIC in Punjab was Autoparts Manufacturing Cluster as identified in 2012. Institute for Autoparts & Hand Tools Technology, Ludhiana is the host institute to carry out activities under the incubator allotted by MOMSME in 2014.

Confederation of Indian Industry (CII) works on the concept of clustering for competitiveness and fostering innovation culture among manufacturing sector. This concept is in line with national objective of the country i.e. 'Building MSMEs'; 'Building India.' CII started its first cluster programme with 20 vendors of Maruti under the guidance of Prof Y T Suda in 1998 and present number of such clusters has risen to 203 with 2192 participating companies. CII is successful running 19 cluster programmes under the MACE Project of Maruti, 02 ACMA clusters and 02 Munjal Group Clusters in NCR, Delhi (CII Report, 2010).

There are six industry support institutions in the state of Punjab assisting the SSAMIs for technology development and their capacity building. Institute for Autoparts Technology (IAPT) Ludhiana, a UNDP/UNIDO Project, is one of the major Industry Support Institutions for assisting the small scale autoparts manufacturing industry sector of Punjab. This institute is helping the autoparts units in skill development, quality improvements and technology development. Besides this, Punjab state has two other institutes under UNDP / UNIDO collaboration i.e. Research & Development (R&D) Centre for Bicycle & Sewing Machines, Ludhiana set up in 1982; and Institute for Machine Tools Technology (IMTT), Batala established in 1994. The Ministry of Micro, Small and Medium Enterprises, Govt. of India has also established two industry support institutes i.e. Central Tool Room (CTR), Ludhiana in 1980 and Central Institute for Hand Tools (CIHT), Jalandhar in 1983. Ministry of Petroleum, Govt. of India has established Central Institute for Plastics Engineering Technology (CIPET), Amritsar in 1989. These institutions are also offering their support for skill development, technology development and acts as a platform to conduct R&D in the manufacturing units.

2.13 The Growth of Automobile Manufacturing Sector of India

The automobile industry in India has witnessed a sea change in post liberalization era of the country since 1991. There was entry of some major international automobile manufacturers in India during the decade of 2010-2020. Besides, the original equipment manufacturers (OEMs), auto component industry has also transformed itself from a traditional role to an integrated organization role (Sahoo *et al.,* 2011). The process of technological development in Indian automobile industry is clearly reflected in the auto-component clusters across the country. The Automobile clusters have developed all over the country i.e. in north India autoparts cluster is spread over national capital region comprising Noida, Faridabad and

Gurgaon. In eastern part of India, it is spread in the cities of Jamshedpur and Kolkata. In South India; the clusteris in the cities of Chennai, Hosur and Bangalore. In Western part of India, the clusteris spread in the cities of Mumbai, Pune and Aurangabad. These clusters have experienced the typical phases of life cycle i.e. pre-foundation phase 1945-1965; emergence phase 1966-1984; growth Phase I 1985-1995; growth Phase II 1996-2007 and sustaining Phase year 2008 onwards. There is a strong influence of government's initiatives taken in recent times which led to an environment of innovation and competitiveness among the automobile manufacturing sector of India.

Indian government has contributed towards growth of automobile industry by liberalizing its Foreign Direct Investment (FDI) policy and through softening the norms for import of technology in 1990's. As a result, the production of vehicles in India has increased from 4.2 million in 1998-99 to 10.7 million in 2011-12 (SIAM 2012). The intense competition both from domestic and global markets, the changing customer liking has resulted in significant improvements in automotive products. Product cycles continue to grow shorter as more OEMs adopt the practice to bring in frequent improvements in features and new models. This was possible primarily due to the deployment of flexible manufacturing technology by the OEMs and auto-component manufacturers. Improved materials technology has facilitated better energy efficiency, competency of internal combustion engine (ICE), reduced weight of vehicles, incorporating high-tech safety features, and emission norms etc. (Nag *et al.,* 2007). All these technological innovations gave way to opening up of the auto-component sector in India. Further, the government has facilitated manufacturing of high technology and critical automobile components and sub-system assemblies by giving an investment friendly environment coupled with a stronger patent regime and extending incentives for in-house R&D in manufacturing units.

ICRA Management Consulting Services Limited (ICRA (2014) studied development of auto-component industry and identified six major sources of information to improve productivity and quality of products: R&D through imitation, customer suggestions, and training of engineers (provided by suppliers of machinery), cluster development programme organized by ACMA or assemblers, and technical and foreign collaboration. The individual large firm's own technological change generating capabilities depends on externally sourced inputs like flow of FDI towards technology development, and technology transfer through collaborations in automobile industry. (Basant *et al.*, 2002, Okada *et al* 2007, Sudhir Kumar *et al.*, 2011).

More and Jain (2012) reported that automobile original equipment manufacturers (OEMs) are expanding their production bases to emerging economies to expand their market reach and leverage the existing capacity for auto-component manufacturing (SMEs) and provide opportunities for suppliers and subcontractors (SMEs) to build innovation capabilities leading to better performance. The innovation systems perspective and global value chain perspective contributes to develop important framework for evaluating innovation performance and maintain competitiveness of firms. These firms utilize external source of innovation and knowledge spillover externalities at cluster. Singh (2012) also holds the view that the firm-level determinants of export competitiveness along with the total exports are increasing and more auto firms are exporting to original equipment manufacturers and are Tier-I Level firms. It means that Indian auto component firms are not merely suppliers to aftermarket segment but are emerging competitive suppliers to global level automobile sector.

2.14 Research Gap

Most of the studies mentioned in above literature review present a global perspective. There has been a general lack of empirical based independent academic research on the issues specific to Indian context. The detailed literature review highlights the importance of innovation culture for a successful organization and most of the studies have been conducted in developed countries. A few sectoral studies have been conducted in the country and the existing literature does not provide a reliable theoretical frame work for a systematic study for evaluation of innovation culture in the autoparts manufacturing sector. Gupta and Dutta (2005) provided a valuable piece of information on India’s National Innovation System mainly dealing with the role of government. Mani (2006, 2007) has reported India’s sectoral system of innovation related to pharmaceutical industry. Arora (2007) examined the role of government in India’s biotechnology innovation system. Hence, the review leads the researcher to study the topic of innovation culture among small scale autoparts manufacturing sector of Punjab state in an effective manner. The present study is an attempt to find the ways to have a credible assessment about status of innovation culture among the SSAMIs. The study also explores the influence of national innovation system on competitiveness and innovativeness in the autoparts manufacturing sector of Punjab.

2.15 Summary of the Chapter

The Chapter on Review of Literature addresses extensively the topic of innovation, the innovation process, issues related to innovation, elements of innovative culture, innovation challenges and best practices to foster innovation. The chapter also covers the study of the influence of National Innovation System on innovativeness and competitiveness in the autoparts manufacturing sector of Punjab. The present study enables the researcher to fill the identified research gap.

CHAPTER – III

DESIGN OF THE STUDY

This chapter presents overall design, methodology and various phases of the study. Issues such as research design, sample selection, data collection and data analysis have been discussed in the following sections. The basic framework used for carrying out the study has also been outlined.

3.1 Research Questions

The manufacturing sector of a nation is considered as an engine of growth and is the key determinant for knowing the overall economic health of a country. The study aims at assessing the status of innovation culture among Small Scale Autoparts Industry of Punjab and to develop a model for fostering innovation in this sector. The research questions for the present study have been designed by taking into consideration the need and objectives of the study. The following research questions have been formulated for the study.

(i) What is the status of innovation culture among Small Scale Autoparts Manufacturing Industry of Punjab?

(ii) Is there any variation in the measure of innovation culture in individual Small Scale Autoparts Manufacturing Industry?

(iii) Is there any influence of national system of innovation on the innovativeness of Small Scale Autoparts Manufacturing Industry of Punjab?

(iv) How and to what extent the elements of national system of innovation affect innovation culture among Small Scale Autoparts Manufacturing Industry of Punjab?

The issues related to the above research questions were taken in the form of statements to meet objectives of the study. Overall six determinants of innovation culture internal to the organization were identified and are shown in Figure 3.1. The research questions (i) and (ii) are related to innovation culture.

Fig 3.1: Determinants of Innovation Culture, Internal to the Organization

Each determinant consists of eight parameters. The summary of parameters studied under scope of research work is given in Table 3.1. All the issues related to research question (i) and (ii) were addressed through these parameters.

Table 3.1: Summary of parameters studied under six determinants of innovation culture.

Research Question	Determinant	Parameter studied under the determinant
(i) What is the status of innovation culture among Small Scale Autoparts Manufacturing Industry of Punjab?	Strategy	Everyone understands goals and direction of the organization.
		Management has a vision for next 05 years to maintain competitive edge.
		Management regularly reviews strengths and competencies of the organization.
		Good ideas are adopted even from other fields.
		Priority is to comprehend and meet customer requirements.
		Organisation makes strategies to meet changing market requirements.
		Organisation does not hesitate in taking ideas from competitors.

<table>
<tr><td rowspan="32">(ii) Is there any variation in the measure of innovation culture in individual Small Scale Autoparts Manufacturing Industry?</td><td></td><td>Management encourages visits to Trade Shows/Exhibitions.</td></tr>
<tr><td rowspan="8">Organization Climate</td><td>The organization has an In-house R&D Department.</td></tr>
<tr><td>We have multipurpose machinery to take up development projects.</td></tr>
<tr><td>We have open and trusting relationships in the organisation.</td></tr>
<tr><td>We repose faith and encourage risk taking for development.</td></tr>
<tr><td>There are no punishments for failure in development projects.</td></tr>
<tr><td>Creative ideas from all levels are considered for development projects.</td></tr>
<tr><td>Management encourages new & creative ideas.</td></tr>
<tr><td>Organisation allocates adequate resources for development projects.</td></tr>
<tr><td rowspan="8">Human Resources</td><td>Organisation rewards successful innovations.</td></tr>
<tr><td>Skill-up gradation programmes are undertaken regularly.</td></tr>
<tr><td>We identify needs and arrange trainings.</td></tr>
<tr><td>Organisation has a policy for development and retention of Talent.</td></tr>
<tr><td>Organisation compensates the extra efforts in creation of new ideas.</td></tr>
<tr><td>The employees are motivated to think, review and generate ideas.</td></tr>
<tr><td>Few personal conflicts in the Organisation.</td></tr>
<tr><td>Employees are not demoralized by failures.</td></tr>
<tr><td rowspan="9">Processes & Procedures</td><td>Learn from mistakes and failures.</td></tr>
<tr><td>Ideas are evaluated before taking trials.</td></tr>
<tr><td>A lot of ideas are generated to take up development projects.</td></tr>
<tr><td>Debates / discussions are held about new projects.</td></tr>
<tr><td>Frequent brainstorming and creative group meetings are held.</td></tr>
<tr><td>Forecasting for Products / Technology is regularly taken up.</td></tr>
<tr><td>Comparison of products with that of competitors is regularly done.</td></tr>
<tr><td>Prototypes/pilot process are build to speed up adoption of new technologies.</td></tr>
<tr><td rowspan="6">Group Characteristics</td><td>Democratic and Participative style of functioning.</td></tr>
<tr><td>Regular Interaction with progressive / lead customers.</td></tr>
<tr><td>Good interaction with suppliers.</td></tr>
<tr><td>Cross functional teams to solve problems.</td></tr>
<tr><td>Information is shared to facilitate mutual learning.</td></tr>
<tr><td>Good interaction with educational institutions.</td></tr>
</table>

		Regular contact with professionals / consultants.
		Utilize services/expertise of R&D support institutions.
	Individual Characteristics	Employees educated in relevant field are recruited.
		Prefer hiring of multi skill/multi task employees.
		Employees take keen interest in creative activities.
		Policy to hire competent / talent.
		Employees with learning aptitude are recruited.
		Employees do not criticize development work.
		Employees work on scientific / technical knowledge base.
		Employees are not scared to take risks for fear of failures.

The issues related to the research questions (iii) and (iv) are about the study of national system of innovation and its influence on innovativeness and competitiveness of the units under study. Overall eightelements of national system of innovation, external to the organization were identified and are shown in Figure 3.2.

Fig 3.2: Elements of National System of Innovation, External to the Organization

Each determinant consists of five parameters. The summary of parameters studied as per scope of the study and to address the research questions (iii) and (iv) is given in Table 3.2. The issues related to the above research questions were addressed through these parameters.

Table3.2: Summary of Parameters studied under Eight Elements of National System of Innovation

Research Question	Element	Parameter covered under the element
	Education	Number and quality of education in the Schools.
		Number and quality of Vocational Training Institutes.
		Number & level of higher education in Colleges.
		Number and level of higher education in Universities.
		Infrastructure for Research in Universities.
	Science & Technology	Central Government S&T institutes.
		State Government R&D Centers/Institutions.
(iii) Is there any influence of national system of innovation on the innovativeness of Small Scale Autoparts Manufacturing Industry?		Govt. support for R&D Projects.
		Setting up In-house R&D in Industry.
		Facilitation / Assistance Centers on IPR issues.
	Markets	Collaboration /JV/MNC Licensee manufacturers.
		Domestic OEM market.
		Domestic Replacement Market.
		International OEM Market.
		International Replacement Market.
	Physical Infrastructure	Quality and Network of Roads.
		Network of Railways.
		Air connectivity and Cargo Terminals.
(iv) How and to what extent the elements of National System of Innovation affect innovation culture among Small Scale Autoparts Manufacturing Industry?		In-land Dry ports / Container Depot.
		Quality and supply condition of Electricity.
	Financial Infrastructure	Functioning and access to financial markets.
		Functioning and support of stock markets.
		Role of Banks/Financial Institutions.
		FDI/Investment by Non-Resident Indians.
		Raising Capital equity or Capital venture.
		Number of Industry / Trade

	Industrial Networking	Associations.
		Role of CII, CICU, APEX/Chambers & Confederations.
		Support from MSME, DICs and NPC for Technology.
		Contribution of Govt. S&T and R&D Institutions.
		Support from In-house R&D of Private Industries.
	Cultural Aspect	Hard working nature of people.
		Desire to learn new things.
		Competitive nature.
		Risk taking capacity
		Openness / Trust worthiness.
	State Induced Incentives	Incentives for Technological up-gradation.
		Incentives for Quality Products.
		Govt. support to Training Programme.
		Incentives for Import of Technology/R.M's.
		Assistance for Participation in Trade fairs/Exhibitions.

3.2 Research Design and Population of the Study

Descriptive research design was used to fulfill the objectives of the study. Descriptive research design involves producing descriptions of different variables of interest and of a given as per the scope of the study. Population of the study consisted of Micro and small scale autoparts manufacturing industries in Punjab. As per available data EDII (2009); there were 1350 Micro and Small units functioning in the autoparts manufacturing sector in Punjab.

3.3 Sampling Frame and Sample Selection

The sampling frame consisted of Micro and small scale autoparts manufacturing industries in Punjab, which were in operation for the last five years as on 31/07/2010. This sector of manufacturing units was chosen as per defined scope of study. The sample of study includes manufacturing units from three different categories based on the type of their operations. These three categories were identified as product manufacturers, processing units and service providers. The Area of Operations being undertaken by each category of respondent organizations is given in Table 3.3.

Table 3.3 Area of Operations under different categories of respondent Organizations

Product Manufacturers	Processing Units	Service Providers
Drive Transmission & Steering Parts including Gears, Shafts, Gear boxes, cross/springs	Forging Units Including Ferrous and non-ferrous alloy forgings	Tool & Die Makers Jig Fixture Tooling Makers Gauge Manufacturers
Engine Parts including Cylinder Head, Valves, Piston & piston rods.	Foundry Units Including ferrous and non-ferrous and pressure die casting parts	CAD/CAM Designer and Software Builders.
Suspension & Braking Parts Manufacturers Body and Chassis Parts	Heat Treatment processors	Testing & Evaluation Labs. Calibration Labs.
Automotive Fasteners	Electroplating / Coating / Surface finishing plants.	Industry Support Institutions both Private an Govt. owned Organizations.
Sheet Metal & Fine Blanking Parts	Proof Machining Units	Tool Manufacturers of Hobbs, Broaches, Thread Rolls, Drills &Milling Cutters.

3.4 Sample Size and Profile of Respondent Organizations

A total number of 205 units operating in autoparts manufacturing cluster in Punjab were approached with the questionnaire. These units represent 1350 number of Small Scale autoparts manufacturing industry and were registered as Micro and Small units. The criteria for a registered unit for manufacturing or processing industry is with investment cap up to Rs. 5 crores and the limit for a service provider unit is Rs. 2 crores as per guidelines of the Ministry of Micro and Small Industry, Government of India. A total number of 110 units responded and participated in the study. A high response rate of 54 percent was achieved due to vigorous persuasion and follow-up by the researcher. Out of 110 respondents, 48 were product manufacturers, 47 processing units and 15 were the service provider. The profile of respondent organizations is show in Figure 3.3.

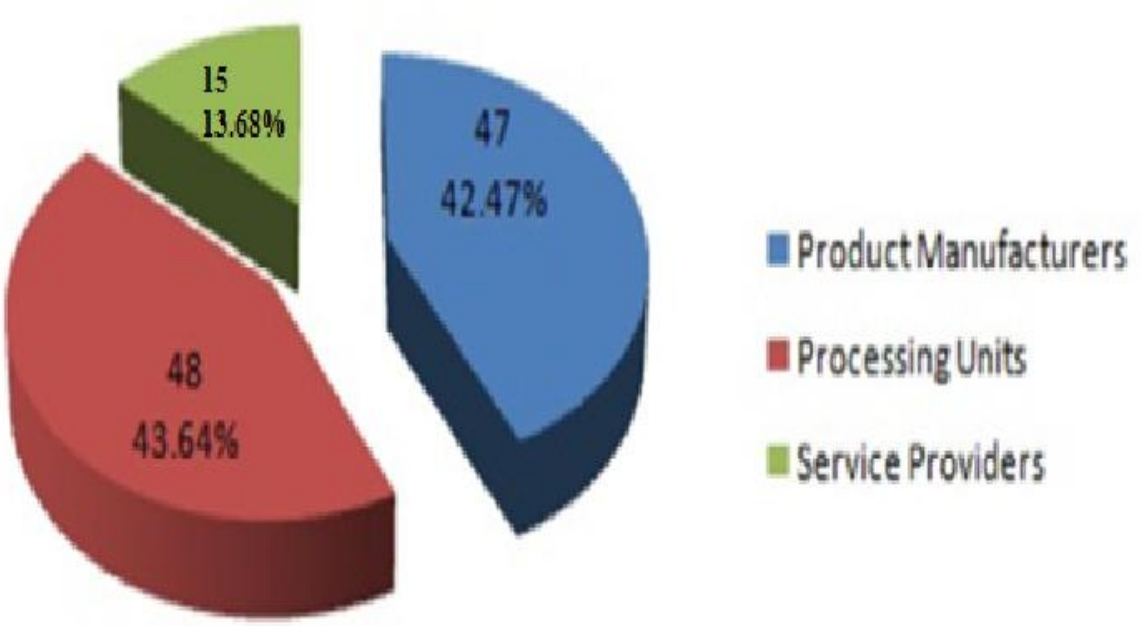


Figure 3.3Profile of the Respondent Organizations

3.5 Formulation of the Questionnaire

For an effective conduct of survey, the foremost task was to design a questionnaire. A detailed questionnaire with objective type questions having choice of answers, relevant to the conceptual frame work of the research was developed. The first section of questionnaire was prepared with the objective to assess prevailing level of innovativeness in small scale autoparts manufacturing industry in Punjab. For this six determinants of innovation culture internal to the organization were identified. The identified determinants of innovation culture are Strategy, Organization Climate, Human Resources, Processes & Procedures, Group Characteristics and Individual Characteristics. Each of the above determinants consists of eight parameters to cover the scope of the study. Hence, there were a total of 48 questions in the first section of the questionnaire. For the purpose of collection of data; a seven point likert scale was used assigning scores from Excellent; 7 to Very Poor 1 to different attributes. The second section of the questionnaire dealt with the national system of innovation. In this section eight different elements consisting of five parameters each were identified to analyze the influence of National Innovation System on the innovativeness of the industry. These identified elements are Education, Science & Technology, Markets, Physical Infrastructure, Financial Infrastructure, Cultural Aspects, Industrial Net Working and State Induced Incentives. Hence, there were a total of 40 questions in the second section of the questionnaire. For the purpose of collection of data; a five point likert scale was used assigning scores from Very Good; 5 to Very Poor 1 to different attributes. The information was sought, keeping in view the small scale auto manufacturers industry of Punjab. The scaled items of questionnaire were used to know the effect of independent variables on the dependent variable. This approach is in line with previous research studies, which employ single scale item for various variables (Ettlie and Hahn, 1994; Suarez *et al.,* 1996; Gupta and Somers, 1996).

3.5.1 Pre-testing of the Questionnaire

The questionnaire was prepared through an extensive literature review and was validated through peer review from each of six academicians, consultants and industry professionals. The process of finalizing the questionnaire was undertaken during the period from January to July, 2010. To ensure relevance and effectiveness, the questionnaire was pre-tested on a representative sample of industry under the scope of research work. Pilot survey of five organizations was undertaken for validation of the tools used for the study. The suggestions received through the peer review were incorporated in the final questionnaire. The objective of this exercise was to confirm that the responses were based on realistic interpretation of the questions.

3.5.2 Validity and Reliability of the Tools Used

For the purpose of carrying out the study, the questionnaire was divided into two sections. The first section of the questionnaire (Appendix-A) was meant for collecting the data regarding organization's innovation culture and the second section of the questionnaire was meant for collecting the data with respect to national system of innovation..

Cronbach's alpha was used for testing the reliability of the set of 48 statements under Section-I of the questionnaire. It can be seen from Table-3.4 that value of Cronbach's alpha for the set of forty eight statements used for evaluation of Innovation Culture came out to be 0.984.

Table3.4: Reliability for the Tools used for Evaluation of Innovation Culture

Cronbach's alpha	0.984
Split-half correlation	0.882
Spearman-Brown Prophecy	0.937

This value of 0.984 was found to be well above the conventional acceptance level of 0.7 (Nunnally, 1978). Therefore, the set of these 48 statements can be treated as reliable instrument. Further, value of split-half correlation and Spearman-Brown Prophecy were found to be 0.882 and 0.937 respectively. As these values were more than 0.8, it was concluded that the instrument was also having internal consistency.

Similarly, the Cronbach's alpha was used for testing the reliability of the set of 40 statements under Section-II of the questionnaire. It can be seen from Table-3.5 that value of 0.965 was found to be well above the conventional acceptance level of 0.7 (Nunnally, 1978).Therefore, the set of the statements can be treated as reliable statement instrument.

Table3.5: Reliability for the Tools used for Evaluation of National System of Innovation

Cronbach's alpha	0.965
Split-half correlation	0.888
Spearman-Brown Prophecy	0.940

Further, value of split-half correlation and Spearman-Brown Prophecy were found to be 0.888 and 0.940 respectively. As these values were more than 0.8, it was concluded that the instrument was also having internal consistency.

3.6 Data Collection and Analysis

Primary data was collected by administering the questionnaire, interviewing the respondents using single source i.e. Entrepreneur or Manager through personal interview methodand by means of direct observations by the researcher. The details of the respondents and their demographic are presented in Annexure-II. Secondary data was collected from available documents with respondent organizations and institutions. These documents were in the shape of proceedings, trade and technical journals, magazines, corporate publications and annual reports published by government or nongovernment organizations. The data collection work was completed during the period Aug to Dec 2010.The whole data collected from respondents was taken on Microsoft Excel spread sheet in coded form. The coding was essential for getting the quantitative analysis and for better interpretation of the findings of research work.

The collected data was analyzed using descriptive statistics such as frequencies, means and standard deviation as well as other suitable statistical techniques. The other statistical techniques such as Analysis of Variance (ANOVA), factor analysis and regression analysis have also been applied. ANOVA has been used to test the significance of differences between various parameters of determinants of innovation culture and the elements of national system of innovation. ANOVA was applied using SPSS 16.0 software. Tukey's multiple comparison tests were also applied to assess the significance of difference between all the pairs of parameters. Factor analysis has been used to summarize the influence of predictor variables under the National System of Innovation on innovation culture of organizations.

Factor analysis was run using SPSS and value of Kaiser-Meyer-Olkin (KMO) i.e. the Measure of Sampling Adequacy came out to be 0.920. KMO value which was found more than 0.50, which is an indication about adequacy of sample size (Field, 2003) for the application of factor analysis. Value of chi-square for Bartlett's Test of Sphericity came out to be 4643.707. This value was found to be significant (p=0.00) with 780 degrees of freedom. Value of KMO and results of Bartlett's Test of Sphericity indicated factor analysis could be performed on the given data set.

In order to evaluate the level of innovation culture in an organization; area diagram as shown in Figure 3.4 was used. The bold lines shown in the Hexagon diagram indicate the highest score in a given situation. The innovation culture has been evaluated by calculating the percentage of the area scored by the individual respondent organization(Tidd, *et. al.,* 2006).The formula used to evaluate the innovation culture is given below:

$$\text{Innovation culture} = \%\text{ area of hexagon} = \frac{\text{Area scored by respondent}}{\text{Total area of the Hexagon}} \times 100$$

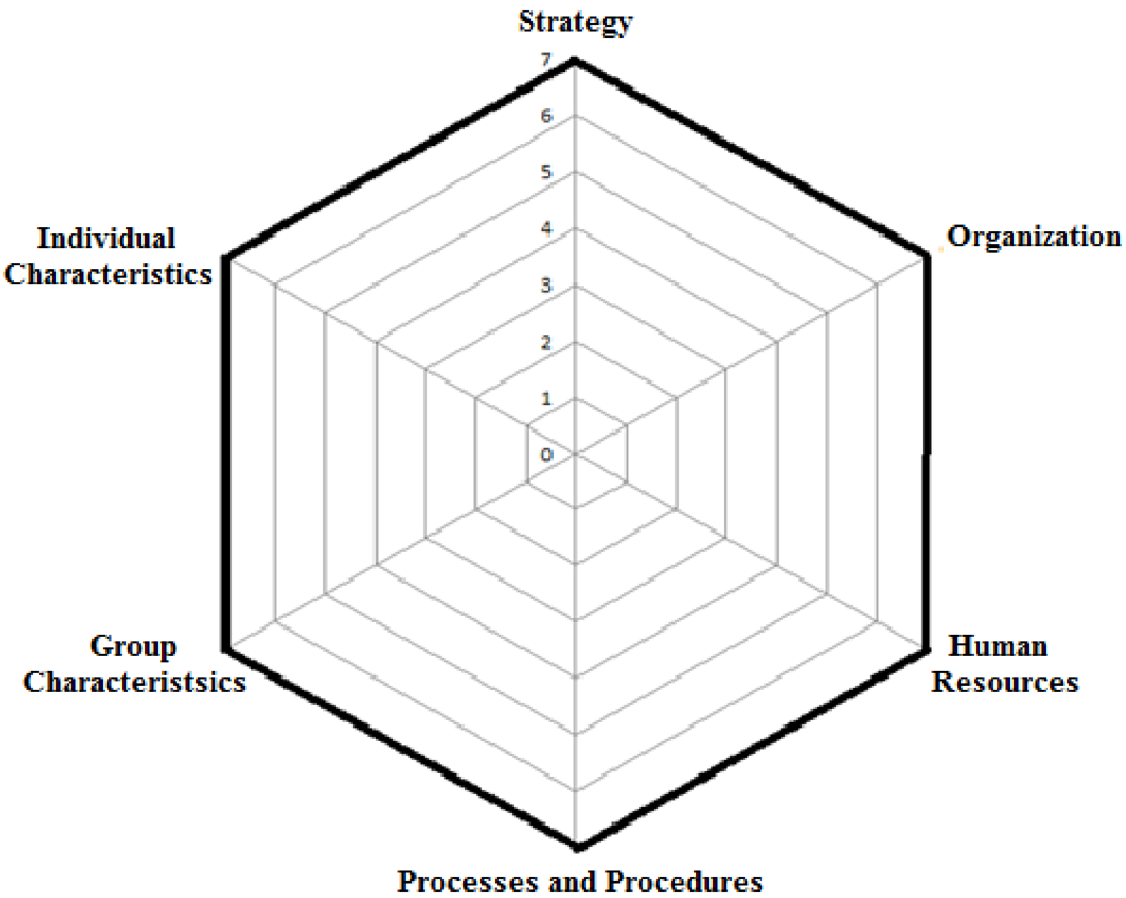


Figure 3.4 Area Diagram used for Evaluation of Innovation Culture

3.7 Conceptual Frame Work of the Study

The present study has been carried out on the basis of a conceptual frame work where, it has been presumed that the elements of national system of innovation influences innovativeness of small sale autoparts manufacturing industry of Punjab. The conceptual frame work of the study as shown in Figure 3.5 indicates that Determinants of Innovation Culture are internal factors of the organization and the elements of national system of innovation are external factors to the organization.

Internal Factors are shown at the Corners of the Inner Hexagon of the conceptual frame work. These are marked as Strategy, Organization Climate, Human Resources, Processes and procedures, Group Characteristics, Individual Characteristics. External Factors are shown at the Corners of the Outer Octagon of the conceptual frame work. These are marked as

Education, Science & Technology, Markets, Physical Infrastructure, Financial Infrastructure, Industrial Networking, Cultural Aspects and State Induced Incentives.

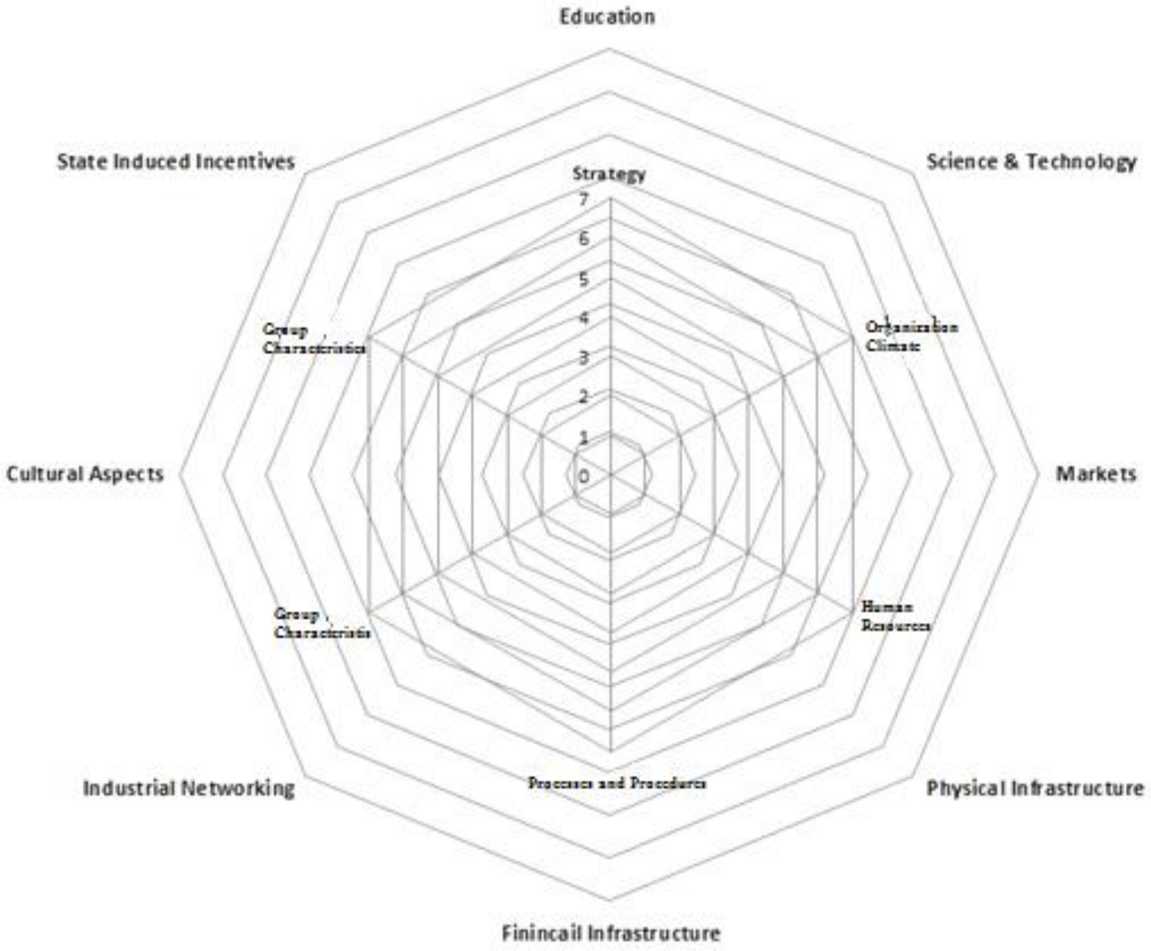


Figure 3.5 Conceptual Frame Work diagram of the Study

3.8 Summary of the Chapter

The present chapter outlines the research questions undertaken in the study and also the methodology adopted in order to find the answer to these questions. Various issues elaborating the research questions have been listed. This chapter also covers the methodology followed for the study including the sampling, the research instruments and their validity as well as the statistical techniques used for analyzing the data.

CHAPTER – IV

RESULTS OF SURVEY BASED RESEARCH

This chapter covers the results of the survey based findings related to the following objectives and relevant issues of the present study. This also addresses the research questions stated in the chapter design of the study. The results are summarized under following sections:

1. Identification of elements of innovation culture.

2. Evaluation of innovation culture among small scale autoparts manufacturing industry of Punjab.

3. Study of national system of innovation of India and other leading countries for the purpose of Bench Marking.

4.1 Identification of elements of innovation culture

A total number of six determinants of innovation culture were identified for the research work, based upon an extensive literature review (Cohen *et al.*,1990; Porter 1998;Tidd, *etal.*,2006 and Camison *et al.*, 2011). These six determinants of innovation culture internal to the organization are shown in Figure 4.1.

Fig 4.1: Determinants of Innovation Culture

Each determinant contains eight parameters which were assigned codes form. The coding was done for the purpose of statistical analysis to know the influence of independent variables upon the Dependent variable of innovation culture. Hence, a total number of 48 statements were taken as internal factors to the organization influencing the innovation culture. The details of the parameters under six determinants of Innovation Culture along with the codes are summarized in Table 4.1.

Table 4.1: Summary of parameters with codes under Determinants of Innovation Culture

Determinant	Parameters	Code
Strategy	Everyone understands goals and direction of the organization.	S_1
	Management has a vision for next 05 years to maintain competitive edge.	S_2
	Management regularly reviews strengths and competencies of the organization.	S_3
	We adopt good ideas even from other fields.	S_4
	Our priority is to comprehend and meet customer requirements.	S_5
	Organisation makes strategies to meet changing market requirements.	S_6
	Organisation does not hesitate in taking ideas from competitors.	S_7
	Management encourages visits to Trade Shows/Exhibitions.	S_8
Organization Climate	The organization has an In-house R&D Department.	O_1
	We have multipurpose machinery to take up development projects.	O_2
	We have open and trusting relationships in the organisation.	O_3
	We repose faith and encourage risk taking for development.	O_4
	There are no punishments for failure in development projects.	O_5
	Creative ideas from all levels are considered for development projects.	O_6
	Management encourages new & creative ideas.	O_7
	Organisation allocates adequate resources for development projects.	O_8
Human Resources	Organisation rewards successful innovations.	H_1
	Skill-up gradation programmes are undertaken regularly.	H_2
	We identify needs and arrange trainings.	H_3
	Organisation has a policy for development and retention of Talent.	H_4
	Organisation compensates the extra efforts in creation of new ideas.	H_5
	Our employees are motivated to think, review and generate ideas.	H_6
	We have few personal conflicts in the Organisation.	H_7
	Our employees are not demoralized by failures.	H_8

Processes & Procedures	We learn from mistakes and failures.	P_1
	Ideas are evaluated before taking trials.	P_2
	A lot of ideas are generated to take up development projects.	P_3
	Debates / discussions are held about new projects.	P_4
	Frequent brainstorming and creative group meetings are held.	P_5
	Forecasting for Products / Technology is regularly taken up.	P_6
	Comparison of products with that of competitors is regularly done.	P_7
	We build prototypes/pilot process to speed up adoption of new technologies.	P_8
Group Characteristics	Democratic and Participative style of functioning.	G_1
	Regular Interaction with progressive / lead customers.	G_2
	Good interaction with suppliers.	G_3
	Cross functional teams to solve problems.	G_4
	We share information to facilitate mutual learning.	G_5
	Good interaction with educational institutions.	G_6
	Regular contact with professionals / consultants.	G_7
	Utilize services/expertise of R&D support institutions.	G_8
Individual Characteristics	Employees educated in relevant field are recruited.	I_1
	Prefer hiring of multi skill/multi task employees.	I_2
	Employees take keen interest in creative activities.	I_3
	Policy to hire competent / talent.	I_4
	Employees with learning aptitude are recruited.	I_5
	Employees do not criticize development work.	I_6
	Employees work on scientific / technical knowledge base.	I_7
	Employees are not scared to take risks for fear of failures.	I_8

4.2 Evaluation of innovation culture among small scale autoparts manufacturing industry of Punjab.

The data to assess and analyze organization culture as an internal factor was collected on seven point likert scale of a structured questionnaire using single source i.e. entrepreneur or manager through personnel interview method. The scores from excellent = 7 to very poor=1 were assigned to the attributes studied as parameters under six determinants of innovation culture. Reliability of the questionnaire was tested using Cronbach's alpha as a measure of reliability and values are tabulated in Table 4.2.

Table 4.2: Reliability Analysis of Determinants of Innovation Culture as Internal Factors

Cronbach's Alpha	**0.984**
Split-Half Correlation	**0.882**
Spearman-Brown Prophecy	**0.937**

It can be seen from the above table that value of Cronbach's Alpha for the set of forty eight statements used for measuring the determinants of innovation culture came out to be 0.984. This value of 0.984 was found to be well above the conventional acceptance level of 0.7 (Nunnally, 1978). Therefore, the set of these 48 statements can be treated as reliable measurement instrument. Further, values of split-half correlation and Spearman-Brown Prophecy were found to be 0.882 and 0.937 respectively. As these values were more than 0.8;hence, it was concluded that the instrument was also having internal consistency.

Statistical evaluation of each parameter covered under all the six Determinants of innovation culture namely; Strategy, Organization Climate, Human Resources, Processes &Procedures, Group Characteristics and Individual Characteristics were taken up and the results are discussed in the following sections. The criteria for rating of different parameters based on mean %age score given by respondents is given in Table 4.3.

Table 4.3:The criteria for rating of different parameters based on mean %age score given by respondents

Category	Mean %age	Indication	Rating
1	Up to 20	Majority responses of SSI's for lowest choice on average.	Very poor
2	21 – 40	Majority responses of SSI's for third or fourth choice on average.	Poor
3	41 – 60	Majority responses of SSI's for second or third choice on average.	Fair
4	61 – 80	Majority responses of SSI's for first or second choice on average.	Good
5	81 – 100	Majority responses of SSI's for highest choice on average.	Very Good

4.2.1 Determinant of Strategy

Various parameters studied under the determinant of Strategy of innovation culture, their mean score and standard deviation along with F ratio and Tukey's significance are presented in Table 4.4.

Table 4.4: Evaluation of Strategy Parameters (Mean Score ± SD)

S. No.	Parameter	Mean	SD	Mean%	Rating
1.	Everyone understands goals and direction of the organization.	2.56	1.06	36.57	Poor
2.	Management has a vision for next 05 years to maintain competitive edge.	2.21	1.21	31.57	Poor
3.	Management regularly reviews strengths and competencies of the organization.	2.02	1.12	28.86	Poor
4.	We adopt good ideas even from other fields.	2.99	1.33	42.71	Fair
5.	Our priority is to comprehend and meet customer requirements.	5.17	1.64	73.86	Good
6.	Organisation makes strategies to meet changing market requirements.	5.20	1.46	74.29	Good
7.	Organizations do not hesitate in taking ideas from competitors.	4.00	1.31	57.14	Fair
8.	Management encourages visits to Trade Shows/Exhibitions.	3.46	1.68	49.43	Fair
*F-ratio		91.298			
**Tukey's Significance		1vs5, 1vs6, 1vs7, 1vs8, 2vs4, 2vs5, 2vs6, 2vs7, 2vs8, 3vs4, 3vs5, 3vs6, 3vs7, 3vs8, 4vs5, 5vs6, 5vs7, 5vs8,			
* Significant at 5% Level.		n = 110			

It can be observed from the table 4.4 that the mean score for making strategies to meet customer requirements was maximum, *i.e.,* 5.20. While, minimum mean score was observed for regular management reviews of strength and competencies of the organization, *i.e.,* 2.02. Analysis of Variance (ANOVA) was used to find out whether there is a significant variation across mean scores of various statements under strategy parameter. Calculated value of F statistic was found to be 91.298 ($p < 0.0001$). From the available result, it can be stated that there was a significant difference across mean scores of various parameters under strategy determinant. Further, post-hoc analysis was done so as to compare means of parameters in pairs. Pairs shown in table 4.4 were found to be significantly different on the basis of mean values at 5 percent level of significance. Further, the comparative of various parameters studied under the determinant of Strategy of innovation culture is shown in Figure 4.2.

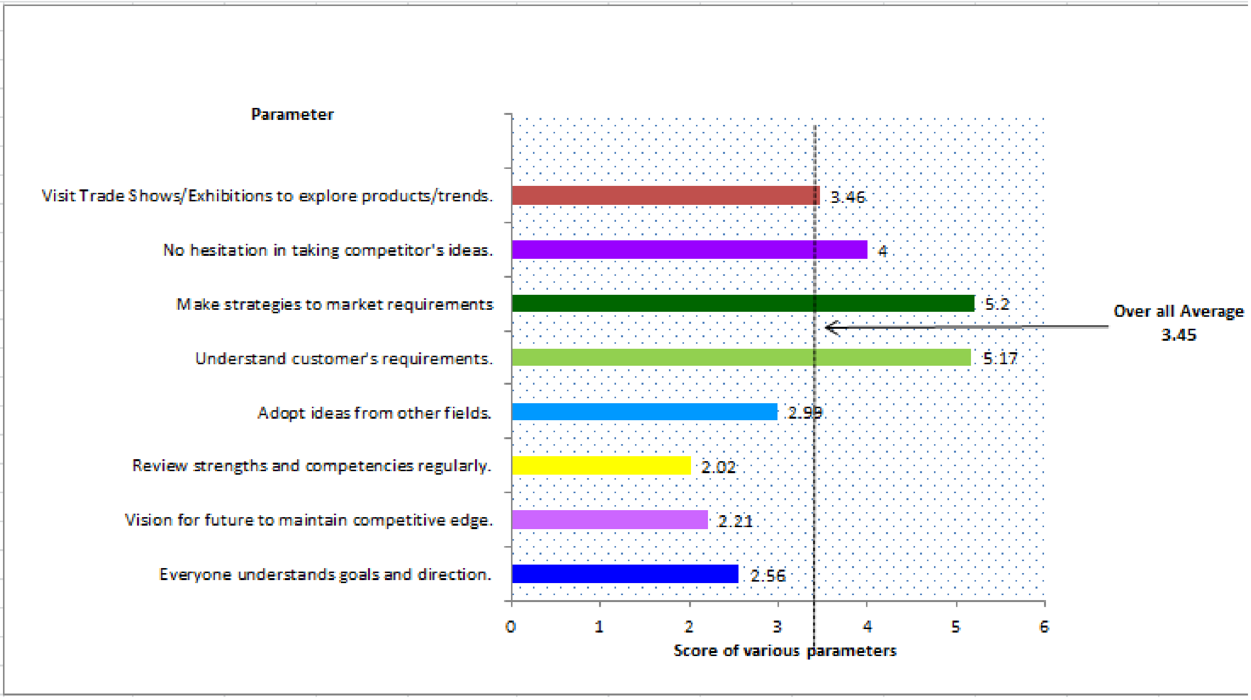


Figure 4.2: Performance of Innovation Strategy Parameters

4.2.2 Determinant of Organization Climate

Various parameters studied under the determinant of Organization Climate of innovation culture, their mean score and standard deviation along with F ratio and Tukey's significance are presented in Table 4.5.

Table 4.5: Evaluation of Organization Climate (Mean Score ± SD)

S. No.	Parameter	Mean	SD	Mean%	Rating
1.	The organization has an In-house R&D Department.	2.56	1.70	36.57	Poor
2.	We have multipurpose machinery to take up development projects.	2.80	1.64	40.00	Poor
3.	We have open and trusting relationships in the organisation.	5.25	1.56	75.00	Good
4.	We repose faith and encourage risk taking for development.	5.29	1.33	75.57	Good
5.	There are no punishments for failure in development projects.	5.20	1.40	74.29	Good
6.	Creative ideas from all levels are considered for development projects.	4.67	1.27	66.71	Good
7.	Management encourages new & creative	4.29	1.59	61.29	Good

	ideas.				
8.	Organisation allocates adequate resources for development projects.	2.93	1.89	41.86	Fair
*F-ratio		62.672			
**Tukey's Significance		1vs3, 1vs4, 1vs5, 1vs6, 1vs7 2vs3, 2vs4, 2vs5, 2vs6, 2vs7 6vs3, 6vs4, 6vs5 7vs3, 7vs4, 7vs5 8vs3, 8vs4, 8vs5, 8vs6, 8vs7			
* Significant at 5% Level.		n = 110			

It can be observed from the table 4.5 that the mean score for reposing faith and encouraging risk taking for development was maximum, *i.e.*, 5.29. While, minimum mean score was observed for having in-house R&D department, *i.e.*, 2.56. ANOVA was used to find out whether there is a significant variation across mean scores of various parameters under organization climate determinant. Calculated value of F statistic was found to be 62.672 (p <0.0001). From the available result, it can be stated that there was a significant difference across mean scores of various parameters under organization climate determinant. Further, post-hoc analysis was done so as to compare means of parameters / statements in pairs. Pairs shown in table 4.5 were found to be significantly different on the basis of mean values at 5 percent level of significance. Further, the comparative of various parameters studied under the determinant of Organization Climate of innovation culture is shown in Figure 4.3.

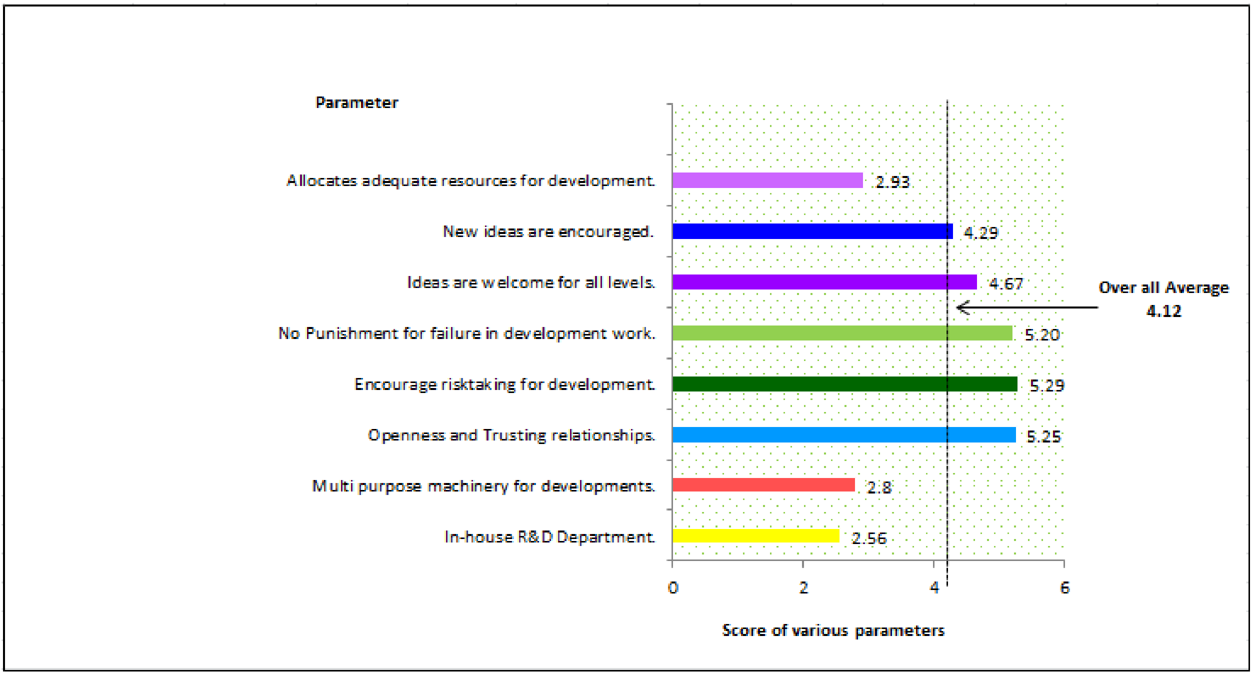


Figure 4.3: Performance of Organization Climate Parameters

4.2.3 Determinant of Human Resources

Various parameters studied under the determinant of Human Resources of innovation culture, their mean score and standard deviation along with F ratio and Tukey's significance are presented in Table 4.6.

Table 4.6: Evaluation of Human Resources Parameters (Mean Score ± SD)

S. No.	Parameter	Mean	SD	Mean%	Rating
1.	Organisation rewards successful innovations.	5.32	1.21	76.00	Good
2.	Skill-up gradation programmes are undertaken regularly.	3.00	1.61	42.86	Fair
3.	We identify needs and arrange trainings.	2.96	1.97	42.29	Fair
4.	Organisation has a policy for development and retention of Talent.	4.09	2.01	58.43	Fair
5.	Organisation compensates the extra efforts in creation of new ideas.	4.14	1.83	59.14	Fair
6.	Our employees are motivated to think, review and generate ideas.	4.59	2.14	65.57	Good
7.	We have few personal conflicts in the Organisation.	4.63	1.14	66.14	Good
8.	Our employees are not demoralized by failures.	3.63	1.61	51.86	Fair
*F-ratio		24.705			
**Tukey's Significance		2vs1, 2vs4, 2vs5, 2vs6, 2vs7 3vs1, 3vs4, 3vs5, 3vs6, 3vs7 4vs1 5vs1 6vs1 8vs1, 8vs4, 8vs5, 8vs6, 8vs7			
* Significant at 5% Level.		n = 110			

It can be observed from the table 4.6 that maximum mean score of 5.32 was observed for organization rewarding successful innovations. While, minimum mean score was observed for identification of training needs and their arrangement, *i.e.*, 2.96 only. Analysis of variance ANOVA was used to find out whether is a significant variation across mean scores of various parameters under Human Resources determinant. Calculated value of F statistic was found to be 24.705 ($p < 0.0001$). From the available result, it can be stated that there was a significant difference across mean scores of various statements under Human Resource parameter. Further, post-hoc analysis was done so as to compare means of parameters / statements in pairs. Pairs shown in table 4.6 were having significantly different means at 5 percent level of significance. Further, the comparative of various parameters studied under the determinant of Human Resources of innovation culture is shown in Figure 4.4.

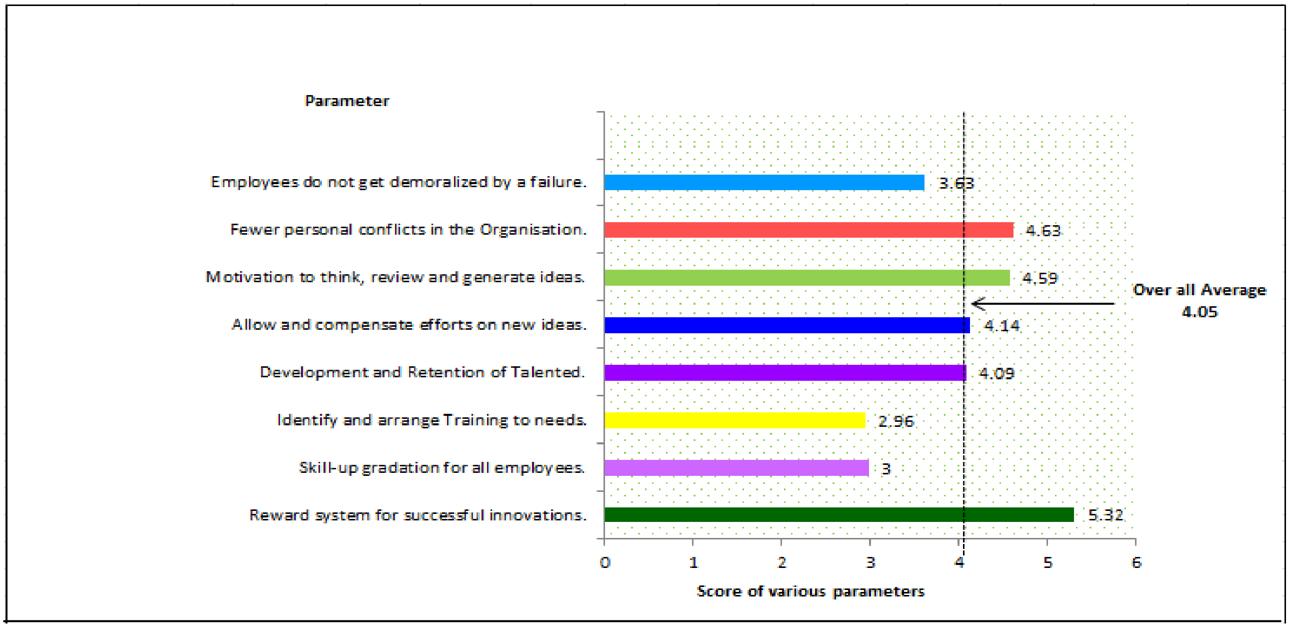


Figure 4.4: Performance of Human Resources Parameters

4.2.4 Determinant of Processes & Procedures

Various parameters studied under the determinant of Processes & Procedures of innovation culture, their mean score and standard deviation along with F ratio and Tukey's significance are presented in Table 4.7.

Table 4.7: Evaluation of Processes & Procedures Parameters (Mean Score ± SD)

S. No.	Parameter	Mean	SD	Mean%	Rating
1.	We learn from mistakes and failures.	4.40	1.21	62.86	Good
2.	Ideas are evaluated before taking trials.	2.50	1.28	35.71	Poor
3.	A lot of ideas are generated to take up development projects.	2.47	1.43	35.29	Poor
4.	Debates / discussions are held about new projects.	2.52	1.58	36.00	Poor
5.	Frequent brainstorming and creative group meetings are held.	2.54	1.04	36.29	Poor
6.	Forecasting for Products / Technology is regularly taken up.	1.90	1.38	27.14	Poor
7.	Comparison of products with that of	4.08	1.34	58.29	Fair

	competitors is regularly done.				
8.	We build prototypes/pilot process to speed up adoption of new technologies.	2.33	1.46	33.29	poor
*F-ratio		47.65			
**Tukey's Significance		2vs1, 2vs7 3vs1, 3vs7 4vs1, 4vs7 5vs1, 5vs7 6vs1, 6vs2, 6vs3, 6vs4, 6vs5, 6vs7			
* Significant at 5% Level.		n = 110			

It can be observed from the table 4.7 that the mean score for learning from mistakes was maximum, *i.e.*, 4.40. Minimum mean score of 1.90 was observed for regularly undertaking forecasting of products/technology. Analysis of Variance (ANOVA) was used to find out whether is a significant variation across mean scores of various statements under process parameter. Calculated value of F statistic was found to be 47.65 ($p < 0.0001$). From the available result, it can be stated that there was a significant difference across mean scores of various statements under processes & procedures parameter. Further, post-hoc analysis was done so as to compare means of statements in pairs. Pairs shown in table 4.7 were found to differ significantly in terms of mean values at 5 percent level of significance.

The comparative of various parameters studied under the determinant of Processes & Procedures of innovation culture is shown in Figure 4.5.

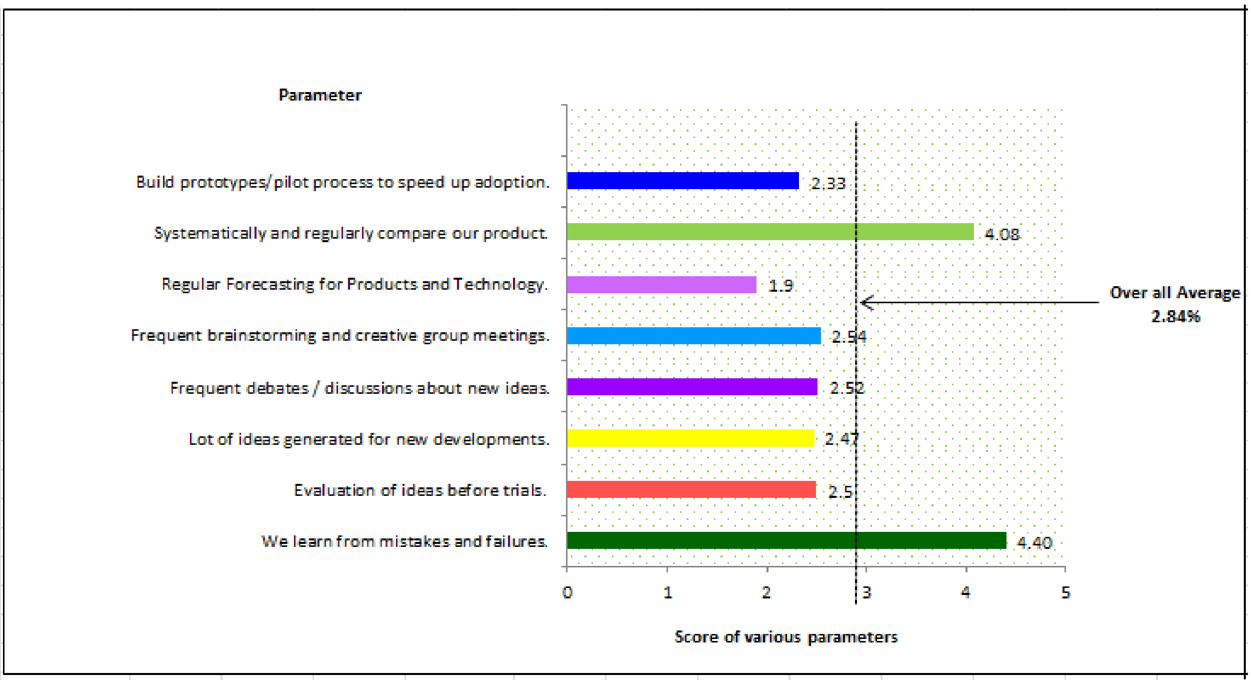


Figure 4.5: Performance of Processes & Procedures Parameters

4.2.5 Determinant of Group Characteristics

Various parameters studied under the determinant of Group Characteristics of innovation culture, their mean score and standard deviation along with F ratio and Tukey's significance are presented in Table 4.8.

Table 4.8: Evaluation of Group Characteristics Parameters (Mean Score ± SD)

S. No.	Parameter	Mean	SD	Mean%	Rating
1.	Democratic and Participative style of functioning.	4.66	1.57	66.57	Good
2.	Regular Interaction with progressive / lead customers.	4.86	1.67	69.43	Good
3.	Good interaction with suppliers.	4.80	1.42	68.57	Good
4.	Cross functional teams to solve problems.	2.87	1.37	41.00	Good
5.	We share information to facilitate mutual learning.	2.41	1.25	34.43	Fair
6.	Good interaction with educational institutions.	3.59	1.11	51.29	Fair
7.	Regular contact with professionals / consultants.	4.22	1.96	60.29	Good
8.	Utilize services/expertise of R&D support institutions.	4.28	1.98	61.14	Good
*F-ratio		37.439			
**Tukey's Significance		4vs1, 4vs2, 4vs3, 4vs6, 4vs7, 4vs8 5vs1, 5vs2, 5vs3, 5vs6, 5vs7, 5vs8 6vs1, 6vs2, 6vs3, 6vs8 7vs2			
* Significant at 5% Level.		n = 110			

It can be observed from the table 4.8 that the mean score for regularly interacting with the progressive/lead customers was maximum, *i.e.,* 4.86. While, minimum mean score was observed for sharing information to facilitate mutual learning, *i.e.*, 2.41. Analysis of Variance (ANOVA) was used to find out whether there is a significant variation across mean scores of various parameters under group characteristics determinant. Calculated value of F statistic was found to be 37.439 ($p < 0.0001$). From the available result, it can be stated that there was a significant difference across mean scores of various parameters under group characteristics. Further, post-hoc analysis was done so as to compare mean values of parameters / statements in pairs. Pairs shown in table 4.8 were found to be significantly different, on basis of mean values, at 5 percent level of significance. Further, the comparative of various parameters studied under the determinant of Group Characteristics of innovation culture is shown in Figure 4.6.

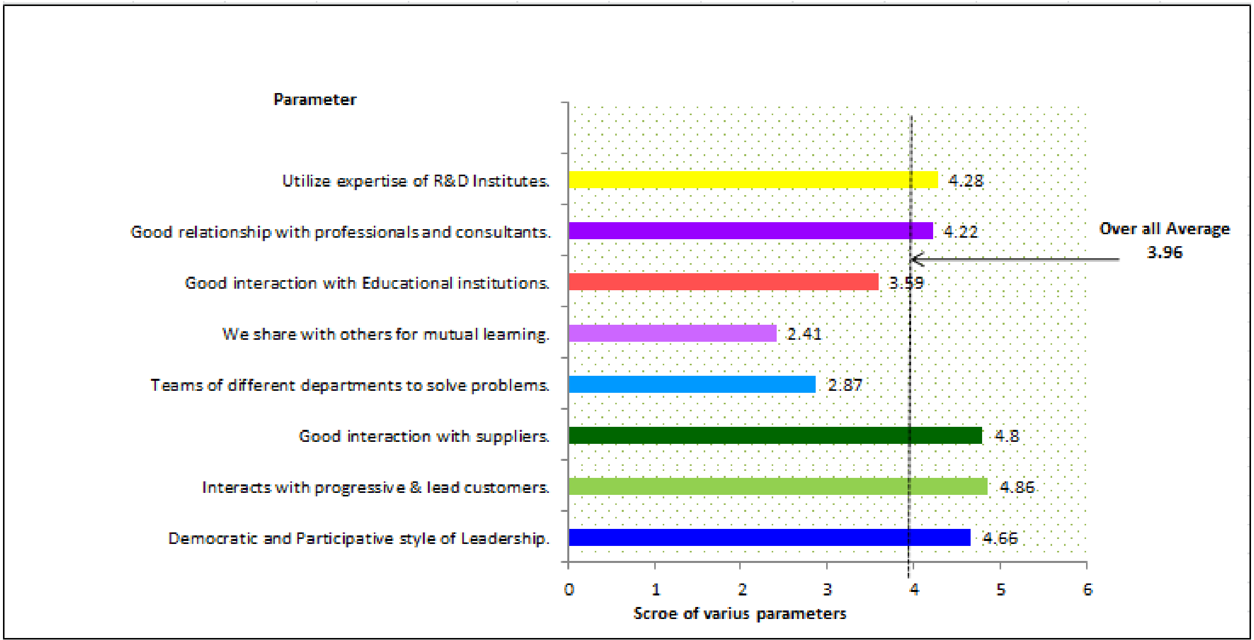


Figure 4.6: Performance of Group Characteristics Parameters

4.2.6 Determinant of Individual Characteristics

Various parameters studied under the determinant of Individual Characteristics of innovation culture, their mean score and standard deviation along with F ratio and Tukey's significance are presented in Table 4.9.

Table 4.9: Evaluation of Individual Characteristics Parameters (Mean Score ± SD)

S. No.	Parameter	Mean	SD	Mean%	Rating
1.	Employees educated in relevant field are recruited.	3.99	1.57	57.00	Fair
2.	Prefer hiring of multi skill/multi task employees.	3.68	1.53	52.57	Fair
3.	Employees take keen interest in creative activities.	4.65	2.05	66.43	Good
4.	Policy to hire competent / talent.	3.24	1.93	46.29	Fair
5.	Employees with learning aptitude are recruited.	4.71	1.63	67.29	Good
6.	Employees do not criticize development work.	4.53	1.81	64.71	Good
7.	Employees work on scientific / technical	2.88	1.43	41.14	Fair

	knowledge base.				
8.	Employees are not scared to take risks for fear of failures.	4.80	1.56	68.57	Good
*F-ratio		18.77			
**Tukey's Significance		1vs5 2vs3, 2vs5, 2vs6, 2vs8 4vs1, 4vs3, 4vs5, 4vs6, 4vs8 7vs1, 7vs2, 7vs3, 7vs5, 5vs6, 5vs8			
* Significant at 5% Level.		n = 110			

It can be observed from the table 4.9 that maximum mean score of 4.80 was observed for employees not being scared to take risks for fear of failure. While, minimum mean score was observed for employees working on scientific/technical knowledge base, *i.e.*, 2.88. Analysis of variance ANOVA was used to find out whether there is a significant variation across mean scores of various statements under individual characteristics. Calculated value of F statistic was found to be 18.77 (p <0.0001). From the available result, it can be stated that there was a significant difference across mean scores of various parameters under individual characteristics. Further, post-hoc analysis was done so as to compare mean values of parameters / statements in pairs. Pairs shown in table 4.9 were found to have significantly different mean values at 5 percent level of significance. Further, the comparative of various parameters studied under the determinant of Individual Characteristics of innovation culture is shown in Figure 4.7.

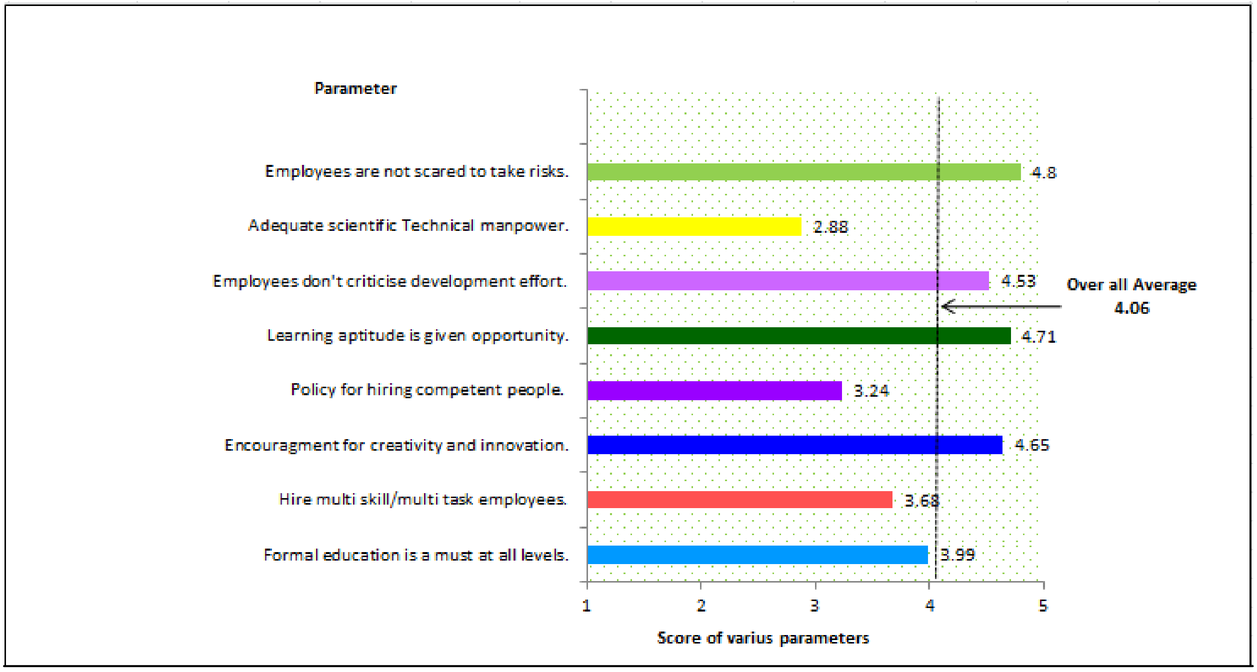


Figure 4.7: Performance of Individual Characteristics Parameters

4.2.7 Overall Analysis of Determinants of Innovation Culture

Various parameters studied under six determinants of innovation culture among Small Scale Autoparts Manufacturing Industry of Punjab are discussed as under. Their mean score and standard deviation along with F ratio and Tukey's significance are presented in Table 4.10.

Table 4.10: Overall Performance of Various Determinants of Innovation Culture (Mean Score ± SD)

S. No.	Determinant	Mean	SD	Mean%	Rating
1.	Strategy	3.45	1.78	49.29	Fair
2.	Organization Climate	4.12	1.91	58.86	Fair
3.	Human Resources	4.05	1.89	57.71	Fair
4.	Processes / Procedures	2.84	1.58	40.57	Fair
5.	Group Characteristics	3.96	1.79	56.57	Fair
6.	Individual Characteristics	4.06	1.82	57.57	Fair
*F-ratio		7.097			
**Tukey's Significance		1vs2, 1vs3, 1vs5, 1vs6 4vs1, 4vs2, 4vs3, 4vs5, 4vs6			
* Significant at 5% Level.		n = 110			

Table 4.10 presents mean values for various determinants of innovation culture. Maximum mean value (4.12) was observed for the determinant of organization climate. Processes & procedures scored minimum mean value of 2.84. it can be seen from the table that Organization Climate, Human Resources, and individual characteristics were high on mean scores. On the other hand, process and procedures along with strategy were low on mean scores. Analysis of variance ANOVA was used to test variations in mean values across six determinants. Calculated value of F statistic came out to be 7.097 ($p < 0.0001$). Results indicate that there was a significant variation across mean values of six determinants of innovation culture. Tukey's test was used for post-hoc analysis. The six determinants of innovation culture with significantly different mean values at 5 percent level of significance have been presented pair wise in Table 4.10. Further, the comparative of six determinants of innovation culture was studied for the Small Scale Autoparts Manufacturing Industry of Punjab.

The overall performance of various parameters covered under all the six determinants of innovation culture is shown in Figure 4.8.

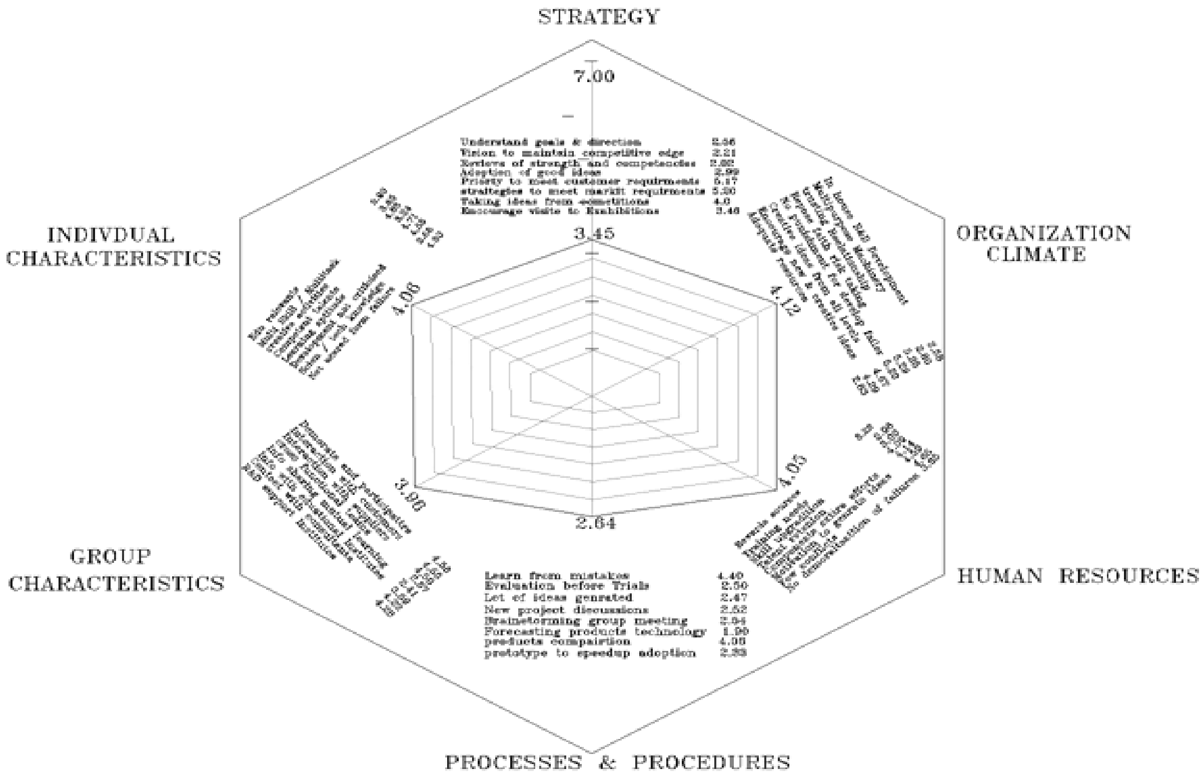


Figure 4.8: Overall Performance of Parameters studied under six Determinants of Innovation Culture

4.2.8 Evaluation of Innovation Culture

A mathematical frame work was used for assessing the innovation culture of an organization. The following equation based on the mathematical frame work of innovation culture was used to evaluate the innovation culture among small scale autoparts manufacturing industry of Punjab. (Tidd, *et al.*, 2006).

$$\textbf{Innovation culture} = \textbf{\% area of hexagon} = \frac{\textbf{Area scored by respondent}}{\textbf{Total area of the Hexagon}} \textbf{ X 100}$$

The hexagon picture used for evaluation of innovation culture in an organization is shown in Figure 4.9.

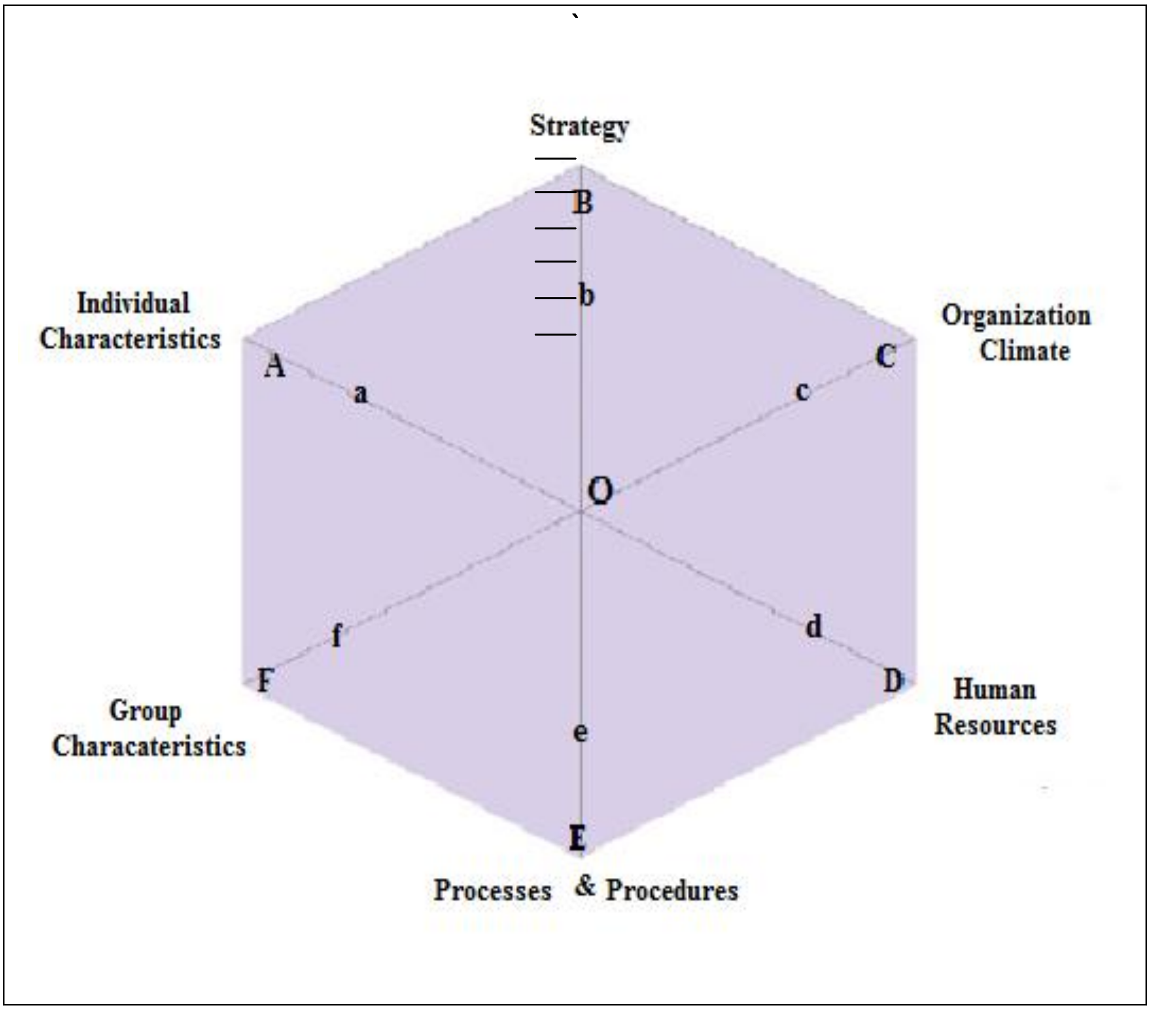


Figure 4.9: Area Diagram used for Evaluation of Innovation Culture

The area of hexagon was calculated on the basis of scores given to six determinants by respondent organizations. The distance from the centre of hexagon to one of its corner represents a determinant. This distance was divided into seven equal parts i.e. matching to the scores of 1 to 7 taken on the likert scale used in the questionnaire. It indicates that the distance **OB** represent the determinant of strategy, **OC** represent determinant of Organization Climate, **OD** represent the determinant of Human Resources, **OE** represent the determinant of Processes & Procedures, **OF** represent the determinant of Group Characteristics and **OA** represent the determinant of Individual Characteristics.

Hence, the equation based on the above mathematical Frame Work used for the evaluation of innovation culture of an organization is as under:

$$\textbf{Innovation Culture} = \textbf{\%age Area of the Hexagon} = \frac{\tfrac{1}{2}\,\text{sine}\,60^\circ \Sigma Ob.Oc.}{\tfrac{1}{2}\,\text{sine}\,60^\circ\, \Sigma OB.OC.} \times 100$$

Innov.Cul. = K (O*rg*.S*tgy*. + S*tgy*.I*ndv*. + I*ndv*. G*roup* + G*roup*P*p*. + P*p*.H*r*. + H*r*.S*tgy*.)

(k = 0.3401)

This mathematical frame work equation was used to evaluate the status of innovation culture of all the respondent small scale autoparts manufacturing industry of Punjab.

Based on the evaluation with respect to each respondent organization; the overall status of innovation culture among small sale autoparts manufacturing industry of Punjab is shown in Figure 4.10. The light area as shown in this figure indicates the area of hexagon based on the average scores given by respondent organizations from small scale autoparts manufacturing industry of Punjab.

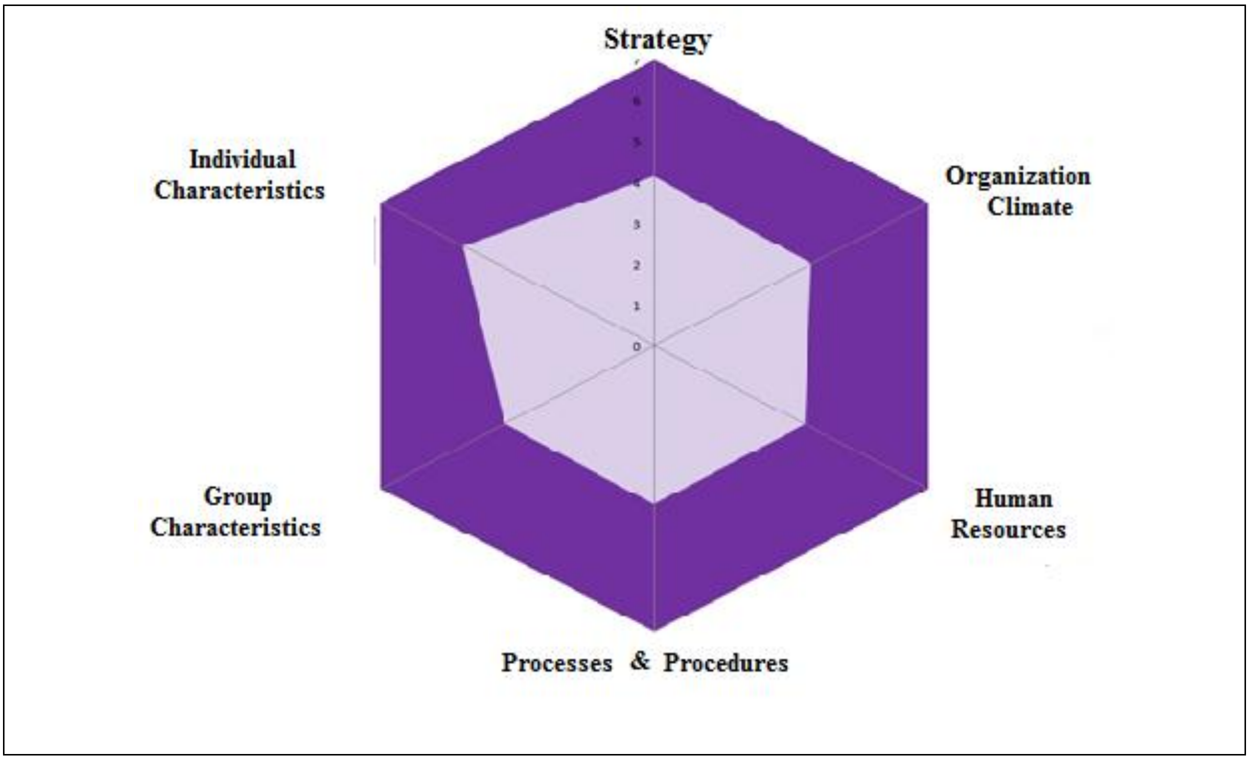


Figure 4.10 Overall status of innovation culture among small sale autoparts manufacturing industry of Punjab

The overall average %age area scored by the respondent organizations under the study of innovation culture among small scale autoparts manufacturing industry is 34% only.

4.2.9 Measure of Variation in the Innovation Culture among Individual Organizations

The same mathematical frame work equation was used to evaluate the status of innovation culture in individual small scale autoparts manufacturing units of Punjab. The values of %age area scored by all the individual 110 respondents small scale autoparts manufacturing of Punjab is shown in Table 4.11. The %age are scored by each respondent organization individual is indicative of the level of innovation culture prevailing in that organization.

Table 4.11: Innovation Culture based on %age area scored by individual respondent organizations

	Scores given to different Determinants of Innovation Culture						
Respondent No.	Strategy	Organization Climate	Human Resources	Processes & Procedures	Group Characteristics	Individual Characteristics	% Area Scored
1	5.13	5.63	6.00	5.63	6.00	5.63	66
2	4.25	4.13	4.13	5.13	4.63	5.50	44
3	5.50	5.88	5.25	5.25	5.13	6.25	63
4	4.00	5.38	4.63	5.13	4.13	5.63	47
5	4.13	3.13	4.00	4.13	4.50	5.13	36
6	5.00	4.88	5.13	3.63	4.25	5.38	45
7	5.50	5.63	5.38	5.50	4.00	5.38	56
8	4.38	3.63	3.88	4.00	4.88	5.00	38
9	3.88	3.50	3.75	3.75	5.13	4.75	35
10	4.00	4.13	4.13	3.75	4.25	5.75	38
11	6.00	6.50	5.63	6.38	5.88	6.13	74
12	5.00	5.75	5.50	5.50	4.00	5.38	55
13	4.38	5.25	4.75	5.25	4.13	5.63	49
14	3.88	5.13	4.63	5.25	4.13	5.75	46
15	4.25	3.25	3.75	3.75	4.63	4.88	34
16	5.00	3.38	3.88	3.63	4.13	5.50	37
17	4.50	5.38	4.75	5.25	4.13	5.75	50
18	5.63	4.88	5.00	3.63	4.25	5.38	47
19	5.13	5.38	4.88	5.25	5.38	6.00	58
20	5.38	5.13	5.25	3.63	4.13	5.38	48
21	5.75	5.75	5.00	5.50	4.00	5.38	56
22	4.38	3.25	3.38	3.75	4.00	5.13	33
23	4.25	3.25	3.75	4.00	4.00	4.75	33
24	4.13	4.00	3.88	3.75	3.88	4.88	34
25	3.88	3.75	3.75	3.75	5.63	5.63	40
26	5.75	6.13	4.50	5.63	5.75	6.13	65
27	5.25	5.75	5.63	6.00	4.00	6.25	61
28	5.75	5.25	5.25	5.50	4.00	5.25	54
29	5.25	5.50	5.25	5.50	3.88	5.25	53
30	3.75	4.88	4.63	5.25	4.00	5.38	44
31	4.00	5.25	4.50	5.25	4.00	5.25	45
32	3.75	5.25	4.38	4.75	3.75	5.25	41
33	4.00	4.63	4.25	4.63	3.63	5.13	39

34	5.25	5.50	5.13	5.50	5.38	6.13	61
35	3.88	4.88	4.63	4.75	3.88	5.13	42
36	4.38	3.00	3.50	3.88	4.50	4.13	31
37	5.25	5.38	5.13	5.38	3.75	5.13	51
38	3.88	3.25	3.50	3.63	4.63	4.63	32
39	5.38	6.00	4.50	5.38	5.63	6.13	62
40	5.00	3.88	3.75	3.63	4.00	5.25	37
41	4.00	3.38	3.13	3.63	4.38	4.88	31
42	3.63	3.25	3.75	3.25	3.63	5.00	29
43	3.50	3.50	3.75	3.75	3.75	5.00	31
44	3.38	3.00	3.75	3.75	4.13	4.88	30
45	3.50	2.88	3.50	3.38	4.00	5.00	28
46	4.38	2.88	3.50	4.88	4.38	5.13	36
47	5.00	5.25	5.25	5.00	3.88	5.25	50
48	4.38	4.88	4.50	4.63	3.88	5.13	42
49	5.50	5.75	4.38	4.38	5.38	5.88	56
50	2.38	2.13	2.29	2.80	2.67	2.40	12
51	2.75	2.13	1.86	2.20	2.00	2.60	11
52	2.38	2.17	2.14	2.25	2.00	2.43	10
53	2.63	2.00	1.86	2.50	2.67	3.00	12
54	5.38	5.88	4.38	4.75	5.50	5.88	57
55	4.50	5.38	4.00	4.88	3.88	4.50	42
56	5.13	4.88	5.00	3.38	3.88	5.00	42
57	3.50	3.13	3.75	3.25	4.38	3.63	26
58	3.50	2.88	3.38	3.63	4.25	3.63	26
59	3.50	3.25	3.38	3.75	4.25	4.88	30
60	3.63	3.75	3.75	3.63	3.63	4.63	30
61	5.63	5.75	5.25	5.38	5.75	5.63	63
62	3.38	3.50	3.50	3.63	4.75	4.63	31
63	4.00	3.38	3.50	3.38	3.88	4.88	30
64	3.63	3.63	3.13	3.75	3.50	5.13	29
65	4.00	3.50	3.50	3.88	4.00	4.50	31
66	3.25	3.88	3.25	3.63	4.00	4.75	29
67	5.25	5.25	5.13	5.50	5.75	5.50	60
68	3.00	2.00	1.86	2.60	2.00	2.25	11
69	2.75	2.00	1.83	2.25	2.17	3.33	12
70	3.88	3.25	3.00	3.75	4.13	4.88	30
71	3.63	3.38	3.38	3.88	4.38	4.25	30
72	3.13	3.50	3.38	3.63	4.13	4.50	28
73	4.25	3.88	3.25	3.50	3.88	4.38	31
74	4.38	3.75	3.38	3.63	4.00	4.50	32
75	4.00	4.38	3.75	3.88	3.75	4.38	33

76	4.13	4.38	3.25	3.38	3.25	4.25	29
77	3.50	3.63	3.25	3.63	3.75	4.63	28
78	3.25	3.63	3.13	3.38	3.75	4.63	27
79	3.50	3.50	3.50	3.25	3.75	4.50	28
80	2.63	2.00	2.20	2.20	2.43	2.17	11
81	2.50	2.14	1.75	2.33	2.60	2.20	10
82	3.63	3.38	3.38	3.25	3.63	4.13	26
83	3.75	3.38	3.25	3.38	3.88	4.63	28
84	3.88	3.63	3.38	3.13	3.63	4.75	29
85	5.25	4.63	5.00	2.88	3.50	4.75	39
86	4.88	4.88	5.00	3.13	3.38	4.75	39
87	5.38	5.00	5.00	3.00	3.38	4.88	41
88	2.63	2.13	1.63	2.00	2.00	2.60	10
89	2.50	2.00	2.00	2.25	2.17	2.33	10
90	2.50	2.14	1.60	2.00	2.40	3.00	11
91	2.80	2.13	1.86	2.20	2.25	2.17	10
92	2.57	2.14	1.71	2.00	2.17	2.50	10
93	2.63	2.00	1.63	2.00	2.00	2.29	9
94	3.75	4.63	4.38	4.50	3.63	4.75	37
95	4.13	4.13	3.25	3.38	3.63	4.88	31
96	4.50	4.75	4.38	4.75	3.50	4.63	40
97	5.38	5.38	4.88	4.50	5.25	4.75	52
98	5.50	4.75	4.75	2.75	3.38	4.75	39
99	5.00	5.25	4.88	3.00	3.63	4.38	39
100	5.00	5.63	5.88	5.00	5.25	5.00	57
101	5.13	4.63	5.00	3.13	3.75	4.63	39
102	5.88	5.00	5.25	5.38	5.50	5.13	59
103	5.13	4.75	4.38	3.13	3.25	4.38	36
104	3.63	3.50	3.75	3.13	3.75	4.00	27
105	4.00	3.25	3.50	3.00	3.50	4.13	26
106	3.75	3.50	3.75	3.13	3.75	4.13	28
107	2.63	2.00	1.80	2.17	2.00	2.00	9
108	2.75	2.00	1.71	2.00	2.00	2.33	9
109	2.71	2.00	1.83	2.00	2.00	2.17	9
110	2.75	2.00	1.86	2.29	2.14	2.29	10

The %age area scored and hence the level of innovation culture prevailing in individual units of al the 110 respondents small scale autoparts manufacturing industry of Punjab is shown in Figure 4.11.

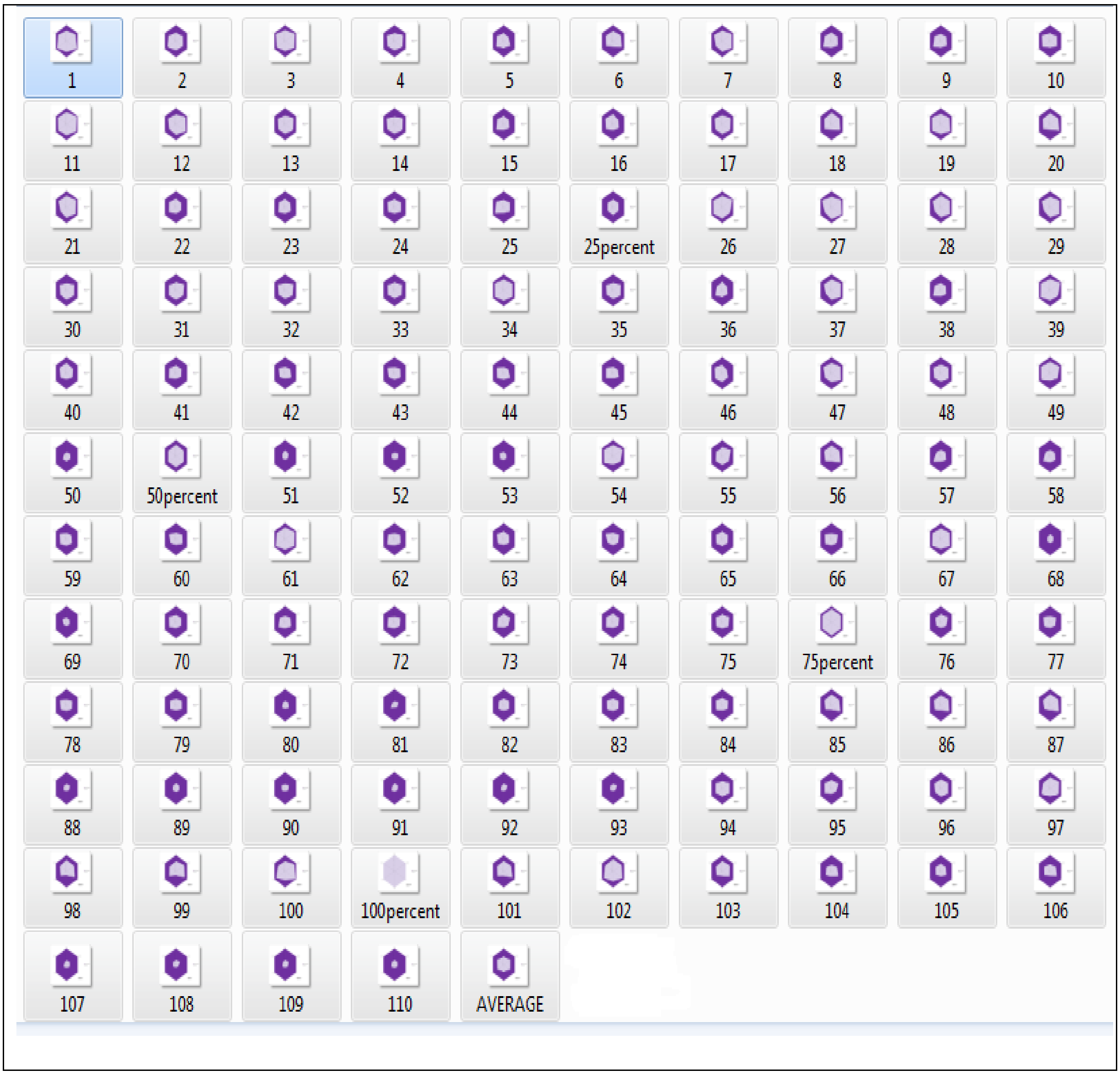
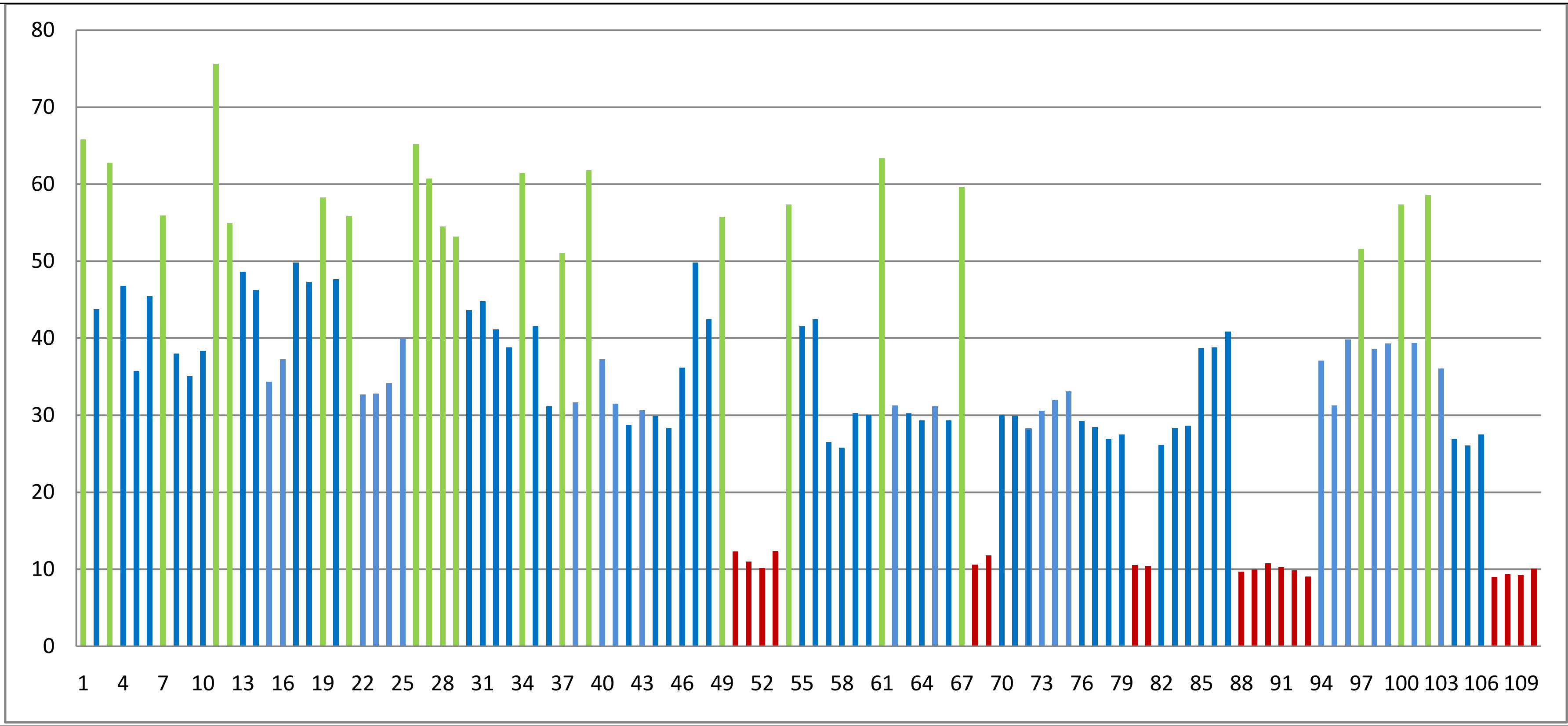


Figure 4.11: %age area and Level of Innovation Culture prevailing among Small Scale Autoparts Manufacturing Industry of Punjab

The pattern of innovation culture prevailing among 110 respondent organizations of small scale autoparts manufacturing industry in Punjab is also shown in a graphical form in Figure 4.12.



%A : 0-25 (18)	**%A : 26-50 (71)**	**%A : 51-75 (21)**	**%A : 76-100 (0)**

Figure 4.12: Distribution of the Level of Innovation Culture among Small Scale Autoparts Manufacturing Industry of Punjab

The criteria for classification of organizations into different types based on %age area scored and hence the level of innovation culture prevailing in the units covered under the study is given in Table 4.12.

Table 4.12: The criteria for classification of organizations into different types based on %age area scored and level of innovation culture

%age area scored	Indication	Type
76 – 100	Organization is capable to generate and absorb technology	I
51 – 75	Organization know the need and has some ability to generate and absorb technology	II
26 – 50	Organization know the need but not how to change	III
Up to 25	Organization don't know the need and how to change	IV

The distribution of respondent organizations into various types is shown in Figure 4.13.

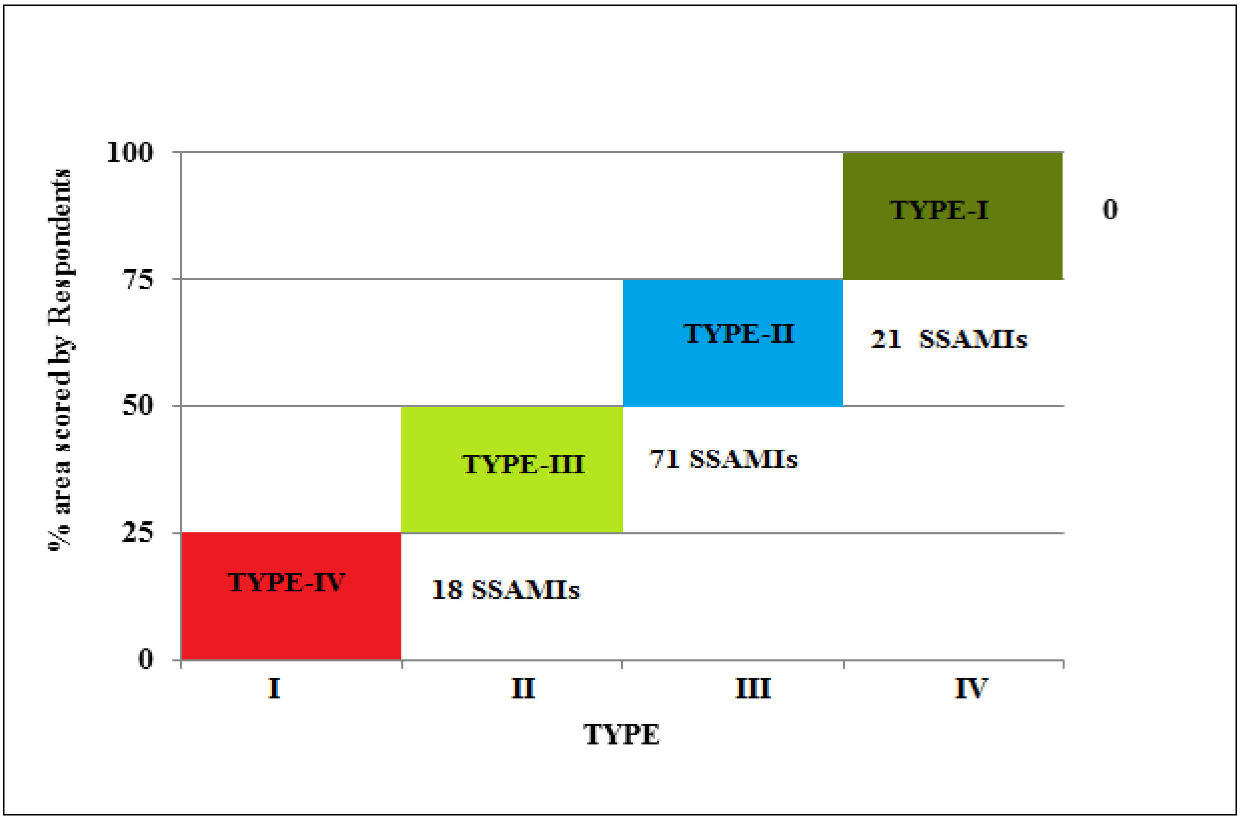


Figure 4.13Distribution of respondent organizations into various types

The overall level of innovation culture in small scale autoparts industry of Punjab is found to be 34% against the optimal and achievable level of 51% – 75%.

The majority; 65% of small scale autoparts industry of Punjab falls under Type-III. The Type-III indicates the industry having the status of “know the need but not how to change”.

Approximately one fifth 19% of the industry falls under Type-II. The Type-II indicates, they “know the need and has some ability to generate and absorb technology”.

No unit in autoparts manufacturing sector of Punjab fall under the highest level of Type-I. The Type-I indicates that the industry is capable to “generate and absorb technology”.

About 16 % of the autoparts manufacturing units of Punjab fall under the lowest category of Type-IV of innovation. The Type-IV means that the industry “don’t know the need and how to change”.No unit is found to be a product innovator in the present study.

A total no. of 21 units i.e. 19% of respondent organizations are found in the optimal range of 51% - 75%.

Another 19 units i.e. 17% are crossing the threshold level of 40% of area score and hence the level of innovation culture. This is a promising indication that the autoparts manufacturing sector of Punjab is moving upwards direction of innovativeness.

The Autoparts manufacturing cluster of Punjab is still in developing stage for undertaking indigenous R&D work or develops production technologies for critical components. Some process innovations are undertaken by adopting Low cost automation concepts derived mainly through foreign technology acquisitions and domestic OEM”s. Recent adoption of quality systems by manufacturers have resulted in development of procedures and routines which helped in building absorptive capacity and innovation culture in their enterprises. Now the small scale autoparts manufacturing units are participating actively in Lean programmes, sharing best practices, adopting advanced manufacturing materials, flexible manufacturing and incremental process innovations. At present, the small scale autoparts industry in Punjab is practicing “low tech” – “low cost” innovations to improve quality and productivity in their manufacturing processes.

4.3 Study of Elements of National System of innovation in the context of Autoparts Manufacturing Sector in Punjab

Innovation systems are country, region or industry specific elements which support developing and successfully marketing new products and services. The national innovation system is 'a set of institutions, whose interactions determine the innovative performance of national firms' (Nelson, 1993). National System of Innovation can also be defined as 'a set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provide the framework within which Governments form and implement policies to influence the innovation process. Organizations can improve their innovation performance by drawing on knowledge sources from the region and beyond. The Regional Innovation System may be defined as the *localized* network of actors and institutions in the public and private sectors whose activities and interactions generate, import, modify and diffuse new technologies (Cooke 1998, 2000).

4.3.1 Identification of Elements of National System of Innovation

Based upon literature review, (Scott *et. al.*, 2000; Roy *et. al.*, 2002; Malerba, 2004; Mavondo *et.al.*, 2005; Herstatt *et.al.*, 2007 and Jaehoon *et.al.*, 2010) following eight Elements of the national innovation system external to the organization are shown in Figure 4.14.

Fig 4.14: Elements of National System of Innovation

Each Element contains 05 parameters which were analyzed to know influence of these as independent variables on dependent variable in the shape of innovation culture. The details of the parameters studied under the elements of national system of innovation are summarized in Table 4.13.This table is showing definition and codes of all the 40 variables in the shape of parameter under eight elements of NSI in the present study.

Table 4.13: Summary of Parameters with codes under eight elements of National system of Innovation

Element	Parameters	Code
Education	Number and quality of education in the Schools.	E_1
	Number and quality of Vocational Training Institutes.	E_2
	Number & level of higher education in Colleges.	E_3
	Number and level of higher education in Universities.	E_4
	Infrastructure for Research in Universities.	E_5
Science & Technology	Central Government S&T institutes.	ST_1
	State Government R&D Centers / Institutions.	ST_2
	Govt. support for R&D Projects.	ST_3
	Setting up In-house R&D in Industry.	ST_4
	Facilitation / Assistance Centers on IPR issues.	ST_5
Markets	Collaboration/JV/MNC Licensee manufacturers.	M_1
	Domestic OEM market.	M_2
	Domestic Replacement Market.	M_3
	International OEM Market.	M_4
	International Replacement Market.	M_5
Physical infrastructure	Quality and Network of Roads.	P_1
	Network of Railways.	P_2
	Air connectivity and Cargo Terminals.	P_3
	In-land Dry ports / Container Depot.	P_4
	Quality and supply condition of Electricity.	P_5
Financial infrastructure	Functioning and access to financial markets.	F_1
	Functioning and support of stock markets.	F_2
	Role of Banks/Financial Institutions.	F_3
	FDI/Investment by Non-Resident Indians.	F_4
	Raising Capital equity or Capital venture.	F_5
Industrial Networking	Number of Industry / Trade Associations.	NW_1
	Role of CII, CICU, APEX/Chambers & Confederations.	NW_2
	Support from MSME, DICs and NPC for Technology.	NW_3
	Contribution of Govt. S&T and R&D Institutions.	NW_4
	Support from In-house R&D of Private Industries.	NW_5
Cultural Aspect	Hard working nature of people.	C_1
	Desire to learn new things.	C_2
	Competitive nature.	C_3
	Risk taking capacity	C_4
	Openness / Trust worthiness.	C_5
	Incentives for Technological up-gradation.	SI_1

State Induced Incentives	Incentives for Quality Products.	SI_2
	Govt. support to Training Programme.	SI_3
	Incentives for Import of Technology/R.M's.	SI_4
	Assistance for Participation in Trade fairs/Exhibitions.	SI_5

4.3.2 Evaluation of National System of Innovation in the Context of Punjab

The data to study the National Innovation System was collected on five point likert scale of a structured questionnaire using single source i.e. Entrepreneur or Manager through personal interview method. Various attributes were assigned scores as under: Very Good - 5, Good - 4, Fair - 3, Poor - 2 and Very Poor - 1. The mean scores were calculated and compared with one way ANOVA using SPSS 16.0 Software. Tukey's multiple comparison tests were also applied to assess the significance of difference between all the pairs of various parameters under each element. Reliability of the questionnaire was tested using Cronbach's alpha as a measure of reliability and values are tabulated in Table 4.14.

Table 4.14: Reliability Analysis of Elements of National System of Innovation

Cronbach's Alpha	**0.965**
Split-Half Correlation	**0.888**
Spearman-Brown Prophecy	**0.940**

It can be seen from the above table that value of Cronbach's Alpha for the set of forty statements used for measuring the determinants as internal factor came out to be 0.965. This value of 0.965 was found to be well above the conventional acceptance level of 0.7 (Nunnally, 1978). Therefore, the set of these 40 statements can be treated as reliable measurement instrument. Further, values of split-half correlation and Spearman-Brown Prophecy were found to be 0.888 and 0.940 respectively. As these values were more than 0.8. Hence, it was concluded that the instrument was also having internal consistency.

Statistical evaluation of each parameter covered under all the eight elements of national system of innovation namely; Education, Science & Technology, Markets, Physical Infrastructure, Financial Infrastructure, Industrial Networking, Cultural Aspect and State Induced Incentives were taken up and the results are discussed in the following sections. The criteria for rating of respondent organization on the basis of scores were taken into five ranges as detailed in Table 4.3 as shown earlier in the chapter.

4.3.3 Element of Education System

Various parameters under the element of 'Education', System, their mean score and standard deviation along with F-ratio and Tukey's significance are presented in Table 4.15 below.

Table 4.15: Evaluation of Education Parameters (Mean Score ± SD)

S. No.	Parameters	Mean	SD	Mean%	Rating
1.	Number and quality of education in the Schools.	3.95	0.62	78.91	Good
2.	Number and quality of Vocational Training Institutes.	3.89	0.79	77.76	Good
3.	Number & level of higher education in Colleges.	2.02	0.89	40.36	Poor
4.	Number and level of higher education in Universities.	2.02	0.92	40.36	Poor
5.	Infrastructure for Research in Universities.	1.55	0.68	30.97	Poor
F-ratio		231.74**			
Tukey's Significance		1vs3,1vs4,1vs5, 2vs3,2vs4,2vs5,3vs5,4vs5			
** Significant at 1% Level.		n = 110			

The findings of the present study show that in the state of Punjab, number and quality of education at high schools (M%=78.91) and VTIs (M%=77.76) are rated as good. The number and level of education in colleges (M% =40.36) and universities (M% =40.36) were reported poor for both these parameters in the element of Education. The score for research infrastructure in the universities (M%=30.97) was given a poor score by respondents. The differences in mean scores of various parameters of Education were found to be significant ($p< 0.01$). Tukey's significance revealed that the mean scores for parameters namely; Number and quality of education in schools and Number and quality of vocational training institutes are significantly higher than parameters about Number & level of higher education in Colleges, Number and level of higher education in Universities and Infrastructure for Research in Universities. The mean score for parameter of Infrastructure for Research in Universities was significantly lower than the parameters of Number and level of higher education in Colleges and Number and level of higher education in Universities. The comparative of various parameters studied under the element of Education system of national system of innovation is shown in Figure. 4.15.

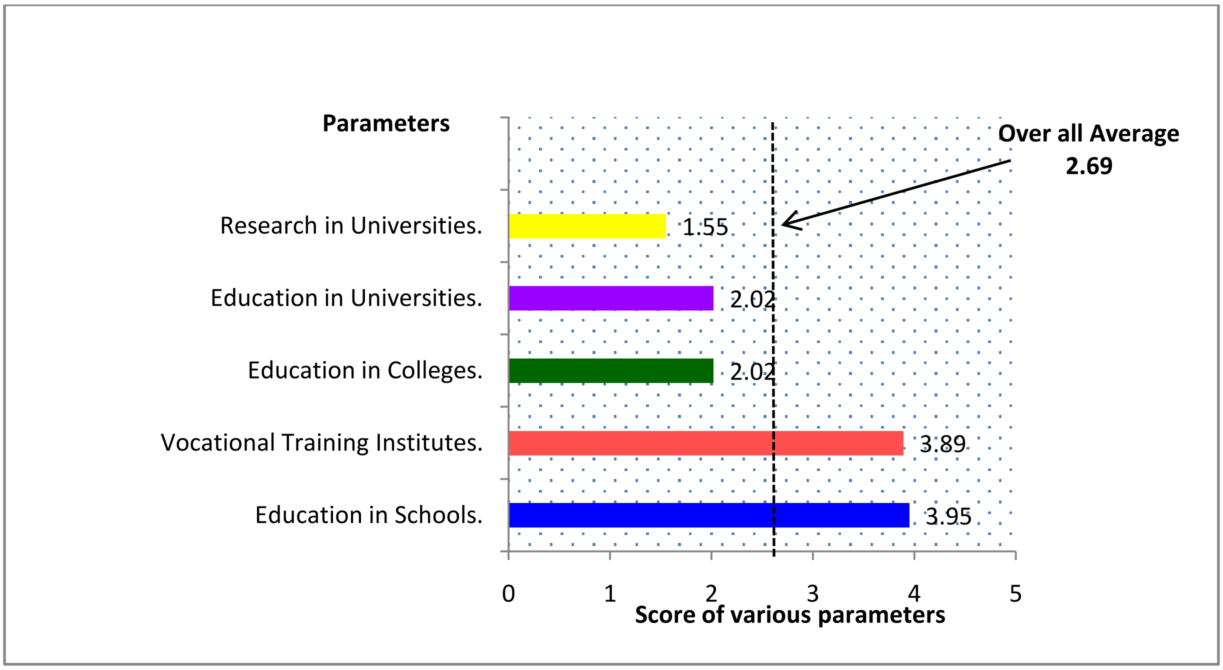


Figure 4.15: Performance of Education System Parameters

4.3.4 Element of Science & Technology

The Government of India has taken major science and technology initiatives by establishing central and state R & D institutes. The table 4.21 depicts various parameters on which information was sought to assess the impact of Science & Technology initiatives on autoparts manufacturing sector in the state of Punjab. Various parameters under the element of Science & Technology, their mean score and standard deviation along with F-ratio and Tukey's significance are presented in Table 4.16.

Table 4.16: Evaluation of Science & Technology Parameters (Mean Score ± SD)

S. No.	Parameters	Mean	SD	Mean%	Rating
1.	Central Government S&T institutes.	3.47	0.79	69.45	Good
2.	State Government R&D Centers / Institutions.	3.49	1.00	69.82	Good
3.	Govt. support for R&D Projects.	1.87	0.78	37.45	Poor
4.	Setting up In-house R&D in Industry.	1.55	0.97	30.91	Poor
5.	Facilitation / Assistance Centers on IPR issues.	1.33	0.76	26.55	Poor
F-ratio		164.43**			
Tukey's Significance		1vs3,1vs4,1vs5,2vs3,2vs4,2vs5,3vs4,3vs5			
** Significant at 1% Level		n = 110			

There are two types of S&T institutes for meeting the R&D requirements of the industry. Central government S&T institutes are run by the Government of India while the state government R&D centers and other industry support institutes are managed by the state government of Punjab. The services rendered by central and state S&T institutes find favour among SSIs as revealed from a good rating of (M%=69.45) for Central Government S&T institutes and (M%=69.82) for State Government R&D Centers / Institutions. The differences in mean scores of various parameters under the element of Science & Technology were found to be significant ($p< 0.01$). Tukey’s significance revealed that the mean scores of parameters about services by Central Government S&T institutes and State Government R&D Centers / Institutions were significantly higher than Govt. support for R&D Projects to Industry, Setting up In-house R&D in Industry and Facilitation / Assistance Centers on IPR issues. The mean score of parameter about Facilitation / Assistance on IPR issues was significantly lower than Govt. support for R&D Projects and Setting up In-house R&D in Industry. The financial support to SSIs for R & D related works by the government presents a dismal picture as a poor rating of (M%=37.45) has been observed for this parameter. Similarly, the status of in-house R&D is also not encouraging Z (M%=30.91). This poor rating is attributed to the fact that majority of the SSIs do not have any practical support under R&D policies of either state govt. or central government of India. A look at standard deviation of various parameters reveals that although State Government R & D Centres are performing their rules yet the variation among SSI about the assistance received is quite high depicted by high standard deviation of 1.00. In house R & D has a low mean score but a high SD of 0.97 which points towards the variation among the SSI on this parameter. The situation for assisting the SSIs on IPR issues has been rated very poor (M%=26.55). It was also observed during the study that lack of awareness among the SSI organization on IPR issues is one of the major causes for such a poor score. A proactive role by the government agencies on the issue is required and policy makers need to be sensitized about the alarming status for this parameter of IPR issues in the element of Science & Technology. The comparative of various parameters studied under the element of Science & Technology system of national system of innovation is shown in Figure. 4.16.

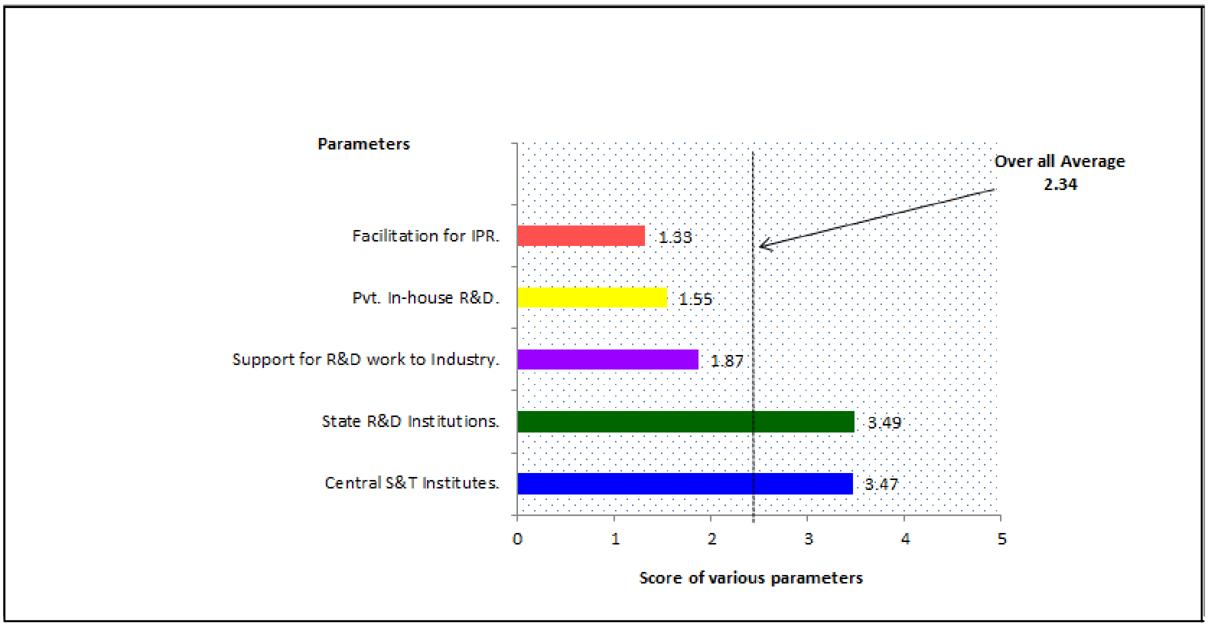


Figure 4.16: Performance of Science & Technology Parameters

4.3.5 Element of Markets

The market orientation is viewed as a pre-requisite to the formulation of the effective competitive response to product and process innovation. The evaluation of different parameters in the element of Markets is given in Table 4.17.

Table 4.17: Evaluation of Markets Parameters (Mean Score ± SD)

S. No.	Parameters	Mean	SD	Mean%	Rating
1.	Collaboration/JV/MNC Licensee manufacturers.	1.27	0.59	25.45	Poor
2.	Domestic OEM market.	3.18	1.04	63.64	Good
3.	Domestic Replacement Market.	3.74	0.44	74.73	Good
4.	International OEM Market.	1.17	0.47	23.45	Poor
5.	International Replacement Market.	1.43	0.68	28.55	Poor
F-ratio		346.37**			
Tukey's Significance		1vs2,1vs3,2vs3,2vs4,2vs5,3vs4,3vs5,4vs5			
** Significant at 1% Level. n = 110					

As per Tukey's significance, the Marketing parameters about Collaboration/JV/MNC Licensee manufacturers and International Replacement Market being at par were significantly lower than Domestic OEM market and Domestic Replacement Market. However, the mean score of parameter about Domestic Replacement Market was significantly higher than all other parameters. A low SD value of 0.44 in domestic replacement market however is heartening. This also points towards the fact that the main business of SSI is in the domestic replacement market. The Punjab state does not have any major automobile manufacturing unit or any Collaborative, Joint Venture or a MNCs licensee manufacturing automotive unit. This discouraging scenario about the element of markets in the regional innovation system demands two-pronged strategy to improve upon. First, the small-scale auto industry need to gear up to meet the International Quality System requirements and must speedily adopt ISO/TS/TQM systems; second, the government must put in more efforts to attract JV/MNCs license/collaborations and major Indian automobile manufacturing units in the state of Punjab. The comparative of various parameters studied under the element of Markets system of national system of innovation is shown in Figure. 4.17.

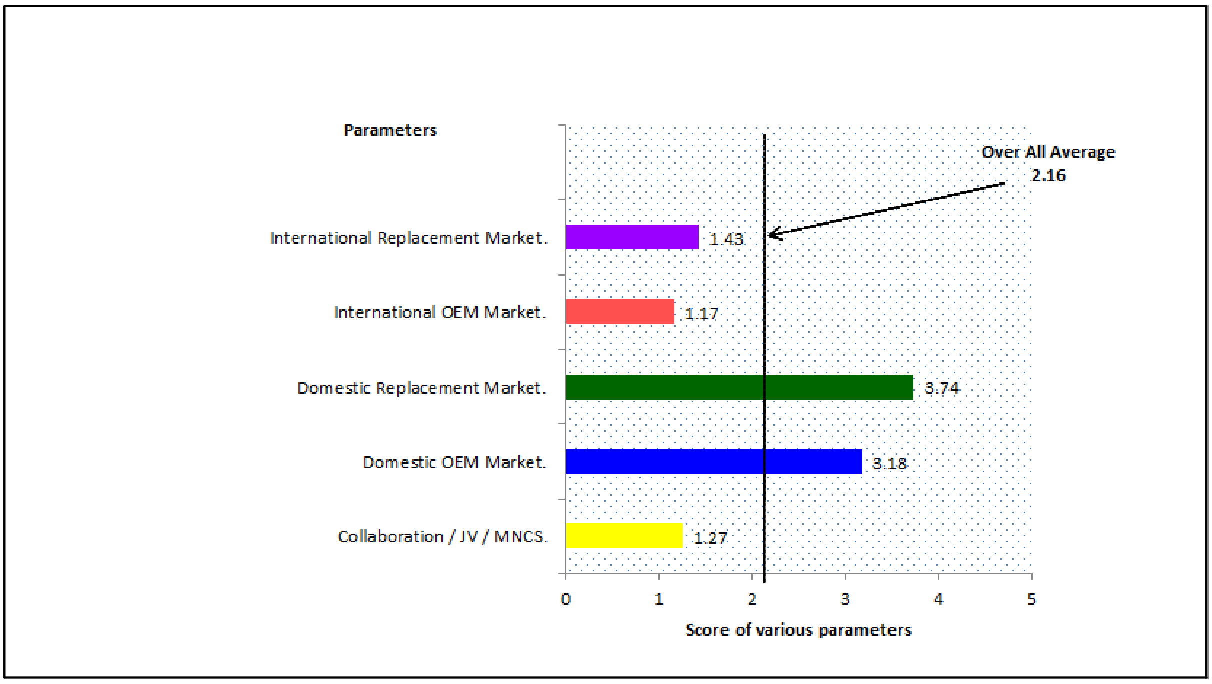


Figure 4.17: Performance of Markets Parameters

4.3.6 Element of Physical Infrastructure

Physical infrastructure includes services such as electricity, transport, roads, water system, communications, irrigation etc., while latter includes education and health facilities. Punjab is considered as one of the best states in India in terms of rail and road and transport network as per National Council of Applied Economic Research (NCAER, 2007). Poor infrastructure of power is a major constraint on competitiveness of SSI'S who cannot afford in house captive power. According to report of Planning Commission (2011), Government of India in the Twelfth Plan has given major thrust on accelerating the pace of investment in infrastructure, as this is a critical factor for sustaining and accelerating growth. Various parameters under the element of Physical Infrastructure, their mean score and standard deviation along with F-ratio and Tukey's significance are presented in Table 4.18.

Table 4.18: Evaluation of Physical Infrastructure Parameters (Mean Score ± SD)

S. No.	Parameters	Mean	SD	Mean%	Rating
1.	Quality and Network of Roads.	3.95	0.73	78.91	Good
2.	Network of Railways.	3.89	0.70	77.82	Good
3.	Air connectivity and Cargo Terminals.	1.74	0.95	34.73	Poor
4.	In-land Dry ports / Container Depot.	1.89	0.65	37.82	Poor
5.	Quality and supply condition of Electricity.	1.72	0.67	34.36	Poor
F-ratio		272.16**			
Tukey's Significance		1vs3,1vs4,1vs5,2vs3,2vs4,2vs5,			
** Significant at 1% Level.		n = 110			

Good transportation network and air connectivity attract more visitors and customers and facilitate interaction through movement of the professional, consultants and employees. This further reinforces internal knowledge sources with external source. The enhanced interaction and exchange of ideas are very important for creativity and innovativeness of organizations. The findings of present study indicate that the network of Roads (M%=78.91) and Railways (M%=77.82) in the state is good. This finding of the study is also in line with the report of National Council of Applied Economic Research (NCAER, 2007), who declared Punjab as one of the best states in India in terms of Rail, Road and Transport Network.

The recent World Bank Report (2012) also found Punjab state as the best place to do business in India for the parameters of Physical Infrastructure. The variation between mean scores of parameters under the element of Physical Infrastructure was significant ($p<0.01$). According to Tukey's significance, the parameters about Quality and Network of Roads and Network of Railways being at par were significantly higher than the parameters about Air connectivity & Cargo Terminals, In-land Dry ports / Container Depot and Quality and supply condition of Electricity. Punjab is a landlocked state and is far away from major Sea Ports of India. At present, the Punjab state has only five Dry Ports/In-land Container Depots. The respondents are not comfortable with the parameter of In-land Dry Ports /ICDs and have given a poor score of (M%=37.82). There is a lack of Air- Connectivity and Presence of Cargo Terminals in the state of Punjab as this parameter has performed at a poor level of (M%=34.73). The quality and power supply conditions required for industrial activity is another grey area for the state to improve upon as a poor rating score of (M%=34.36) has been reported by the SSIs. Interestingly, this finding is in extreme contrast to the fact that Punjab has 100% Rural Electrification and is Ranked No. 1 State of the country. The comparative of various parameters studied under the element of Physical Infrastructure system of national system of innovation is shown in Figure. 4.18.

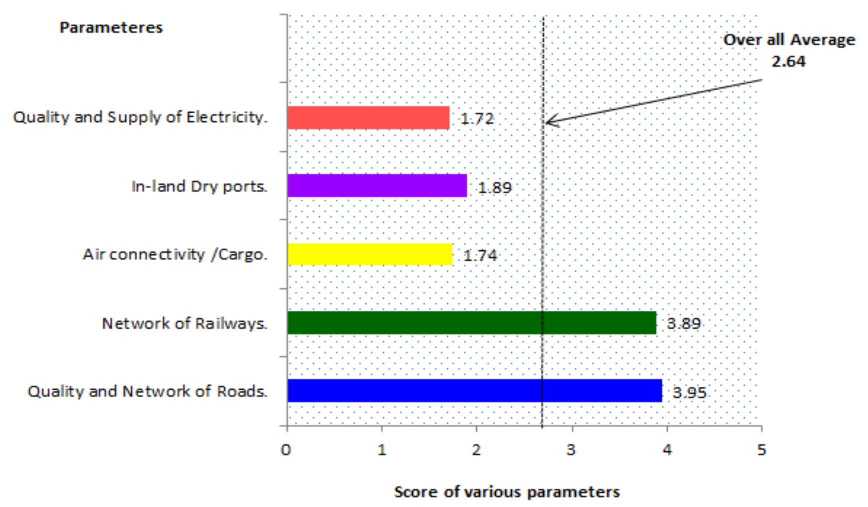


Figure 4.18: Performance of Physical Infrastructure Parameters

4.3.7 Element of Financial Infrastructure

Financial means in the form of raising equity, funding through venture capital and easy credit loan facility from banks are the key resources in carrying out innovative activities in the small scale industries. The lack of financial resources, inadequacy of management and marketing, lack of skilled workers, weakness in external information and difficulties in coping with government regulations are the factors that limit the competitiveness of small firms. The state government adopts preferential policies for small scale sector, through reducing tax, to encourage them for soft loans and technological upgradation. The element of Financial Infrastructure was studied for parameters covering role of financial markets, stock markets, Banks/Financial Institutions, Raising Capital Equity / Venture and Foreign Direct Investments (FDIs) and investment by non-resident Indian (NRI's). Table 4.19 presents the details.

Table 4.19: Evaluation of Financial Infrastructure Parameters (Mean Score ± SD)

S. No.	Parameters	Mean	SD	Mean%	Rating
1.	Functioning and access to financial markets.	2.96	1.14	59.27	Fair
2.	Functioning and support of stock markets.	2.82	1.16	56.36	Fair
3.	Role of Banks/Financial Institutions.	2.72	1.09	54.36	Fair
4.	FDI/Investment by Non-Resident Indians.	1.25	0.58	25.09	Poor
5.	Raising Capital equity or Capital venture.	2.18	1.01	43.64	Fair
F-ratio		51.73**			
Tukey's Significance		1vs4,1vs5,2vs4,2vs5,3vs4,3vs5,4vs5			
** Significant at 1% Level. n = 110					

The respondents expressed satisfaction over functioning and access to financial markets (M%=59.27) by giving a fair rating score. A fair score of (M%=54.36) was reported on the role of banks/financial institutions in providing their assistance and services of loans / credits to the small scale enterprises of the state. The supply of financial means in the form of raising equity in capital markets or funding by venture capital has been rated with a poor score of (M%=43.64). FDI is another important channel for transfer of technology required for fostering innovations. Unfortunately, the investments through FDIs or through investment by Non-Resident Indians (NRI'S) has been rated very poor with score of (M%=25.09). The finding of study demands a positive and pro-active financial policy for providing required level of financial support to small scale enterprises in the country. There is also a dire need of FDI's or investment by NRI's and the state government must take necessary measures for attracting FDIs and investment from NRI's in the state. The comparative of various parameters studied under the element of Financial Infrastructure system of national system of innovation is shown in Figure. 4.19.

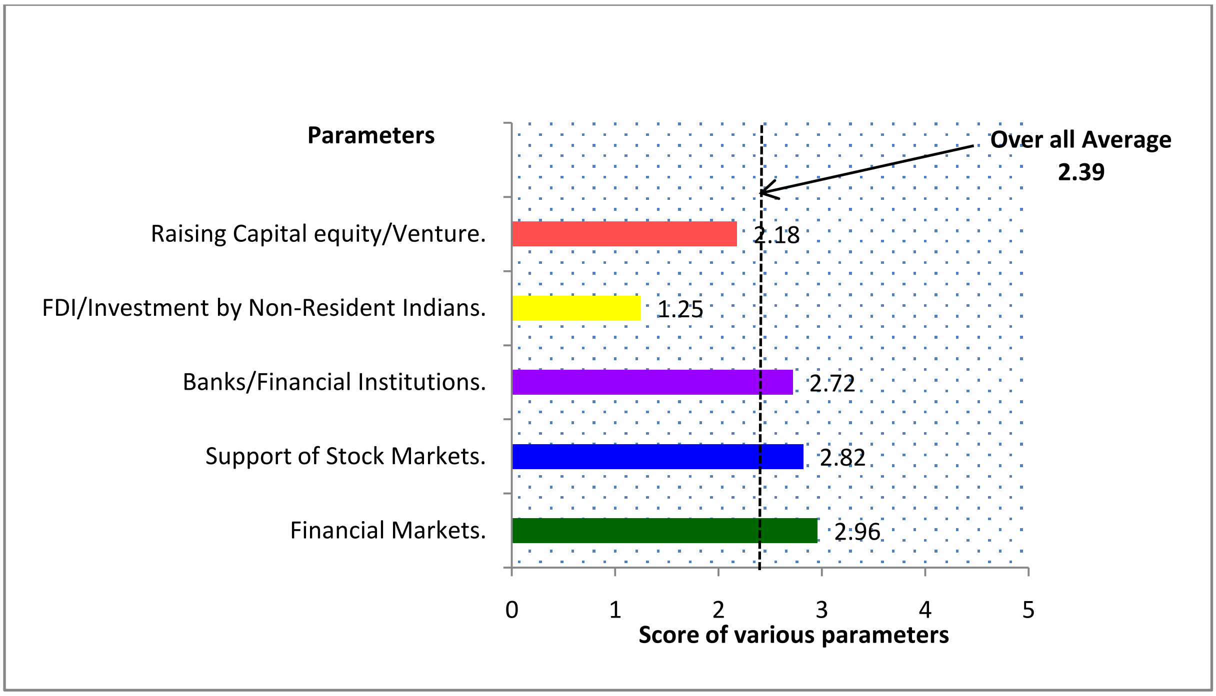


Figure 4.19: Performance of Financial Infrastructure Parameters

4.3.8 Element of Industrial Networking

The evaluation of different parameters under the Element of Industrial Networking is given in the Table 4.20.

Table 4.20: Evaluation of Industrial Networking Parameters (Mean Score ± SD)

S. No.	Parameters	Mean	SD	Mean%	Rating
1.	Number of Industry / Trade Associations.	3.81	0.88	76.18	Good
2.	Role of CII, CICU, APEX/Chambers & Confederations.	3.66	1.03	73.27	Good
3.	Support from MSME, DICs and NPC for Technology.	2.58	0.85	51.64	Fair
4.	Contribution of Govt. S&T and R&D Institutions.	3.80	1.17	76.00	Good
5.	Support from In-house R&D of Private Industries.	1.35	0.64	27.09	Poor
F-ratio		145.39**			
Tukey's Significance		1vs3,1vs5,2vs3,2vs5,3vs4,3vs5,4vs5			
** Significant at 1% Level.		n = 110			

There are about a total of 2,43,000 small scale units both in registered and non-registered categories in Punjab. There are more than 100 Industry and Trade Associations working in the state. In the present study, the respondents reported the presence and working of these industrial associations at a good level by giving this parameter a score of (M%=76.18). Most of associations are Sector / Trade specific and lead the industries by taking up different issue with the policy makers in the State Government and with Government of India. The variation between different parameters of Industrial Networking was found significant ($p<0.05$). The parameters about Number of Industry / Trade Associations and Role of CII, CICU, APEX/Chambers & Confederations being at par were significantly higher than the parameters about Support from MSME, DICs and NPC for Technology and the parameter about Support from In-house R&D of Private Industries as indicated by Tukey's significance.

The parameter about Support from MSME, DICs and NPC for Technology was found significantly higher than the parameter about Support from In-house R&D of Private Industries and lower than Contribution of Govt. S&T and R&D Institutions. This also indicates that the parameter about Support from In-House R&D of Private Industries is the lowest among all parameters under the Element of Industrial Networking. There are strong reservations when it comes to rendering in-house R&D of Industry facilities to fellow entrepreneurs. This is clearly reflected from a very poor score (M%=27.09) for this parameter. Such a poor score for this parameter is perhaps due to fear of leakage of information about each other's developmental projects. The region in and around Ludhiana has uniqueness in the country where a lot of sub-contracting work is available at a very competitive price. The social intelligence of the small firms is very strong due to a network of brotherhood of small time entrepreneurs. These entrepreneurs have grown together and know who and who is in the business. Face to face transfer of 'tacit' knowledge coupled with the presence of a very active subcontracting network resulting in a rich pool of technical knowledge and spillover information. These are very important factors for a strong social capital of small scale entrepreneurs of Punjab which is facilitating incremental innovations in their enterprises. This strong social capital of SSI's of Punjab is also considered responsible for their competiveness in pricing, delivery and winning customers. The comparative of various parameters studied under the element of Industrial Networking system of national system of innovation is shown in Figure. 4.20.

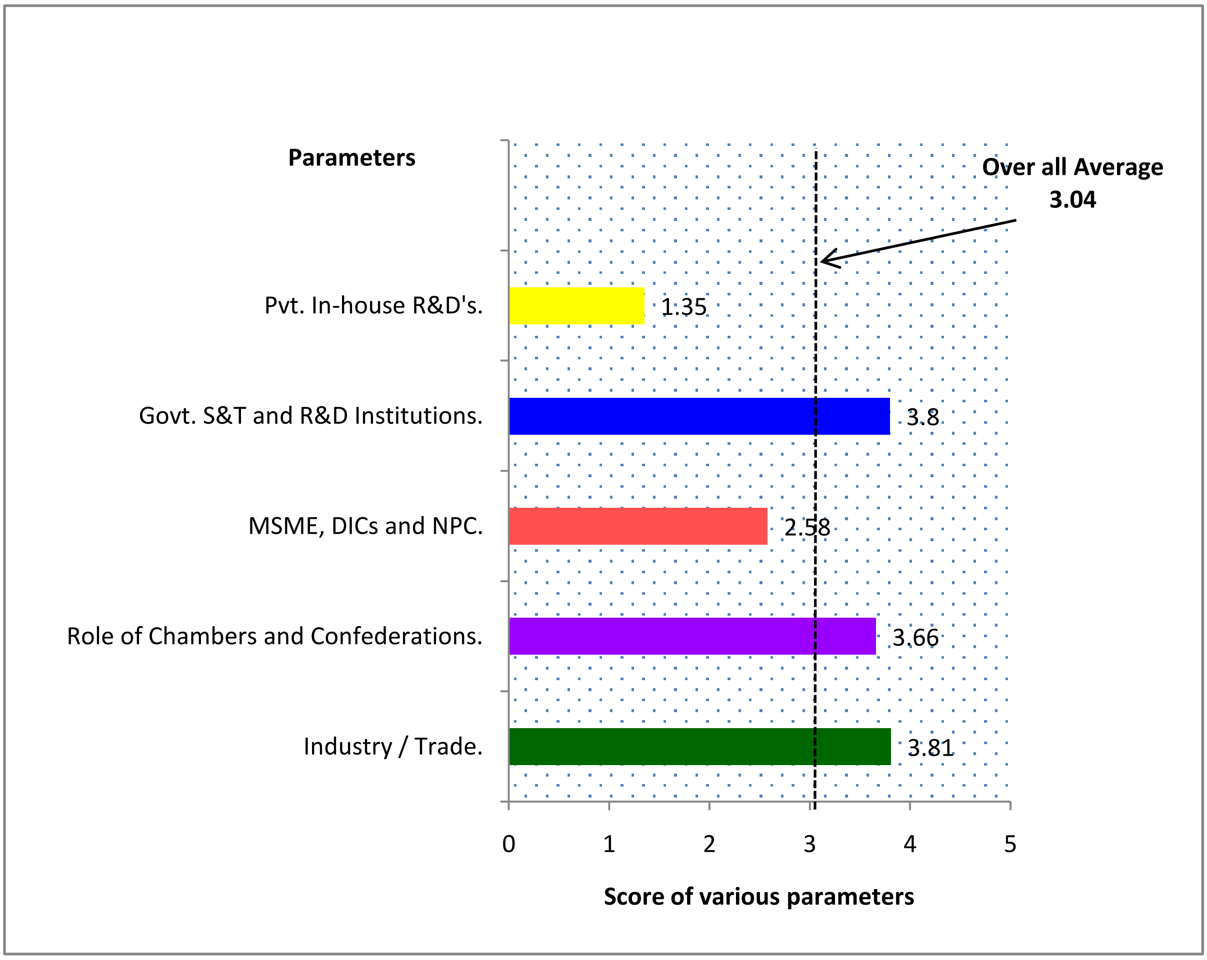


Figure 4.20: Performance of Industrial Networking Parameters

4.3.9 Element of Cultural Aspects

Cultural Aspect being a soft factor is difficult to judge but at the same time has a major role in promoting innovativeness in an organization. Cultural setting of any region of a nation is very important in fostering innovative culture, as it depends on individual characteristics of employees working in organizations. Cultural aspects being soft factors are difficult to determine and judge objectively. This cultural aspect Element of National Innovation System was studied for parameters of hard work, competitiveness, risk taking capacity, openness, trust-worthiness and desire to learn. The evaluation of different parameters in this Element of Cultural Aspect is given in Table 4.21.

Table 4.21: Evaluation of Cultural Aspect Parameters (Mean Score ± SD)

S. No.	Parameters	Mean	SD	Mean%	Rating
1.	Hard working nature of people.	3.73	0.78	74.55	Good
2.	Desire to learn new things.	3.76	0.83	75.27	Good
3.	Competitive nature.	3.85	0.58	76.91	Good
4.	Risk taking capacity	3.62	0.79	72.36	Good
5.	Openness / Trust worthiness.	3.47	1.09	69.45	Good
F-ratio		3.32*			
Tukey's Significance		3 vs 5			
* Significant at 5% Level.		n = 110			

The results of the study revealed that the competitiveness nature of people of Punjab has a achieved a good score (M%=76.91). The people of the State are also reported to have a strong desire to learn (M%=75.27). Both these parameters are essential for the success of entrepreneurship activities in any region and are a promising finding of the present study. The variation between different parameters under element of Cultural Aspect was found significant ($p < 0.05$). According to Tukey's significance, the parameters of Competitive Nature of people was significantly higher than the parameter about Openness / Trust worthiness of people of Punjab. All other parameters were found statistically at par by the respondents. The people of Punjab are open and trustworthy which is reflected from a good rating score (M%=69.45). Risk taking capacity of the people of Punjab has also been reported at a good level with score of (M%=72.36). The overall status of all parameters under the Element of Cultural Aspect is found at a good level with an average grand mean score of 3.69 on a scale of 5. The comparative of various parameters studied under the element of Cultural Aspects of national system of innovation is shown in Figure. 4.21.

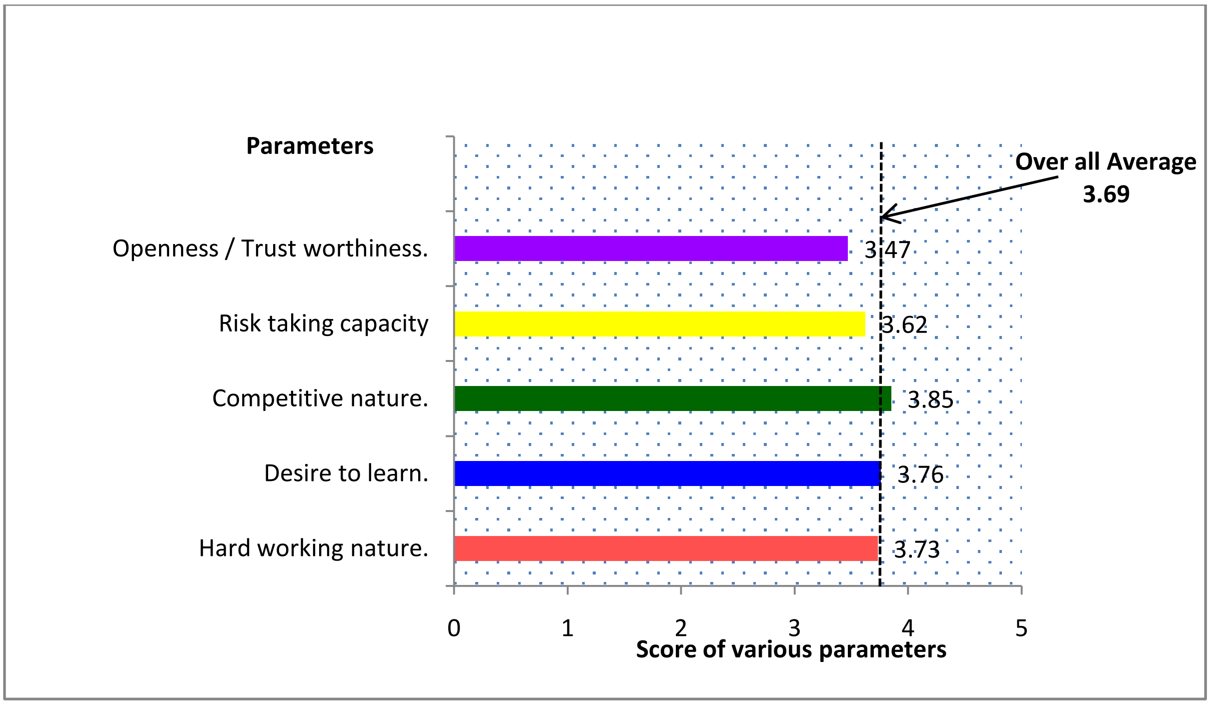


Figure 4.21: Performance of Cultural Aspects Parameters

4.3.10 Element of State-Induced Incentives

To study various parameters of the Element of 'State Induced Incentives', the information regarding incentive schemes for Technology up-gradation, Quality products, import of Technology/Raw materials, Sponsored Training Programme and Assistance for participation in industrial Trade Fairs / Exhibitions was collected from the study. The evaluation of different parameters under the Element of State-Induced Incentives is given in the Table 4.22.

Table 4.22: Evaluation of State-Induced Incentive Parameters (Mean Score ± SD)

S. No.	Parameters	Mean	SD	Mean%	Rating
1.	Incentives for Technological up-gradation.	2.28	0.74	45.64	Fair
2.	Incentives for Quality Products.	1.95	0.77	39.09	Poor
3.	Govt. support to Training Programme.	2.42	0.90	48.36	Fair
4.	Incentives for Import of Technology/R.M's.	1.61	0.78	32.18	Poor
5.	Assistance for Participation in Trade fairs/Exhibitions.	2.65	1.19	52.91	Fair

F-ratio	22.85**
Tukey's Significance	1vs4,1vs5,2vs4,2vs5,3vs4,4vs5
** Significant at 1% Level.	n = 110

The grand mean score of these parameters is 2.18 on a scale of 5 and calls for attention of government to make improvements in their support mechanism for bringing about Technological upgradation and innovativeness in the small scale auto parts manufacturing sector. The comparative of various parameters studied under the element of State-Induced Incentive of national system of innovation is shown in Figure. 4.22.

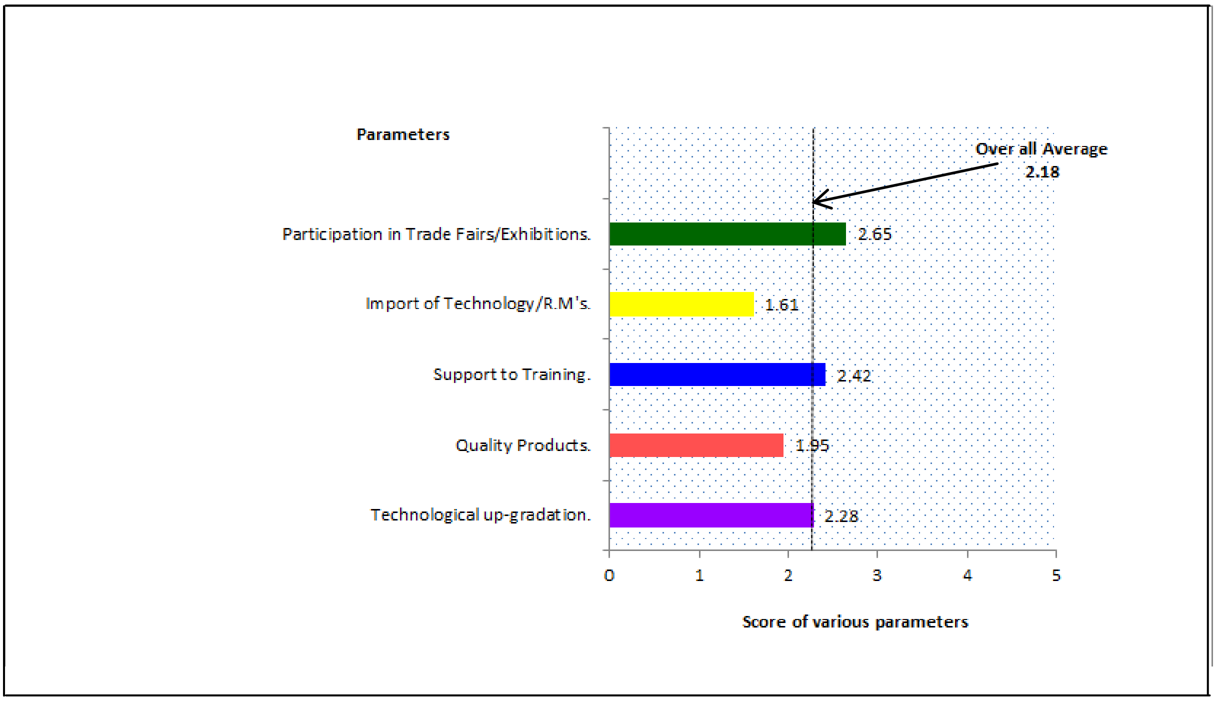


Figure 4.22: Performance of State-Induced Incentive Parameters

4.3.11 Overall Status of National Innovation System in the Context of Punjab State

The present study depicts the results of a detailed survey conducted to assess the influence of different Elements of national innovation system. Eight relevant National Innovation System elements comprising various parameters were identified in the context of Punjab State. The analysis of data was carried out to find out facilitating parameters under each element causing innovativeness among Small Scale Autoparts Manufacturing Industry of Punjab. The other elements of the NSI were also identified which need attention of policy makers to improve upon. The data analysis of this chapter has also been used to meet the objective of the study i.e. to assess the influence of national system on innovativeness of the Small Scale Autoparts Manufacturing Industry of Punjab and is being dealt in Chapter-VI. Overall evaluation of different elements of National System of Innovation is given in Table 4.23.

Table 4.23: Overall Evaluation of different Elements of National Innovation System (Mean Score ± SD)

S. No.	Elements	Mean	SD	Mean%	Rating
1.	Education	2.68	0.68	53.60	Fair
2.	Science & Technology	2.34	0.72	46.80	Fair
3.	Markets	2.16	0.49	43.20	Fair
4.	Physical Infrastructure	2.64	0.62	52.80	Fair
5.	Financial Infrastructure	2.39	0.77	47.80	Fair
6.	Industrial Networking	3.04	0.84	60.80	Good
7.	Cultural Aspects	3.69	0.39	73.80	Good
8.	State Induced Incentives	2.18	0.66	43.60	Fair
F-ratio		66.81**			
Tukey's Significances		1vs2,1vs3,1vs5,1vs6,1vs7,1vs8,2vs4,2vs6,2vs7,3vs4 ,3vs6,3vs7,4vs6,4vs7,4vs8, 5vs6,5vs7,6vs7,6vs8,7vs8			
** Significant at 1% Level.		n = 110			

The strongest influencing element of national innovation system 'Cultural Aspects' (3.69). The people of Punjab are hardworking, competitive and eager to learn. They are open and have the courage to take risk. Networking among units as also with other agencies, particularly CII, MSME, DIC, NPC has also emerged to at a good level with a score of 3.04. Only parameter of Industrial networking which is at a poor level is the support & co-operation from Private In-house R & D's to fellow manufacturers. All other elements of Regional Innovation System of the State are of a fair level. Out of these Education (2.68) and Physical Infrastructure (2.64) are on the higher side of 'fair' classification while Financial Infrastructure (2.39), Science & Technology (2.34), State induced incentives (2.18) and Markets (2.16) are on the lower side of fair category. Further, it is seen that within main elements of National System of Innovation, following parameters have been identified with a very low level of performance in the present study. The comparative of various elements of national system of innovation is shown in Figure. 4.23.

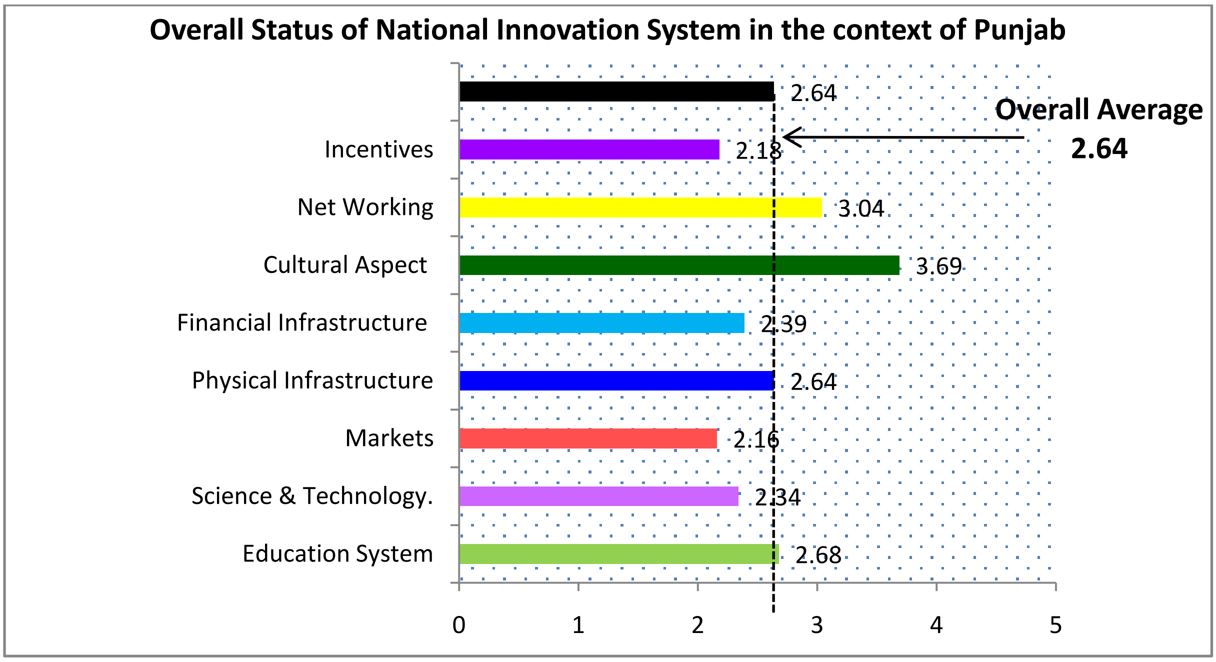


Figure 4.23: Overall performance of various Elements of National Innovation System in the context of Autoparts Manufacturing Sector of Punjab

Overall performance of various Elements of National Innovation System with respect to Small Scale Autoparts Manufacturing Sector in Punjab is show in Figure 4.24

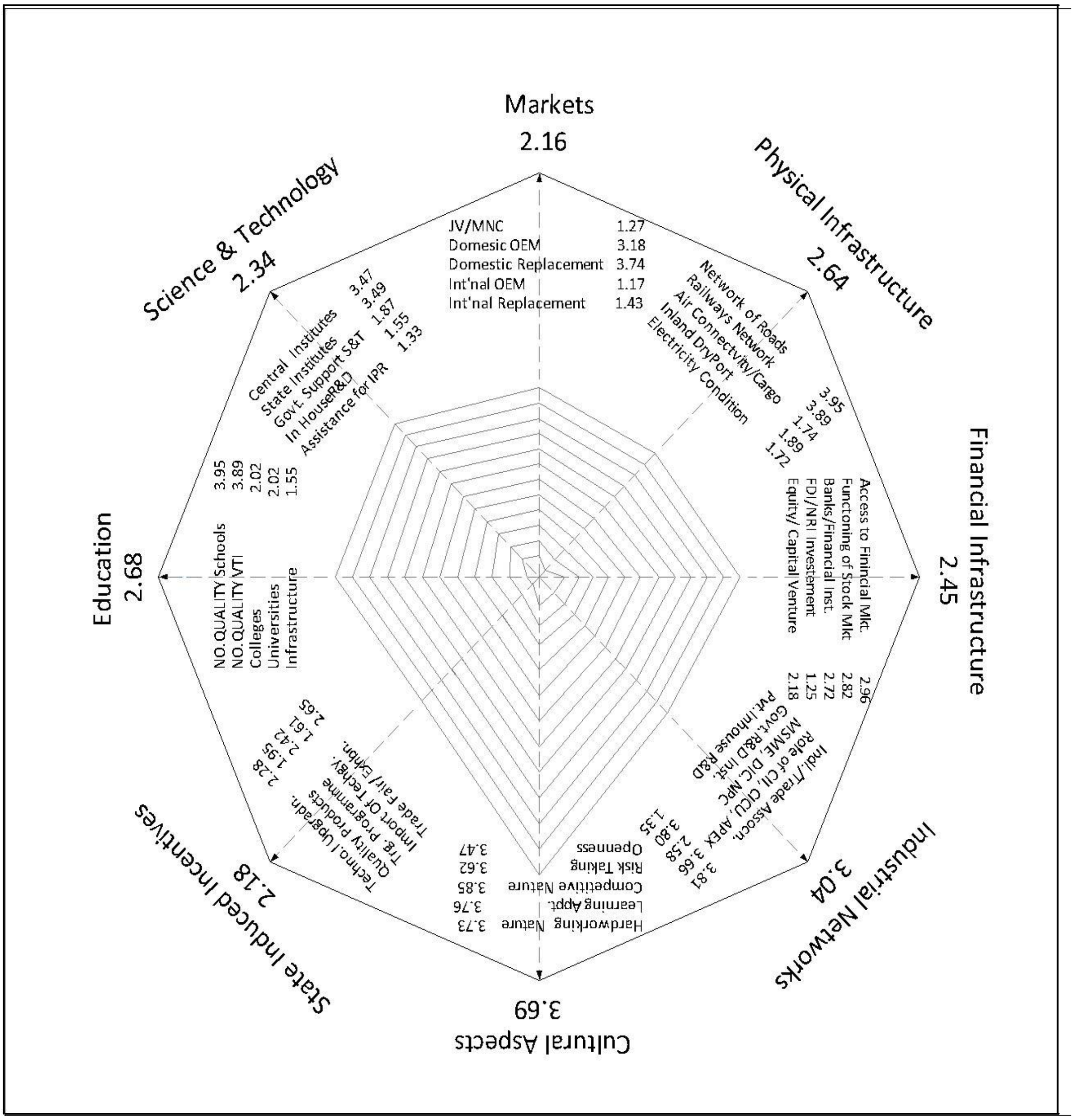


Figure 4.24: Detailed performance of various Parameters under the elements of National Innovation System

The strongest influencing element of National System of Innovation is 'Cultural Aspects' (3.69). The people of Punjab are hardworking, competitive and eager to learn. They are open and have the courage to take risk. Networking among units as also with other agencies, particularly CII, MSME, DIC, NPC has also emerged to at a good level with a score of 3.04. Only parameter of Industrial networking which is at a poor level is the support & co-operation from Private In-house R & D's to fellow manufacturers. All other elements of National Innovation System of the State are of a fair level. Out of these Education (2.68) and Physical Infrastructure (2.64) are on the higher side of 'fair' classification while Financial Infrastructure (2.39), Science & Technology (2.34), State induced incentives (2.18) and Markets (2.16) are on the lower side of fair category.

Further, it is seen that within main elements of National System of Innovation, following parameters have been identified with a very low level of performance in the present study.

The parameters of the element of Education in colleges and universities have been given a poor score of (2.02) only. The parameters of IPR (1.33); government support of R&D (1.87) and assistance for in-house R&D (1.55) under the element of Science & Technology have been reported with very poor scores. Under the element of Markets; the parameters of joint ventures & MNC's(1.27); International OEM (1.17) and International replacement (1.43) have shown a very poor performance and are identified as areas of concern. Similarly, the element of Physical Infrastructure has shown very poor scores for its parameters of Air connectivity & cargo terminals (1.74); Inland Dry Ports (1.89) and availability of quality electric power (1.72). Similarly, a very poor score of (1.25) has been given to the parameters of FDI / NRIs under the element of Financial Infrastructure. Very poor scores have also been reported for the parameters of import of technologies (1.61) and assistance for quality product (1.95) under the element of State induced incentives. Surprisingly a very poor score of (1.35) has been reported to the parameter of extending facility of Private in-house R&D under the element of Industrial Networking. It is showing a clear reflection that the established units are not willing to extend their R&D facility to fellow entrepreneurs. The policy makers in the state government and in the government of India need to pay attention to improve upon the physical and financial infrastructures in Punjab. The state government needs to make its industrial policies attractive to the original equipment manufacturers of the country for setting up their automobile manufacturing plants in Punjab. More efforts by the state government is also required to attract foreign direct investments and investments from its diaspora of Non-resident Indians to set up their businesses in Punjab.

4.4 Study of National System of Innovation of India and other leading countries for the purpose of Bench Marking

The National System of Innovation of China, Korea and Taiwan were studied in details and it is found that the NIS of China can be considered for the purposes of bench marking. China has witnessed phenomenal growth in its manufacturing sector and has very impressive output of the innovation system in the shape of registered patents, published research articles and high-technology product export. In order to have impressive innovation output a very close interaction of S&T frame work of the country with user industry and innovators is required. Dobson (2010) has predicted China and India to be economic powerhouses of the world by year 2030. The recent Global Manufacturing Competitiveness Index Report 2010. (Deloitte and Council on Competitiveness, USA 2010), places India at a second place with index score of 8.15 against China at 1st place score of 10 and has predicted the same places for both India and China even after 05 years predicting a further improvement in India score to a level 9.01. At present, India is aspiring to achieve a faster, sustainable and inclusive growth, where Science and Technology frame work of the country will play a pivotal role. Government has taken some strong initiatives directing towards promotion of innovations in manufacturing sector and formed a draft National Innovation Act 2008 (DST, 2008). Recently, the Government has introduced Science, Technology and Innovation Policy STI, 2013 and India has declared 2010 to 2020 as the "Decade of Innovation" (Ministry of Science and Technology, 2013). Overall, the policy makers in our government are trying their best to give a Robust National System of Innovation to the country.

4.5 Summary of the Chapter

This chapter presents the results obtained in the study. These results have been organized in four sections based on the objectives of the study. First section deals with identification and evaluation of elements of Innovation Culture. Second section deals with evaluation of status and measure of variation in Innovation Culture among individual SSAMIs. Third section describes the details about influence of various elements of national innovation system of India and other leading countries for the purpose of Bench Marking.

CHAPTER – V

ROLE AND CONTRIBUTION OF VARIOUS AGENCIES IN DEVELOPING INNOVATION CULTURE

A comprehensive study was undertaken regarding the role and contribution of industry support institutions and various agencies in fostering innovation culture among autoparts manufacturing sector in the state of Punjab. Under this, the role of Confederation of Indian Industry (CII); Automotive Component Manufacturers Association of India (ACMA); National Productivity Council (NPC); was studied. The industry support institutions were setup with the support of Ministry of MSME, Government of India, United Nations Industrial Development Organization (UNIDO) and Punjab State Government. These institutes form art of the National System of Innovation in the context of auto parts manufacturing sector of Punjab. Study of these six industry support institutions was also aimed to know their impact on the National Innovation System and hence on the innovativeness in the manufacturing sector.

5.1 The Role of Industry Support Institutions and various agencies in fostering innovativeness among Small Scale Auto Parts Manufacturing Industry of Punjab

The role of Industry Support Institutions and various agencies in fostering innovativeness among Small Scale Auto Parts Manufacturing Industry of Punjab was investigated under the objective 3 of the present study.

5.1.1 Industry Support Institutions

There are six industry support institutions in the state of Punjab. All these institutes are autonomous bodies and are registered Government Owned Societies. Three out of the six institutions namely; Central Tool Room (CTR), Ludhiana, Central Institute for Hand Tools (CHIT), Jalandhar and Central Institute for Plastics Engineering and Technology (CIPET), Amritsar are industry support institutions owned by Government of India. The remaining three institutes namely; Research and Development Center for Bicycle & Sewing Machines (R&D Center), Ludhiana, Institute for Autoparts & Hand Tools Technology (IAHT), Ludhiana and Institute for Machine Tools Technology (IMTT), Batala are the Punjab State Government Owned Societies. The governing board of all these institutes have members from local industry and representatives of various industrial associations and are responsible to propose investments, prioritization of projects and user service charges. These institutes are mandated to be self-sufficient in their operations. However, the non-recurring expenses such as additional buildings, infrastructure upgradation and procurement of latest Plant, Machinery and Equipment are funded under various schemes of Government of India.

5.1.2 Illustrations of Industry Support Institutions

5.1.2.1 Research and Development Center, Ludhiana

The Research and Development Center, (R&D Center), Ludhiana was set up in year 1982-83 with an initial investment of Rs. 66 million by Government of Punjab coupled with an assistance of US$ of 3.04 million by the United Nations Industrial Development Organisation (UNIDO). The objective behind setting up this centre was to provide impetus to SME's of Bicycle and Sewing Industry in Ludhiana which could not establish their owned in-house R&D. The facilities offered by the centre for manufacturing and quality control conform to modern technological standards. The center has well equipped Design and Testing labs, Precision Tool Room, CNC Machining and HRD Training Sections. Labs and testing section has facilities for Stereoscopic / Chemical and Physical Testing. The Standards / Calibration Room are equipped with Universal Measuring Microscope & CNC-Co-ordinate Measuring Machine. This industry support institute has a strong cliental pool of about 2400 SMEs engaged in manufacturing of light engineering items.

The major strength of the R&D Center is in design and fabrication of special purpose machines, Testing Rigs, Cold Forging and Skill Development Trainings. The Centre is pioneer in introducing about 72 nos. of testing equipment, 28 nos. of Special Purpose Production Machines, 47 nos. of Cold Forging Forming Tools. It has handled about 1,10,000 of test samples and has undertaken 56 Technical Assistance Turn-Key Projects in the area of low cost automation, energy efficient and environment friendly technologies. There has been huge material saving by the introduction of Cold forging technology in the manufacturing of Pedal Axle, BB Axle, BB cup fittings, Cones. The path breaking technological intervention in managing the cold stage tube swaging and tube butting technology has eliminated the process of sheet cutting and welding in making front fork and frame element of a bicycle. This single technological intervention has earned millions of carbon credits for the city of Ludhiana and all the major bicycle manufacturers of India namely Hero Cycles, Avon Cycles, Atlas Cycles

and TI Cycles, Chennai have also gone for these technologies. The trials and adoption of above said technologies was very fast due to closely net-worked SMEs around R&D Center.
This centre has filed 04 patents under Design Act, 2000 with controller general of patent design and trade mark India the Registrar, Govt. of India for design of BB Axles Cold forging dies, Tube Swaging machine, Static load test rig for Bicycle component and Attachment for Swaging Machine rolls making. Thus the center has played its role of being an incubator for the SMEs of Punjab and is a platform for carrying out open innovations in this region of the country. Successful development of Cold Heading Quality CHQ steel was done by working in a close co-operation with secondary steel plant and wire rod conversion mills. This has resulted in process innovations by adoption through low cost automation and environment friendly technologies leading to a heavy reduction in the input costs resulting enhanced productivity and competitiveness of the manufacturing sector. These technological developments were further improvised for their application in the Hand Tools, Auto-Components, Furniture, and Agriculture equipment manufacturing industry. The R&D Center is a public funded organisation and there are practically no restrictions for access to its development and facilities. This has led to extensive exchange of ideas for the small entrepreneurs and new start-up ventures to grow on accumulated knowledge of R&D Center in bringing about their products successfully to the Markets. Annual reports (2007-2012)

R&D Center has a team of 39 engineers and scientists, who are providing various services to entrepreneurs. This team with set of multiple skills in the areas of Mechanical, Metallurgical, CAD/CAM, Testing and Analysis is very effective and in giving solution to technical routine problems of SMEs. During the course of time, the accumulated knowledge base has led to a higher absorption capacity of this organisation. The interaction and networking with industry has resulted in formation of a well knitted and a cohesive community of creators, doers and operators around the R&D Center, where incremental improvements and process innovation are a norm in its routine working. The affairs of the R&D Center are managed by a Governing Council with majority of members from the industry and hence the investments for new technologies are always user driven. The HRD wing of the R&D Center is providing a large pool of skill work force through its regular, formal and informal diploma / certificate training courses. The institute has very effective technical information, dissemination cell, which has well stocked library of about 780 reference books and standards and 14 technical periodicals / journals. The technical facilities are very well utilized by the students through the process of ‘learning by doing’. Scientists and engineers working in the R&D Center are also very actively involved in providing the support to research work undertaken by post graduate, research scholars of the Region. Annual reports (2007-2012).

R&D Center is also a National level Institute for Bicycle in India and has a well-equipped bicycle Test Rigs Lab, which has the recognition of Bureau of Indian Standards. All the testing and calibration labs of this center are NABL accredited and are instrumental for bringing quality culture in the region. The User friendly services of the center are popular among the Industry which is evident from their revenue earnings rising from ` 30 million in financial year 2007-08 to a level of ` 51 million in 2011-12.

5.1.2.2 Institute for Autoparts &Hand Tools Technology, Ludhiana

Institute for Autoparts & Hand Tools Technology, was set-up by Punjab Government with the assistance of UNIDO in 1994 at Ludhiana. This industrial city has Manufacturing clusters in Auto-components, Fasteners, Foundry; Forgings, Agriculture Implements and Farm equipments. The Institute was established with the high precision technological resources in the areas of Testing & Evaluation, Non-Destructive Testing, Advance Heat Treatment, Design and CNC Machining facilities to assist SMEs in raising their capabilities to manufacture quality auto-components. The Punjab Government spent an amount of ` 43 million and the UNIDO contributed US$ 4.03 million by providing foreign technical expertise, fellowship trainings to engineers and high-end precision machinery. There are about 2000 Small & Medium Scale Manufacturers of Automotive Components operational in Punjab State. Most of these small scale units are suppliers in Automotive Market and are of Tier 2 and Tier 3 supplier category. The major auto component manufacturers in the State are suppliers of Engine Parts, Transmission Parts, Chassis Parts and Sheet Metal Components. These small scale manufacturers are looking for assistance in the ever changing technological scenario in the Automotive Manufacturing Sector. There are no major automotive manufacturers in the state and SMEs are deprived of learning process of typical vendor development programmes. The growing automotive sector in the country was an opportunity as well as a challenge for the SME’s of the State to gear-up and consolidate their manufacturing base by up-gradation of skills and know-how to meet new challenges. The institute is operationally sustainable through its services of Technology Development, Quality Control, Skill up-gradation Trainings, NDT, Heat Treatment and Reverse Engineering.

The mandate for the Institute is to acquire, run and demonstrate high end technologies for the purposes of dissemination of technical know-how to the SMEs. There are no restrictions for the industry to seek knowledge about the new technologies. Entrepreneurs visit the institute for solutions to their problems covering development of new products, pre-mature failure of parts and components, 3-D surfaces inspections, NDT evaluation for foundry and forging parts. The wide spectrum availability of facilities along with multiple set of skills of the institute is very well utilized by the SMEs in the area of problem solving.

The institute has introduced some cutting edge technologies of Vacuum Hardening, Cryogenic Processing, White Light Scanning, 3-D printing and industrial radiography in the state of Punjab. These technologies have benefited the SMEs in raising their competitive edge. The process of vacuum heat treatment and cryogenics contributed immensely in manufacture of high precision and highly productive die and moulds for the sheet metal Formers and pressure die casters of the state. These High end Heat Treatment processes help in achieving required set of mechanical and metallurgical properties along with zero surface defects and minimization of distortions / warping. SMEs of Punjab now need not to send their tool, dies and moulds for treatment to far of places in south or western India. The institute has treated 127 tons of special steel in vacuum hardening and has handled more than 19600 precision machining jobs. This has saved a lot of time and money of SMEs of Punjab. Annual reports (2007-2012).

Rapid Prototype is State of the Art equipment with the Institute found useful to assist entrepreneurs in accelerating their "Reverse Engineering" efforts in bringing about their improved Product to markets. This new technology tool is also very helpful for skill up-gradation of young Engineers and Researchers to carry out work in Product and Process innovations. The 3-D Tol software of CNC CMM Machine is a unique facility which helps exporters to access and monitor the quality of in process and finished product involving 3D surfaces, contours and profiles.

Non-destructive Testing (NDT) facility of the Institute is also well equipped with Industrial Radiography / X-ray equipment, Ultra Sonic Testing, Portable Spectrometer, Magnetic Particle Inspection (MPI) equipment. This up-graded NDT Section is very effectively used by Entrepreneurs to check their Tools / Dies / R.M.'s and Products to meet higher and sometimes mandatory quality requirements to arrive at 'zero defects' manufacturing in compliance with various quality systems. The new high-end technologies are also offered for ‘hand on training’ during the short term ‘skill up-gradation training programs’ which are quite popular among SMEs. ASNT level-I & level-II certificate courses are also offered by the institute in Radiography, Ultrasonic Testing, MPI and Die-Penetrate Testing Techniques. During the last five years, this institute has tested about 89000 test samples and has solved 346 technical problems of the entrepreneurs. All these services were availed by local industry by paying user charges; Annual reports (2007-2012). The facilities of the Institute are frequently used by research scholars and a patent driven research was undertaken by using Cryogenic treatment processor and CNC wire EDM equipment and hence we are partner as a co-inventor in filling the Patent title “Cryogenic treatment of brass wire for improved machining characteristics” has been published (U/S 11A; year 2011) by controller general of patent design and trade mark India. The technical support services have helped them to do continuous improvements and carry incremental innovations by bringing down their inputs cost and by raising quality and productivity levels.

All the new high tech facilities are vital source for carrying out innovations among SMEs. The revenue earning of the institute is an indicator about usefulness of various technical support assistance being provided to SMEs in the shape of technology development, quality control, skill development programmes. The job work handled in the common facility section of the institute reflects another dimension of its role in fostering innovations through demonstration of high-tech machinery and equipment. The institute is the only National level Hand Tools Testing Lab. in the country approved by BIS. Atomic Energy Regulatory Board, in India (AERB), Mumbai has also issued the license to the institute to operate the only Industrial Radiography facility available in the state of Punjab. A team of 31 technical employees of the institute are handling the high-tech areas very effectively and assisting SMEs in their innovative efforts. The rapid growth in revenue earning from ` 9 million in 2007-08 to a level of ` 20 million in 2011-12 clearly shows the popularity and usefulness of the recently acquired technologies and support services by this institute during the last five years.

5.1.2.3 Institute for Machine Tools Technology, Batala

Institute for Machine Tools Technology (IMTT) is one of the UNIDO established Projects which was set up by Punjab Government in year 1994-95. The technical support infrastructure was aimed to assist machine building industry in a small township of Batala. The institute helps industry in Design, Development, Quality Control, Precision Machining, Heat Treatment and Foundry Practice. A comprehensive skill up-gradation programme was taken up to impart training in scientifically advanced technical areas to local youth and entrepreneurs. This institute has accumulated knowledge base in the field of calibration and is a leading NABL accredited calibration lab. The capacity building in calibration was made possible with the support of Central Machine Tools Institute (CMTI), Bangalore. Institute also impart trainings for TQM system and solve technical problems in small foundries. Institute extends facilities for testing of sand, moulds, tensile strength and metallographic evaluation of castings.

The technology development initiatives of IMTT are to facilitate improvement in quality, energy efficiency and reducing input costs in machine tool manufacturing. The institute has developed six special purpose machines for single / double head boring operations. Institute also regularly take up alignment and leveling work for machine tool beds and surface plates right on shop floor using portable electronic leveler and collimator. This small industrial town of Batala has a strong technical infrastructure support which is as good as having a dedicated in house R&Ds in an enterprise perusing innovations. Institute’s team of 27 technical personnel had handled about 10,000 instruments / gauges for calibration, tested about 45,000 samples and trained 476 trainees resulting in their operational sustainability with annual revenue hovering around ` 10 million for the last five years. The pro-active support and services provided by IMTT has increased the competitiveness of machine tool manufacturers of the state. Annual reports (2007-2012).

5.1.2.4 Central Tool Room, Ludhiana

Central Tool Room (CTR) was established by Govt. of India at Ludhiana in year 1980 with the financial support from Germany. CTR is a Society under Ministry of MSME, Govt. of India. The growth and development of engineering industry in an around Ludhiana was due to technical intensive services of this tool room. The core competency of CTR is skill training, making precise press tools, injection moulds, jig, fixtures and dies for regional SMEs. It is an institution par excellence in providing solutions for design, development, manufacturing, skill development and project consultancy. The Institute has established its brand image as one of the top skill certification institute in Northern India and is running a four years diploma course in the tool & die making. The pass out students of CTR is always in demand and is readily absorbed in regional SMEs.

This tool room is instrumental in establishing and dissemination of technology in the field of heat treatment of high alloy tool steels of HSS, H11, H13, DB5, and DB6 in Punjab. The organisation is also a pioneer institute for dissemination of advanced reverse engineering tool of RPT 3-D printing since year 2000. The short term / part time training courses run by CTR in CAD/CAM, CNC machining and specialized heat treatment are extremely popular among SMEs. A technical competent team of 23 engineers and scientists assisted by 65 technical operators have solved 1270 problems, provided 550 precision tools, delivered 1150 inspection gauges, imparted short term trainings to 6200 candidates, heat treated 325 tons of special steels and printed approximately 26000 3D jobs during last five years.

Central Tool Room is the leader among all industry support institutions operating in the state of Punjab. The trends of revenue earning shows a growth of more than 50% during these five years as its revenue swells from ` 47 million in 2007-08 to ` 72 million in year 2011-12. All the services provided by CTR have played important role in enhancing creativity and innovativeness among young engineers and entrepreneurs. Annual Reports (2007-2012).

5.1.2.5 Central Institute for Plastics and Engineering Technology, Amritsar

Central Institute for Plastics and Engineering Technology (CIPET), Amritsar is one of the 15 centres set up by the CIPET, Chennai. This institute was set up in the year 1988-89 by the Government of India for providing training and technical services to plastics and allied industry in the Northern Region. This institute undertakes design and fabrication of plastics processing moulds and extends testing facility for plastic raw material and plastic products. The institute runs PG diplomas in 'plastics processing", "plastics moulds design" and "plastics moulds technology". The institute is very popular for short term training programmes in the field of plastic manufacturing industry. The training services of CIPET have created a large pool of skilled manpower in the areas of plastics processing, technologies and mould making in this region of the country. They are also assisting the entrepreneurs in trouble shooting of process related problems making long life moulds and providing facility of testing and analysis of raw materials / finished plastics products. The institute is the only Nodal agency approved by State Governments for pre-delivery and site-inspection of HDPE/PV pipes and plastics product procurements. The services of CIPET are very helpful to the entrepreneurs in starting new plastic industry. The laboratories of institute are NABL and BIS accredited which are boons to the SMEs of the region.

Their specialization services are also availed by entrepreneurs to deal with compounding and formulation problems in plastic processing. A team of 24 engineers and science graduates of the institute have fabricated 76 moulds, developed 04 special purpose machines and have tackled 119 technical troubles shooting for SMEs in last five years. The services provided in quality control area are also very impressive, as they have conducted about 52,000 testing and calibrated 4,500 instruments & gauges. The institute is operationally self-sufficient and is meeting the entire major recurring expenses through it services. The productivity & competitiveness of plastics industry of the region has increased due to technical support of CIPET. The SMEs operating in plastics engineering industry have undertaken many technological developments and quality control practices due to availability of trained manpower generated by this institute. This has facilitated innovativeness among SMEs which are undertaking quality improvements, adopting quality systems and hence getting into the process of incremental innovations with institute's support in technology developments. The institute's annual revenue of ` 9 million in year 2007-08 has grown to a level of `32 million in year 2011-12. A steep rise of about 250% in revenue during last five years is a strong indicator of usefulness of CIPET's services to the SMEs of Punjab.

5.1.2.6 Central Institute for Hand Tools, Jalandhar

Central Institute for Hand Tools (CIHT) was established as a Government owned Society at Jalandhar in year 1983. This institute was set up in the background that about 80% of small scale hand tools manufacturers are located in and around Jalandhar. The hand tools industry is playing a vital role in technical and economic development of the city. This is a National level institute for hand tools sector and is an autonomous organisation under Ministry of MSME, Government of India. During the last five years; CIHT has initiated the largest skill upgradation program in the state of Punjab under the skill development initiative of Govt. of India. Their biggest strength is design and fabrication of forging Dies / Moulds and has been successful in manufacturing 1224 moulds and 610 gauges for the SMEs during last five years. A team comprising 43 technical personnel has successfully imparted training to a large number of about 5100 trainees in the area of CAD/CAM, Heat Treatment and Tool & Dies. The support of the institute in the area of technology development and skill upgradation has facilitated innovativeness among SMEs. The entrepreneurs started incremental innovation activities targeted at quality improvement, waste minimization and productivity improvement; which were possible only due to initiative and support from CIHT. The infrastructure and experience of engineers also supported 08 PG scholars and also under took 55,000 precision machining jobs. This industry support institution earned revenue of ` 37 million in the year 2011-12; registered a 100% growth in their revenue of Rs. 18 million in year 2007-08. This growth in revenue is a testimony to the usefulness and popularity of institute's services in the Region. Annual reports (2007-2012).

5.1.3 To Study the contribution of Industry Support Institutions

A detailed study about contribution of six industry support institutions of Punjab was undertaken. For the purpose of evaluating the contribution of these institutes, identification of various parameters of their services was done. These services are helping the Small Scale Auto Parts Manufacturing Industry of Punjab in capacity building of their technological base. The data was collected on a well-structured questionnaire using interview method. The interviews were held with General Managers and 02 Senior Managers each from all the six Institutes. The roles and responsibilities of deferent level of mangers interviewed is summarized in a table at Annexure–II. Researcher of the present study remained, General Manager of R&D Centre, Ludhiana from May, 1998 to April, 2005; January 2014 to date and is also the General Manager of Institute for Autoparts & Hand Tools Technology, Ludhiana since May 2005. This data was collected with respect to their accounting, finance, administration, consultancy, and marketing departments. The relevant information about the objectives and specialization areas of each institute was based on project documents, governing council proceedings and feedback from user industry. The primary data was collected for the period from the financial year of 2007-08 to 2011-12.

5.1.3.1 Profile of Manpower working in six Industry Support Institutions

Manpower indicates the deployment of managers, engineers and scientists in each institute. Put together; there are 59 managers / engineers, 57 diploma engineers, 25 science graduates and 194 technical operators are working exclusively for the SMEs of Punjab. The graphical presentation about the manpower of these institutes is shown in Figure 5.1.

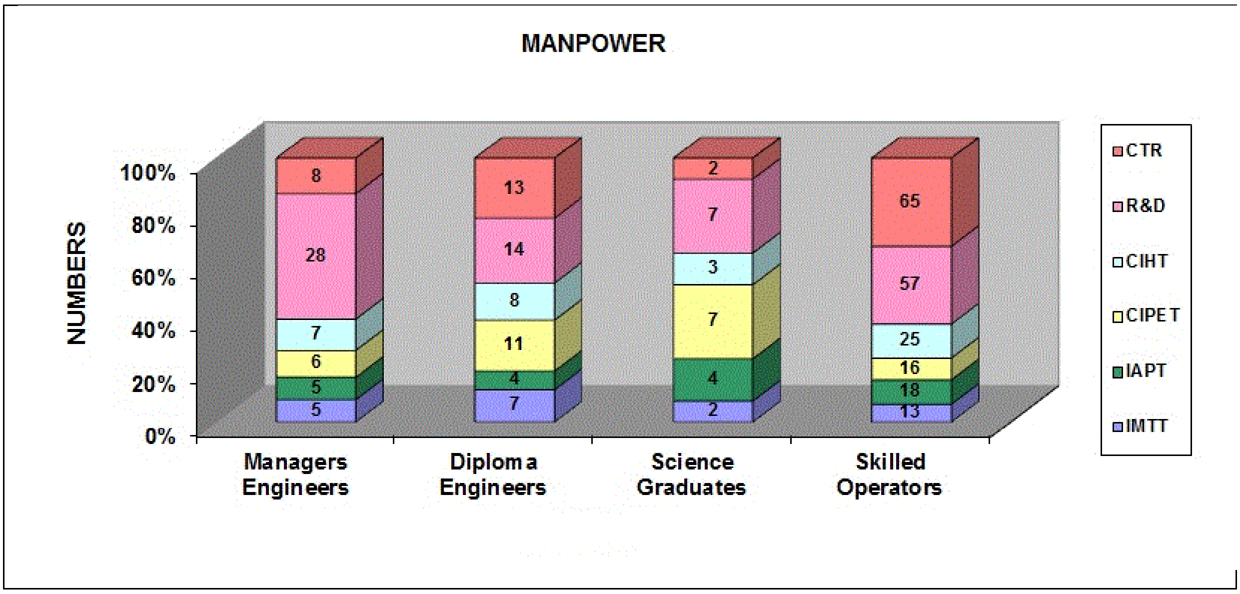


Figure 5.1: Profile of Manpower Working in the Industry Support Institutions (Annual reports; 2007-12)

This forms an invaluable asset in the shape of a team of highly experienced technical manpower with multiple set of skills in various areas of general and special engineering applications. This team is also responsible for a strong knowledge accumulation base in the institutes which is regularly built through interaction and exchange of ideas with the entrepreneurs. The frequent exchange of ideas also offers a platform for open innovation among SMEs of Punjab.

5.1.3.2 Contribution of Institutes in Manufacturing Process Improvements

The team of technical manpower working in six industry support institutions in Punjab is quite effective in supporting the industry in manufacturing process improvement area and is helpful problem solving, product development and research projects undertaken by the SMEs. They have solved 2953 problems. 1009 JFT / Dies / Moulds; 49 special purpose machines and 1938 inspection gauges and made 49 SPMs. (R&D; 2012) All these initiatives were achieved by appropriating the technical know-how to local conditions which helped in introducing 'low cost automation' in the manufacturing industry leading to higher productivity levels of regional SMEs. The graphical presentation about the contribution of the institutes in supporting the manufacturing process improvements among SMEs is shown in Figure 5.2. (Annual reports; 2007-12)

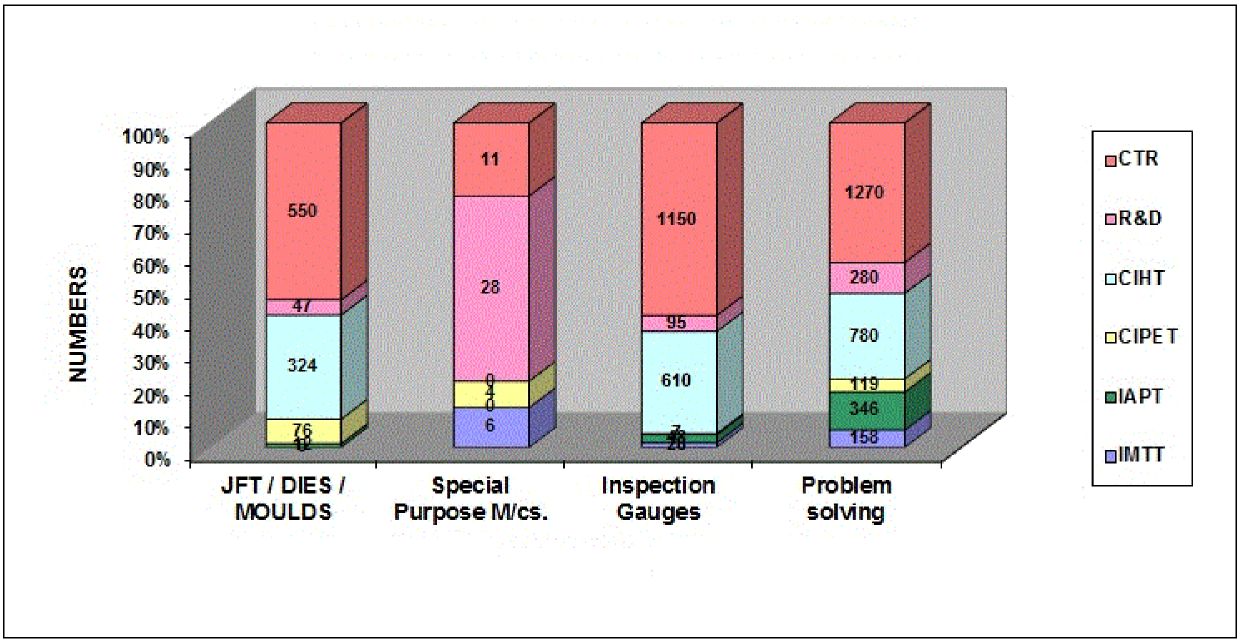


Figure 5.2: Contribution of Institutes in Manufacturing Process improvements (Annual reports; 2007-12)

It has led to improved quality products, environment friendly processes, higher productivity and lower input costs through the role played by the institutes in facilitating the open innovations among SMEs.

5.1.3.3 Contribution of Institutes in Quality Control

The region in and around Punjab state has witnessed sea change in the quality culture of SMEs. Because of significant role played by the six institutes, a large number of manufacturing units have gone for ISO-9000, TQM, ISO TC 16949 and quality systems in the first decade of 21st century. These institutes have handled 3,13,000 test samples, 32,300 calibrations and has assisted the industry by providing 30 test rigs. The performance of the institutes in providing the services to strengthen quality control programme in SMEs is shown in Figure 5.3. (Annual reports; 2007-12)

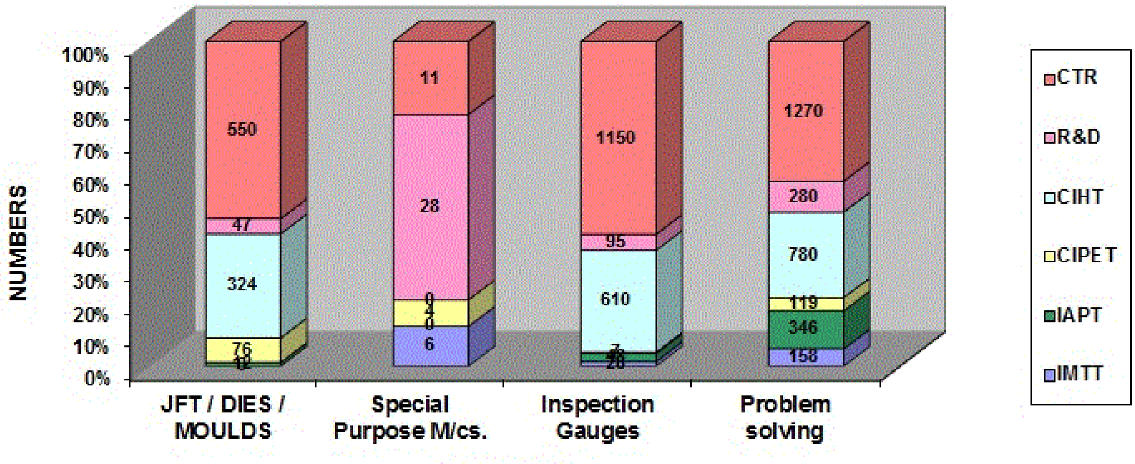


Figure 5.3: Contribution of Institutes in Quality Control

(Annual reports; 2007-12)

The assistance of these institutes in quality control area reflects the quality culture prevailing in the region. The testing and calibration services offered by these institutes are availed either to meet mandatory requirements of quality system or are targeted to monitor the quality of their product and that of competitors. All these services have helped in taking quality improvement and ultimately small innovations among SMEs. It has been just like an extended in-house testing facility for manufacturers and exporters of Punjab. Extensive skill upgradation training programmes in quality control, testing, inspection, validation and calibration of gauges were also conducted by these institutions. The installation and maintenance of quality systems led to adoption of standardized routines, procedures and documentation. Adoption of quality systems is also identified with the process of incremental innovations.

5.1.3.4 Contribution of Institutes in Skill Training

The training, not only make an individual skillful but also ignite an attitude towards learning. In the 21st century organizational vision revolves around quality human resource. Irrespective of their size and turnover, organizations are now quite open to spare time & money on training & development activities. These institutes have churned out 2488 diploma engineers, who had the best possible exposure to the latest plant / machinery and had the opportunity to share and learn under the expert faculty (Annual report of R&D Polytechnic 2012). The most effective programmes run by all these institutes is to offer short term highly skill oriented training programmes. These programmes are tailor made to meet the technical needs of the local industry as well as to suit the training hours for part time trainees from the SMEs. During the last five years, a total number of 13816 trainees have been trained in the fields covering CADCAM, Precision CNC Machines, Plastic Engineering, TQM, Quality Control, Tool and Die Making, Testing Calibration, Special Heat Treatment and Maintenance under short term training courses Figure 5.4 shows the number of skill up-gradation programmes and the number of trainees trained by different institutes during the last five years. (Annual reports; 2007-12).

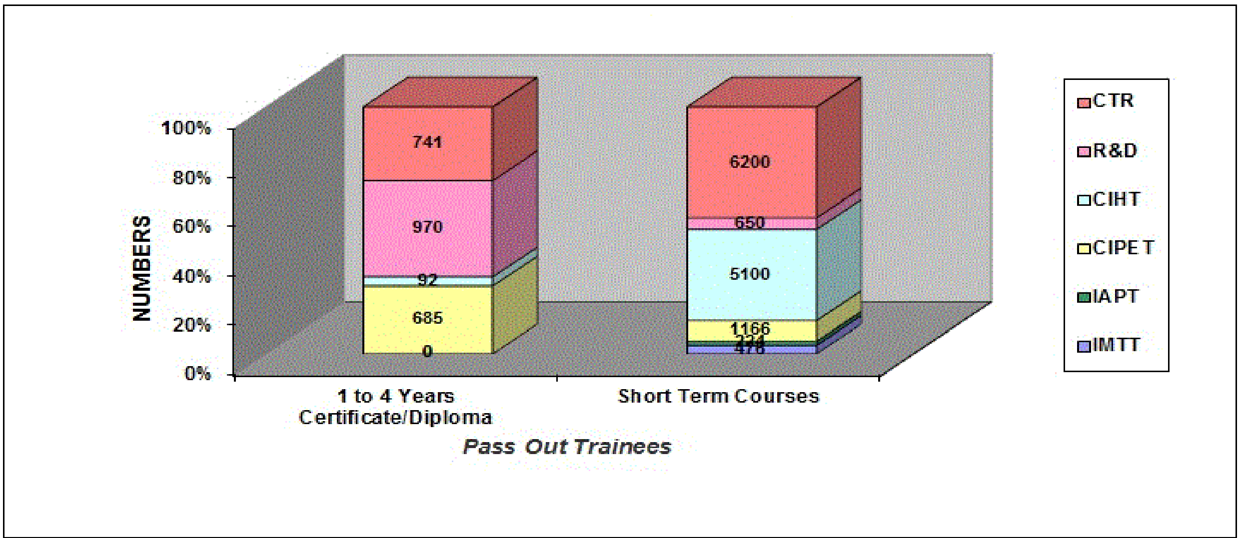


Figure 5.4: Contribution of Institutes in Skill Training
(Annual reports; 2007-12)

5.1.3.5 Contribution of Institutes in providing Common Facilities

The running of common facility by these institutes is a model in itself as these have fulfilled their mandate of Acquire, Run and Demonstrate new Technologies. This has resulted into a very speedy and effective dissemination of technical knowhow. The SMEs have also appropriated the acquired technical know-how to local conditions by developing low cost automated plants and equipments for taking mass production jobs. The common facility offered by various institutes is in the area of special heat treatment, cold forging and CNC precision machining. The high-end plant, machinery & equipment were installed in the common facility sections of various institutes with the purpose of giving demonstration and hands on training to entrepreneurs. These institutes also undertake small batch production lots for the local SMEs. The successful running of this costly equipment in the institutes provides a competitive edge to the local entrepreneurs. The support of Institute's Common facility to SMEs of Punjab and Region is shown in Figure 5.5 (Annual reports; 2007-12).

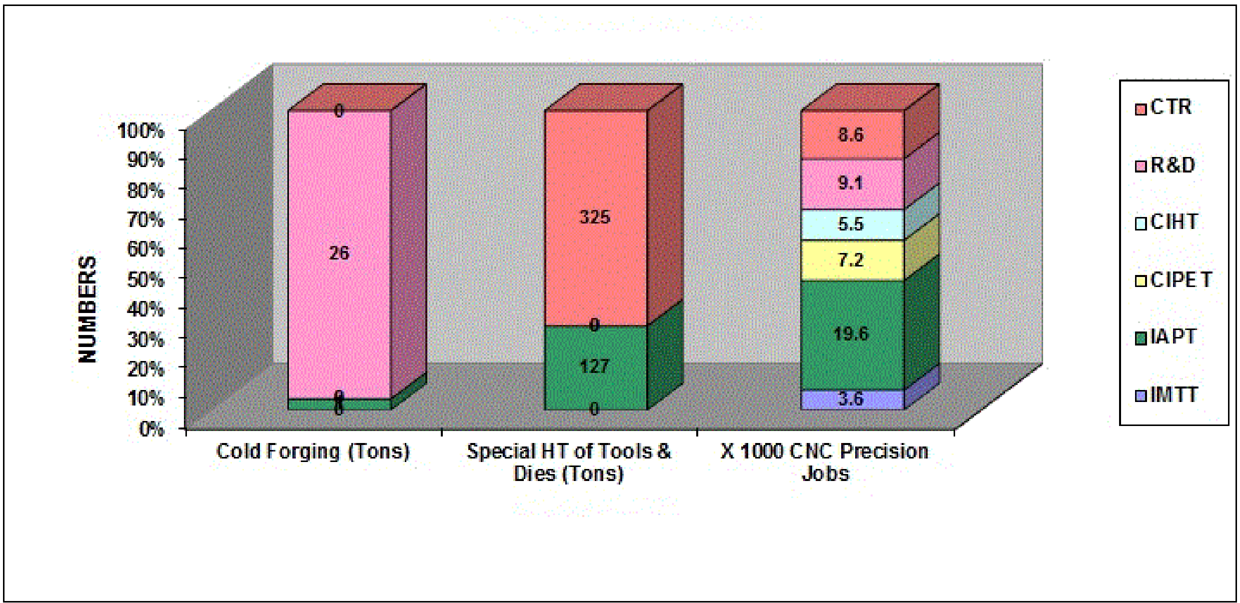


Figure 5.5: Contribution of Institutes in providing Common Facilities (Annual reports; 2007-12)

The services are availed by paying user charges and these institutes are found effective in supporting the technology development initiatives by SMEs. There are enormous intangible benefits associated with the sustainable operation of these institutions.

These institutes are a perfect host to the common facility of mass production in certain engineering processes for the local industry. The R&D Centre and IAHT are effectively running the facilities of cold forging and heat treatment processing for the local industry on mass production scales. These common facilities are offered and run practically on 24 x 7 working hours basis. Similarly, the IMTT, Batala, CIEPT, Amritsar, CIHT, Jalandhar, R&D Centre and IAHT are handling a number of products machining developments and doing mass production on CNC Precision Machines. In totality these institutes have undertaken about 53,600 precision machining jobs, cold forged 27 tons of steel and have handled about 452 tons of alloys steels for the purpose of special heat treatment. The successful running of common facilities has helped in ensuring utilization and sustainable growth in generation of operational revenue by these institutes. (Annual reports; 2007-12).

5.1.3.6 R&D Support to the SMEs by Industry Support Institutes

The R&D Support given by these institutes is invaluable when viewed from the angle of infrastructure and deployment of manpower in these institutes. The reverse engineering tools available with the institutes in the shape of white light scanner, CAD/CAM and RPT are a boon to the SMEs of Punjab. These facilities have made them confident in handling the product development in high-tech areas, as per requirements of their global customers. This unique initiative by industry support institutions has caused creativity and innovativeness among the SMEs. These institutes have provided 1425 design drawings, undertaken about 27400 RPT jobs and conducted 584 product developments in the last 05 years. The performance of the institutes in providing R&D support to the entrepreneurs is shown in Figure 5.6. (Annual reports; 2007-12).

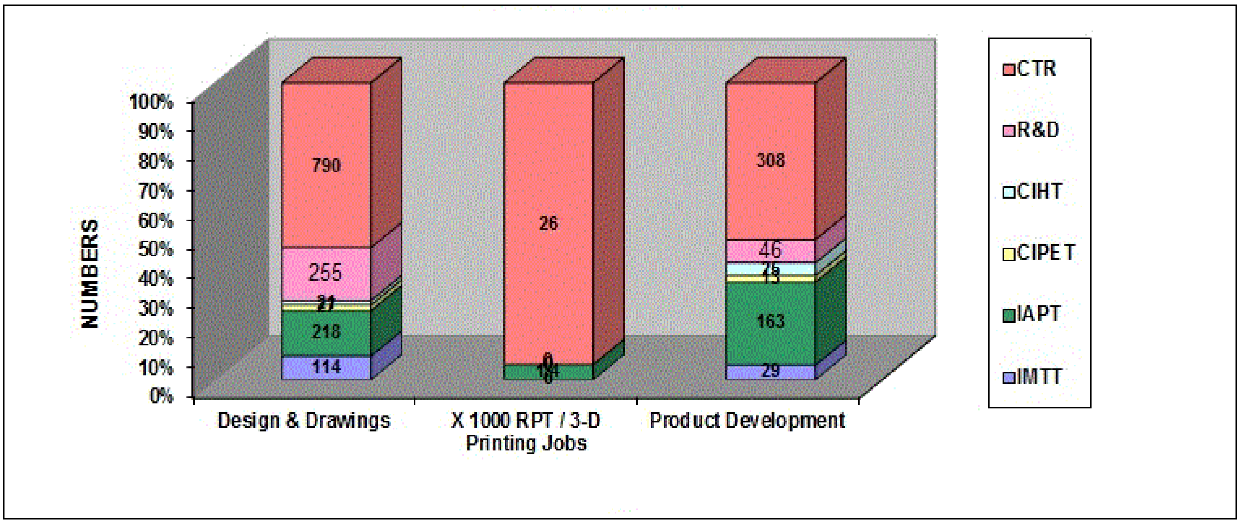


Figure 5.6: R&D Support to the SMEs by Industry Support Institutes (Annual reports; 2007-12)

5.1.3.7 Technical Dissemination by Industry Support Institutes

The role of these institutes in dissemination of technical knowledge through an access to reference standard books and technical journals in their libraries has also been found very important. There is stock of 4678 reference books / standards and 40 technical journals / periodicals are available in these institutes. Support to research scholars was recorded to know the relevance of technology development initiatives undertaken by these institutes with the academic research.

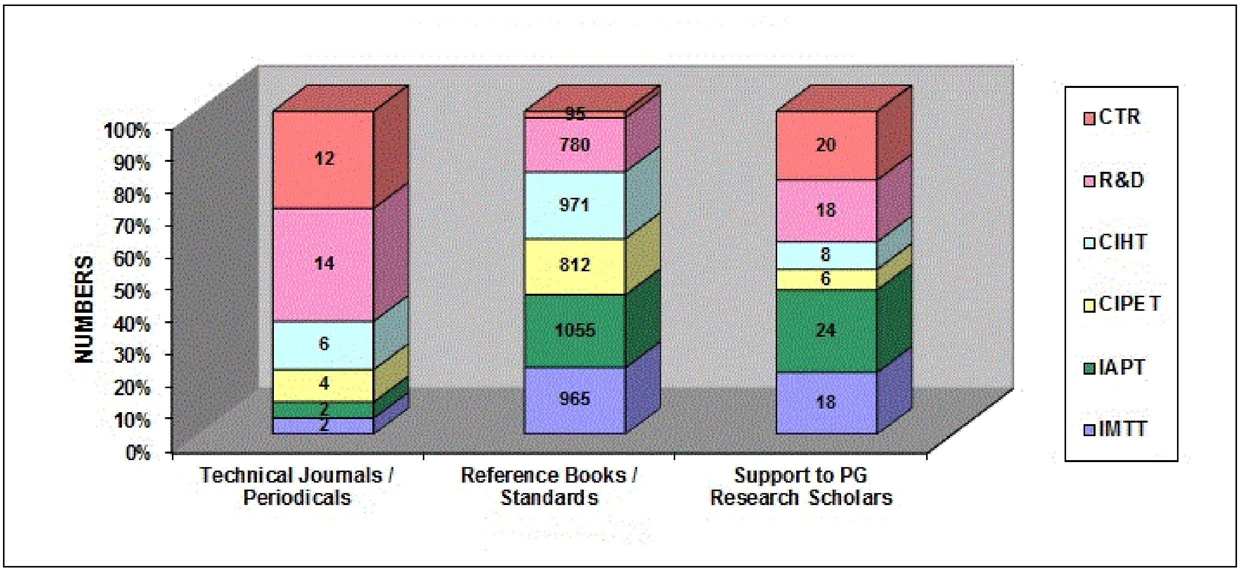


Figure 5.7: Technical Dissemination by Industry Support Institutes (Annual reports; 2007-12)

The SMEs and research scholar frequently visit libraries of these institutes to update their knowledge and for reference to solve the problems or peruse academic research work. These institutes have given vital support to 94 PG research scholars by offering guidance to conduct research work on the latest technologies. This ultramodern facility of 3D printing, wire EDM & Spectroscopic analysis had been a major source to fuel creativity and innovation among young entrepreneurs, engineers and research scholars. The status of technical dissemination facilities available with the institutes is depicted in Figure 5.7. The R&D Centre has filed four patents and the Institute for Autoparts and Hand Tools Technology filed one patent during the last five years. The filing of patents is an indicator that patent driven research work is being done by these institutes in association with regional SMEs. (Annual reports; 2007-12).

5.1.3.8 Overall Performance of Industry Support Institutes

The performance of all the six institutes in generation of operational revenues from the financial year 2007-08 to 2011-12 is shown in Figure 5.8. (Annual reports; 2007-12).

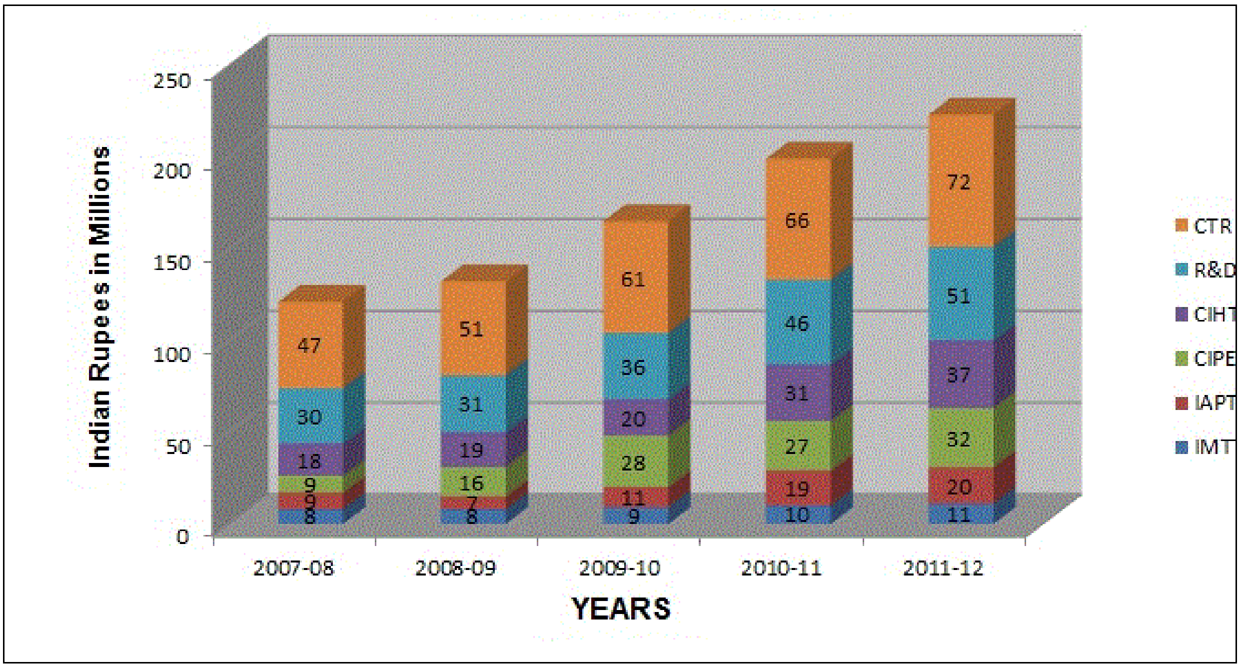


Figure 5.8: Overall Performance of Industry Support Institutes (Annual reports; 2007-12)

The Overall growth and trends in generation of operational revenue by all the six industry support institutors is shown in Figure 5.9.

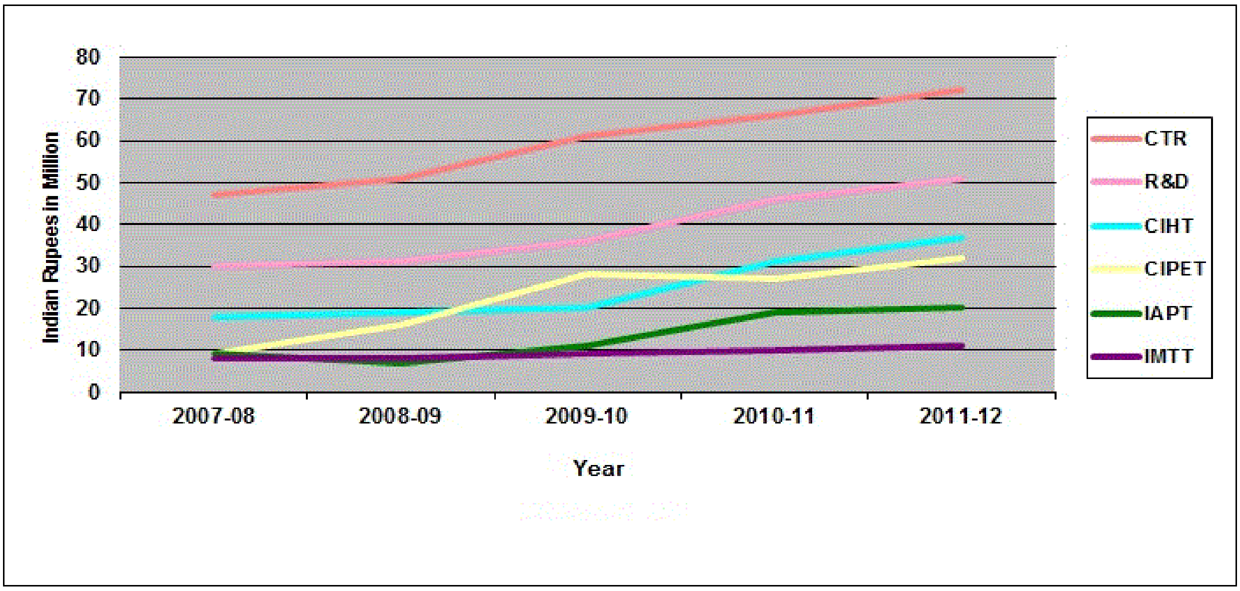


Figure 5.9: Overall Growth and Trends of Operational Revenue of Industry Support Institutes of Punjab

The upward trend in generation of operational revenue by all the institutes is a promising finding. The sustainability of these institutes for the last more than two decades reflects the relevance of their services and assistance to the changing technological scene and manufacturing activities of the region. All the institutes are growing overtime significantly. The revenue of three institutes over the period of last 05 years increased significantly; Central Tool Room (CTR) at the rate of 11.75%; R&D Centre at the rate of 15.67% and Institute for Machine Tools Technology (IMTT) at the rate of 8.98% compounded annually ($p<0.01\%$). There is also upward trend in growth rate for remaining three institutes; such as Central Institute for Hand Tools growing at a rate of 21.30%, Central Institute for Plastic Engineering Technology at a rate of 35.80% and Institute for Autoparts & Hand Tools Technology at a rate of 29.64%; compounded annually ($p<0.05\%$). (Annual reports; 2007-12).

Trends in Revenue General by six Industry Support Institutes operating in the State of Punjab and the Region are shown in Table 5.1. (Annual reports; 2007-12).

Table 5.1: Trends in Revenue of Different Industry Support Institutes

Name of Institute	Operation Revenue During the Financial Years (F.Y.) (` Million)								t-value	Trend Coefficients	
	FY 07-08	FY 08-09	FY 09-10	FY 10-11	FY 11-12	Aver-age	CV	CGR		a	b
CTR	47	51	61	66	72	59.40	17.44	11.75	11.07**	39.90	6.50
CIHT	18	19	2	31	37	25.00	34.06	21.30	4.27*	10.00	5.00
CIPET	9	16	28	27	32	22.40	42.66	35.80	3.47*	5.30	5.70
R&D	30	31	36	46	51	38.80	24.00	15.67	6.97 **	21.70	5.70
IAPT	9	7	11	19	20	13.20	44.95	29.64	2.96*	3.00	3.40
IMTT	8	8	9	10	11	9.20	14.17	8.98	7.00 **	6.80	0.80

** Significant at 1% Level.
* Significant at 5% Level.

The institutes were studied for their performance for the period 2007-12. Government of India has been very active in pursuing its Science & Technology initiatives by making capital investments in Plant, Machinery and Equipment in order to equip these institutes with 'Cutting Edge Technologies' in these institutes of Punjab. The figures of 'Revenue' for the period of study (2007-12) were collected to know the growth trends in revenue earning of individual institutes. The services of these institutes are availed by paying user charges which has resulted into enormous intangible benefits to regional SMEs.

The entrepreneurs adopting the initiatives in the area of Skill Development, R&D projects, Technology Development and Technical dissemination with the help of these institutes is a testimony to their success. These institutes are in fact an extended in-house R&D for the SME's. Today's fast changing technological environment demand 'high mix low volume' products of shorter life cycle. In this scenario; collaborations and networking has become an indispensable option for large as well as SMEs.

The organizations need external resources and networking to catch-up with deadlines to bring new products in market. These industry support institutes offer a platform for exchange of ideas among entrepreneurs and knowledge accumulation in these institutes is facilitating the process of open innovation in the region and is of a great help to the SMEs to stay competitive in Domestic and International Markets. These institutes are found effective in supporting the technology development initiatives by SMEs. The technology development initiatives have helped to promote creativity and innovations among regional entrepreneurs.
The study reveals that Government has been very active for timely and vital support to these institutes. This has helped in ensuring utilization of new facilities and a sustainable growth in operational revenue of these institutes. The mandate for both Central and State Governments to run these institutes on self-sufficient basis has worked very well and has been proved strategically a right decision in ensuring optimum utilization of the public funds. These highly interactive, self-reliant institutes are the virtual In-house R&D to SMEs. The technical professionals of these institutes are imparting skill upgradation training and act as a source to fuel creativity and innovation among young entrepreneurs, engineers and research scholars.

These institutes also offer a platform for exchange of ideas among entrepreneurs and knowledge accumulation of these institutes are facilitating the process of open innovation. The growth and sustainability in generating revenue is a testimony to success of these institutes. The speedy and efficient dissemination of technical know-how of these institutes have caused creativity and innovativeness among SMEs of the region. In view of the excellent role played by six industry support institutions of Punjab; this strategy can be adopted for fostering technological innovations in other auto clusters situated at Bangalore, Chennai and Pune by setting up similar infrastructure of Plant Machinery and equipments as installed in these industry support institutions.

5.2 Role of various agencies in fostering innovation culture among Small Scale Auto Parts Manufacturing Industry of Punjab

The role of following agencies was studied to know their contribution in fostering innovation culture in the manufacturing sector of Punjab.

5.2.1. Confederation of Indian Industry (CII)

Confederation of Indian Industry (CII) is a non-government organisation, working to create an environment conducive for growth of industry in India. CII is having a membership of over 8000 organizations representing SME's, MNC's, Public Sector and about 400 sectroal level Associations. CII works closely with government on policy issues, enhancing efficiency and for competitiveness of MSME Sector. It is also provides a platform for sectoral consensus building and networking. CII's had an agenda in the year 2011-12 is "Business for Livelihood" which was aimed at spread of growth to disadvantaged sections of society, building skills and fostering a climate of good governance.

At present, there are about 12 million SME's in India contributing nearly 40 per cent of the country's total industrial output. Strengthening of SME's in the country is a must to meet the challenges of domestic as well as international Markets. (CII, 2010) Enhanced competiveness of SME's can be achieved by bringing improvement in product quality and reduced input costs. With this aim, the CII - AVANTHA Centre for Competitiveness for SMEs was established in 2004 at Chandigarh. This Centre is providing services through SME's Clusters formed on the basis of location, sector or OEM Vendors. The cluster approach encourages SMEs to form, share and draw from a common knowledge pool. This Centre has successful clusters at Mohali, Gurgaon and Jalandhar and is also running parallel clusters across the country at Jaipur, Faridabad, Lucknow, Pune, Kolkata, Chennai and various other locations in the India. This unique concept of "Clustering for Competitiveness" was started with 20 Vendors of Maruti by Prof. Y Tsuda in 1998 and success of this initiative has led CII to present stage of 203 clusters having participation of about 2192 Companies. Maruti Centre for Excellence, (MACE), ACMA, UNIDO and NIQR are partners to this clustering programme of CII. The cluster approach has proven to be very effective mean to learn, share and grow exponentially in the Indian Manufacturing Industry as seen in the first CII Maruti Vendor cluster programme of 1998. The cluster approach encourages to sharing of knowledge and experiences among cluster members in the areas of "Best practices", Manufacturing Excellence, Energy Efficiency, Cost competitiveness and total Employee involvement. This cluster programme of CII is also very much in line with the national objective of India i.e. 'Building MSME's'; 'Building India'. CII is running 19 clusters with Maruti's MACE at Gurgaon, 02 ACMA Clusters and 02 Munjal Group Clusters in the NCR Region. The other Automotive clusters being run are in collaboration with UNIDO are at Jamshedpur, Bangalore and Pune. At present, there are 4 clusters operating with the help of CII in Punjab. Two are vendor clusters namely Eastman Vendor Cluster, Ludhiana and Mohali CII Godrej Vendor Cluster; a Foundry cluster at Batala/Jalandhar and a Hero Cycle Cluster – III at Ludhiana. (CII, 2010).

5.2.1.1 CII Mission on Innovation in Manufacturing

One of the endeavors of CII is to reposition the country from a low-cost manufacturer to a creative and innovative product developer. CII believes that this can only be triggered by innovation and hence has undertaken a "Mission for Innovation in Manufacturing". The Mission is led by Dr. Surinder Kapur as the Chairman. Presidents and Heads of Specific Industry Associations, Specialists, invitees, representatives from NMCC, CII, Counselors constitute the Mission members. This mission is planned to run from 2006-2012 and is working over strategies to bring an era of Innovation in Indian Manufacturing by changing mindsets and adopted practices. Mission has a focus on select sectors and pursuing companies to adopt innovation as their business strategy. Machine tool industry and Auto-components industry are among the select sectors. The transformation of Indian companies would be brought about by adopting globally benchmarked processes. Some useful CII publications on the subject of innovation have also been brought about. CEO's Handbook for innovation and CII publication titled "Innovate to Grow" are quite popular in the Industry. CII is also a collaborating partner with INSEAD in bringing out annual Report on "Global Innovation Index" (CII, 2010).

Another prestigious initiative of CII is "National Innovation Grid" providing innovators with continuous access to outside domain knowledge and its infrastructure for physical creation. It also support innovation teams and entrepreneurs for successful commercialization. It provide link to Entrepreneurship Learning Centers equipped with rapid prototyping, fabrications, machining centers, tool rooms, testing centers etc. The CII Innovation Node is also linked to the Cambridge system, for innovation U.K. and provides access to CII Innovation Grid members. It also helps to link members to registered innovation centers of corporate members of this CII Mission.

5.2.2 Automotive Component Manufacturers Association of India (ACMA)

The Automotive Component Manufacturers Association of India (ACMA) is the nodal agency for the Indian Auto Component Industry. ACMA was established in 1959 and has witnessed the growth of automotive sector of the country from a restrictive market to global leaders in small car and manufacturing bike segment. ACMA's active involvement in Trade Promotion, Technology up-gradation and Quality enhancement has made it a vital catalyst for Automotive industry's development. ACMA is represented on a number of panels, committees and councils of the Government of India through which it helps in the formulation of policies conducive to the Indian automotive industry.

For exchange of information and especially for co-operation in trade matters, ACMA has a Memoranda of Understanding with its counterparts in Australia, Brazil, Canada, Egypt, France, Germany, Iran, Italy, Japan, Malaysia, Pakistan, South Africa, South Korea, Spain, Sweden, Thailand, Tunisia, Turkey, UK, USA and Uzbekistan.

ACMA represents over 600 companies, whose production forms a majority of the total auto component output in the organized sector. These Markets supply components to vehicle manufacturers, Tier-1 suppliers, Defence, Railways and Replacement market. A variety of components are also being exported by the members to OEMs and aftermarket worldwide. The Automotive Component Industry's output for the financial year 2010-11 is US$ 39.9 billion with a growth rate of 33% against financial year 2009-10. Auto Component Sector has been making rapid strides towards achievement of world-class Quality Systems by imbibing ISO 9000/ISO 14001/QS 9000/TS 16949 Quality Systems. The following details the level of ACMA Member: 576 certified ISO 9000; 208 awarded ISO 14001, 467 certified TS 16949, 105 certified OHSAS 18001, 15 won TPM Award, 12 won Deming prize, 1 won Japan Quality Medal, 1 won Shingo Silver Medallion and 3 won JIPM Excellence Award Annual report ACMA (2012).

The industry has been exporting around 13% of its output worth US$ 5.2 billion. In the year 2010-11. Principal export items include replacement parts, tractor parts, motorcycle parts, piston rings, gaskets, engine valves, fuel pump nozzles, fuel injection parts, filter & filter elements, radiators, gears, leaf springs, brake assemblies& bearings, clutch facings, head lamps, auto bulbs & halogen bulbs, spark plugs and body parts.

ACMA runs a cluster programs known as ACMA Center for Technology (ACT). UNIDO and Ministry of Heavy Industries, Govt. of India and ACMA are partners in this cluster program which is running a 30 months ACT / UNIDO Foundation Cluster Programme. The main inputs in the foundation cluster programme are Introduction to Lean, 5-S, Quality Management, Productivity Improvement, Inventory Management and Equipment Maintenance. The expected output of these basic programmes is "Lean thinking", Productive Work Culture, Quality Excellence and Culture of Improvement. The next stage is 24 months Advance cluster programme, which is based on the concept of integrated cellular manufacturing along with advance 5-S and continual improvement. This programme is targeted at total employees involvement and intensive application of Kaizen and QCC. The overall vision of ACT cluster programme is aimed to achieve "New Product Development Cluster" Stage of Companies in the country. This stage can only be achieved after strengthening of the organization with installation of competent engineering services departments of CAD & CAM, Process Engineering, JIG Fixtures, Tooling, die & Mould Manufacturing, Maintenance & Ultimately Testing & Validation facility. (ACMA, 2012).

5.2.3 National Productivity Council

NPC is national level organization to promote productivity culture in India. Established as a Registered Society in 1958, it is an autonomous, multipartite, non-profit organization with equal representation from employers' & workers' Organizations and Governments. NPC is also a constituent of Tokyo-based Asian Productivity Organization (APO). The mission statement of NPC is "Development, dissemination and application of knowledge and experience in productivity, for promoting consciousness and improvement in productivity, with the objective of strengthening the performance and competitiveness of the economy as well as of improving the working conditions and quality of life". For a sustained economic growth, higher productivity through innovation is the key factor and is critical to competitiveness. In recent years china has overtaken ASEAN in the level of output per worker, while the gap between India and ASEAN has narrowed markedly. The Productivity levels are growing in all the three sectors of Agriculture, Industrial and service sector in both china and India. NPC is playing a catalytic role for growth of Productivity levels in the country. The following three working groups of NPC are identified which interacts extensively with SME`s from cluster approach. Environment Management Group focuses on waste minimization and pollution prevention. Energy Management Group offer services in Resource Conservation; Cleaner Production and Energy Efficiency. Process Management Group takes up the areas of "Best Practice Benchmarking"; "Reverse Engineering"; Six Sigma, ISO 17025 and ISO/TS 16949. NPC is also a nodal agency for implementation of Lean Manufacturing Programme of Ministry of MSME. At present, NPC has taken up the Lean Programmes in Autoparts, Hand Tools and Foundry Clusters with the participation of about 50 Companies in the State of Punjab. (NPC, 2013).

5.2.4 Role of Ministry of MSME Government of India

5.2.4.1 National Manufacturing Competitiveness Council (NMCC)

To enhance productivity, competitiveness and employment generation in the manufacturing sector, the Government of India set up the National Manufacturing Competitiveness Council (NMCC) in 2004 to serve as a forum for coherent policy initiatives. This highest level autonomous body formulated on behalf of the Government of India a "National Strategy for Manufacturing" aimed at sustaining a 12 percent rate of growth in the manufacturing sector necessary to support overall economic growth rates of eight to nine percent in the Indian economy (MSME, 2006). The share of manufacturing sector (within the Industry sector) has shown only a marginal improvement from 16.6% in 1991 to 17% of Indian GDP 2003. In comparison, in some East Asian economies the share of manufacturing has ranged from 25% to 35% of their GDP. It is known that stagnation of manufacturing as a proportion of GDP has adverse impact on employment generation. Therefore it is imperative to boost manufacturing given the huge anticipated increase in the workforce over the next decade. As observed by the National Manufacturing Competitiveness Council in its national manufacturing strategy, the challenges faced by Indian manufacturers raise important questions for both Industry and Government. "This calls for 'breakthrough' and bold thinking on the part of all stakeholders. Only bold aspirations can enable India benefit from emerging opportunities in the manufacturing sector".

The competitiveness in the sector will largely depend on the capacity of the industries to innovate and upgrade. The industry will also benefit if it has strong domestic competition, home based suppliers and demanding local customers. There is no denying the fact that the factors like labour cost, duties, interest rate and economies of scale are the most important determinants of competitiveness. But productivity is the prime determinant of the competitiveness and also impacts the national per capita income. The globally successful OEMs and auto makers will ultimately make their base in places which are high on productivity factor and where essential competitive advantages of the enterprise can be created and sustained. It would also involve core products and process technology creation apart from maintaining productive human resource and reward for advanced skills. The OEMs also look for the policies of the state which stimulates innovations in new technologies. The NCMP describes the MSEs as “the most employment-intensive segment”. Realizing that manufacturing is a driver of economic growth; government of India is reviving the manufacturing sector, to enable them to compete in the new post liberalization environment. New schemes are introduced to strengthen their competitiveness. These schemes are made by the National Manufacturing competitiveness Council of India (NMCC) in consultation with the Ministry of industries. The government initiatives through the National Competitiveness Manufacturing Programmes (NCMP) are quite successful in stimulating the innovation culture in the Indian Manufacturing Sector. The implementation of NCMP is being undertaken through various State and Regional level MSME Development Institutes under the Ministry of MSME, Govt. of India.

5.2.4.2 Innovation Cluster in Autoparts Manufacturing Sector at Ludhiana, Punjab

National Innovation Council (NInC) was set up by the government of India in the year 2012 to drive innovation in the country. NInc is undertaking various initiatives to strengthen the national innovation ecosystem including enhancing the competitiveness of various industrial sectors. NInC is spearheading formation of industry innovation clusters across the country. These clusters will aim to be regional hubs of innovation, bringing together industry, professional service organizations, academia, state and society to encourage collaboration, knowledge sharing and growth under this innovation cluster. The clusters which are initially taken as an Industry innovation Clusters from Punjab Auto Parts Cluster Ludhiana, Sports Goods Cluster, Jalandhar and Engineering Cluster, Mohali. A Cluster innovation Management committee has been formed under the Chairmanship of Director MSMED, Ludhiana to manage innovations in three identified clusters in the state of Punjab.

The first innovation cluster under NinC in the State of Punjab is being established at Ludhiana in the Autoparts Manufacturing Sector. This innovation cluster will operate under the MSME Development Institute, Ludhiana and the Monitoring Committee constitutes from the DI&C (Pb.), IAHT, SIDBI and the CEO of SPV of this autoparts cluster. This cluster has started delivering results by initiation of innovation culture in the cluster on sustainable basis with the active involvement of Member Industry, Academia and Research Institutes.

Eight Schemes at unit level and Nine Schemes at group level in the Autoparts Cluster has been taken up during the operation of this innovation cluster. As the cluster has started its activities and the programme to have an innovation incubator in the auto sector has been initiated as per the following schemes of MSME.

5.2.4.3 Support for Entrepreneurial and Managerial Development of SMEs Through Incubators

Micro and Small Enterprises (MSEs) are recognized as an important constituent of the national economies. Recognizing their contribution to country's industrial production, exports, employment and creation of entrepreneurial base, the Central and state Governments have been implementing several schemes and programmes for promotion and development of these enterprises. Government of India launched a scheme for giving Support for Entrepreneurial and Managerial Development of SMEs through Incubators.

The main objective of the scheme is to promote emerging technological and knowledge-based innovative ventures that seek the nurturing of idea such entrepreneurial ideas have to be fostered and developed in a supportive environment before they become attractive for venture capital. Hence the need arises for incubation centres: to promote and support untapped creativity of individual innovators and to assist them to become technology based entrepreneurs.

The term 'innovation' covers a very wide domain and in so far as micro and small enterprises are concerned, it could signify any activity and new/ingenious procedure or product that is likely to be of use to society (or to specific segments thereof) and therefore marketable in the long run. The purpose of the present scheme is to support students/ ex-students of science and technology and entrepreneurs try out their innovative ideas (processes and products) at the laboratory or workshop stage and beyond (to the extent possible) – to carry forward the idea from its mere conception to 'know-how' and then to 'do how' stage.

Ministry of MSME has approved IAHT to act as a host Institute in year 2014 for running of Incubator for development of Ideas of (8 to 10) Incubitee to commercialization stage in this innovation incubator for the entrepreneurs in autoparts manufacturing sector. This incubator at IAHT shall operate by providing the support and guidance of Mentor in the technical areas of Cold Forging and Heat Treatment.

5.3 Summary of the Chapter

This chapter deals with the role and contribution of industry support institutions and various Agencies in fostering innovativeness among small scale auto parts manufacturing industry of Punjab. The first part of the chapter deals with six Industry Support Institutions facilitating innovation culture in autoparts manufacturing sector in Punjab. The second part gives an overview of the role of agencies in fostering innovativeness among small scale autoparts manufacturing industry of the State.

CHAPTER – VI

DEVELOPMENT OF A MODEL FOR FOSTERING INNOVATION CULTURE FOR SMALL SCALE AUTOPARTS MANUFACTURING INDUSTRY OF PUNJAB

This chapter presents a mathematical model that was developed to know the influence of national system of innovation on the innovativeness among the small scale autoparts manufacturing industry of Punjab. The details are discussed below:

As an outcome of extensive data analysis of various parameters collected under six Determinants of Innovation culture and eight Elements ofNational System of Innovation, it was observed that there is a relationship between the internal environment of an organization and the external environment in the shape of an innovation system around an organization. With this presumption in mind, the technique of factor analysis was applied to know the influence of external factors in the shape of National Innovation System on the innovation culture of organizations.

6.1 Development of Model to Foster Innovation Culture

6.1.1. Innovation culture as a dependent variable

The six identified Determinants of Innovation Culture were taken as Strategy, Organization Climate, Human Resources, Processes & Procedures, Group Characteristics and Individual Characteristics. The influence of these determinants was evaluated by using area diagrams of a Hexagon. The percentage area (% A) scored by respondent organizations was taken as an indication for the level of innovation culture in that organization. In doing the factor analysis; the percentage area (% A) was taken as a dependent variable.

6.1.2 Elements of National System of Innovation as independent variables

Eight elements of national system of innovation with respect to small scale autoparts manufacturing industry of Punjab were identified based on literature review. These 08 identified elements of NSI are Education, Science & Technology, Markets, Physical Infrastructure, Financial Infrastructure, Cultural Aspect, Industrial Networking and State induced incentives. Each element contains 05 distinct parameters. Hence, overall 40 statements under the study of National System of Innovation were taken as external factors and also as independent variables.

6.1.3 Factor analysis

Factor analysis was used for finding out the principal dimensions on which external factors can be measured. The following discussion deals with issues such as reliability and validity of the set of statements, results pertaining to factor analysis and factor definitions.

6.1.3.1 Reliability of Tool

Cronbach's alpha is used as a measure of reliability. It can be seen from Table 6.1given below that value of Cronbach's alpha for the set of forty statements used for measuring external factors came out to be 0.965. This value of 0.965 was found to be well above the conventional acceptance level of 0.7 (Nunnally, 1978). Therefore, the set of the statements can be treated as reliable measurement instrument. Further, values of split-half correlation and Spearman-Brown Prophecy were found to be 0.888 and 0.940 respectively. As these values were more than 0.8, it was concluded that the instrument was also having internal consistency.

Table 6.1: Reliability Analysis for the used Independent Variables in factor analysis

Cronbach's Alpha	0.965
Split-Half Correlation	0.888
Spearman-Brown Prophecy	0.940

6.1.3.2 Evaluation of KMO, Bartlett's Test and Extraction of Factors

Factor analysis was run using SPSS and the results have been discussed as follows. Table-6.2 shows that value of Kaiser-Meyer-Olkin (KMO) i.e. the Measure of Sampling Adequacy came out to be 0.920. KMO value more than 0.50 is an indication of adequate sample size (Field, 2003).

Table-6.2: Values for KMO Measure and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.920
Bartlett's Test of Sphericity	Approx. Chi-Square	4643.707
	Degrees of Freedom	780
	Significance	0.00

Value of chi-square for Bartlett's Test of Sphericity came out to be 4643.707. This value was found to be significant (*p*=0.00) with 780 degrees of freedom. Value of KMO and results of Bartlett's Test of Sphericity indicated factor analysis could be performed on the given data set.

Results from factor analysis have been presented in Table-6.3.While extracting the factors Principal Component Analysis was used and rotation method used was Varimax Rotation with Kaiser normalization. In all, three components were extracted and minimum factor loading used for the analysis was 0.1.

Table6.3: Rotated Component Matrix

Code	Parameter under the element of NSI	Component		
		1	2	3
E1	Number and quality of education in the Schools.	**.676**	.479	.232
E2	Number and quality of Vocational Training Institutes.	**.560**	.435	.214
E3	Number & level of higher education in Colleges.	**.719**	.490	.191
E4	Number and level of higher education in Universities.	**.684**	.488	.218
E5	Infrastructure for Research in Universities.	**.835**	.263	
SC1	Central Government S&T institutes.	**.636**	.253	.345
SC2	State Government R&D Centers / Institutions.	**.658**	.453	.152

SC3	Govt. support for R&D Projects.	**.801**	.279	.192
SC4	Setting up In-house R&D in Industry.	**.666**	.258	.429
SC5	Facilitation / Assistance Centers on IPR issues.	**.828**	.140	
M1	Collaboration/JV/MNC Licensee manufacturers.	**.676**		.482
M2	Domestic OEM market.	**.670**	.603	
M3	Domestic Replacement Market.			**.440**
M4	International OEM Market.	**.635**		.541
M5	International Replacement Market.	**.798**		.411
INF1	Quality and Network of Roads.	**.706**	.470	.193
INF2	Network of Railways.	**.696**	.387	.177
INF3	Air connectivity and Cargo Terminals.	**.758**	.325	
INF4	In-land Dry ports / Container Depot.	.325	**.680**	.471
INF5	Quality and supply condition of Electricity.	**.737**	.381	
FIN1	Functioning and access to financial markets.	.507	**.664**	
FIN2	Functioning and support of stock markets.	.245	**.744**	
FIN3	Role of Banks/Financial Institutions.	.265	**.710**	
FIN4	FDI/Investment by Non-Resident Indians.	.257	**.397**	.311
FIN5	Raising Capital equity or Capital venture.	**.595**	.546	-.193
N1	Number of Industry / Trade Associations.	**.794**	.268	.121
N2	Role of CII, CICU, APEX/Chambers & Confederations.	**.834**	.422	.145
N3	Support from MSME, DICs and NPC for Technology.	**.851**	.188	.269
N4	Contribution of Govt. S&T and R&D Institutions.	**.624**	.571	.298
N5	Support from In-house R&D of Private Industries.	**.889**	.200	
CL1	Hard working nature of people.	**.140**	.101	
CL2	Desire to learn new things.	.374	.394	**.434**

CL3	Competitive nature.			**.200**
CL4	Risk taking capacity		**.299**	.138
CL5	Openness / Trust worthiness.	.323	.313	**-.661**
ICN1	Incentives for Technological up-gradation.	.393	**.753**	
ICN2	Incentives for Quality Products.	.102	**.531**	
ICN3	Govt. support to Training Programme.	.282	**.770**	
ICN4	Incentives for Import of Technology/R.M's.	**.483**	.457	.296
ICN5	Assistance for Participation in Trade fairs/Exhibitions.	.590	**.512**	-.256

6.1.3.3. Factor Definitions

Three factors were obtained from Principal Component Analysis. Factor loading and the extracted factors from the analysis have been presented in Table-6.4. These three factors were able to explain 62.56 percent variance in the data set. Factor definitions for the extracted factors have been tabulated in table 6.4 and explained in the following sections:

Table 6.4: Extracted Factors from Factor Analysis

Factor	Factor Name	Eigen Value Total	% of Variance	Items	Item Loading
1.	**Support for Capacity Building**	20.379	50.949	E1	.676
				E2	.560
				E3	.719
				E4	.684
				E5	.835
				SC1	.636
				SC2	.658
				SC3	.801
				SC4	.666
				SC5	.828
				M1	.676
				M2	.670
				M4	.635
				M5	.798
				INF1	.706
				INF2	.696
				INF3	.758
				INF5	.737
				FIN5	.595
				N1	.794
				N2	.834
				N3	.851
				N4	.624
				N5	.889
				ICN4	.483
				CL1	.140

2.	**Monitoring Aspects**	2.875	7.188	FIN1	.664
				FIN2	.744
				FIN3	.710
				FIN4	.397
				INF4	.680
				ICN1	.753
				ICN2	.531
				ICN3	.770
				ICN5	.512
				CL4	.299
3.	**Cultural Aspects**	1.771	4.428	CL2	.434
				CL3	.200
				CL5	-.661
				M3	.440

6.1.3.3.1 Support for Capacity Building

This factor deals with the support for capacity building and explains 50.95 percent variation as shown in the Table-6.4. Items covered under this factor include quality and availability of education, science and technology environment, market related factors and quality of networking. All these variables are helpful in capacity building for fostering the innovation culture.

6.1.3.3.2 Monitoring Aspects

This factor deals with the monitoring aspects that can be supportive for enhancing innovation capacities of the organizations. Variables represented by this factor include financial infrastructure and incentives provided by the governments. It can be seen from Table-6.4 that variation explained by this factor is 7.188 percent.

6.1.3.3.3 Cultural Aspects

This factor is concerned with the cultural aspects. Variables represented by this factor include desire to learn about new technologies and aspects related to competitiveness, openness and trust. It can be seen from Table-6.4 that variation explained by this factor is 4.428 percent.

6.1.3.4 Regression Analysis for the Development of Model

Table-6.5 Shows that innovation score directly varies with Support for capacity building, monitoring aspects and cultural aspects. It can be seen from the table that all the independent variables were the significant predictors of innovation score. Support for capacity building was having highest value of standard beta, *i.e.,* 0.821.

Table 6.5: Multiple Regression Results

Source	Coefficient	Std. Error	Std. Beta	t-value	Prob.
Intercept	35.689	0.412	-	86.584	<0.0001
Support for Capacity Building	12.759	0.414	0.821	30.814	<0.0001
Monitoring Aspects	6.807	0.414	0.438	16.439	<0.0001
Cultural Aspects	3.792	0.414	0.244	9.159	<0.0001
R^2: 0.925, Adjusted R^2:0.923					

Regression equation obtained from the analysis has been presented as follow:

Innovation Score = Innovation Culture = 35.689 + 12.759 SCB + 6.807* MA + 3.792 * CA*

(SCB = Support for Capacity Building; MA = Monitoring Aspects and CA= Cultural Aspects)

Value of coefficient of determination came out to be 0.925. It signifies that 92.5 % of variation in innovation score is on account of the independent variables used in the model.

The influence of national system of innovation (NSI) on fostering of innovation culture among small scale autoparts manufacturing industry of Punjab is presented in a pictorial form as Figure-6.1 given below.

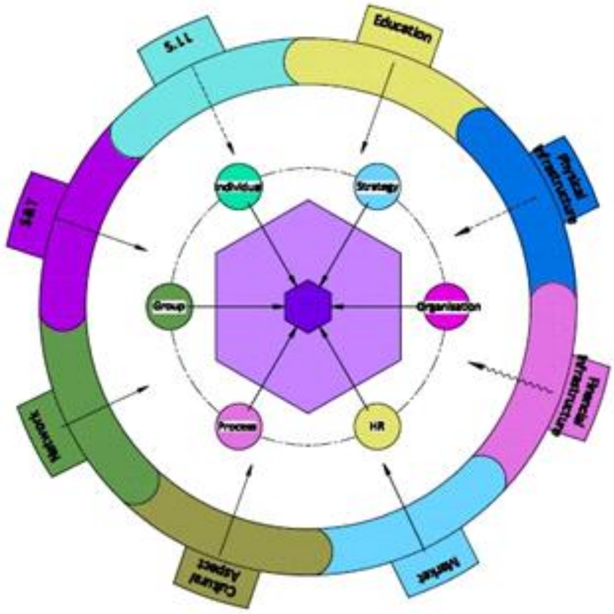


Figure 6.1: Pictorial Diagram of the Model for Fostering Innovation Culture among Small Scale Autoparts Manufacturing Industry of Punjab

6.1.3.5 Equation of the Model

As per the outcome of factor analysis, the following equation emerged for a model for fostering innovation culture in small scale autoparts manufacturing industry of Punjab.

Innovation Culture = 35.689 + 12.759* SCB + 6.807* MA + 3.792 * CA

Where;

SCB = Support for Capacity Building for innovativeness in the organization

MA = Monitoring Aspect / Regulatory Measures

CA = Cultural Aspects

6.1.3.6 Conclusions

1. There is strong evidence of a positive influence of National System of Innovation on the innovation capacity of Small Scale Autoparts Manufacturing Industry of Punjab.

2. Support for capacity building factor covering the variables under the elements of education, science and technology environment, market and quality of networking is found major contributor towards capacity building for innovation of organizations.

3. The Monitoring aspects covering variables of financial infrastructure and Government incentives is found supportive for enhancing innovation capacity of organizations.

4. The factors of Cultural aspects representing the variables of desire to learn, openness and trust are also found contribution towards innovation culture.

6.2 Summary of the chapter

This chapter has presented the results obtained from the development of a model for fostering innovation culture for small scale autoparts manufacturing industry of Punjab. The chapter also deals with the identification of influencing factors of the National System of Innovation which are fostering the Innovation Culture among Small Scale Autoparts Manufacturing Industry of Punjab.Statistical techniques of Factor and Regression Analysis were used to obtain an equation for the model. Three factors such as Support for Capacity Building (SCB), Monitoring Aspects (MA) and Cultural Aspects (CA) were found to be the major contributing factors towards promoting the innovativeness and competitiveness in the enterprises.

CHAPTER – VII
SUMMARY AND CONCLUSIONS

This chapter summarizes the major findings of the various phases of the study. It also describes conclusions of the work, recommendations and directions for future research.

7.1 Summary of the Study

The present study was undertaken in the small scale auto parts manufacturing industry of Punjab for exploring the status of innovation culture. The study assumes importance due to the fact that no such study has earlier been conducted in this sector. An extensive review of literature was undertaken to find out the major issues related to innovation culture. The study is based on survey of 110 small scale units operating in the autoparts manufacturing sector of the Punjab state out of which 48 were product manufacturers, 47 were processing units and 15 were service providers. For the purpose of carrying out the study a questionnaire was developed. This questionnaire was validated by conducting a pilot survey in five organizations. The questionnaire was finalized by incorporating the suggestions received during the pilot survey. The primary data was collected through interviews with Senior Managers, Managers, Departmental Heads and Owners of the Units. A pre-tested, structured and non-disguised questionnaire was administered covering the related issues under various determinants and elements of Innovation Culture and National System of Innovation. This ensured the collection of a quality data. Besides the collection of data form primary source; the secondary data was collected from policy documents, proceedings, annual reports, technical journals, magazines and publications of various Government and non-government organizations. Appropriate Statistical Techniques have been used for analyzing the data.

7.2 Summary of the Findings

This section deals with the findings of the study. Major findings of the study have been summarized in four parts. The first part deals with the innovation culture among the auto parts units. The second part covers the influence of national system of innovation on innovativeness of the units.The third part deals with the role and contribution of various agencies and institutions in fostering innovation culture among Small Scale Autoparts

Manufacturing Industry of Punjab.The fourth part deliberates on the development of the model.

7.2.1 Performance of Determinants of Innovation Culture

All the determinants of innovation culture are found at a fair level of mean score rating.

- The determinant of OrganizationClimate is observed to have maximum mean value (4.12).
- The determinant of Human Resources with mean value (4.04), Individual Characteristics with mean value (4.03) and Group Characteristics with mean value (3.96) are found at fair level.
- The Strategydeterminant is found at a fair level with mean value (3.45)
- The determinant of Processes &Procedures is found at the lowest performance among the six elements of innovation culture with a mean value (2.84).

7.2.1.1 Performance of Parameters under Determinant of Strategy

- Making strategies to meet changing market requirements is found with highest level of performance withmean value (5.20)
- Priority to meet customer requirements is also at good level with mean value (5.17)
- No hesitation in taking ideas from competitors found a favour at good levelwith mean value (4.00)
- Management encourages visits to Trade Shows/Exhibitions mean value (3.46)
- There is not much inclination to adoptgood ideas from others mean value (2.99)
- There is a lack of understanding about goals and direction of organization mean value (2.56)
- Poor level of vision of the organisation for next 05 years to maintain competitive edge mean value (2.21)
- Strengths and competencies of organizationare not regularly reviewed mean value (2.02).

7.2.1.2 Performance of Parameters under Determinant of Organization Climate

- Organisation repose faith in their employees and encourage them to take risks for development is at the highest level of good rating with mean value (5.29).
- There are open and trusting relationships within organisation mean value (5.25)
- Organizations don't punish their employees in case of failure in development projects mean value (5.20)
- Employees at all level within the organization are invited for creative ideas for development projects is found at a good level mean value (4.67)
- Organizationsencourage new & creative ideas mean value (4.29)
- The small scale industry has constrained resources to fund the developmental projects as the performance of this parameter is found at a poor level with mean value (2.93)
- There is lack of multipurpose and flexible machinery in small scale industry for taking up development projects mean value (2.80)
- There is a lack of In-house R&Ds with SSAMIs as a poor score of mean value (2.56) is reported.

7.2.1.3 Performance of Parameters under Determinant of Human Resources

The performance of various parameters under the element of Human Resource is found from fair to good level of rating.

- Organisation rewards successful innovations mean value (5.32)
- Fewer personal conflicts are found in the SSIs mean value (4.63)
- Organizations motivate employees to think, review and generate ideas mean value (4.59)
- Employees are duly compensated for their extra efforts in creation of new ideas for the organisation mean value(4.14)
- Small Scale Industry of the manufacturing sector of Punjab adopts the policy for development and retention of Talent as a good rating of mean value (4.09) score is reported.
- Small scale industry of Punjab has supportive organisation structure as their employees are not demoralized for failures in their endeavors mean value(3.63)
- There is a fair level of programmes for taking up Skill-up gradation training in the unitsmean value(3.00).

- There is a lack of system for identifying the needs and arranging the trainings for the employees in the SSIs of Punjab as a poor score mean value(2.96) is reported.

7.2.1.4 Performance of Parameters under Determinant of Processes &Procedures

There is a lack of culture for adopting processes and procedures in the small scale manufacturing units as majority of the parameters under the element of Process in present study have been reported with poor scores. Only two parameters have been reported with the results as fair to good.

- There is a practice in the SSIs to learn from mistakes and failures mean value (4.40)
- The SSI manufacturing units adopts the practice to compare their products with that of competitors as good mean value (4.08) is observed.
- Organizations do not practice frequent brainstorming and creative group meetings as a poor score mean value (2.54) has been reported.
- SSIs do not hold regular meetings to deliberate and discuss about new projects mean value (2.52).
- Organisation seldom evaluate the ideas before taking trials, mean value (2.50) indicates a poor level of performance of this parameter.
- SSIs do not generate number of ideas to choose the best one for undertaking the development projects as poor score of mean value (2.47) is reported.
- Manufacturing units are not practicing to build prototypes or take process trials for speedingup the adoption of new technologies, evident from reported poor mean value (2.33)
- Organizations do not adopt the practice of forecasting for new products, technology as poor mean value (1.90) is observed.

7.2.1.5 Performance of Parameters under Determinant of Group Characteristics

The performance of majority of the parameters is observed as of good rating. The detailed findings of the parameters of the element are discussed below.

- Organizations are quite in regular touch by interacting with progressive and lead customers of their products or services, mean value (4.86) is of higher level of good rating.
- SSIs undertake good level of interaction with suppliers mean value (4.80)

- Organizations adopt a Democratic and Participative style of functioning in their units as is evident from a good level of reported mean value (4.66).
- Organizations also avail the services of experts of R&D support institutions operating in the manufacturing sector of Punjab as a good level of mean value (4.28) is reported.
- SSIs frequently deploy services of professionals and consultants operating in the SSAMIs as evident from a good score of mean value (4.22).
- There is an evidence of good level interaction with educational institutions of the state as observed from reported good mean value (3.59).
- Organizations don't encourage operation of cross functional teams to solve problems as evident from the poor mean value (2.87) scored.
- SSIs do not believe in sharing of information with fellow industry and shows lack mutual learning among themselves. Poor score mean value (2.41) is reported for this parameter under the element of Group Characteristics.

7.2.1.6 Performance of Parameters under Determinant of Individual Characteristics

The results of the study show that performance of the parameter under the determinant of Individual Characteristics is reported from fair to good level.

- Employees working in the SSIs are not scared to take risks for fear of failures mean value (4.80)
- Organizations prefer recruitment of employees with learning aptitude as reported from a good level of mean value (4.71).
- Employees working in SSAMIs take keen interest in creative activities mean value (4.65).
- Employees working SSIs operating in Auto Parts Manufacturing sector of Punjab do not criticize development work of fellow employees as indicative from the good level of mean value (4.53).
- Organizations prefer recruitment employees educated in relevant field mean value (3.99).
- SSIs prefer hiring of multi skill/multi task employees mean value (3.68)
- Organizations practice the policy of hiring competent and talented manpower mean value (3.24).

- There is a lack of application of scientific / technical knowledge by the employees if the SSIs in Punjab as a mean value (2.88) is observed of a poor level.

7.2.2. Findings on Status of Innovation Culture among Small Scale Auto Parts Manufacturing Industry of Punjab

- The overall level of innovation culture in small scale autoparts industry of Punjab is found to be 34% against the optimal and achievable level of 50% – 75% in the present scene of autoparts manufacturing sector of India.
- The majority; 65% of small scale autoparts industry of Punjab falls under type – II. The type II indicate the industry “know the need but not how to change”.
- Approximately one fifth; 19% of the industry falls under type – III. The type III indicate, they “know the need and has some ability to generate and absorb technology”.
- No unit in among SSAMIs fall under the highest level of type-IV. The type-IV indicates that the industry is capable to “generate and absorb technology”.
- About 16 % of the autoparts manufacturing units of Punjab falls under the lowest category of innovation capability which means “don’t know the need and how to change”.
- No unit is found to be a product innovator.
- A total no. of 21 units i.e. 19% of respondent organizations are found in the optimal range of 52% - 75%.
- Another 19 units i.e. 17% are crossing the threshold level of 40% of area score and hence the level of innovation culture. This is a promising indication that the autoparts manufacturing sector of Punjab is moving upwards direction of innovativeness.
- The SSAMIs in Punjab are practicing “low tech” – “low cost” innovations to improve their quality and productivity in their manufacturing processes.

7.3 Performance of Elements of National System of Innovation

7.3.1 Performance of Parameters under the Element of Education

- Number and quality of education at high schools (M%=78.91) and VTIs (M%=77.76) are rated as good.
- Number and level of education in colleges (M% =40.36) and universities (M% =40.36) were reported poor.
- Research infrastructure in the universities (M%=30.97) was lowest in poor rating.

7.3.2 Performance of Parameters under the Element of Science & Technology

- The services rendered by Central Government S&T institutes (M%=69.45) is of good rating level.
- State Government R&D Centers / Institutions (M%=69.82) are also providing services at good rating level.
- Govt. support for R&D Projects(M%=37.45)was found at a poor level.
- Support for setting up in-house R&D(M%=30.91) is also at poor level.

The parameter about Facilitation / Assistance on IPR issues(M%=26.55) was found lowest at poor level.

7.3.3 Performance of Parameters under the Element of Physical Infrastructure

- Road network (M%=78.91) and Railways (M%=77.82) in the state is of good level.
- In-land Dry Ports /ICDs(M%=37.82) are found at poor level.
- Air connectivity and Cargo Terminals (M%=34.73) is also at poor level.
- The quality and power supply conditions(M%=34.36) are lowest of poor level.

7.3.4 Performance of Parameters under the Element of Financial Infrastructure

- Access to financial markets (M%=59.27) is at a fair rating.
- The role of banks/financial institutions (M%=54.36) and Functioning and Support of Stock Markets (M%=54.36) are found at a fair level.
- Funding by Capital market/venture capital (M%=43.64) is at poor level.
- Investments through FDIs/NRI's (M%=25.09) is found at a very poor level.

7.3.5 Performance of Parameters under the Element of Industrial Networking

- There are more than 100 Industry and trade associations working in the state of Punjab.
- Number of Industrial/Trade associations(M%=76.18) found at higher level of good rating.
- Contribution by Govt. S&T and R&D Institutions (M%=76.00) is at a good level.
- Role of CII, CICU, APEX/Chambers & Confederations.(M%=73.27) is also found good.

- Support from MSME, DICs and NPC for Technology (M%=51.64) has been rated as fair.
- Giving support from In-house R&D of Private Industries to fellow units (M%=27.09) is rated at the lower level of poor rating.

7.3.6 Performance of Parameters under the Element of Markets

- Performance of the parameter of Domestic Replacement Market (M%=74.73) is at a good level.
- Domestic OEM market (M%=63.64) parameter is also found at good level.
- The parameter International Replacement Market (M%=28.55) is at poor level.
- Collaboration/JV/MNC Licensee manufacturers (M%=25.45) is also at the poor level of rating.
- International OEM Market (M%=23.45) parameter is rated at lower level of poor rating.

7.3.7 Performance of Parameters under the Element of Cultural Aspects

All the parameters under the element of Cultural aspect are performing at higher level of the good rating.

- Competitive nature (M%=76.91)
- Desire to learn new things (M%=75..27)
- Hard working nature of people (M%=74.55)
- Risk taking capacity (M%=72.36)
- Openness / Trust worthiness (M%=69.45).

7.3.8 Performance of Parameters under the Element of State-Induced Incentives

The performance of the parameters under the Element of Incentives is found from poor to fair level only.

- The Assistance for Participation in Trade fairs/Exhibitions (M%=52.91) rated as fair.
- Govt. support to Training Programme (M%=48.36) parameter is also at fair level
- Incentives for Technological up-gradation (M%=45.64) is fair level.
- Incentives for Quality Products (M%=39.09) parameter is at poor level.
- Incentives for Import of Technology/R.M's (M%=32.18) at a lower level of poor rating.

7.4 Findings on the Role of Industry Support Institutions and Agencies

7.4.1. Role of Industry Support Institutions

- There are six Industry support institutions operating in the manufacturing sector of Punjab.
- Research & Development (R&D) Centre for Bicycle & Sewing Machines (R&D), Ludhiana was set up in year 1982.
- Institute for Machine Tools Technology, (IMTT) Batala was set up in year 1994.
- Institute for Autoparts & Hand Tools Technology, (IAHT), Ludhiana was set up in year 1994.
- Central Tool Room (CTR), Ludhiana was set up in year 1980.
- Central Institute for Hand Tools (CIHT), Jalandhar was set up in year 1983.
- Central Institute for Plastics Engineer Technology CIPET at, Amritsar was set up in year 1989.

7.4.2. Contribution of Industry Support Institutions

- There are 59 managers /engineers, 57 diploma engineers, 25 science graduates and 194 technical operators working exclusively for the SMEs of Punjab.
- These institutions have solved 2953 problems. 1009 JFT / Dies / Moulds; 49 special purpose machines and 1938 inspection gauges and made 49 SPMs during the period 2007-2012 for the manufacturing sector.
- These institutes have handled 313000 testing, 32300 calibrations and have assisted the industry by providing 30 test rigs during the span of five years (2007-12).

- These institutes have churned out 2488 diploma engineers, and imparted skill upgradation training to 13816 trainees in the fields covering CADCAM, Precision CNC Machines, Plastic Engineering, TQM, Quality Control, Tool and Die Making, Testing Calibration, Special Heat Treatment and Maintenance during 2007-12.
- Theseinstitutes have undertaken about 53,600 precision machining jobs, cold forged 27 tons of steel and have handled about 452 tons of alloys steels for the purpose of special heat treatment during 2007-12.
- These institutes have provided 1425 design drawings, undertaken about 27400 RPT jobs and conducted 584 product developments in the last 05 years (2007-12).
- There is stock of 4678 reference books /standards and 40 technical journals / periodicals are available in these institutes which are helpful for technical dissemination among SMEs.
- These institutes have extended the experimental equipment support to 94 PG research scholars on the latest technologies of White Light Scanning, 3D Printing, Cryogenic Treatments, Wire EDM Machining and Vacuum Hardening.
- The revenue generation by three institutes witnessed significant increase; Central Tool Room (CTR) at the rate of 11.75%; R&D Centre at the rate of 15.67% and Institute for Machine Tools Technology (IMTT) at the rate of 8.98% compounded annually ($p<0.01\%$).
- There is also upward trend in growth rate for remaining three institutes; such as Central Institute for Hand Tools growing at a rate of 21.30%, Central Institute for Plastic Engineering Technology at a rate of 35.80% and Institute for Autoparts & Hand Tools Technology at a rate of 29.64%; compounded annually ($p<0.05\%$).
- These highly interactive, self-reliant institutions are virtual In-house R&D for SMEs operating in manufacturing sector of Punjab.
- The strongest influencing element of NSI is ‘Cultural Aspects’ (M%=73.8) indication that people of Punjab are hardworking, competitive, eager to learn, open and have the courage to take risk.
- The element of Networking is found at a good level (M%=60.8).
- The element ofEducation (M%=53.6), Physical Infrastructure (M%=52.8) are on the higher side of fair rating.
- Financial Infrastructure (M%=47.8), Science & Technology (M%=46.8), State induced incentives (M%=43.6) and Markets (M%=43.2) are on the lower side of fair rating.

7.4.3. Role and Contribution of various Agencies

A comprehensive study was undertaken regarding role and contribution of NMCC, ACMA, CII and NPC, in fostering the innovation culture among SSAMIs.

- The total no. of MSME's in India has risen from 105.21 lakhs units in year 2001-02 to a level of 311.52 lakhs units in year 2010-11.
- There are 94.94% units engaged in Micro sector, 4.89% in small sector and 0.17% in Medium sector.
- The deployment of manpower with MSMEs has risen from 595.66 lakhs persons in year 2006-07 to a level of 732.24 lakhs persons in year 2010-11.
- There are total number 546 members of the Automotive Components Manufacturers Association of India. (ACMA)
- 524 ACMA Industry Members in India has adopted the ISO 9000 QMS.
- 342 ACMA Members are complying with requirements of TS 16949 Quality Management System.
- 81 ACMA members are QS 9000 certified.
- 154 ACMA Members are complying with ISO 14001.
- 47 ACMA Membersare certified for OHSAS 18001.
- There is only one Autoparts Manufacturing Cluster is operating under the scheme of (Ninc)/NMCP operating in Punjab since year 2012.
- Institute for Autoparts & Hand Tools Technology, Ludhianais the first and the only host Institute (setup in 2014)operating for carrying out activities under the incubator scheme of MoMSME.
- CII is running successfully 203 cluster programs with the participation of 2192 manufacturing enterprises throughout India.

7.5 Findings on the Development of Model for Fostering the Innovation Culture among Small Scale Autoparts Manufacturing Industry of Punjab

- There is strong evidence of a positive influence of National System of Innovation on the innovation capacity of SSAMIs of Punjab
- 03 factors were obtained from Principal Component Analysis. Factor loadings and explains 62.56 percent variance in the data set.
- The major factor identified for contributing to innovativeness among the SSAMIs is Support for Capacity Building (SCB) and explains 50.95 percent variation. Items

covered under this factor include quality and availability of education, science and technology environment, market related factors and quality of networking. All these variables are helpful in capacity building for fostering the innovation culture.

- The next important factor influencing the innovation culture is Monitoring Aspects (MA) which explains 7.188 percent of variation of the data set. This factor deals is found supportive for enhancing innovation capacities of the organizations. Variables represented by this factor include financial infrastructure and incentives provided by the governments.
- Cultural Aspects (CA) is another factor which explains 4.428 percent of the variation. This factor include desire to learn about new technologies and aspects related to competitiveness, openness and trust.
- The equation of the model obtained after factor and regression analysis isInnovation Culture = 35.689 + 12.759* SCB + 6.807* MA + 3.792 * CAWhere, SCB = Support for Capacity Building; MA = Monitoring Aspects; CA= Cultural Aspects and value of coefficient of determination came out to be 0.925.
- The strongest predictor is found to be SCB with Standard Beta value of 0.821followed by the MA with Beta value of 0.438 and CA at Beta value of 0.244.

7.6 Contributions of the Study

The major contributions of the present study are listed below:

1. It is the first study related to innovation culture among small scale auto parts manufacturing industry of Punjab.
2. The Study provides a valuable insight regarding the existing status of the innovation culture among SSAMIs of Punjab.
3. Major attributes affecting the innovation culture have been identified.
4. The Model developed in the study can be used for self-assessment of the innovation culture in individual units.
5. The stake holders of units engaged in manufacturing sectors cam identify the parameters for the purpose of adopting best practices to spur innovation in their respective organizations.
6. This study a successful attempt in revealing the area that requires adoption by the entrepreneurs.

7. The study identifies grey areas for attention of policy makers to make improvements in making a supportive and robust National Innovation System for the manufacturing sectors.

7.7 Recommendations of the Study

Keeping in view the results obtained from the study and the observation made during the study, a few suggestions are being made. Firstly, the Ministry of Science & Technology, Govt. of India may take up strengthening of the infrastructure for providing R&D support and resources to small scale industry of Punjab State. Secondly, the industry support institutions of the state may be considered for further strengthening with cutting edge technologies of the future. Thirdly, the Punjab Govt. must pursue a major OEM to setup an automobile manufacturing plant in the State. This will facilitate the technological development of autoparts manufacturing sector of Punjab. Lastly, since Punjab is landlocked state and require more number of Dry-Ports/ICDs and Air-cargo terminals in the state.

7.8 Limitations of the Study

The following are major limitations of the study.

1. As the study is based on the primary data collected from respondents, accuracy of the results is limited to the accuracy of the information provided by the respondents.
2. As the survey method has been used for the study, limitations of survey method naturally become the limitation of the study.
3. The responses were collected at the top management level of entrepreneur or senior manager only and hence the data lacks possible information from other levels in the organization.
4. The development of technology is happening at a fast pace and the study has captured only the manufacturing and technological scenario at the time of research work. Hence, the results obtained from the research may hold true for time window of the study.

7.9 Directions for Future Research

The present study is an attempt to evaluate the status of innovation culture and to develop a model for fostering innovativeness among Small Scale Autoparts Manufacturing Industry of Punjab. For gaining further insight into the subject of innovation and the influence of the national system of innovation on the manufacturing sector, few future research directions have been listed as follows:

1. The study can be extended to other manufacturing sectors of Punjab State.
2. The study can also be taken up for autoparts clusters operating in other regions of the country.
3. A Study can also be undertaken for medium and large scale automotive manufacturers of Punjab.

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Annexure-I

QUESTIONNAIRE

SECTION: GENERAL

NAME & ADDRESS OF ORGANISATION			
NAME & DESGINATION OF RESPONDENT			
CONTACT	e-mail/Number		
Type of Activities undertaken	**Manufacturer** □		
	Processor □		
	Service Provider □		
	Any Other □		
PRODUCT(S)			
Whether belongs to Small Scale Industry		Yes ☐	No ☐

Year of Inception	
Accreditation / Certification (If any)	

SECTION – I

Following are some statements about handling the subject of Innovation in your Organization. For each statement please put a score between 1 (= Not true at all) **to 7 (=** Very True) **under the column of score.**

S. No.	**Statement**	**Score 1 to 7**
1.	Everyone understands the overall goals and direction of the Organisation.	
2.	We have a Democratic and Participative style of Leadership.	
3.	Organisation has an in-house R&D Department to implement new Ideas.	
4.	Formal education in relevant field is a must for employees at all levels in the organization	
5.	We have reward system for successful innovations.	
6.	We learn from our "Mistakes and Failures".	
7.	We have a vision for the next five years to maintain the competitive edge in the market.	
8.	Organisation keeps interaction with progressive & lead customers to explore concepts/products.	
9.	We have a set of multi purpose machinery and equipment to develop new products.	
10.	Hiring of multi skill and multi task employees is preferred in the Organisation.	
11.	Our Organization is committed for skill-up gradation of its employees.	
12.	Fresh ideas are evaluated by a team before giving a chance for trials.	
13.	We review our strengths and competencies regularly to meet ever changing market challenges.	
14.	Our Organization maintains good interaction with suppliers.	
15.	In our Organization, there are more openness and trusting relationships among employees.	
16.	People are encouraged for creativity and innovation.	

17.	We identify Training needs of employees and arrange Training Programmes accordingly.	
18.	We generate a lot of ideas before taking up mass production of new products or a new process.	
19.	We adopt good ideas from fields other than the field of our activities.	
20.	We appoint teams of different departments to solve specific problems.	
21.	We repose faith in employees to encourage them take risks involved in the development work.	
22.	We have a policy to hire competent people.	
23.	Our HR policy is for Development and Retention of Talented employees.	
24.	Organisation has frequent debates and discussion about new ideas.	
25.	The organization understands requirements of its customers.	
26.	We share our experiences with others to facilitate mutual learning.	
27.	There is no Punishment for failure in the R&D effort or a development Project.	
28.	Employees with learning aptitude are given opportunity in development work.	
29.	We allow and compensate employees for working extra time on new ideas.	
30.	We have frequent brainstorming and creative group meetings.	
31.	We continuously make strategies to meet market requirements.	
32.	We have a good interaction with local and regional Educational Institutions.	
33.	Our Organisation motivates employees to think, review and generate new ideas.	
34.	Our employees are positive to development work and do not criticise failures.	
35.	New ideas stand little chance if not coming through a senior member of management.	
36.	Forecasting for new Products and Technology is regularly done in our Organisation.	

S. No.	Statement	Score 1 to 7
37.	We don’t hesitate taking ideas from outside or even from our competitors.	
38.	We have good relationship with professionals and consultants in the field of our activity.	
39.	New ideas are received favourably and are encouraged in our Organisation.	
40.	Organisation has adequate scientific technical manpower.	
41.	We have fewer personal conflicts in the Organisation.	
42.	We systematically and regularly compare our product with others.	
43.	Managers visit Trade Shows/Exhibitions to explore market trends and to identity new products.	
44.	We utilize services and expertise of Industrial R&D service Institutions.	
45.	The Organisation allocates adequate resources for development of new product or a processes.	
46.	Generally our employees are scared to take risks for fear of failure.	
47.	Our employees do not get demoralized by a failed innovative effort.	
48.	We build prototypes or undertake pilot process to speed up its adoption for mass production.	

SECTION – II

Following are the statements about some key elements of National system of Innovation in the local context of Punjab. Please put a score between 1 (= Very Poor) **to 5 (=** Excellent) **under the column of score:**

S. No.	**Statement**	**Score 1 to 5**
1.	Number and quality of education in the Schools of Punjab.	
2.	Number and quality of Vocational Training Institutes in Punjab.	
3.	Number and level of higher education in Colleges in the State of Punjab.	
4.	Number and level of higher education in Universities of Punjab.	
5.	Infrastructure for research work at the University level.	
6.	Presence of industrial associations related to manufacturing sector.	
7.	Number of Industrial R&D Centers and Research Institutions in the State of Punjab.	
8.	Number of Collaborative units and Joint Ventures in the Autoparts Manufacturing in Punjab.	
9.	Presence of licensee manufacturer for MNC's in Autoparts Manufacturing.	
10.	Role of CII, CICU, APEX Chamber, PHD Chamber of Commerce etc. in the State of Punjab.	
11.	Number of lead manufacturers in Autoparts Sector in the State of Punjab.	
12.	Manufacturers in the State of Punjab as OEM suppliers to domestic Automobile plants.	
13.	Autoparts manufacturers in Punjab as suppliers for domestic replacement / spare parts market.	
14.	Autoparts manufacturers in Punjab as suppliers to International OEM markets.	
15.	Autoparts Manufacturers as suppliers to International spare parts and replacement markets.	
16.	Quality and network of Roads in the State of Punjab.	
17.	Network of Railways in the State Punjab.	
18.	Air connectivity and Cargo Terminals in the State of Punjab.	

19.	Number and quality of In-land Container / Warehousing facilities to the Dry Ports in Punjab.	
20.	Quality and supply conditions of electrical power in the State of Punjab.	
21.	Availability of Schemes and incentives to Industry technological up-gradation.	
22.	Facilitation / Assistance Centres in Punjab State to take care of IPR issues.	
23.	Number and level of Science and Technology Institutions in Punjab.	
24.	Level of Govt. support for R&D funding to the Industry.	
25.	Availability of incentives for manufacturing of quality products.	
26.	Availability of incentives and Rewards for productivity and exports.	
27.	Role of MSME, DIC, NPC and S&T in organizing Technology Awareness Seminars.	
28.	Availability of Govt. support or sponsored training programme for Industrial manpower.	
29.	Availability of subsidy and incentives for acquiring imported technology/ special raw materials.	
30.	Govt. assistance to industry for participation/visit to international trade fairs/ exhibitions.	
31.	Functioning and access to financial markets in the State of Punjab.	
32.	Functioning and number of stock markets in Punjab.	
33.	Availability of finance through banks/financial Institutions for Entrepreneurs of Punjab.	
34.	Number and level of investment by NRIs in the Industrial Sector of Punjab.	
35.	Scope and facilities for Raising of equity or capital venture in Punjab.	
36.	Commitment and hardworking nature of the people of Punjab.	
37.	Proficiency and desire to learn new technologies by the Punjabis.	
38.	Competitive nature of Punjabis.	
39.	Risk taking capacity of the Punjabis.	
40.	The Openness and trust worthiness of Punjabis.	

ANNEXURE-II

Details of Small Scale Autoparts Manufacturing Industry included in the Survey

S. No.	Name of the SSI	Address	City/ Town	Respondent	Type of Industry
1.	Emson Gears,	D-42,Focal Point,	Ludhiana	Mr. Ashok Dhall, MD 9814020948	P/M
2.	Baba Gurmukh Singh Auto P.Ltd.	Phase– VIII, Focal Point	Ludhiana	Mr. Darshan Singh	P/M
3.	Akal Spring Ltd.,	A-8, Phase-V, Focal Point,	Ludhiana	Ms. Sandeep Riat, MD 9815555011	P/M
4.	Balwinder Mechanical Works	Indl. Area-C	Ludhiana	Mr. Balwinder Singh	P/M
5.	Carsil Auto Products Pvt. Ltd.,	D-48, Phase-V, Focal Point	Ludhiana	Mr. M.P. Singh 9815513700	PRO
6.	Engineers International			Mr. N.P. Singh	PRO
7.	Popular Engg. Co.	G.T. Road	Phagwara	Mr. Anil Sharma	P/M
8.	Estate Products (India)			Mr. Charan Singh Kohali	P/M
9.	G.S. Radiators Ltd.			Mr. Ranjodh Singh	P/M
10.	I.P. Foundry & Engg. Works,	1644/1, Deep Singh Nagar, Opp. Aarti Steel, Focal Point,	Ludhiana	Mr. Harminder Singh	PRO
11.	Precision Auto Engg.			Mr. Raj Kumar Gupta	P/M
12.	Kanwal Duroparts P. Ltd.			Mr. Bakshi Mahinder Singh	P/M
13.	Kwality Engg. Co.			Mr. Sujan Singh	P/M
14.	Kharay Induction Hardening	Vishwakarma Chowk,	Ludhiana	Mr. Gurdip Singh	PRO
15.	Moonlight Auto Pvt. Ltd.,	C-102/105, Phase-V, Focal Point,	Ludhiana	Mr. Rochak Bassi	P/M
16.	National Metal Inds,	Indl. Area-B, Plot No. 675, Link Road,	Ludhiana	Mr. Mandeep Singh Hardeep Singh	PRO
17.	Nexo Inds. Ltd.,	OverLock Road,	Ludhiana	Mr. Rajinder Singh	P/M
18.	Rishi International	E340, Phase-V-A, Focal Point,	Ludhiana	Mr. Rishi Gupta	SER
19.	Jaldhara Small Tools (P)Ltd.,	Kup, Malerkotla.	Kup.	Mr. Aman Jain,	SER
20.	Sovik Auto Pvt. Ltd.,	G.T. Road,	Ludhiana	Mr. M.S. Saini	PRO

		Dhandari Kalan,		Vikas Saini	
21.	Gusty Engineers	Zirakpur, Ahmedgarh Road,	Zirakpur	Mr. V.K. Saini	P/M
22.	P.S. Mechanical Works,	New Shimla Puri, Gali No. 4, Array Wali Gali, Daba Chowk,	Ludhiana	Mr. Paramjeet Singh	SER
23.	Udhey Fasteners,	4124/3A Guru Nanak, St. No. 6, Opp.ITI, Gill Road,	Ludhiana	Mr. Sukhjinder Singh	PRO
24.	Varun Malleable	F-68,Phase-VII, FocalPoint,	Ludhiana	Mr. V.K. Khullar	PRO
25.	Vira Industries,	C-73, Phase-V, Focal Point,	Ludhiana	Mr. Rajnish Jain, Mr. Varinder Jain,	P/M
26.	Bajajsons Ltd.,	C-103, Phase-V, Focal Point,	Ludhiana	Mr. S.P.Bajaj	P/M
27.	Sri Tools Industries	Focal Point,	Ludhiana	Mr. S.C. Ralhan	PRO
28.	Hi-Tech Castings	Sahnewal.	Ludhiana.	MD	PRO
29.	Nicks(India)Tools,	E-162-165, Phase-IV, Focal Point	Ludhiana	Mr. Surindra Mahendru, CEO	P/M
30.	Simbros Industries Pvt. Ltd.,	Single Cycle Road, Backside BigbenInds., Indl. Area-C,	Ludhiana	Mr. Ved Parkash,	P/M
31.	Shree Pal Clutch Pvt. Ltd.,	735, Indl. Area-B,	Ludhiana	Mr. Gian Singh Chawla, Mr. Harjit Singh Chawla	SER
32.	Saroop Sons Industries Limited,	C-62,Focal Point,	Ludhiana	Mr. Subhash Bajaj	P/M
33.	S.A. Mechanical Works	11028, St. No. 8, Partap Nagar,	Ludhiana	Mr. Azad Singh	PRO
34.	New Swan Auto Components (P)Ltd.,	622, Indl. Area-B,	Ludhiana	Mr. Upkar Singh, MD	P/M
35.	Nirmal Products	Jaspal Banger Road, Inl. Area-C, Near jaspal Kanda, Dhandari Kalan	Ludhiana	Mr. Anil Jindal Mr. Mahavir Jindal	P/M
36.	Mahendru Industries			Mr. Inder Singh	PRO
37.	Alamgir Industries (Regd.)	D-56, Phase-V, Focal Point,	Ludhiana	Mr. G.P. Singh / Mr.Manjit Singh	P/M
38.	Aman Metal Product Tool &Die Makker.	K-347, Ph-VIII	Ludhiana	Mr. Rajinder Singh	SER
39.	Allied Engineers,	C-64, Phase-V,	Ludhiana	Mr. Gurpreet Singh	P/M

		Focal Point,		Narula,	
40.	Auto International (India)	Indl. Area–C	Ludhiana	Mr. K.K. Dhingra	PRO
41.	Kapurthala Ind. Corp.	Indl. Estate	Ludhiana	Mr. Harminder Singh	PRO
42.	Krishna Engg.Works	Pathankot Road	Jalandhar	Mr. GS Juneja	P/M
43.	M KC Ind. Corp	Indl. Estate	Ludhiana	Mr. Maninder Singh	SER
44.	Multitech Professional Institute.		Ludhiana	Mr. Jatinder Datta	SER
45.	Super Spark India	581-B, Indl. Area-B,	Ludhiana	Mr. Kulbir Singh	SER
46.	Kangaroo Industries Ltd.,	Focal Point,	Ludhiana	Mr. S.K. Vadehra, Director Technical	P/M
47.	Samrat Forgings Ltd.,	SAS Nagar,	Derabassi	Mr. Prem Lal	PRO
48.	Accurate Tools Mfg. Co.,	E-305, Ph-IV-A, Focal Point,	Ludhiana		SER
49.	B.R.K. Industries	C-65, Phase-V, Focal Point,	Ludhiana	Mr. Bharpur Singh	P/M
50.	Crawler & Dumpers Auto Inds.	Sarabha Nagar, G.T. Road	Ludhiana	Mr. Surinder Singh	PRO
51.	Bharat International	C-27,Focal Point	Ludhiana	Mr. G.S. Kahlon	P/M
52.	Ravi Inds.,	Jassian Road,	Phillaur	Mr. Ankit.	P/M
53.	C-Forge			Mr. Sharanjit Singh	PRO
54.	Sonu Exports (India)	D-223, Phase-VII, Focal Point,	Ludhiana	Mr. Ram Lubhaya	PRO
55.	RN Gupta &Co. Ltd.,	Focal Point,	Ludhiana	Mr. M.B. Shivashankra F.D.	P/M
56.	Auto Pin Industries	3093, Station Road, Dhandari Kalan,	Ludhiana	Mr. Rakesh Ahuja Sh. Kunal Ahuja	PRO
57.	Canon Industries,	39-A, Textile Colony,	Ludhiana	Mr. Nitin Gupta, Mr. Balwant Rai Gupta	P/M
58.	Dashmesh Auto Engineers,	Plot2552, St. No. 3, Janta Nagar, Gill Road,	Ludhiana	Mr. Daljeet Singh	PRO
59.	Emson Products (India),	11445, St. No.2, PartapNagar	Ludhiana.	Mr. Mohan Singh Mr. Rajpal Singh	P/M
60.	Ess Ess AgroInds.,	549, Indl. Area-B, Near P.O. Miller Ganj,	Ludhiana	Mr. Sarbjit Singh	PRO
61.	New Swan Enterprises			Mr. Upkar Singh	P/M
62.	G.S. Auto Comp. Pvt.	GS Estate, Post	Ludhiana	Mr. Surinder Singh	PRO

	Ltd.,	Box No. 711, G.T. Road			
63.	Gaidu Auto Inds.,	3954, Shimlapuri, Daba Road, St. No. 11,	Ludhiana	Mr. Gurmeet Singh Gaidhu	PRO
64.	GDPA Fasteners	Near Raiwal Godown,	Jalandhar 144004	Mr. Yashraj Aggarwal	PRO
65.	Hindustan Expo	C-246, Phase-VIII, Focal Point,	Ludhiana	Mr. Baljit Sight Sethi	P/M
66.	Inder Industries	10133/1, St. No. 32, Janta Nagar,	Ludhiana	Mr. Inderpal Singh	PRO
67.	Mehta Sons Inds.	Nirankari St. No. 6, Miller Ganj,	Ludhiana	Mr. SurinderMehta	P/M
68.	M.T. Industries	D-267, Phase-VIII, FocalPoint,	Ludhiana	Mr. SumeetSingh	PRO
69.	SatbirProducts	G.T. Road, Gias Pura,	Ludhiana	Mr. Lakhbir Singh	P/M
70.	INDSHOK Pvt.Ltd,	C-182, Phase-VI, Focal Point,	Ludhiana	Mr. M.P. Singh	P/M
71.	J.B. Auto Engineers,	A-7,Indl. Estate,	Ludhiana	Mr. Bachan Singh	PRO
72.	Jai Gears Pvt.Ltd.,	A-8(A), Phase-V, Focal Point,	Ludhiana	Mr. Akhilesh Chauhan	P/M
73.	R-Tek Mould	St. No. 7, Hargobind Nagar,Sua Road, Near Jain Colony,	Ludhiana	Mr. Ravinder Singh	SER
74.	Gahir Auto Industries	Indl. Estate,	Ludhiana	Mr. Jagjit Singh	PRO
75.	Gemini Auto Industries	Indl. Area-A	Ludhiana	Mr. Daljit Singh Sahni	PRO
76.	Gita Forging	Focal Point,	Ludhiana	Mr. Girdhari Lal	PRO
77.	Goodwill Exports	Indl. Estate	Ludhiana	Mr. Baljit Singh	PRO
78.	A.L. Cold Forge Pvt. Ltd.,	E-23, Phase-IV, Focal Point,	Ludhiana	Mr. Jaswinder Singh	PRO
79.	Anand Forging & Stamping	Singla Cycle Road, Dhandari Kalan,	Ludhiana.	Mr. Jaideep Singh	PRO
80.	J.S. Heat Treatment	10555, St. No. 9, PartapNagar,	Ludhiana	Mr. Gurmukh Singh	SER
81.	Kahlon International			Mrs. Pritam Kaur	P/M
82.	Imperial Bolts & Fasteners,	922-Indl. Area-B,	Ludhiana		PRO
83.	Jay Kay Forging,	Inds. Area ‘C’,	Ludhiana	Mr. Avtar Singh	PRO

		Jaspal Bhangar Road, Guru Kirpa Colony,			
84.	Miglani Auto Agencies,	Mann Nagar, St No. 2, Near Nirmal Palace, Daba Road,	Ludhiana	Mr. Aman Miglani Mr. R.N. Miglani	PRO
85.	N.S. Foundry Works	St. No. 6, New Janta Nagar,	Ludhiana	Mr. Shree Ram	PRO
86.	Pumco Inds.	St. No. 7, Partap Nagar,	Ludhiana	Mr. Raghbir Singh	P/M
87.	Sekhon Forgings,	E-72, Phase-IV, Indl. Shed, Focal Point,	Ludhiana	Mr. Gurdev Singh	PRO
88.	Nim Indl. Corp.	Partap Chowk, 1st Lane, Near Sangeet Cinema	Ludhiana	Mr. B.K. Mahajan	P/M
89.	Perfect Inds.(India)	C-65, Phase-V, Focal Point,	Ludhiana.	Mr. Maninder Singh	P/M
90.	Yashka Stamping	D-353, Phase-VIII, Focal Point,	Ludhiana	Mr. Sumit Bajaj	PRO
91.	Nim Ind. Corp.			Mr. Parveen Mahajan	P/M
92.	Flying International	E353, Phase-VI, Focal Point	Ludhiana	Mr. Gurmit Singh	P/M
93.	Balwindera Tools Pvt. Ltd.,	Ind. AreaC, Sua Road, Near Eastman Chowk, Dhandari Kalan	Ludhiana	Mr. Balwinder Singh Mr.MandeepSingh	PRO
94.	Rajesh Fasteners,	10568/1, St. No. 6, PartapNagar,	Ludhiana	Mr. Rajesh Kumar	PRO
95.	Shiv Auto Bolt,	611-Vishavkarma Puri, St. No. 1, GillRoad,	Ludhiana	Mr.Subash Chander	PRO
96.	WarriorFasteners	E-339, Phase-IV-A, Focal Point,	Ludhiana	Mr. Madan Mohan	PRO
97.	Happy Forgings Ltd.,	Kanganwal Road, P.O. Jugiana,	Ludhiana	Mr. N.S. Juneja	PRO
98.	S.S. Engineering Works,	349, Indl. Area-A,	Ludhiana	Mr. Sham Lal	PRO
99.	R.K. Cast & Forge,	G.T. Road, Dhandari Kalan,	Ludhiana	Mr. Anubhav Goyal	PRO
100.	Deepak Fasteners	E536, Phase-VI,	Ludhiana	Mr. Sanjeev Kalra	P/M

	Ltd.,	Focal Point,		Mr. Deepak Kalra	
101.	Duwel Exports,	9, Indl. Area,	Phagwara	Er. A.K. Kholi	P/M
102.	RKDie Manufacturers		Ludhiana	Mr. Rattan Kumar	SER
103.	Ubhi Engineers,	19-B, Indl. Estate,	Ludhiana	Mr. Harbans Singh Ubhi,	P/M
104.	Sohal Indl. Corp.,	Guru Vihar, Rahon Road,	Ludhiana	Mr. K.S. Sohal,	PRO
105.	Panesar Engineers,	St. No. 2, Opp. Kamal Dharam Kanda, Sua Road, Giaspur,	Ludhiana	Mr. Gurmail Singh	SER
106.	Gagan Tracto Inds,	C-26,Focal Point,	Ludhiana	Mr. Jashandeep Singh	P/M
107.	Texlene Forging,	Vil. Jandiali,	Kohara	Mr. RaviKant	PRO
108.	Sobti Auto Engineers,	Indl. Area,	Phagwara	Mr. Subod Kant Sobti.	P/M
109.	B.H. Engineers,	K-185, Ph-VIII, FocalPoint,	Ludhiana	Mr. Prithpal Singh	SER
110.	Rattan Mechanical Works,	H-6, Sarabha Nagar, Opp PAU Gate No. 2, Ferozepur Road,	Ludhiana	.Mr. Balwinder Singh Rattan,	SER

P/M: Product Manufacturer
PRO: Processing Unit
SER: Service Provider

Table 5.2 Role and Responsibilities of Different Levels of Respondents working in Industry Support Institutions in Punjab.

S.No.	Name of the Industry Support Institution	Level of the respondent	Role & Responsibility Area
1.	Central Tool Room ,Ludhiana	General Manager Manager Training Manager Tool Room	Chief Executive Of the Institute To plan and monitor conduct of Skill training Programs To plan & monitor manufacturing of Tool & Dies, quality Control, Heat Treatment & New developments
2.	Central Institute for Hand Tools, Jalandhar	General Manager Manager Training Manager Technical	Chief Executive Of the Institute To plan and monitor conduct of Skill training Programs To Supervise Manufacturing of Tool & Dies, Forge Shop, Heat treatment and Laboratories
3.	Central Institute for Plastic Engineering and Technology, Amritsar	General Manager Senior Manager Manager Technical	Chief Executive Of the Institute To plan and monitor conduct of Skill training, Quality Control and Labs. To plan and monitor manufacturing of Mould and Dies for Plastic Products & New Developments
4.	Research and Development Centre for Bicycle & Sewing Machine, Ludhiana	General Manager Manager Training Manager Technical	Chief Executive Of the Institute Skill Training Programs and Operation of Laboratories Responsible for Design, Tool room Common Facility and Manufacturing of Special Purpose Machines.
5.	Institute for Machine Tools Technology, Batala	General Manager Assistant Gen. Manager Dy. Manager Technical	Chief Executive Of the Institute Marketing , Consultancy and Accounting Plan and Monitor manufacturing of Tools & Dies, Heat Treatment, quality control, Design and Laboratories.
6.	Institute for Autoparts and Hand Tools Technology, Ludhiana	General Manager Dy. Manager Technical Asst. Manager Technical	Chief Executive Of the Institute Responsible for operation of Testing & Calibration Labs, Heat Treatment, Admn & Marketing. Plan and Monitor activities in Design, Tool Room, Skill Training and Common Facilities.

Descriptives

Descriptive Statistics

	N	Mean		Std. Deviation	Variance
	Statistic	Statistic	Std. Error	Statistic	Statistic
SS1	110	2.564	.1013	1.0625	1.129
SS7	110	2.209	.1156	1.2123	1.470
SS13	110	2.018	.1073	1.1250	1.266
SS19	110	2.991	.1269	1.3306	1.771
SS25	110	5.173	.1565	1.6415	2.695
SS31	110	5.200	.1396	1.4639	2.143
SS37	110	4.000	.1252	1.3133	1.725
SS43	110	3.464	.1606	1.6847	2.838
Strategy	110	3.45227	.097735	1.025056	1.051
OO3	110	2.564	.1621	1.7001	2.890
OO9	110	2.809	.1563	1.6395	2.688
OO15	110	5.255	.1492	1.5647	2.448
OO21	110	5.291	.1268	1.3296	1.768
OO27	110	5.209	.1343	1.4083	1.983
OO35	110	4.673	.1212	1.2715	1.617
OO39	110	4.291	.1514	1.5875	2.520
OO45	110	2.936	.1805	1.8929	3.583
Orgn	110	4.12841	.127482	1.337045	1.788
HH5	110	5.318	.1162	1.2186	1.485
HH11	110	3.000	.1539	1.6142	2.606
HH17	110	2.964	.1885	1.9766	3.907
HH23	110	4.091	.1922	2.0162	4.065
HH29	110	4.145	.1746	1.8316	3.355
HH33	110	4.591	.2047	2.1473	4.611
HH41	110	4.636	.1094	1.1472	1.316
HH47	110	3.636	.1543	1.6183	2.619
HR	110	4.04773	.136864	1.435440	2.060
PP6	110	4.400	.1157	1.2131	1.472
PP12	110	2.500	.1224	1.2833	1.647
PP18	110	2.473	.1365	1.4317	2.050
PP24	110	2.518	.1510	1.5839	2.509
PP30	110	2.545	.0997	1.0461	1.094
PP36	110	1.900	.1323	1.3877	1.926
PP42	110	4.082	.1286	1.3487	1.819
PP48	110	2.336	.1393	1.4607	2.134

Descriptive Statistics

	N	Mean		Std. Deviation	Variance
	Statistic	Statistic	Std. Error	Statistic	Statistic
PRO	110	2.84432	.109581	1.149290	1.321
GG2	110	4.66	.150	1.575	2.482
GG8	110	4.86	.159	1.673	2.798
GG14	110	4.80	.136	1.426	2.033
GG20	110	2.87	.131	1.375	1.892
GG26	110	2.41	.120	1.258	1.583
GG32	110	3.59	.106	1.111	1.235
GG38	110	4.22	.188	1.969	3.879
GG44	110	4.28	.189	1.987	3.947
Group	110	3.96250	.121227	1.271439	1.617
II4	110	3.99	.150	1.577	2.486
II10	110	3.68	.147	1.538	2.366
II16	110	4.65	.196	2.052	4.213
II22	110	3.24	.184	1.930	3.723
II28	110	4.71	.156	1.639	2.685
II34	110	4.53	.173	1.811	3.279
II40	110	2.88	.137	1.432	2.050
II46	110	4.60	.151	1.587	2.517
Indv	110	4.03409	.132853	1.393373	1.941
Valid N (listwise)	110				

Descriptives

Descriptive Statistics

	N	Mean		Std. Deviation	Variance
	Statistic	Statistic	Std. Error	Statistic	Statistic
E1	110	3.945	.0590	.6183	.382
E2	110	3.8878	.07536	.79037	.625
E3	110	2.018	.0847	.8881	.789
E4	110	2.018	.0876	.9185	.844
E5	110	1.5485	.06437	.67512	.456
EDU	110	2.68362	.064897	.680646	.463
SC1	110	3.473	.0750	.7865	.619
SC2	110	3.491	.0956	1.0022	1.005
SC3	110	1.873	.0743	.7794	.608
SC4	110	1.545	.0928	.9734	.947
SC5	110	1.327	.0720	.7555	.571
SCI	110	2.342	.0691	.7246	.525
M1	110	1.273	.0562	.5890	.347
M2	110	3.182	.0994	1.0421	1.086
M3	110	3.736	.0422	.4426	.196
M4	110	1.173	.0445	.4665	.218
M5	110	1.427	.0652	.6835	.467
MKT	110	2.158	.0467	.4900	.240
INF1	110	3.945	.0694	.7274	.529
INF2	110	3.891	.0663	.6953	.483
INF3	110	1.736	.0901	.9451	.893
INF4	110	1.891	.0624	.6545	.428
INF5	110	1.718	.0634	.6654	.443
INFRA	110	2.636	.0589	.6173	.381
FIN1	110	2.964	.1088	1.1408	1.301
FIN2	110	2.818	.1105	1.1588	1.343
FIN3	110	2.718	.1042	1.0932	1.195
FIN4	110	1.255	.0555	.5816	.338
FIN5	110	2.182	.0959	1.0062	1.013
FINFRA	110	2.387	.0730	.7659	.587
N1	110	3.809	.0842	.8830	.780
N2	110	3.664	.0986	1.0341	1.069
N3	110	2.582	.0811	.8501	.723
N4	110	3.800	.1117	1.1715	1.372
N5	110	1.355	.0614	.6438	.414
NET	110	3.042	.0798	.8372	.701
CL1	110	3.727	.0741	.7771	.604

Descriptive Statistics

	N	Mean		Std. Deviation	Variance
	Statistic	Statistic	Std. Error	Statistic	Statistic
CL2	110	3.764	.0795	.8342	.696
CL3	110	3.845	.0551	.5777	.334
CL4	110	3.618	.0753	.7896	.624
CL5	110	3.473	.1039	1.0896	1.187
CULTURE	110	3.685	.0368	.3855	.149
ICN1	110	2.282	.0709	.7436	.553
ICN2	110	1.955	.0735	.7709	.594
ICN3	110	2.418	.0860	.9024	.814
ICN4	110	1.609	.0743	.7793	.607
ICN5	110	2.645	.1130	1.1854	1.405
INCENTIVE	110	2.182	.0631	.6617	.438
Valid N (listwise)	110				

Annexure - IV

SPS OUTPUT

```
FACTOR
  /VARIABLES E1 E2 E3 E4 E5 SC1 SC2 SC3 SC4 SC5 M1 M2 M3 M4 M5 INF1 INF2 INF
  /MISSING LISTWISE
  /ANALYSIS E1 E2 E3 E4 E5 SC1 SC2 SC3 SC4 SC5 M1 M2 M3 M4 M5 INF1 INF2 INF3
  /PRINT INITIAL DET KMO EXTRACTION ROTATION
  /FORMAT BLANK(.10)
  /PLOT EIGEN
  /CRITERIA FACTORS(3) ITERATE(25)
  /EXTRACTION PC
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /SAVE REG(ALL)
  /METHOD=CORRELATION.
```

Factor Analysis

Notes

Output Created		07-SEP-2014 21:19:09
Comments		
Input	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	110
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.

Notes

Syntax		FACTOR /VARIABLES E1 E2 E3 E4 E5 SC1 SC2 SC3 SC4 SC5 M1 M2 M3 M4 M5 INF1 INF2 INF3 INF4 INF5 FIN1 FIN2 FIN3 FIN4 FIN5 N1 N2 N3 N4 N5 CL1 CL2 CL3 CL4 CL5 ICN1 ICN2 ICN3 ICN4 ICN5 /MISSING LISTWISE /ANALYSIS E1 E2 E3 E4 E5 SC1 SC2 SC3 SC4 SC5 M1 M2 M3 M4 M5 INF1 INF2 INF3 INF4 INF5 FIN1 FIN2 FIN3 FIN4 FIN5 N1 N2 N3 N4 N5 CL1 CL2 CL3 CL4 CL5 ICN1 ICN2 ICN3 ICN4 ICN5 /PRINT INITIAL DET KMO EXTRACTION ROTATION /FORMAT BLANK(.10) /PLOT EIGEN /CRITERIA FACTORS(3) ITERATE(25) /EXTRACTION PC /CRITERIA ITERATE(25) /ROTATION VARIMAX /SAVE REG(ALL) /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.45
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	Maximum Memory Required	196056 (191.461K) bytes
Variables Created	FAC1_2	Component score 1
	FAC2_2	Component score 2
	FAC3_2	Component score 3

[DataSet1]

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.920
Bartlett's Test of Sphericity	Approx. Chi-Square	4643.707
	df	780
	Sig.	.000

Communalities

	Initial	Extraction
E1	1.000	.740
E2	1.000	.549
E3	1.000	.793
E4	1.000	.753
E5	1.000	.772
SC1	1.000	.588
SC2	1.000	.661
SC3	1.000	.757
SC4	1.000	.694
SC5	1.000	.712
M1	1.000	.689
M2	1.000	.812
M3	1.000	.209
M4	1.000	.704
M5	1.000	.806
INF1	1.000	.757
INF2	1.000	.666
INF3	1.000	.681
INF4	1.000	.790
INF5	1.000	.689
FIN1	1.000	.706
FIN2	1.000	.615
FIN3	1.000	.580
FIN4	1.000	.321
FIN5	1.000	.690
N1	1.000	.717
N2	1.000	.895
N3	1.000	.832
N4	1.000	.804
N5	1.000	.831
CL1	1.000	.033
CL2	1.000	.484
CL3	1.000	.043
CL4	1.000	.113
CL5	1.000	.640
ICN1	1.000	.722
ICN2	1.000	.299
ICN3	1.000	.676

Communalities

	Initial	Extraction
ICN4	1.000	.530
ICN5	1.000	.675

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	20.379	50.949	50.949	20.379	50.949	50.949
2	2.875	7.188	58.136	2.875	7.188	58.136
3	1.771	4.428	62.564	1.771	4.428	62.564
4	1.574	3.936	66.501			
5	1.422	3.556	70.057			
6	1.266	3.166	73.223			
7	1.070	2.676	75.899			
8	1.064	2.660	78.558			
9	.975	2.437	80.996			
10	.792	1.979	82.975			
11	.745	1.862	84.837			
12	.702	1.755	86.592			
13	.496	1.241	87.832			
14	.464	1.160	88.993			
15	.456	1.141	90.134			
16	.386	.964	91.098			
17	.368	.921	92.019			
18	.339	.846	92.865			
19	.293	.734	93.599			
20	.252	.630	94.229			
21	.229	.573	94.801			
22	.198	.494	95.296			
23	.194	.485	95.781			
24	.184	.460	96.241			
25	.173	.432	96.673			
26	.148	.371	97.043			
27	.143	.358	97.401			
28	.136	.339	97.740			
29	.123	.307	98.047			
30	.113	.282	98.329			

Total Variance Explained

Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	14.356	35.890	35.890
2	7.733	19.332	55.222
3	2.937	7.342	62.564
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
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22			
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24			
25			
26			
27			
28			
29			
30			

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
31	.102	.254	98.584			
32	.096	.239	98.823			
33	.085	.212	99.035			
34	.078	.195	99.230			
35	.073	.182	99.412			
36	.060	.149	99.562			
37	.054	.135	99.697			
38	.047	.118	99.815			
39	.042	.106	99.920			
40	.032	.080	100.000			

Total Variance Explained

Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
31			
32			
33			
34			
35			
36			
37			
38			
39			
40			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

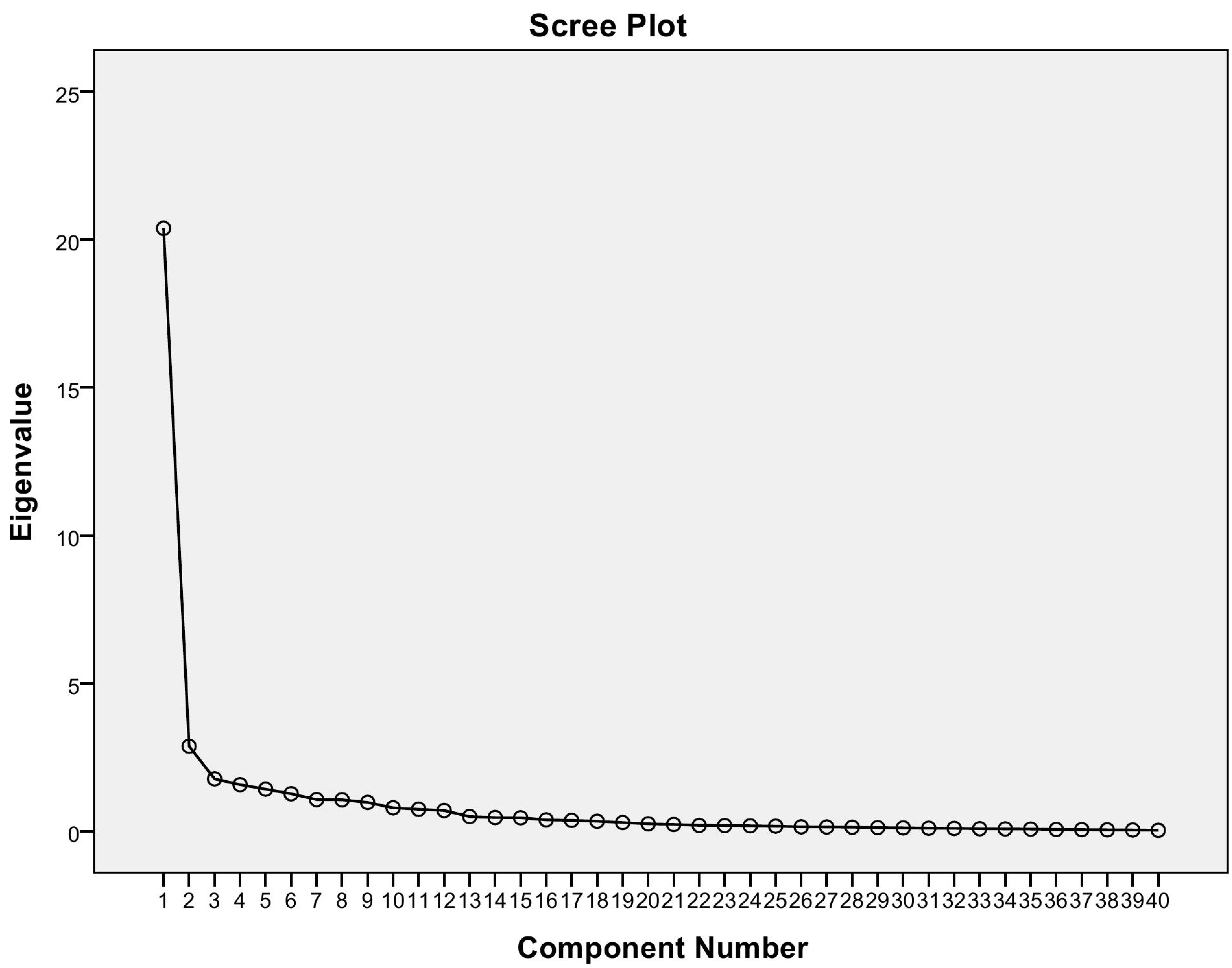
	Component		
	1	2	3
E1	.857		
E2	.735		
E3	.890		
E4	.866		
E5	.812		-.335
SC1	.725	-.241	
SC2	.813		
SC3	.844	-.175	-.115
SC4	.768	-.301	.115
SC5	.770	-.213	-.272
M1	.641	-.527	
M2	.875	.214	
M3	.204	-.256	.318
M4	.676	-.478	.136
M5	.738	-.505	
INF1	.870		
INF2	.814		
INF3	.801		-.196
INF4	.725		.508
INF5	.802		-.206
FIN1	.757	.364	
FIN2	.594	.471	.200
FIN3	.585	.465	.146
FIN4	.486		.291
FIN5	.744	.324	-.175
N1	.819	-.134	-.170
N2	.939		
N3	.851	-.303	-.126
N4	.877		.185
N5	.828	-.108	-.367
CL1	.158		
CL2	.604	-.119	.324
CL3		-.144	.124
CL4	.133	.141	.275
CL5	.305	.546	-.499
ICN1	.728	.408	.160
ICN2	.386	.290	.257

Component Matrix[a]

	Component		
	1	2	3
ICN3	.636	.487	.184
ICN4	.700		.198
ICN5	.709	.342	-.236

Extraction Method: Principal Component Analysis.

a. 3 components extracted.



Rotated Component Matrix[a]

	Component		
	1	2	3
E1	.676	.479	.232
E2	.560	.435	.214
E3	.719	.490	.191
E4	.684	.488	.218
E5	.835	.263	
SC1	.636	.253	.345
SC2	.658	.453	.152
SC3	.801	.279	.192
SC4	.666	.258	.429
SC5	.828	.140	
M1	.676		.482
M2	.670	.603	
M3			.440
M4	.635		.541
M5	.798		.411
INF1	.706	.470	.193
INF2	.696	.387	.177
INF3	.758	.325	
INF4	.325	.680	.471
INF5	.737	.381	
FIN1	.507	.664	
FIN2	.245	.744	
FIN3	.265	.710	
FIN4	.257	.397	.311
FIN5	.595	.546	-.193
N1	.794	.268	.121
N2	.834	.422	.145
N3	.851	.188	.269
N4	.624	.571	.298
N5	.889	.200	
CL1	.140	.101	
CL2	.374	.394	.434
CL3			.200
CL4		.299	.138
CL5	.323	.313	-.661
ICN1	.393	.753	
ICN2	.102	.531	

Rotated Component Matrix[a]

	Component		
	1	2	3
ICN3	.282	.770	
ICN4	.483	.457	.296
ICN5	.590	.512	-.256

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 8 iterations.

Component Transformation Matrix

Component	1	2	3
1	.819	.540	.195
2	-.308	.700	-.645
3	-.484	.468	.739

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

```
RELIABILITY
 /VARIABLES=E1 E2 E3 E4 E5 SC1 SC2 SC3 SC4 SC5 M1 M2 M3 M4 M5 INF1 INF2 INF
 /SCALE('ALL VARIABLES') ALL
 /MODEL=ALPHA
 /STATISTICS=DESCRIPTIVE SCALE
 /SUMMARY=TOTAL.
```

Reliability

Notes

Output Created		07-SEP-2014 21:21:43
Comments		
Input	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	110
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=E1 E2 E3 E4 E5 SC1 SC2 SC3 SC4 SC5 M1 M2 M3 M4 M5 INF1 INF2 INF3 INF4 INF5 FIN1 FIN2 FIN3 FIN4 FIN5 N1 N2 N3 N4 N5 CL1 CL2 CL3 CL4 CL5 ICN1 ICN2 ICN3 ICN4 ICN5 /SCALE('ALL VARIABLES') ALL /MODEL=ALPHA /STATISTICS=DESCRIPTIVE SCALE /SUMMARY=TOTAL.
Resources	Processor Time	00:00:00.06
	Elapsed Time	00:00:00.09

[DataSet1]

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	110	100.0
	Excluded[a]	0	.0
	Total	110	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.970	40

Item Statistics

	Mean	Std. Deviation	N
E1	3.9455	.61832	110
E2	3.8878	.79037	110
E3	2.0182	.88806	110
E4	2.0182	.91853	110
E5	1.5485	.67512	110
SC1	3.4727	.78646	110
SC2	3.4909	1.00225	110
SC3	1.8727	.77943	110
SC4	1.5455	.97337	110
SC5	1.3273	.75552	110
M1	1.2727	.58903	110
M2	3.1818	1.04207	110
M3	3.7364	.44262	110
M4	1.1727	.46647	110
M5	1.4273	.68348	110
INF1	3.9455	.72740	110
INF2	3.8909	.69527	110
INF3	1.7364	.94507	110
INF4	1.8909	.65449	110
INF5	1.7182	.66542	110
FIN1	2.9636	1.14080	110
FIN2	2.8182	1.15879	110
FIN3	2.7182	1.09320	110
FIN4	1.2545	.58162	110
FIN5	2.1818	1.00624	110
N1	3.8091	.88302	110
N2	3.6636	1.03407	110
N3	2.5818	.85006	110
N4	3.8000	1.17153	110
N5	1.3545	.64376	110
CL1	3.7273	.77707	110
CL2	3.7636	.83421	110
CL3	3.8455	.57766	110
CL4	3.6182	.78963	110
CL5	3.4727	1.08964	110
ICN1	2.2818	.74356	110
ICN2	1.9545	.77087	110
ICN3	2.4182	.90241	110

Item Statistics

	Mean	Std. Deviation	N
ICN4	1.6091	.77927	110
ICN5	2.6455	1.18543	110

Reliability

Notes

Output Created		07-SEP-2014 21:22:11
Comments		
Input	Active Dataset	DataSet1
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	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	110
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.
Syntax		RELIABILITY /VARIABLES=E1 E2 E3 E4 E5 SC1 SC2 SC3 SC4 SC5 M1 M2 M3 M4 M5 INF1 INF2 INF3 INF4 INF5 FIN1 FIN2 FIN3 FIN4 FIN5 N1 N2 N3 N4 N5 CL1 CL2 CL3 CL4 CL5 ICN1 ICN2 ICN3 ICN4 ICN5 /SCALE('ALL VARIABLES') ALL /MODEL=SPLIT /STATISTICS=DESCRIPTIVE SCALE /SUMMARY=TOTAL.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.03

[DataSet1]

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	110	100.0
	Excluded[a]	0	.0
	Total	110	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Part 1	Value	.965
		N of Items	20[a]
	Part 2	Value	.923
		N of Items	20[b]
	Total N of Items		40
Correlation Between Forms			.888
Spearman-Brown Coefficient	Equal Length		.940
	Unequal Length		.940
Guttman Split-Half Coefficient			.940

a. The items are: E1, E2, E3, E4, E5, SC1, SC2, SC3, SC4, SC5, M1, M2, M3, M4, M5, INF1, INF2, INF3, INF4, INF5.

b. The items are: FIN1, FIN2, FIN3, FIN4, FIN5, N1, N2, N3, N4, N5, CL1, CL2, CL3, CL4, CL5, ICN1, ICN2, ICN3, ICN4, ICN5.

Scale Statistics

	Mean	Variance	Std. Deviation	N of Items
Part 1	49.0999	142.573	11.94041	20[a]
Part 2	56.4818	137.353	11.71976	20[b]
Both Parts	105.5817	528.347	22.98580	40

a. The items are: E1, E2, E3, E4, E5, SC1, SC2, SC3, SC4, SC5, M1, M2, M3, M4, M5, INF1, INF2, INF3, INF4, INF5.

b. The items are: FIN1, FIN2, FIN3, FIN4, FIN5, N1, N2, N3, N4, N5, CL1, CL2, CL3, CL4, CL5, ICN1, ICN2, ICN3, ICN4, ICN5.

```
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS R ANOVA COLLIN TOL
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT Innoscore
  /METHOD=ENTER FAC1_1 FAC2_1 FAC3_1.
```

Regression

Notes

Output Created		07-SEP-2014 21:37:29
Comments		
Input	Active Dataset	DataSet1
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	Weight	<none>
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	N of Rows in Working Data File	110
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS R ANOVA COLLIN TOL /CRITERIA=PIN(.05) POUT(.10) /NOORIGIN /DEPENDENT Innoscore /METHOD=ENTER FAC1_1 FAC2_1 ...
Resources	Processor Time	00:00:00.06
	Elapsed Time	00:00:00.06
	Memory Required	2908 bytes
	Additional Memory Required for Residual Plots	0 bytes

```
[DataSet1]
```

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	REGR factor score 3 for analysis 1, REGR factor score 2 for analysis 1, REGR factor score 1 for analysis 1[b]	.	Enter

a. Dependent Variable: InnoScore

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.962[a]	.925	.923	5.49027

a. Predictors: (Constant), REGR factor score 3 for analysis 1, REGR factor score 2 for analysis 1, REGR factor score 1 for analysis 1

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	39294.576	3	13098.192	434.534	.000[b]
	Residual	3195.168	106	30.143		
	Total	42489.744	109			

a. Dependent Variable: InnoScore

b. Predictors: (Constant), REGR factor score 3 for analysis 1, REGR factor score 2 for analysis 1, REGR factor score 1 for analysis 1

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	45.325	.523		86.584	.000
	REGR factor score 1 for analysis 1	16.204	.526	.821	30.814	.000
	REGR factor score 2 for analysis 1	8.645	.526	.438	16.439	.000
	REGR factor score 3 for analysis 1	4.816	.526	.244	9.159	.000

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	REGR factor score 1 for analysis 1	1.000	1.000
	REGR factor score 2 for analysis 1	1.000	1.000
	REGR factor score 3 for analysis 1	1.000	1.000

a. Dependent Variable: InnoScore

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	REGR factor score 1 for analysis 1	REGR factor score 2 for analysis 1	REGR factor score 3 for analysis 1
1	1	1.000	1.000	.00	.39	.61	.00
	2	1.000	1.000	.00	.00	.00	1.00
	3	1.000	1.000	.00	.61	.39	.00
	4	1.000	1.000	1.00	.00	.00	.00

a. Dependent Variable: InnoScore

LIST OF RESEARCH PUBLICATIONS

Publications in International Journals
• **Sangha B.S**, Singh T.P. and Batish Ajay (2013). *Industry support institutions fostering innovations culture among SME's of Punjab, India*: A Strategic Perspective. Asian Journal of Technology Management Vol. 6 No. 1 (2013): 37-48.
Publications in National Journals
• **Sangha B.S**, Singh T.P. and Batish Ajay (2014). *Development of a Model to Foster Innovation Culture; A Study of Small Scale Autoparts Manufacturing Industry of Punjab.* International Journal of Commerce and Business Management Vol. 7 No. 2, Oct, 2014. Accepted vide No. IJCBM/40/14 Dated 19/07/2014.
Publications in International Conferences
• **Sangha B.S**, Singh T.P. and Batish Ajay (2008) *Development of a Model for fostering innovation culture in small scale autoparts manufacturing industry of Punjab* In; Proceedings of Glogift 08 Eight Global Conference of Global Institutes of flexible system Management held at Stevens Institute of technology New Jersey, USA, June 14-16 2008. pp1-9.
• **Sangha B.S**, Singh T.P. and Batish Ajay (2012). *An Assessment of Regional Innovation System among small scale autoparts industry of Punjab*. In: Proceedings of VII Annual International Conference of Knowledge forum held on Nov 30-Dec 2, 2012 at Symbiosis International University, Pune, India. pp 117-145.
• **Sangha B.S**, Singh T.P., Batish Ajay and Amandeep Sangha (2014). *Regional Innovation System (RIS) complementing Innovativeness and Competitiveness of Indian Auto-Components SMEs; paper accepted after the comments of review for ELLTA – 2014* Exploring Leadership & Learning Theories in Asia being held at Universiti Sains Malaysia. Nov-17, 2014.