UNDERSTANDING INNOVATION

INDIAN NATIONAL INNOVATION SURVEY

With special focus on MSMEs

2014

National Science and Technology Management Information System (NSTMIS), Department of Science and Technology, Govt.of India, New Delhi

CSIR-National Institute of Science, Technology and Development Studies (NISTADS), New Delhi

Understanding Innovation
Indian National Innovation Survey

Report of the project Sponsored by NSTMIS, Department of Science and Technology
Govt. of India, New Delhi

Project Team

Pradosh Nath,N. Mrinalini, G.D. Sandhya

Knowledge Partner

ParveenArora, Advisor, NSTMIS, DST

Research Team

Praveen Rawat, DebanjanaDey
Roshan Kumar, Sanjay Kumar

Cover Design

Debasish Mukherjee

CSIR-National Institute of Science, Technology And Development Studies (NISTADS), New Delhi

Reference: Title of the Publication (Year). National Science and Technology Management Information System (NSTMIS), Department of Science and Technology (DST), Government of India.

Citation: In-text: **(NSTMIS,DST GoI Year)**

Disclaimer

Despite our best efforts some unintentional errors may have still crept in while processing and interpreting large volume of field data. The project team and research team are solely responsible for any such unintentional errors. Neither DST nor CSIR-NISTADS would be held responsible for the same.

सत्यमेव जयते

के. विजयराघवन
K. VijayRaghavan

सचिव
भारत सरकार
विज्ञान और प्रौद्योगिकी मंत्रालय
विज्ञान और प्रौद्योगिकी विभाग
टेक्नोलाजी भवन, नया मेहरौली मार्ग, नई दिल्ली - 110016

SECRETARY
Government of India
Ministry of Science and Technology
Department of Science and Technology
Technology Bhavan, New Mehrauli Road, New Delhi - 110016

FOREWORD

National Science Technology Management Information System (NSTMIS), Department of Science and Technology (DST) has been continuously engaged in the evidence generation and analysis on Science, Technology and Innovation (STI) resources for evidence based policy planning for S&T sector in the country.

As a part of the new initiative Science, Technology, Innovation and Creation of Knowledge (STICK), a National Innovation Survey framework has been conceptualized and designed through in-depth discussions with the national and international experts for launching the National Innovation Survey. As a step forward, a national report entitled "Understanding Innovation: Indian National Innovation Survey" with special focus on MSMEs has been brought out recently by DST.

The national report, first of its kind, benchmarks innovation potentiality of Indian firms in terms of innovation activities, sources of innovation, linkages, human resource, effects and factors affecting innovation activities. The report is based on the analysis of sample survey of 9001 firms, largely MSMEs, spread across 26 states and 5 Union Territories across various industrial sectors in the country.

A commendable effort has been made by the DST and CSIR-NISTADS project team to put together fundamental issues related to innovations in the context of developing economies to make this report useful to policy makers, planners and the scientific community.

I hope the report, as a unique initiative, would provide required impetus in devising evidence based policy prescriptions or recommendations for strengthening the innovation infrastructure and growth of MSMEs in the country.

K. VijayRaghavan

Prof. K. VijayRaghavan
Secretary

New Delhi
November, 2014

Acknowledgement

The project team at NISTADS would like to thank NSTMIS, DST for generous support and encouragement in addition to knowledge support for carrying out this important study. The team also would like to acknowledge the administrative and infrastructure support provided by CSIR-NISTADS.

Contents

	Page Number
Acknowledgement	I
Abbreviation and Terminologies used	III - IX
Figures and Tables description	XI - XXII
Executive Summary	XXIII - XXXIV
Overall observations in brief	XXXV - XXXVI
Introduction	1 - 9
• A. Framework: Measuring Innovation .... 1 - 5	
• B. Theoretical Understanding and Chapterisation .... 6 - 9	
Chapter I - Innovative Firms	11 - 25
Chapter II - Size and Innovation	27 - 41
Chapter III - Age and Innovation	43 - 56
Chapter IV - Ownership type and Innovation	57 - 70
Chapter V - Types of Innovation..	71 - 88
Chapter VI - R&D and Non-R&D Innovative firm	89 - 100
Chapter VII - Non-technological Innovations	101 - 112
Chapter VIII - Barriers to Innovation	113 - 144
Chapter IX - States and Innovation by firms	145 - 173
Chapter X - Sectors and Innovation by firms	175 - 202
Chapter XI - Understanding Innovation	203 - 211
Chapter XII - International Comparison	213 - 221
Chapter XIII - Summary, discussion and policy implication	223 - 226
Annexure I - State Profile and Union Territory Profile	227 - 292
Annexure II - Data Sources and Methodology of the Survey	293 - 304
Annexure III - Innovation Survey: A Cross Country Comparison	305 - 312

Abbreviations

APCTT – Asian Pacific Centre for Transfer of Technology
BDO – Block Development Officer
BRICS - Brazil, Russia, India, China and South Africa
CAPART – Council for Advancement of People's Action and Rural Technology
CFTS – Cash for Financial and Technical Services
CGMSE – Credit Guarantee Fund Scheme for Micro & Small Enterprises
CGTMSE – Credit Guarantee Fund Trust for Micro and Small Enterprises
CIIE – Centre for Innovation, Incubational Entrepreneurship
CMTI – Central Manufacturing Technology Institute
CSR – Corporate Social Responsibility
CSIR – Council of Scientific and Industrial Research
DAE – Department of Atomic Energy
DIC – District Industry Centre
DOS – Department of Space
DRDA – District Rural Development Agency
DC –Development Commissioner
DSIR – Department of Scientific and Industrial Research
DST – Department of Science and Technology
EDI – Entrepreneurship Development Institute
FDI – Foreign Direct Investment
FICCI – Federation of Indian Chamber of commerce and Industry
FWWB – Friends of Women's World Banking
GDP – Gross Domestic Product
GIAN – Grassroots Innovators Augmentation Network
GOI – Government of India
HDFC – Housing Development Finance Corporation
HGTP – Home Grown Technology Programme
HRD – Human Resource Development
IB – Individual Banking
ICAR – Indian Council of Agricultural Research
ICMR – Indian Council of Medical Research
ICT – Information and Communication Technology
IDEMI – Institute for Design of Electrical Measuring Instruments
IIE – Indian Institute of Entrepreneurship
IPR – Intellectual Property Rights
ISTSL – India SME Technology Services Ltd.
KVIC – Khadi and Village Industries Commission
MACTS – Mutually Aided Cooperative Thrift and Credit Societies
MES – Moduler Employable Scheme
MFI –Micro finance Institutions
MGIRI – Mahatma Gandhi Institute for Rural Industrialization
MOFPI – Ministry of Food Processing Industries
MOLE – Ministry of Labour and Employment
MSME – Micro, Small and Medium enterprises
MSME-DI – MSME Development Institutes
MSME-EDI – MSME Entrepreneurship Development Institution
MSMEDO – MSME Development Office
MSMETC – MSME Testing Centres

MSMETI – MSME Training Institutes
MSMETS – MSME Testing Stations
NABARD – National Agricultural Bank of Rural Development
NCJD – National Centre for Jute Diversification
NIC – National Informatics Centre
NID – National Institute of Design
NIESBUD – National Institute for Entrepreneurship and Small Business Development
NIFTEM – National Institute of Food Technology Entrepreneurship and Management
NIF – National Innovation Foundation
NIMSME – National Institute for Micro, Small and Medium Enterprises
NIT – National Institute of Technology
NGO – Non-Governmental Organizations
NMITLI – New Millennium Indian Technology Leadership Initiative
NPC – National Productivity Council
NSIC – National Small Industries Corporation
NSTEDB – National S&T Entrepreneurship Development Board
NSTMIS – National Science and Technology Management Information System
NRDC – National Research and Development Corporation
PPP – Public-Private Partnership
PRDSF – Pharmaceutical Research and Development Support Fund
R&D – Research and Development
RDI – Research and Development Institutes
RIN – Rural Innovators Network
RISC – Rural Industries Service Centre
RMK – Rashtriya Mahila Kosh
RRBs – Regional Rural Banks
S&T – Science and Technology
SDIS – Skill Development Initiative Scheme
SEVA – Sustainable Agricultural & Environmental Voluntary Action
SFC –State Financial Corporations
SHG – Self-help Groups
SIDBI – Small Industries Development Board of India
SIDC – State Industrial and Infrastructure Development Organizations
SIRO -- Scientific and Industrial Research Organizations
SME – Small and Medium Enterprises
SPV – Special Purpose Vehicle
SRISTI – Society for Research Initiatives for Sustainable Technologies and Institution
STEP – Science & Technology Entrepreneurship Park
TBSE – Technology Bureau for Small Enterprise
TBI – Technology Business Incubators
TDI – Technology Development Institutes
TDC – Technology Development Centres
TDPP –Technology Development and Demonstration Programme
TePP – Technopreneur Promotion Programme
TIME IS – Technology Innovation Management and Entrepreneurship Information Service
TOC – Technical Consultancy Organizations
VPT – Vocational Training Providers

Terminologies used

Innovation has to be understood from four different perspectives: the innovation itself, innovators, activities that lead to innovation, and diffusion of innovation. For the present survey we have used 'Oslo Manual: Guidelines for collecting and interpreting innovation data, 3rd edition, 2005. Workable definitions of 'types of innovation' and 'innovation activities' have been used following the Oslo manual. We have also defined 'innovation potentiality' for states and sectors following the Manual. Appropriate quotes are reproduced here at the end of this note.

Innovation is changes made in the product and production processes. Changes are technological as well as non-technological. The later includes changes in organisational and marketing practices. Together there are four broad types of innovations identified by OECD.

The innovation survey could be subjective or/and objective. The objective survey begins with identified innovations, whereas the subjective study uses firms or production units as reference point. The present survey belongs to the latter category of the innovation survey.

The subjective survey, therefore, identifies the changes made by a firm in its product and processes. To identify changes introduced by a firm broad categories have to be defined so that all important changes are captured. For the present survey categories are 'product innovation', 'process innovation', product quality and standardisation' 'saving/efficient use of inputs', 'use of alternative material', 'inducting or introducing new machines'.

While highlighting the innovation scenario in the developing economies, the Oslo manual points out, 'the acquisition of embodied technology (equipment) for both product and process innovation is a major component of innovation. Minor or incremental changes are the most frequent type of innovation activity in some developing countries, together with innovative applications of existing products or processes'.

Changes have been further qualified with activities that have been undertaken to bring in those changes. Innovation activities are divided into R&D and non-R&D activities. R&D activities are further divided into intra and extra mural R&D. Non-R&D activities related to innovations include acquisition of technology/new machine and acquisition of other external knowledge, training of manpower and market introduction of innovation.

The final test is the 'novelty' of innovation. If certain changes introduced by a firm are 'new to firm' can that be called innovation? The thumb rule is to '… exclude changes that are minor or lack a sufficient degree of novelty'. 'However, an innovation does not need to be developed by the firm itself but can be acquired from other firms or institutions through the process of diffusion'. 'Diffusion is the way in which innovations spread, through market or non-market channels, from their very first implementation to different consumers, countries, regions, sectors, markets and firms. Without diffusion, an innovation has no economic impact. The minimum requirement for a change in a firm's products or functions to be considered an innovation is that it is new (or significantly improved) to the firm'.

For ready reference we reproduce the crucial definitional and conceptual issues from the Oslo Manual 3rd edition, 2005, OECD Publishing.

Innovation

*An **innovation** is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.* (Para 146)

Innovation Activities

Innovation activities are all scientific, technological, organisational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations. Some innovation activities are themselves innovative, others are not novel activities but are necessary for the implementation of innovations. Innovation activities also include R&D that is not directly related to the development of a specific innovation.

Innovation comprises a number of activities that are not included in R&D, such as later phases of development for preproduction, production and distribution, development activities with a lesser degree of novelty, support activities such as training and market preparation, and development and implementation activities for innovations such as new marketing methods or new organisational methods which are not product and process innovations. Innovation activities may also include acquisition of external knowledge or capital goods that is not part of R&D. (Para 40,41 and 128-130, 326-330, 498)

Innovative firm

*An **innovative firm** is one that has implemented an innovation during the period under review. Such innovations need not have been a commercial success: many innovations fail. Innovative firms can be divided into those that have mainly developed innovations on their own or in co-operation with other firms or public research organisations, and those that have mainly innovated by **adopting innovations (for example new equipment)** developed by other firms. Innovative firms can also be distinguished by the types of innovations they have implemented; they may have implemented a new product or process, or they may have implemented a new marketing method or organisational change.* (Para 47)

Choice of the survey approach: Subject v/s Object

There are two main approaches to collecting data on innovations:

i. *The "subject" approach starts from the innovative behaviour and activities of the firm as a whole. The idea is to explore the factors influencing the innovative behaviour of the firm (strategies, incentives and barriers to innovation) and the scope of various innovation activities, and above all to examine the outputs and effects of innovation. These surveys are designed to be representative of all industries so that the results can be grossed up and comparisons made between industries.*

ii. *The "object" approach involves the collection of data about specific innovations (usually a "significant innovation" of some kind or a firm's main innovation). The approach involves collecting some descriptive, quantitative and qualitative data about the particular innovation at the same time that data is sought about the firm.*

From the point of view of current economic development, it is the differential success of firms that shapes economic outcomes and is of policy significance. This favours a subject-based approach, although innovation surveys can combine both approaches by including general questions on the firm and specific questions on a single innovation. It is the subject, the firm, that is important, and this is the approach has been chosen as the basis for these guidelines. (Para 52,53)

Sectoral aspects of innovation

Innovation processes differ greatly from sector to sector in terms of development, rate of technological change, linkages and access to knowledge, as well as in terms of organisational structures and institutional factors. Some sectors are characterised by rapid change and radical innovations, others by smaller, incremental changes.

In high-technology sectors, R&D plays a central role in innovation activities, while other sectors rely to a greater degree on the adoption of knowledge and technology. Differences in innovation activity across sectors (e.g. whether mainly incremental or radical innovations) also place different demands on the organisational structure of firms, and institutional factors such as regulations and intellectual property rights can vary greatly in their role and importance. It is important to take these differences into account when designing policy. They are also important for measurement, both when collecting data that allow for analysis across sectors and regions and when ensuring that the measurement framework is applicable to a broad range of industries. (Para 106,107)

Innovation in low- and medium-technology industries

Innovation in low- and medium-technology industries (LMTs) often receives less attention than innovation in high-technology industries. However, innovation in LMTs can have a substantial impact on economic growth, owing to the weight of these sectors in the economy.

LMTs are generally characterised by incremental innovation and adoption. As such, innovation activities are often focused on production efficiency, product differentiation and marketing. An important aspect of innovation in these industries is the fact that it is more complex than the simple adoption of new technologies. In many cases, innovation activities in LMTs involve the incorporation of high-technology products and technologies. Prominent examples are the use of ICT and biotechnology (e.g. in food processing) in the development of new products and production processes. LMTs use and application of advanced *technologies can place new demands on the skills of their workforce and can affect their organisational structure and their interactions with other firms and public research institutions.* (Para 112, 113)

Innovation in small and medium-sized enterprises

Small and medium-sized enterprises (SMEs) are of necessity more specialised in their activities. This increases the importance of efficient interaction with other firms and public research institutions for R&D, exchange of knowledge and, potentially, for commercialisation and marketing activities.

Finance can be a determining factor for innovation in SMEs, which often lack internal funds to conduct innovation projects and have much more difficulty obtaining external funding than larger firms. Surveys can provide data on the degree to which financial constraints affect the ability of SMEs to innovate. (Para 114,115)

Regional aspects of innovation

The notion that regional factors can influence the innovative capacity of firms has led to increasing interest in analysing innovation at the regional level. Regional differences in levels of innovation activity can be substantial, and identifying the main characteristics and factors that promote innovation activity and the development of specific sectors at regional level can help in understanding innovation processes and be valuable for the elaboration of policy.

As a parallel to national innovation systems, regional innovation systems may develop. The presence, for example, of local public research institutions, large dynamic firms, industry clusters, venture capital and a strong entrepreneurial environment can influence the innovative performance of regions. These create the potential for contacts with suppliers, customers, competitors and public research institutions. Infrastructure also plays an important role. (Para 116,117)

Potentially Innovative firm

A particular subject of interest in developing countries is the "potentially innovative firm". Innovation-active firms are those "that have had innovation activities during the period under review, including those with ongoing and abandoned activities". Potentially innovative firms are a subset of these, those that have made innovation efforts (i.e. conducted innovation activities) but have not achieved results (innovations) during the period of analysis. (Para 505)

Acquisition of machinery, equipment and other capital goods

Innovation activities also involve the acquisition of capital goods, both those with improved technological performance and those with no improvement in technological performance that are required for the implementation of new or improved products or processes. This category only includes the acquisition of capital goods for innovation that is not included in R&D activities. Note that this category also includes acquisition of capital goods from foreign units of MNEs (which is not included in R&D).

Capital goods for innovations are composed of acquisition of land and buildings, of machinery, instruments and equipment and, in line with the revised System of National Accounts – SNA, of computer software, which is a component of intangible investment and considered as capital formation.

Land and buildings includes the acquisition of land and buildings for product and process innovation activities including major improvements, modifications and repairs.

Machinery, instruments and equipment includes major instruments and equipment acquired for use in product and process innovation activities of the firm. (Para 326 - 329)

Weak innovation systems

Fewer resources are devoted to innovation activities system-wide, thereby reducing the innovation potential of enterprises. The government is a major player in R&D execution and funding, mainly owing to a low level of resources devoted to R&D by businesses.

Flows of information within national systems of innovation are fragmented, and in some cases there is an absence of linkages between science and enterprises. Weak or absent linkages challenge the capacities of firms to overcome (technology-related) problems and draw firms towards solutions that mostly rely on acquisition of embodied technology.

Barriers to accumulation of capabilities by enterprises are high and difficult to tackle, particularly in the case of highly qualified human capital, local and international linkages, and tacit knowledge incorporated in organizational routines. (Para 495-498)

Characteristics of innovation

The acquisition of embodied technology (equipment) for both product and process innovation is a major component of innovation. Minor or incremental changes are the most frequent type of innovation activity in some developing countries, together with innovative applications of existing products or processes.

Organisational change is an extremely significant aspect of the innovation process. Besides its direct impact on enterprise performance, it also contributes to the enterprise's ability to absorb new technologies incorporated in machinery and other equipment (the most frequent type of innovation). Heterogeneity frequently prevails with regard to firms' technological, organisational and managerial patterns, with "high technology" firms coexisting with informal businesses, and with many enterprises lacking a formal organisational structure. This creates a need for organisational change, often independent of product and process innovation. (Para 499 - 500)

Figures and Tables description

Figures	
Chapter I	**Page Number**
Figure 1.1: Types of innovations	12
Figure 1.2: Organisational Innovation	13
Figure 1.3: Marketing Innovation	13
Figure 1.4: Size of the innovative firms	14
Figure 1.5: Ownership type of the innovative firms	14
Figure 1.6: Age (year of establishment) of the innovative firms	15
Figure 1.7: Competitive status of the innovative firms vis-a-vis others	15
Figure 1.8: Gains from innovations	16
Figure 1.9: Novelty of innovations	16
Figure 1.10: Activities towards innovations	17
Figure 1.11: Source of innovation	18
Figure 1.12: Sourcing Technology	18
Figure 1.13: Acquiring technology	18
Figure 1.14: Extent of technology	19
Figure 1.15: R&D activities of innovative firms	19
Figure 1.16: Mode of acquiring new technology	20
Figure 1.17: Acquisition agreement of technology	20
Figure 1.18: Source of finance	21
Figure 1.19: Expenditure for innovation	21
Figure 1.20: Skill base of the Innovative firms	22
Figure 1.21: Training provided by innovative firms	22
Figure 1.22: Orientation of Training	22
Figure 1.23: Funds for Training	23
Figure 1.24: ICT Acquisition	23
Figure 1.25: ICT Usage level	23
Figure 1.26: Accessing Sources of Information	24
Figure 1.27: Factors influencing innovation	25
Chapter II	
Figure 2.1: Size wise share of the innovative firms	28
Figure 2.2: Types of Innovation and Size of the firms	29
Figure 2.3: Size wise distribution of innovative firms and their competitive status vis-a-vis others (I)	30
Figure 2.4: Size wise distribution of innovative firms and their competitive status vis-a-vis others (II)	30

Figure 2.5: Size wise distribution of innovative firms and their competitive status vis-a-vis others (III)	30
Figure 2.6: Product Outcome and size of the firms	31
Figure 2.7: Process Outcome and size of the firms	31
Figure 2.8: Other Outcome and size of the firms	32
Figure 2.9: Size and Novelty of innovations	32
Figure 2.10: Size-wise Innovation Activities performed by Innovative firms (I)	33
Figure 2.11: Size-wise Innovation Activities performed by Innovative firms (II)	33
Figure 2.12: Size-wise Innovation Activities performed by Innovative firms (III)	34
Figure 2.13: Sources of innovation and size of innovative firms	34
Figure 2.14: Sourcing technology and size of innovative firms	35
Figure 2.15: Acquiring technology and size of innovative firms	35
Figure 2.16: Extent of technology and size of innovative firms.	36
Figure 2.17: Mode of acquisition and size of innovative firms	36
Figure 2.18: Acquisition agreement and size of innovative firms	37
Figure 2.19: Expenditure incurred for innovation activities and size of innovative firms	37
Figure 2.20: Financing of innovation expenditure and size of innovative firms	38
Figure 2.21: Human resource pool and size of innovative firms	38
Figure 2.22: Training of human resources and size of innovative firms	39
Figure 2.23: Size of the Innovative firms and ICT Acquisition	39
Figure 2.24: Size of the Innovative firms and ICT Usage level	40
Figure 2.25: Size of the Innovative firms and information source	40
Chapter III	
Figure 3.1: Age wise share of the innovative firms	44
Figure 3.2: Age, size and innovativeness	45
Figure 3.3: Types of Innovation and Age of the firms	45
Figure 3.4: Age of the firms and their competitive status vis-a-vis others (I)	46
Figure 3.5: Age of the firms and their competitive status vis-a-vis others (II)	46
Figure 3.6: Age of the firms and their competitive status vis-a-vis others (III)	47
Figure 3.7: Product Outcome and age of the firms	47
Figure 3.8: Process Outcome and age of the firms	48
Figure 3.9: Other Outcome and age of the firms	48
Figure 3.10: Age and Novelty of innovations	49
Figure 3.11 Age and Innovation Activities (I)	49
Figure 3.12 Age and Innovation Activities (II)	49
Figure 3.13 Age and Innovation Activities (III)	50
Figure 3.14: Sources of innovation and Age of innovative firms	50
Figure 3.15: Sourcing technology and age of innovative firms	51

Figure 3.16: Extent of technology and age of innovative firms.	51
Figure 3.17: Mode of acquisition and age of innovative firms	52
Figure 3.18: Acquisition agreement and age of innovative firms	52
Figure 3.19: source of funds and Age of innovative firms	53
Figure 3.20: Expenditure and age of innovative firms	53
Figure 3.21: Human resource pool of innovative firms	54
Figure 3.22: Training of human resources by innovative firms	54
Figure 3.23: Extent of ICT acquisition and age of firms	55
Figure 3.24: Extent of ICT use and age of firms	55
Figure 3.25: Source of Information and Age of the firms	56
Chapter IV	
Figure 4.1: Ownership wise share of the innovative firms	58
Figure 4.2: Ownership type and Size of the innovative firms	59
Figure 4.3: Ownership type and Age of the innovative firms	59
Figure 4.4: Competitive positions and Ownership pattern of innovative firms (I)	60
Figure 4.5: Competitive positions and Ownership pattern of innovative firms (II)	60
Figure 4.6: Competitive positions and Ownership pattern of innovative firms (III)	61
Figure 4.7: Product outcome and ownership of innovative firms	61
Figure 4.8: Process outcome and ownership of innovative firms	62
Figure 4.9: Other outcome and ownership of innovative firms	62
Figure 4.10: Ownership and Novelty of innovations	63
Figure 4.11: Activities performed by Innovative firms and ownership (I)	63
Figure 4.12: Activities performed by Innovative firms and ownership (II)	64
Figure 4.13: Sources used and ownership	64
Figure 4.14: Sourcing technology and ownership	65
Figure 4.15: Source of technology and ownership	65
Figure 4.16: Extent of technology and ownership	65
Figure 4.17: Mode of acquisition and ownership	66
Figure 4.18: Source of Fund and ownership	66
Figure 4.19: Expenditure incurred and ownership	67
Figure 4.20: Human Resource pool and ownership	67
Figure 4.21: Training provided and ownership	68
Figure 4.22: ICT acquired and ownership	68
Figure 4.23: Extent of ICT use and ownership	69
Figure 4.24: Information Source and Ownership	69

Chapter V	
Figure 5.1: Firms engaged in different types of innovations	72
Figure 5.2: Age group and type of innovation (% of innovative firms)	73
Figure 5.3: Comparative presence of innovative firms (of different age groups) in different types of innovation	74
Figure 5.4: Comparative share of innovative firms (for paired age group and types of innovations) as percentage of total innovative firms	74
Figure 5.5: Ownership group and type of innovation (% of innovative firms)	75
Figure 5.6: Comparative presence of innovative firms (of different ownership groups) in different types of innovation	75
Figure 5.7: Comparative share of innovative firms (for paired ownership group and types of innovations) as percentage of total innovative firms	76
Figure 5.8: Firm size group and type of innovation (% of innovative firms)	76
Figure 5.9: Comparative presence of innovative firms (of different size groups) in different types of innovation	77
Figure 5.10: Comparative share of innovative firms as percentage of total innovative firms	77
Figure 5.11 Competitive positions of the firms after innovation (I)	78
Figure 5.12 Competitive positions of the firms after innovation (II)	78
Figure 5.13 Competitive positions of the firms after innovation (III)	78
Figure 5.14 Competitive positions of the firms after innovation (IV)	79
Figure 5.15 Types of innovation and novelty of innovation	79
Figure 5.16 Types of innovation and gains from innovation (I)	80
Figure 5.17 Types of innovation and gains from innovation (II)	80
Figure 5.18 Types of innovation and gains from innovation (III)	80
Figure 5.19 R&D and non-R&D dimensions in different types of innovation	81
Figure: 5.20 Types of innovation and innovation activities	81
Figure 5.21 Sources used for types of innovation	82
Figure 5.22 Types of innovations and sources of technology	82
Figure 5.23: Extent and Nature of technology	83
Figure 5.24: Non-technological innovations in different types of innovation	83
Figure 5.25: Mode of acquiring technology from external sources	84
Figure 5.26: Mode of acquiring technology	84
Figure 5.27: Expenditure and types of innovation	84
Figure 5.28: Source of fund and types of innovation	85
Figure 5.29: Human resource pool of innovative firms	85
Figure 5.30: Training of human resources by innovative firms	86
Figure 5.31: Extent of ICT use by innovative firms	86
Figure 5.32: Extent of ICT use by innovative firms	87
Figure 5.33: Extent of ICT use by innovative firms	87
Figure 5.34: Sources of information used by innovative firms	87

Figure 5.35: Sources of information used by innovative firms	88
Chapter VI	
Figure 6.1 R&D and Non-R&D Innovators	90
Figure 6.2 Size with R&D and Non-R&D innovators	90
Figure 6.3 Age groups with R&D and Non-R&D innovators	91
Figure 6.4 Ownership with R&D and Non-R&D innovators	91
Figure 6.5 R&D and non- R&D innovators and types of Innovation	92
Figure 6.6.1 Competitive status of the firms	92
Figure 6.6.2 Competitive status of the firms	92
Figure 6.7 Gains from innovation	93
Figure 6.8 Novelty of innovation	93
Figure 6.9 Source of innovation	93
Figure 6.10 Acquisition of external knowledge	94
Figure 6.11 Source of acquisition of external knowledge	94
Figure 6.12 Extent of technology (external knowledge)	95
Figure 6.13 Non-technological innovations	95
Figure 6.14 Mode of acquiring external knowledge	96
Figure 6.15 Agreements for acquired external knowledge and R&D capability	96
Figure 6.16 Mode of expenditure incurred for acquiring external knowledge	96
Figure 6.17 Financing innovation activities	97
Figure 6.18 Financing external knowledge (technology) and R&D capability	97
Figure 6.19 Human Resource base	98
Figure 6.20 Training Human Resource	98
Figure 6.21 Sources of funds for Training	98
Figure 6.22 ICT acquisitions and R&D capability of the firm	99
Figure 6.23 ICT usage level and R&D capability of the firm	99
Figure 6.24 Source of information for innovation and R&D capability of the firm	100
Chapter VII	
Figure 7.1 Distribution of innovative firms doing Non-technological innovations	102
Figure 7.2 Size-wise distribution of innovative firms with respect to Non-technological innovations	103
Figure 7.3 Age-wise distribution of innovative firms with respect to Non-technological innovations	103
Figure 7.4 Ownership-wise distribution of innovative firms with respect to Non-technological innovations	104
Figure 7.5 Types of innovations with respect to Non-technological innovations	104
Figure 7.6 Non-technological innovations and their status vis-a-vis others in the industry	105

Figure 7.7 Non-technological innovations and gains from innovation	105
Figure 7.8 Non-technological innovations and novelty of innovation	106
Figure 7.9: Innovative firms with non-technological innovations and sources of innovations	106
Figure 7.10: Innovative firms with non-technological innovations and external knowledge acquired	107
Figure 7.11: Innovative firms with non-technological innovations and source of external knowledge acquired	107
Figure 7.12 Innovative firms with non-technological innovations and Mode of acquiring external knowledge	108
Figure 7.13 Innovative firms with non-technological innovations and Agreements for external knowledge	108
Figure 7.14 Innovative firms with non-technological innovations and Mode of Expenditure incurred	109
Figure 7.15 Innovative firms with non-technological innovations and Skill base of human resource employed	109
Figure 7.16 Innovative firms with non-technological innovations and training provided	110
Figure 7.17 Innovative firms with non-technological innovations and sources of funds for training	110
Figure 7.18 Innovative firms with non-technological innovations and ICT infrastructure	111
Figure 7.19 Innovative firms with non-technological innovations and usage of ICT	111
Figure 7.20 Innovative firms with non-technological innovations and Source of information for Innovation	112
Chapter VIII	
Figure 8.1: Barrier to innovation	115
Figure 8.2: Cost of innovation as barrier	115
Figure 8.3: Firm size and cost of innovation as barrier	116
Figure 8.4: Firms' age and cost of innovation as barrier	116
Figure 8.5: Ownership type and cost of innovation as barrier	116
Figure 8.6: Innovation type and cost of innovation as barrier	117
Figure 8.7: Access to knowledge as barrier to innovation	117
Figure 8.8: Firm size and knowledge factor as barrier	118
Figure 8.9: Firms' age and knowledge factor as barrier	118
Figure 8.10: Firms' ownership and knowledge factor as barrier	119
Figure 8.11: Types of innovation and knowledge factor as barrier	119
Figure 8.12: Infrastructure factor as barrier to innovation	120
Figure 8.13: Firm size and Infrastructure factor as barrier to innovation	120
Figure 8.14: Firms' age and Infrastructure factor as barrier to innovation	121
Figure 8.15: Firm ownership and Infrastructure factor as barrier to innovation	121

Figure 8.16: Types of innovation and Infrastructure factor as barrier to innovation	122
Figure 8.17: market factor as barrier to innovation	122
Figure 8.18: Firm size and market factor as barrier to innovation	123
Figure 8.19: Firms' age and market factor as barrier to innovation	123
Figure 8.20: Firms' ownership and market factor as barrier to innovation	124
Figure 8.21: Types of innovation and market factor as barrier to innovation	124
Figure 8.22: Other factors as barrier to innovations	125
Figure 8.23: Firm size and other factors as barrier to innovations	125
Figure 8.24: Firms' age and other factors as barrier to innovations	125
Figure 8.25: Firms' ownership and other factors as barrier to innovations	126
Figure 8.26: Types of innovations and other factors as barrier to innovations	126
Figure 8.27: Finance from own enterprise as barrier to innovations	127
Figure 8.28: Finance from outside sources as barrier to innovations	127
Figure 8.29: Innovation cost as barrier to innovations	128
Figure 8.30: Skilled manpower as barrier to innovations	129
Figure 8.31: Technology information as barrier to innovations	129
Figure 8.32: Information on market as barrier to innovations	130
Figure 8.33: Infrastructure as barrier to innovations (I)	131
Figure 8.34: Infrastructure as barrier to innovations (II)	131
Figure 8.35: Market domination as barrier to innovations	132
Figure 8.36: New market as barrier to innovations	132
Figure 8.37: Niche market as barrier to innovations	133
Figure 8.38: Protection as barrier to innovations	133
Figure 8.39: Regulatory requirements as barrier to innovations	134
Figure 8.40: Demand as barrier to innovations	134
Figure 8.41: Govt. policy constraint as barrier to innovations	135
Figure 8.42: Management as barrier to innovations	135
Figure 8.43: Finance as barrier to innovations	136
Figure 8.44: Finance as barrier to innovations	137
Figure 8.45: innovation cost as barrier to innovations	137
Figure 8.46: Skilled manpower as barrier to innovations	138
Figure 8.47: Technology information as barrier to innovations	138
Figure 8.48: Market information as barrier to innovations	139
Figure 8.49: Infrastructure as barrier to innovations	139
Figure 8.50: Infrastructure as barrier to innovations	140
Figure 8.51: Market factor as barrier to innovations	140
Figure 8.52: New market as barrier to innovations	141
Figure 8.53: opportunities as barrier to innovations	141
Figure 8.54: Protection as barrier to innovations	141

Figure 8.55: Regulatory requirement as barrier to innovations	142
Figure 8.56: Demand factor as barrier to innovations	142
Figure 8.57: Govt. policy constraint as barrier to innovations	143
Figure 8.58: Management as barrier to innovations	143
Chapter IX	
Figure 9.1: Innovation Intensity (in %) and Innovation Potentiality of different states	149
Figure 9.2: Innovation Potentiality of different states	149
Figure 9.3: Ranking of the states in terms of Innovation Potentiality	150
Figure 9.4: States' share in sample and innovative firms with respect to innovation potentiality	150
Figure 9.5: Size of the innovative firms in different states (in %)	151
Figure 9.6: All states together the median value of shares for different size groups	151
Figure 9.7: Share of the age groups in the total innovative firm in the state	152
Figure 9.8: Share of the group in total innovative firm in a state	153
Figure 9.9: Product innovations (in %) in states	155
Figure 9.10: Process innovations (in %) in states	155
Figure 9.11: Product quality and standardisation (in %) in states	156
Figure 9.12: Saving/more efficient use of inputs (in %) in states	156
Figure 9.13: Alternative material (in %) in states	157
Figure 9.14: New machines (in %) in states	157
Figure 9.15: Novelty of Innovation in states	158
Figure 9.16: Innovation Activities performed by Innovative firms (I)	159
Figure 9.17: Innovation Activities performed by Innovative firms (II)	160
Figure 9.18: Source of innovation used by innovative firms	161
Figure 9.19: Source of Technology acquired	161
Figure 9.20: Form of technology sourced	162
Figure 9.21: Extent of technology sourced	163
Figure 9.22: Expenditure for Innovations in states	163
Figure 9.23: Arranging finance for sourcing technology for innovations in states (I)	164
Figure 9.24: Arranging finance for sourcing technology for Innovations in states (II)	165
Figure 9.25: Agreement on technology for Innovations in states (I)	166
Figure 9.26: Agreement on technology for Innovations in states (II)	166
Figure 9.27: sources availed by Innovative firms for Innovation Activities/Expenditure	167
Figure 9.28: Non-R&D innovations in the states	168
Figure 9.29: Non-technological Innovations in states	168

Figure 9.30: Scientist/Engineers employed and training of employees by Innovative Firms	169
Figure 9.31: Accessing sources for training	170
Figure 9.32: Accessing funding sources for training	170
Figure 9.33: ICT Hardware use by innovative firms in states	171
Figure 9.34: ICT Software use by innovative firms in states	171
Figure 9.35: ICT use by innovative firms	172
Figure 9.36: Source of information used by innovative firms (I)	172
Figure 9.37: Source of information used by innovative firms (II)	173
Chapter X	
Figure 10.1: Innovation Intensity (%) and Innovation Potentiality of different sectors	179
Figure 10.2: Innovation Potentiality of different sectors	179
Figure 10.3: Ranking of the sectorss in terms of Innovation Potentiality	179
Figure 10.4: Distribution of firms surveyed and Innovative firms with respect to Sectors	180
Figure 10.5: Share of a size group in the innovative firms in different sectors	181
Figure 10.6: All sectors together the median value of shares for different size groups	182
Figure 10.7: Share of the age groups in total innovative firms in the sector	182
Figure 10.8: Share of the group in total innovative firm in a sector	183
Figure 10.9: Product innovations in sectors	185
Figure 10.10: Process innovations in sectors	185
Figure 10.11: Product quality and standardisation in sectors	186
Figure 10.12: Saving/more efficient use of inputs in sectors	186
Figure 10.13: Alternative material in sectors	187
Figure 10.14: New machines in sectors	187
Figure 10.15: Novelty of Innovation in sectors	188
Figure 10.16: Innovation Activities performed by Innovative firms	189
Figure 10.17: Innovation Activities performed by Innovative firms	189
Figure 10.18: Source of innovation used by innovative firms	190
Figure 10.19: Source of Technology acquired	190
Figure 10.20: Form of technology sourced	191
Figure 10.21: Extent of technology sourced	192
Figure 10.22: Expenditure for Innovations in sectors	192
Figure 10.23: Arranging finance for sourcing technology for innovations by sectors	193
Figure 10.24: Agreement on technology for Innovations in sectors (I)	194
Figure 10.25: Agreement on technology for Innovations in sectors (II)	194
Figure 10.26: sources availed by Innovative firms for Innovation	195

Activities/Expenditure	
Figure 10.27: Non-R&D innovations in the sectors	196
Figure 10.28: Non-technological Innovations in sectors	196
Figure 10.29: Scientist/Engineers employed and training of employees by Innovative Firms	197
Figure 10.30: Accessing sources for training	198
Figure 10.31: Accessing funding sources for training	198
Figure 10.32: ICT Hardware use by innovative firms in sectors	199
Figure 10.33: ICT Software use by innovative firms in sectors	199
Figure 10.34: ICT use by innovative firms	200
Figure 10.35: Source of information used by innovative firms (I)	200
Figure 10.36: Source of information used by innovative firms (II)	201
Chapter XI	
Figure 11.1: Rank correspondence of different indicators	209
Chapter XII	
Figure 12.1: Percentage of innovative firms in different countries (% percentage of innovative firms)	214
Figure 12.2: Percentage of innovative firms engaged in product and process innovations (% of innovative firms)	215
Figure 12.3: Introduction of new or improved product in the market (% of innovative firms)	215
Figure 12.4: Non-technological innovation by the innovative firms (% of innovative firms)	219

Tables

Chapter VIII	**Page Number**
Table 8.1: Cost factor as barrier- correlation coefficient with innovation potentiality	128
Table 8.2: Knowledge barrier - correlation with innovation potentiality	130
Table 8.3: Infrastructure barrier - correlation with innovation potentiality	131
Table 8.4: Market barrier – correlation with innovation potentiality	134
Table 8.5: Other factor barrier – correlation with innovation potentiality	136
Table 8.6: Cost factor as barrier – correlation with innovation potentiality	137
Table 8.7: Knowledge as barrier – correlation with innovation potentiality	139
Table 8.8: Infrastructure as barrier- correlation with innovation potentiality	140
Table 8.9: Market barrier – correlation with innovation potentiality	142
Table 8.10: Infrastructure as barrier- correlation with innovation potentiality	144

Chapter IX	
Table 9.1: State-wise share in the population, sample base and innovative firms	148
Table 9.2: Types of innovation undertaken by firms	153
Table 9.3: Complementarity among types of innovations	154
Table 9.4: Innovation related activities of the innovative firms	159
Table 9.5: Innovation related activities of the innovative firms	160
Table 9.6: Correlation with Innovation potentiality	161
Table 9.7: Correlation between forms of technology and innovation potentiality	162
Table 9.8: Correlation between extent of technology and innovation potentiality	163
Table 9.9: Correlation between Nature of expenditure and innovation potentiality	164
Table 9.10: Correlation between source of fund and innovation potentiality	165
Table 9.11: Correlation between technology agreement and innovation potentiality	166
Table 9.12: Correlation between technology agreement and innovation potentiality	166
Table 9.13: Funds of Innovation Activities	167
Table 9.14: Correlation between non-technology and innovation potentiality	169
Table 9.15: Correlation of ICTisation with innovation potentiality	172
Table 9.16: Correlations between sources used and innovation potentiality	173
Chapter X	
Table 10.1: Sector-wise share of population, sample base and innovative firms	178
Table 10.2: Types of innovation undertaken by firms	183
Table 10.3: Complementarity among types of innovations	184
Table 10.4: Innovation related activities of the innovative firms	188
Table 10.5: Innovation related activities of the innovative firms	190
Table 10.6: Correlation with Innovation potentiality	191
Table 10.7: Correlation between forms of technology and innovation potentiality	191
Table 10.8: Correlation between extent of technology and innovation potentiality	192
Table 10.9: Correlation between Nature of expenditure and innovation potentiality	193
Table 10.10: Correlation between source of fund and innovation potentiality	193
Table 10.11: Correlation between technology agreement and innovation potentiality	194
Table 10.12: Correlation between technology agreement and innovation potentiality	195
Table 10.13: Funds of Innovation Activities	195
Table 10.14: Correlation between non-technology and innovation potentiality	197
Table 10.15: Correlation of ICTisation with innovation potentiality	199

Table 10.16: Correlations between sources used and innovation potentiality	201
Chapter XI	
Table 11.1: Innovation support system	205
Table 11.2: Access of NIS by the innovative firms (%)	206
Table 11.3: Indicative factors of Regional System of Innovation (RIS)	207
Table 11.4: Correlation among RIS, HDI and innovation potentiality of states	208
Table 11.5: Sectoral strength of innovation of the states	210
Table 11.6: Correlation among IAS, CSSI and innovation potentiality of states	210
Chapter XII	
Table 12.1: Activities related to innovation (% of innovative firms)	216
Table 12.2: Sources of information and knowledge used by innovative firms in different countries (% of innovative firms)	217
Table 12.3: Outcome of innovation claimed by innovative firms (% of innovative firms)	218
Table 12.4: Cost factor as barrier to innovation	220
Table 12.5: Knowledge factor as barrier to innovation	220
Table 12.6: Market factor as barrier to innovation	221

Executive Summary

About the survey

Over the last few years **NSTMIS, DST** had involved various stakeholders in evolving an appropriate framework to measure the innovation and knowledge creation capabilities in Indian context. The NSTMIS framework draws upon the inputs of the pilot innovation survey, sectoral innovation studies, and interactions with the national and international experts while adapting the internationally accepted concepts and definitions on the measurement of innovation to launch the National Innovation Survey.

The survey is not about identification of innovations that is happening in Indian industries. It is about understanding the process that makes innovation happen or constraints innovation from happening. The understanding is through developing and examining a set of indicators that would help promoting and monitoring innovation in Indian production system.

'Innovation' - as it has been used in the survey

As it is broadly defined, innovation is 'application of new knowledge in the production system, and realisation of the benefit of the new application from the market'. This is the standard internationally accepted definition for the researchers in this field. Two important aspects are to be noted. First, 'production units' as innovators - as it is to be applied and taken to the market. This makes the distinction between innovations and other discoveries or inventions. The other aspect is the 'newness' or Novelty. An innovation is new to the world has the highest novelty factor compared to the one that is new only in the domestic market on in the local market. Innovation that is new only to the innovator firm has novelty value only for the firm.

In the Oslo Manual, 2005, and the Draft National Innovation Act 2008 innovation has been described as '..a process for incremental or significant technical advance or change, which provides enhancement of measureable value and shall include i) increase in market share, ii) competitive advantage, iii) improvement in the quality of products or services, iv) reduction of costs.

The operational aspect of the definition requires accounting the types of changes and then qualifying those for 'significant' or 'incremental' changes and further examining the gains in terms of the above four clauses. Changes have been accounted for 'new product', 'new process', 'product quality and standardisation', 'saving/more efficient use of inputs', 'alternative material', 'new machines', etc.

These changes have been seen in terms of 'significance' and 'incremental' nature under categories; namely, changes are 'new to the firm', 'new to the market', 'new in India' and 'new to the world'.

Population base of the survey

A sample of total of 9001 out of 208415firms was surveyed across 26 states and 5 Union Territories of India based on the ASI 2009-10 database. 35.37% firms reported different types of changes in their production, organisational and marketing practices and considered as engaged in innovative activities. Firm size has been measured by the size of the work force: below 100 (share in the sample 88.08%), 100 – 499 (share in the sample 10.20%), 500-999 (share in the sample 1.07%), 1000 and above (share in the sample 0.66%). It is evident that the sample has overwhelming presence of the firms having less than 100 work forces.

Limitation of the Survey

The survey is based on ASI 2009-10 database of a sample of 208415 firms. A sample was drawn from the ASI sample that was reresentative of whole of India. A sample out of sample may not be an ideal population base to work on. The sample with its geographical spread, however, provided a reliable and workable population base for all parts of the country. There is no other data source with preliminary identification of the industrial units for drawing samples.

Again the ASI database is heavily biased towards manufacturing sector, so is, as a result, the sample in the ASI. The study, therefore, inadequately represents sectors other than manufacturing sector.

The survey has been conducted through visits to the sample units. In many cases hard data is not easily parted by the respondents. The survey, therefore, is weak in terms of hard data, namely, revenue, R&D expenditure, other expenditures, wages, manpower etc. but quite strong in soft information.

The survey does not provide any idea about changes in the innovation scenario. The questionnaire had provision for at least three years information on innovation trelated activities. It has been realised during the course of the survey that data on R&D expenditure, training, acquisition of technology and knowledge etc. is essentially once in a period investment, without much yearly variations. The survey, therefore, presents a cross-section comparative view of innovation and not a time series understanding.

Structure of the Report

The structure of the presentation of the result of the survey is as follows. We begin with broad understanding of innovations and innovators identified by the survey. This is followed with examining the attributes like innovative firms' size, ownership and age. We look at the types of innovations, innovation strategies of firms in terms of accessing and mobilising various technological and non-technological resources. We look at the barriers to innovations as articulated by innovative firms. Detailed scenarios are presented for states and sectors. A comparative performance of innovation system has been analysed at the end. We also present a snapshot of international comparisons.

Innovations and innovators

- Most of the innovations are in the form of introducing new machines, followed by improvement of the quality of the existing products, process and product innovations.
- **In terms of the percentage share in the total sample most of the innovative firms have less than 100 workforces**, are privately owned, and equally divided among pre 1990, 1990-2000 and after 2000 as year of establishment.
- Innovative firms consider themselves either at par or ahead of their competitors.
- Increased range of products, improved quality and standards, increased production capacity and reduced environmental impact are the gains from innovations.
- Most of the innovations are 'new to firm' types.
- Domestic financial institutions are the main external Sources for finance.
- About 53% innovative firms do not employ any scientist or engineers.
- Access to knowledge/information has been found most important barrier in addition to cost factor and availability of skilled manpower.

Firm size and innovation

- Sample firms are categorized into four size classes, namely, below 100, 100 to 499, 500 to 999 and 1000 and above workforces.
- Size group-wise share in innovative firms in total innovative firms: Below 100 - 85.93%, 100-499 – 11.81%, 500-999 – 1.54, 1000 and above 0.72%. However within the group share of innovative firms - for Below 100 – 34.51%, 100-499 – 40.96%, 500-999 – 51.04%, 1000 and above 38.99%. It shows that firms within larger size categories show more propensities to innovate.
- In terms of R&D activities, technology in-licensing, employing qualified manpower, organisational and marketing practices mostly larger firms are more active than their smaller counterparts.

- Product innovations by the small firms are mainly minor innovations and ‘new to the firm’ type. Large firms engaged in product innovation have gained increased market share.
- Involvement in R&D activities increases with size and most of these activities are in-house activities. Extramural R&D activities are rare and even rarer for the small sized firms.
- Innovations by the small firms are mostly by using their own sources. Accessing external source for knowledge and information is mostly practiced by the large firms.
- The average number of skilled manpower increases with the size of the firms. The same has been observed for training of employees.

Age of the firm and innovation

- Firms are categorised into three broad groups based on their year of establishment as ‘before 1990’, ‘1990 to 2000’ and ‘after 2000’.
- Firms established during the nineties and before 1990 are more innovation active than the new firms. Among the firms of all age groups the novelty factor is very low however firms established after 2000 are marginally ahead of others in claiming their innovations to be new to the market.
- Mostly old large firms established before 1990 show more innovation related activities than those set up at a later age. Among the newly established ones firms with below 100 and 100 to 499 workforce are more innovative.
- The incidence of product innovation, process innovations and product quality standardization are more among the firms established before 1990 and they mostly claim their innovations to have increased the range of goods and services, improved their capacity of production and also addressed social issues.
- The new firms (firms established after 2000) though they have shown lesser innovativeness, their innovations are mostly ‘new to the market’, which among the firms established at an earlier age is low.
- Firms established during the nineties and after 2000 mostly acquired technology from external sources in the form of patents while those established before 1990 mostly acquired know-how of the technology.
- Mostly the older firms on an average had more number of skilled manpower resources in their enterprises than the new firms and they are also more engaged in human resource development programmes to train their employees.

Firms' Ownership and innovation

- We find that ownership pattern does not have much significant effect on firms' technological innovation performance. However, some ownership types (e.g., private and public Ltd) do have a positive effect.
- Majority of the large firms that are innovative are mostly public Ltd enterprises and Public Sector Units (PSUs).
- Public Ltd firms and PSU's established before 1990 reported more innovation activities than those established after the economic liberalization and these firms mainly claim their innovations to be new to the Indian market and also new to the world in contrast to firms with other ownership types who mainly claim their innovations to be new to the firms only.
- Private firms that were established during the nineties show more propensity to innovate than those established before 90 and after 2000.
- Firms engaging in extramural R&D are rare. However, the public Ltd, PSU's and family owned enterprises reported more of such engagement than others.
- For human resource base we find Public Ltd enterprises on an average having maximum number of scientists and engineers and it is the private sector firms, which train maximum number of their employees.
- The sources of information are mainly the firm's own internal sources and availing institutional knowledge source seems very weak among the firms. However within the PSU's and the family businesses a few claim of some strong linkages.

Types of innovation

- About 70% of innovative firms have innovations in the form of introducing new machines, followed by quality and standard related activities by 40% of the firms. About 32% and 34% firms claimed Product and process innovations respectively. Small firms are more in numbers in all types of innovations. Private, partnership and proprietary business, which account for about 80% of innovative firms are mainly engaged in introduction of new machines. Around 45% of the innovative firms are generally affirmative about competitive positions being at par with the peers.
- Predominant types of innovation are 'new to the firm' category. Use of alternative material, however, has about 20% innovative firms claiming 'new to the Indian market' and about 10% claiming innovations 'new to the world market'.

- Extra mural R&D has some presence in innovations related to alternative materials but overall non- R&D based innovation has predominance among innovative firms.
- Percentage share of scientist and engineer in the total employees is about 8% for 'new product' type innovation. The share is highest for 'alternative material' at 11.11%. High skilled manpower is not much in use among innovative firms for augmenting innovation.
- R&D and technology management are the areas where ICT is used by about on average 20% firms in all types. ICT for ERP is strong among the firms engaged in new process and new product technology. About 40% firms among those engaged in 'alternative material' type of innovations do use external source for information. It is interesting to note that market source has preference over institutional sources for access to information by innovative firms.

R&D and innovation

- Out of the total innovative firms 36.90% have formal R&D setup. 35.05% of the total innovative firms have intramural R&D setup whereas 11.43% of them have opted for extramural R&D.
- Firms with formal R&D setup are ahead in product innovation and process innovation whereas firms, which do not have formal R&D setup, (i.e. Non-R&D firms) have more focus on New Machines.
- In terms of novelty aspect of innovations, R&D firms have higher percentage of firms claiming their innovations to be 'new to market' than Non-R&D firms.
- R&D firms have done more of both organisational and marketing innovations than Non-R&D firms.
- R&D firms have more number of firms with higher number of 'scientist & engineers' as compare to Non-R&D firms.

Non-technological innovations

- 59.89% of innovative firms are involved with non-technological innovations, out of which 46.48% of the innovative firms are into marketing innovation and 43.09% are into organisational innovation.
- There are no clear cut relationship between size, age and ownership of the firm with the occurrence of non-technological innovations. Types of innovation also do not seem to vary over firms doing or not doing non-technological innovations.

- Innovative firms that are inclined towards non-technological innovations are slightly ahead of their peers (in their opinion), in gains from innovations in comparison to the innovative firms, which are not into non-technological innovations.

Barrier to Innovation

- Access to knowledge/information has been found most important barrier by about 40% of the innovative firms. This is followed by cost factor associated with innovation.
- Availability of skilled manpower is the most important problem for 88% of the innovators. Problem with access to market information and availability of information technology follow closely. Infrastructure as barrier has been expressed by much less percentage of innovative firms.
- Govt. regulatory requirements have scored highest as market barrier, followed by established players in the market.
- Internal resources remain strong barrier for all types of innovations. Innovation cost for 'product', 'process' and 'alternative material' is a barrier as expressed by more than 70%% of the innovators. Firms engaged in innovation on alternative material and efficient use of inputs are more prone to availability of lab facilities.

State level scenario

- The Survey has covered 26 states and five Union Territories. For inter-state comparison of innovation scenarios we have defined two indicators, namely, Innovation Intensity and Innovation Potentiality. Innovation Intensity is defined as a ratio between number of innovative firms in a state and total number of firms in the respective state. Innovation Potentiality is defined as weighted Innovation Intensity, where weights are share of a state in total innovative firms.
- Total number of innovative firms out of a sample of 9001: 3184. Overall innovation intensity of India: 35.37%. In all states the smallest size category (Below 100) has maximum share of the innovative firms in the state (above 96 % in Maharashtra, whereas 64% is the lowest recorded for Tripura).
- The age groups' share in the total innovative firms in a state show that Bihar, Himachal Pradesh, Uttaranchal, along with other smaller states like Tripura, Sikkim etc. having 'after 2000' firms in the higher share of innovative firms.

- While private enterprises dominate the scene in most of the states, in Punjab it is partnership firms that have as high as 41% share of innovative firms. On the other hand states like Bihar, Tripura and Nagaland have high shares of proprietary firms are highly significant.
- States with much lower innovation potentiality have higher shares of product and process innovation. At all India level most ubiquitous is innovation in the form of introduction of new machines. Correlations with innovation potentiality give coefficients that are small in magnitude and negative for all types. The states that are low in 'new product' type of innovations are comparatively higher in 'new machine' types, and not the other way round. Highest positive correlation is between 'new process technology' and 'saving/more efficient use of inputs'. Again, innovations in 'alternative material' show high correlations with 'new product' and 'new process' innovations.
- Across the states most of the innovations are new to firms. Higher percentage of firms reporting 'new to India' innovation in Himachal Pradesh is due to the presence of Drugs & Pharma and Electrical goods industry.
- It is apparent that acquisition of technology is the most popular way to innovation. Training of the manpower in new technology and in-house R&D has moderate presence in popularity among the innovative firms. It is to be noted that firms in Gujarat tops in all the three indicators
- The external interactions for innovation appear to be low key for the Indian firms. About 80% claim that their innovations are internally sourced. Correlation with innovation potentiality has coefficient 0.44 suggesting that states having higher innovation potentiality do depend more on internal strength of sourcing innovation.
- Fund arranged using own sources is the preferred route for the innovative firms. Borrowing fund for sourcing technology is not popular among the innovative firms, at the same time, accessing government fund is rare. Correlations between innovation potentiality of the states and source of fund shows that lower the innovation potentiality more is the dependence on own source of fund. On the other hand states with higher innovation potentiality has higher incidence of sourcing from various sources, namely, borrowing from financial institutions and accessing government schemes.
- Except Gujarat and Sikkim all the states have innovative firms not engaged in R&D activities, intra or extra mural. States like Karnataka, Andhra Pradesh and Tamil Nadu that are high in innovation potentiality have higher percentage of firms not engaged in R&D activities.

- Correlation coefficient between organisational and marketing innovation is as high as 0.75. So, both forms of non-technological innovations go hand in hand, except that marketing innovations have comparatively higher presence in Gujarat, Assam and Tripura. But as the correlation with innovation potentiality shows, organisational innovation has negative relation (small magnitude) whereas positive correlations (of small magnitude) with marketing innovation.
- Most of the innovative firms prefer training in-house. This also does not show much variation over the states as shown in figure. Training in institutions abroad or training with collaborators are rare initiatives. This is also true for accessing sources of funding for training. Rarely innovative firms in states have accessed government or foreign sources for training their employees.
- There is high positive correlation with hardware procurement by states and innovation potentiality. This is true also for software procurement. The purpose of ICT use is mostly for ERP and also for R&D and technology management.

Sector level scenario

- There are 36 sectors that have shares in identified innovative firms totaling 3184. It is to be mentioned here that most of the sectors having larger shares of the innovative firms fall in the low-tech category (as par Eurostat high tech classification of manufacturing industries). It is therefore expected that most of the innovations by the small firms (predominant category in the sample) in the low-tech industry would of 'new to the firm' and introducing 'new machine' types.
- As it was in the case of states, for sectors also we have defined two indicators, namely, Innovation Intensity and Innovation Potentiality. Innovation Intensity is defined as a ratio between number of innovative firms in a sector and total number of firms in the respective sector. Innovation Potentiality is weighted Innovation Intensity, where weights are share of a sector in total innovative firms.
- Rubber and Plastic product sector (NIC 22) has the highest innovation potentiality and second highest share in innovative firms. Manufacturing of food products (NIC 10), which has second highest innovation potentiality, has the highest share of sample as well as innovative firms. They are followed by Tobacco (NIC 13), chemical and chemical products (NIC 20), non-metallic mineral products (NIC 23), basic metals (NIC 24), and fabricated metal products (NIC 25) and have significant shares of total innovative firms.

- Firms with less than 100 workforce dominate the innovation scenario in most of the sectors. Tobacco products (NIC 12), wearing apparel (NIC 14), Computer and electronics (NIC 26), transport equipment (NIC 30) and furniture (NIC 31) have significant presence of larger firms with 100 to 499 workforce.
- Sectors having more than average share of product innovations are not those with highest innovation potentiality. In case of process innovation the picture is opposite – negative relation of moderate magnitude with innovation potentiality. Innovations in product quality and standard have recorded 42.37% of innovative firms at the all India level. However, in terms of innovation potentiality of the sectors no clear pattern is evident. Innovations in more efficient input use show negative correlation with innovation potentiality of the sectors. On the other hand innovation in alternative material use in production system is not very popular.
- Sectors that shows higher usage of external source have negligible shares in the sample and mainly of service industry groups, namely, computer repair (NIC 95), professional and scientific activities (NIC 74) and waste treatment (NIC 38). There is somewhat indication that higher the innovation potentiality lesser is the dependence on internal sources.
- The nature of expenditure for acquiring innovation related capabilities are managed as onetime payment. There is no meaningful correlation with innovation potentiality of the sectors. It means that the behavioural pattern does not change with the innovation potentiality.
- The sectoral scenario for arranging funds for sourcing technology is generally non-innovative. The sector-wise division of innovative firms do show inclination for using domestic financial sources used as often as internal sources. Except the farming sector internal source remain the most trusted source for innovative firms in all sectors. Accessing govt. funding is rare.
- Most of the sectors have large number of innovative firms who are not engaged in R&D activities, intra or extra mural. NIC 21, which is the pharmaceutical, sector and generally considered as R&D intensive is an exception from the general trend.
- Correlation coefficient between organisational and marketing innovation is as high as 0.56. So, both forms of non-technological innovations go hand in hand, except that marketing innovations have comparatively higher presence in NIC 12 (tobacco product), NIC 38 (waste treatment), NIC 74 (Professional and scientific activities) and NIC 82 (Office administration equipments). But as the correlation with innovation potentiality shows,

both forms of non-technological innovations do not have any relation with innovation potentiality.

- Average share of scientist and engineers is about 7%. NIC 22 – rubber and plastics sector has as high as 24% workforce as scientist and engineer.
- Training of the employees is given mostly in-house and this is the practice across the sectors. Training in institutions abroad or training with collaborators are rare initiatives.
- This is also true for accessing sources of funding for training. Rarely innovative firms in any sector have accessed government or foreign sources for training their employees.

National Innovation System (NIS), Regional Innovation System (RIS) and Sectoral Innovation System (SIS)

- Disconnect between the supply and demand system is apparent. So far the NIS is concerned it has been seen that accessing institutional facilities for technological support to innovation is quite high in a few states, like, Assam, Gujarat, Madhya Pradesh, Meghalaya etc. But for states like Karnataka, Kerala and Tamil Nadu – states that are known to be innovation leaders – have poor records in accessing institutional support system for technological knowledge and information.
- Accessing institutional sources of finance is very rare among the innovative firms. Similarly institutional training programme for human resource development is also rarely accessed.
- There is, however, no correlation between states accessing support systems and the overall incidence of 'novelty of innovation', which is overwhelmingly burdened with 'new to firm' category of innovation.
- The RIS on the other hand has high positive correlation with innovation potentiality of the states. States ranked lower in RIS also have poor innovation potentiality. Weak RIS leads to ineffective innovation eco-system.
- Innovation potentiality has negative correlation with Comparative Status of Sectoral Innovation (CSSI) and high positive correlation with Innovation Alignment of Sectors (IAS). These indicate that the presence of the sector that has high innovation potentiality can improve the innovation eco-system of the states.

International Comparison

- In terms of percentage of innovative firms, India is close to the eastern European countries such as Slovakia, Lithuania and Hungry at the bottom of the list.

- In innovation related activities India is far behind the developed countries in intra-mural R&D, but compares well with countries like Poland, but at the same time compares poorly for extra-mural R&D and acquisition of external knowledge.

- Acquisition of machinery, equipment and software has been observed as one of the most important innovation activity accessed by many countries including BRICS countries.

- For non-technological innovations India figures at the top along with those in Cyprus.

Overall observations in brief

- The survey represents mainly the small firms in low-tech manufacturing sectors (as per OECD). Advanced R&D led innovation activities are not expected from the samples.
- Overall a dichotomous innovation system is decipherable from the observations of the survey. Small firms have largest share of the total innovative firms, as they have largest share in the sample. Their innovations are restricted to 'new to firm' category' and corresponding innovation activities are acquiring new machines using internal resources.
- As far as possible these firms avoid external dealings, be it financial resources acquiring new knowledge/technology, financial support or human resource development. Most of them do not access the available wide network of innovation support system offered by various govt. agencies.
- The scenario indicates weak and uncertain market potential of the cost associated with innovations.
- This is reflected in their views on barrier to innovations wherein cost of innovation, availability of skilled manpower and market figure most prominently.
- R&D as the source of innovation remain prerogative of the large firms. Some of these firms do access the support system and also do acquire new technology/knowledge etc. from the market.
- IPR related issues are not found to be of any concern for the innovation activities of the firms.
- Acquistion of machinery, equipment and software emerged as the most important innovation related activity not only in India even in other countires including BRIC countries.

Policy implications

- The STI policy 2013 document envisages an innovation eco-system that emphasises the R&D led dynamism to push the production frontier to an internationally competitive higher economic value. The survey identifies the areas that require support to elevate the innovation activities of the Indian enterprises to attain global height.
- When seen from the perspective of NIS, RIS and SIS, a macro level scenario emerges where the innovations systems require to be rejigged to be more inclusive to accommodate small firms.

- At the NIS level the disconnect between the innovation support system and innovators (particularly small firms) require to be addressed more effectively.
- One way is to introduce the outcome audit of the fund alloctaed and spent for various programmes related to innovation support. The purpose would be to assess the return on the money spent for such purposes. The return may be enumerated as the number of firms accessed the support and the gains accrued to the firm through the support.
- At the RIS level the survey reveals the same textbook wisdom. The infrastructure, physical, educational and health related, has the ultimate role on innovation dynamics of a state.
- The SIS can provide a short-cut route to trigger innovation by initiating high-tech high-innovation led indutries at the states.
- RIS and SIS together indicate the areas of interventions to be guided through State Innovation Councils activated through National Innovation Council.

Areas for Further investigations

Innovation is human capital dependent. Skilled manpower, access to knowledge etc are seen as important barriers to innovations. Innovation surveys have hitherto neglected the working conditions of the human resources, their training opportunities for skill development, and approach to overall human resource development planning. In the context of developing economies like India aspiring to be at the helm of technology leadership, an assessment of the state of human resources in the enterprises and ways and means to elevate the overall standard requires to be examined. Such studies can be undertaken for the firms with and without R&D activities, for sectors that have high innovation potentialities, states that require attention for elevation of their innovation potentialities and for the rural industries and technologies used in rural production system.

Introduction

A. Framework

Measuring Innovation: The National Innovation Survey

S&T driven innovation and knowledge are the key drivers of growth in the 21st Century. Recognizing this, Government of India has declared 2010-2020 as the **decade of innovation** and a new policy focusing on Science, Technology and Innovation has been declared.

Innovation is widely accepted as a complex process having feedback mechanism and involves interactive relations among science, technology, learning, production, institutions, organizations, policy and market.

The traditional S&T indicators used in the assessment and planning of national scientific resources have limitations in capturing the multidimensional innovation process. Many industrialized countries and of late, some of the developing countries have started Innovation Surveys to develop a set of indicators reflecting their national specificities. The **STICK** programme addresses this gap and aims at developing innovation indicators in Indian context.

STICK Initiative

To align with the changing paradigm on innovation the National Science and Technology Management Information System (NSTMIS), Department of Science & Technology has evolved a new initiative named **'Science, Technology, Innovation and Creation of Knowledge (STICK)'**.

DECADE OF INNOVATION

President of India in her address to Parliament on 4th June 2009 mentioned that next ten years would be dedicated as a Decade of Innovation. Prime Minister of India in the 97th Session of Indian Science Congress held on 3rd January, 2010 at Thiruvananthapuram, Kerala also mentioned in his speech that the Government has declared 2010-2020 as the "Decade of Innovations". The main aim of this declaration is to *develop an innovation eco-system in the country* to stimulate innovations and to produce solutions for the societal needs in terms of healthcare, energy, urban infrastructure, water and transportation.

Courtesy: www.parliamentofindia.gov.in

The **STICK** aimed at a) developing indicators to understand the dynamics of innovation and knowledge creation activities and its relation with the economic growth and b) benchmarking the performance of the national innovation system.

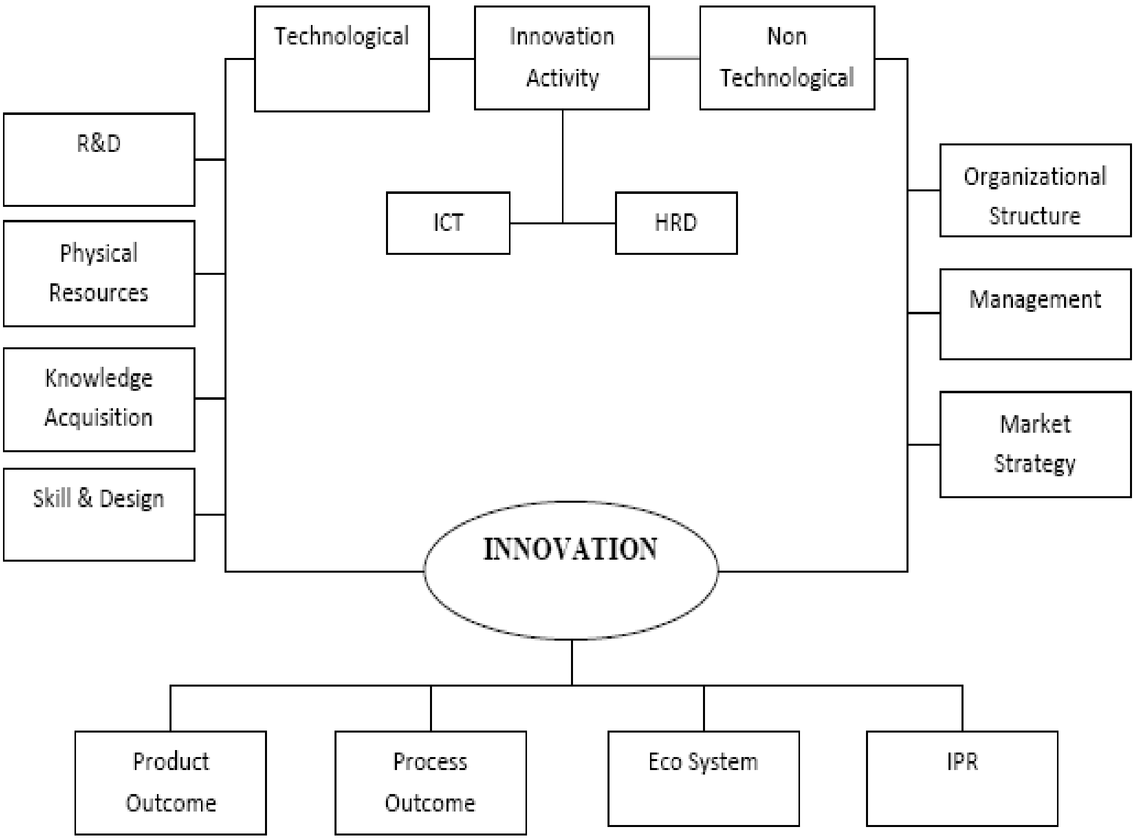
STICK shall lead to policy interventions, development of appropriate incentive structures including cross-cultural comparisons for efficient planning, and fostering the innovation eco-system in India.

National Framework

Over the last few years **NSTMIS, DST** had involved various stakeholders in evolving an appropriate framework to measure the innovation and knowledge creation capabilities in Indian context. The NSTMIS framework draws upon the inputs of the pilot innovation survey, sectoral innovation studies, interactions with the national and international experts while adapting the internationally accepted concepts and definitions on the measurement of innovation.

The STICK envisages measuring innovation and knowledge creation capabilities in terms of product and process innovation, organizational and marketing innovation apart from the new knowledge generation to develop innovation indicators as per the conceptual model (see Fig.1). Based on the various innovation indicators, a STICK Score Card shall be formulated to judge the innovativeness of the various sectors/ regions of the national innovation system.

Figure 1: Schematic view of innovation



Based on the above graphical view of innovation we identify following areas of institutional intervention that can help promote innovations. The identified areas are:

1. Technology Generation: Mainly the R&D organizations as source of new knowledge;
2. Technology diffusion/ Marketing: Organisations responsible for marketing on shelf technologies;
3. Technology Consultancy: Organisations providing consultancy services related to choice of technology, new technology and also technology upgradation;
4. Tools, equipment, prototype development: Organisations imparting skill, R&D and also designing capabilities;
5. Common facilities/ testing centres: Organisations providing facilities for testing, standards, calibration etc;
6. Raw material, machine and equipment supply: particularly important for SMEs and also for a few strategic industries arrangements for supply of raw material is an essential support for innovation. Like raw material, access to required machine and equipment is a critical issue for innovation;
7. Finance, refinance, venture capital: Since innovation bears certain degree of risk, financing, risk financing and refinancing are important support system for innovation;
8. Infrastructure development: Basic infrastructure facilities are the most important support system for innovation;
9. Training and skill development: This helps innovation in two ways – skilled manpower is the pre-requisite for any enterprise on the innovation path; again skilled manpower themselves can bring in new innovations;
10. Entrepreneurship development: Innovation is about enterprises. In a modern world of business and industries an enterprise has to face complex issues related to management. Entrepreneurship development programme are for making budding entrepreneurs confident in assessing the business environment and accessing various facilities and opportunities for making new innovation successful;

The STICK initially concentrates on surveying innovation activities in the industrial sector, which would later be scaled up to the basket of sectors namely public and private research institutions, tiny and unorganized sector including the grass root innovations.

As a part of the framework, the national innovation survey would target a population of more than 2 lakhs enterprises in various industrial sectors spread across 26 States & 6 Union Territories in the country through a statistically valid sampling design. Information on various aspects of innovation would be elicited through a structured questionnaire from the enterprises through personal visits, website including postal and telephonic response etc.

Deliverables

The STICK Programme shall deliver the following:

- National Innovation Indicators Report
- Sectoral, Regional and Industrial Innovation Indicators Reports
- Special Bulletins.

SCHEMES PROMOTING INNOVATION: under

a. Technopreneur Promotion Programme (TePP);
b. Technology business incubators under Science and Technology Entrepreneurship Development scheme;
c. Drugs and Pharmaceuticals Research;
d. Innovation Clusters;
e. Small Business Innovative Research Initiative (SBIRI);
f. Biotechnology Industrial Partnership Programme (BIPP);
g. Open source drug discovery (OSDD) projects; and
h. Grass root innovations through National Innovation Foundation.

Courtesy: www.parliamentofindia.gov.in

Pilot Survey

The National Innovation Survey was preceded by a pilot survey. The Pilot Survey was based on 100 innovators respondents from the manufacturing sector from Delhi (65), Bangalore (12), Hyderabad (13) and other (13). Sectors covered are Engineering 17, Pharma 15, Auto component 21, IT 5 Food 11, Bio-tech 6 Chemical 8 and Misc. 5.

The survey followed the same questionnaire as was for the NIS focusing on firm level attributes and innovations, Innovation activities, sources of finance, human resource development etc. Broad findings of the survey was that 42% of innovative firms in the range of Rs.100–1000 Cr. Product and process innovations are most dominating types of innovations. The group has higher innovation intensity defined by share of R&D

expenditure in the total turnover. Internal source is the mainly used for financing innovation related activities; acquiring technology, new knowledge, training human resources etc.

The survey indicated weak linkages between innovative firms and innovation support system as an important issue understanding innovation eco-system. It has been observed that clients, supplier etc are main sources of information for the innovative firms.

The surveyed firms claimed increased range of product, product quality and enhanced market share as gains from innovation.

As for barrier to innovations availability of finance, access to market, lack of skilled manpower, and lack of facilities like testing and R&D figure most prominently. Details of the survey are available at www.nationalinnovationsurvey.in

The National Innovation Survey (NIS)

The NIS was finally launched in 2010. The details of methodology are given in Annexure 2 of this Report. The survey was based on sample drawn from ASI 2009-10 database for 31 states and Union Territories following NIC two-digit classification. Total 36 NIC two-digit sectors have been identified as having firms engaged in innovation activities. It is therefore not known innovators-respondent based survey as it was done in the case of the Pilot study. It is also not based on a few selected sectors. Again, in case of NIS samples' revenue and R&D expenditure data were not available for large number of sample firms. The firm size was, therefore, assessed on the basis of workforce of the firm instead of turnover. This is also the standard practice in many other international studies. In the absence of revenue and R&D expenditure data firm level innovation intensity could not be estimated in the case of NIS study. Instead we have defined innovation potentiality of the states and sectors for state and sector level comparability.

As we shall see in the NIS Survey results presented in this Report, broad findings of the NIS do match with those of the Pilot Survey with certain differences arising out of the differences in choosing respondents. The Pilot survey respondents were known for their innovations and chosen on the basis of the innovations done. In case of NIS innovators were to be identified. The NIS found New Machinery is the main form of innovations, whereas in case of Pilot study respondents were mostly from Product and Process innovations.

B. Theoretical Understanding and Chapterisation

The survey is not about identification of innovations that is happening in Indian industries. It is about understanding the process that makes innovation happen or constraints innovation from happening. The understanding is through developing and examining a set of indicators that would help promoting and monitoring innovation in Indian production system.

There are more than one perspectives of innovation. The differences in perspectives emanate from the socio-politico-economic conditions within which the actors of innovations function. As it is broadly defined, innovation is 'application of knowledge in the production system, and realisation of the benefit of the new application from the market'. Two important actors, therefore, are production unit or firm and the market. These two actors again reinforce each other. Strong market forces make firm more innovation oriented and offer opportunities for realisation of the benefits of innovation by the firm. Weak market forces on the other hand may function as a disincentive to innovations through the inadequate prospect of realisation of benefit of innovation. This understanding is more functional, theoretically tenable and inducible through policy options than other understanding that sees innovation as revealed talents of individuals or a team dissociated from the production system and market mechanism. Of course, how to integrate such talents in the production system remains an important challenge for the policy makers.

Innovation, therefore, can be identified only when it has completed the journey constituted of both application and realisation. So, in a condition of the presence of efficient innovation support system and strong market forces there would be many more innovations by the production system (firms) than in the cases where both innovation support system and market forces are weak. The latter cases describe the developing economies, whereas the former is the way developed economies would be described. In other words the former better fits a developed economy where innovation is a final outcome; a potentiality realised, whereas the latter is about understanding production system's unrealised potential to innovate of the firms or individual, or the production system in general. The third perspective better describes country like India. Such countries, as generally understood, have more potentiality to innovate than what they have shown as final innovations. These perspectives, however, do not have any quarrel among them. One becomes more relevant than others in a particular context.

Any innovation is the ultimate outcome of various actions undertaken in operational, organizational and marketing activities. These are reflected in the changes initiated in all these spheres of activities. These changes are intended actions by a firm to make innovation happen. An innovative firm can be defined by number of innovations in its fold. It can also be defined by the initiatives towards changes that would make innovation possible. The first one indicates the innovation potential realized by a firm, whereas the second one indicates the potential to innovate. Innovation as final outcome can be evaluated by the indicators like patents, market gains etc. Potentiality, on the other hand, is not easy to enumerate or evaluate and, therefore, poses a challenge for the researchers. The challenge is particularly important for developing countries like India, which have more potentiality to innovate than what is realized as innovations in its economic activities.

The survey, therefore, addresses the question of innovation in Indian industries beginning with a broad definition of innovation, which traces changes introduced by a firm in its production activities, in production organization and marketing arrangement. Clearly all changes are not innovation, but changes with the novelty factors added, do indicate innovations. The approach enriches the understanding in two distinct ways. First, it reveals the nature and types of innovations in terms of changes in the activities, but most importantly it reveals the special characteristics of the innovation dynamics in the context of countries outside the developed world. More precisely, it addresses the question like why the changes, and if the changes are towards innovations what are the gains from the same in terms of relative competitive positions in the market. As we shall see, the approach reveals a whole new understanding about innovation dynamics of India.

Countries can be characterised in terms of their respective innovation potentialities that is realised, under realised, or unrealised. Accordingly a developed country is one with innovation potentiality realised. A less developed country can be described as innovation potentiality unrealised, whereas a developing economy is one where innovation potentiality is

Inclusive innovation is another dimension added to the policy priorities for promotion of innovation. There could be variants of inclusive innovations, from innovations ‘for’ to innovation ‘by’ the people at bottom of the economic pyramid. The present study does not address this question directly. Main focus of the study has been innovation initiatives undertaken by the firms. Issues addressed are how to make their innovation potential realised, how to make the firms in different production sectors more technologically competitive, and how to create a better innovation eco-system for the firms in various production sectors.

To look at innovation as unrealised potentiality helps setting the research and policy agenda for promotion of innovations in the developing economies. In this study the endeavour has been to explore, elaborate and explain innovation potentiality of the Indian production systems, and identify the policy priorities. Our concern is not identification of innovation that has happened. It is about understanding the process that makes innovation happen or hinders it from happening. Innovation as realised potentiality is much easier to measure compared to the unrealised counterpart. The former can be understood in terms of patent and other IPR related claims. They can also be visible in terms of new product or processes. Innovation as unrealised potentiality poses formidable challenge to the researchers for indicators. In the present study the potentiality has been captured by various changes initiated by a firm. Innovative firms have been identified as those who introduced technological and/or non-technological changes in their respective production operation and production and marketing organization. A change by itself does not qualify to be an innovation. But changes (as an intended act) undertaken by a firm can be seen as ‘innovation potentiality’ of that firm. At the firm level we identify this potentiality to innovate by enumerating changes (the firm has introduced) that can be grouped under operational, organizational or/and marketing changes. This

In the present study innovation potentiality of a firm has been captured by the technological and non-technological changes introduced by a firm in its production operation, organisation and marketing activities. Such firms have been identified as having innovation potentiality. We have used the nomenclature is further examined by detailed information on activities (both technological and non-technological) undertaken by the firm, including sourcing or creating various hardware and software capabilities, finances, and Human Resources. Throughout the report the word "innovative" has been used for innovation potentiality of a firm. Together these issues constitute the indicators on which the questionnaire for the survey has been designed.

The conceptualization had proceeded the following ways. Innovation is an intended act undertaken by a firm. It accesses various sources for various types of information to identify the scope of innovation and sets the goal. Based on the information gathered from various sources it sets the road map, a strategy to achieve the goal. The strategy is essentially exploration and accessing various sources for mobilisation of physical, financial and human resources. On the other hand it also sources technology (partial or full), knowledge (both tacit and formal), enter into various types of collaborations and agreements. In terms of innovation the outcome would be changes in product, process, quality, energy consumption, raw material use etc. And in terms of gains it would see expansion of market, new products in the portfolio, cost saving etc. along with better competitive positions in the market. Sourcing and processing information play crucial role in all aspects of innovation related activities; from goal setting, strategizing to accessing resources. In reality the process is not as linear as it is stated here for the sake of brevity.

The innovation dynamics at the firm level varies over regions (states/provinces), industries (sectors) etc. in addition to firm's own internal dynamics. The sectoral and regional specificity of innovation dynamics is well known. The present survey attempts to capture the specificities within the overall or aggregated scenario of innovation dynamics. This helps identification of the comparative specificities and better understanding of the innovation dynamics of the Indian economy.

As for the population base of the survey we have used ASI database (2009-10), which is the only systematic enumeration of the industries across the states and sectors (following NIC codes). The survey has used two-digit NIC code as the population base of the survey. ASI database (2009-10) enumerated total 208415 firms in 32 states and UTs. The stratified random sampling was done for 31 states (Manipur was excluded because of prevailing unrest in the state), 96 industrial segments for firm sizes classified under four categories in terms of the size of the work force. Information was collected from 9001 firms using a pre-designed questionnaire.

The study is based on the data generated through National Innovation survey –a firm level survey covering 31 states and Union Territories. Stratified random sampling was taken to represent states and two digit NIC codes from the population of 208415 reported in ASI (2009 – 10). The stratified random sampling was done for 31 states (Manipur was excluded because of prevailing unrest in the state), 96 industrial segments for firm sizes classified under four categories in terms of the size of the work force. Information was collected from 9001 firms using a pre-designed questionnaire. Throughout this report reference to a sector would always mean the corresponding NIC code.

This Report presents the insights gathered from the survey data. The report is structured around broad issues that surfaced from the analyses of the data. Technical aspects like methodology, sampling, coverage and data are presented in the Annexure 2. Annexure 1 provides brief innovation profiles of the 26 states and 5 Union Territories. Annexure 3 presents a comparative approaches adopted and results derived by the surveys underatken by other countries. Annexure 4 gives the Questionnaire that has been used for the Survey.

The main body of the result leading to understanding innovation in Indian context is presented in 13 main chapters sequenced as follows. The first chapter is named Macro perspective that provides overall picture of innovation. Questions like - are innovation activities related to size of firm (chapter 2), age of the firm (chapter 3) and ownership types of the firm (chapter 4) examined in the subsequent chapters. Chapter 5 examines various aspects of types of innovation essentially in the form of changes introduced by the firms both technological and non-technological types. Chapter 6 makes a distinction between innovative firms with R&D and without R&D related activities to examine the comparative innovation related activities. Chapter 7 throws light on the non-technological innovations, or, organisational and market related innovations undertaken by firms. Chapter 8 discusses the barriers to innovations as articulated by the firms studied. Chapter 9 and 10 bring in state and sector specificities, respectively for innovation. In chapter 11 we try to examine the overall innovation scenario in terms of Regional innovation System., National Innovation System and Sectoral Innovation System. Chapter 12 presents international comparisons of the results derived from surveys. The last chapter presents summary, discussion and policy implications.

The study is based on National Innovation Survey Data covering 26 States and 5 Union Territories. Samples were drawn to represent states and UT and also the production sectors defined by two digit NIC codes. Population base was taken from ASI 2009-10.

Total population base: 208415 units Total sample surveyed: 9001

The report has four annexures. Annexure 1 presents brief profile of the states and Union Territories covered in the suyrvey. Annexure 2 details the methodology of sampling and data collection. Annexure 3 presents the coverage in different surveys undertaken by selected countries. Annexure 4 is for the full questionnaire used for the survey.

I
Innovative Firms

Highlights

- Technological innovations are in the form of 'introduction of new machines' followed by 'product quality and standard'.
- Only 35% innovative firms initiated Non-technological innovations (both organisational and marketing).
- Most of the innovative firms have less than 100 workforces, are privately owned, and equally divided among pre 1990, 1990-2000 and after 2000 as year of establishment.
- Innovative firms consider themselves either at par or ahead of their competitors.
- Increased range of products, improved quality and standards, increased production capacity and reduced environmental impact are the gains from innovations.
- Most of the innovations are 'new to firm' types.
- Domestic financial institutions are the main external Sources for finance.
- About 53% innovative firms do not employ any scientist or engineers.
- Cost factor and availability of skilled manpower are the most important barriers to innovation.

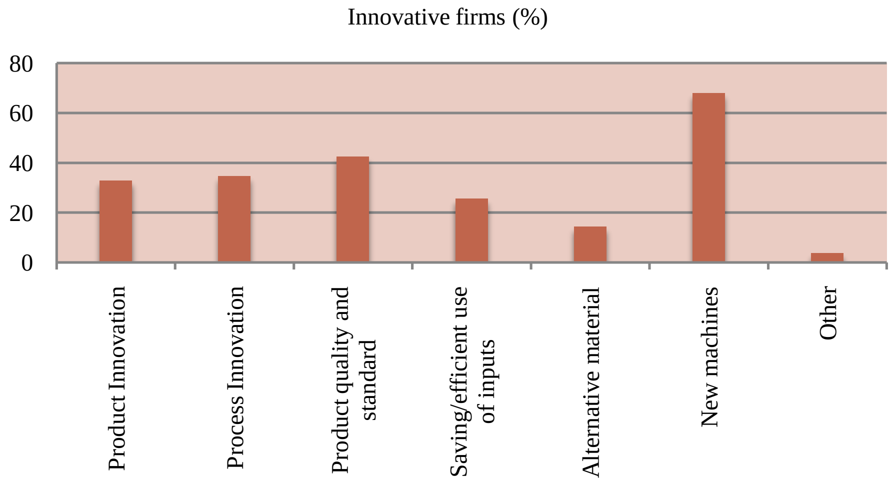
Innovative Firms

A total of 9001 firms were surveyed across 26 states and 5 Union Territories of India and out of these 35.37% firms reported different types of changes in their production, organisational and marketing practices. This chapter presents the overall innovation scenario observed in the survey. Broadly structured as running view from types, novelty and gains of innovation, to types and characteristics of the innovators their strategies, mobilisation of physical, financial and human resources etc.

Types of Innovations

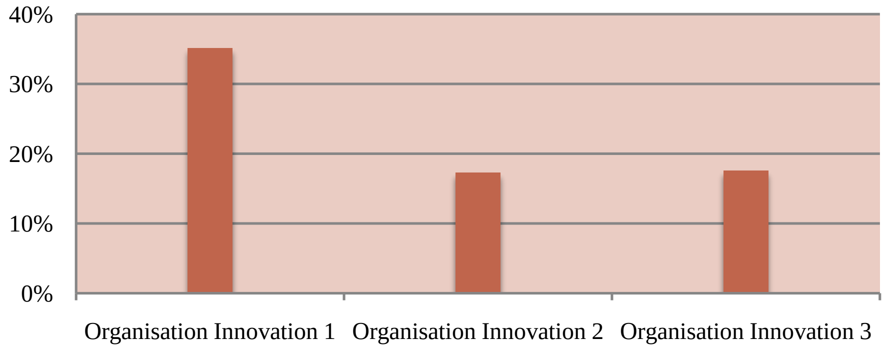
Innovative firms were identified based on their responses on certain changes initiated by them in different categories like product innovations, process innovation, quality and standard, improvement in the existing product, changes in the input use, use of new or alternative material, introduction of new machines etc. Figure 1.1 shows the types of innovations carried out by the innovative firms. Figure refers to the percentage of total innovative firms engaged in particular type of innovation. Many innovative firms have reported more than one type of innovations but majority (about 68%) of firms have mentioned introducing new machineries in the production system. Product quality and standardisation is claimed by 42% of firms and product and process innovations by 33% and 35% of firms respectively.

Figure 1.1: Types of innovations



Innovation activities also include new business practices or bringing about changes in organising procedures and marketing concepts and strategies of the firms. An organisational innovation is a new organisational method within a firm's business activity which may include implementation of new or significant changes in firm structure that are intended to improve the firm's use of knowledge, the quality of goods and services or the efficiency of work flows. Figure 1.2 shows the changes in organisational behaviour of the firms. About 35% firms indicated new or improved management systems to better use or exchange information, knowledge and skills within their enterprises.

Figure 1.2: Organisational Innovation



Note:

Organisation Innovation 1-New or significantly improved management systems to better use or exchange information, knowledge and skills within your enterprise.

Organisation Innovation 2-A major change to the organization of work within your enterprise such as changes in the management structure or integrating different departments or activities

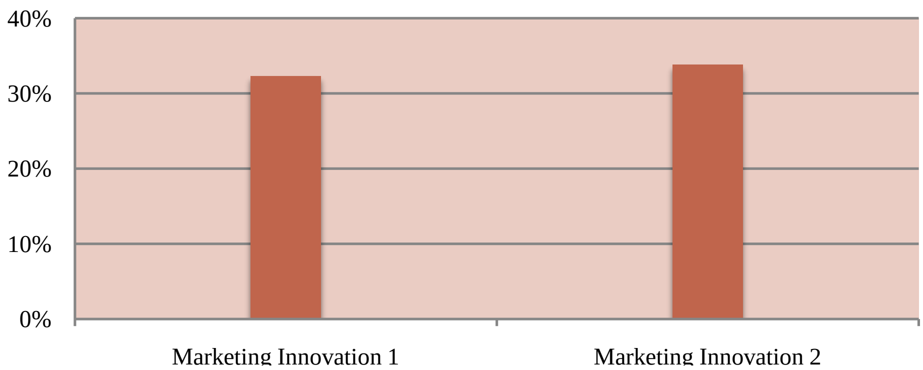
Organisation Innovation 3-New or significant changes in your relations with other firms or public institutions such as through alliances, partnerships or outsourcing

Marketing Innovation can be broadly categorised as consisting of following activities or initiatives taken by the firms to create or enter new market.

- implementation of new or significantly improved designs
- expansion of production and marketing domain
- targeting and creating new market

Figure 1.3 shows the changes in marketing strategies as reported by the firms.

Figure 1.3: Marketing Innovation



Note:

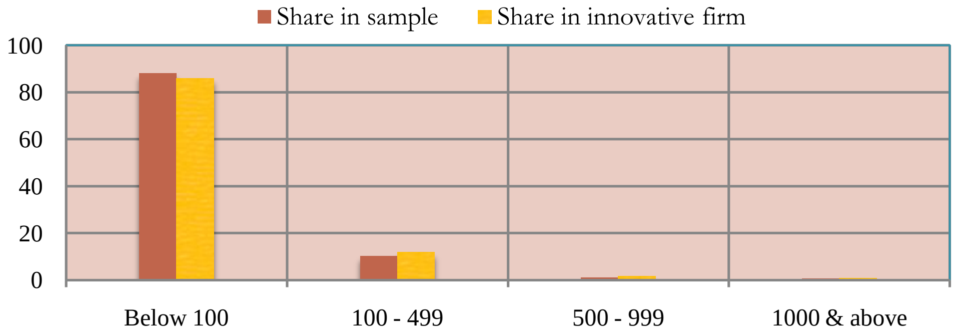
Marketing Innovation 1-Significant changes to the design or packaging of a goods or service (excluding routine/ seasonal changes such as clothing fashions)

Marketing Innovation 2-New or significantly changed sales or distribution methods such as internet sales, franchising direct sales or distribution licenses

Size of the innovative firms

In the absence of reliable data on turnover of a firm, we have used the total workforce of the firm as measure of the size of the firm. Figure 1.4 shows the size of the innovative firms. Firms that fall in the 'below 100' category of workforce constitute more than 80% of the total sample and about 86% of the total innovative firms. Firms in the 100- 499 category have 10% share of the sample and 11% share of the innovative firms. Share of the innovative firms, having workforce more than1000, is only 0.72%.

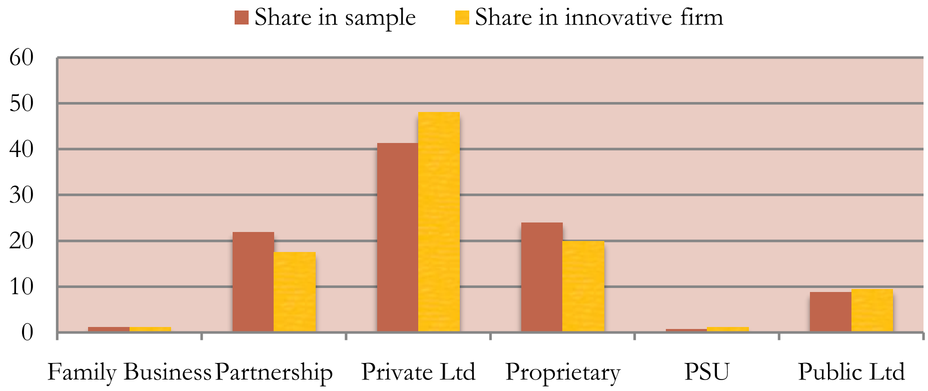
Figure 1.4: Size of the innovative firms



Ownership type of the innovative firms

The ownership type of firms is shown in the figure 1.2.More than 45% innovative firms are privately owned, whereas about 20% each are under partnership or proprietary business.

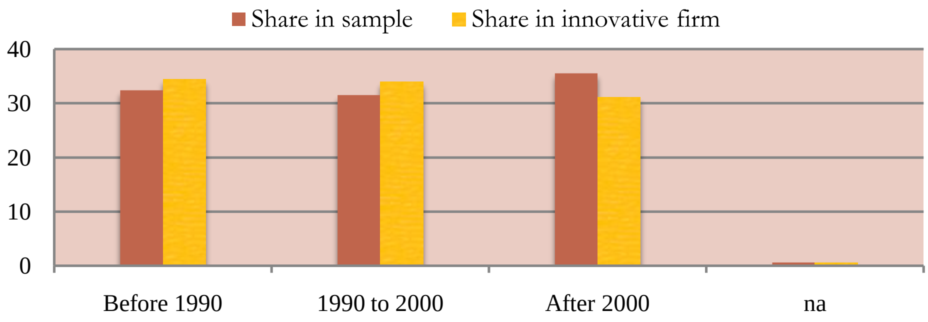
Figure 1.5: Ownership type of the innovative firms



Age of the innovative firms

It is interesting to note that innovative firms are more or less equally distributed over the three broad age groups, namely, firms established before 1990, that is before the first definite step towards opening up of the Indian economy; firms established between 1990 and 2000 – post opening up growth phase of the Indian economy; and after 2000 the new firms in a liberalised economy (refer Figure 1.6). It might mean that the new look Indian economy provide innovation opportunities for old and new alike. It may also mean that there was hardly any change in the innovation environment between pre and post opening-up of the Indian economy.

Figure 1.6: Age (year of establishment) of the innovative firms



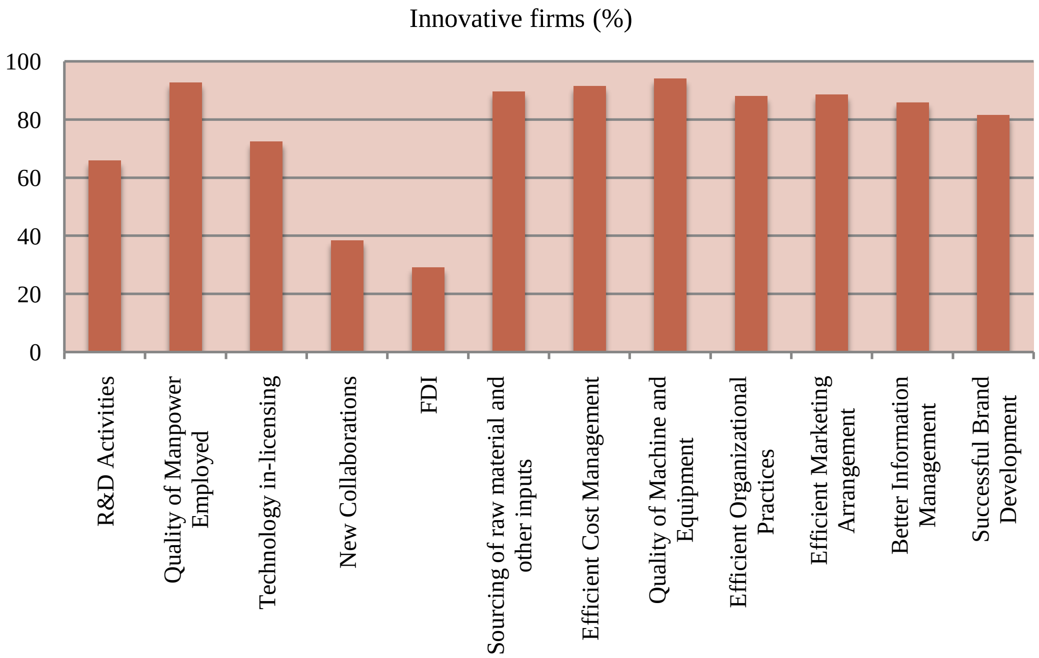
Post Innovation Position of firms

How do the innovative firms perceive themselves vis-a-vis their competitors in the context of their achievements through innovations? This is captured by the perceptions of firms about their respective competitive positions in the industry, kinds of gains made by the innovative firms and novelty of their innovations.

i. Competitive status of innovative firms

Figure 1.7 presents the perceptions of the innovative firms in this regard. Most of the innovative firms consider themselves ahead of, or at par, with their competitors. It can also be stated from the figure that making new collaborations and attracting FDI are not the strong points of the innovative firms. Only 65% firms consider themselves ahead or at par in R&D related activities, again showing not much involvement in R&D activities.

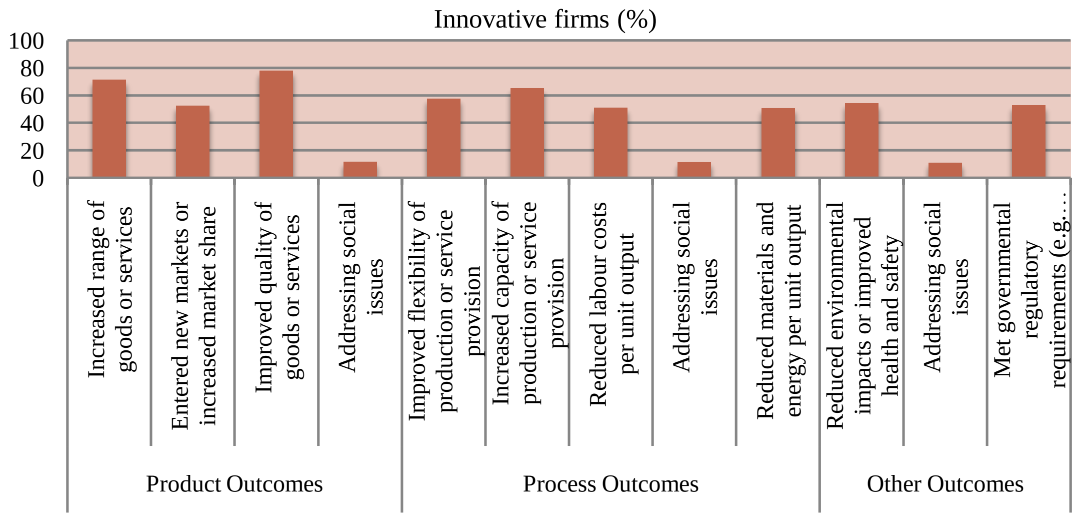
Figure 1.7: Competitive status of the innovative firms vis-a-vis others



ii. Gains from innovation

The extent of gains from innovation, the nature of the gains etc. are examined in the following figure (figure 1.8). The figure shows the percentage of innovative firms expressing the various types of gains from the innovations undertaken. More than 70% firms claim improved quality of goods or services and increased range of goods or services as their major gains from innovation. About 53% of firms have claimed their innovation to have increased their market share. Most of the firms have also claimed increased capacity of production or service provision as their outcome of innovation.

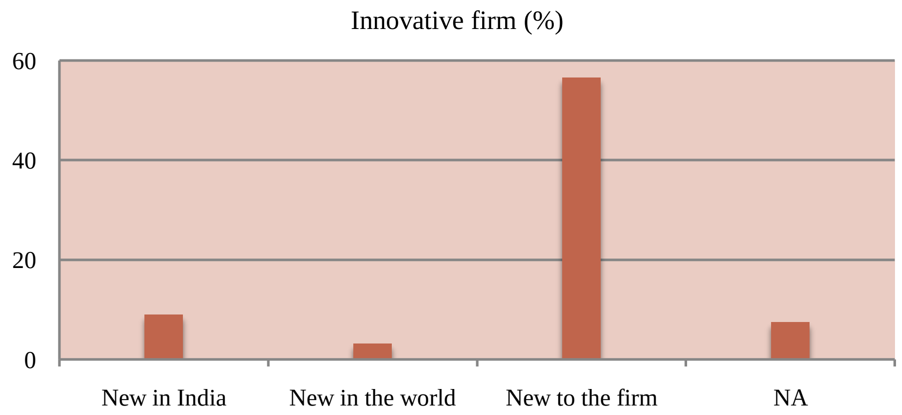
Figure 1.8: Gains from innovations



iii. Novelty of innovation

Innovation is all about novelty in doing things. Figure 2.3 suggests that for 57% firms' innovations undertaken was new to the firm. In other words, innovations by these firms were to catch up with the competitors in the market. Only 9% firms claimed their innovations to be new to the country.

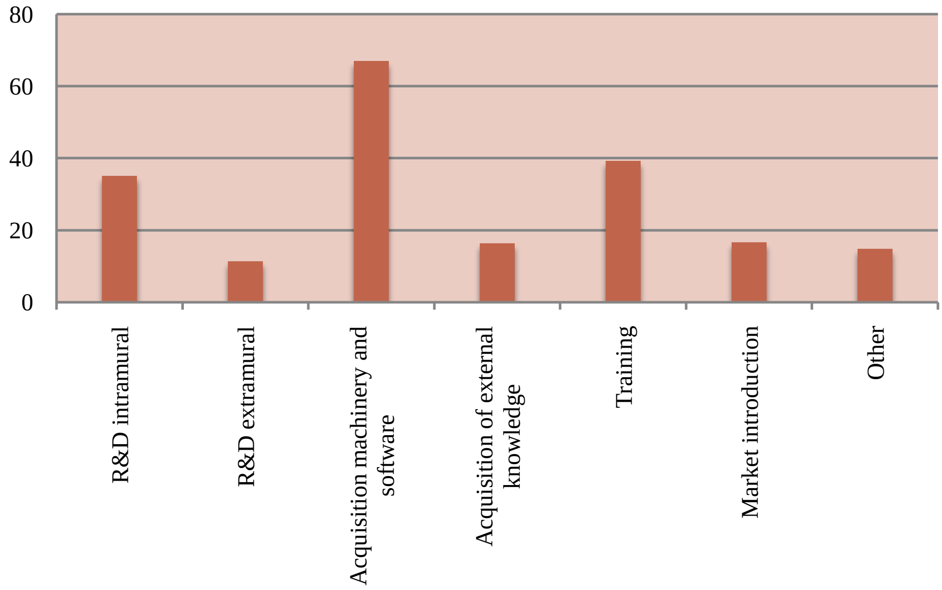
Figure 1.9: Novelty of innovations



Innovation Activities

Activities generally associated with innovation are broadly grouped under R&D (both extra mural and intra mural), acquisition of hardware and software, acquisition of knowledge, training of the manpower, activities related to market introduction of innovation etc. Figure 1.10 shows that about 30% of the innovative firms have some kind of intra-mural R&D activities, 40% firms have emphasis on training. But for close to 70% firms' innovation activities are centred around acquisition of hard and software.

Figure 1.10: Activities towards innovations



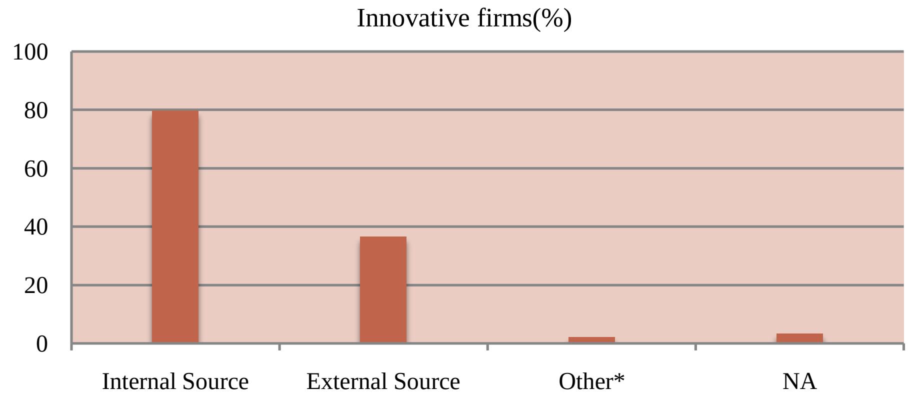
Strategies for Innovations

There are various ways a firm reaches the innovation end. It depends on wide variety of business practices and allocation of resources for innovation. We have identified the following few as important acts, which together or singularly can contribute to innovation. These are: sourcing innovation; sourcing technology; intra-mural R&D; extra mural R&D; bringing about changes in firm structure and management methods. Broadly they are divided into technological and non-technological innovations. A firm's strategies for innovation would be a mix of some of these means.

i. Sourcing innovation

By whom were these product or process innovations developed? The sources include internal sources, external sources and with other enterprise or institutions which include universities/government laboratories etc. The following figure (figure 1.11) shows the percentage of innovative firms along with their sources of innovation. Majority of the firms (about 80) mentioned that their innovations were developed by internal sources, 37% mentioned external sources and only 2.2% said in collaboration with other enterprise or institutions.

Figure 1.11: Source of innovation



ii. Sourcing Technology

Firms acquire technology from external sources to gain technological competencies and to facilitate or upgrade their production system. From the following graph (figure 1.12) the percentage of firms acquiring patented technology, knowhow or trade secret to upgrade their facilities can be figured out. Of the innovative firms only 3.6% of firms have acquired patented technology followed by 1.4% firms acquiring knowhow. And mostly these technologies are acquired from open domestic markets as shown in figure 1.13. Only 4 to 5% of firms acquire the technology from foreign market and collaborators.

Figure 1.12: Sourcing Technology

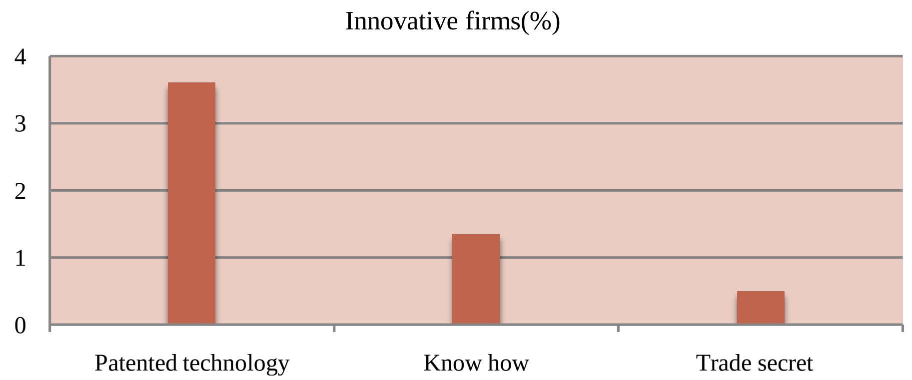
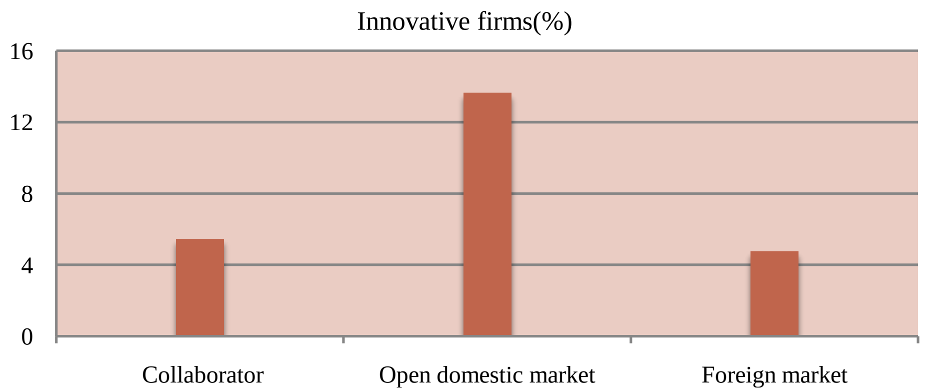


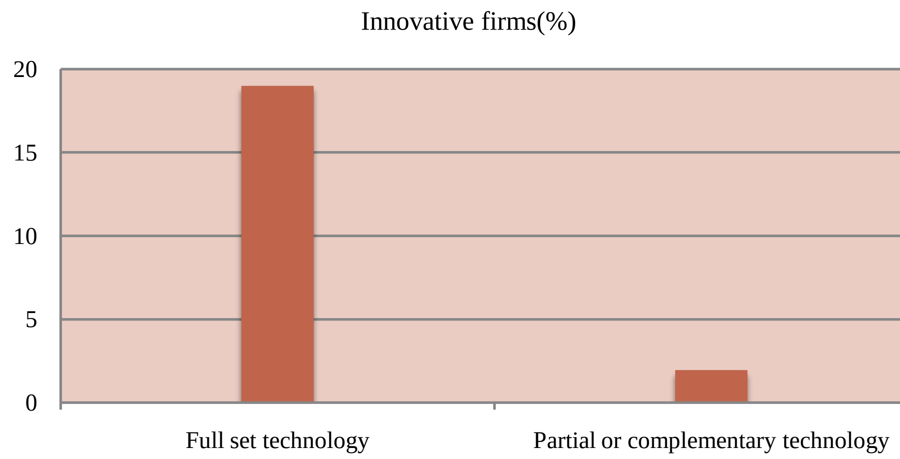
Figure 1.13: Acquiring technology



iii. Extent of technology

The technologies are acquired either as full set technology or partial technology. Figure 1.14 shows the extent of technology acquired by the firms. About 20% of the innovative firms acquire full set technology whereas only 2% acquire partial or complementary technology.

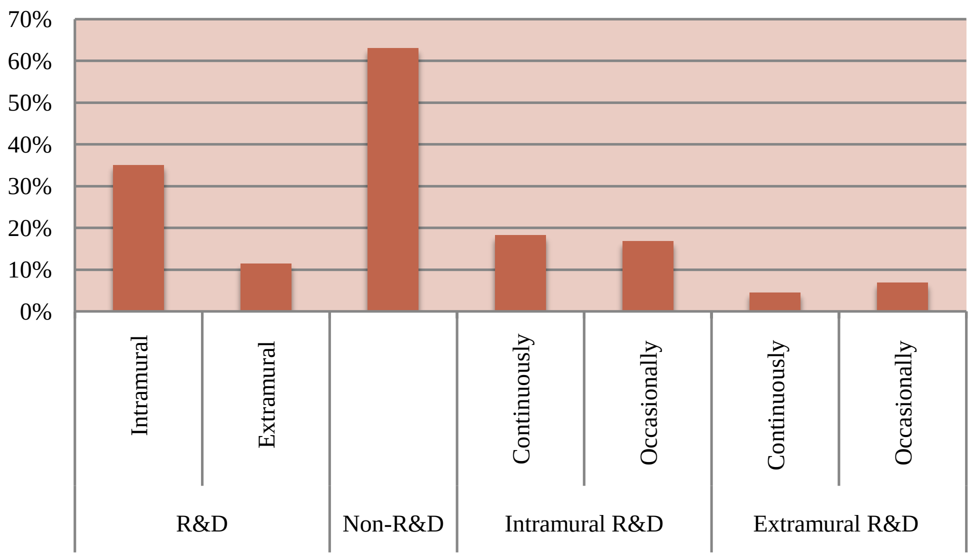
Figure 1.14: Extent of technology



iv. R& D activities of the innovative firms

For a firm to innovate it requires synergizing R&D along with sourcing technology. The following figure (1.15) is based on the responses of the firms either involved in R&D activities or not and also those doing R&D whether it is internally within the firm's own set up or externally in collaboration with other university or research institute. From the figure it is seen that only 45% of the innovative firms are involved in R&D of any form and mostly these activities are intramural which is also indicative of limited collaboration with research institute or universities to enhance innovativeness.

Figure 1.15: R&D activities of innovative firms



Transactions

How do the firms acquire these new technologies? On what terms and conditions do they acquire these technologies? Firm's mode of acquiring new technology is shown in figure 1.16. It is seen that about 15% of the innovative firms purchased the technology followed by about 9%, who licensed the technology from external sources. Mostly these technologies were acquired on an agreement for their maintenance, up gradation and also providing necessary training to the employees of the firms. Figure 1.17 gives an account of the acquisition agreement by the innovative firms while acquiring the technology.

Figure 1.16: Mode of acquiring new technology

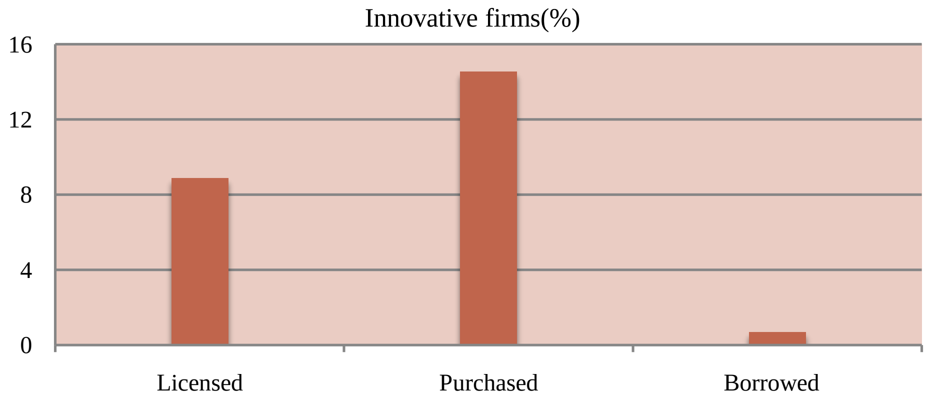
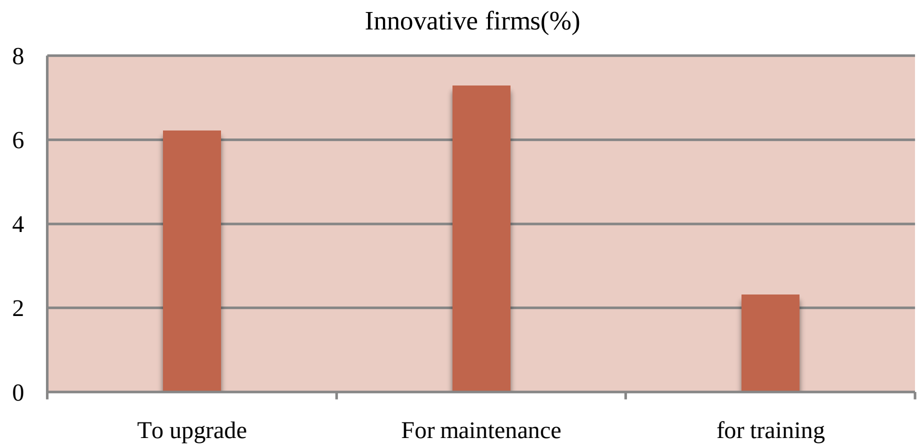


Figure 1.17: Acquisition agreement of technology



Financing

Availability of fund for innovation is an important aspect of the innovation ecosystem. Figure 1.18 revels that most of the firms depend on domestic financial institutes and internal sources for financing innovations. Only 1.5% of innovative firms responded to have availed government funds for their innovation activities. The expenditure incurred for such innovation activities is shown in figure 1.19.Though the response rate is very poor, about 14% of innovative firm mentioned their expenses were incurred as onetime payment followed by 2% firms who mentioned as onetime payment and upfront.

Figure 1.18: Source of finance

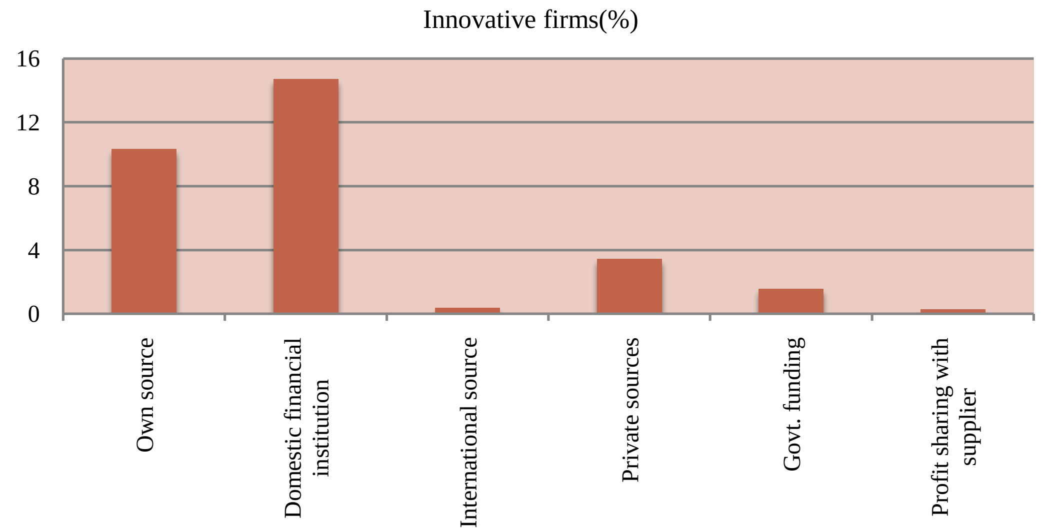
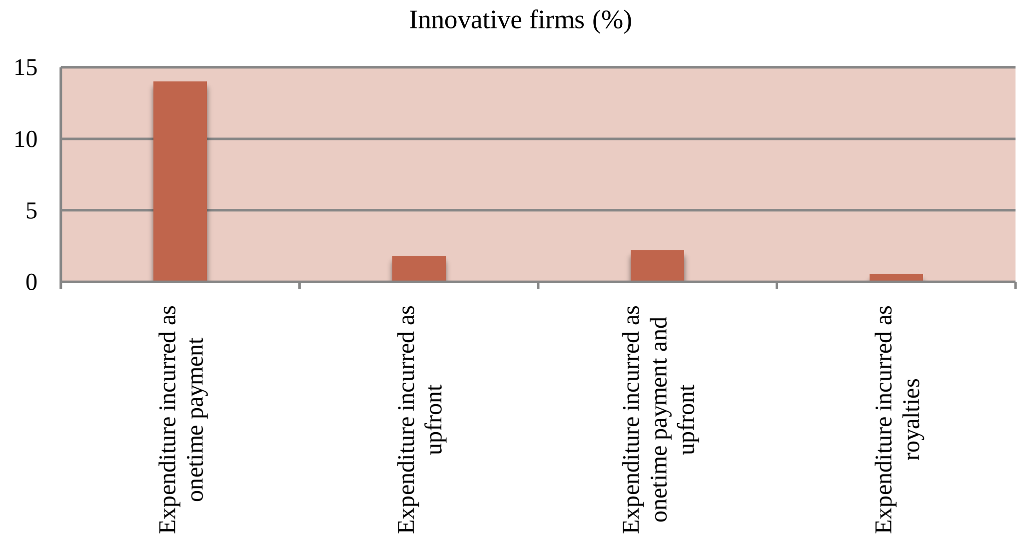


Figure 1.19: Expenditure for innovation



Human Resource

Another indispensible component of innovation related activities is human resource. Figure 1.20 shows the percentage of innovative firms having the number of scientists, engineers and management professionals employed in their enterprise. From the figure it is seen that most of the firms have less than 10 technical persons. More than 50% firms have reported of not having any scientist or engineers in their organisation and only about 35% mentioned of having less than 10 scientists and engineers working for them. For skill development and to be at par with their competitors the firms impart training to their employees. When surveyed, about 50% firms mentioned of human resource development programme and providing training but accessing the skill development programmes outside the firm is very rare among the innovative firms. Out of the firms providing training about 45% opt in-house training (figure 1.21).

Figure 1.20: Skill base of the Innovative firms

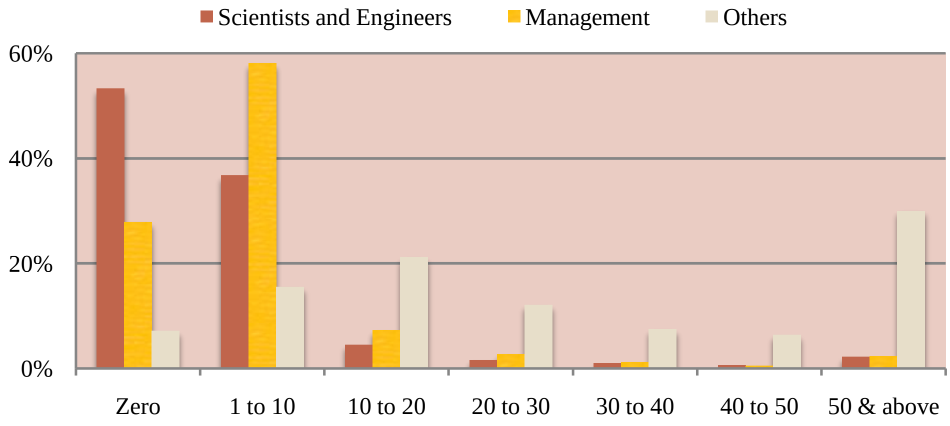
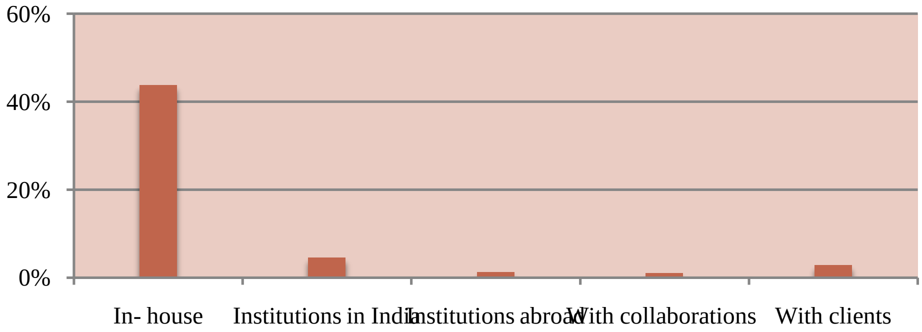


Figure 1.21: Training provided by innovative firms



The orientation of the training provided is shown in figure 1.22. Mostly the firms provide training for technology skill development, management programmes and also on new product and processes. Such initiatives are encouraged as it helps a step forward meeting innovation end. However very few firms mentioned of R&D project related and information technology related training which again shows poor R&D infrastructure and less ICT usage.

Funding of training and skill development is shown in figure 1.23. About 90% of the firms providing training access mainly internal sources to fund their training programmes. Very few firms are seen to access government funds to provide training.

Figure 1.22: Orientation of Training

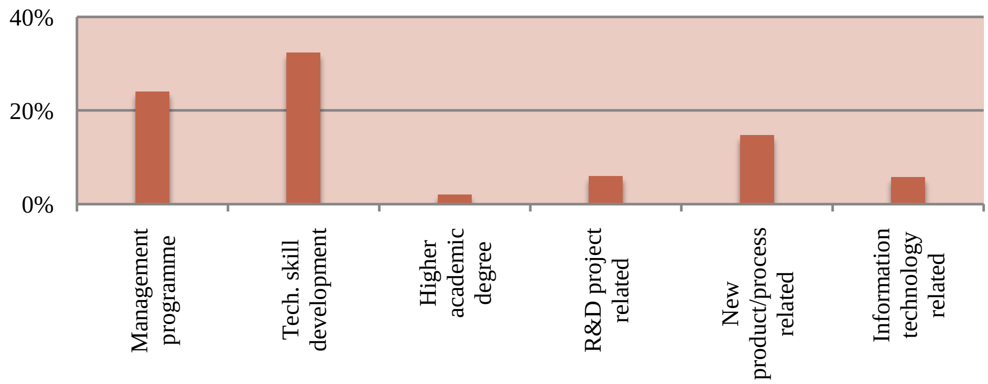
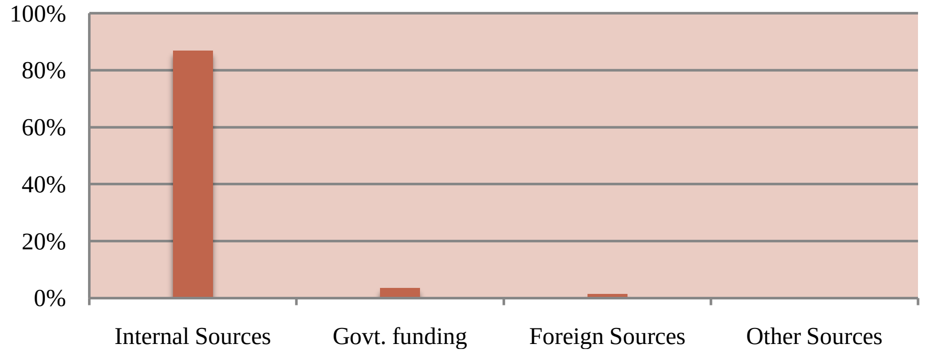


Figure 1.23: Funds for Training



Informatisation

Innovation as application of new knowledge makes accessing and processing of information an important tool to accomplish innovation. Extent of ICT use has been used as an indicator of informatisation of the innovative firms. Figure 1.24 shows the percentage of firms acquiring computer software like database, operating system, application software etc. and hardware like server, PCs modem etc. during the last three years. More than 50% of the innovative firms responded to have acquired hardware and about 43% acquired software for usage. Also 35% of innovative firms mentioned of using software for more than three years. Their level of usage during the last three years is shown in the next figure (figure 1.25). Overall it is seen that use of ICT for is quite insignificant among the innovative firms.

Figure 1.24: ICT Acquisition

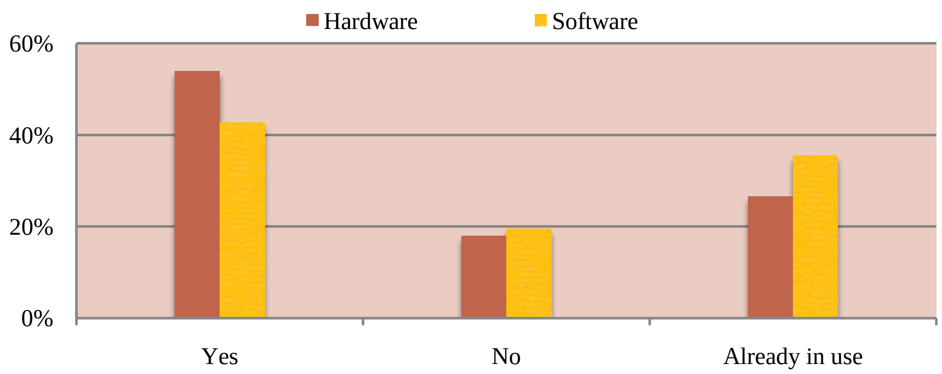
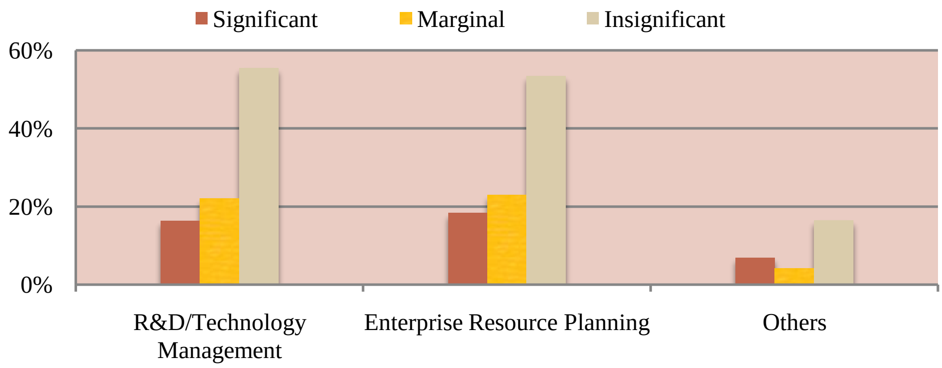


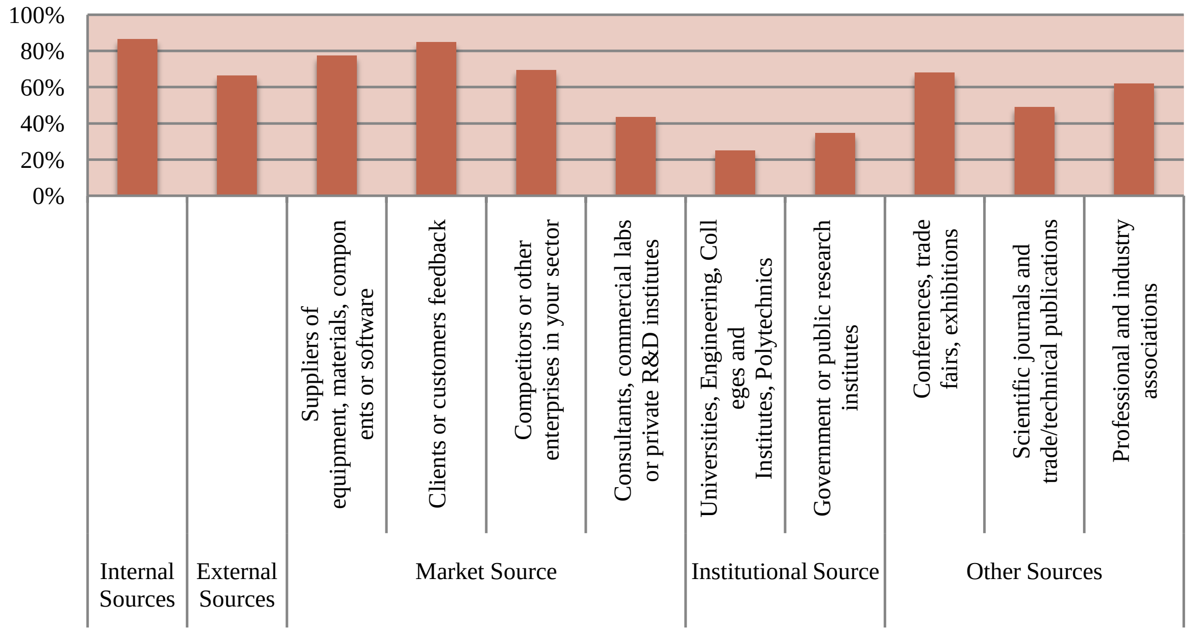
Figure 1.25: ICT Usage level



Source of Information

It is important to know how well networked a firm is in terms of accessing resources that contribute to strengthening of innovation activities. By resources we mean inputs such as technological, financial, managerial etc, also in the form of soft inputs (information and knowledge) and hard inputs (machines and equipments). Firms can gain knowledge, advice or even inspiration for their prospective innovation related projects from a variety of both public and private sources. Figure 1.26 refers to engagement of firms with external sourcing like innovation related knowledge and information.

Figure 1.26: Accessing Sources of Information

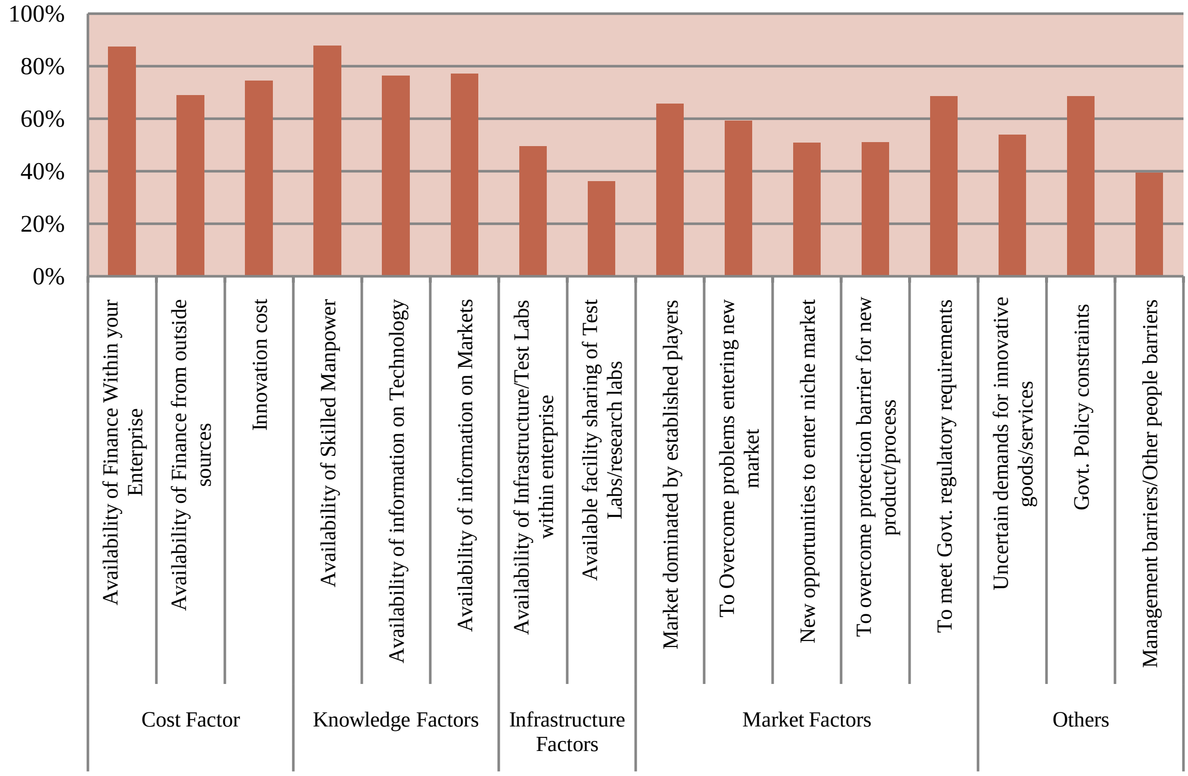


Innovative firms reported internal and market sources as most important for information on innovation. It appears that they are dependent more on their own sources coupled with networking with clients and customers, suppliers and consultants of external technology and also with competitors.Very few has reported accessing institutional source of knowledge which shows weak linkages between them.

Barrier

There are various factors that are perceived as critical for promotion of innovation. These factors can be internal obstacles that the firm encounter while carrying out innovation activities as well as external factors preventing innovations. The survey asked about a range of factors and their effect on the ability to innovate. Figure 1.27 shows the percentage of firms considering a factor very important barrier to innovation. As seen in the figure the most important factors that hinder innovation are non availability of finance, skilled manpower, information on market, new technology etc.

Figure 1.27: Factors influencing innovation



In Nutshell

Broad picture that emerges is that innovations in Indian firms are mainly in the form of introducing 'new machines'. Also the novelty factor of the innovation is essentially 'new to the firm'. The innovative firms, therefore, are concerned about following the industry practice and not leading the industry. Privately owned small firms are the mainstay of the innovation initiatives. This is consistent with the fact that most of the firms depend on their own resources for accessing new technology, new knowledge and information. Very few have R&D activities and scientist and engineers as part of their innovation related activities. High cost associated with innovation accompanied by access to market constrained by established players is perceived as the main barrier to innovation.

II

Size and Innovation

Highlights

- Sample firms are categorized into four size classes, namely, below 100, 100 to 499, 500 to 999 and 1000 and above workforces.
- Firms within larger size categories show more propensity to innovate.
- In terms of R&D activities, technology in-licensing, employing qualified manpower, organisational and marketing practices mostly larger firms are more active than their smaller counterparts.
- Product innovations by the small firms are mainly minor innovations and 'new to the firm' type. Large firms engaged in product innovation have gained increased market share.
- Involvement in R&D activities increases with size and most of these activities are in-house activities. Extramural R&D activities are rare and even rarer for the small sized firms.
- Innovations by the small firms are mostly by using their own sources. Accessing external source for knowledge and information is mostly practiced by the large firms.
- The average number of skilled manpower increases with the size of the firms. The same has been observed for training of employees.

Size and Innovation

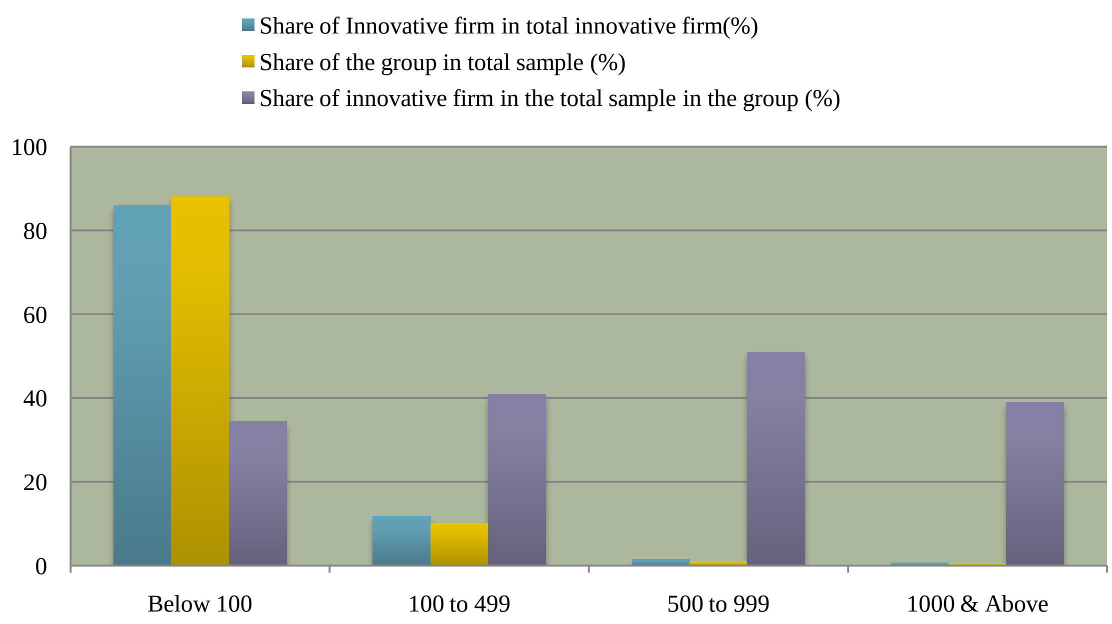
This chapter focuses on size and innovation activity of the firms. Size of the firms has been considered as an important determinant of innovation, having evidences supporting contesting hypotheses that both small and large firms being innovative. The data generated from the survey can throw light on this issue in Indian context. For the present purpose we have taken total workforce employed as a measure of size of the firm. Based on workforce employed firms are classified into four size categories namely, below 100, 100 to 499, 500 to 999 and 1000 and above. For the present purpose we have termed firms having workforce less than 100 as small firms, firms with 100 to 499 workforces as medium firms, with 500 to 999 as medium-large and with more than that as large firms.

We examine all the issues related to innovation in terms of size of the firms. We look at the types of innovations in terms of size, and present observations if innovation strategies, resource mobilisation, innovation activities, human resources etc. are dependent on firm size? The observations are based on 3184 innovative firms identified by the survey from a sample of 9001 firms across states and sectors.

Are small firms more innovative?

The following figure (figure 2.1) gives a picture of the share of innovative firms of different size categories. The figure presents three ratios, namely, share of innovative firms in a size group in total innovative firms, Share of a size group in total sample, and share of innovative firms in the total sample for the group. From the figure we find that the group with 500 to 999 workforce have higher share of innovative firms proportionate to the group's share in the sample. Next to it is the group with 100 to 499 workforce closely followed by 1000 & above. Though the share of firms surveyed is more in below 100 category, their innovation activity appears to be lower than those with larger workforce base.

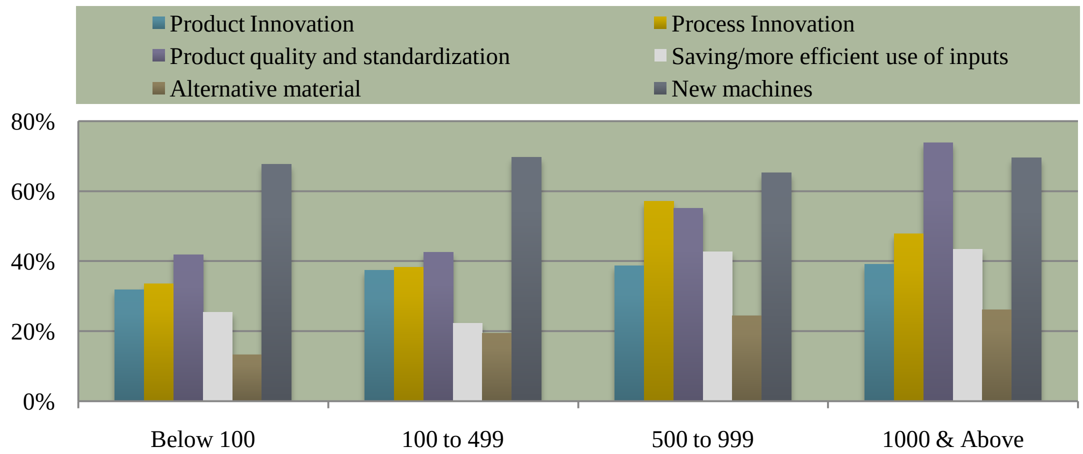
Figure 2.1: Size wise share of the innovative firms



Do types of innovation relate to size?

The most common type of innovation as seen in earlier section is introduction of new machines in their production system followed by product quality standardisation. Figure 2.2 shows the types of innovation in terms of different size category. 'New machines', being the dominant type of innovation, is higher for all the size groups except for the large firms with workforce 1000 and above. The large firms having 500 to 999 and 1000 and above workforces are more involved in activities like product quality standardisation and efficient use of inputs which are less common among the small sized firms. Also process innovation and product innovation are reported more by the large firms than their smaller counterparts.

Figure 2.2: Types of Innovation and Size of the firms



Post Innovation Position and Size

i. Can smaller firm improve their competitive positions through innovation?

Innovations create better competitive positions for the firms in the industry. One of the major drives for innovation is to be at par or ahead of their peers in the industry. To assess the competitive status of the firms we examine how the firms rank themselves post innovation against their competitors in activities like R&D, quality of manpower employed, technology in-licensing, new collaborations, FDI, cost management, sourcing raw materials, quality of machines and equipments, organisational practices, marketing arrangement, information management, and successful brand development. The following three figures (Figure 2.3, 2.4 and 2.5) describe how the smaller and larger firms rank themselves against their competitors. In general we find most of the innovative firms of all size categories either consider themselves ahead or at par with their competitors in majority of activities, however, small firms show weak links for FDI and new collaborations. In terms of R&D activities, and technology in-licensing, large firms are seen to be more involved as compared to their smaller counterparts (figure 2.3). Large firms claimed to be ahead of others in the industry in employing qualified manpower. In terms of organizational and marketing practices it is seen that small firms slightly lag behind in both the practices (about 88% firms) in comparison to 94% of large firms doing the same. Again for successful brand development the large firms are seen to take an edge over the others. (Refer figure 2.5).

Figure 2.3: Size wise distribution of innovative firms and their competitive status vis-a-vis others (I)

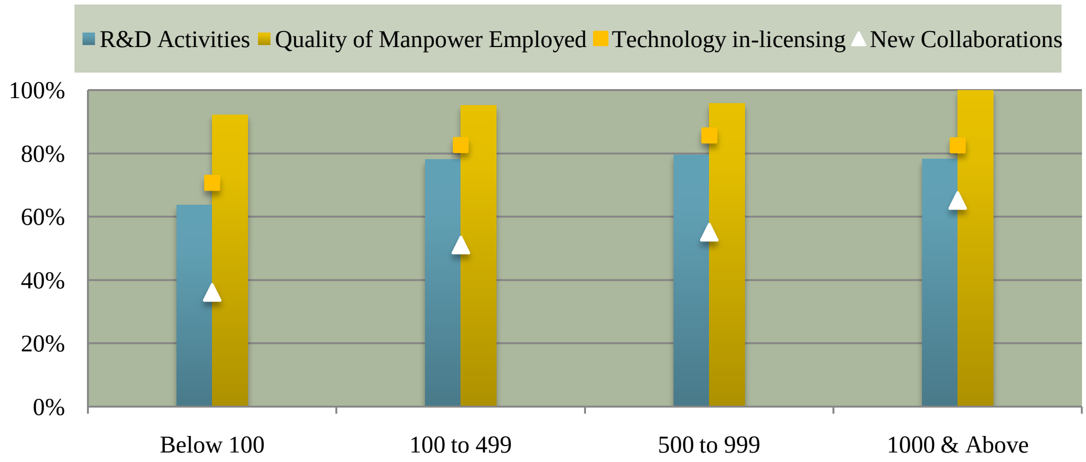


Figure 2.4: Size wise distribution of innovative firms and their competitive status vis-a-vis others (II)

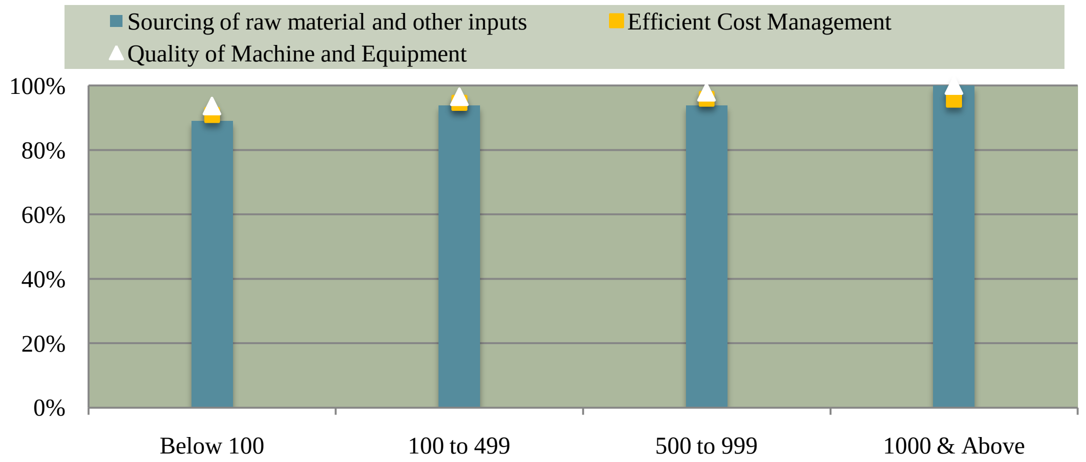
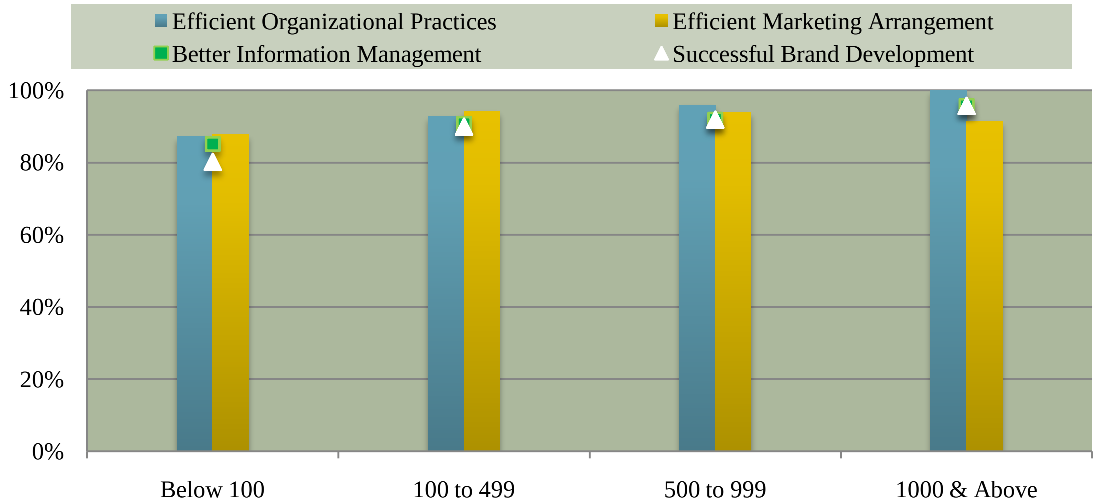


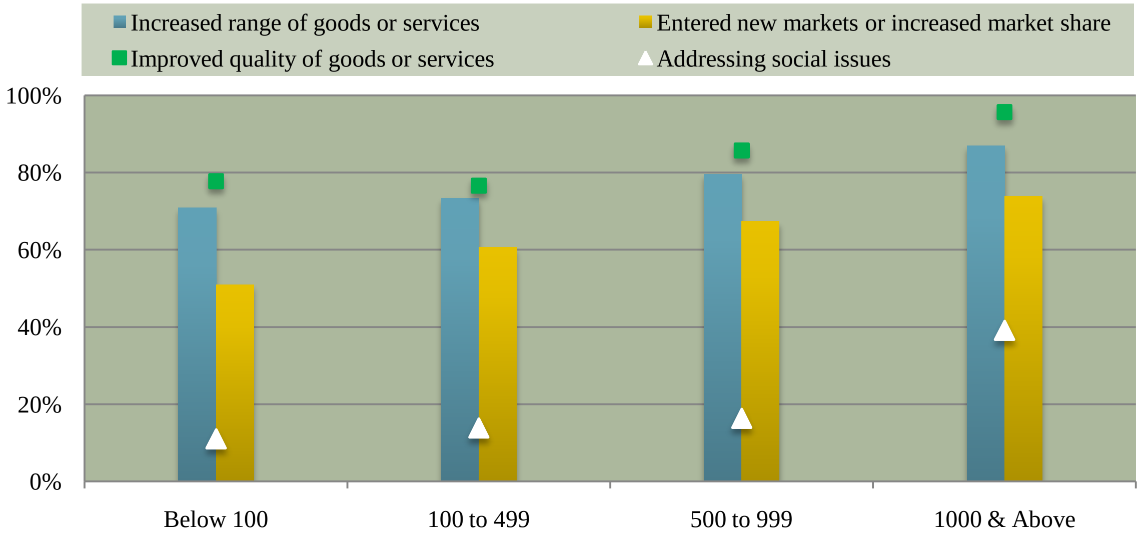
Figure 2.5: Size wise distribution of innovative firms and their competitive status vis-a-vis others (III)



ii. Does size matter for gains from innovation?

Gains from innovation indicate how successful were each of the product and process innovations in terms of certain specific outcomes as shown in figure 2.6, 2.7 and 2.8. These figures show size and the percentage of innovative firms expressing the various types of gains from the innovations undertaken. The outcomes for product innovations are mostly same for small and medium sized firms. About 96% of firms having 1000 and above workforce mentioned ‘improved quality of goods or services’ and about 40% of them address social issues. It is 11% for small firms.

Figure 2.6: Product Outcome and size of the firms



Similarly, when the outcomes of the process innovation are analysed for the firms of varying sizes it is seen that mostly large firms benefit out of these innovations (figure 2.7). They claim their innovation to have increased their capacity of production, reduced labour cost and also reduced materials and energy per unit output. About 40% of large firms indicate addressing social issues whereas very few small firms mentioned of this.

Figure 2.7: Process Outcome and size of the firms

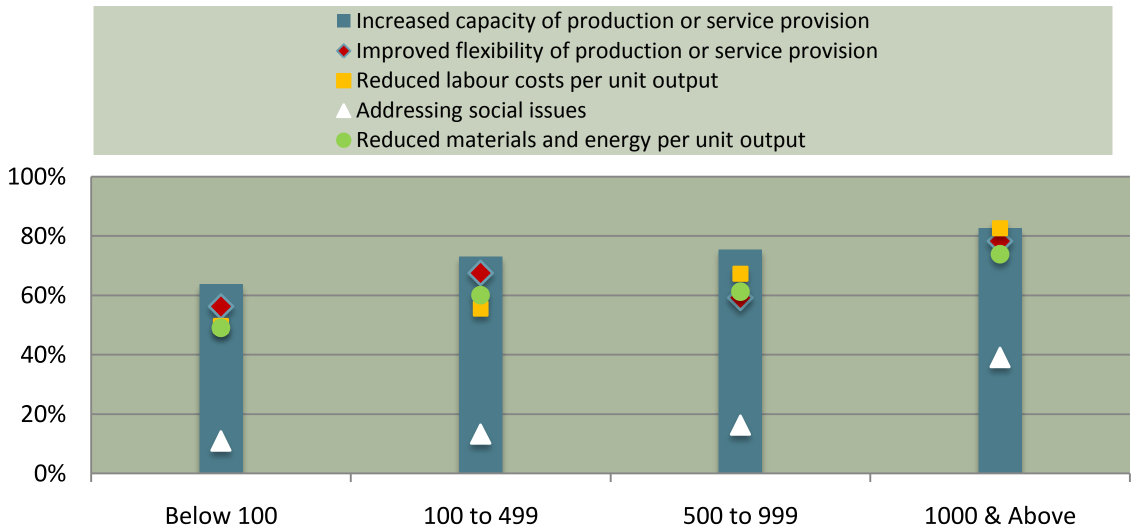
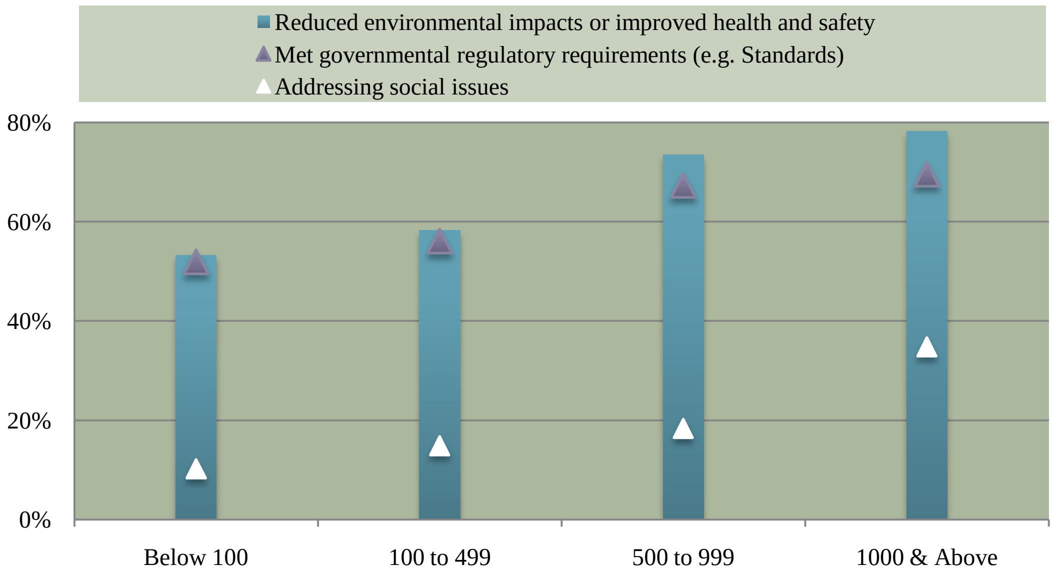


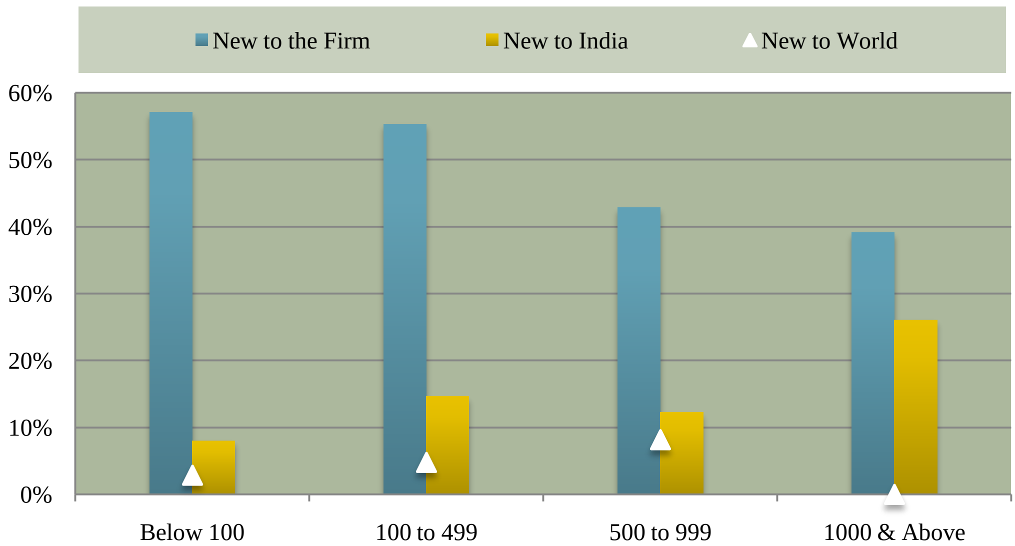
Figure 2.8: Other Outcome and size of the firms



iii. Does Size influence novelty of innovations?

Novelty of innovation is generally restricted to its newness to the innovative firms and rarely to Indian or world market. This observation is highest among the small size firms (refer figure 2.9). On the other hand, those firms who claim their innovation to be new to the country are mostly large size firms.

Figure 2.9: Size and Novelty of innovations



Do innovation activities differ among the small and large firms?

Activities related to innovation are grouped into six broad categories. Figures 2.10 – 2.12 give a detail of size wise distribution of innovative firms and their engagement in these activities. About 67% of firms from below 100 size category and about 78% of firms within 1000 and above size category reported of acquisition of technology.

As compared to the large firms, there is a decline in activities related to R&D, training program implementation, external knowledge acquisition and market introduction of innovation among the small size firms. Only 11% of firms having below 100 work force reported undertaking extramural R&D i.e. R&D in collaboration with agencies external to the firms, like, universities and research institutes. Among the larger firms, having 500 to 999 and 1000 and above workforce, about 25 to 30% firms have extramural R&D. In case of imparting training to their employees, about 61% of firms from 500 to 999 size category are engaged in training programmes for skill development and is followed by 1000 and above category (56.52%), whereas only 38% of firms below 100 categories do the same. For market introduction of innovation only the large firms with greater workforce base have initiated related actions (28.57%).

Figure 2.10: Size-wise Innovation Activities performed by Innovative firms (I)

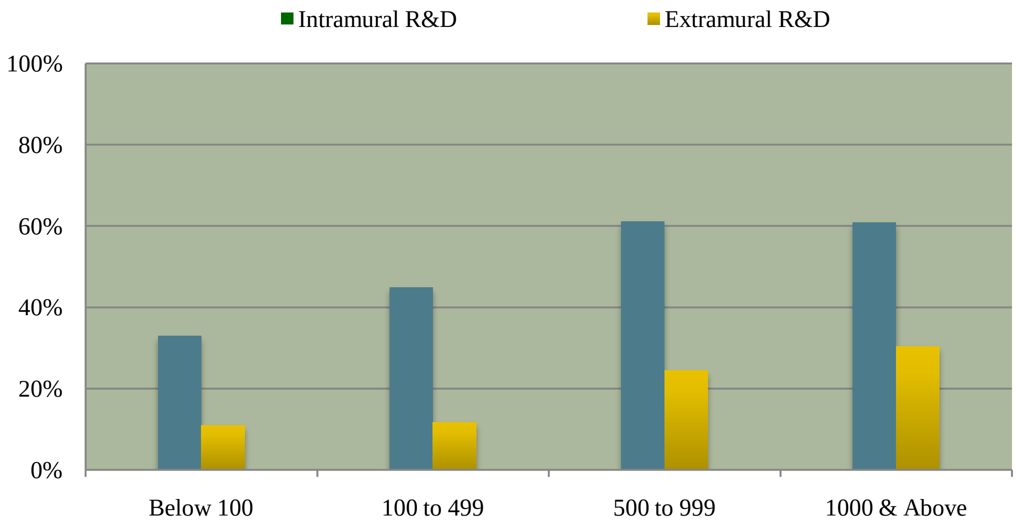


Figure 2.11: Size-wise Innovation Activities performed by Innovative firms (II)

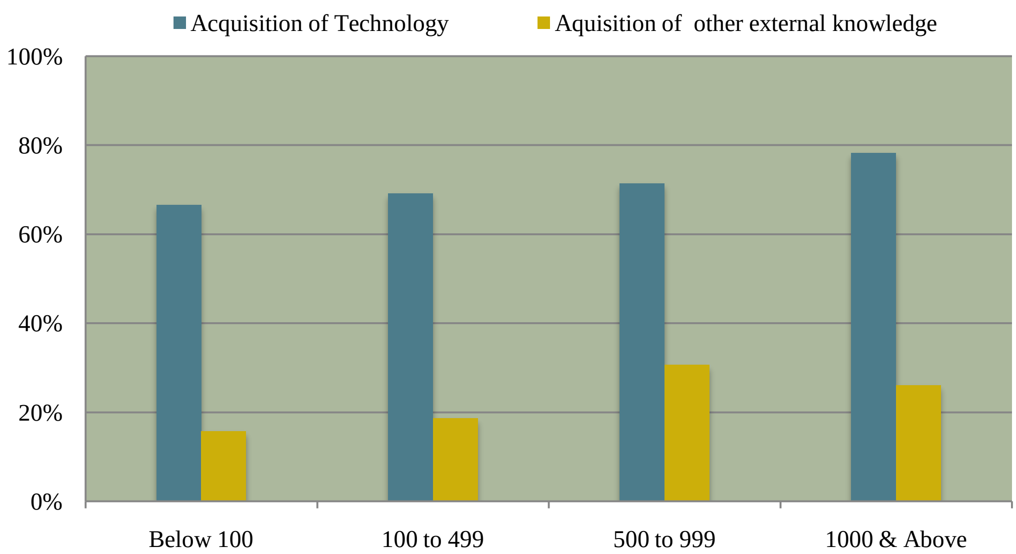
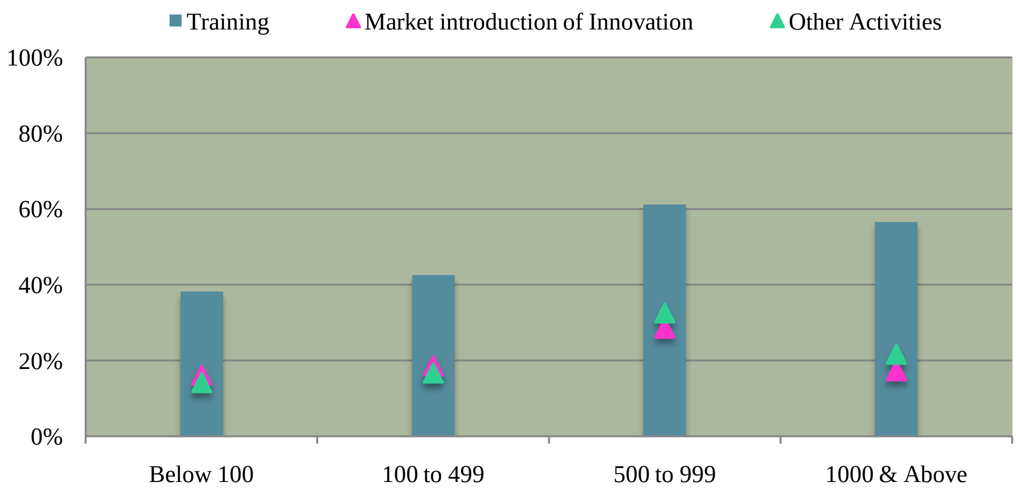


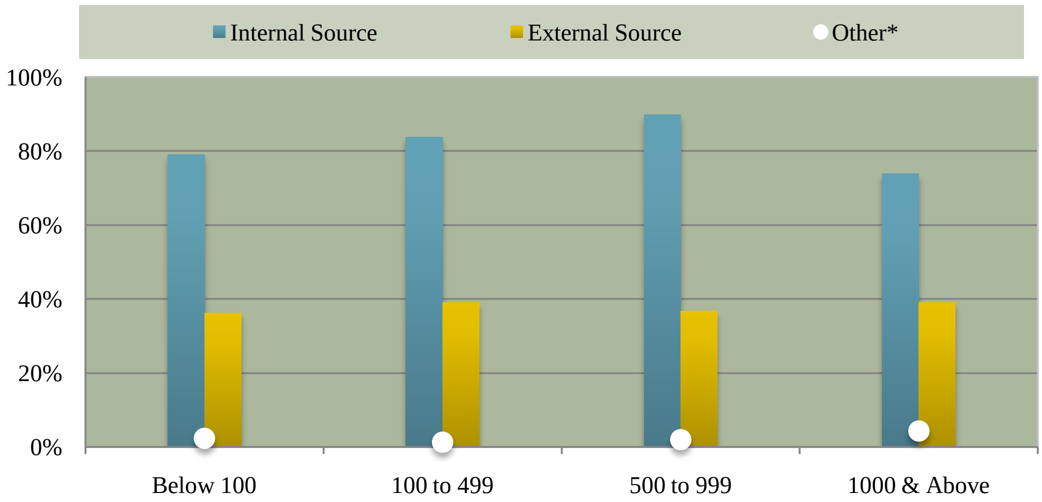
Figure 2.12: Size-wise Innovation Activities performed by Innovative firms (III)



Strategies for Innovation and Size

Innovation strategies broadly include mobilising resources and accessing various sources for different requirements of innovation. The sources are grouped as internal sources, external sources and other sources which include collaboration with other enterprise or institutions. It is expected that large firms would utilize more of external resources in terms of linkages and collaborations however in this case as represented in figure 2.13, large firms with a greater human resource base (1000 & above) do not show much difference in terms of accessing external sources of innovation. On an average about 36% of firms mentioned of accessing external sources for their innovations. About 79% of small firm mentioned their innovation to be developed using internal sources followed by 89% of firms from 500 to 999 group.

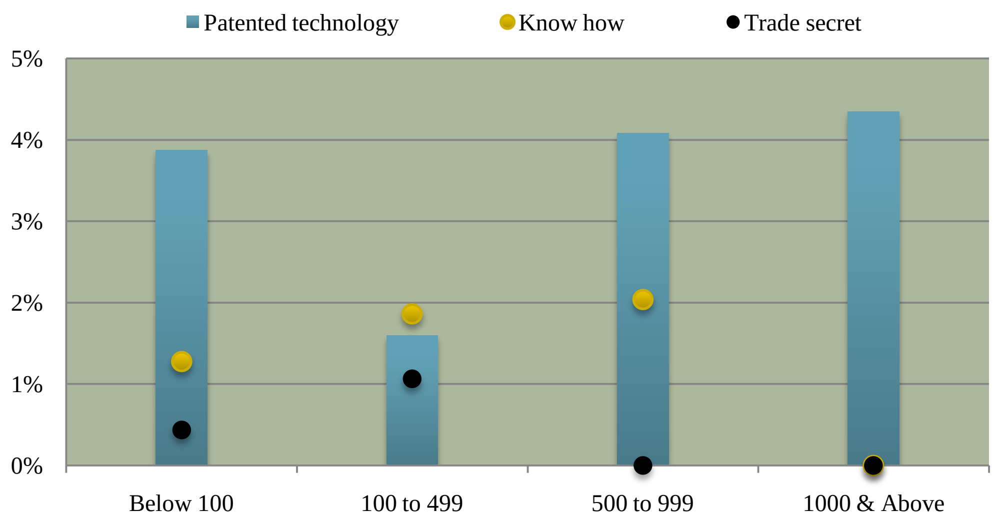
Figure 2.13: Sources of innovation and size of innovative firms



(Other* - With other enterprise or institution like universities, Govt. labs)

In general majority of the firms rely on their internal sources to facilitate the process of innovation. Technologies are mainly sourced from external sources, which may be in the form of patented technology, knowhow and trade secrets. The size of the innovative firms and their technology sourcing is shown in figure 2.14. Firms with larger workforce base mostly source patented technology alone and few firms with 500 to 999 work forces also source technology knowhow.

Figure 2.14: Sourcing technology and size of innovative firms.



Technologies are acquired from open domestic markets, from collaborators and also from foreign markets either as full set technology or as partial or complementary technology. The source from which technologies are acquired and the size of firms is shown in figure 2.15 and figure 2.16 reveals the extent of technology acquired. Firms with labour size below 100,100 to 499 and 500 to 999 acquired technologies from all the three sources and mostly from open domestic market whereas firms with 1000 and above labour size obtained technologies mainly from foreign market and from collaborator. It becomes clear that large firms only have access to foreign markets in terms of obtaining technologies. As regard the extent of technology it is seen that majority of firms obtain full set of technology however few firms from below 100 and 100 to 499 category also obtain partial or complementary technology (refer figure 2.14).

Figure 2.15: Acquiring technology and size of innovative firms.

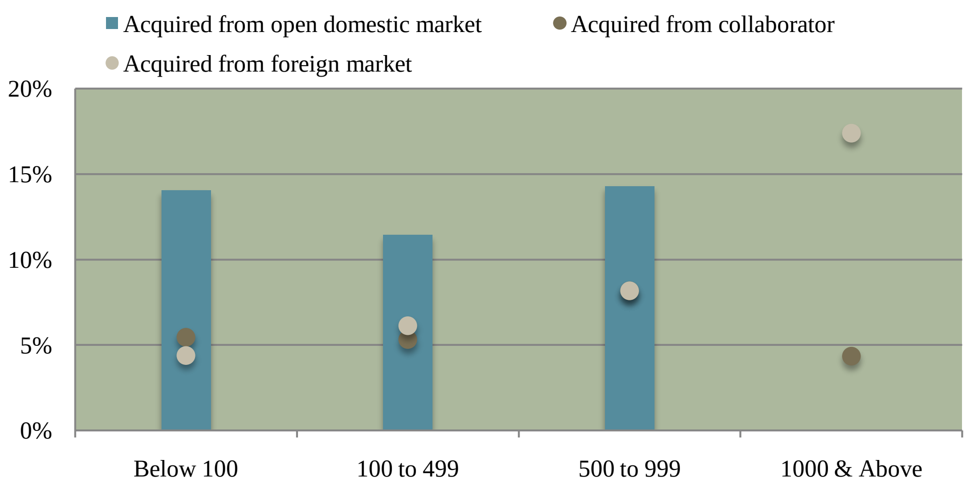
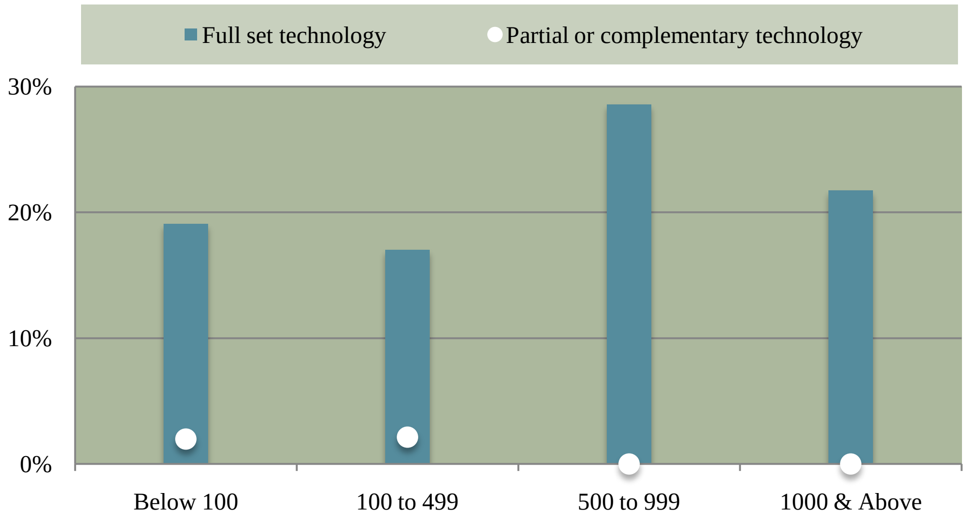


Figure 2.16: Extent of technology and size of innovative firms.



Transactions & Expenditure and Size

For an innovation to happen one of the main inputs is acquisition of technologies from external sources which are generally in the form of advanced machinery, equipment or computer hardware/software and other external knowledge like patents and non patented inventions, knowhow, trade secrets etc. These technologies are acquired from external sources on agreement for upgrades, maintenance and training. The mode of acquiring technologies as per the size of the firms is shown in figure 2.17 and figure 2.18. The figures show that most of the innovative firms of all size categories preferred purchasing and in-licensing the technology. However not much variation in the acquisition pattern is seen among them. Among the firms with 500 to 999 work forces about 19% and 12% of them have purchased and licensed the technology respectively. Most of the firms with 500 to 999 and 1000 and above workforce made agreement for maintenance followed by upgrades. On the other hand only 7% of small firms have agreement on maintenance and even smaller share of firms for upgrades and training.

Figure 2.17: Mode of acquisition and size of innovative firms

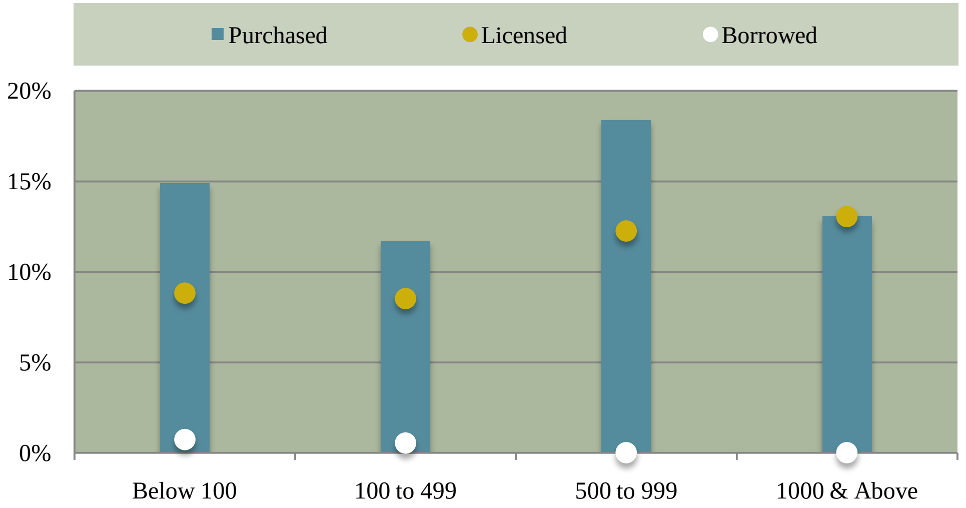
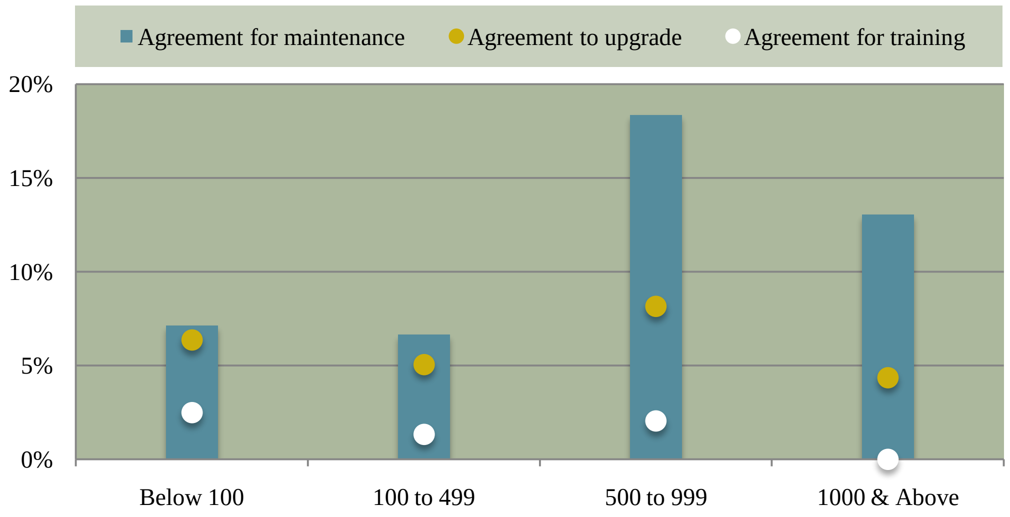
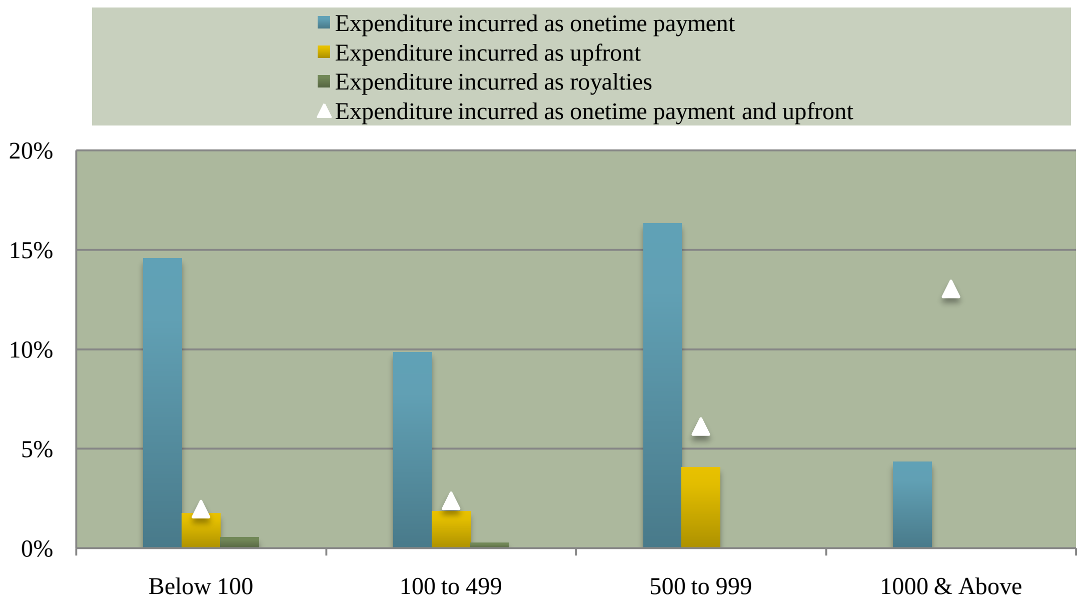


Figure 2.18: Acquisition agreement and size of innovative firms



The expenditure incurred for innovation activity and size of the firm is shown in figure 2.19. From the figure we see expenditure incurred by the large size firms is mostly onetime payment and upfront, which among the firms of lower size group is a rare mode of expenditure. However, innovative firms from below 100 size category, majority of them (14.5%) made onetime payment and also few firms mentioned their expenditure to be incurred as upfront.

Figure 2.19: Expenditure incurred for innovation activities and size of innovative firms

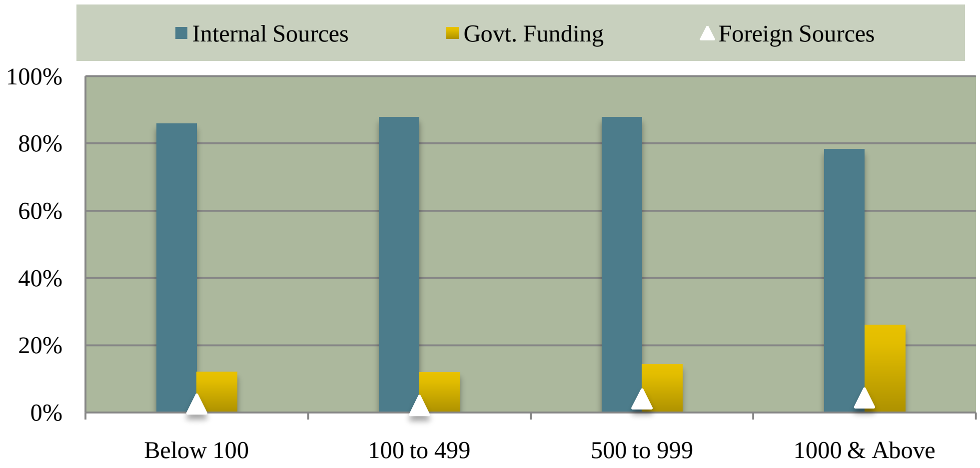


How do firms manage their expenses for innovation and does size play any role here?

The main innovation related expenses of the firm are incurred to meet their needs towards innovation activities. Mobilisation of resources for this purpose is captured through three broad sources - firm's own internal sources, funds from the government, and foreign sources.

Government funds include support from the government in the form of tax credits or deduction, grants, subsidized loans and loan guarantees. The following figure (figure 2.20) gives an account of the firms of varying sizes accessing various sources of finance for promoting innovation activities. It is seen that majority of the firms rely on their internal source of finance for activities related to innovation and availing government funding is a limited activity. Very few firms are in a position to avail government funds and benefits. The share of firms accessing government funds increases with the size of the firm, i.e. mostly large firms derive the government led benefits in terms of funds and resources. Similarly funds from foreign sources are also mainly availed by the large firms.

Figure 2.20: Financing of innovation expenditure and size of innovative firms



Human Resource and Size

Figure 2.21 show if human resource capacity varies with size of the firm. We see that firms having 1000 and above workforce on an average has maximum number of skilled employees. Firms within 500 to 999 size category organises more training programmes whereas share of total employees trained among all the firms is highest within firms with below 100 categories. Training imparted is mostly in-house training whereas few large firms also provide training in other institutions in India (refer figure 2.22).

Figure 2.21: Human resource pool and size of innovative firms.

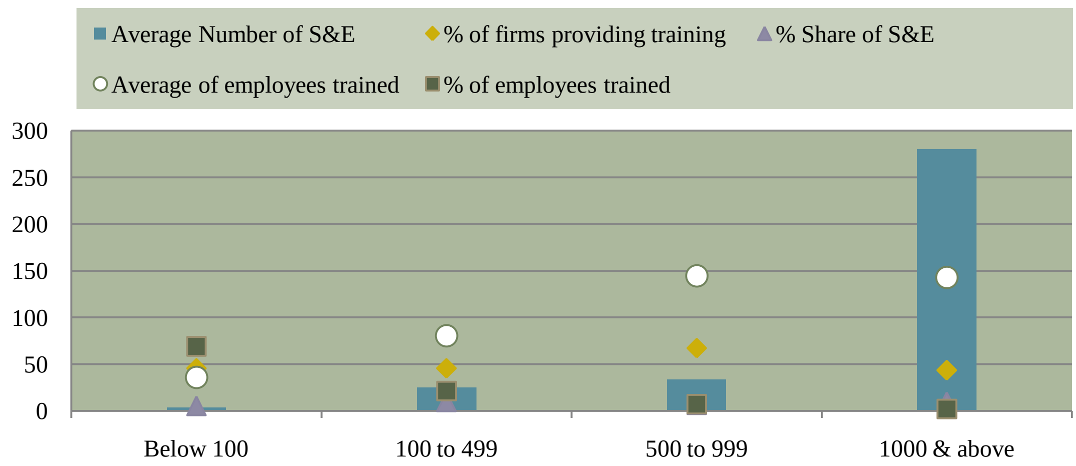
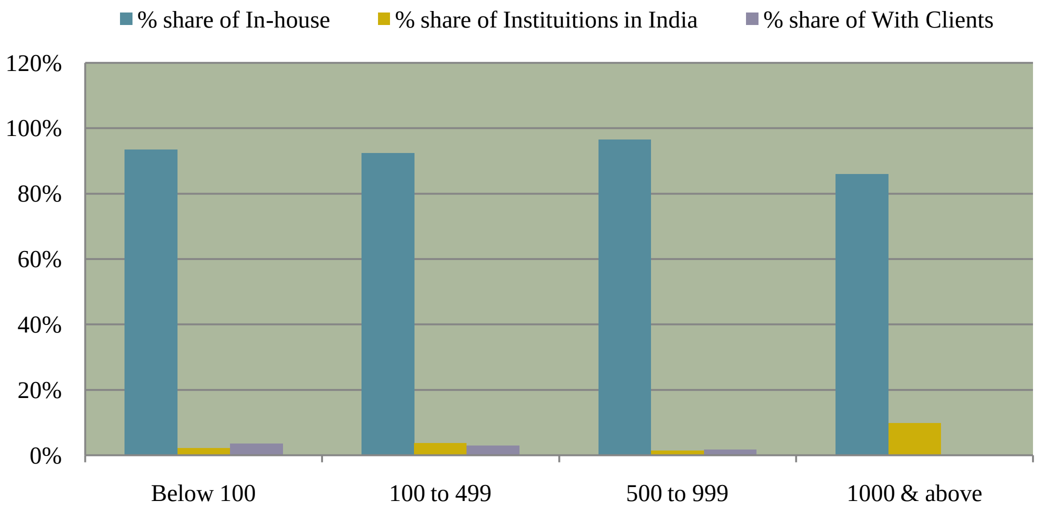


Figure 2.22: Training of human resources and size of innovative firms



Information & Communication Technology and Size

ICT infrastructure plays an important role in firm's innovation related initiatives. It improves the efficiency and effectiveness of the firm's delivery system. Acquisition of ICT includes both hardware and software and the acquisition pattern of the firms as per their size (figure 2.23) shows that large sized firms are more involved in acquisition of hardware and software as compared to their smaller counterparts. However the number of firms already using ICT infrastructure is quite few which is indicative of the fact that firms are starting to recognise ICT as an important component for innovation and to be technologically equipped which was not the case earlier. Also large firms mainly use such technology for the purpose of enterprise resource planning and for R&D and technology development whereas only few small sized firms do the same (figure 2.24).

Figure 2.23: Size of the Innovative firms and ICT Acquisition

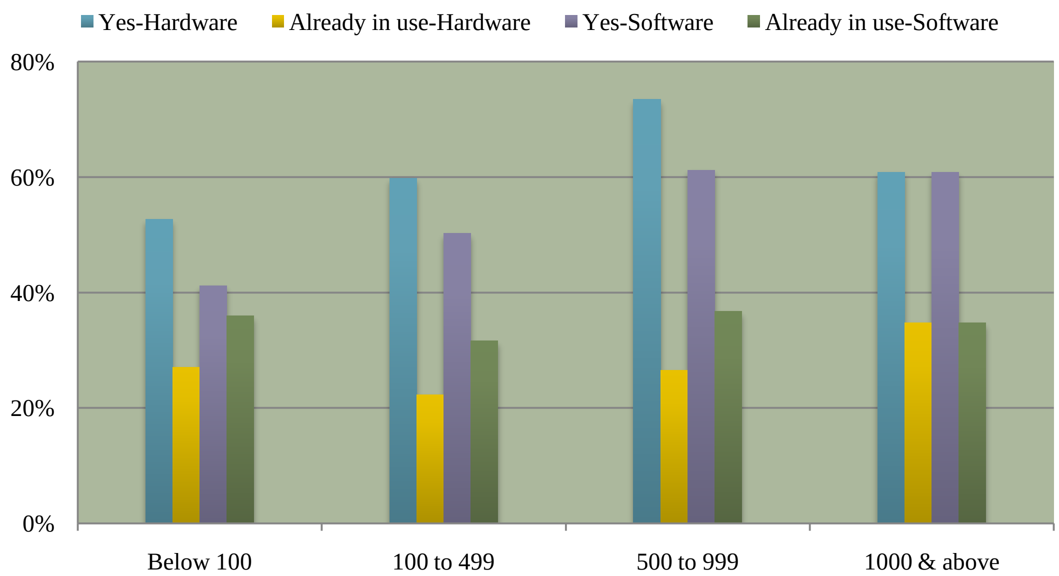
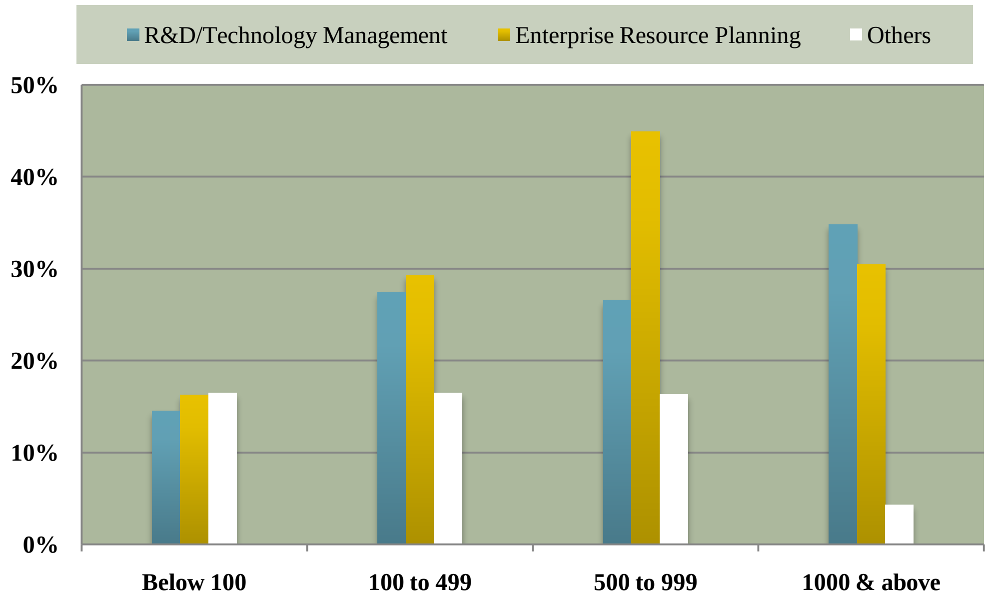


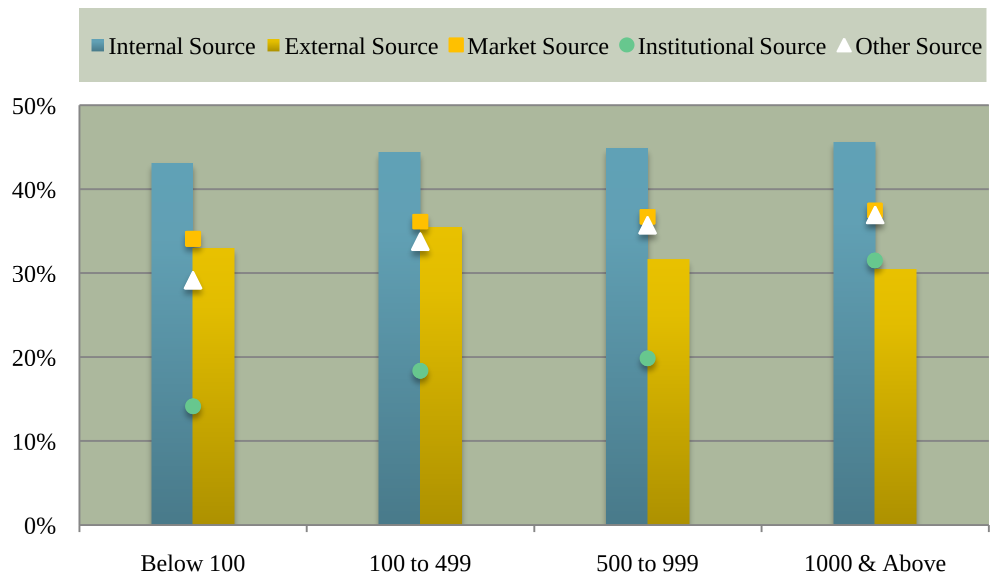
Figure 2.24: Size of the Innovative firms and ICT Usage level



Information source and Size

It is important to know how far enterprises connect themselves with internal and external sources to gain guidance, advice or even inspiration for their prospective innovation project. Figure 2.25 gives interesting insight regarding firms' behaviour in accessing information from various sources. It shows that majority of the innovative firms use internal sources irrespective of the size categories. Only large firms are the users of institutional sources for information and knowledge.

Figure 2.25: Size of the Innovative firms and information source



In Nutshell

Sample firms are categorized into four size classes, namely, below 100, 100 to 499, 500 to 999 and 1000 and above workforces. Firms within larger size categories show more propensity to innovate. In terms of R&D activities, technology in-licensing, employing qualified manpower, organisational and marketing practices mostly larger firms are more active than the smaller counterparts. Product innovations by the small firms are mainly minor innovations, i.e., new to the firm. Large firms engaged in product innovation have gained increased market share. Involvement in R&D activities increases with size and most of these activities are in-house activities. Extramural R&D activities are rare and even rarer for the small sized firms. Innovations by the small firms are mostly by using their own sources. Accessing external source for knowledge and information is mostly practiced by the large firms. The average number of skilled manpower increases with the size of the firms. The same has also been observed for training of employees.

III

Age and Innovation

Highlights

- Firms are categorised into three broad groups based on their year of establishment as ‘before 1990’, ‘1990 to 2000’ and ‘after 2000’.

- Firms established during the nineties and before 1990 are more innovation active than the new firms.

- The incidence of product innovation, process innovations and product quality standardization are more among the firms established before 1990 and they mostly claim their innovations to have increased the range of goods and services, improved their capacity of production and also addressed social issues

- The new firms (firms established after 2000) though they have shown lesser innovativeness, their innovations are mostly ‘new to the market’, which among the firms established at an earlier age is low.

- Firms established during the nineties and after 2000 mostly acquired technology from external sources in the form of patents while those established before 1990 mostly acquired knowhow of the technology.

- Mostly the older firms on an average had more number of skilled manpower resources in their enterprises than the new firms and they are also more engaged in human resource development programmes to train their employees.

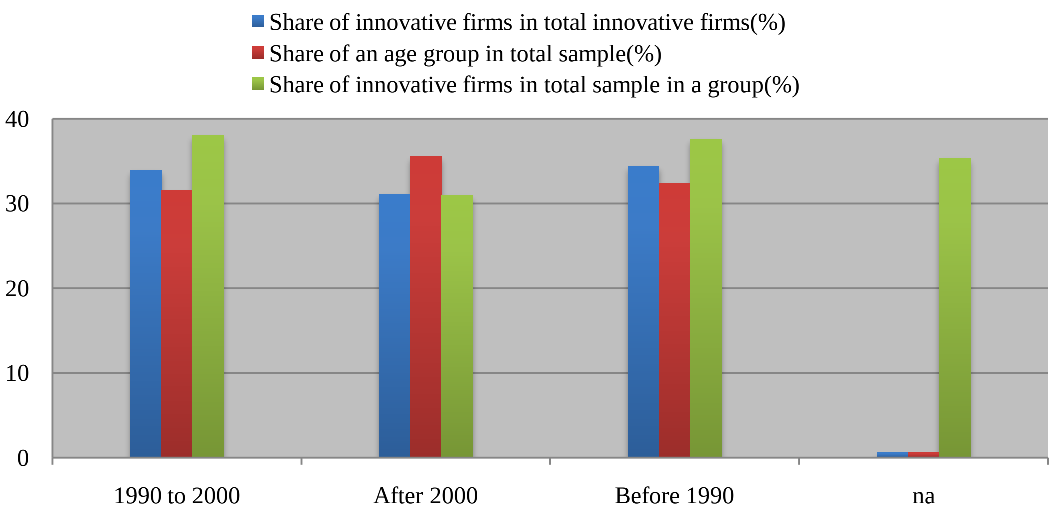
Age and Innovation

This chapter is focused on the age of the firms and the innovation activities they are involved in. Initially we examine the age of the firms in terms of basic size and type of innovations. Next we examine age of the firms with their post innovation positions, which includes competitive status, outcome from innovation, and novelty of innovation. Further innovation activities, strategies of innovation, transactions for innovation, financing innovation activities human resource base, use of information technology and information source are studied with the age of the firms. We have categorised the firms into three broad groups as per their year of establishment. These are 'before 1990', '1990 to 2000' and 'after 2000'.

Are younger firms more innovative?

Figure 3.1 gives an idea of the share of innovative firms and the sample firms in the respective age categories as mentioned above. Innovativeness of firms within a particular age group is ascertained by the share of innovative firms in the group to total number of sample surveyed in that group and from the figure we see that firms established post liberalisation period i.e. between 1990 to 2000 show more innovation activities. Also it is to be mentioned that there is not much difference in innovation activeness among firms established before the economic liberalisation.

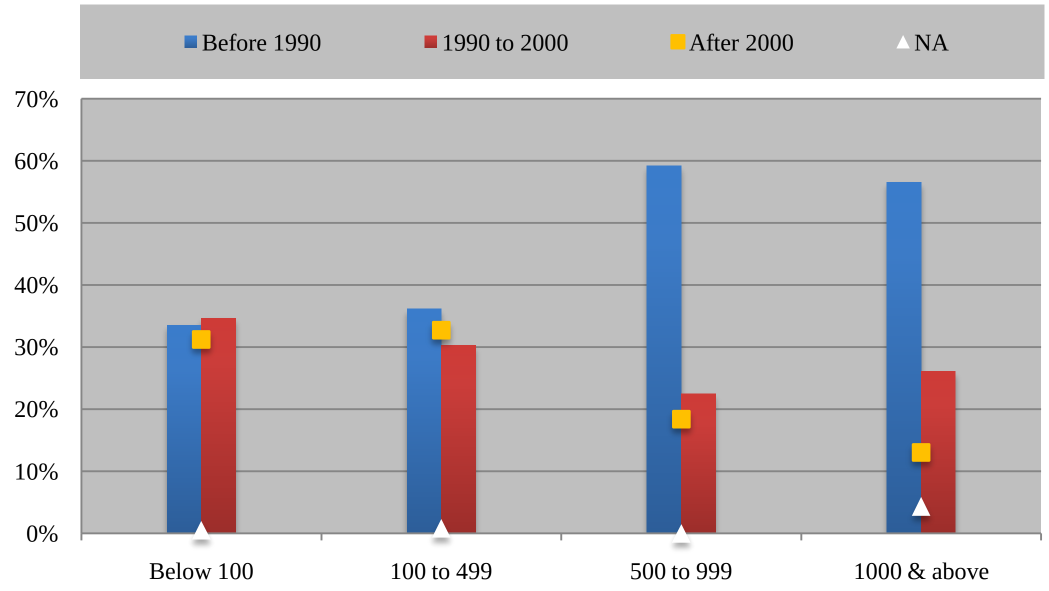
Figure 3.1: Age wise share of the innovative firms



Does age of the firm relate to size in terms of innovativeness?

When age and size are both considered to enumerate the innovativeness of the firm it is seen that mostly old large firms established before 1990 show more innovation related activities than those set up in the nineties i.e. over the years their innovativeness has decreased. On the other hand firms that were started after 2000, mostly smaller firms with below 100 and 100 to 499 workforce were more innovative than new large firms.

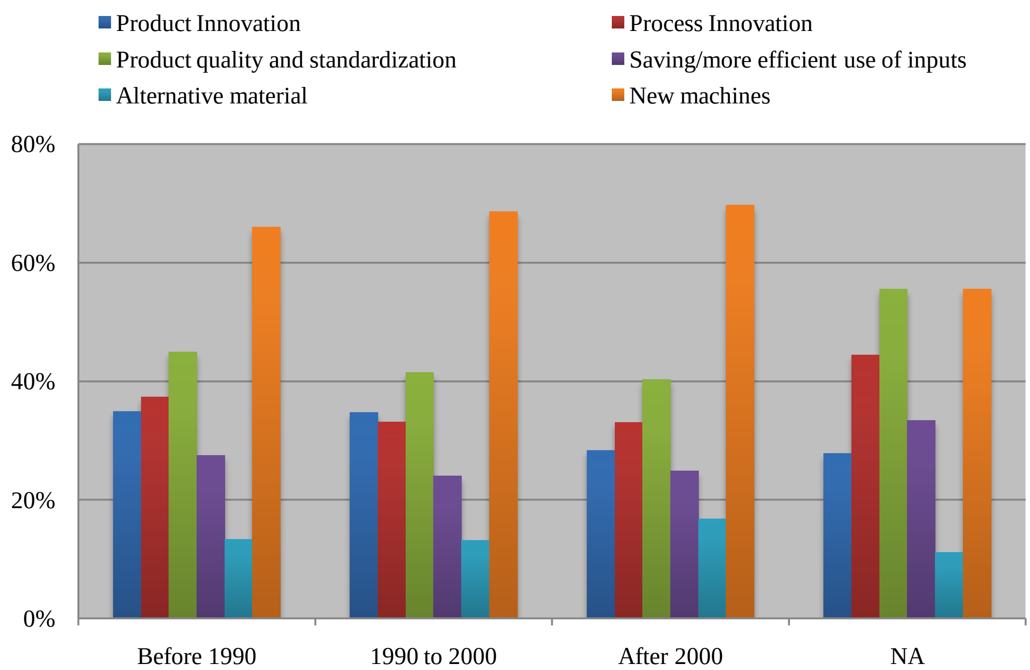
Figure 3.2: Age, size and innovativeness



Do types of innovation relate to age?

Hardly any change in pattern in the types of innovation is seen among the firms established in different periods. Introduction of new machines, which is the most favoured type of innovation, remains the most practiced type for all the firms established in different periods. For process innovation it is seen that firms established before 1990 are more involved than those established at a later years and also older firms (established before 1990 and between 1990 and 2000) were more involved in product innovations.

Figure 3.3: Types of Innovation and Age of the firms



Post Innovation Position and Age

i. Can smaller firm improve their competitive positions through innovation?

The post innovative positions of the firms are presented in the following three figures (3.4, 3.5 and 3.6), which represent how the firms position themselves against their peers in the industry. There appears no significant difference in the firms' responses against the various parameters, which embodies their competitiveness. For R&D related activities the newer firms ranked themselves lower as compared to the older firms. In terms of Foreign Direct Investment the firms established in the nineties ranks themselves slightly higher (about 31.76%).

Figure 3.4: Age of the firms and their competitive status vis-a-vis others (I)

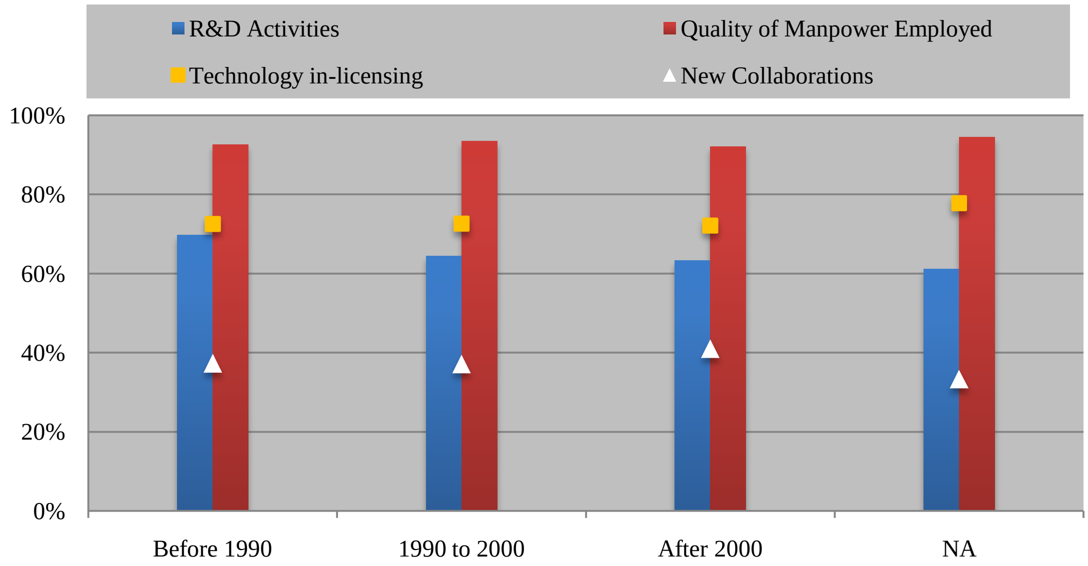


Figure 3.5: Age of the firms and their competitive status vis-a-vis others (II)

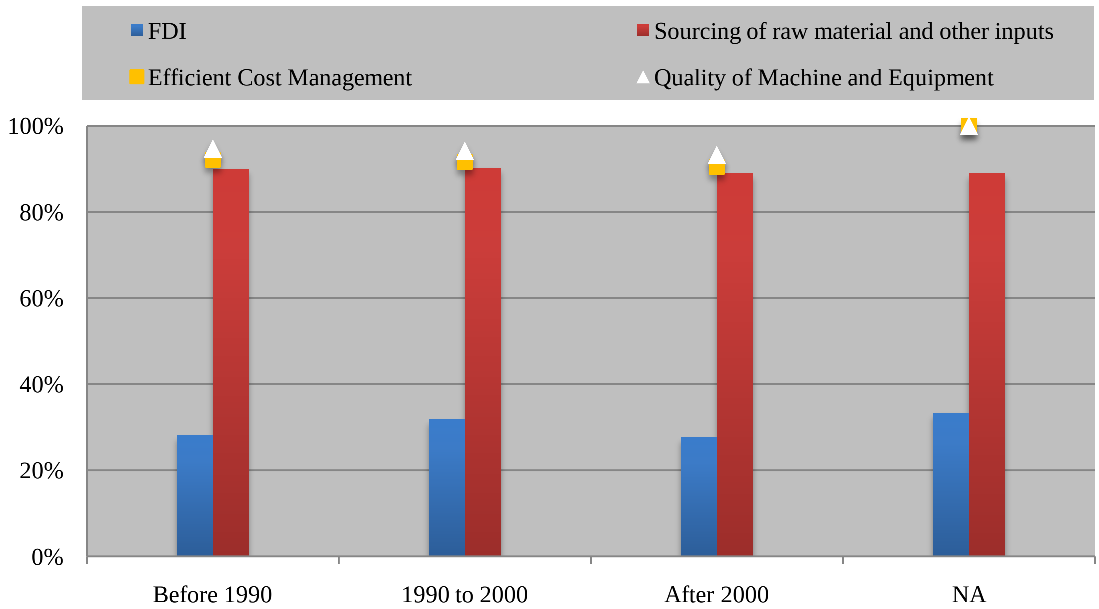
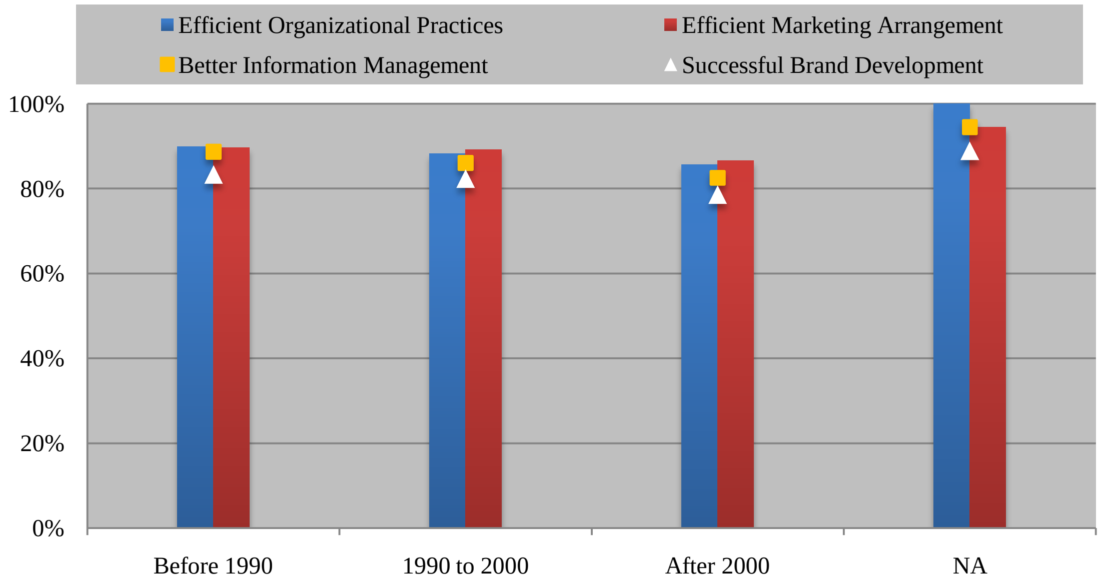


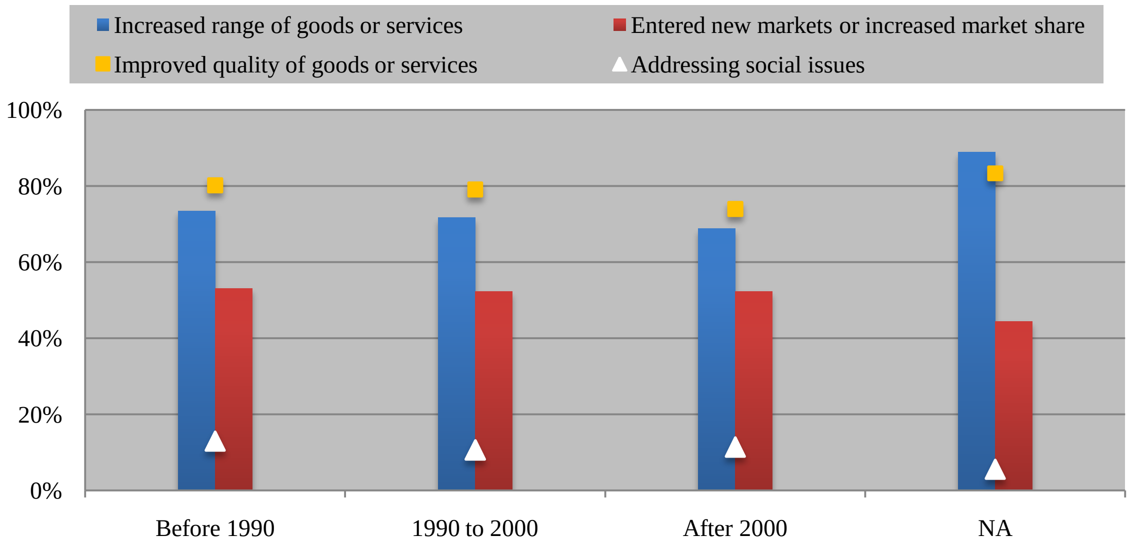
Figure 3.6: Age of the firms and their competitive status vis-a-vis others (III)



ii. Does age of the firm relates to gains from innovation?

The achievements from the innovations are presented in the following three figures (3.7, 3.8 and 3.9), which indicate their outcomes from product, process innovations and other outcomes respectively. It has been seen that mostly firms established before 1990 claim significant success of their innovations in terms of increased range of goods and services produced by them and also improved quality of goods and services.

Figure 3.7: Product Outcome and age of the firms



As an upshot of process innovations mostly firms claimed gains in increased capacity of production and provision of services, improved flexibility in their production, reduction in labour cost and also reduction in the uptake of material and energy per unit output. Mostly firms established after 2000 claimed more success for their innovation than others. Other outcomes as a result of innovation, which in turn benefited the firms, include reduction in environmental impacts, meeting governmental standards and addressing social issues. About 55% of firms claim reduction in environmental impacts, 52% in meeting governmental standards and only 10% in addressing social issues.

Figure 3.8: Process Outcome and age of the firms

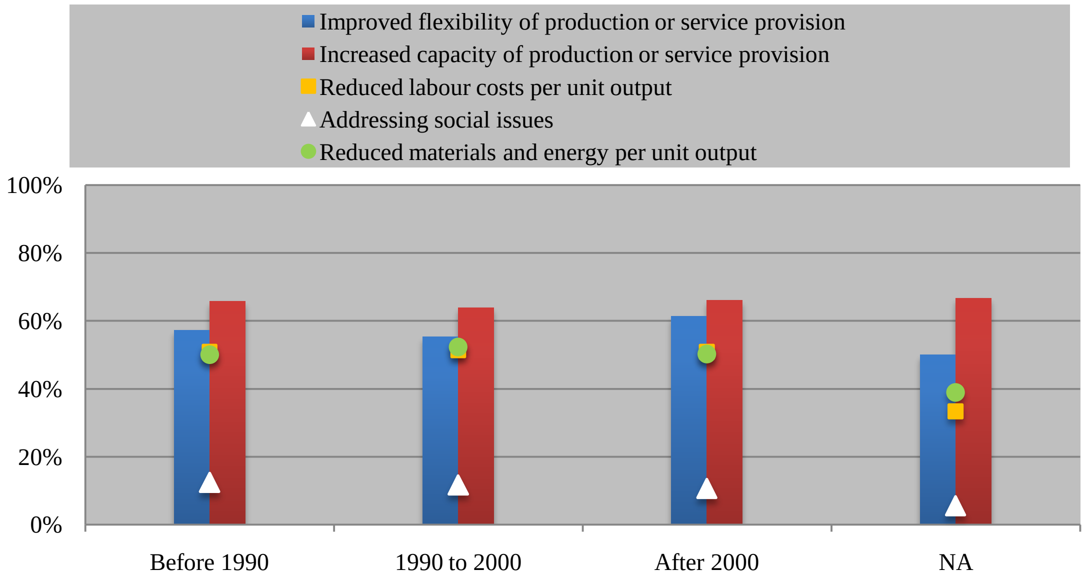
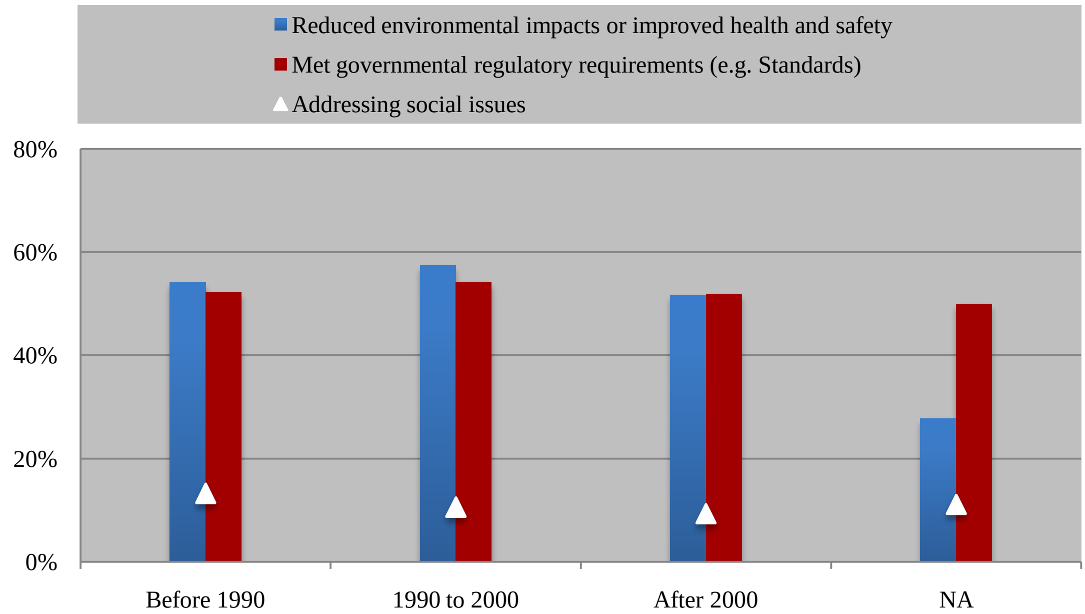


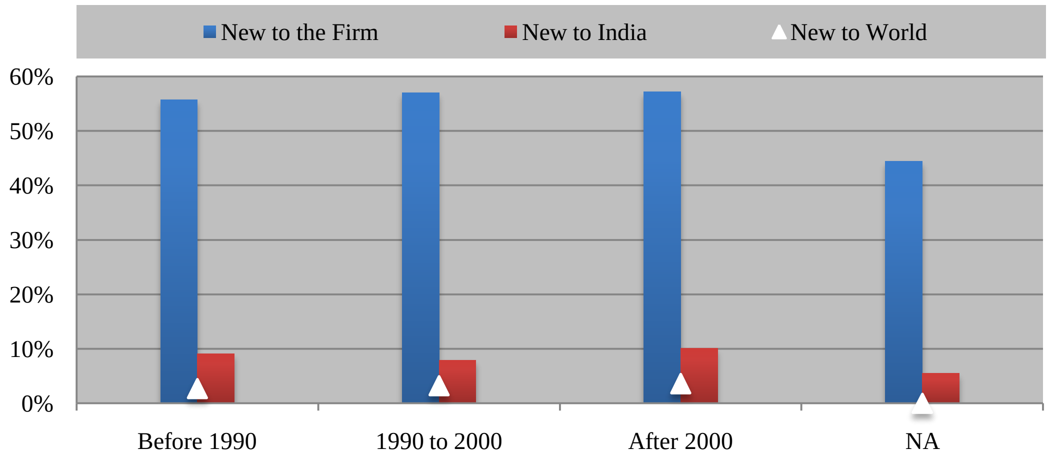
Figure 3.9: Other Outcome and age of the firms



iii. Age of firm and Novelty of innovations

There appears to be not much significant relationship between age of the firm and novelty of their innovations as indicated in figure 3.10. From the figure we see that most of the innovations irrespective of their age are new to the firm. On an average about 9% firms claimed their innovations to be new to the Indian market.

Figure 3.10: Age and Novelty of innovations



Innovation Activities and Age

Figures 3.11 – 3.13 list the innovation activities performed by firms and the age of the firms. From the figure we tried to find out if there is any change in these activities among the firms established in different periods. We find that acquisition of technology and other external knowledge remains same for firms of all age groups whereas intramural R&D is more practiced among firms established before 1990 than firms established at later periods.

Figure 3.11 Age and Innovation Activities (I)

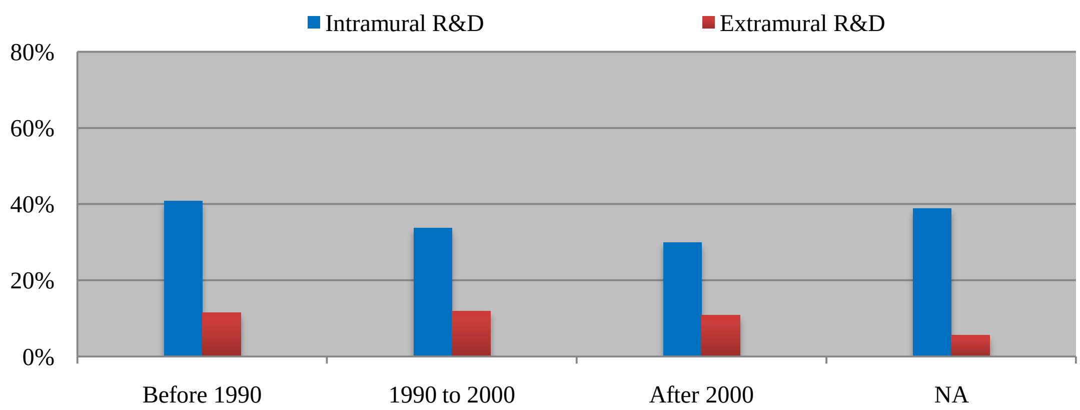


Figure 3.12 Age and Innovation Activities (II)

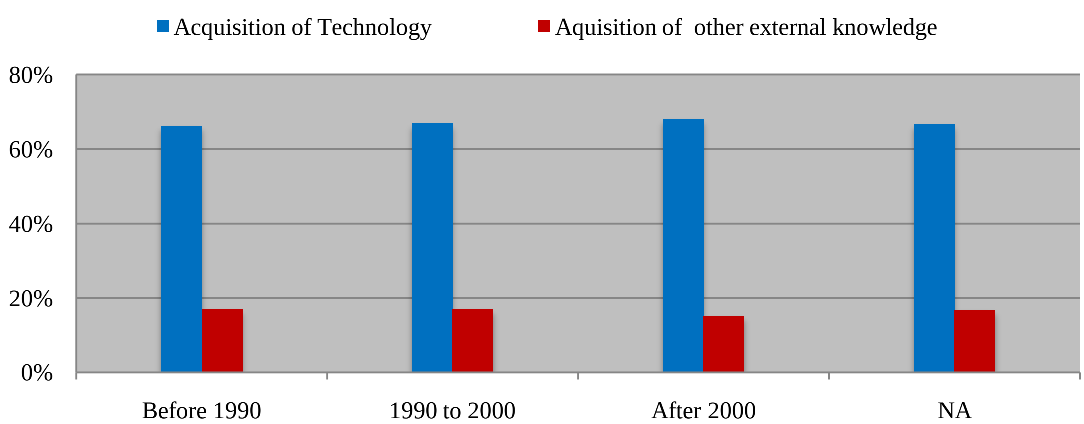
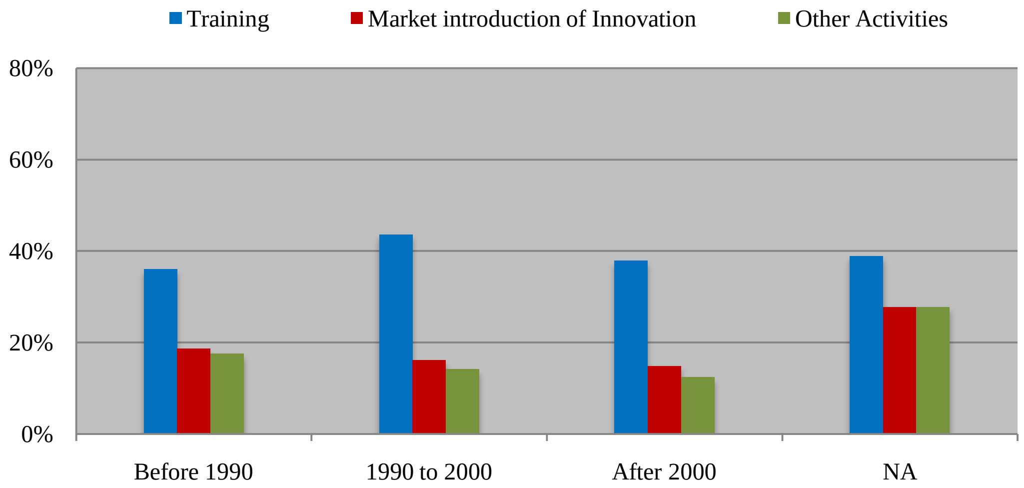


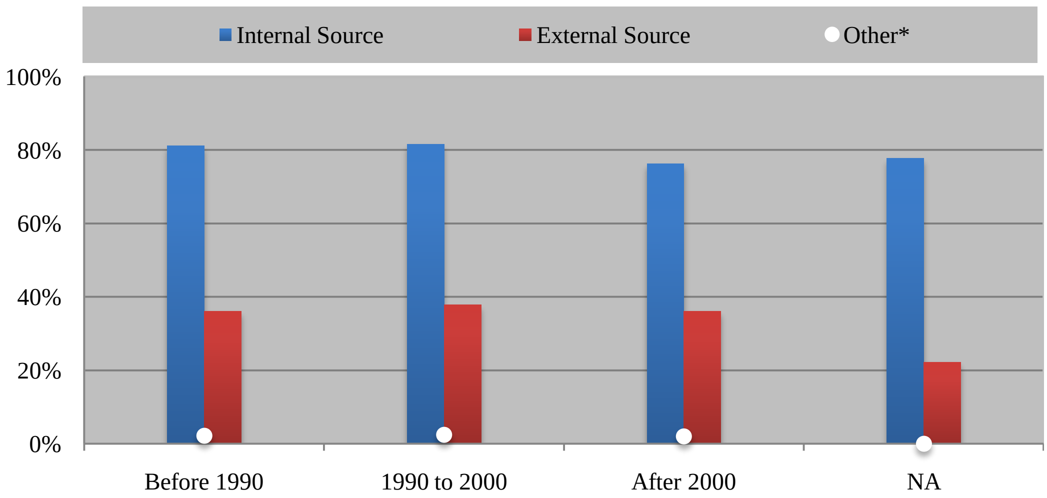
Figure 3.13 Age and Innovation Activities (III)



Strategies for Innovation and Age

The sources accessed by the firms for carrying out their innovation related activities and age of the firms is shown in figure 3.14. We see that firms of all the age groups mostly access their internal sources for any innovation related activities and older firms (established before 1990 and within 1990 to 2000) show a slight higher inclination towards external sources than the new firms. In terms of availing external sources we again see less variation among the firms and on an average about 36% firms gain from external sources for innovation. The most highly accessed external source of technology is in the form of patented technology and mostly firms established between 1990 and 2000 claimed to access it more than the rest (Figure 3.15). The technology is generally accessed as full set technology. However, a few firm from 'before 1990' also accesses partial or complementary technology (refer figure 3.16).

Figure 3.14: Sources of innovation and Age of innovative firms



(Other* - With other enterprise or institution like universities, Govt. labs)

Figure 3.15: Sourcing technology and age of innovative firms

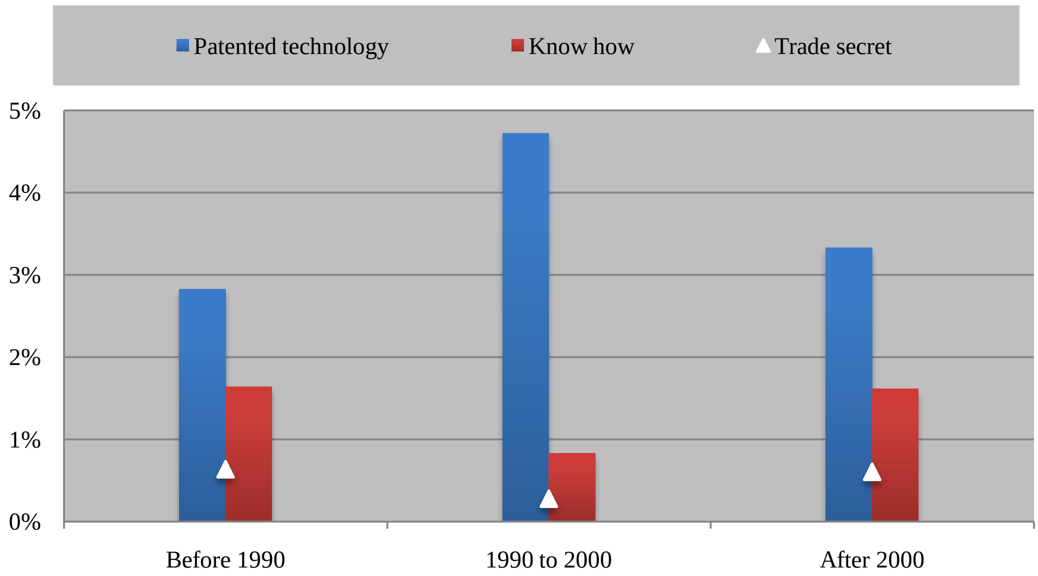
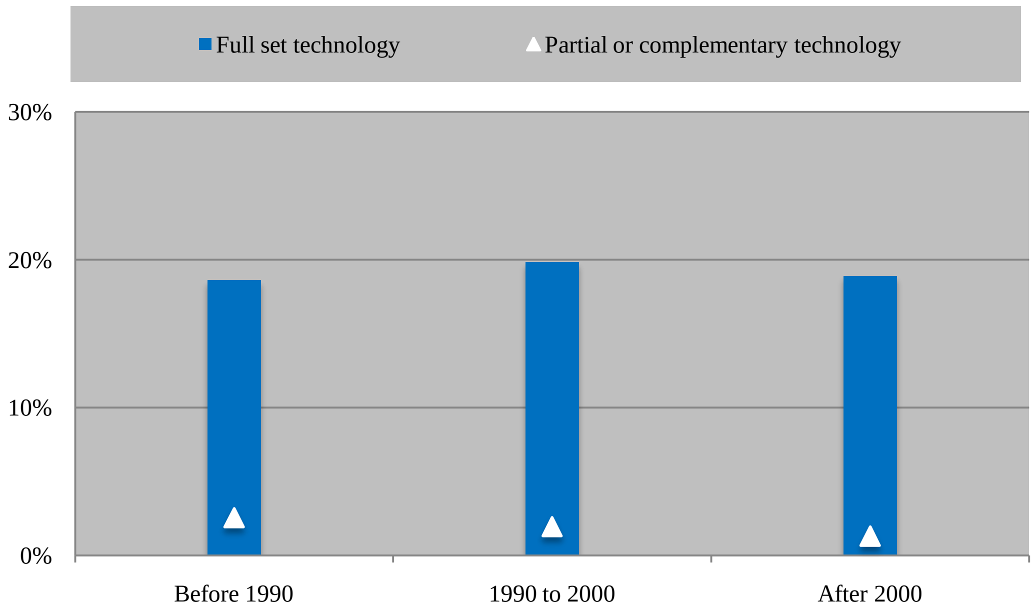


Figure 3.16: Extent of technology and age of innovative firms.



Transactions and Age

Firms, which acquire technologies from external sources either, license or purchase the technology. Their mode of acquisition and age is shown in figure 3.17. From the figure we see that most of the firms who acquire technologies from external sources prefer purchasing the technology to licensing and the new firms are more into purchasing the technologies than licensing. The next figure 3.18 gives an idea of the acquisition agreement made by the firms and their age. Here we find firms mostly making agreement for maintenance followed by upgrades and training.

Figure 3.17: Mode of acquisition and age of innovative firms

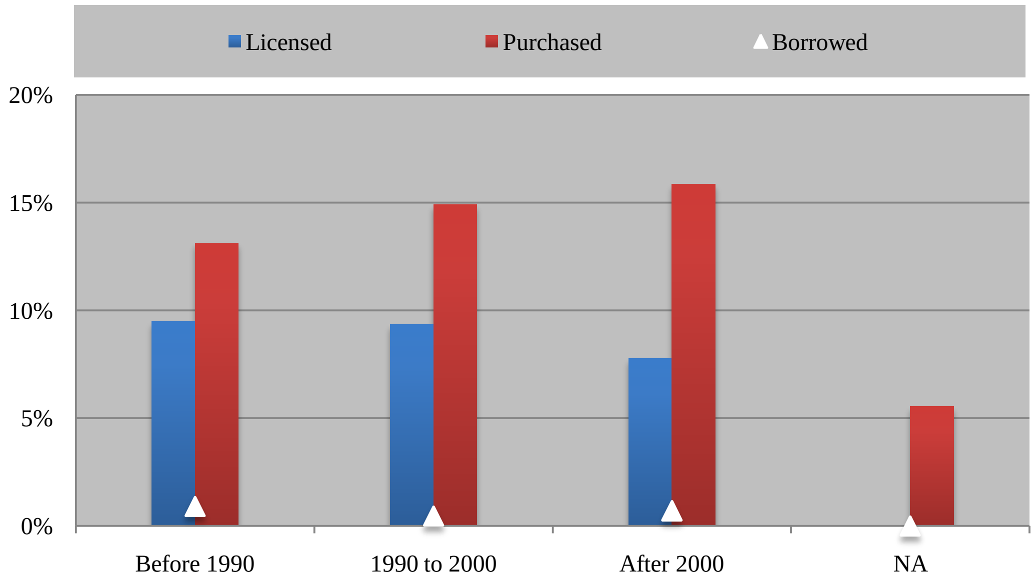
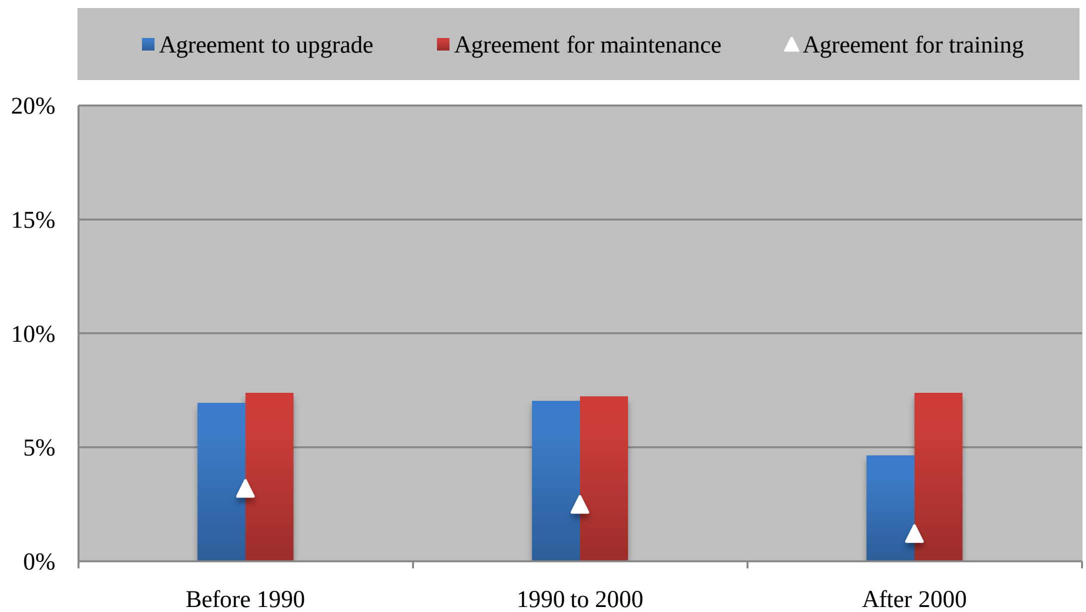


Figure 3.18: Acquisition agreement and age of innovative firms



Financing Innovation and Age

The funds for innovation activities are either arranged by the firm's own internal sources or borrowed from financial institutions (figure 3.19). Here it is seen that firms established before 1990 mostly borrowed funds from domestic financial institutions than the firms that were established after 2000. Arranging funds from private sources are also found common among the firms of all ages. The expenditure incurred by the firms for these activities is shown in the next figure 3.20 and it is seen that the most preferable mode of incurring expenses is onetime payment.

Figure 3.19: source of funds and Age of innovative firms

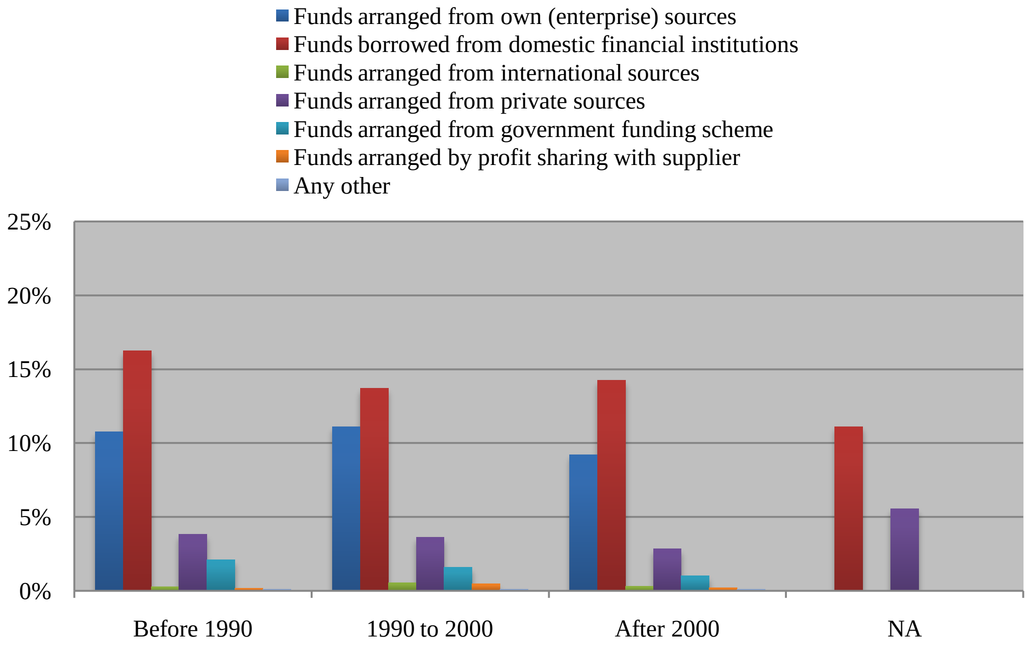
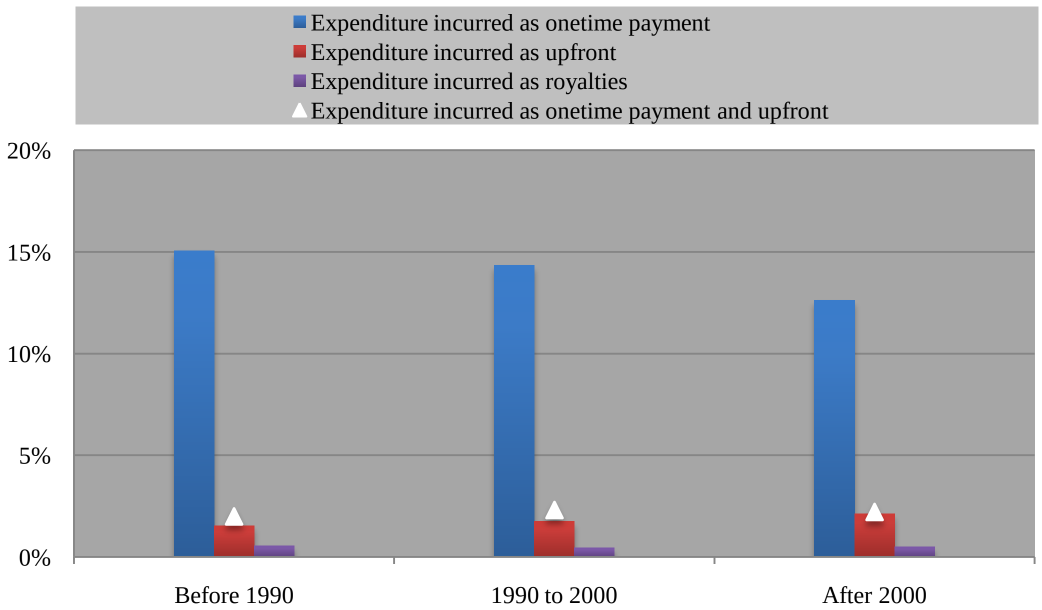


Figure 3.20: Expenditure and age of innovative firms



Human resources for innovations and Age

The following figures 3.21 and 3.22 give a detail picture of the human resource pool of the innovative firms of all age groups and training provided by them for human resource development. From the figures we see that it is mostly the old firms which have more skilled manpower than the new firms, i.e. firms that were established before 1990 has on an average more number of skilled personnel in their enterprise and they also trained more employees in several in house skill development programmes. Whereas out of total number of employees employed the share of scientist and engineers are highest among the firms established between 1990 and 2000.

Figure 3.21: Human resource pool of innovative firms

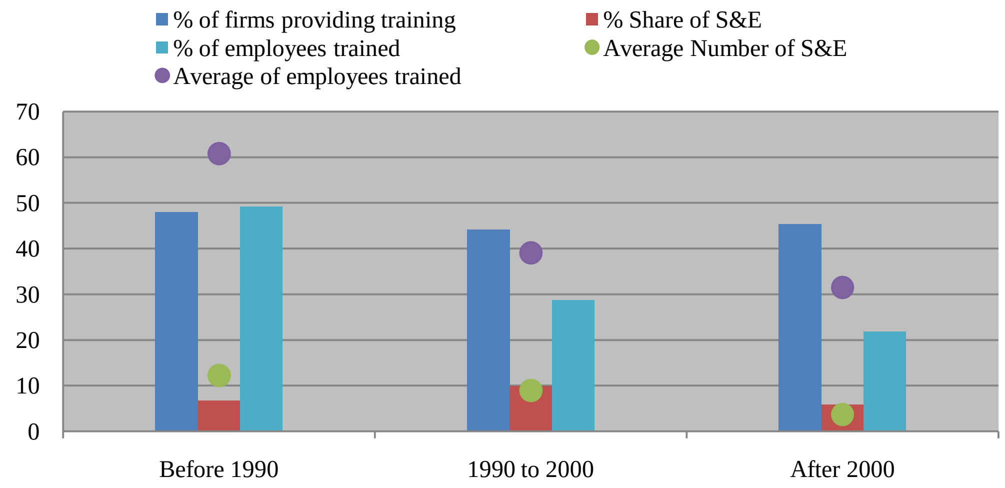
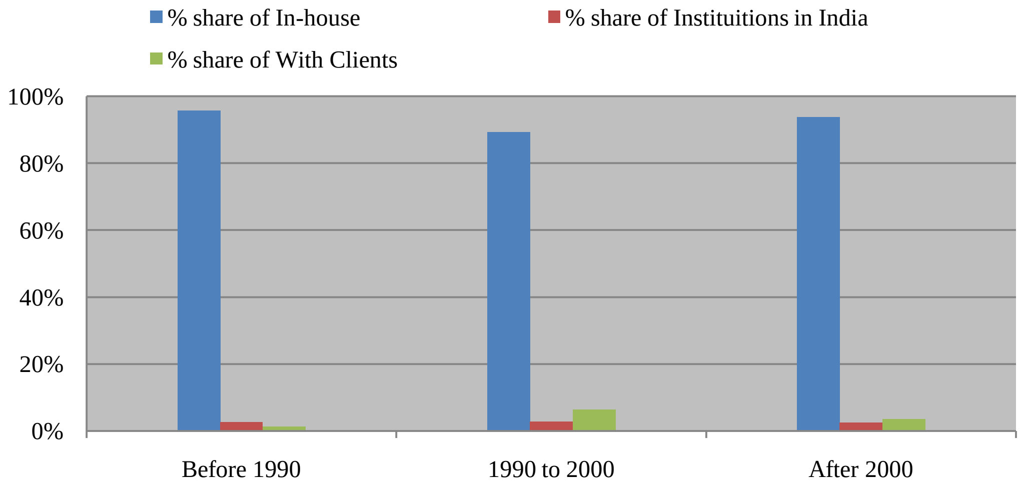


Figure 3.22: Training of human resources by innovative firms



Information & Communication Technology and Age

It is expected that the new firms would be more proactive in ICT acquisition and usage. However as revealed in Figure 3.23, which presents the hardware and software acquisition level of the firms of different age groups, we see that firms set up between 1990 and 2000 to be mostly involved in hardware and software acquisition. They are followed by those established before 1990 in terms of acquiring both hardware and software.

Figure 3.24 presents the purpose for which the ICT has been used by the firms. Majority of firms responded enterprise resource planning (ERP) as the area where ICT is commonly used. Highest share of firms established before 1990 uses ICT technology for ERP. However this usage level shows a declining pattern among the firms established at later periods. ICT used for R&D and technology management is also highest (about 19.62%) among the firms set up before 1990, followed by the firms set up at a later period.

Figure 3.23: Extent of ICT acquisition and age of firms

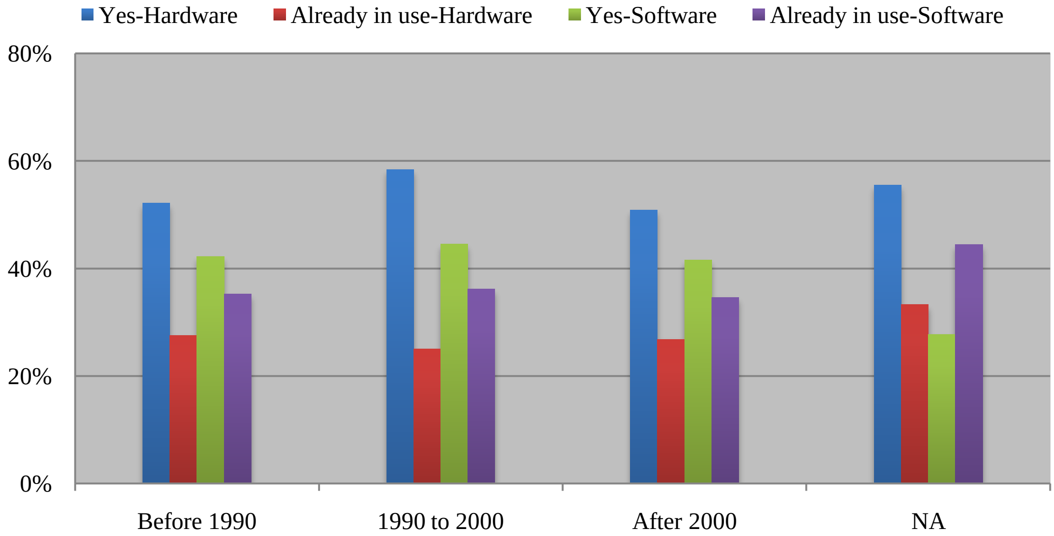
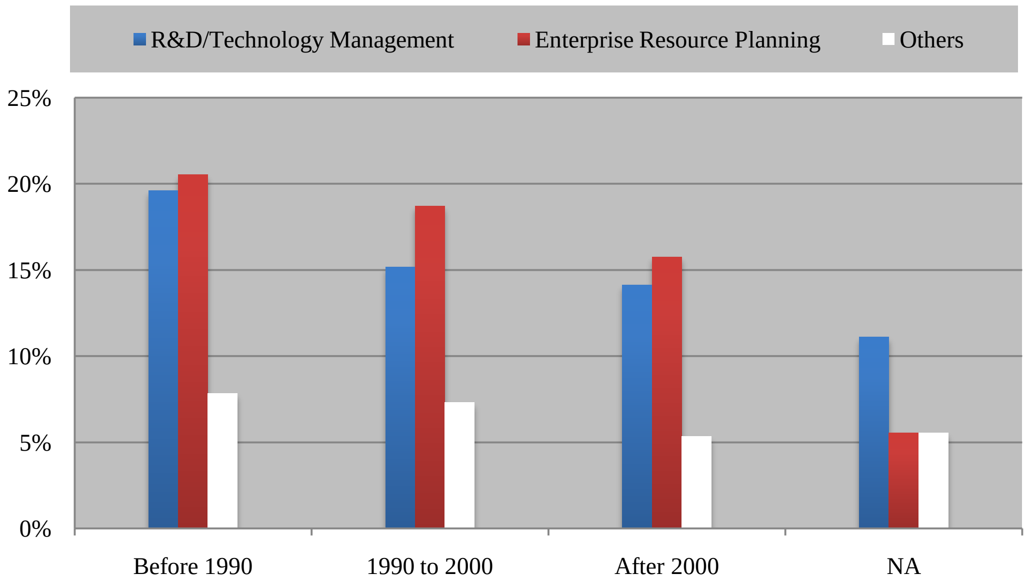


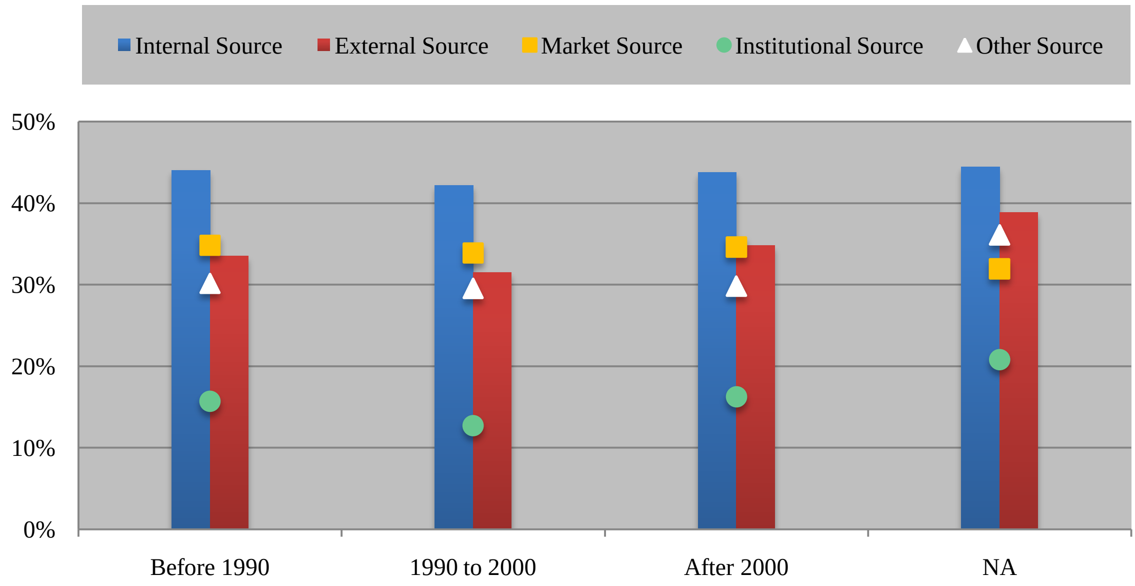
Figure 3.24: Extent of ICT use and age of firms



Information Source and Age

The information source plays an important role in innovation activities and figure 3.25 gives a detail of the various sources that provided information to the firms with respect to their ages. Internal source is the most common source used by on an average 43% of firms of all ages. Next to it is followed by market sources and external sources. Accessing institutional source of finance is more common among the firms established before 1990 and after 2000.

Figure 3.25: Source of Information and Age of the firms



In Nutshell

Firms are categorised into three broad groups based on their year of establishment as 'before 1990', '1990 to 2000' and 'after 2000'. Firms established during the nineties and before 1990, are more innovation active than the new firms. The incidence of product innovation, process innovations and product quality standardization are more among the firms established before 1990 and they mostly claim their innovations to have increased the range of goods and services, improved their capacity of production and also addressed social issues. The new firms (firms established after 2000) though they have shown lesser innovativeness, their innovations are mostly 'new to the market', which among the firms established at an earlier age is low. Firms established during the nineties and after 2000 mostly acquired technology from external sources in the form of patents while those established before 1990 mostly acquired knowhow of the technology. Mostly the older firms on an average had more number of skilled manpower resources in their enterprises than the new firms and they are also more engaged in human resource development programmes to train their employees.

IV

Ownership type and Innovation

Highlights

- We find that ownership pattern does not have much significant effect on firms' technological innovation performance. However, some ownership types (e.g., private and public Ltd) do have a positive effect.

- Majority of the large firms that are innovative are mostly public Ltd enterprises and Public Sector Units (PSUs).

- Public Ltd firms and PSU's established before 1990 reported more innovation activities than those established after the economic liberalization and these firms mainly claim their innovations to be new to the Indian market and also new to the world.

- Private firms that were established during the nineties show more propensity to innovate than those established before 90 and after 2000.

- Firms engaging in extramural R&D are rare. However, the public Ltd, PSU's and family owned enterprises reported more of such engagement than others.

- For human resource base we find Public Ltd enterprises on an average having maximum number of scientists and engineers and it is the private sector firms, which train maximum number of their employees.

- The sources of information are mainly the firm's own internal sources and availing institutional knowledge source seems very weak among the firms. However within the PSU's and the family businesses a few claim of some strong linkages.

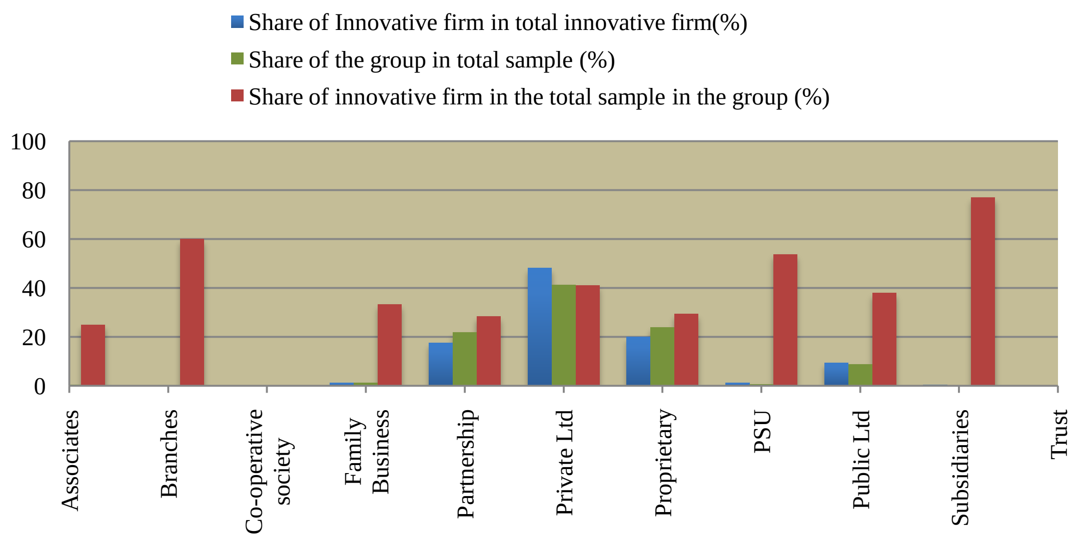
Ownership type and Innovation

This chapter focuses on ownership pattern of firms and analyses if there is any relation between ownership pattern and innovativeness of the firms. This is mainly done by examining the ownership types with respect to various components like innovation performance, strategies for innovation, post innovation gains and sources of innovation so as to ascertain the status of the firm involved in these activities. Ownership type includes associates, branches, co-operative society, family business, partnership, private ltd, proprietary, public sector undertakings (PSU), public ltd, subsidiaries and trust.

Types of ownership and Innovativeness

Figure 4.1 gives a detail of the share of firms within each type of ownership and their innovativeness. From the figure we see that majority of firms surveyed were mainly under private, proprietary, partnership and public ltd ownership and we find private firms to be more involved in innovation activities followed by public, partnership and proprietary firms. Firms, which are subsidiaries, branches and PSU's, are also involved in most of the innovative activities.

Figure 4.1: Ownership wise share of the innovative firms

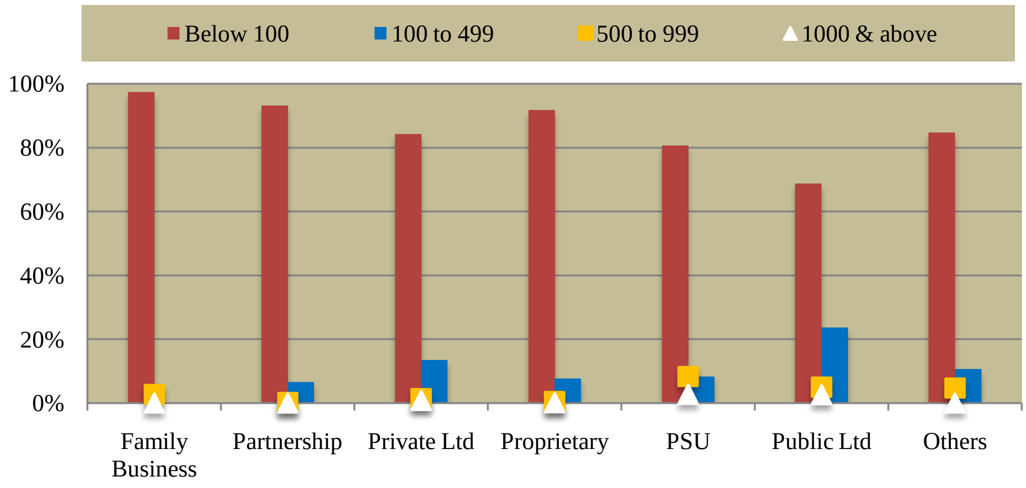


Ownership type and Size and age of firms

We examine the ownership type with respect to age and size of firms. The following figure 4.2 and figure 4.3 describe ownership types of firms with size and age respectively. We see that major share of innovative firms within each ownership category is a firm with below 100 workforce. Within the public ltd enterprises, 69% of innovative firms have below 100 workforce followed by 24% and 5% firms with 100 to 499 and 500 to 999 workforce respectively. Firms within '500 to 999'-size category are mostly innovative within PSU, public, family business and private type of ownership**.** Within the public ltd enterprises we find 44% of innovative firms established before 1990, 29% within 1990 and 2000 and 27%

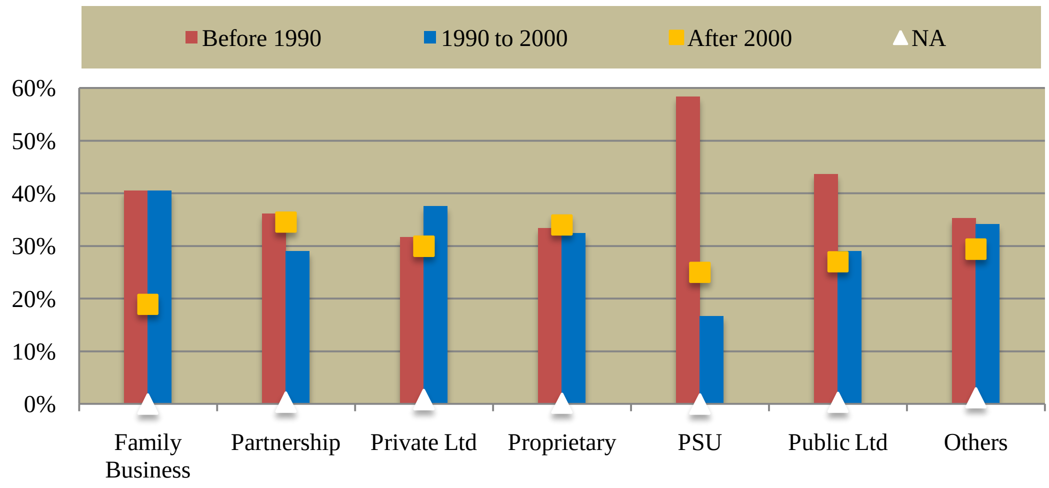
established after 2000. On the other hand among the private ltd companies the innovative firms are mainly those established after the economic liberalization.

Figure 4.2: Ownership type and Size of the innovative firms



(Others include branches, subsidiaries and associates)

Figure 4.3: Ownership type and Age of the innovative firms



(Others include branches, subsidiaries and associates)

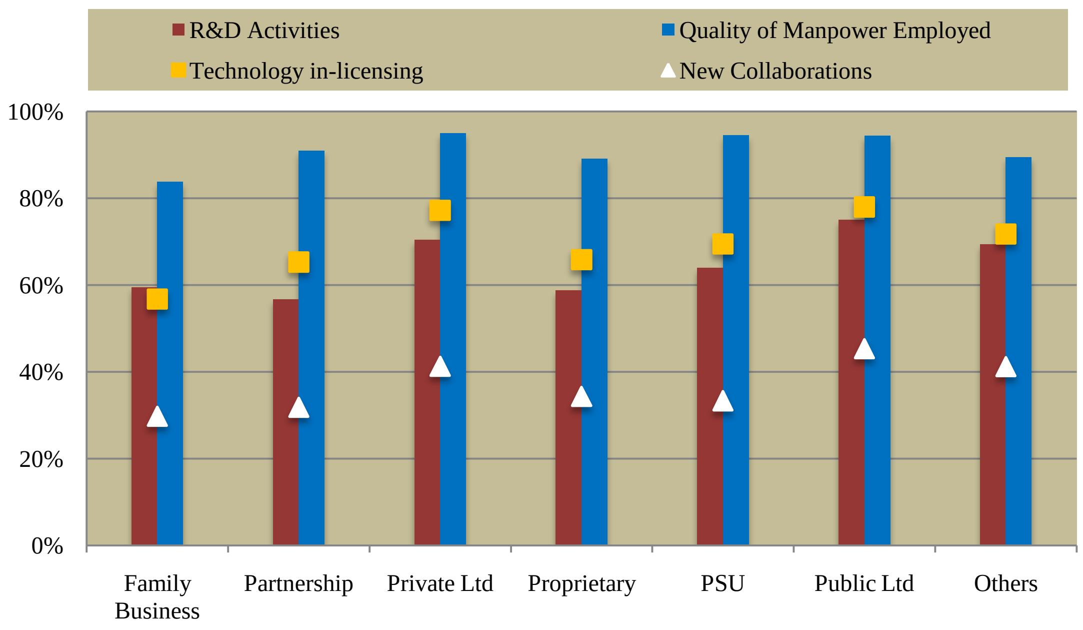
Post Innovation Position and Ownership type

i. Does ownership pattern influence competitive positions through innovation?

The post innovation competitive position of the firms is presented in the following three figures (figure 4.4, 4.5 & 4.6). The competitive position of the firm has been ascertained through 12 broad categories to see how the firms render themselves vis-a-vis their peers against these categories. The categories include R&D activities, technology in-licensing, quality of manpower employed and new collaboration (presented in figure 4.4) FDI, sourcing raw materials, efficient cost management and quality of machines and equipments (figure

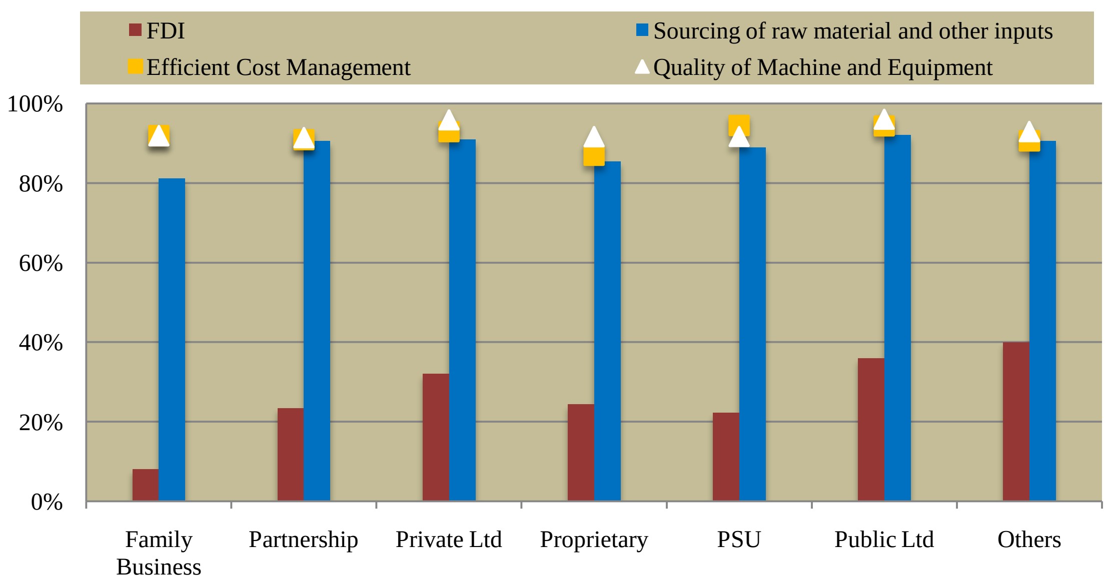
4.5) efficient organisational and marketing practices, information management and brand development (figure 4.6). Around 90% of innovative firms of all categories consider themselves at par with others in the industry in terms of employing manpower, quality of machines procured, sourcing raw materials, cost management and information management. In terms of R&D activities and technology in-licensing about 75% of public Ltd enterprises consider themselves at par or ahead of others.

Figure 4.4: Competitive positions and Ownership pattern of innovative firms (I)



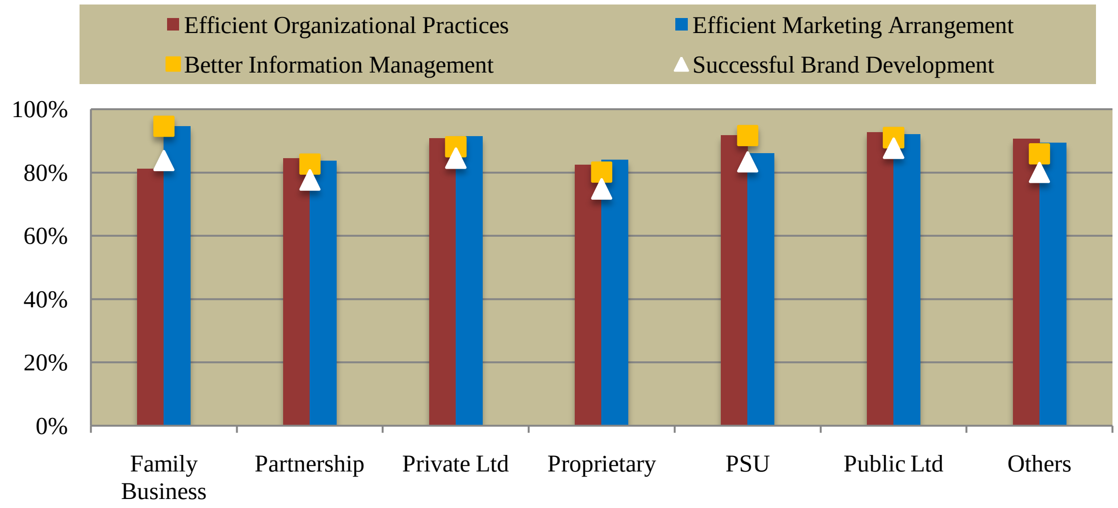
(Others include branches, subsidiaries and associates)

Figure 4.5: Competitive positions and Ownership pattern of innovative firms (II)



(Others include branches, subsidiaries and associates)

Figure 4.6: Competitive positions and Ownership pattern of innovative firms (III)

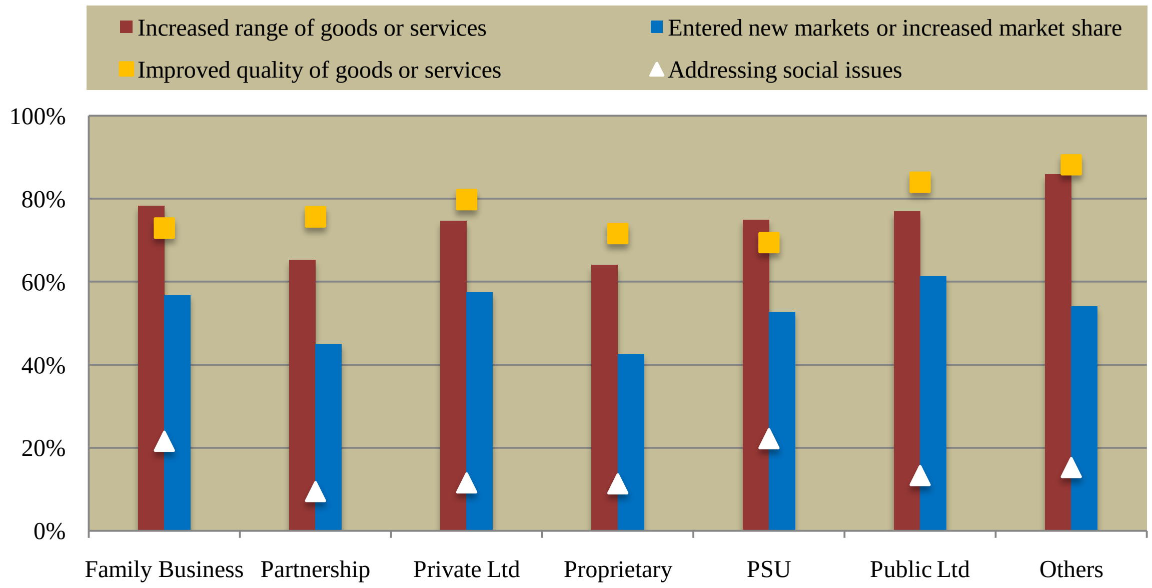


(Others include branches, subsidiaries and associates)

ii. Does ownership pattern have any influence over the outcome of innovations?

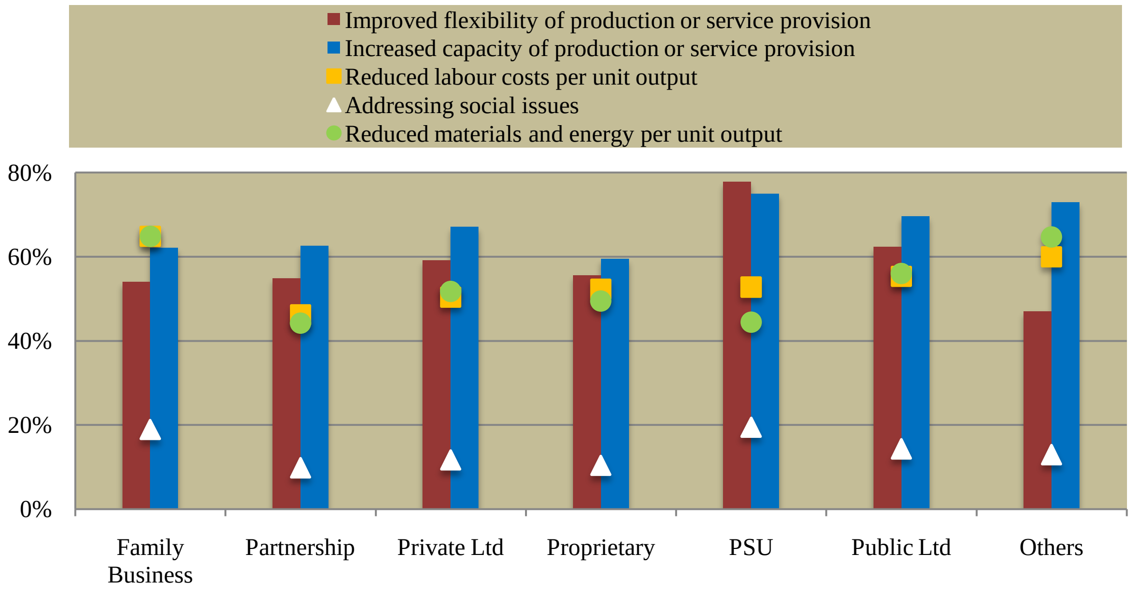
To ascertain whether ownership pattern of firms differ with the outcome of innovations we examine the following three figures (figure 4.7 to 4.9), which indicate the outcome of various innovation initiatives taken by the firms and their ownership type. For each type of innovation we see uniform outcome as indicated by the firms of all the ownership types. However a slight higher share of private and public Ltd enterprises consider their innovations to be more successful in increasing range of goods, improving quality of goods, increasing production capacity and reducing environmental impacts.

Figure 4.7: Product outcome and ownership of innovative firms



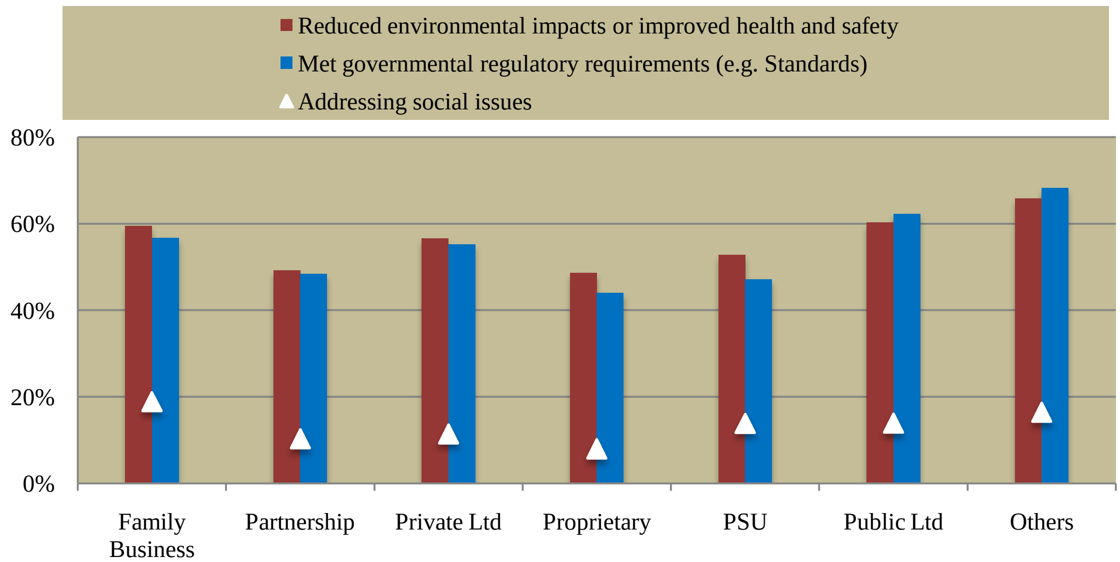
(Others include branches, subsidiaries and associates)

Figure 4.8: Process outcome and ownership of innovative firms



(Others include branches, subsidiaries and associates)

Figure 4.9: Other outcome and ownership of innovative firms

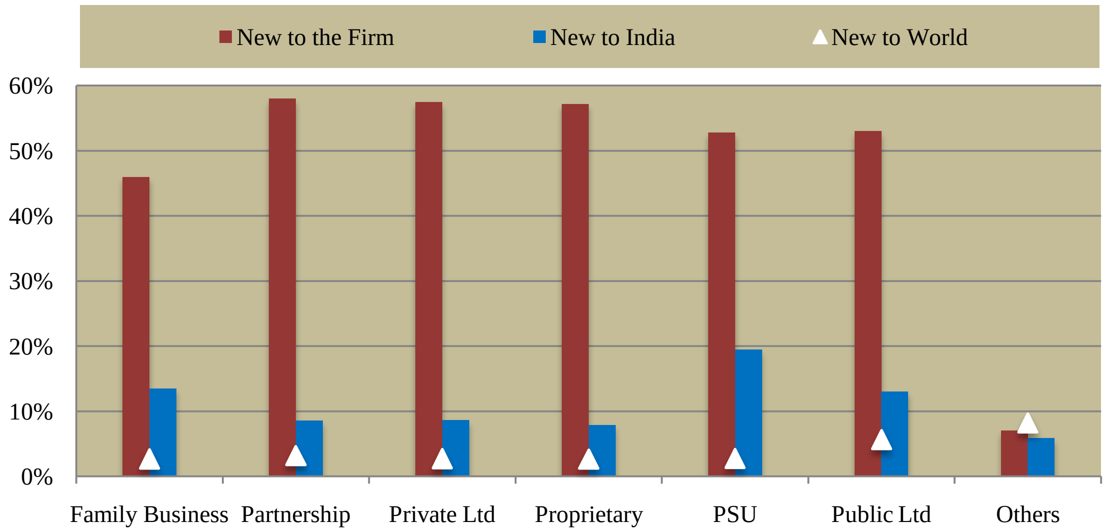


(Others include branches, subsidiaries and associates)

iii. How new the innovations are for the firms of different ownership type?

The extent of newness of innovation is captured by the novelty aspect of innovation. Figure 4.10 shows the ownership pattern of the innovative firms and the novelty of their innovations. Most of the firms claim their innovations to be new to the firm only, however about 20% of the PSU's claim their innovations to be new to the Indian market followed by 13% of the public sector firms. Also 6% of public ltd firms claim their innovations to be new to the world.

Figure 4.10: Ownership and Novelty of innovations

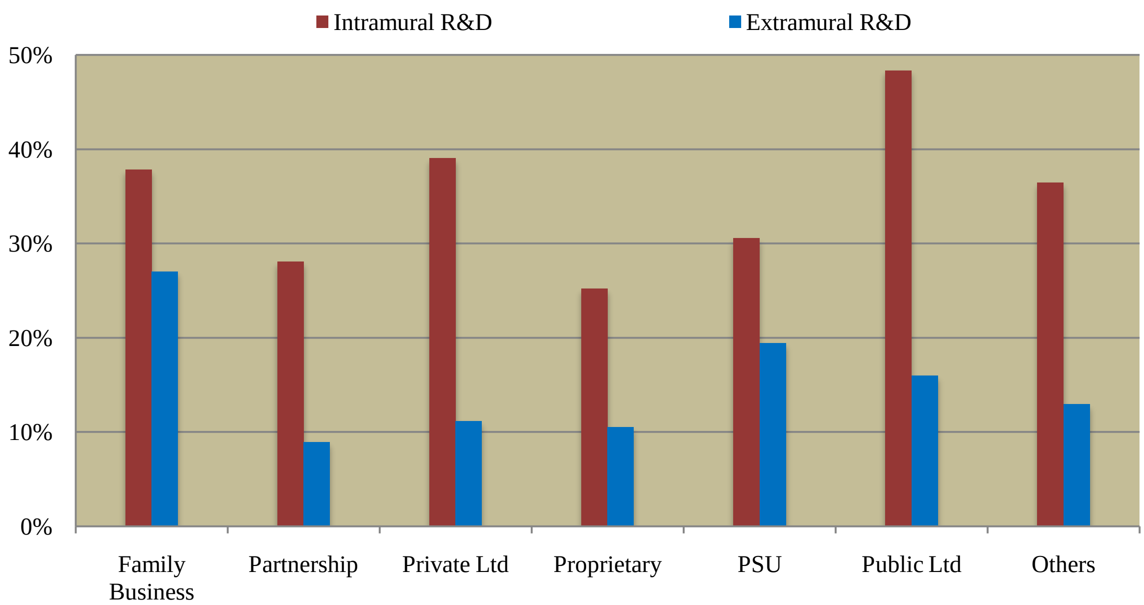


(Others include branches, subsidiaries and associates)

Innovation Activities and Ownership

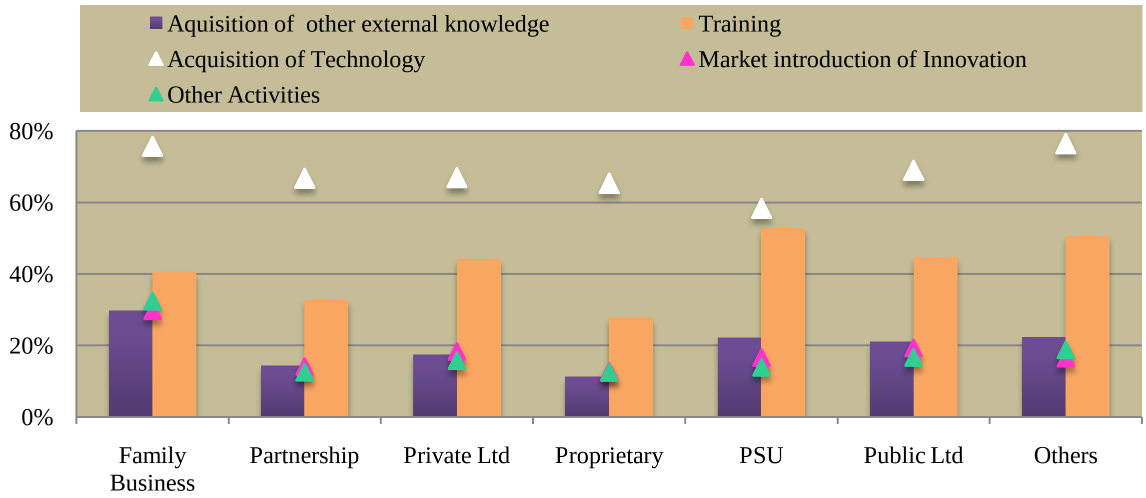
As discussed earlier the activities related to innovations is divided under six broad categories and involvement of the innovative firms in these activities along with their ownership type is presented in figures 4.11-4.12. We see that most of the firms commonly practice acquisition of technology and apart from this intramural R&D is practiced by 48% of public sector firms followed by 39% of private sector firms. Extramural R&D is rarely practiced by the firms but PSU's are ahead in this as 20% of their firms go for extramural R&D collaborations.

Figure 4.11: Activities performed by Innovative firms and ownership (I)



(Others include branches, subsidiaries and associates)

Figure 4.12: Activities performed by Innovative firms and ownership (II)

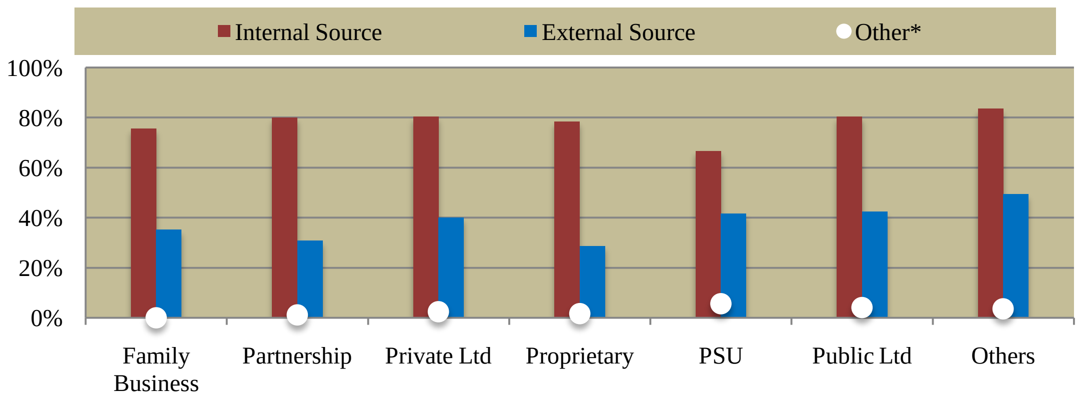


(Others include branches, subsidiaries and associates)

Strategies for Innovation and Ownership

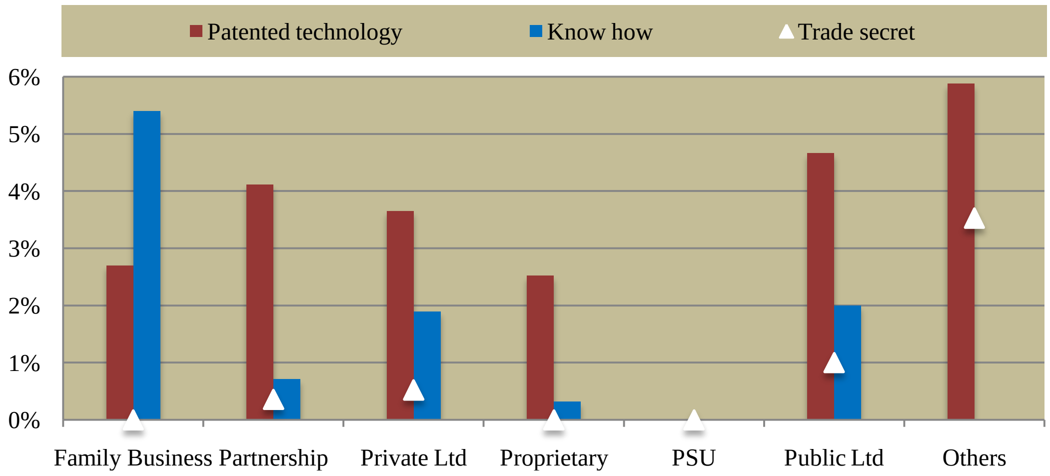
Strategies for innovation include mix of various factors when put together enhances the innovative capacity of the firms. The source used by the firms for the development of new product or process with respect to their type of ownership is shown in figure 4.13. Most of the firms use their own internal sources for innovation and very little variation is seen among them who opt for external or other sources. External sources are accessed mainly to acquire technological competencies. We find around 4% firms from each of public, private and partnership categories obtain patented technologies from external sources (figure 4.14). Also about 5% firms, which are family businesses type, obtain technological knowhow from other sources. These technological competencies are mostly acquired from open domestic market (figure 4.15) Acquiring technology from foreign market is mostly seen within private, PSU and public ltd firms. The extent of technology acquired whether partial or full set is shown in figure 4.16. Most of the firms acquire full set technology.

Figure 4.13: Sources used and ownership



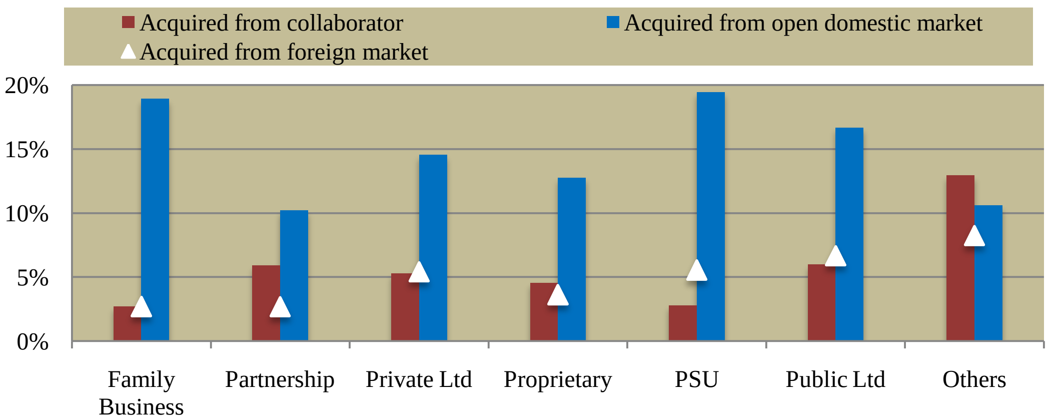
(Others include branches, subsidiaries and associates)

Figure 4.14: Sourcing technology and ownership



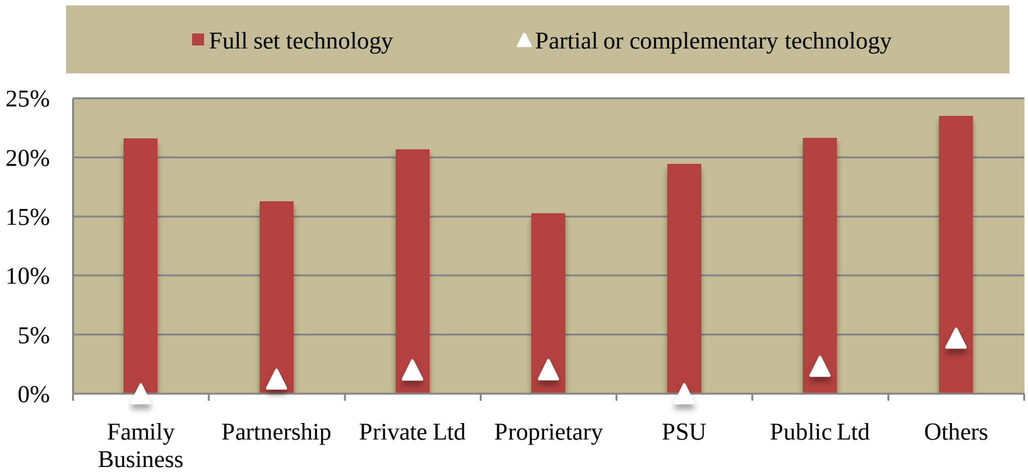
(Others include branches, subsidiaries and associates)

Figure 4.15: Source of technology and ownership



(Others include branches, subsidiaries and associates)

Figure 4.16: Extent of technology and ownership

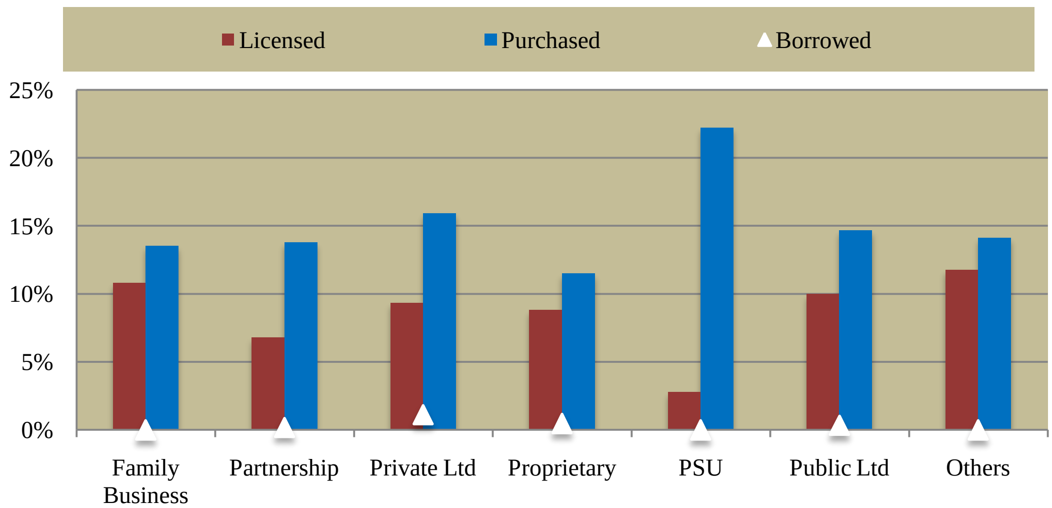


(Others include branches, subsidiaries and associates)

Transactions and Ownership

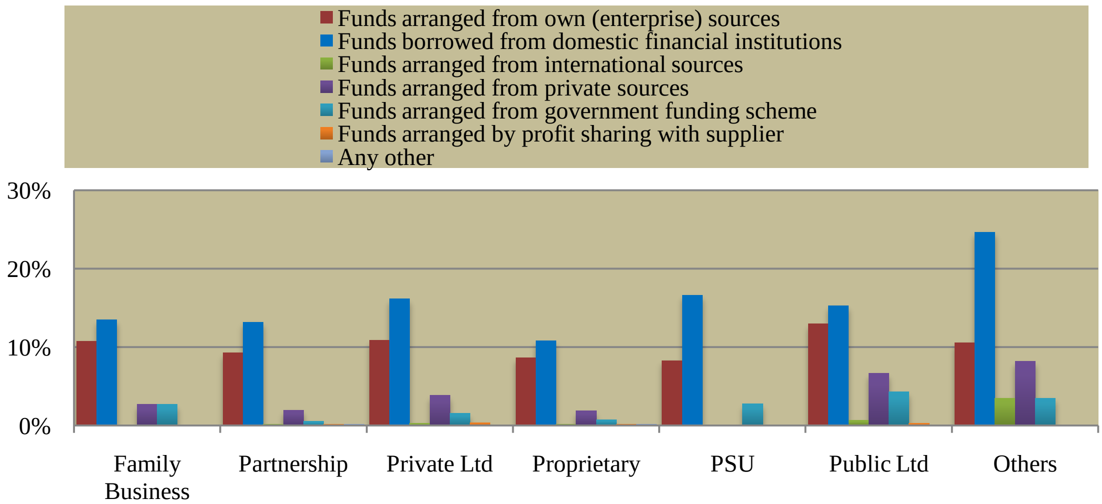
We have seen earlier that innovative firms mostly source technologies from internal sources and only a few firms have sourced technologies from external sources. Their mode of acquisition and ownership type is shown in figure 4.17. Most of the firms that are PSU purchased the technology and about 15% of public ltd firms purchased the technology and 10% licensed it. Similar is the case with private and partnership firms. Arrangements of funds and expenditure incurred for these activities are shown in figure 4.18 and 4.19 respectively. Not much variation is seen in terms of arrangement of funds among the firms. Funds were mostly borrowed from domestic financial institutions and from own internal sources. The expenses for procuring technologies and other are mostly incurred as onetime payment (figure 4.19).

Figure 4.17: Mode of acquisition and ownership



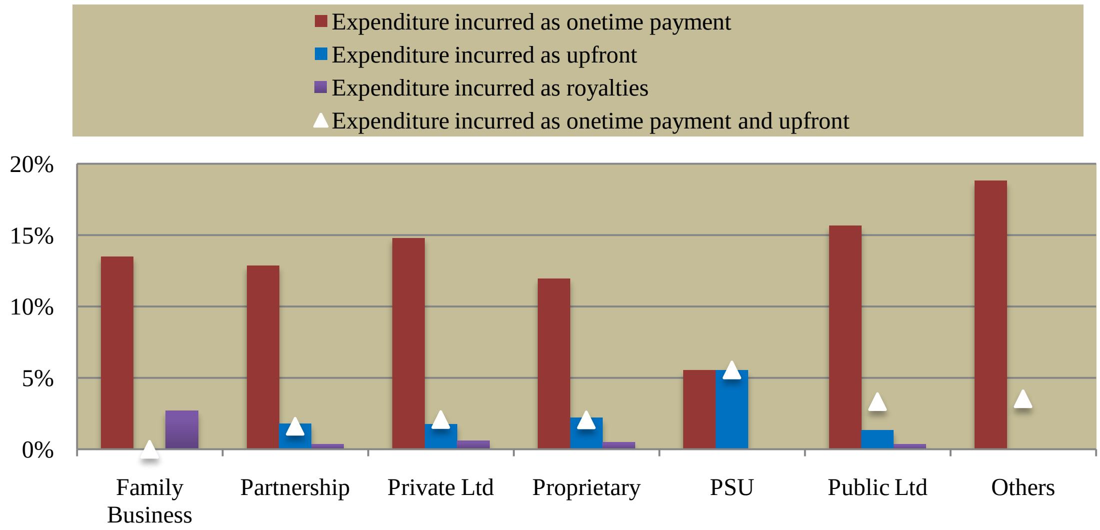
(Others include branches, subsidiaries and associates)

Figure 4.18: Source of Fund and ownership



(Others include branches, subsidiaries and associates)

Figure 4.19: Expenditure incurred and ownership

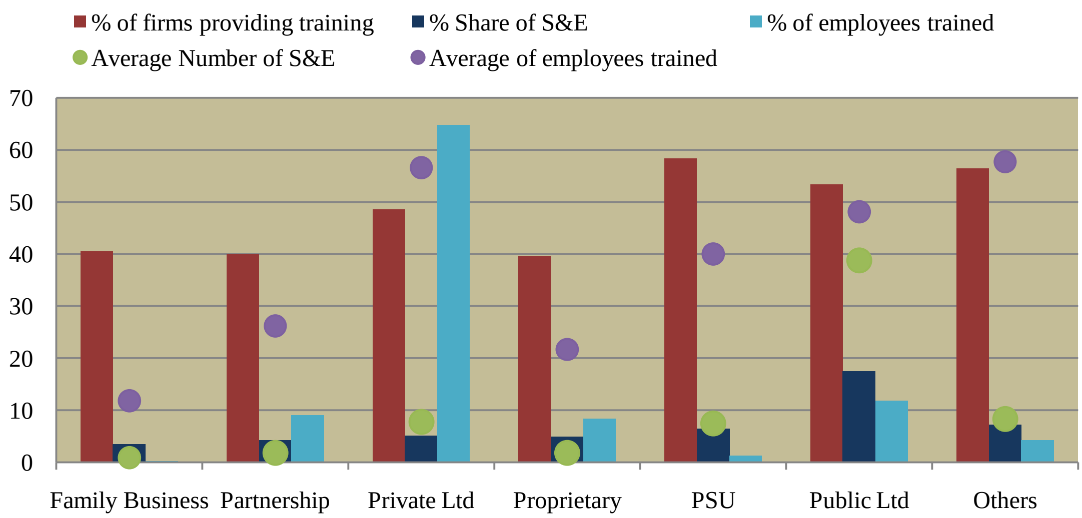


(Others include branches, subsidiaries and associates)

Human Resource and ownership type

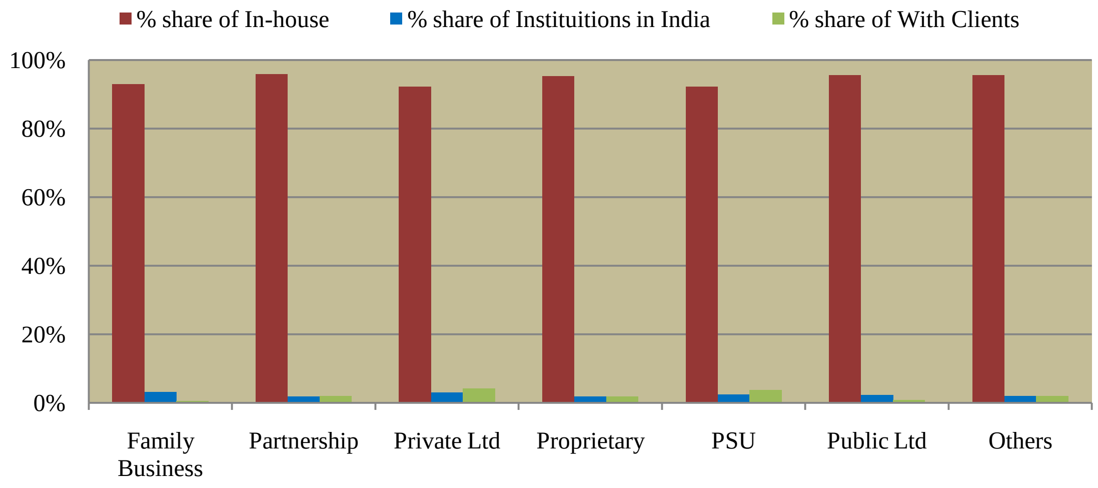
The human resource pool among the firms of different ownership types is shown in figure 4.20. We see that firms that are public Ltd enterprises have on an average higher number of scientists and engineers and also out of total employees employed the share of scientist and engineers are highest within this group. On an average about 45% of firms of different ownership types provide training to their employees and it the private sector, which trains maximum number of their employees. Most of the training imparted is in house training (Figure 4.21)

Figure 4.20: Human Resource pool and ownership



(Others include Subsidiaries, Associates and Branches)

Figure 4.21: Training provided and ownership

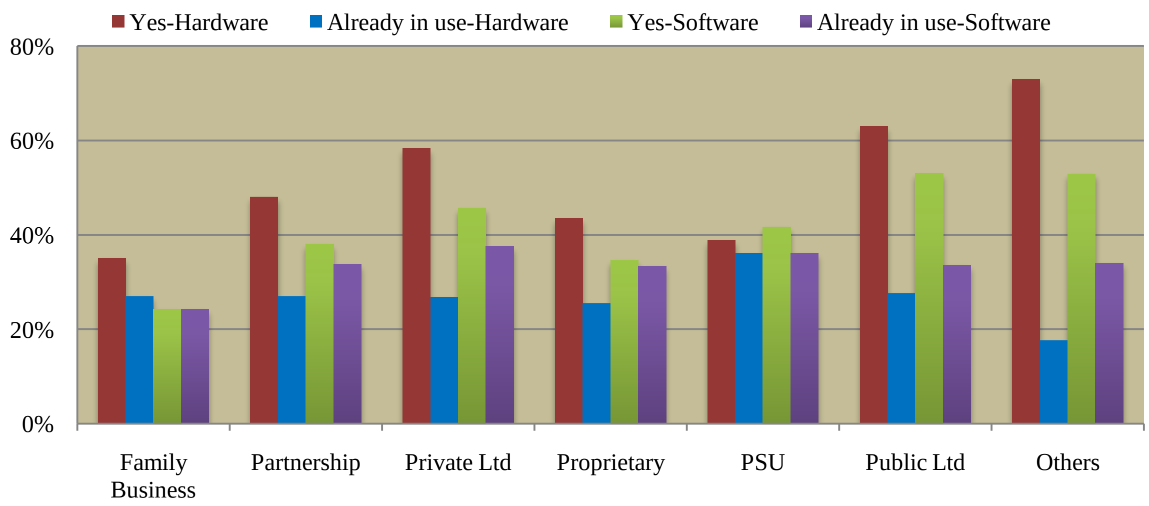


(Others include Subsidiaries, Associates and Branches)

Informatisation and Ownership types

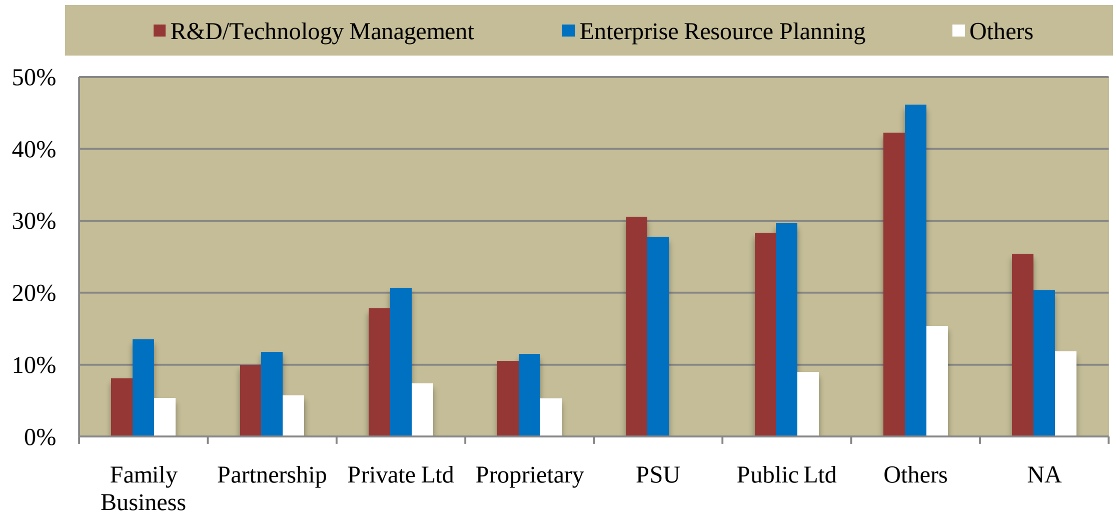
The degree of ICTisation within an enterprise enables speeding up the process of innovation. Here we have captured the hardware and software capacity of the firms to assess the extent of ICTisation. Figure 4.22 and 4.23 details the hardware and software acquisition and the usage of it subsequently. Acquisition of hardware and software is more among the public and private firms, however lesser share of firms have responded to have ICT already in their use which is indicative of the fact that ICT is getting more diffused within the firms. Nearly same percentage of firms within public and PSU governance use the ICT for R&D management and enterprise resource planning (figure 4.23).

Figure 4.22: ICT acquired and ownership



(Others include Subsidiaries, Associates and Branches)

Figure 4.23: Extent of ICT use and ownership

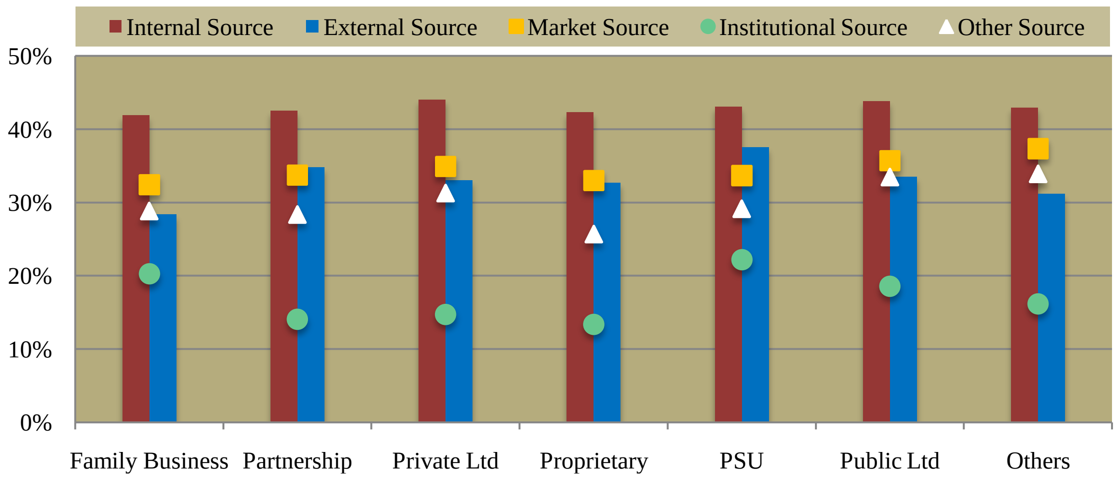


(Others include branches, subsidiaries and associates)

Information source and Ownership

The sources that provided information related to innovation projects to the firms are grouped under 4 heads which consist of internal source, external source, market source, institutional source and other sources. The relationship between information source and ownership type is shown in figure 4.24. Again there is no much variation seen among the firms of different ownership types in terms of accessing information from the above-mentioned sources. Accessing institutional sources appears to be weak sources among the firms, however within the PSU's and the family businesses few claim of some strong linkages.

Figure 4.24: Information Source and Ownership



(Others include branches, subsidiaries and associates)

In Nutshell

On analysing the various ownership patterns of the firms with their innovation initiatives we find no significant effect of ownership types on firm's technological innovations. However, some ownership types (e.g., private and public Ltd) do show some positive effect. We find that majority of the large firms that are innovative are mostly public Ltd enterprises and Public Subsidiary Units (PSUs) and these public Ltd firms and PSU's established before 1990 reported more innovation activities than those established after the economic liberalization. On the novelty aspects of the innovations we find that PSUs are main claimants of innovations to be new to the Indian market and also new to the world. In terms of innovativeness we find that the private firms established during the nineties to be more innovate than those established before 90 and after 2000. R&D initiatives by the firms or involvement in R&D activities is very low among the firms and firms are mostly engaged in intramural R&D activities. Firms engaging in extramural R&D are rare activity and the public Ltd, PSU's and the family businesses are the ones who reported more of such engagement than others. For human resource base we find Public Ltd enterprises on an average having maximum number of scientists and engineers than others and private firms who train maximum number of their employees than others. We find that mostly firms irrespective of their different ownership patterns basically use their own internal sources for availing various innovation related information.

V

Types of Innovation

Highlights

- About 70% firms have innovations in the form of introducing new machines, followed by quality and standard related activities by 40% of the firms. About 32% and 34% firms claimed Product and process innovations respectively.

- Small firms dominate all types of innovations. Private, partnership and proprietary business which account for about 80% of innovative firms are mainly engaged in introduction of new machines. Around 45% of the innovative firms are generally affirmative about post innovation competitive positions being at par with the peers.

- Innovations are predominant 'new to the firm' category. Use of alternative material, however, has about 20% innovative firms claiming 'new to the Indian market' and about 10% claiming innovations 'new to the world market'.

- Extramural R&D has some presence in innovations related to alternative materials, but overall non- R&D based innovation has predominance among innovative firms.

- Percentage share of scientist and engineer in the total employees is about 8% for 'new product' type innovation. The share is highest for 'alternative material' at 11.11%. High skilled manpower is not much in use among innovative firms for augmenting innovation.

- R&D and technology management are the areas where ICT is used by about on average 20% firms in all types. ICT for ERP is strong among the firms engaged in new process and new product technology. About 40% firms among those engaged in 'alternative material' type of innovations do use external source for information. It is interesting to note that market source has preference over institutional sources for access to information by innovative firms.

- Improvement of quality, cost reduction, environment/health/safety and meeting government regulations remain the main types of gains from innovations. Social issues are not the concerns of innovations.

Types of Innovation

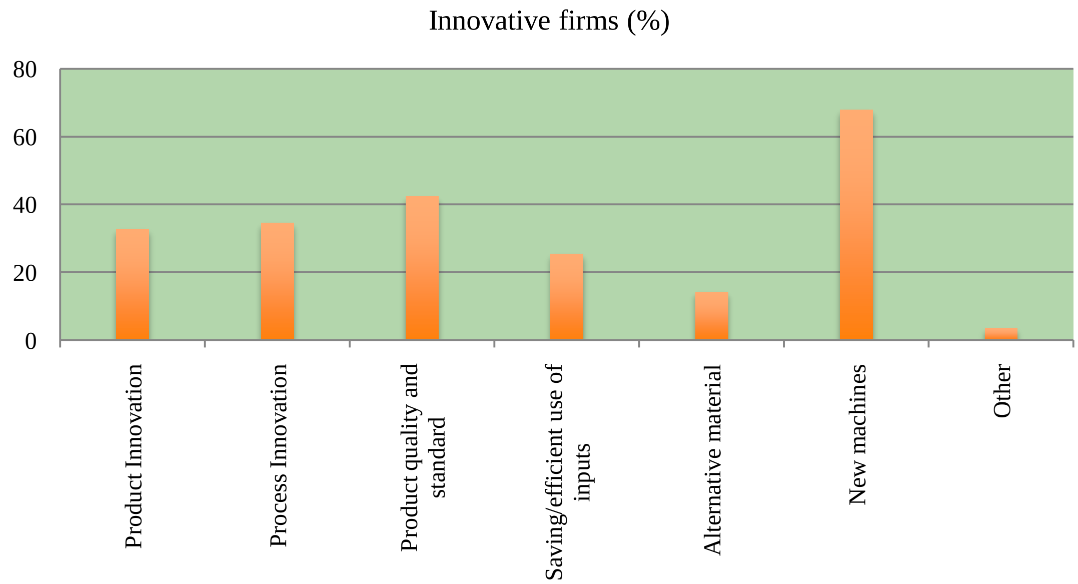
This chapter focuses on types of innovation as distinguishing factors of innovations and innovators. Do the strategies for innovation differ over the types of innovation, as they do over age, ownership and size of innovators? What are the post innovation gains from different types of innovations? How does resource mobilastion (human as well as physical) vary over types of innovations.

The survey did not distinguish between minor, major or/and radical innovations. This limitation was due to the non-existence of information on the possible indicators like expenditure on innovation or R&D, manpower engaged both in numbers and capability levels etc. that could help form ideas on the nature of innovations from the input side. Similarly, on the output side indicators, it was not possible to ascertain the contributions of innovations towards the revenue and profit of the firms. This chapter examine the types of innovations in terms of the firm level attributes like size, age and ownership pattern. We also explore if types of innovations explain differences in strategies, if any, nature and extent of resource deployment, and post innovation gains and status of the firms.

As described earlier, innovations have been captured in terms of changes initiated by a firm in the production operation, organisational practices and marketing arrangements. The changes in the production operations have been grouped under ‘product innovation’, ‘process innovation’, product quality and standardisation’ ‘saving/efficient use of inputs’, ‘use of alternative material’, ‘inducting or introducing new machines’.

As shown in the figure 5.1, more than 60% firms have innovations in the form of introducing new machines, followed by quality and standard related activities by 40% of the firms. About 32% and 34% firms claimed Product and process innovations respectively.

Figure 5.1: Firms engaged in different types of innovations



Innovative firms and types of innovations

What influences the type of Innovation- Is it size, ownership or age of the firm? These questions are explored in this section. We have examined the questions in three different perspectives. First, share of particular age group in total innovative firms in a type of innovation, for eg if there are 100 innovative firms engaged in product innovation, we calculate the share of different age group firms in that 100. Second, if there are 100 innovative firms in an age group (say before 1990) we calculate the percentage of firms in that age group engaged in a particular type of innovation (say product innovations). Third, if there are 100 firms in an age group (say before 1990) engaged in a particular type of innovation (say product innovation) we calculate the percentage share of the group in that type in total innovative firms (all groups of firms and types of innovations taken together).

Age of the firm and types of innovations

Figure 5.2 shows (the firms in) different age groups (total innovative firm in an age group as 100) share in a type of innovation. As evident from the figure there is not much difference in the pattern of innovation activities. Innovation types have more or less similar presence of innovative firms from all three age groups. However firms established before 1990 show marginally more number of firms engaged in most of the innovation types, particularly in product quality and standardisation, process innovation and product innovation than others established at later phase i.e. firms established between 1990 to 2000 and after 2000.

Figure 5.2: Age group and type of innovation (% of innovative firms)

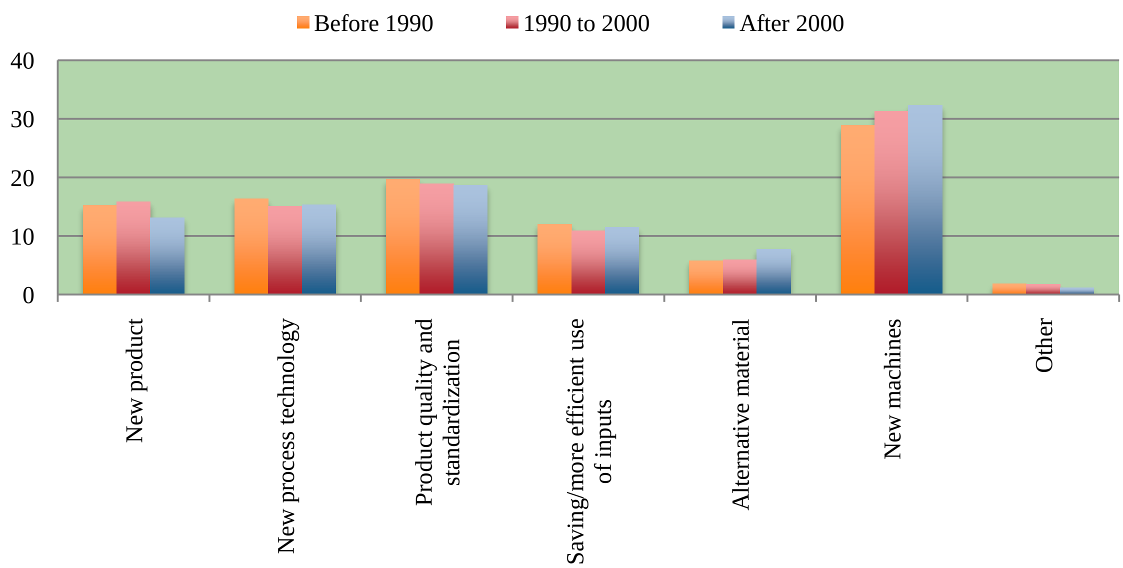
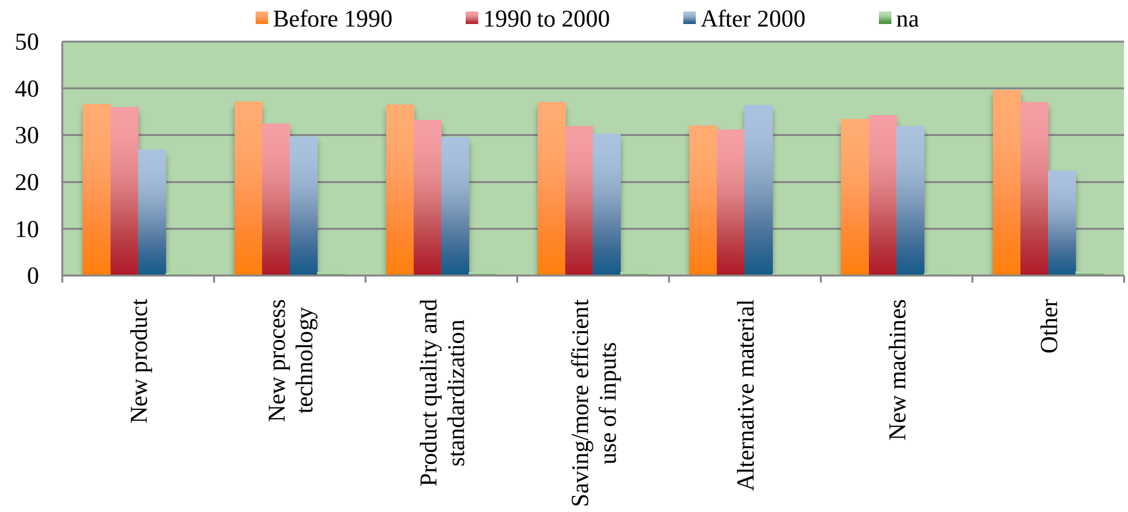


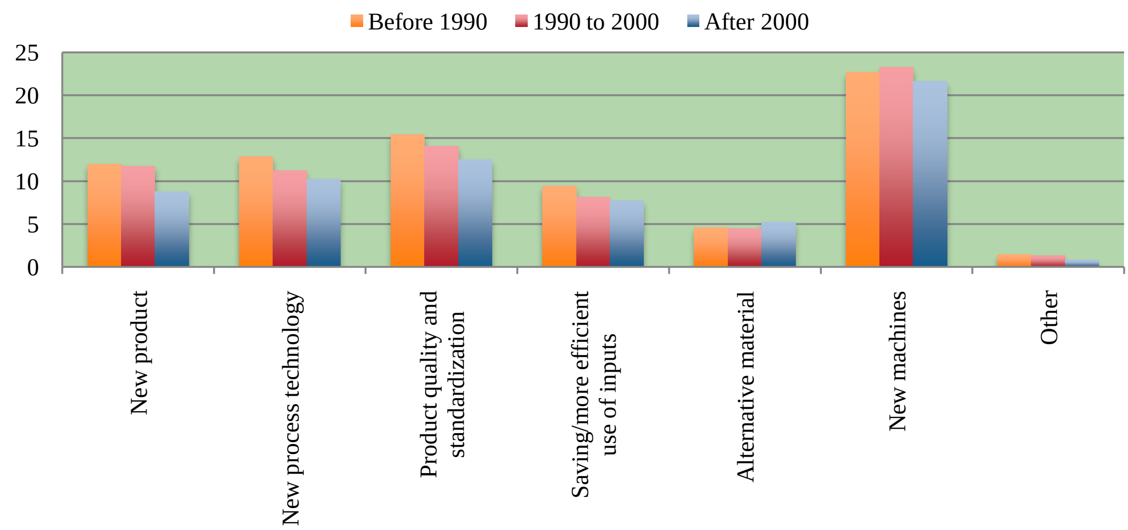
Figure 5.3 shows comparative presence of innovative firms in different types of innovations (innovative firms in a type of innovation as 100). It is to be noted that Firms established before 1990 are ahead of other groups in all types of innovations, except in alternative materials where new firms (established after 2000) are more active.

Figure 5.3: Comparative presence of innovative firms (of different age groups) in different types of innovation



In figure 5.4 total innovative firms identified by the survey is taken as hundred for the share of each age group in a type of innovation. Again firms established before 1990 have better presence in all types except in new machines where firms established during 1990 to 2000 have marginally better presence.

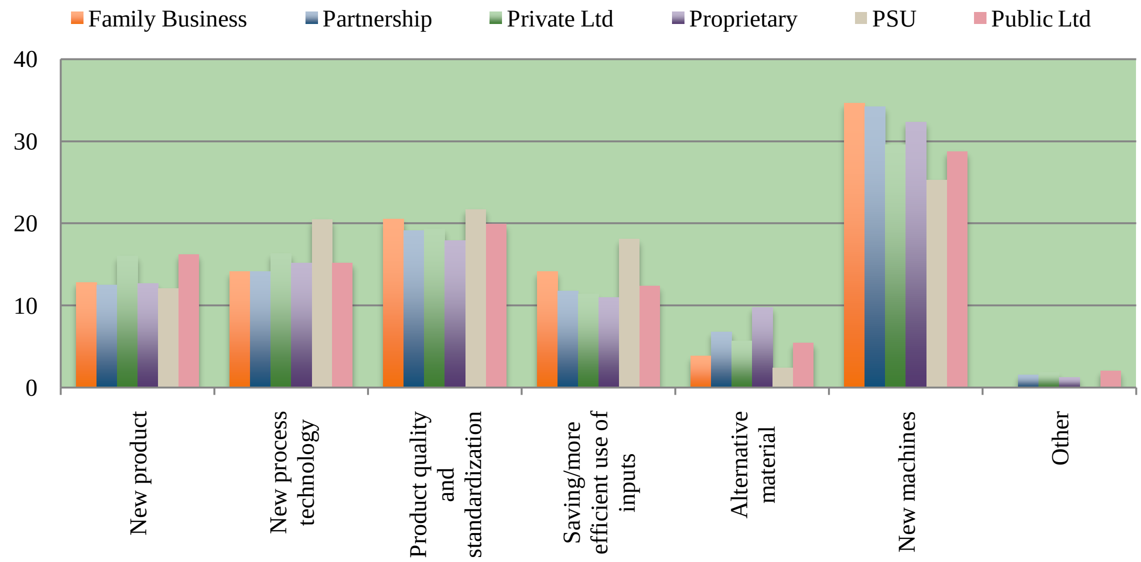
Figure 5.4: Comparative share of innovative firms (for paired age group and types of innovations) as percentage of total innovative firms



Ownership of the firm and types of innovations

Types of innovation and ownership pattern of firms are shown in figure 5.5 (number of innovative firms in an ownership type as 100). Here also the pattern of innovation activities does not change much. Private, partnership and proprietary business which account for about 80% of innovative firms are mainly engaged in introduction of new machines followed by product quality standardisation, process innovation and product innovation. Public Ltd. firms too are seen to follow the same trend. On the other hand firms which are associates and branches though only few have reported any innovation related activities shows more of product and process innovation.

Figure 5.5: Ownership group and type of innovation (% of innovative firms)

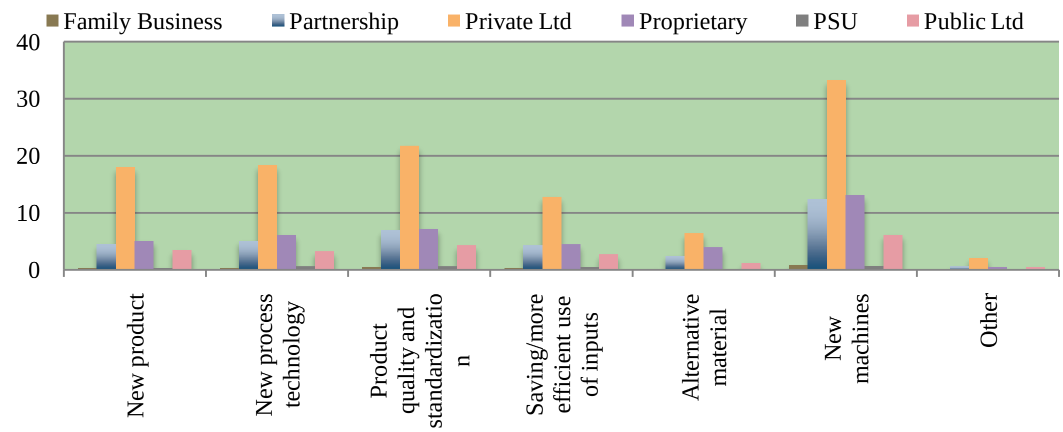


In figure 5.6 number of innovative firms in a type of innovation is taken as 100. The comparative performance over the ownership patterns shows the dominant presence of private ownership firms in all types. This is distantly followed by Public limited companies.

Figure 5.7 takes total innovative firms as hundreds and compares the shares of an ownership pattern in a type of innovation. Again privately owned firms take the largest shares in all types of innovations.

Figure 5.6: Comparative presence of innovative firms (of different ownership groups) in different types of innovation

Figure 5.7: Comparative share of innovative firms (for paired ownership group and types of innovations) as percentage of total innovative firms



Size of the firm and types of innovations

Figure 5.8 shows the different types of innovation activities undertaken by the firms of the four size categories (number of innovative firms in a size group taken as 100). Introduction of new machines is the most favoured type of activities initiated by the firms of all size groups followed by product quality and standardisation. Large firms with workforce 1000 and above has shown a higher trend in product quality and standardisation. As shown earlier, firms of the size below 100 has largest share of innovation related activities. These firms are mainly involved in introduction of new machines followed by product quality and standardisation, process innovation and product innovation.

Figure 5.9 takes number of innovative firms in an innovation type as 100 and shows predominance of smaller size firms in all types of innovations.

Figure 5.10 has total innovative firms as 100. In all types of innovations the smaller size firms have largest shares. About 60% innovative firms are engaged in introduction of new machines followed by product quality, new process, and new product in that order.

Figure 5.8: Firm size group and type of innovation (% of innovative firms)

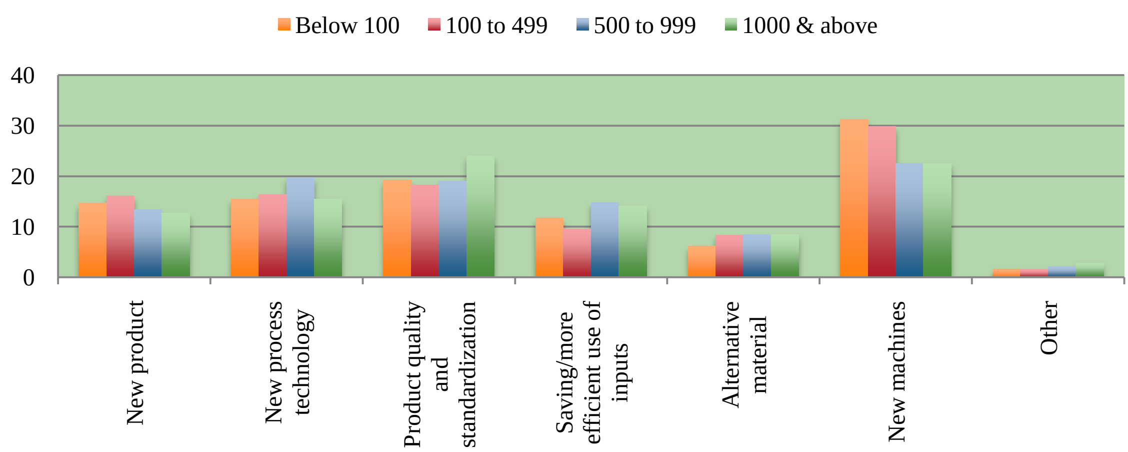


Figure 5.9: Comparative presence of innovative firms (of different size groups) in different types of innovation

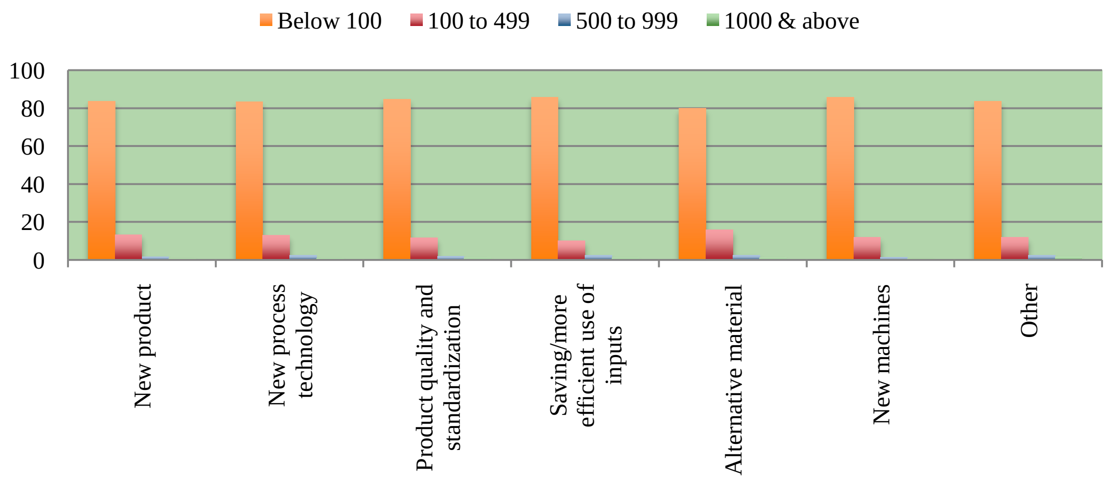
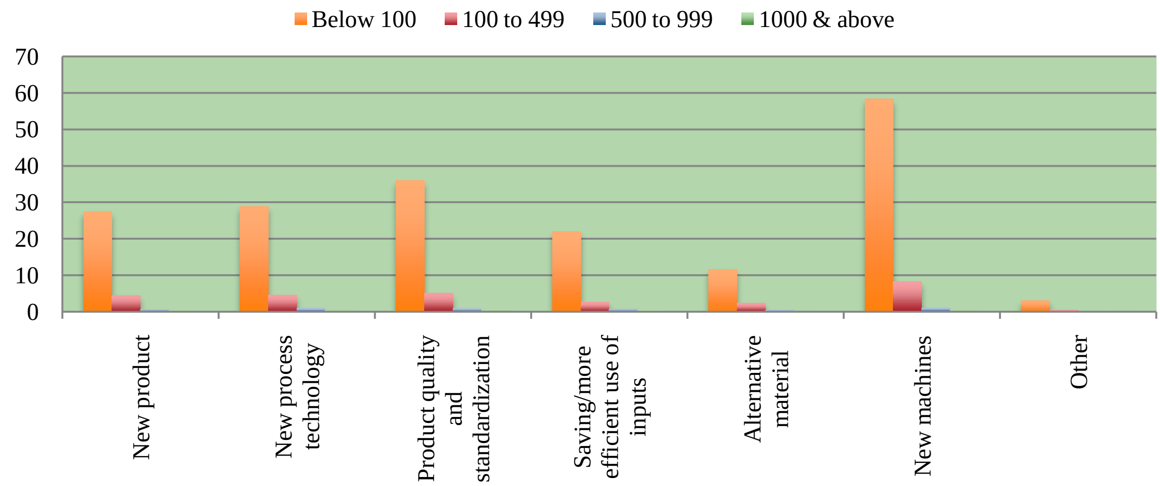


Figure 5.10: Comparative share of innovative firms as percentage of total innovative firms



Post innovations

Figures 5.11 to 5.14 present the post innovation competitive positions of the innovative firms as expressed by the innovative firms. Competitive positions were the self articulations of the firms if they are at par with the peers in their respective industries. Firms' competitive positions have been captured through 12 broad categories, namely, Cost management, organisational practices, machine and equipment (in figure 5.11), R&D activities, manpower, machine and equipment (figure 5.12), Marketing management, information management, brand development (figure 5.13), technology in-licensing, collaborations and FDI (figure 5.14). Around 45% of the innovative firms are generally affirmative about competitive positions being at par with the peers. However, new collaborations and access to FDI remain the weak areas post innovations (figure 5.14).

Figure 5.11 Competitive positions of the firms after innovation (I)

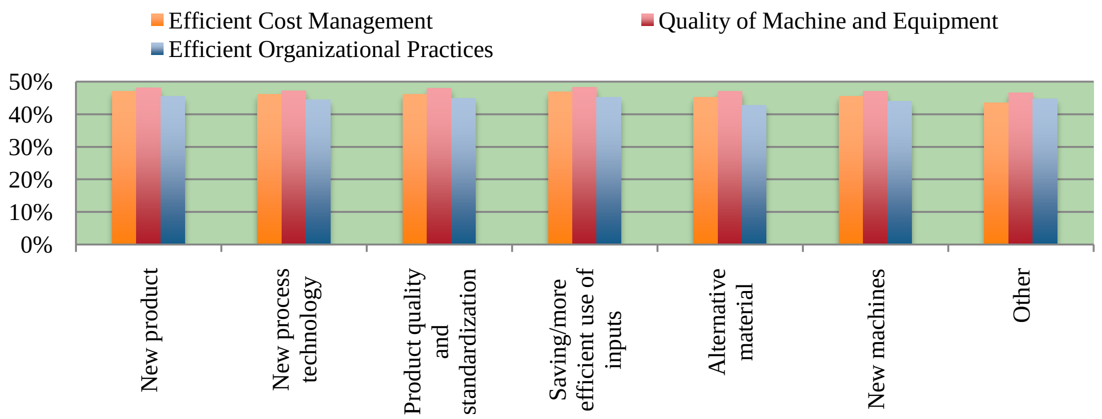


Figure 5.12 Competitive positions of the firms after innovation (II)

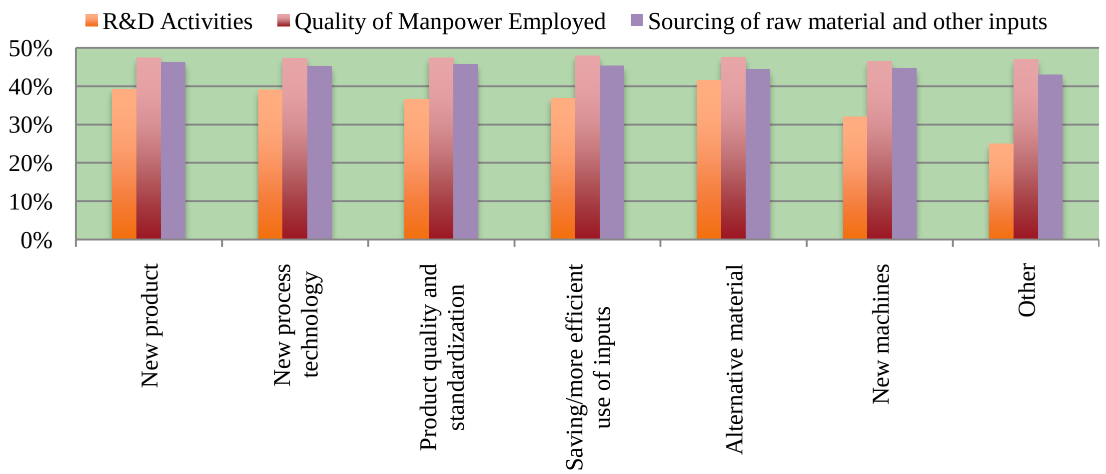


Figure 5.13 Competitive positions of the firms after innovation (III)

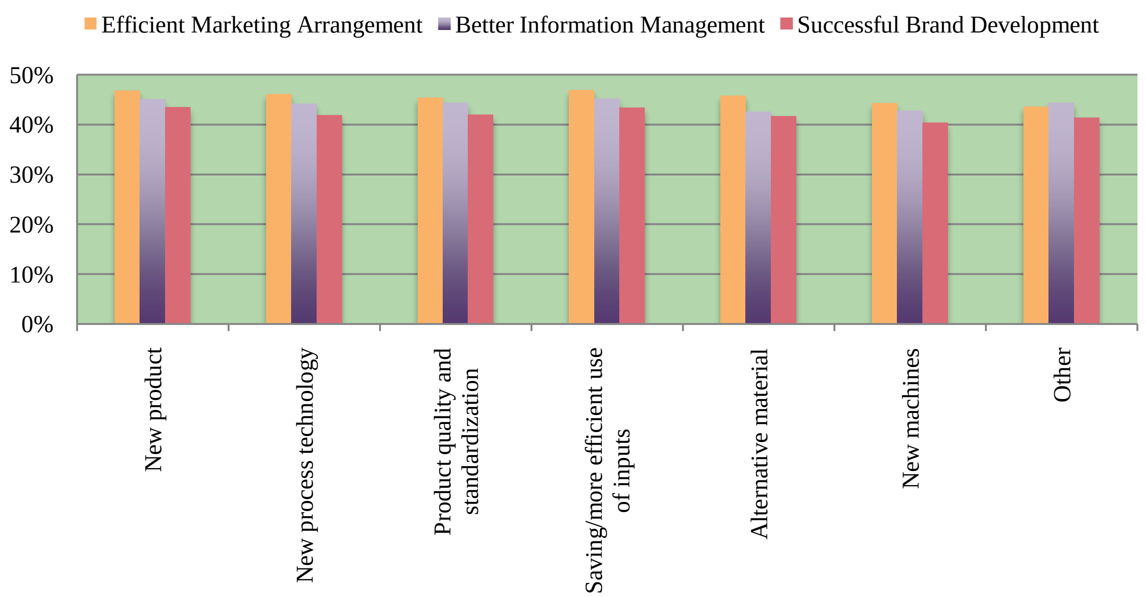
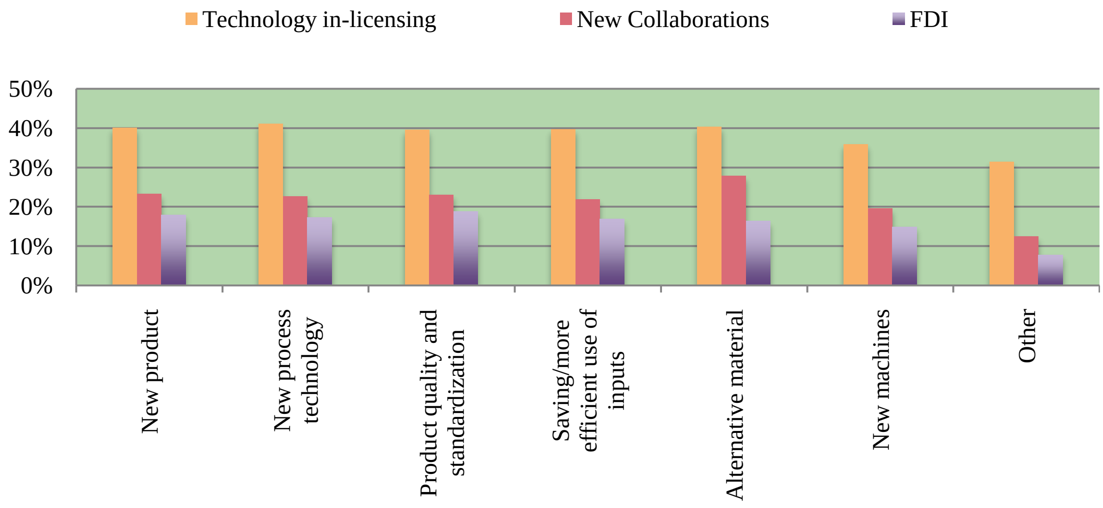


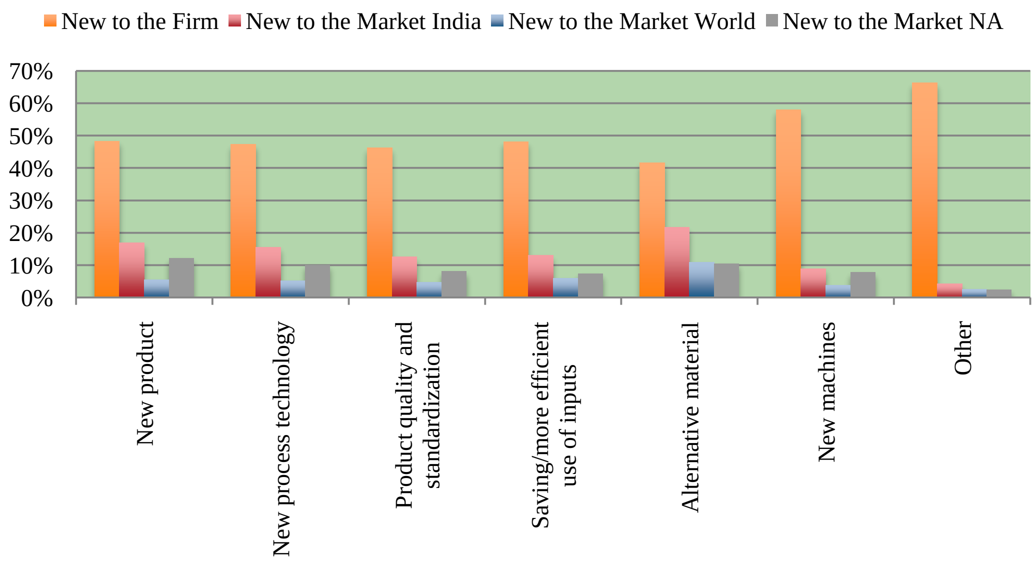
Figure 5.14 Competitive positions of the firms after innovation (IV)



Novelty in innovation

Which types of innovations have more claims on novelty? Figure 5.15 shows that in all types predominant types of innovation are 'new to the firm' category. Use of alternative material, however, has about 20% innovative firms claiming 'new to the Indian market' and about 10% claiming innovations 'new to the world market'. There are similar claims from about 15% firms in 'new product' and 'new process' types.

Figure 5.15 Types of innovation and novelty of innovation



Gains from innovation

Innovative firms' gains from innovations show a uniform pattern across innovation types (figure 5.16-18). Improvement of quality, cost reduction and meeting government Regulations, remain the main types of gains from innovations. Social issues are not the concerns of innovations.

Figure 5.16 Types of innovation and gains from innovation (I)

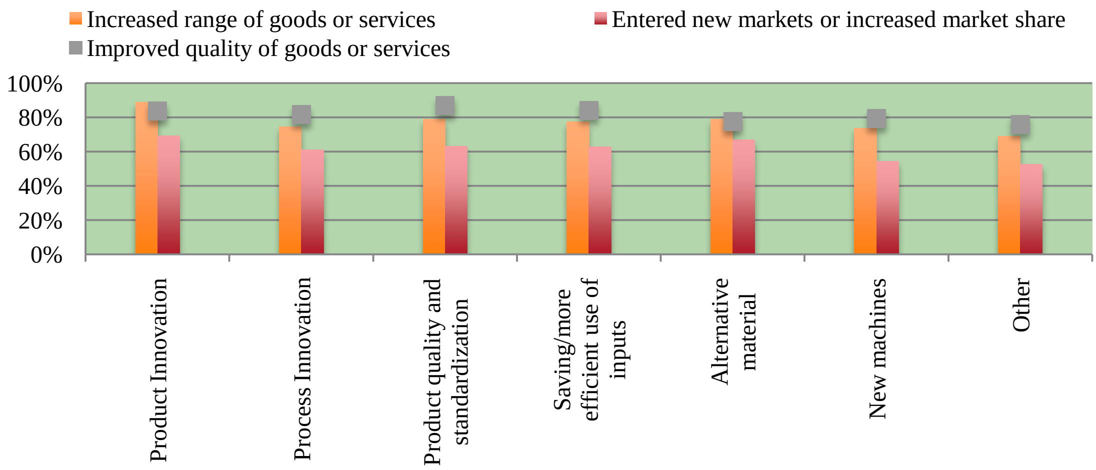


Figure 5.17 Types of innovation and gains from innovation (II)

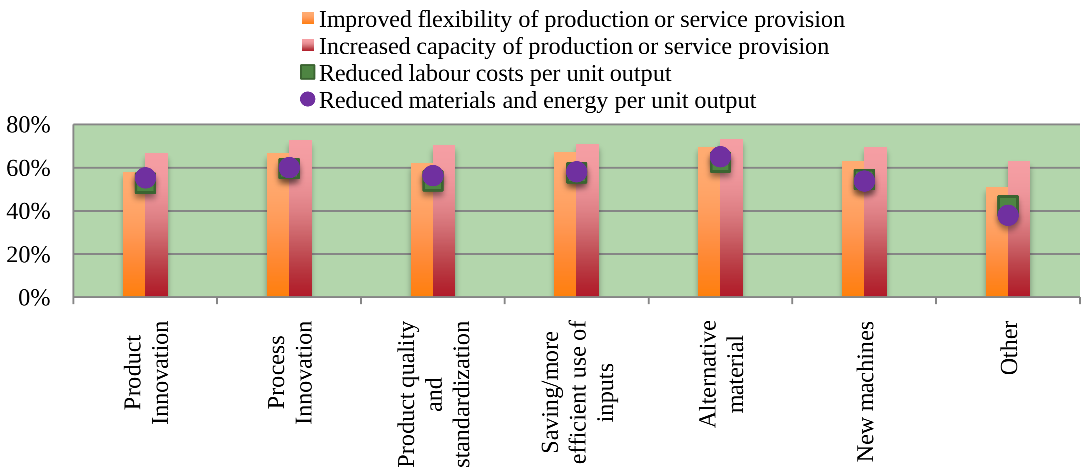
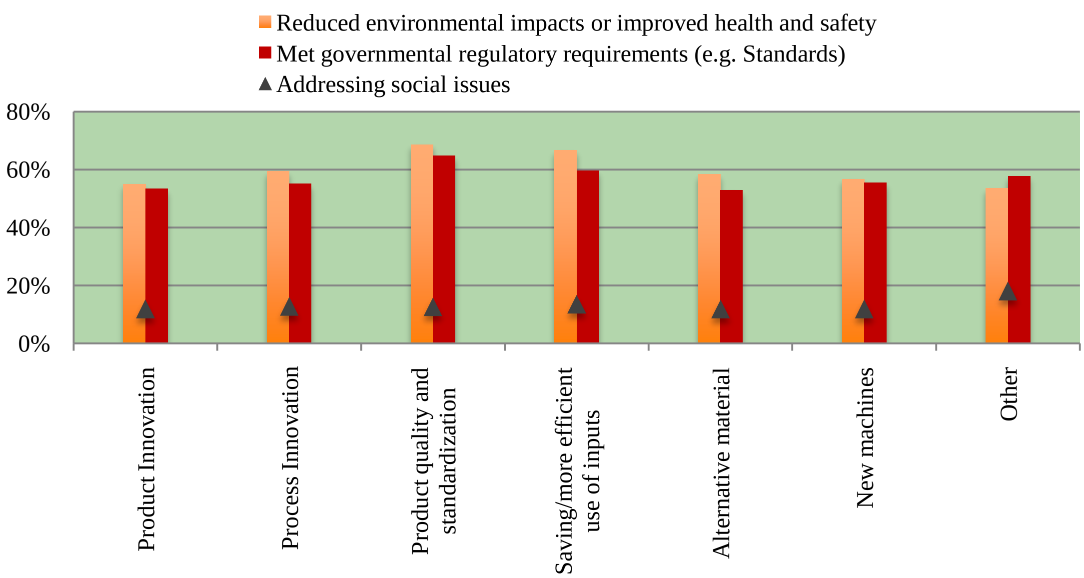


Figure 5.18 Types of innovation and gains from innovation (III)



Activities related to types of innovations

Activities undertaken by innovative firms for introduction of innovation and realisation of benefits of innovation are broadly divided into R&D and non-R&D activities. Again R&D activities are divided between intramural and extra mural R&D initiated by firms. Figure 5.19 shows that product and process innovations are associated mainly with intra mural R&D. Extra mural R&D has some presence in innovations related to alternative materials,but overall non- R&D based innovation has predominance among innovative firms. Among the non-R&D activities related to innovations, acquisition of technology and training of manpower are the priorities (figure 5.20).

Figure 5.19 R&D and non-R&D dimensions in different types of innovation

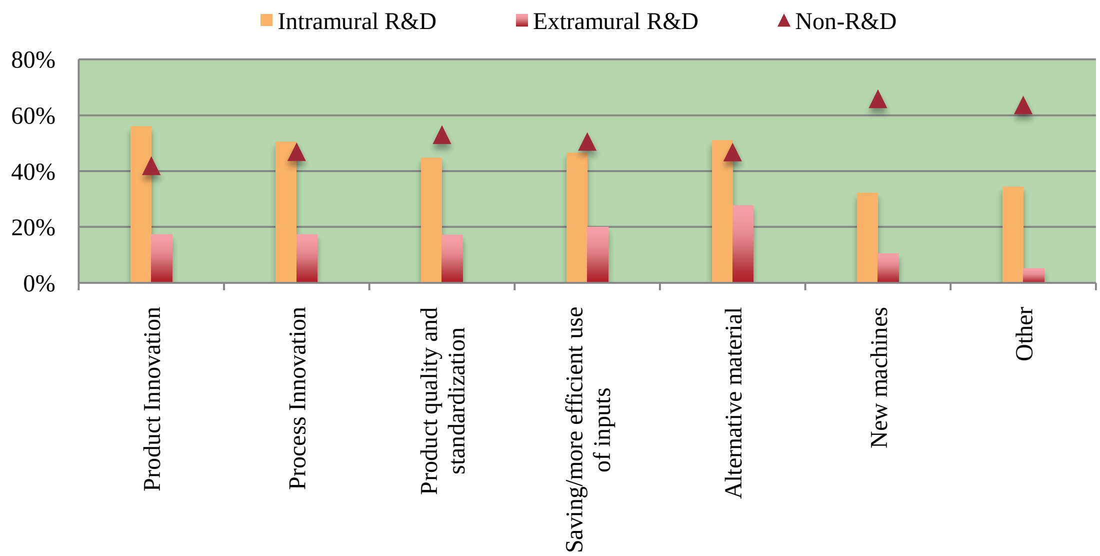
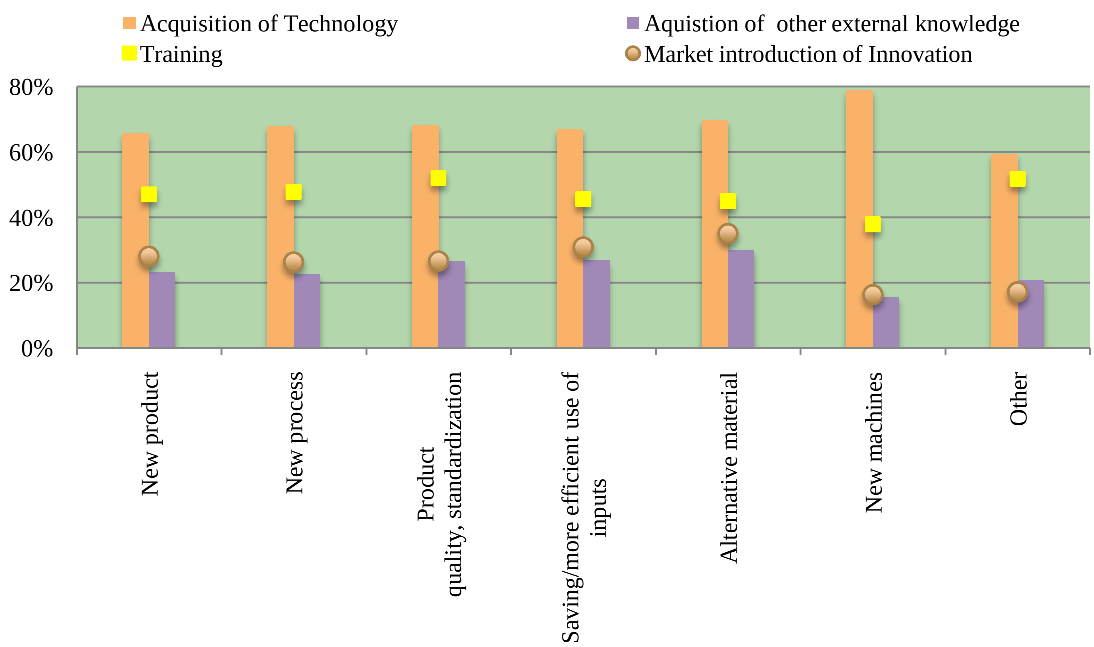


Figure: 5.20 Types of innovation and innovation activities



Strategies for Innovations

Strategies adopted for innovations have been seen in terms of source of innovation and technology and type of technology. Figure 5.21 shows the preferences across the types of innovations. Again variations are not very significant. Most of the firms claim internal source as the most tried source of innovation. External sources are important for innovations in introduction of new machines. Figure 5.22 shows that in the external sources used by innovative firms getting patented technology is the most practiced source. Another aspect of the strategies for innovation is the preference for full set technology while sourcing technology for innovations (figure 5.23).

Figure 5.21 Sources used for types of innovation

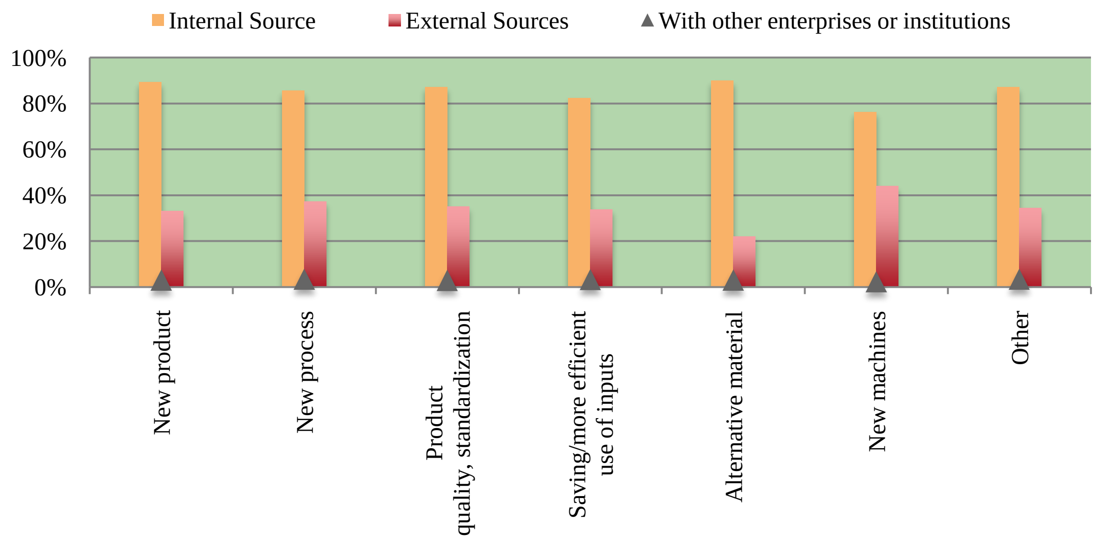


Figure 5.22 Types of innovations and sources of technology

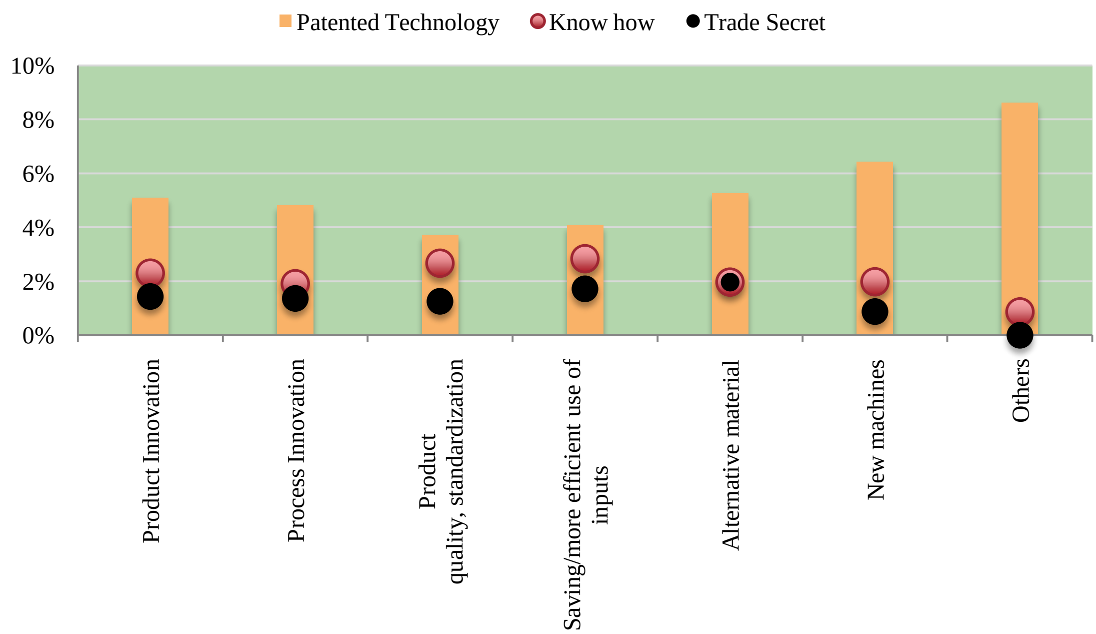
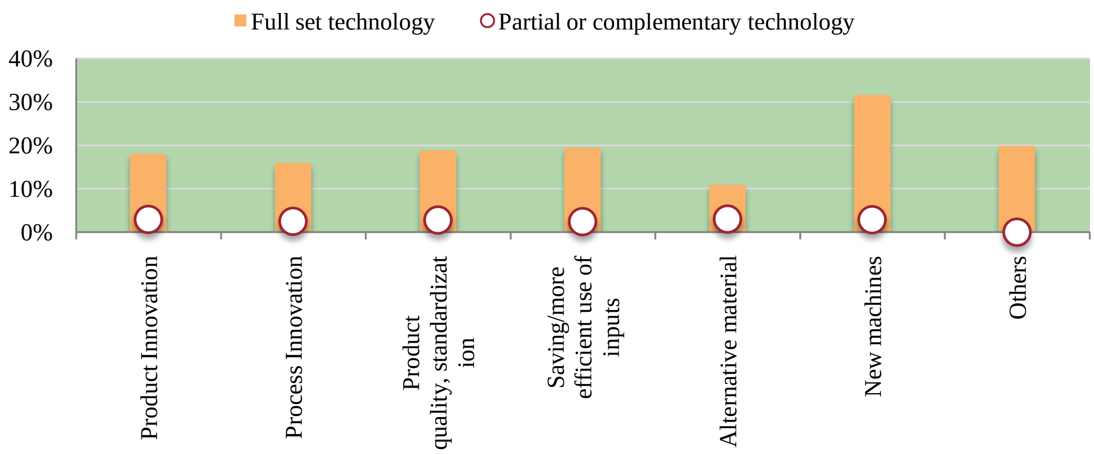


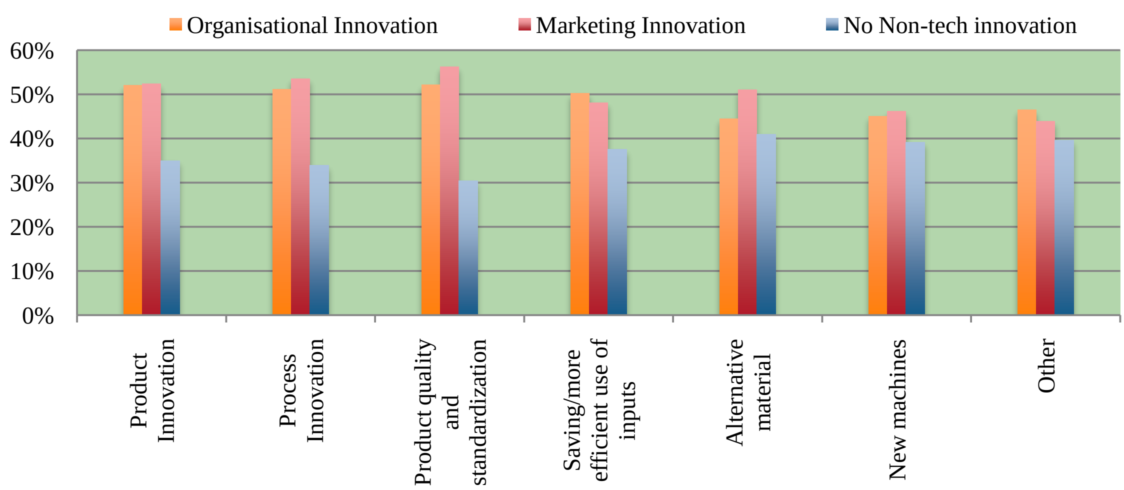
Figure 5.23: Extent and Nature of technology



Non-technological innovation in different types of innovation

As an important component of technological innovations the non-technological innovations have been examined in terms of organisational and marketing innovations. Figure 5.24 shows that there is not much distinctive variations in the practice of non-technological innovations over various types of innovations.

Figure 5.24: Non-technological innovations in different types of innovation



Transactions for innovations

We have seen innovative firms generally source technology from internal sources. Purchase or licensing is not very popular. 'New machine' as form of innovation is most popular and in that about 25% purchase technology and about another 15% procure license as the route to technology (figure 5.25). Innovative firms acquired technology mostly from the domestic open market, as shown in figure 5.26. Around 5% firms acquired technology from foreign source. As we have seen earlier, introduction of new machine is the most prevalent type of innovation. Innovative firms in this category mostly source their technology from the open domestic market. While sourcing technologies firms in 'new machine' innovation categories prefer upfront onetime payment (figure

5.27). Fund for such payment is mostly arranged through domestic financial institutions or from own sources (figure 5.28).

Figure 5.25: Mode of acquiring technology from external sources

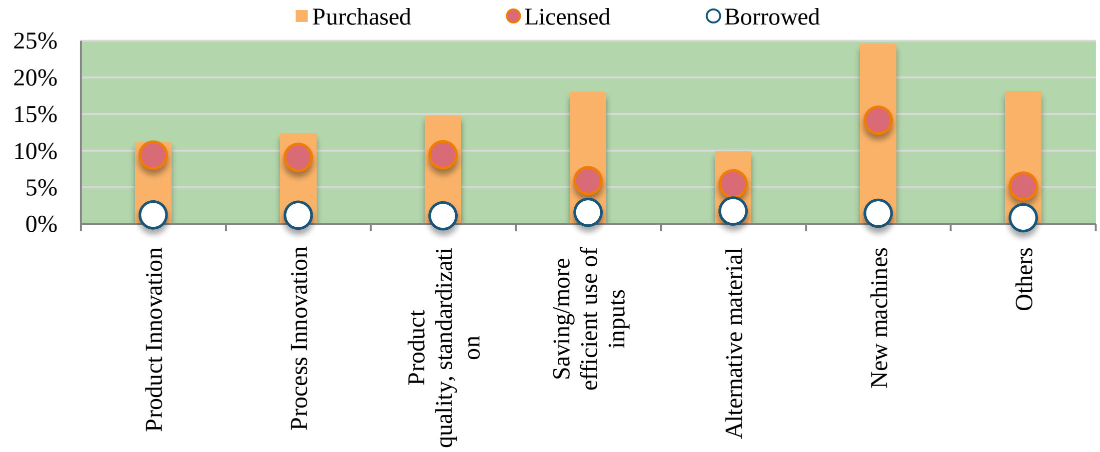


Figure 5.26: Mode of acquiring technology

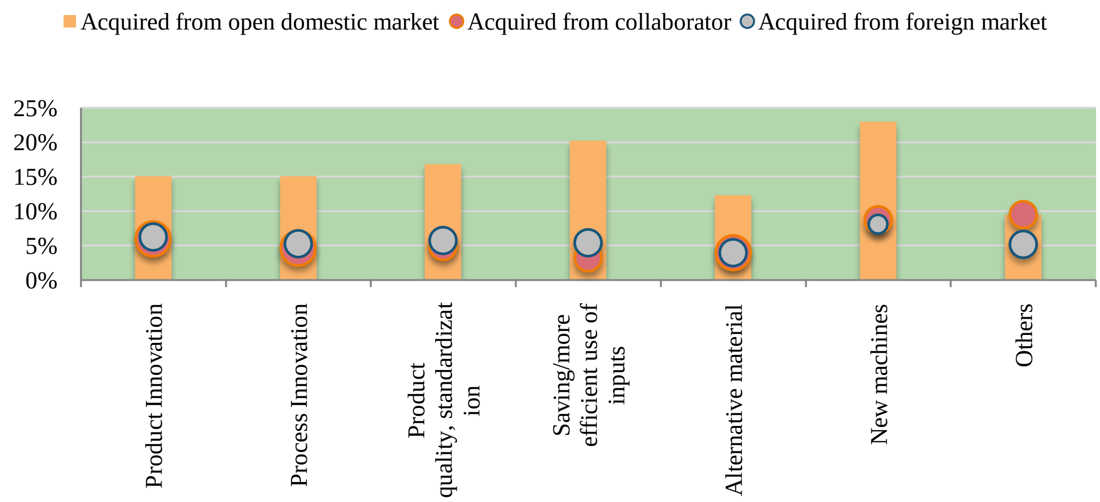


Figure 5.27: Expenditure and types of innovation

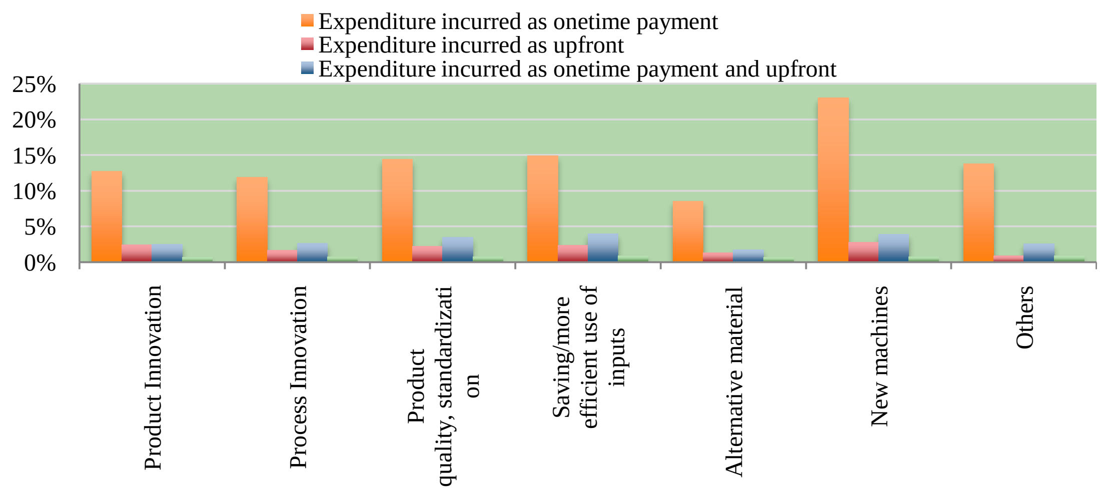
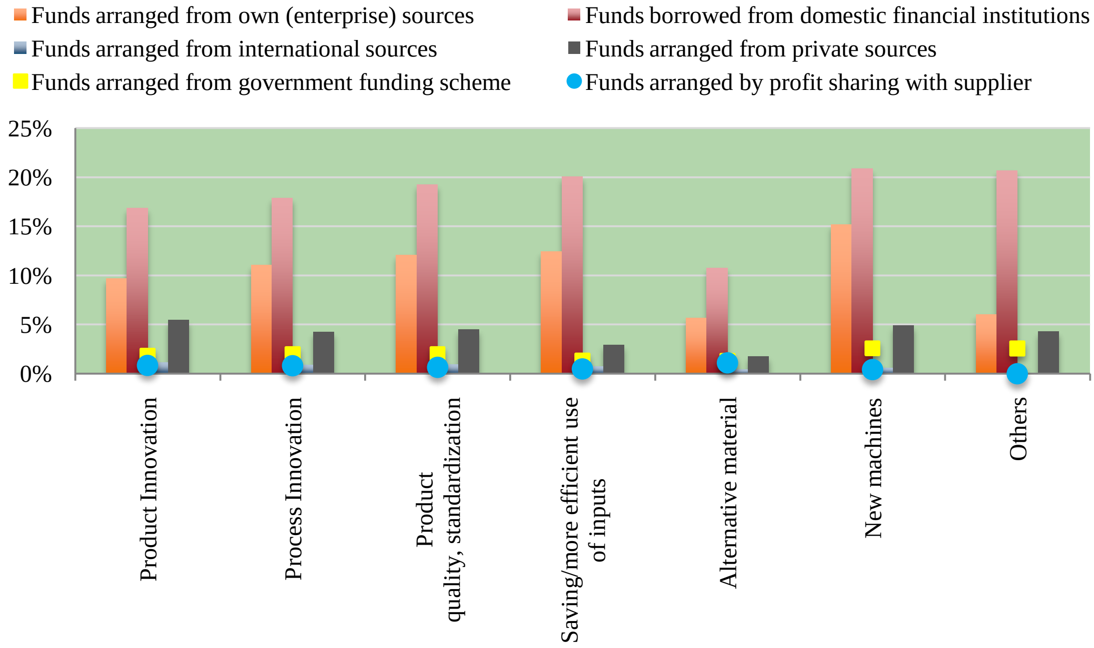


Figure 5.28: Source of fund and types of innovation



Human resources for innovations

Percentage share of scientist and engineer in the total employees is about 8% for 'new product' type innovation (figure 5.29). The share is highest for 'alternative material' at 11.11%. The figure shows that high skilled manpower is not much in use among innovative firms for augmenting innovation. On an average 50% firms provide training to the employees. Even for the training innovative firms hardly access any external institutional facilities. As figure 5.30 shows in all types more than 80% firms go for internal arrangements for training of their employees.

Figure 5.29: Human resource pool of innovative firms

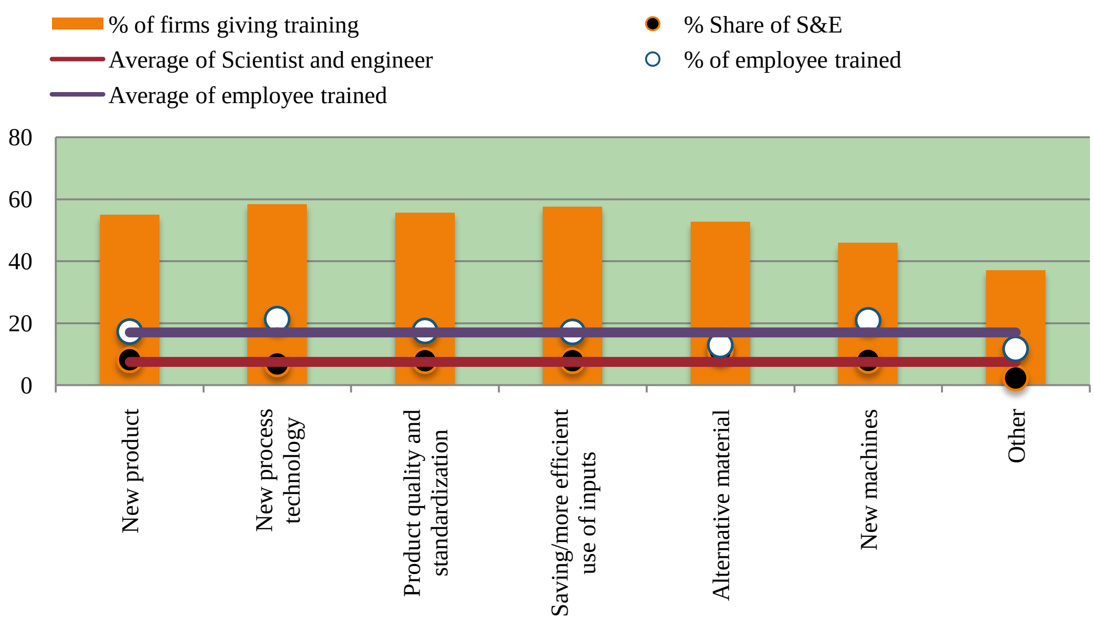
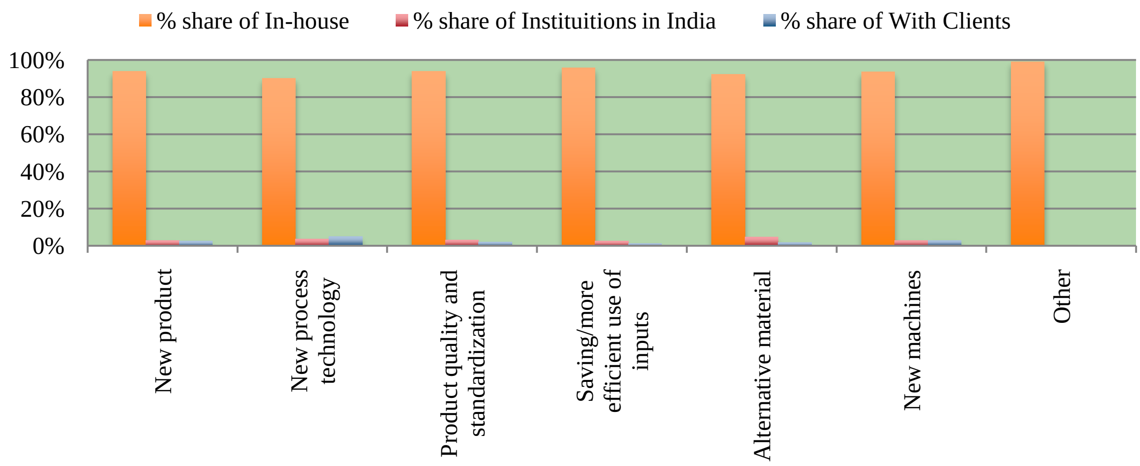


Figure 5.30: Training of human resources by innovative firms



Informatisation and types of innovation

Types of innovations are expected to guide the extent of ICT use in the activities of the innovative firms. Figures 5.31 and 5.32 show software and hardware use of the innovative firms in different types of innovations. Innovators in the 'new product' category have the highest percentage of new software procurement and also for software already in use. In case of hardware it is 'product quality and standardisation' that shows highest percentage acquiring new hardware followed by 'new product' and 'new machine categories. Latter two have similar presence also in software procurement and in use.

Figure 5.33 shows the purpose for which ICT has been used. R&D and technology management are the areas where ICT is used by about on average 20% firms in all types. ICT for ERP is strong among the firms engaged in new process and new product technology. Internal source of information is the most prevalent among all types of innovative firms (figure 5.34). About 40% firms among those engaged in 'alternative material' type of innovations do use external source for information. It is interesting to note that (figure 5.35) market source has preference over institutional sources for access to information by innovative firms.

Figure 5.31: Extent of ICT use by innovative firms

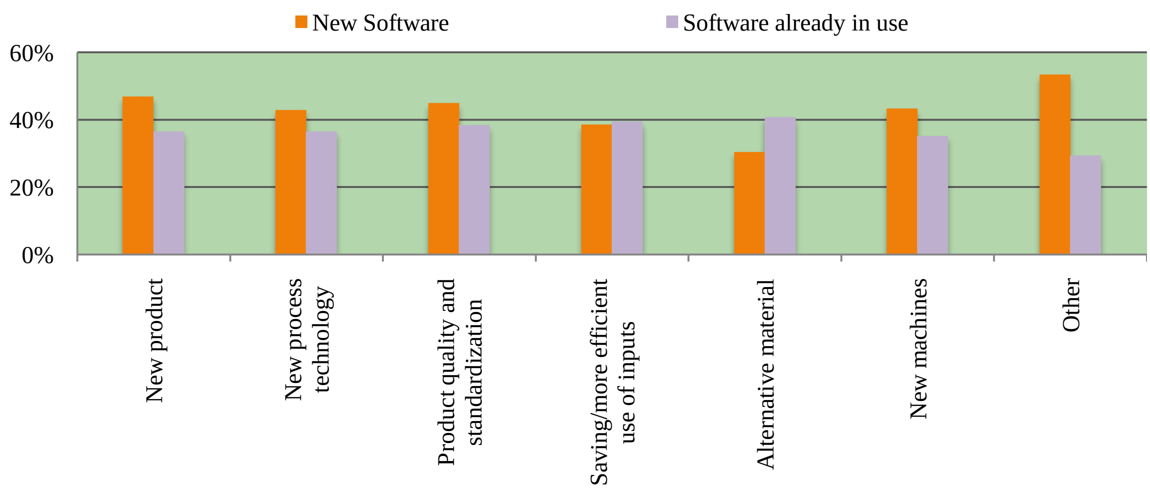


Figure 5.32: Extent of ICT use by innovative firms

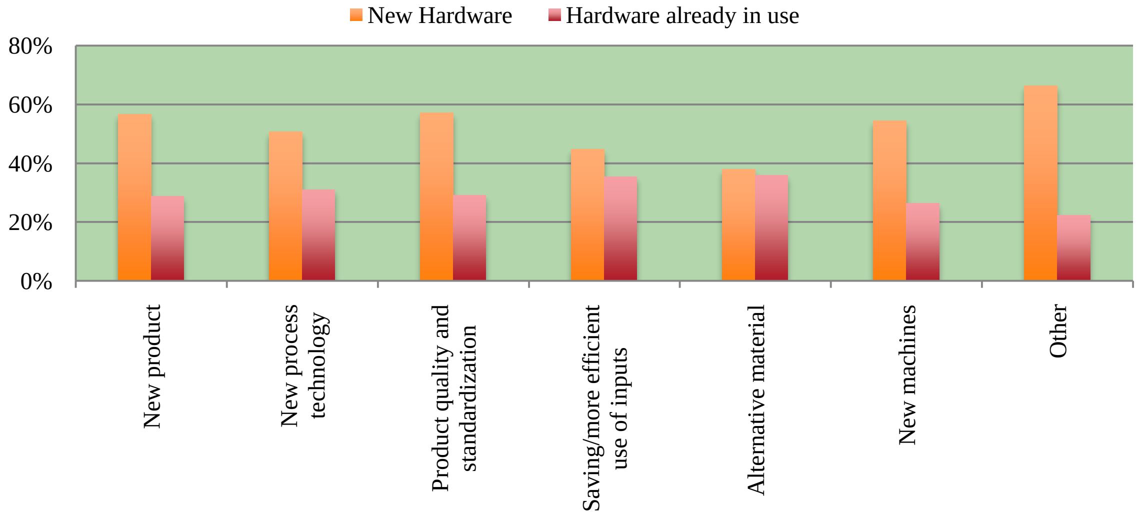


Figure 5.33: Extent of ICT use by innovative firms

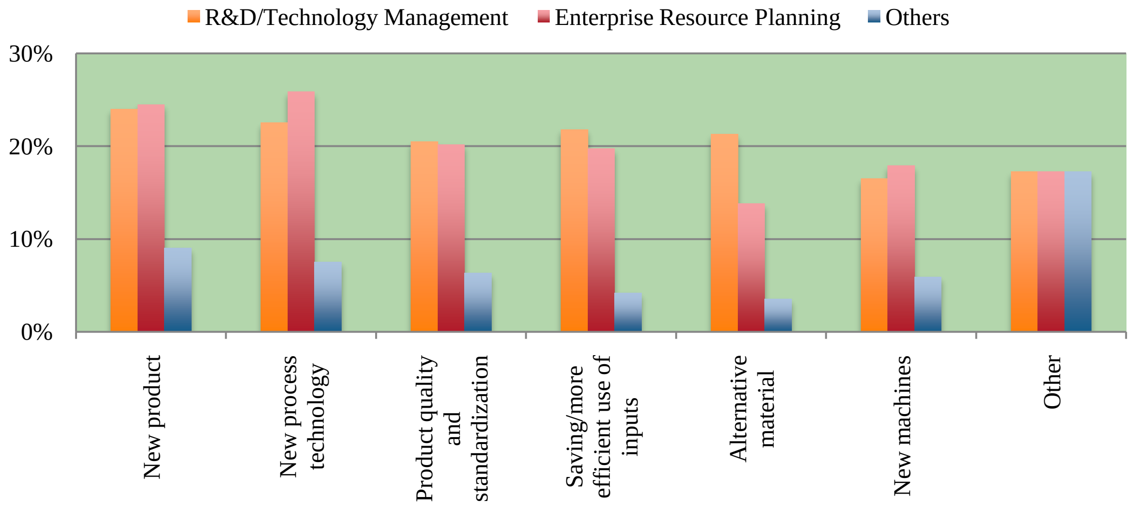


Figure 5.34: Sources of information used by innovative firms

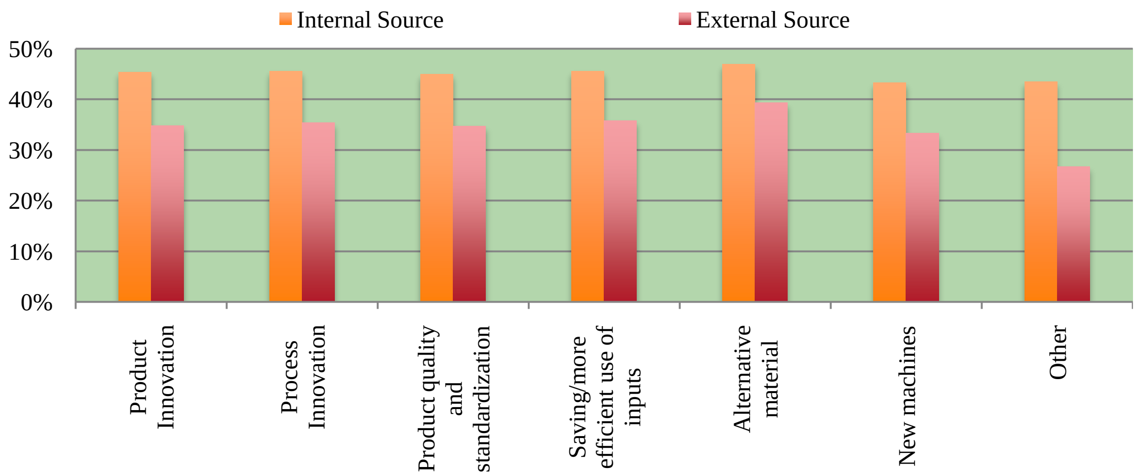
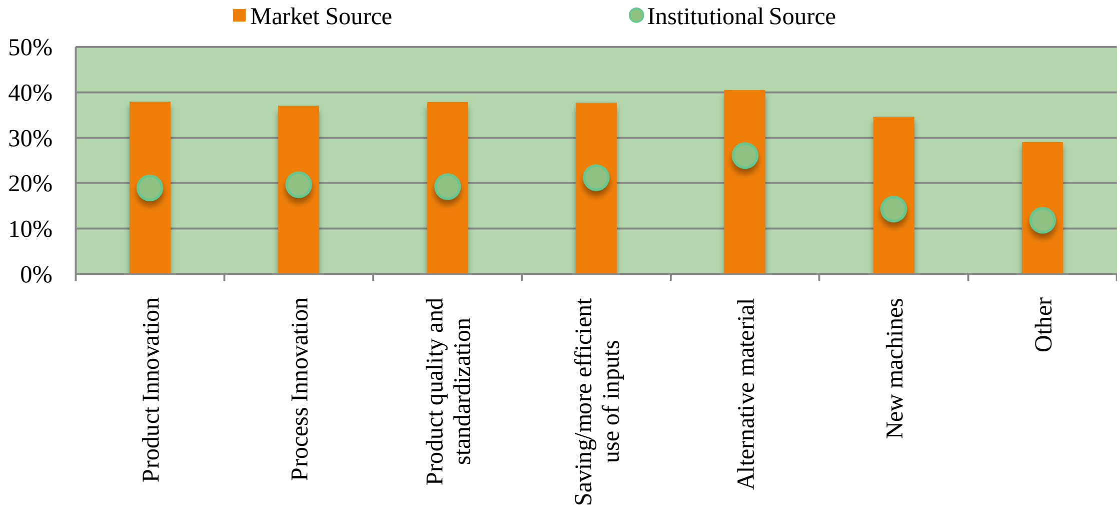


Figure 5.35: Sources of information used by innovative firms



In Nutshell

About 70% firms have innovations in the form of introducing new machines, followed by quality and standard related activities by 40% of the firms. About 32% and 34% firms claimed Product and process innovations respectively. Small firms dominate all types of innovations. Private, partnership and proprietary business which account for about 80% of innovative firms are mainly engaged in introduction of new machines. Around 45% of the innovative firms are generally affirmative about competitive positions being at par with the peers.

Predominant types of innovation are ‘new to the firm’ category. Use of alternative material, however, has about 20% innovative firms claiming ‘new to the Indian market’ and about 10% claiming innovations ‘new to the world market’.

Extra mural R&D has some presence in innovations related to alternative materials,but overall non- R&D based innovation has predominance among innovative firms.

Percentage share of scientist and engineer in the total employees is about 8% for ‘new product’ type innovation. The share is highest for ‘alternative material’ at 11.11%. High skilled manpower is not much in use among innovative firms for augmenting innovation.

R&D and technology management are the areas where ICT is used by about on average 20% firms in all types. ICT for ERP is strong among the firms engaged in new process and new product technology. About 40% firms among those engaged in ‘alternative material’ type of innovations do use external source for information. It is interesting to note that market source has preference over institutional sources for access to information by innovative firms.

Improvement of quality, cost reduction, environment/health/safety and meeting government regulations remain the main types of gains from innovations. Social issues are not the concerns of innovations.

VI

R&D and Non-R&D Innovative firms

Highlights

- Out of the total innovative firms 36.90% have formal R&D setup. 35.05% of the total innovative firms have intramural R&D setup whereas 11.43% of them have opted for extramural R&D.

- Firms with formal R&D setup are ahead in product innovation and process innovation whereas firms, which do not have formal R&D setup, (i.e. Non-R&D firms) have more focus on New Machines.

- In terms of novelty aspect of innovations, R&D firms have higher percentage of firms claiming their innovations to be 'new to market' than Non-R&D firms.

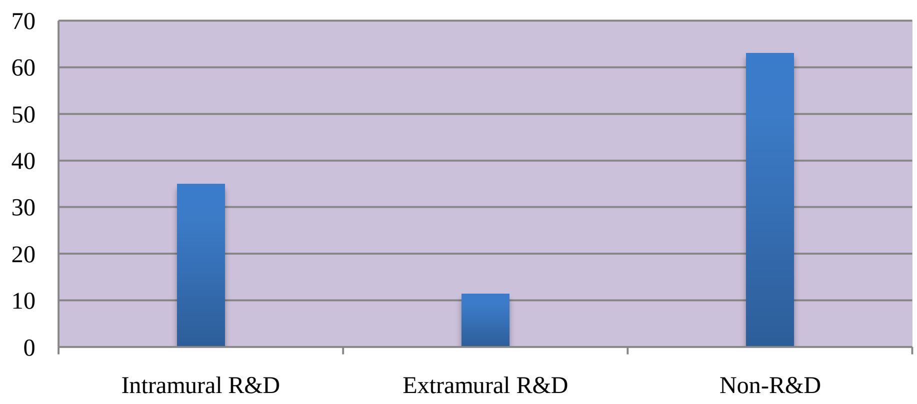
- R&D firms have done more of both organisational and marketing innovations than Non-R&D firms.

- R&D firms have more number of firms with higher number of 'scientist & engineers' as compare to Non-R&D firms.

R&D and Non-R&D Innovative firms

R&D is an important but not the only route to innovation. An innovative firm can access knowledge and other necessary components (hard and software) to innovation from different sources. The survey differentiates innovative firms with and without involvement in R&D activities as innovator (R&D) and innovator (non-R&D) respectively. Figure 6.1 shows distribution of innovative firms with their engagement in R&D activities. There are 35.05% of innovative firms, which do intramural R&D. Similarly, 11.43% of innovative firms do access extramural R&D. There are 63.10% innovative firms who are not engaged in any kind of R&D activity. It indicates that innovative firms are largely into Non-R&D category, which may be due to the presence of large number of small firms (below 100 workforces) in the sample.

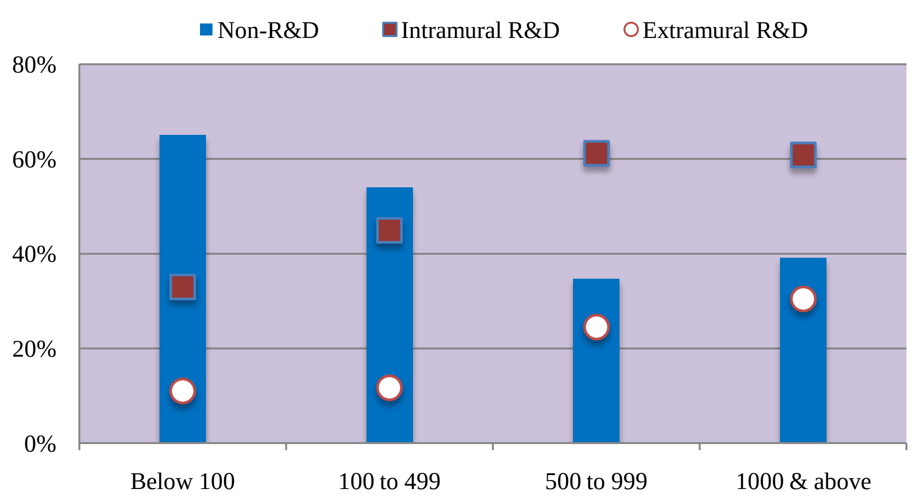
Figure 6.1 R&D and Non-R&D Innovators



R&D and Non-R&D innovative firms and size

The figure 6.2 shows that Non-R&D innovative firms are much higher in numbers in the lower firm size groups. On the other hand both intramural and extramural R&D activities have significantly higher presence among larger size of firms.

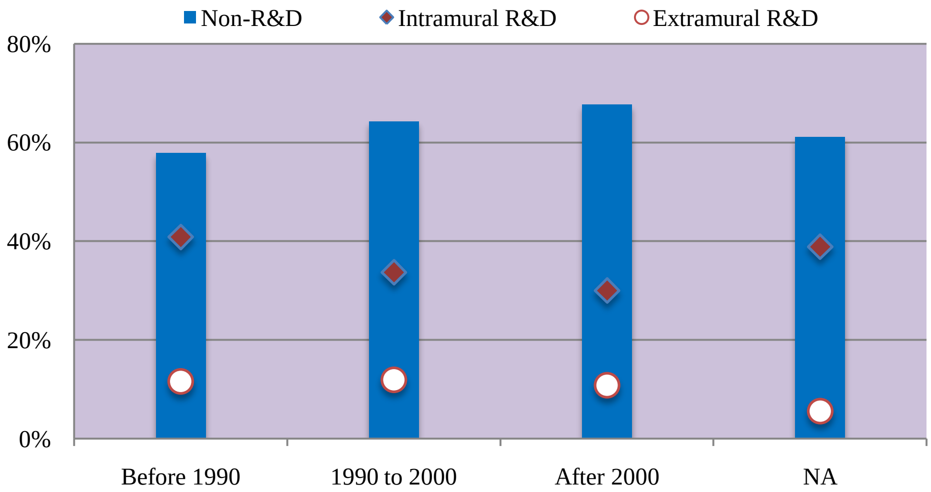
Figure 6.2 Size with R&D and Non-R&D innovators



R&D and Non-R&D innovative firms and age of the firms

Older firms have better presence in the R&D led innovation compared to firms established after 1990 (figure 6.3).

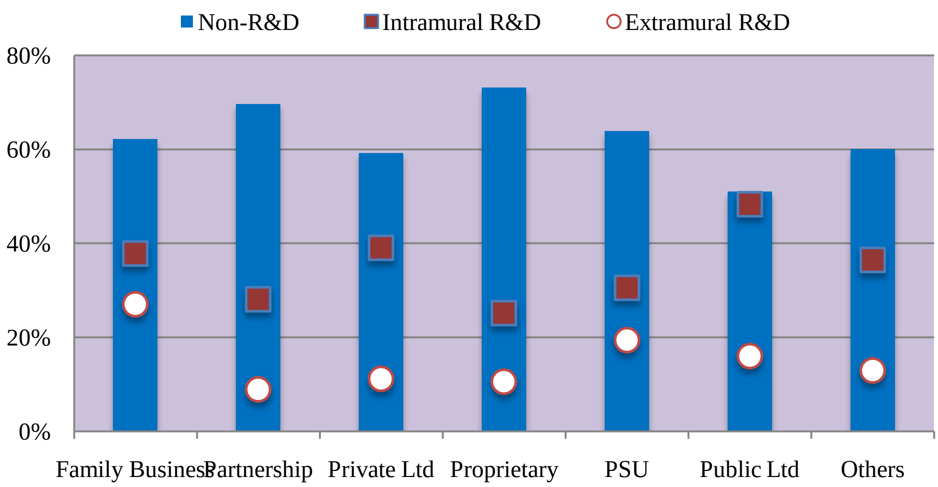
Figure 6.3 Age groups with R&D and Non-R&D innovators



R&D and Non-R&D innovative firms and Ownership

Public limited companies are ahead of other types of ownership in intramural R&D. Whereas PSUs and family owned firms are more engaged in extramural R&D (figure 6.4).

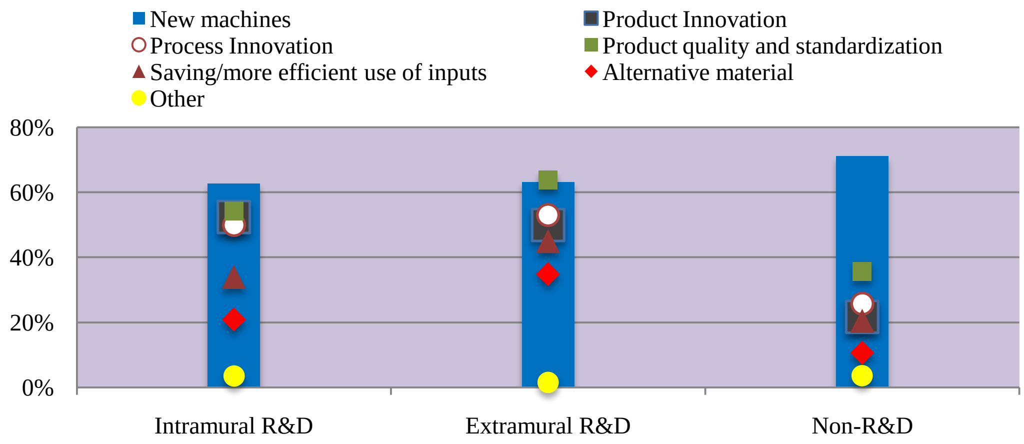
Figure 6.4 Ownership with R&D and Non-R&D innovators



R&D capability and types of innovation

Does type of innovation differ for R&D and Non-R&D innovators? Product and process innovations are significantly higher among R&D firms, whereas 'new machine' as the type of innovation is more prevalent among Non-R&D firms (figure 6.5).

Figure 6.5 R&D and Non-R&D innovators and types of Innovation



Post innovation

Figures 6.6.1 and 6.6.2 assess the post innovation competitive positions of the R&D and Non-R&D firms. There are not much significant difference in the post innovation positions of the R&D and Non-R&D innovators in all the 12 parameters chosen for the assessment.

Figure 6.6.1 Competitive status of the firms

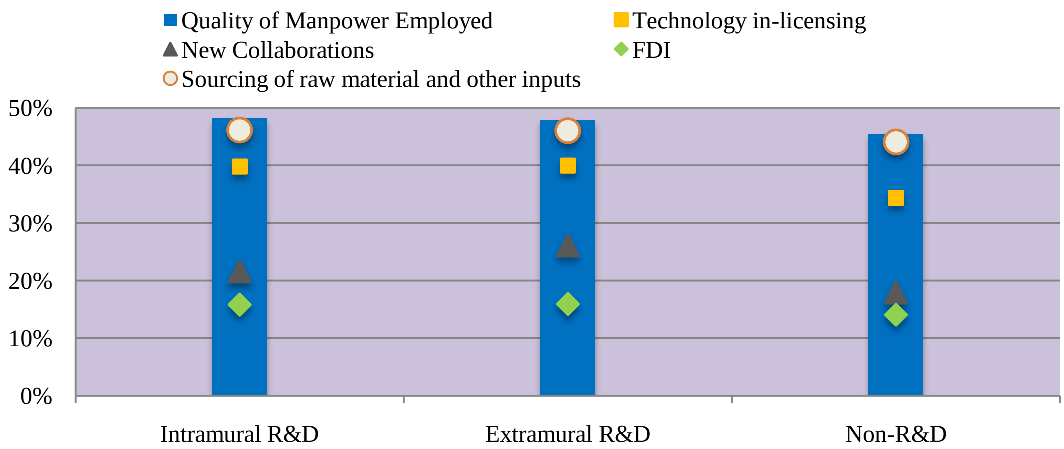


Figure 6.6.2 Competitive status of the firms

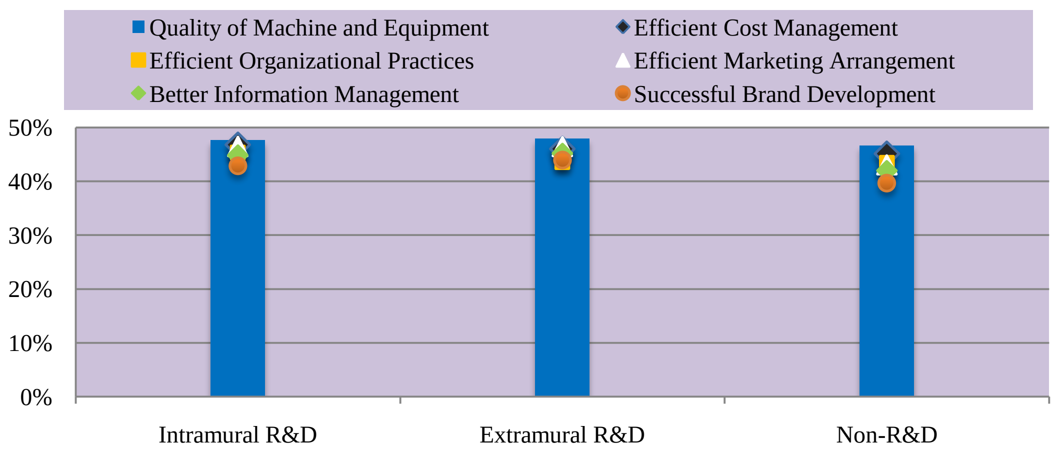
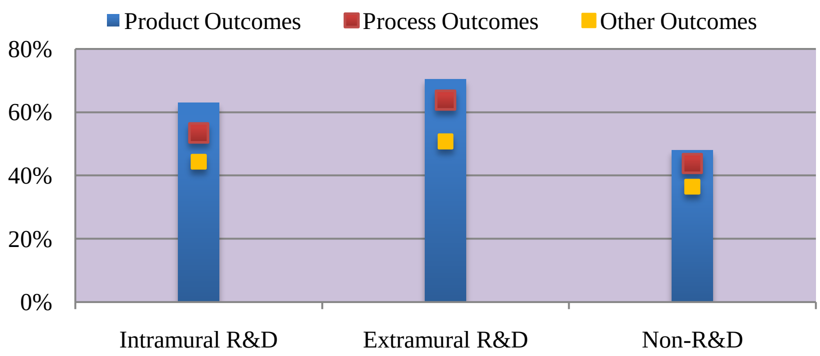


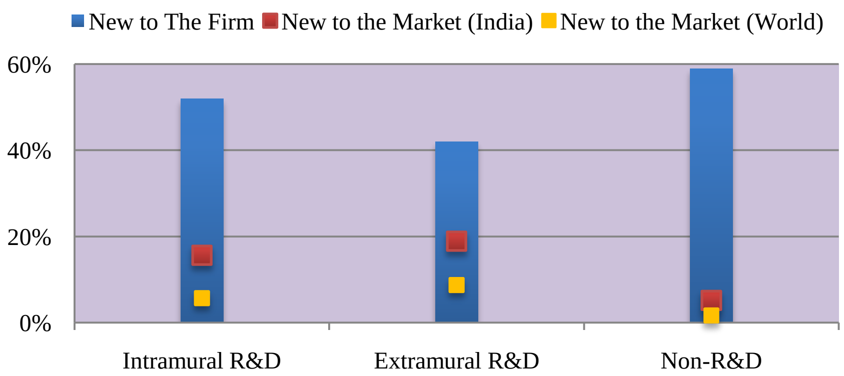
Figure 6.7 shows gains from innovations for the R&D and Non-R&D firms. It is interesting to note that higher percentage of Non-R&D innovators claim gains in all outcomes.

Figure 6.7 Gains from innovation



'New to the firm' remains the dominant types of innovation for both R&D and Non-R&D innovators with extramural R&D firms having slightly higher claims on 'new to the market' category (figure 6.8).

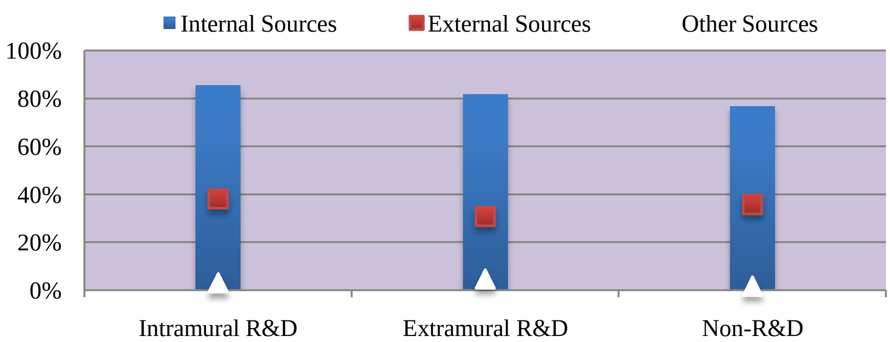
Figure 6.8 Novelty of innovation



Strategies for innovation

More than 80% of firms involved in R&D (both intramural and extramural) and about 77% of Non-R&D innovators use only internal sources for their innovation activities (figure 6.9).

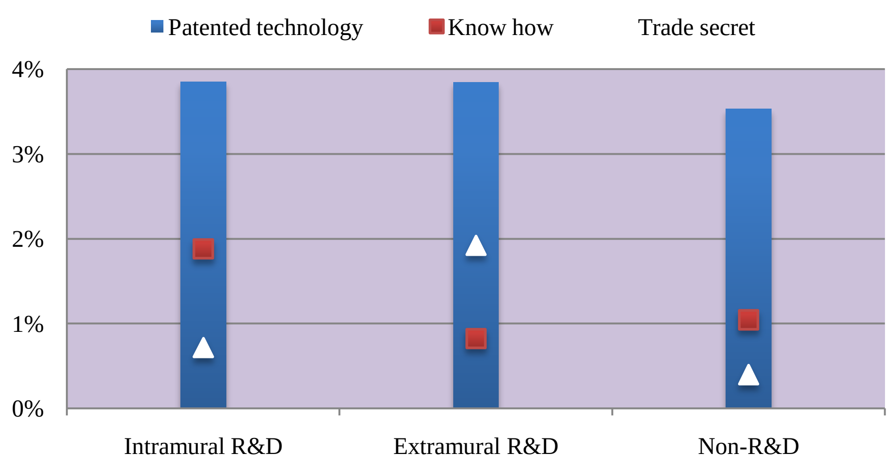
Figure 6.9 Source of innovation



i. Acquisition of external knowledge

Figure 6.10 gives insights on the external knowledge acquired by innovative firms. Only 3.85% firms with own R&D setup have acquired patented technology. The corresponding figure for Non-R&D innovators is 3.53%. 1.88% of intramural R&D innovators, 0.82% of extramural R&D innovators and 1.05% of Non-R&D innovators access knowhow for developing innovations. The scenario is similar while acquiring 'trade secret', with 1.92% of extramural R&D innovators making use of this strategy and rest were using it quite rarely.

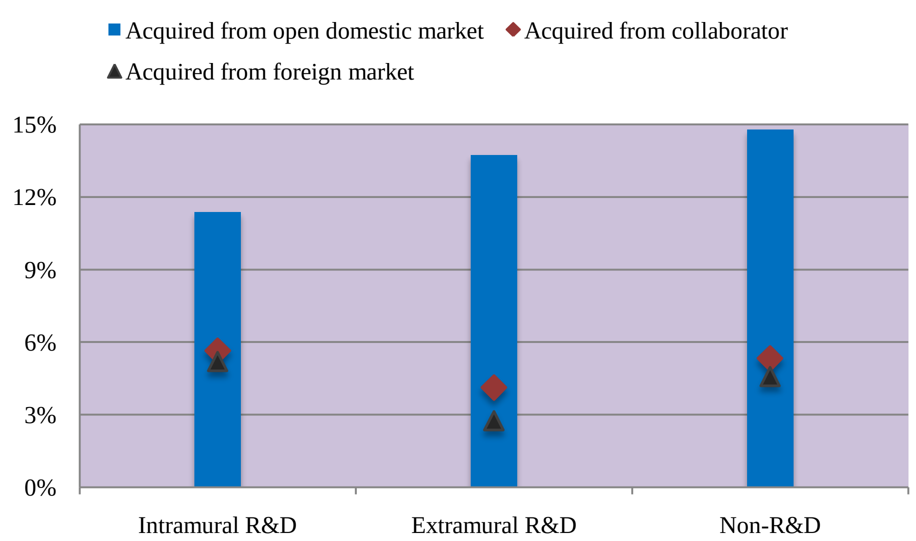
Figure 6.10 Acquisition of external knowledge



ii. Source of acquisition of external knowledge

Figure 6.11 reflects firm's choices for sourcing external knowledge. About 11.38% of intramural R&D innovators, 13.74% of extramural R&D innovators and 14.78% of Non-R&D innovators have preference for 'acquiring from the open domestic market' to other sources (foreign and collaborators).

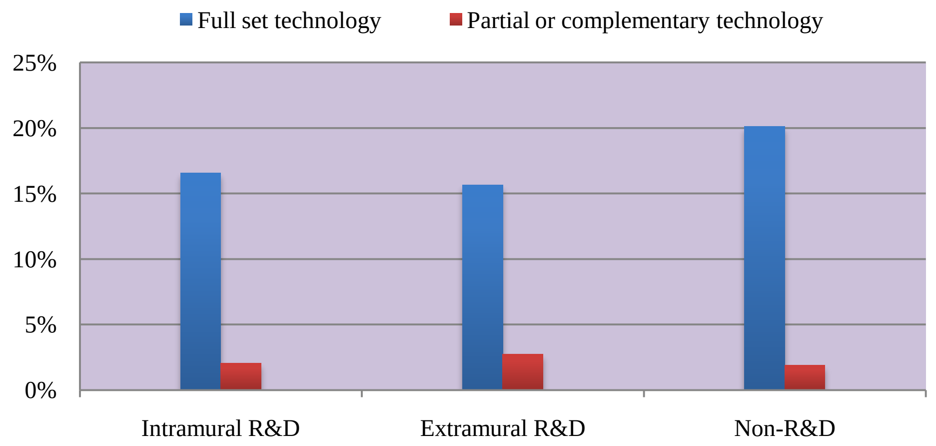
Figure 6.11 Source of acquisition of external knowledge



iii. Extent of Technology

Figure 6.12 shows the extent of technology accessed by different firms categorised with their R&D activities. Firms from all the three categories have shown preference to full set technology.

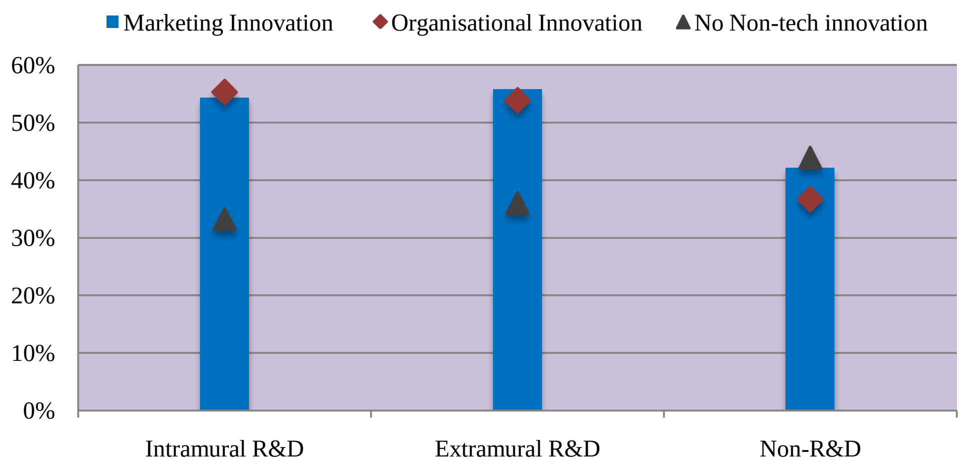
Figure 6.12 Extent of technology (external knowledge)



iv. Non-technological activities and R&D capability

From the figure 6.13 we find that about 55% of firms who are involved in intramural and extramural R&D activities have also undertaken ‘organisational changes’ and ‘marketing changes’. Also firms that are non R&D innovators are also behind in non-technological innovations. The figure also shows firms not engaged in any non-technological innovations (referred as No Non-tech innovation).

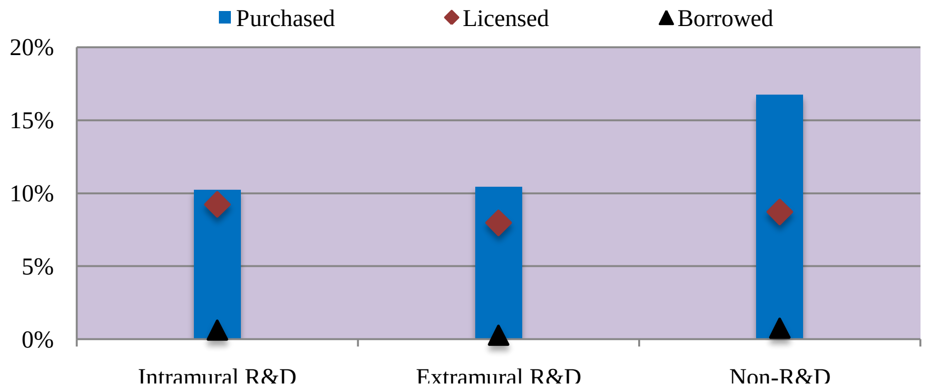
Figure 6.13 Non-technological innovations



Transaction for external technology

Figure 6.14 shows mode of transaction for acquiring external knowledge. Intramural R&D innovators and extramural R&D innovators have followed almost similar strategies for acquiring external knowledge. While outright purchase is the dominant mode for all types of innovators, for Non-R&D firms it is much higher compared to others.

Figure 6.14 Mode of acquiring external knowledge



External acquisition being rare, entering on to agreement for post acquisition needs is rarer. Figure 6.15 shows that agreement to upgrade is preferred by R&D innovators, where as Non-R&D innovators have preference for agreement for maintenance. Training of the manpower appears to be non-priority for the innovative firms.

Figure 6.15 Agreements for acquired external knowledge and R&D capability

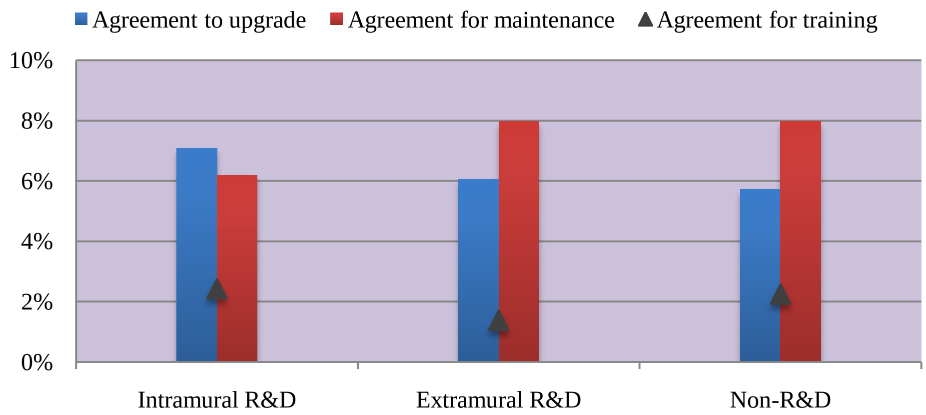
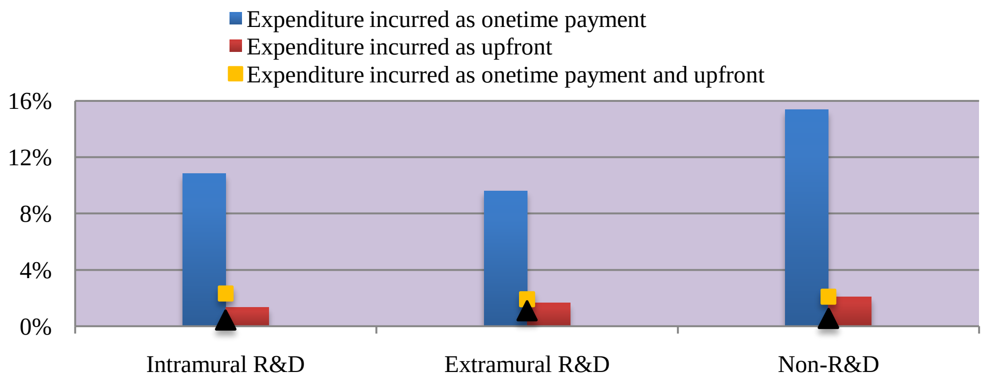


Figure 6.16 suggests that 'expenditure as onetime payment' is preferred by all the firms irrespective of their R&D capability. Non-R&D innovators are with 15.38% are ahead of others in this regard.

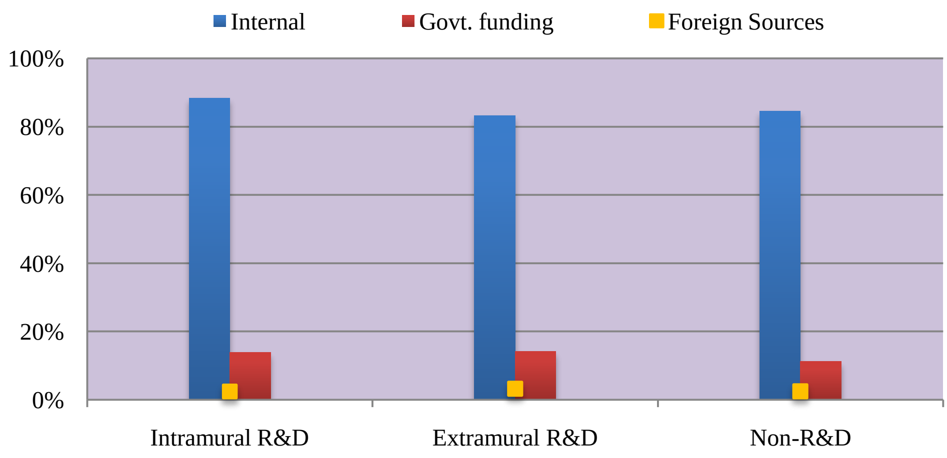
Figure 6.16 Mode of expenditure incurred for acquiring external knowledge



Financing innovation

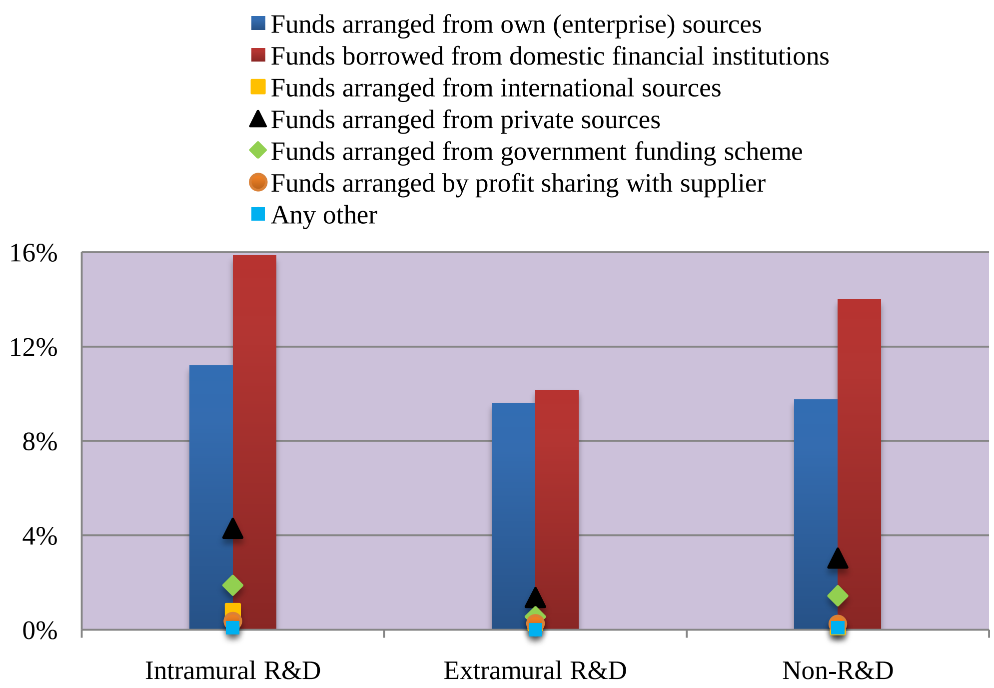
More than 80% of the firms under each category have used their internal sources for financing innovation activities. Intramural R&D innovators are slightly ahead of others with 88.44% of them choosing internal sources to fund their innovation activities (figure 6.17).

Figure 6.17 Financing innovation activities



According to figure 6.18 out of seven identified ways of financing external knowledge (technology) the most preferred alternative adopted by firms irrespective of their R&D capability classification is ‘Funds borrowed from domestic financial resources’ followed by ‘Funds arranged from own (enterprise) sources.

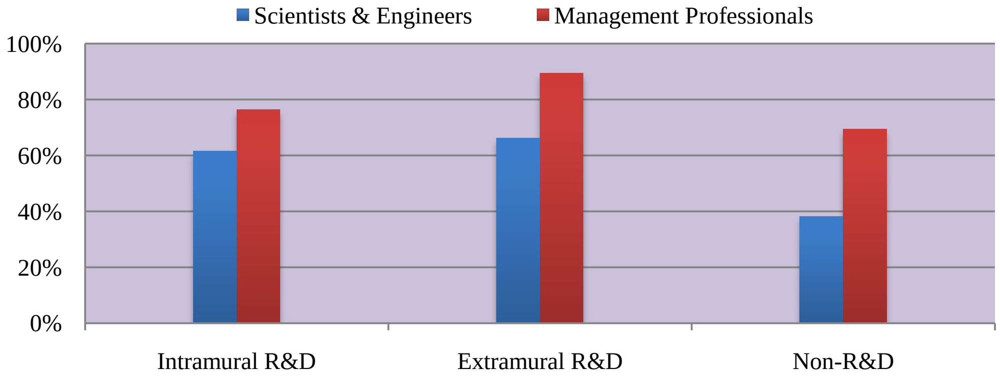
Figure 6.18 Financing external knowledge (technology) and R&D capability



Human Resource for Innovation

About 60% of R&D innovators have scientist and engineers in their workforce compared to 38% of the Non-R&D innovators (figure 6.19).

Figure 6.19 Human Resource base



i. Training Human Resource for Innovation

Figure 6.20 shows that Non-R&D firms are far behind in providing training to their employees compared to R&D firms. Again for sources of fund for training, as shown in figure 6.21, innovative firms in all categories mostly depend on internal sources; govt. sources being rarely used.

Figure 6.20 Training Human Resource

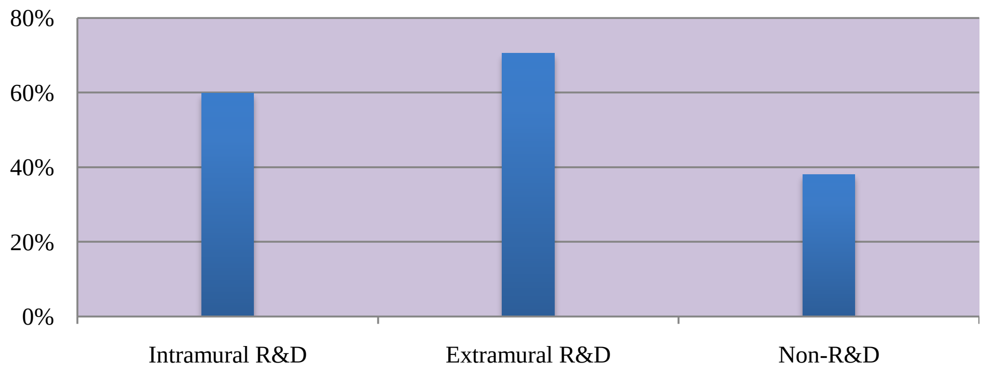
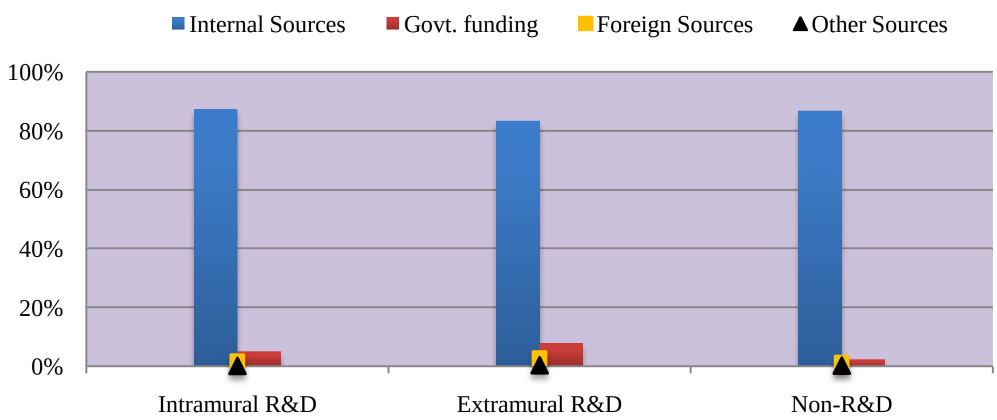


Figure 6.21 Sources of funds for Training



ICT infrastructure and its usage

Figure 6.22 shows the variation amongst the R&D and Non-R&D innovative firms in using ICT (software and hardware). In terms of both hardware and software acquisition we find the firms involved in intramural R&D acquiring it more than others while firms practicing extramural R&D are relatively old users of the hardware capacity.

Figure 6.23 shows that Intramural R&D innovative firms have used their ICT platform (29.03%) for both R&D/Technology management and Enterprise resource planning while extramural R&D innovative firms are significant users of ICT for R&D/Technology management alone.

Figure 6.22 ICT acquisitions and R&D capability of the firm

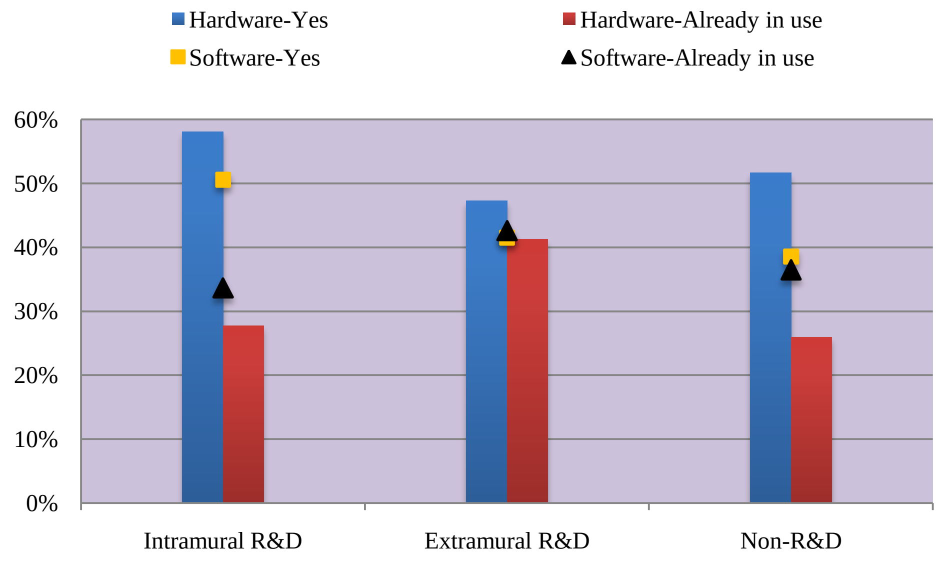
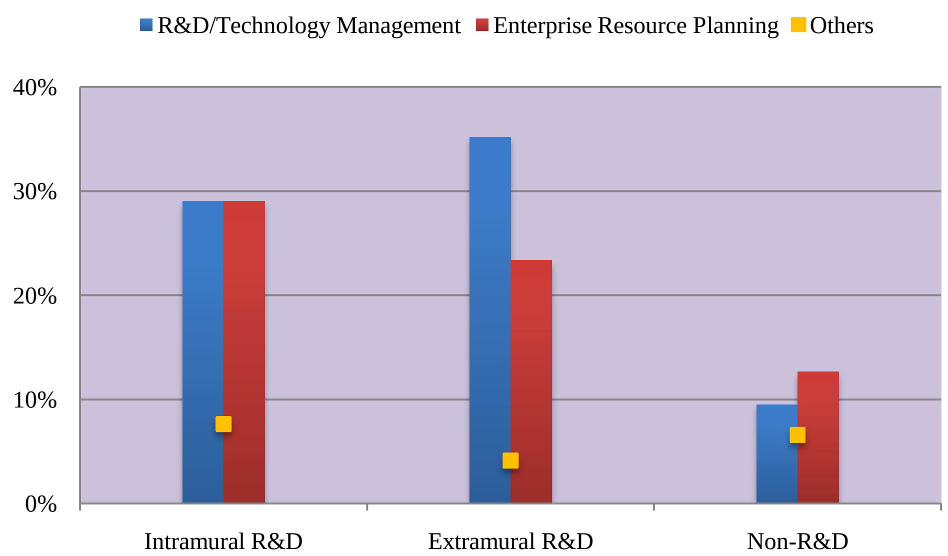


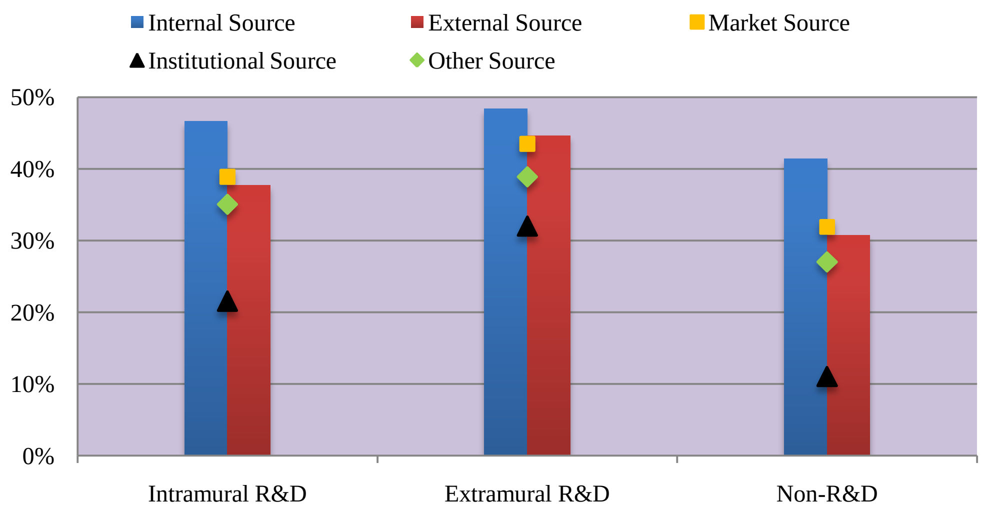
Figure 6.23 ICT usage level and R&D capability of the firm



Source of Information for innovation

The source of information for innovation with respect to their R&D practice is shown in figure 6.24. More than 40% of the firms under each category have rated internal source as an important source of information. External Sources and market sources are also highly rated by the firms practicing extramural R&D as source of information for innovation.

Figure 6.24 Source of information for innovation and R&D capability of the firm



In Nutshell

R&D is not the strong point of the innovative firms in India. Out of the total innovative firms 36.90% has formal R&D setup. 35.05% of the total innovative firms have intramural R&D setup whereas 11.43% of them access extramural R&D. Firms with formal R&D setup are ahead in product and process innovations, whereas firms, which do not have formal R&D setup, (i.e. Non-R&D firms) have more focus on New Machines. In terms of novelty aspect of innovations, R&D firms have higher percentage of firms claiming their innovations to be ‘new to market’ than Non-R&D firms. R&D firms have done more of both organisational and marketing innovations than Non-R&D firms. R&D firms have more number of firms with higher number of ‘scientist & engineers’ as compare to Non-R&D firms.

VII

Non-technological Innovations

Highlights

- 59.89% of innovative firms are involved with non-technological innovations, out of which 46.48% of the innovative firms are into marketing innovation and 43.09% are into organisational innovation.

- There are no clear cut relationship between size, age and ownership of the firm with the occurrence of non-technological innovations. Types of innovation also do not seem to vary over firms doing or not doing non-technological innovations.

- Innovative firms that are inclined towards non-technological innovations are slightly ahead of their peers (in their opinion), in gains from innovations in comparison to the innovative firms which are not into non-technological innovations.

Non-technological Innovations

Non-technological innovation is as important as technological innovation like product and process innovation for effective innovation eco-system. Significance of non-technological innovation arises due to its complementary relationship with technological innovations. The Survey has considered two types of Non-technological innovations i.e. organisational and marketing innovation. They are further classified into following activities.

Organisational innovation

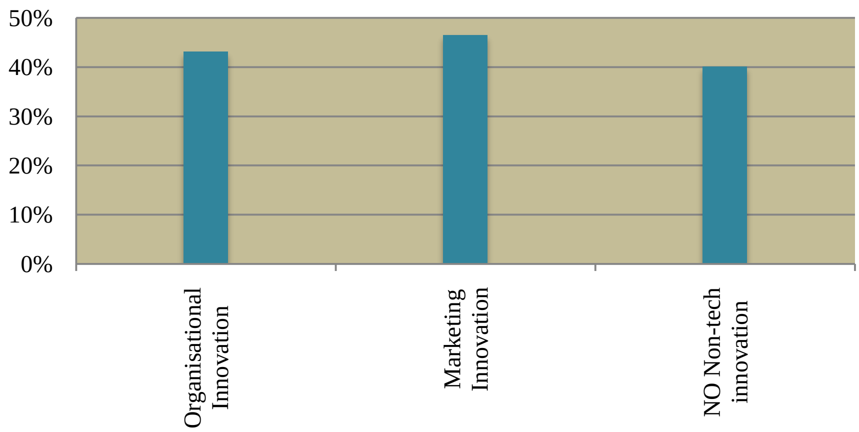
New or significantly improved management systems to better use or exchange information, knowledge and skills within your enterprise.
A major change to the organization of work within your enterprise such as changes in the management structure or integrating different departments or activities.
New or significant changes in your relations with other firms or public institutions such as through alliances, partnerships or outsourcing.

Marketing innovation

Significant changes to the design or packaging of a goods or service (exclude routine/ seasonal changes such as clothing fashions).
New or significantly changed sales or distribution methods such as internet sales, franchising, direct sales or distribution licenses.

Firms doing at least any one of the above mentioned activities is counted as non-technological innovation. The figure below (figure 7.1) describes the distribution of innovative firms with respect to their involvement in non-technological innovation. It is seen that 43.09% of innovative firms are involved in organisational innovation where as 46.48% in marketing innovation. 40.11% of firms haven't done any non-technological innovations (refer to 'NO non-tech innovation').

Figure 7.1 Distribution of innovative firms doing Non-technological innovations



Innovative firms doing non-technological innovations are further classified with respect to their size (workforce), age and ownership patterns. Figure 7.2 shows innovative firms' distribution with their respective size in non-technological innovations. Firms within '500 to 999' size category is ahead of all other in both organisational and marketing innovation. The figure also indicates that large firms (500 to 999 and 1000& above) are more into organisational innovation, whereas, smaller firms (below 100 and 100 to 499) are more into marketing innovation.

Figure 7.2 Size-wise distribution of innovative firms with respect to Non-technological innovations

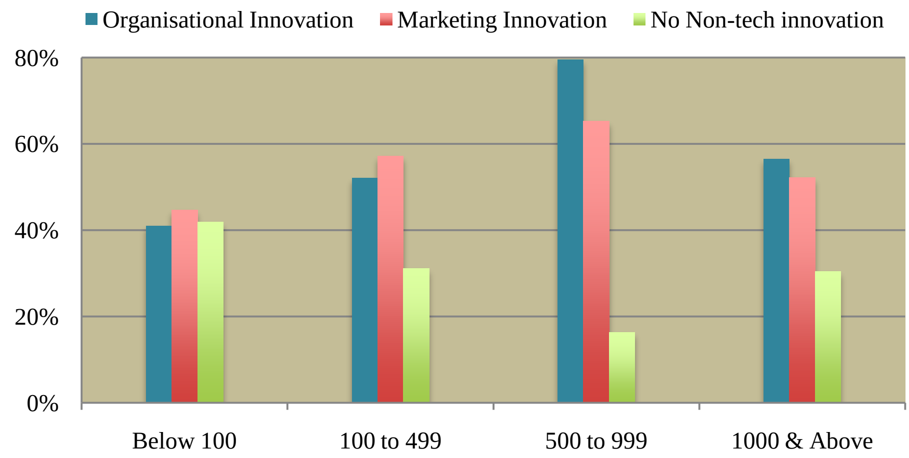


Figure 7.3 presents age wise distribution of innovative firms involved in non-technological innovations. Both marketing and organisational innovations have almost equal percentage of firms in each group; marketing innovation being slightly more preferred alternative. 47.27% of innovative firms that were set up after 2000 have preference for marketing innovation in all size categorise. 44.17% of innovative firms established between 1990 and 2000 have made changes in their organisational set up.

Figure 7.3 Age-wise distribution of innovative firms with respect to Non-technological innovations

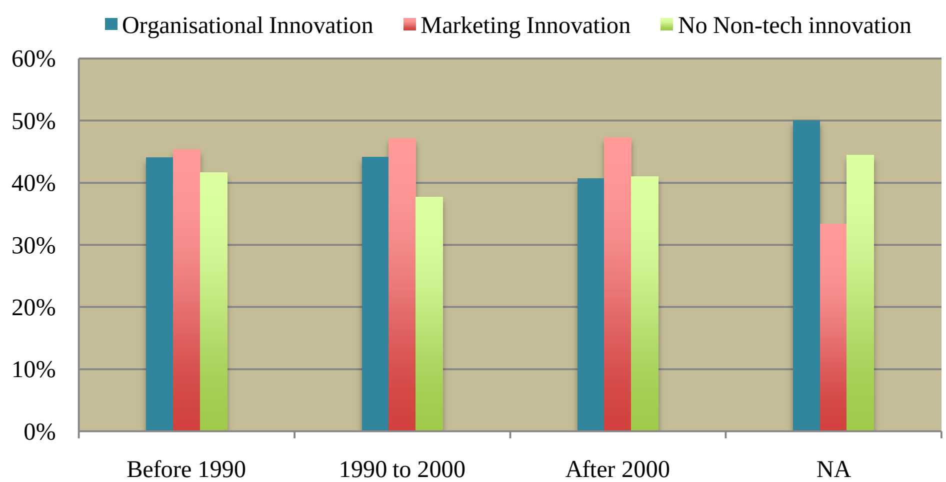
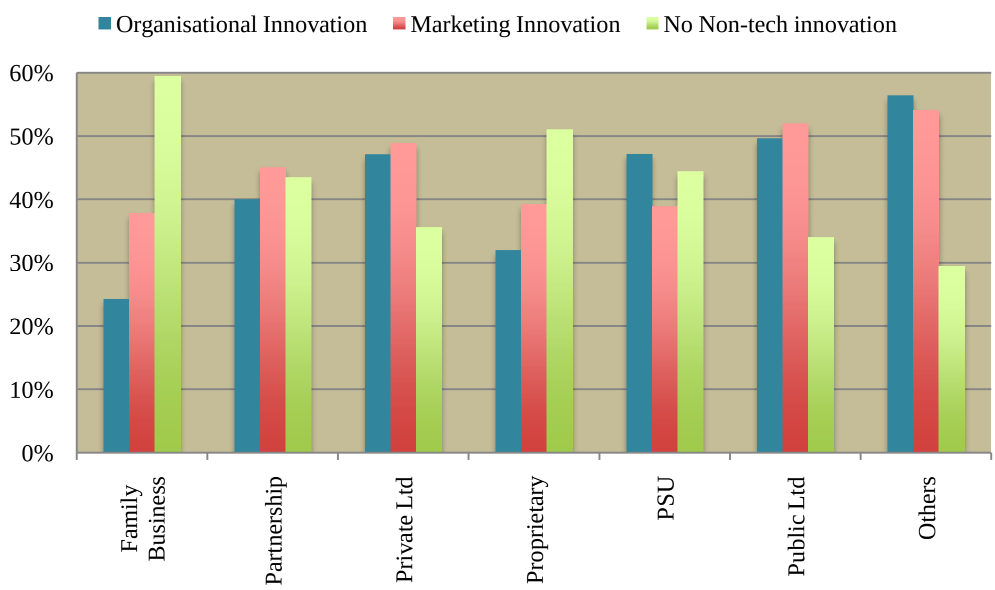


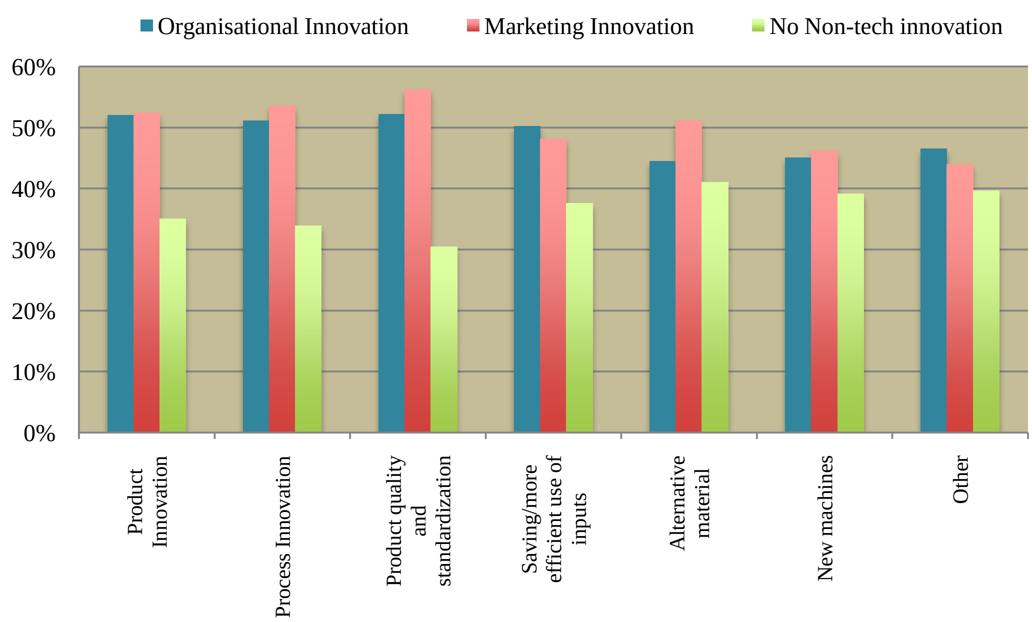
Figure 7.4 shows ownership types in non-technological innovations. Public limited firms are the ones with highest share in both organisational and marketing innovations. They are closely followed by private limited companies of which 47.13% and 48.89% are involved with organisational and marketing innovations.

Figure 7.4 Ownership-wise distribution of innovative firms with respect to Non-technological innovations



Non-technological innovations have complementary relationship with technological innovations. Figure 7.5 shows that innovative firms which have done ‘Product quality and standardization’ are also active in non-technological innovations with 52.19% and 56.26% of them engaged in organisational and marketing innovations respectively.

Figure 7.5 Types of innovations with respect to Non-technological innovations



Post innovation Positions

Figure 7.6 shows the number of innovative firms with non-technological innovations (in %) responding 'ahead' or 'at par' for the indicators assessing their status vis-a-vis others in the industry. There aren't many significant differences between the firms doing non-technological innovations and those who are not. However, for factors such as 'technology-in-licensing', 'New collaborations' and FDI where number of firms (in %) with non-technological innovations who felt they are 'ahead' or 'at par' with their peers is significantly higher.

Figure 7.6 Non-technological innovations and their status vis-a-vis others in the industry

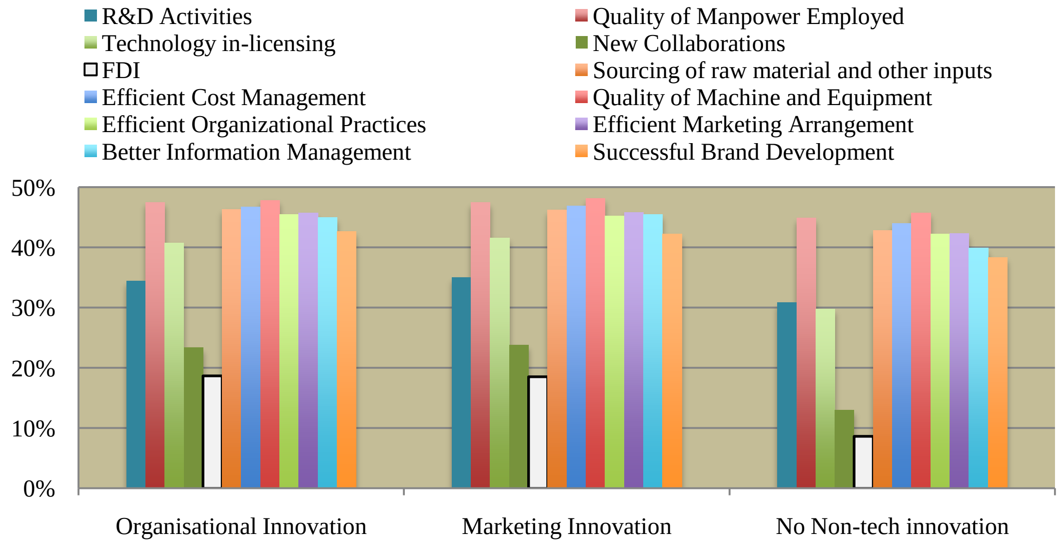


Figure 7.7 shows the number of innovative firms (in %), which have done non-technological innovation and have outcomes achieved by them as gains from innovation. Clearly, innovative firms with non-technological innovation (either organisational innovation or marketing innovation) have higher number of firms in each of the outcomes.

Figure 7.7 Non-technological innovations and gains from innovation

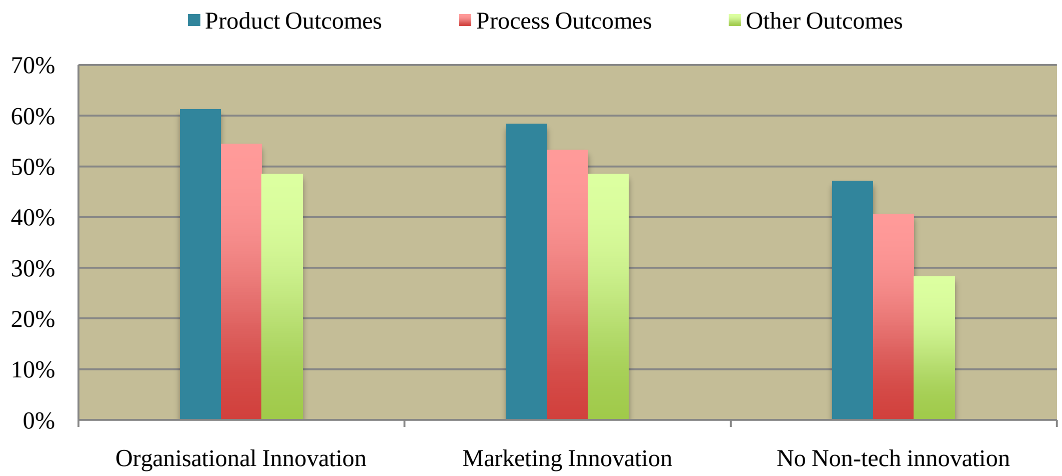
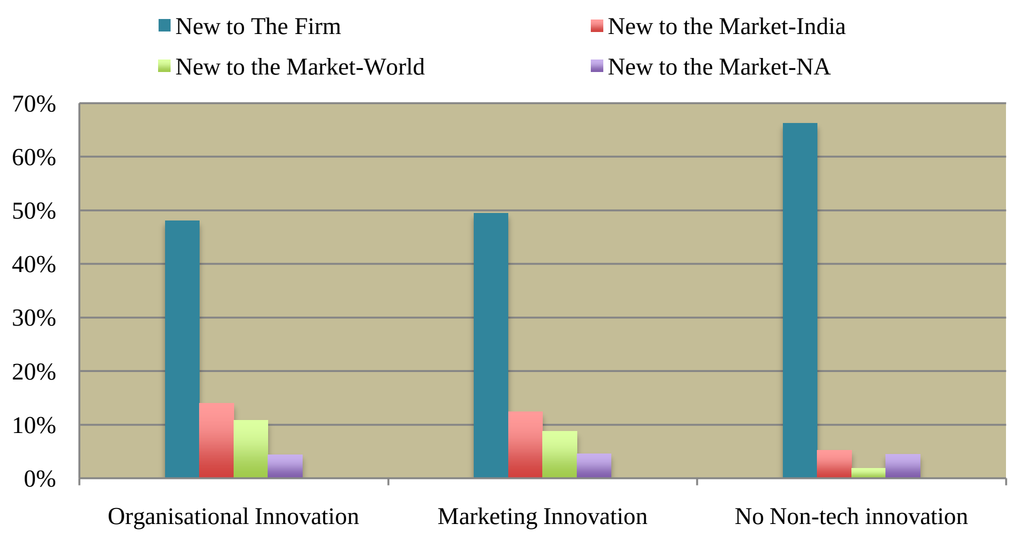


Figure 7.8 shows the novelty level claimed by innovative firms (in %) with non-technological innovation. Innovative firms without technological innovations are significantly higher in innovations that are mostly new to the firm, whereas innovative firms with non-technological innovations are ahead in both new to the market-India and new to the market-World.

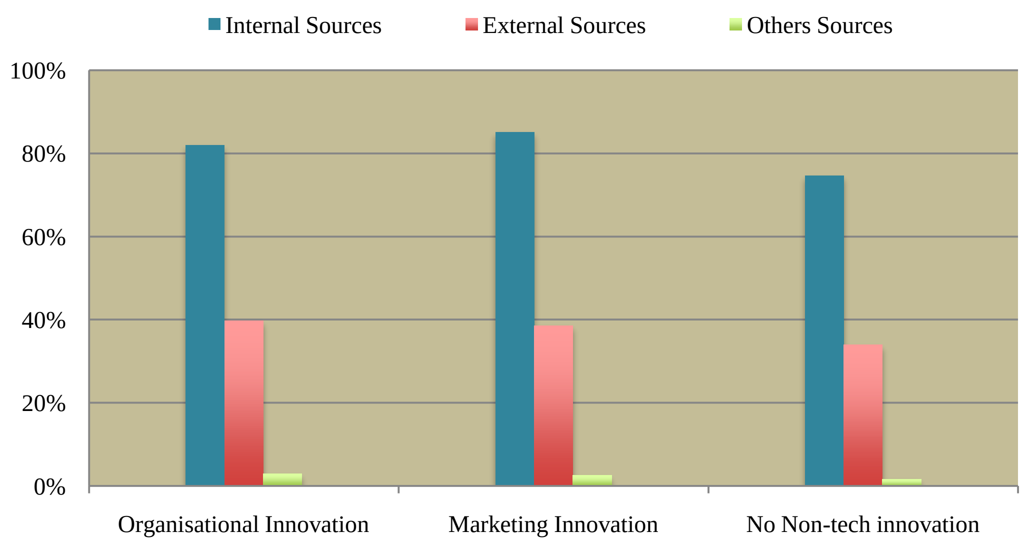
Figure 7.8 Non-technological innovations and novelty of innovation



Strategies for innovation

Figure 7.9 shows how innovative firms with non-technological innovations have sourced their innovations. Among the three ways -internal source, external source and other sources (with other enterprises or govt. labs), there are no major differences between innovative firms with or without non-technological innovations. However, internal sources are the foremost source for developing innovations which is more than 75% under each category of firm.

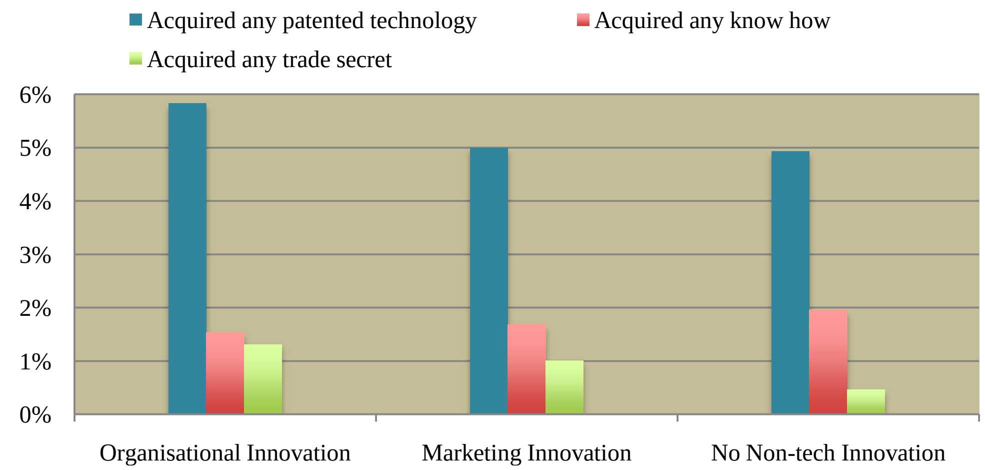
Figure 7.9: Innovative firms with non-technological innovations and sources of innovations



i. Acquisition of external knowledge

Figure 7.10 shows the type of external knowledge acquired by innovative firms with and without non-technological innovations. It clearly shows that the group which have done non-technological innovations have higher number of firms in all the types of external knowledge acquired except for the type, 'know how'. Another observation is that innovative firms have inclination for 'patented technology' as it was favoured by all the innovative firms irrespective of whether they have done non-technological innovations or not.

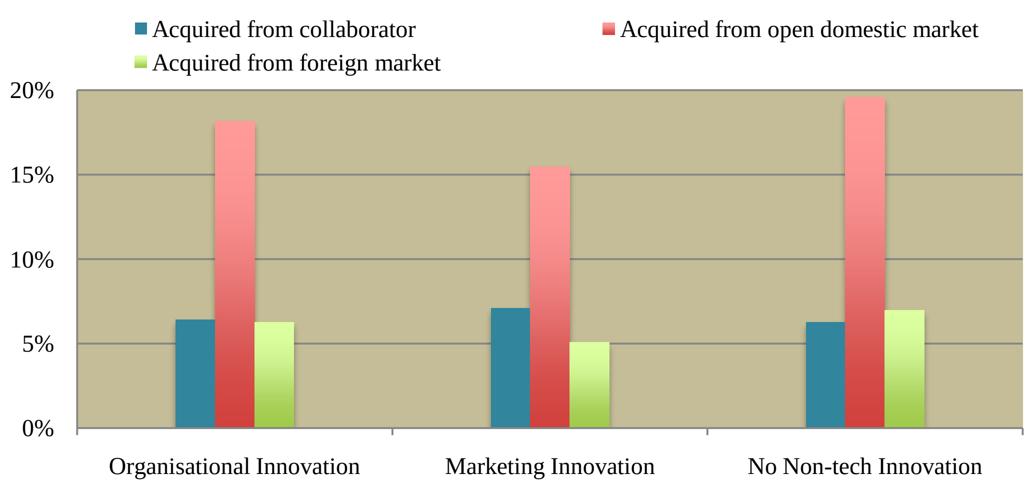
Figure 7.10: Innovative firms with non-technological innovations and external knowledge acquired



ii. Source of acquisition of external knowledge

Figure 7.11 shows that innovative firms with non-technological innovations are ahead only in using collaborator as a source for acquiring external knowledge and in rest of the others, innovative firms without non-technological innovations are ahead. Also, in comparing overall scenario, open domestic market as a source of acquiring external knowledge is very much ahead of the other two sources.

Figure 7.11: Innovative firms with non-technological innovations and source of external knowledge acquired



iii. Transactions for external sources

Figure 7.12 shows that, innovative firms with non-technological innovations favour licensing as the mode for acquiring external sources for innovations whereas firms without non-technological innovations prefer purchasing external technology. Innovative firms would prefer purchase technology to borrowing the same.

Figure 7.12 Innovative firms with non-technological innovations and Mode of acquiring external knowledge

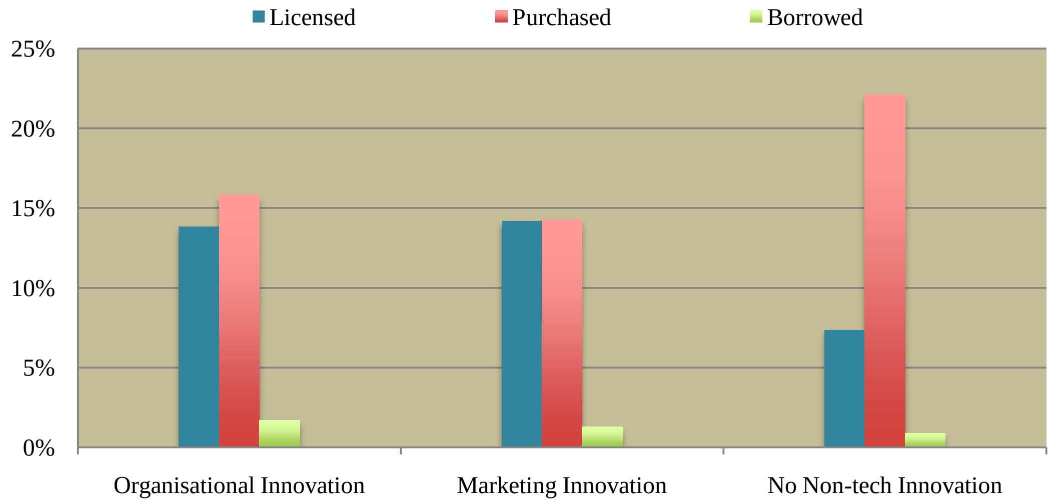


Figure 7.13 enumerates the types of agreements made while accessing external knowledge. Agreement for maintenance is the most intensively used method by all the innovative firms followed by agreement to upgrade. Agreement for training and agreement to upgrade were used more efficiently by innovative firms with non-technological innovations than by innovative firms without non-technological innovations.

Figure 7.13 Innovative firms with non-technological innovations and Agreements for external knowledge

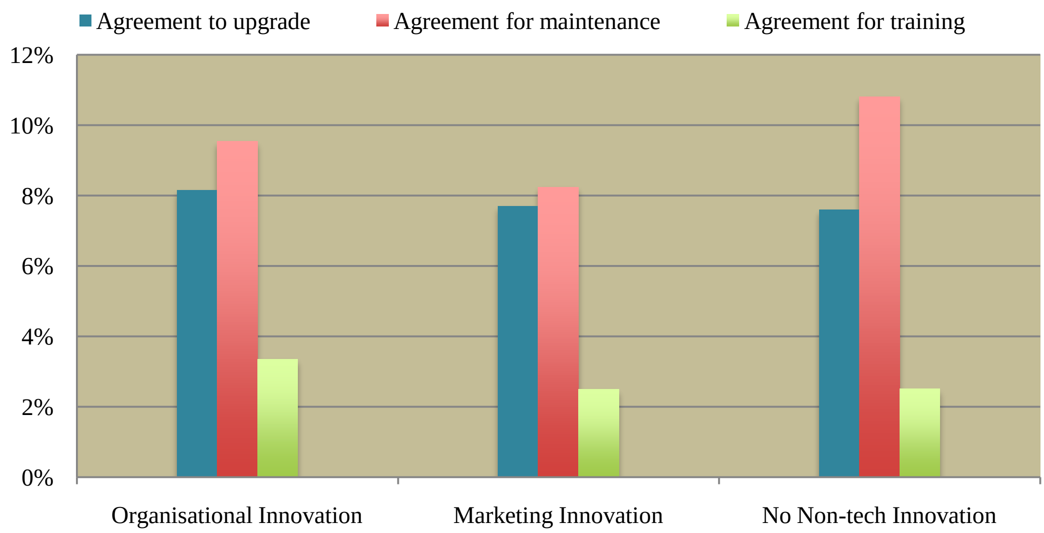
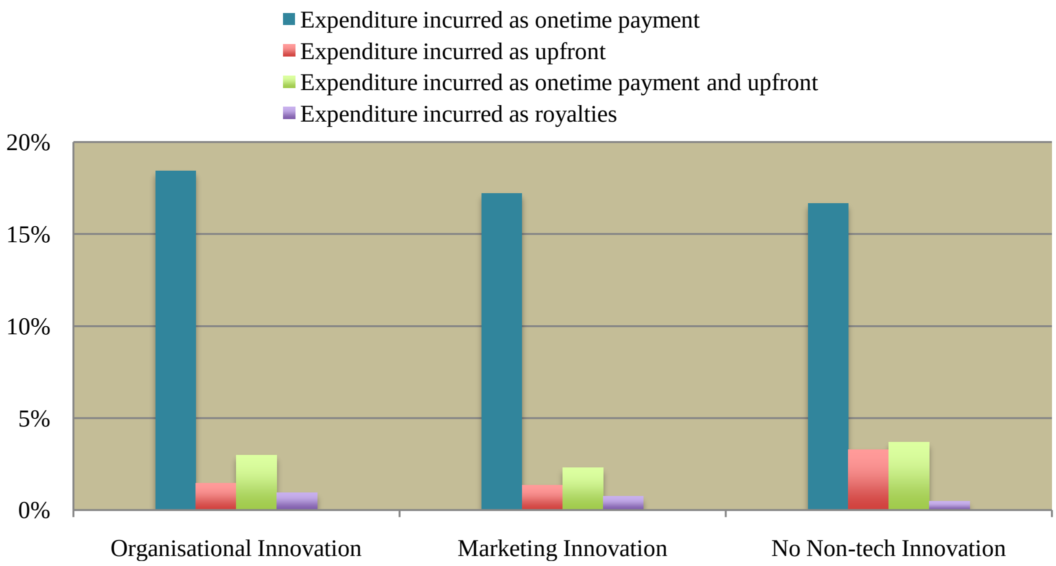


Figure 7.14 shows that the innovative firms strongly prefer expenditure incurred as onetime payment. Preference, for other alternatives such as upfront and royalties is almost negligible irrespective of whether they do non- technological innovation or not.

Figure 7.14 Innovative firms with non-technological innovations and Mode of Expenditure incurred



Human Resource for Innovation

Figure 7.15, shows that there is hardly any major difference in respect of skill base of human resources employed by innovative firms doing non-technological innovations and the others. Firms involved with organisational innovation are slightly better off in having more number of scientists and engineers. For management professional innovative firms without non-technological innovations are slightly ahead.

Figure 7.15 Innovative firms with non-technological innovations and Skill base of human resource employed

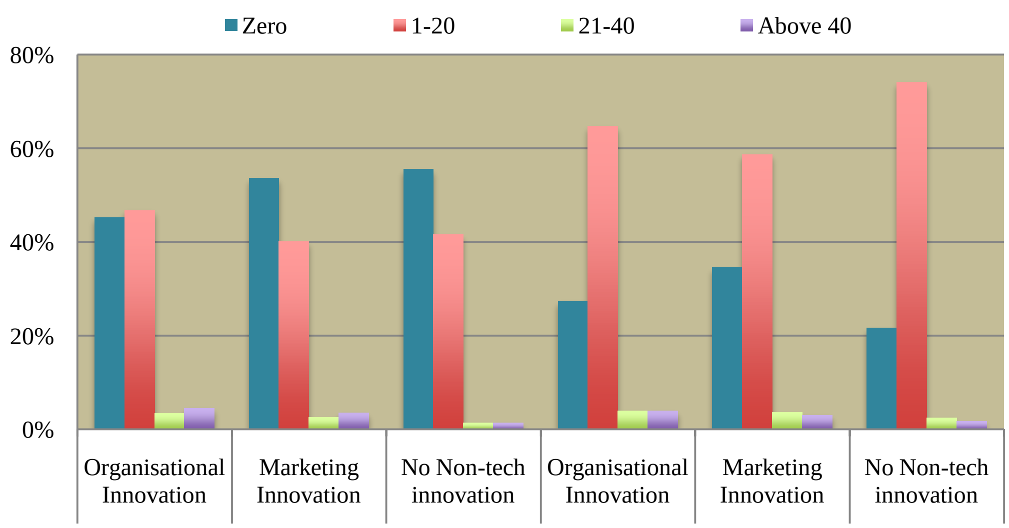
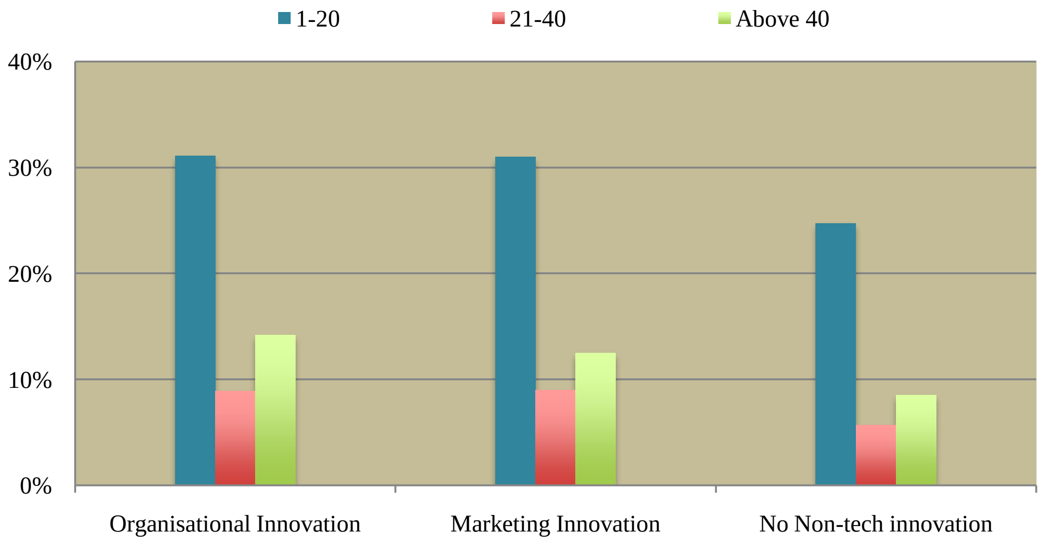


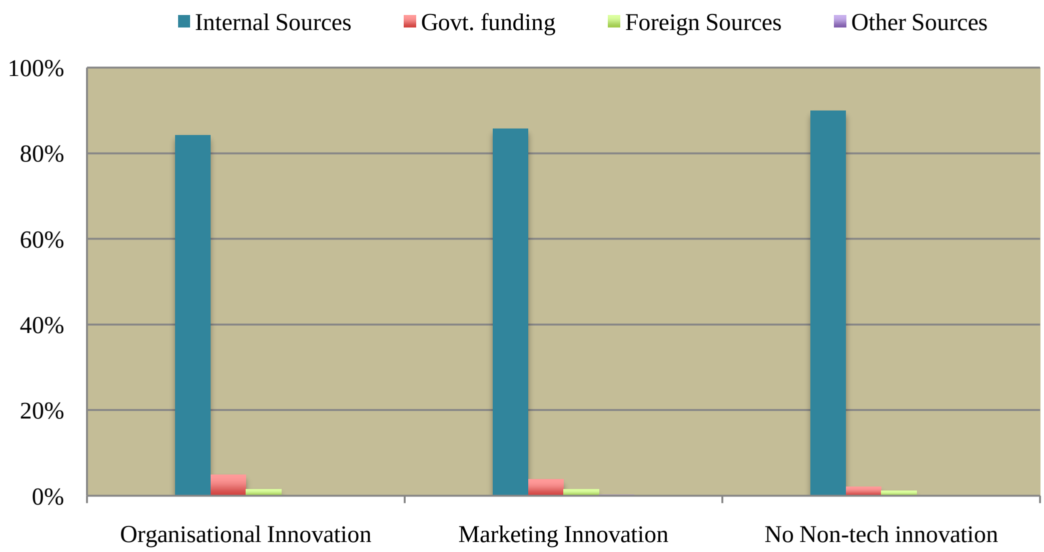
Figure 7.16 presents the information about the training provided by the innovative firms with and without non-technological innovations. The figure reflects that innovative firms with non-technological innovations have higher share in providing training to human resource employed.

Figure 7.16 Innovative firms with non-technological innovations and training provided



The following figure 7.17 shows that internal sources are the most accessed mode of funding training programme for both groups of innovative firms. Govt sources are rarely accessed.

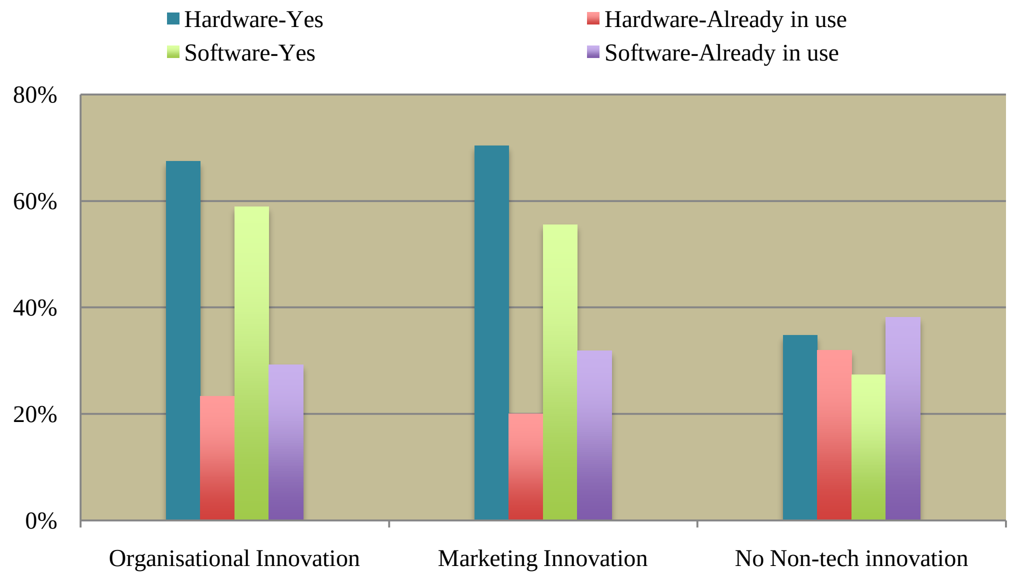
Figure 7.17 Innovative firms with non-technological innovations and sources of funds for training



ICT infrastructure and its usage

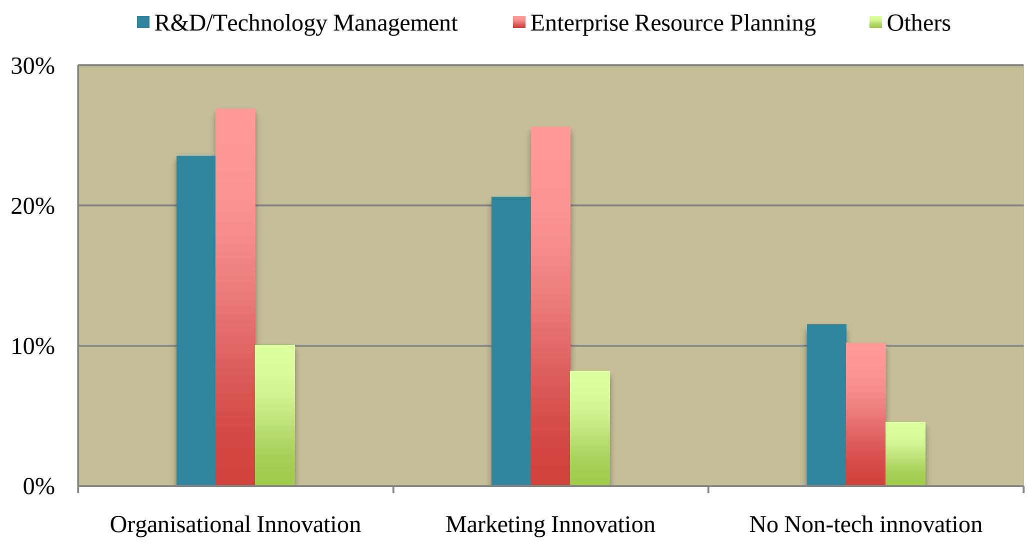
From the figure 7.18, it is clear that higher number (in %) of innovative firms with non-technological innovation have availed both hardware and software in some form or the other. It is similar in both firms doing organizational and marketing innovations.

Figure 7.18 Innovative firms with non-technological innovations and ICT infrastructure



The usage of ICT by the firms with non-technological innovation is shown in figure 7.19. The figure conveys that innovative firms with non-technological innovations are ahead in all the alternative uses of ICT platforms. And the most preferred option availed by them is enterprise resource planning.

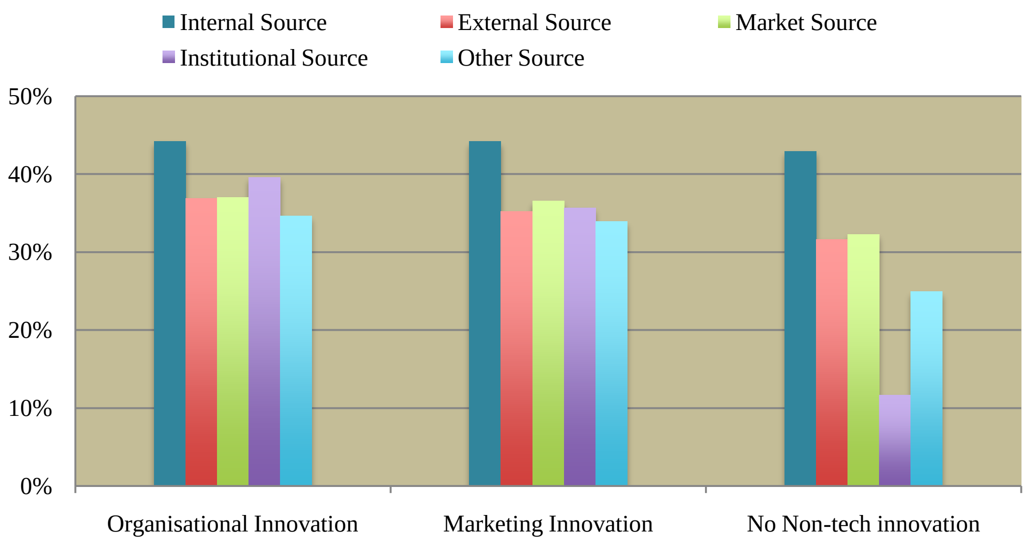
Figure 7.19 Innovative firms with non-technological innovations and usage of ICT



Sources of information for Innovation

Figure 7.20 shows the various sources of information used by innovative firms. Internal sources are the main source of information for innovation as revealed by the diagram below irrespective of firms doing non-technological innovations or not.

Figure 7.20 Innovative firms with non-technological innovations and Source of information for Innovation



In Nutshell

Out of total innovative firms 59.89% are involved in non-technological innovations, and 46.48% of them are into marketing innovation whereas, 43.09% are into organisational innovation. There are no clear-cut relationship between size, age and ownership of the firm with the actions on non-technological innovations. Types of innovations also do not vary much between firms doing non-technological innovations and others. Innovative firms that are inclined towards non-technological innovations are slightly ahead of their peers (in their opinion) compared to those who are not into non-technological innovations.

VIII

Barriers to Innovation

Highlights

- Access to knowledge/information has been found most important barrier by about 40% of the innovative firms. This is followed by cost factor associated with innovation. When classified in terms of the age of the firms, old and new firms alike consider lack of own resources as most important barrier coupled with high cost of innovation. The same is for ownership pattern-wise.

- As for knowledge factor availability of skilled manpower is the most important problem for 88% of the innovators. Problem with access to market information and availability of information technology follow closely. A small percentage of firms have expressed infrastructure as barrier to innovation. Govt. regulatory requirements have scored highest as market barrier, followed by domination of the established players in the market.

- Internal resources remain strong barrier for all types of innovations. Innovation cost for ‘product’, ‘process’ and ‘alternative material’ is a barrier as expressed by more than 70% of the innovators. Firms engaged in innovation on alternative material and efficient use of inputs are more prone to availability of lab facilities.

- Negative correlations with states’ innovation potentiality imply that higher the innovation potentiality of a state lower is the perceptions of cost as barrier among the innovative firms. Higher the potentiality lesser is the problems with availability of finance, outside or inside. On the other hand knowledge factor as barrier has been the common perception among innovative firms in all the states.

- Cost factor is important barrier for all sectors, so is the knowledge factor. Existing market domination has been perceived as an important barrier by innovative firms in most sectors.

Barriers to Innovation

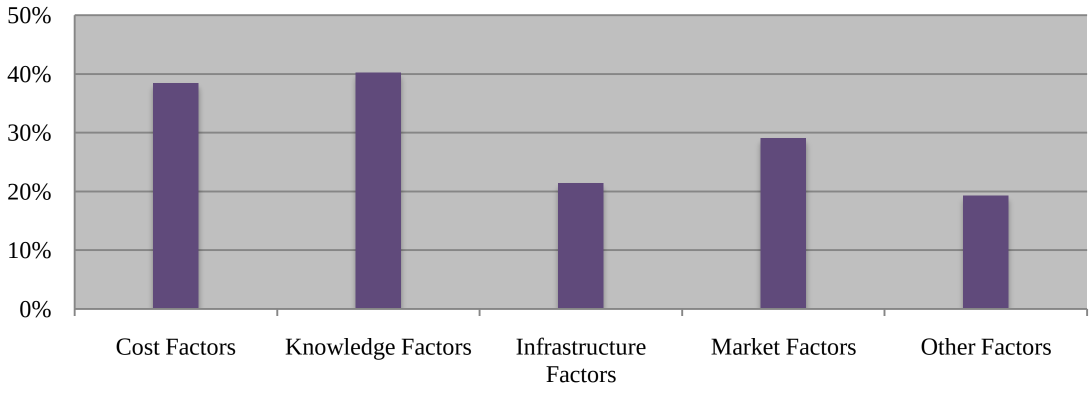
Barriers to innovation were divided in the five broad categories with corresponding sub-categories as shown below. From the responses ones marked as ‘important’ as barrier have been counted.

1. Cost of innovation
    - Availability of Finance within your enterprise
    - Availability of Finance from outside sources
    - Innovation cost
2. Access to the knowledge/information
    - Availability of skilled manpower
    - Availability of information on Technology
    - Availability of information on Markets
3. Infrastructure related constraints
    - Availability of Infrastructure/Test Labs within enterprise
    - Available facility sharing of test labs/ research labs
4. Market related constraints
    - Market dominated by established players
    - To overcome problems entering new market
    - New opportunities to enter nich market
    - To overcome protection barrier for new product/process
    - To meet govt. regulatory requirements
5. Others for Govt. policy and management related issues
    - Govt. Policy constraints
    - Management barriers/Other people barriers

This chapter presents the understanding of barrier to innovation as perceived by innovators, through types of innovations along with state and sector level scenarios.

Figure 8.1 presents the overall scenario for the four broad categories. Access to knowledge/information has been found most important barrier by about 40% of the innovative firms. This is followed by cost factor associated with innovation.

Figure 8.1: Barrier to innovation

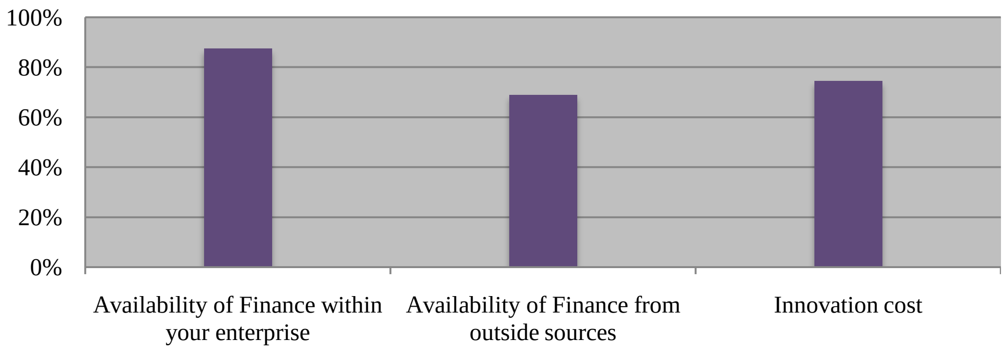


In the following we examine each of the factors separately for types of innovators, and innovations and also for states and sectors.

Barriers to Innovation: Cost factor

Cost factor has been detailed further with availability of finance and in general the cost of innovation. Figure 8.2 shows that availability of finance within the enterprise is the majority of innovators' problem. But not less important is the problem of getting finance from outside sources as expressed by about 69% of the innovators.

Figure 8.2: Cost of innovation as barrier



Cost factors as perceived by types of innovators

Figure 8.3 shows the perception of innovators of different firm size groups for cost as barrier to innovations. Although smaller firms express (87%) the lack of own resources, the same is also shared by firms in other size categories.

When classified in terms of the age of the firms (figure 8.4), old and new firms alike consider lack of own resources as most important barrier coupled with high cost of innovation. The same is for ownership pattern-wise (figure 8.5).

Figure 8.3: Firm size and cost of innovation as barrier

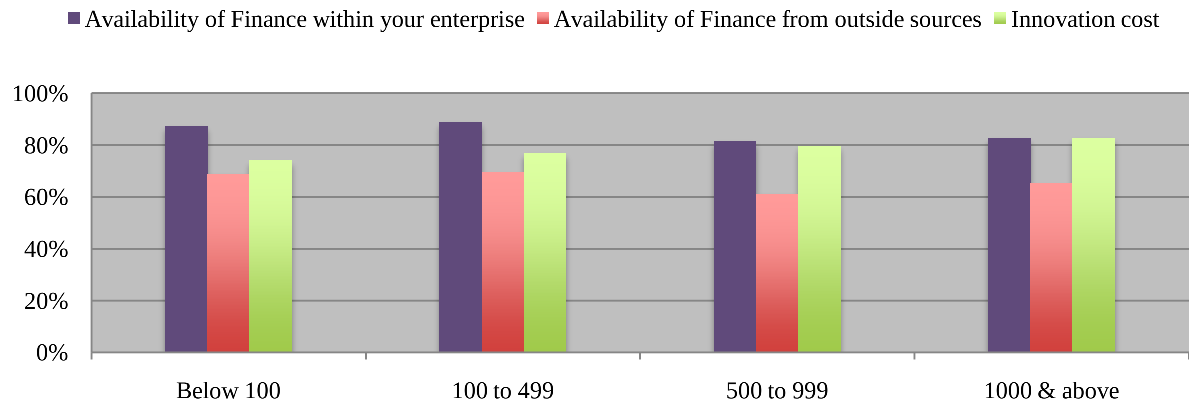


Figure 8.4: Firms' age and cost of innovation as barrier

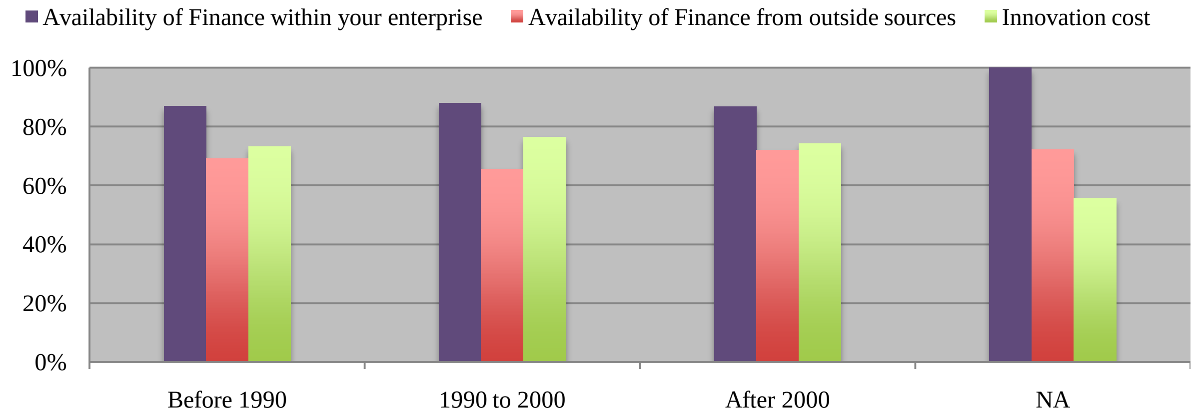
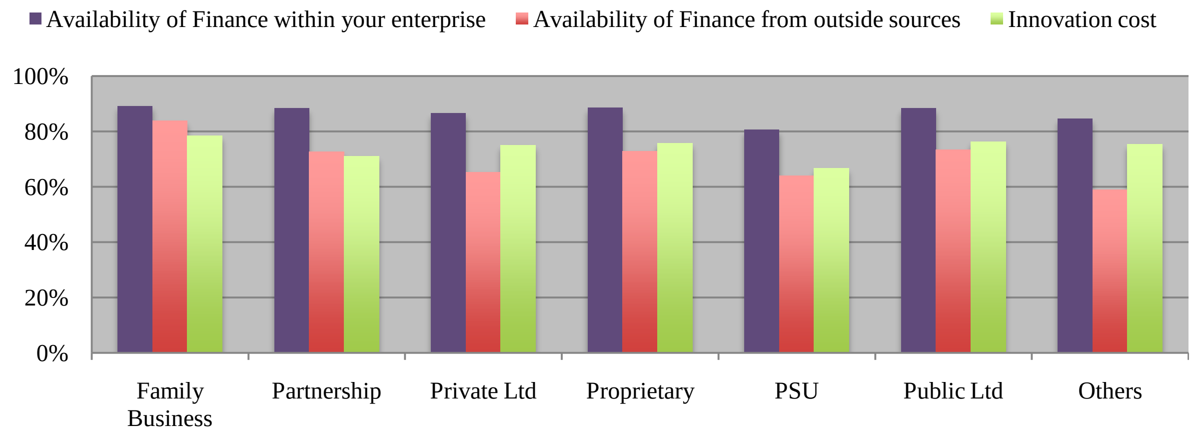


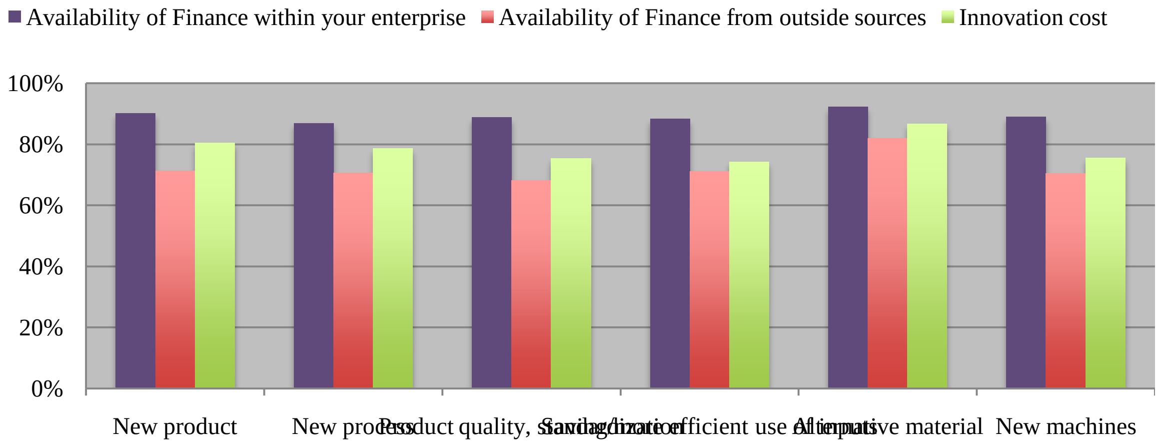
Figure 8.5: Ownership type and cost of innovation as barrier



Cost factors as perceived through types of innovations

Internal resources remain strong barrier for all types of innovations. Innovation cost for 'product', 'process' and 'alternative material' is a barrier as expressed by more than 70% of the innovators.

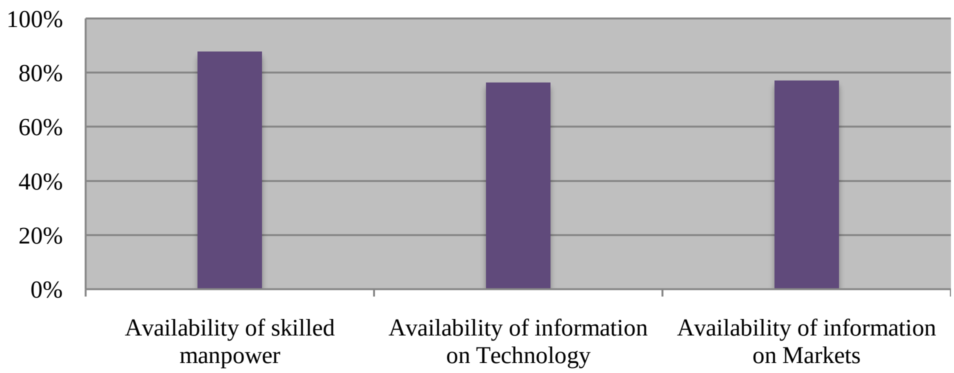
Figure 8.6: Innovation type and cost of innovation as barrier



Barriers to Innovation: Knowledge factor

Knowledge factor as innovation barrier has been examined in terms of human resources, extent of information technology use, and availability of market information. Figure 8.7 shows that availability of skilled manpower to make the innovation functional in the enterprise is the most important problem for 88% of the innovators. Problem with access to market information and availability of information technology follow closely.

Figure 8.7: Access to knowledge as barrier to innovation



Knowledge factors as perceived by types of innovators

Availability of skilled manpower remains the major issue with small firms but not much less for the large firms as well (figure 8.8). It is to be noted that availability of information on market and technology are more important barriers to larger firms than it is for smaller counter part.

The same views were expressed by the firms in different age categories (figure 8.9).

Figure 8.10 shows no variation in perception for knowledge as barrier to innovation.

Figure 8.8: Firm size and knowledge factor as barrier

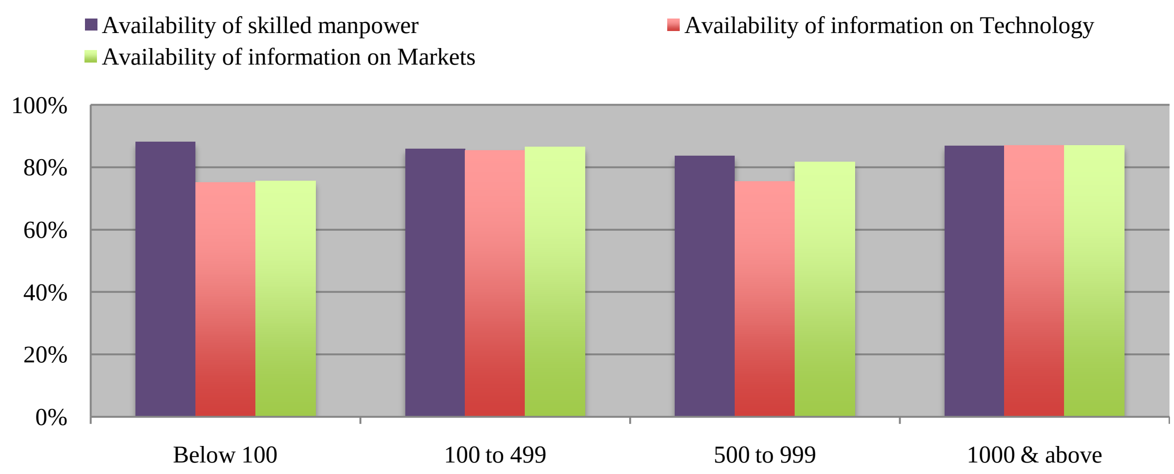


Figure 8.9: Firms' age and knowledge factor as barrier

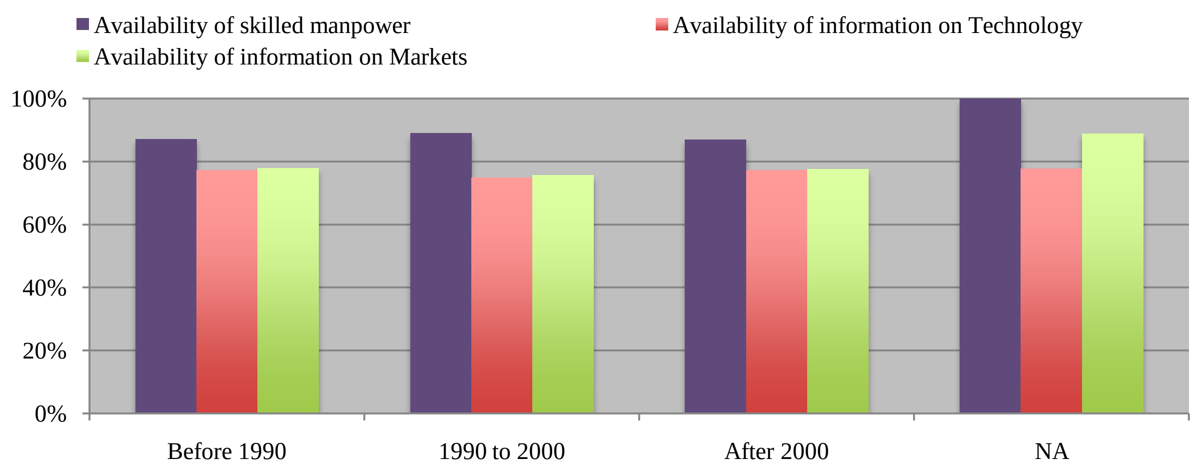
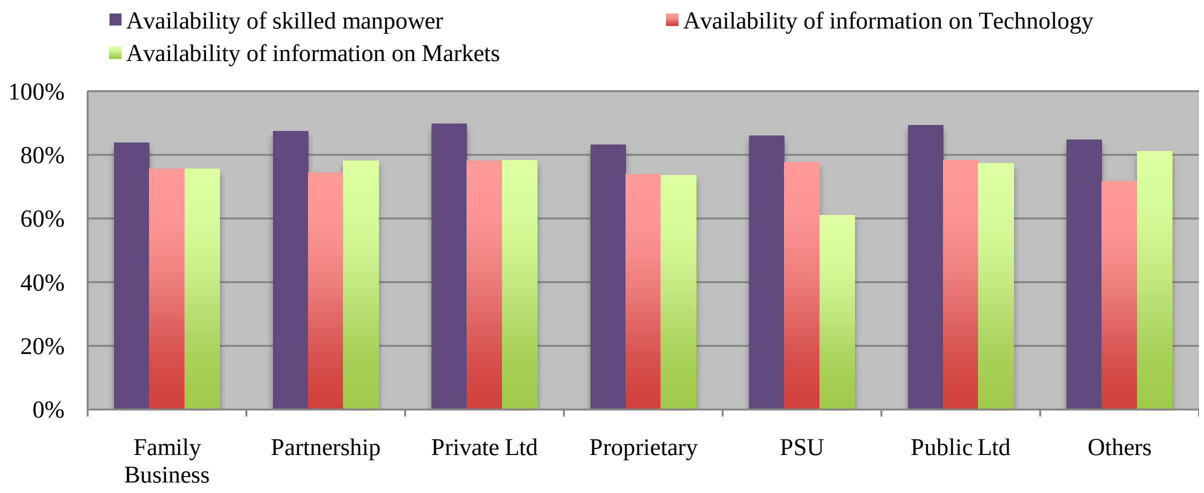


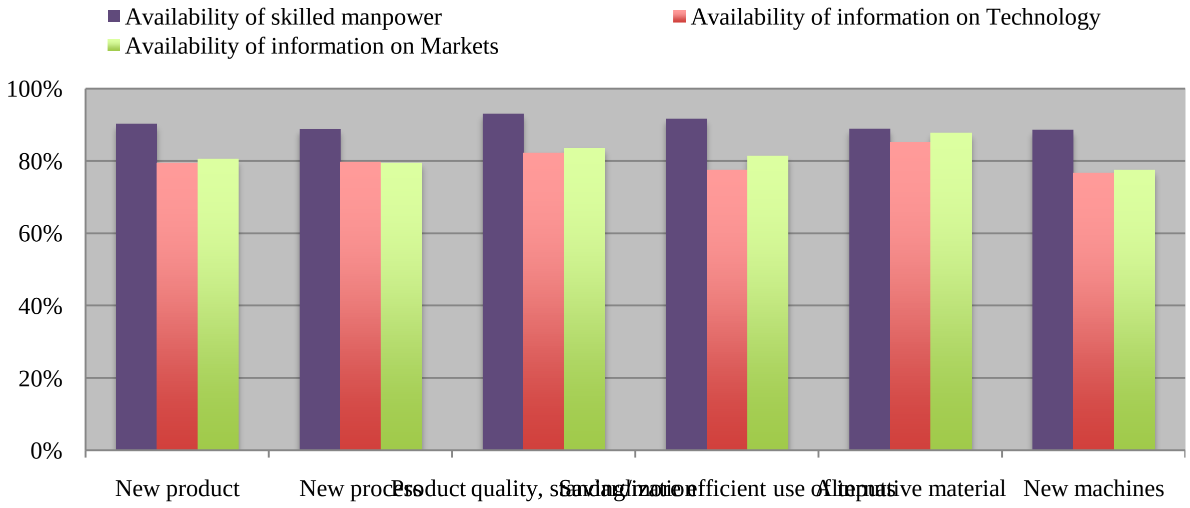
Figure 8.10: Firms' ownership and knowledge factor as barrier



Knowledge factors as perceived through types of innovations

As shown in figure 8.11 all knowledge factors remain important issues for innovative firms in all types of innovations

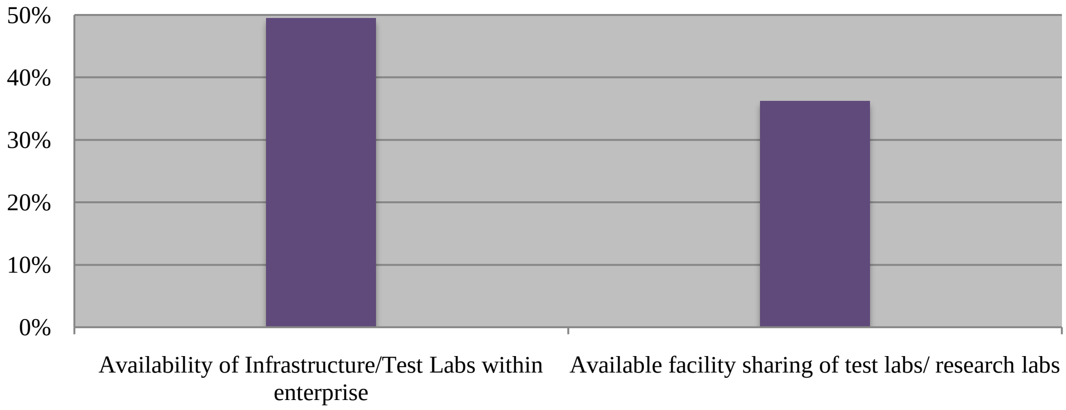
Figure 8.11: Types of innovation and knowledge factor as barrier



Barriers to Innovation: Infrastructure factor

For technological innovation infrastructure is access to research and test labs both inside and outside the enterprise. As figure 8.12 shows, compared to cost and knowledge factors infrastructure factor is perceived barrier by much less number of innovative firms. It is less than 50% for internal arrangement and about 36% for access to external facilities.

Figure 8.12: Infrastructure factor as barrier to innovation



Infrastructure factors as perceived by types of innovators

It is interesting to note from figure 8.13 that larger firms feel more constrained by the limited availability of infrastructure facility both in and outside the enterprise. Again firms established between 1990 an 2000 are much less concerned about infrastructure related problem compared to firms in other two categories of age (figure 8.14). In terms of the ownership pattern PSUs and Public limited companies are more concerned of infrastructure facilities (figure 8.15).

Figure 8.13: Firm size and Infrastructure factor as barrier to innovation

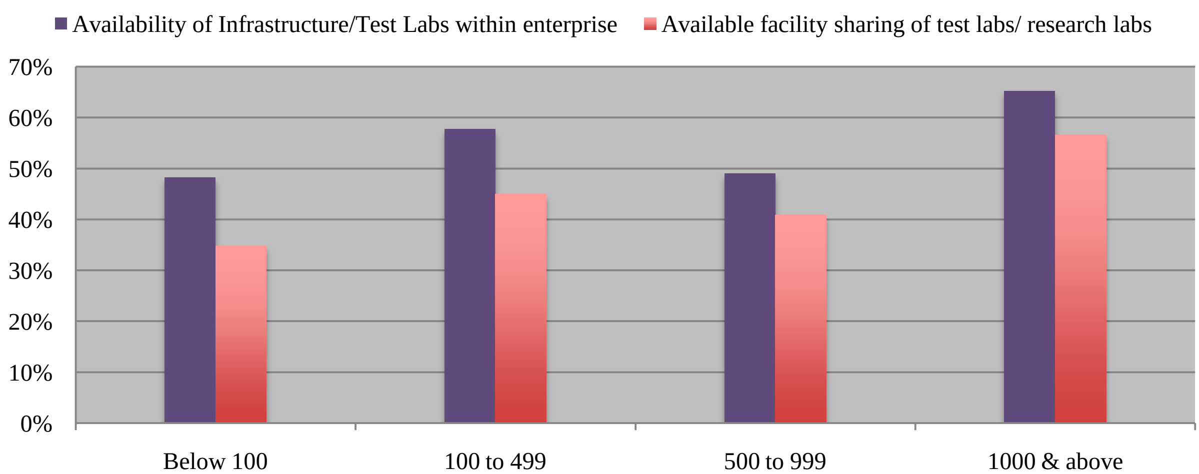


Figure 8.14: Firms' age and Infrastructure factor as barrier to innovation

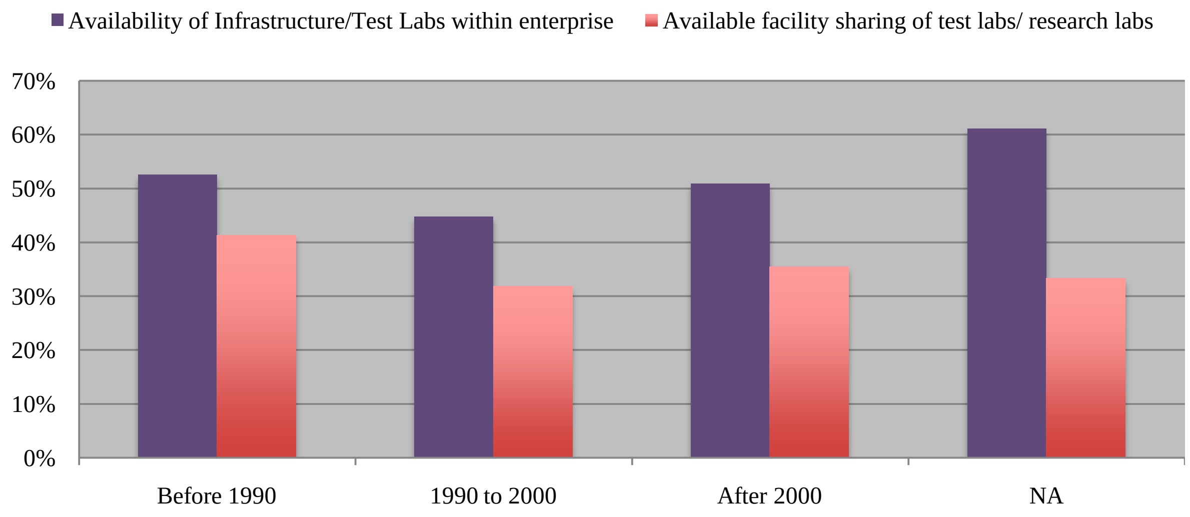
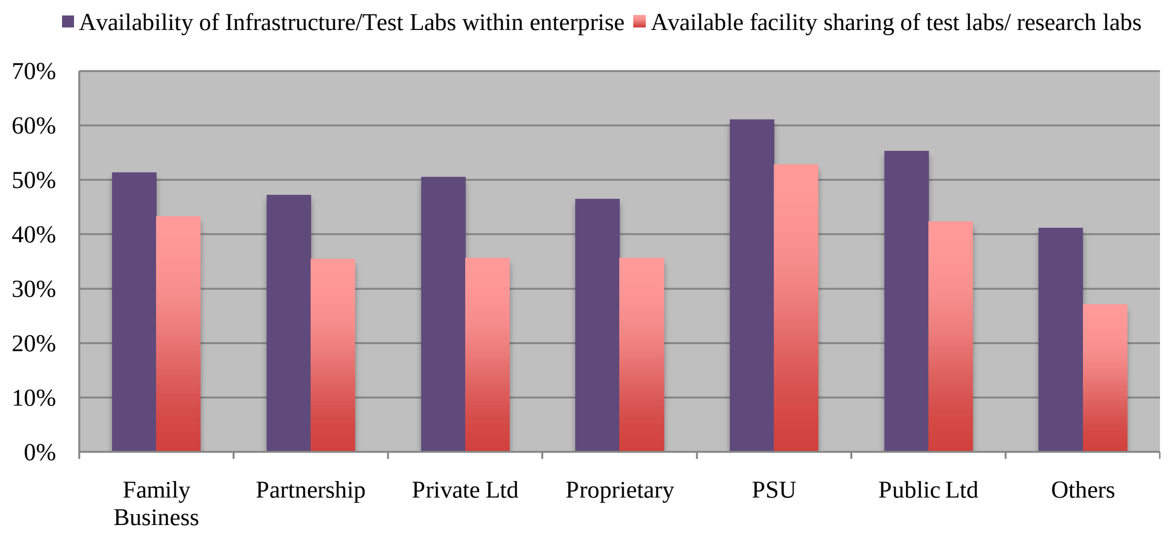


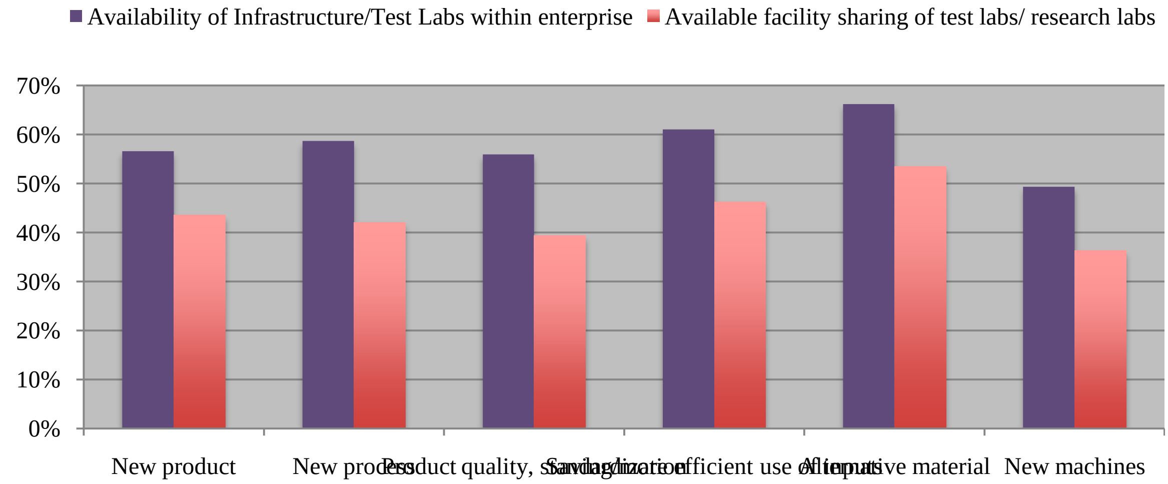
Figure 8.15: Firm ownership and Infrastructure factor as barrier to innovation



Infrastructure factors as perceived through types of innovations

Firms engaged in innovation on alternative material and efficient use of inputs are more prone to availability of lab facilities (figure 8.16)

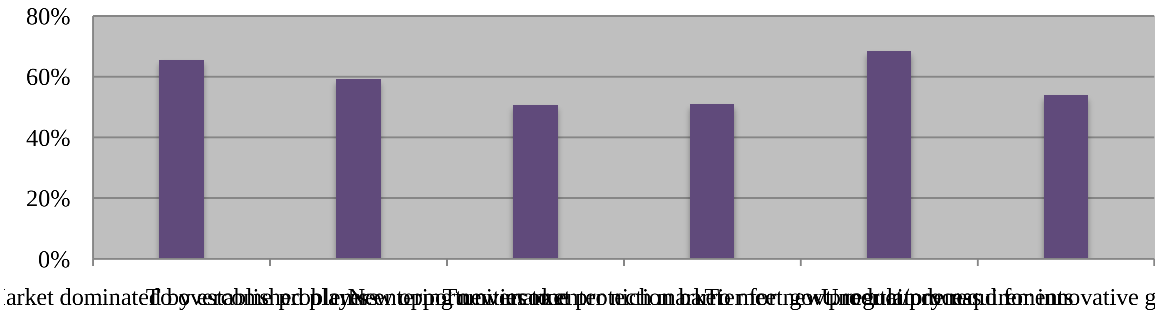
Figure 8.16: Types of innovation and Infrastructure factor as barrier to innovation



Barriers to Innovation: market factor

Market factors have been addressed by six broad issues, namely, domination of established player, problem of entering new market, opportunities for niche market, protection barrier for new product and process, regulatory requirements, demand uncertainties for innovative goods and services. Figure 8.17 shows the responses of the innovative firms for all the six issues. It is to be noted that govt. regulatory requirements have scored highest as barrier. This is followed by established players in the market.

Figure 8.17: market factor as barrier to innovation



Market factors as perceived by types of innovators

Firms across size categories suggest regulatory requirements and domination of the established players are two most important market related barriers (figure 8.18). And the scenarios are the same when seen for the age and ownership types of firms (figure 8.19 and 8.20)

Figure 8.18: Firm size and market factor as barrier to innovation

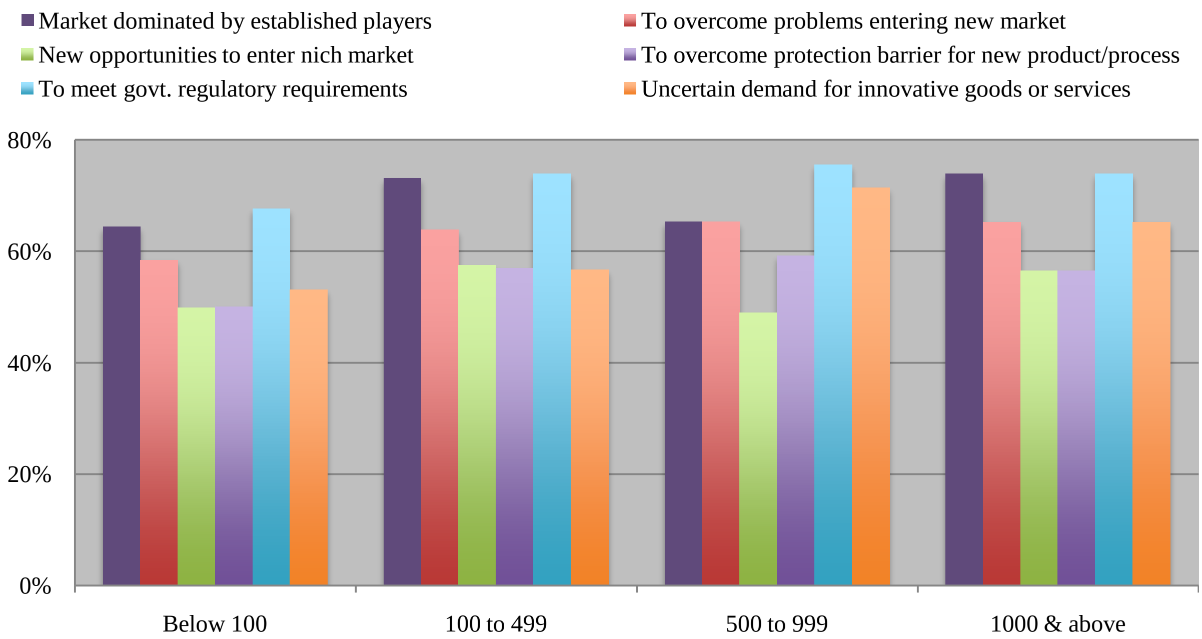


Figure 8.19: Firms' age and market factor as barrier to innovation

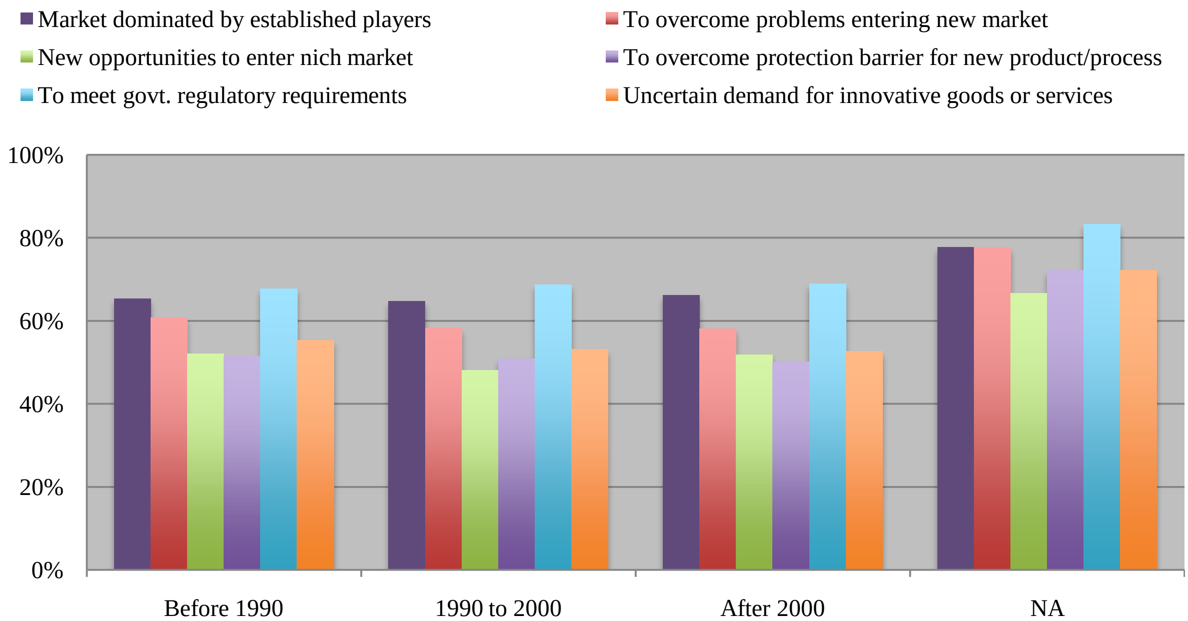
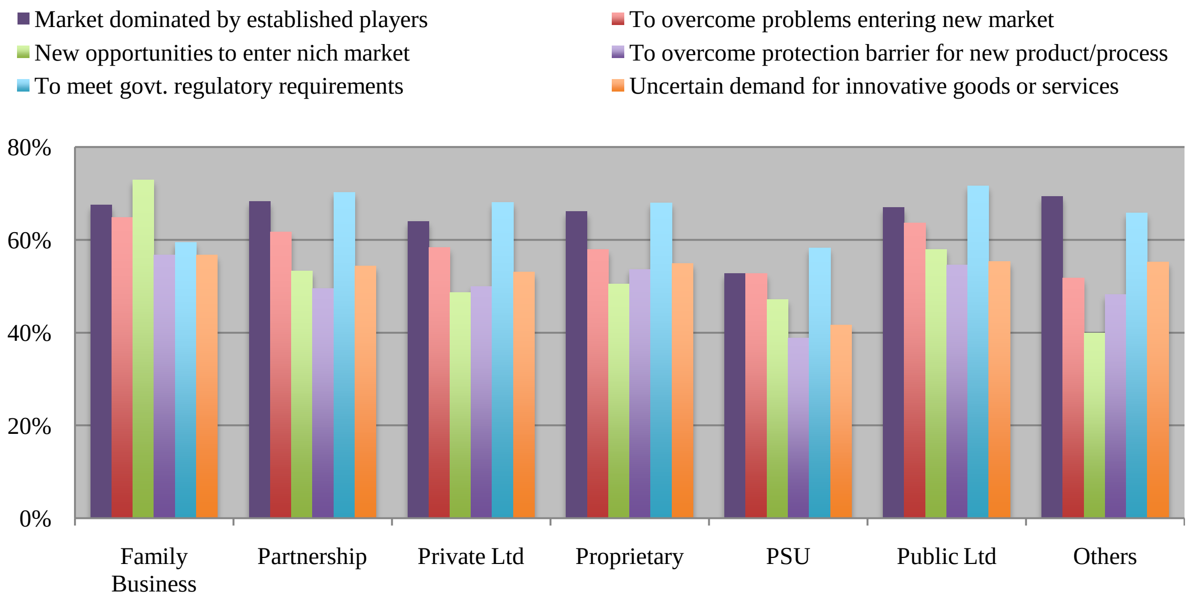


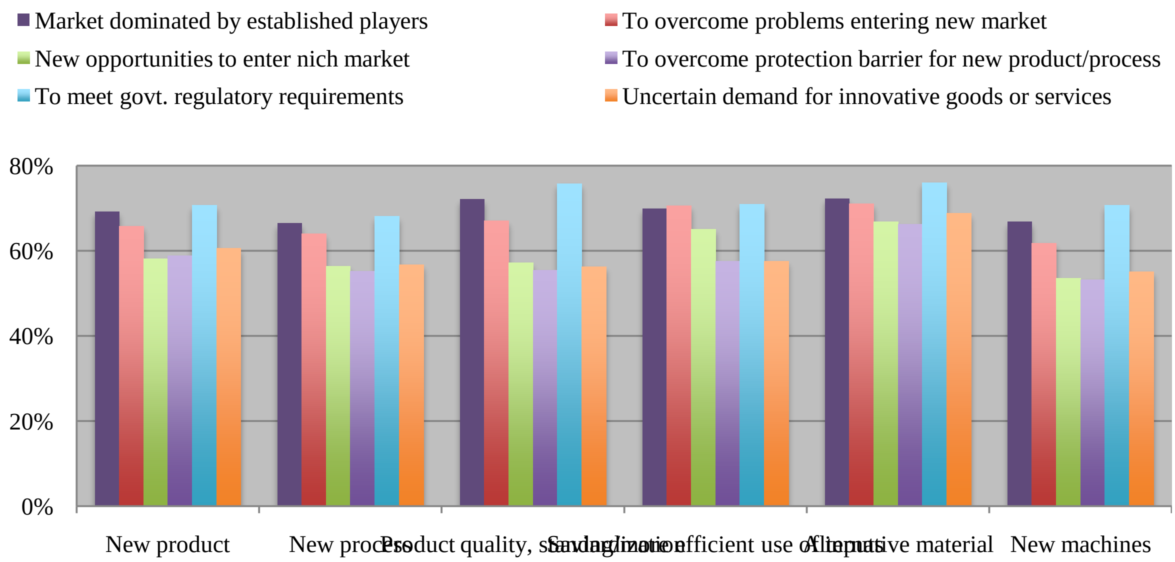
Figure 8.20: Firms' ownership and market factor as barrier to innovation



Market factors as perceived through types of innovations

Around 70% of innovators in each types of innovation also considers govt. regulatory requirement and market domination by established players are the main barriers (figure 8.21).

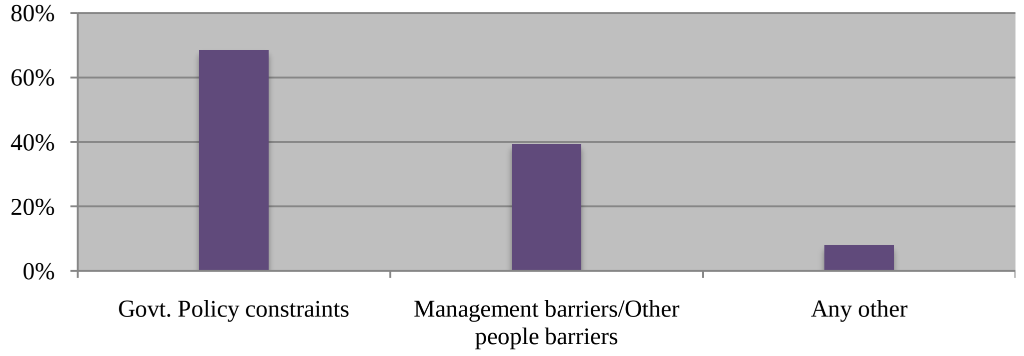
Figure 8.21: Types of innovation and market factor as barrier to innovation



Barriers to Innovation: Other factors

Other factors include govt. policies and also the internal issues of management of the enterprise. Figure 8.22 shows that govt. policies are largely perceived as anti innovation.

Figure 8.22: Other factors as barrier to innovations



Other factors as perceived by type of innovators

Firm size (figure 8.23), age (figure 8.24) and ownership pattern (figure 8.25) all show govt policy constraints as important barrier to innovations.

Figure 8.23: Firm size and other factors as barrier to innovations

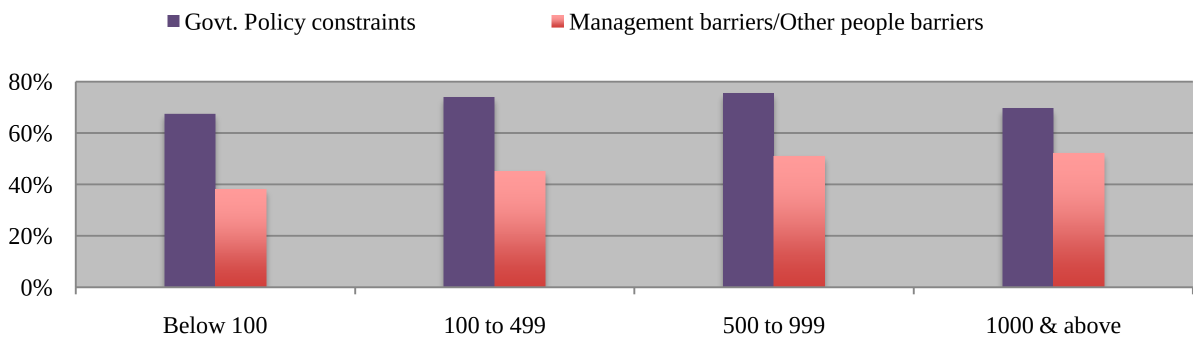


Figure 8.24: Firms' age and other factors as barrier to innovations

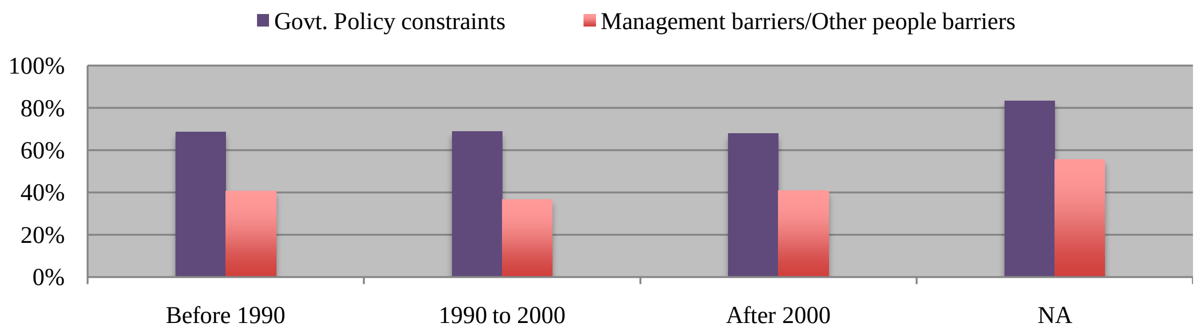
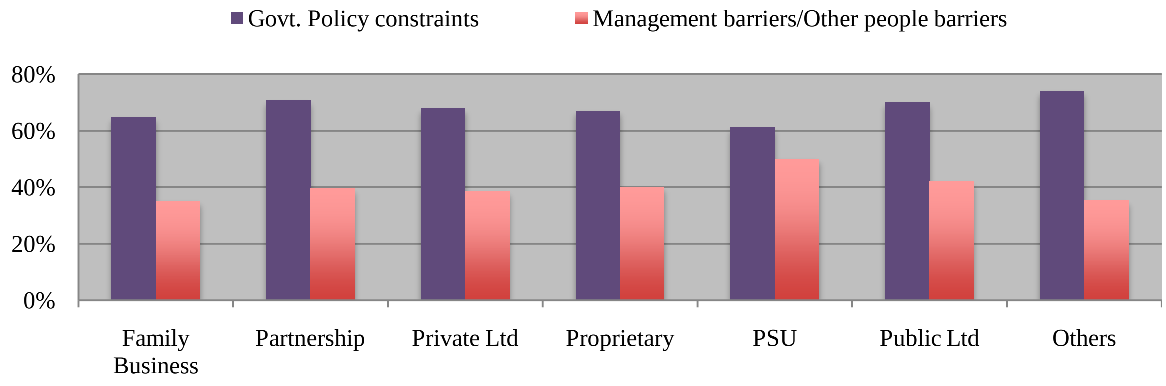


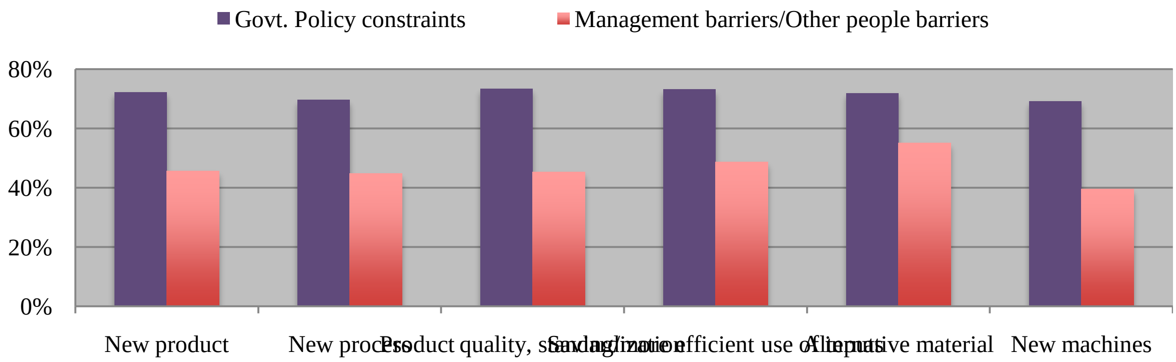
Figure 8.25: Firms' ownership and other factors as barrier to innovations



Other factors as perceived through type of innovations

Across all types of innovation govt. policy constraints viewed as important barrier to innovation by over 70% innovative firms (figure 8.26).

Figure 8.26: Types of innovations and other factors as barrier to innovations



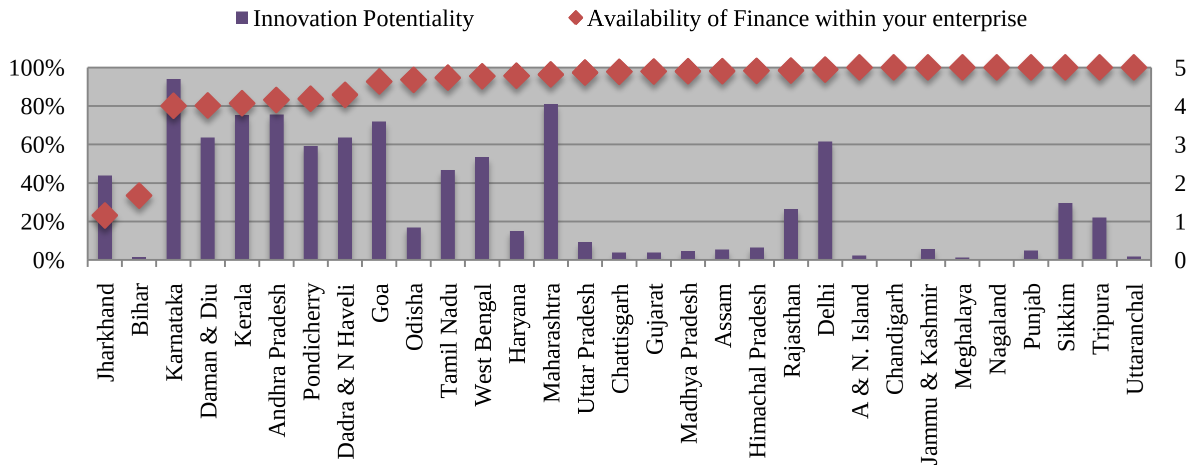
Barriers to Innovation: State level scenario

When these perceptions are aggregated at state level certain unique features are revealed. Observations are presented for each sub-category in a broad category. State-wise responses have been ranked for the sake of convenience of reading the figures.

Cost factor as barrier to Innovation

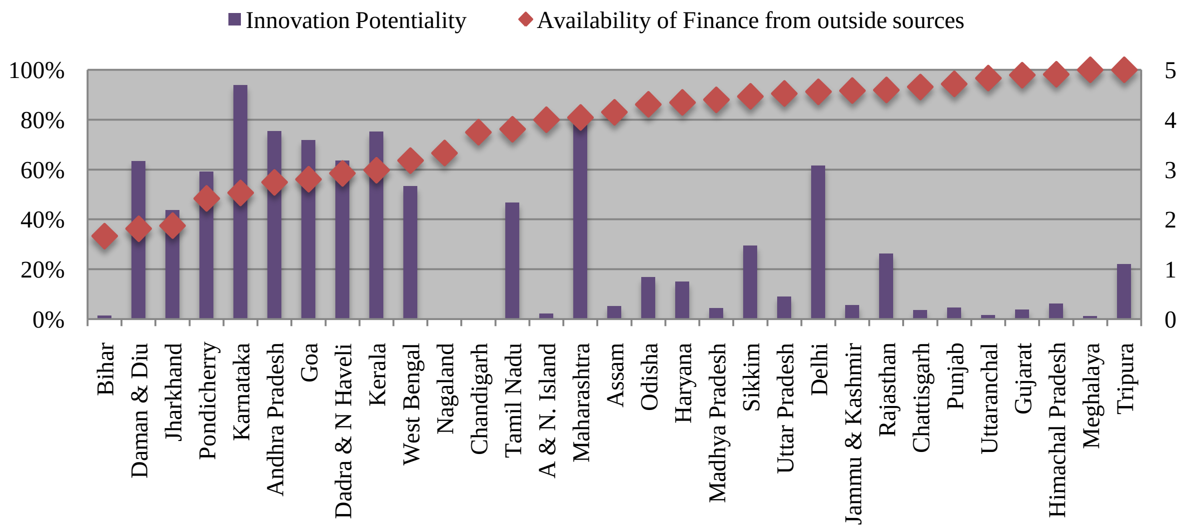
Figure 8.27 through 8.29 shows state level understanding of the subcategories of the cost factor as barrier to innovations by the innovative firms. Overall observations are presented as correlations with innovation potentialities of the states and the barriers in table 8.1. Negative correlations with states' innovation potentiality higher the innovation potentiality of a state lower is the perceptions of barrier among the innovative firms. Higher the potentiality lesser is the problems with availability of finance, outside or inside.

Figure 8.27: Finance from own enterprise as barrier to innovations



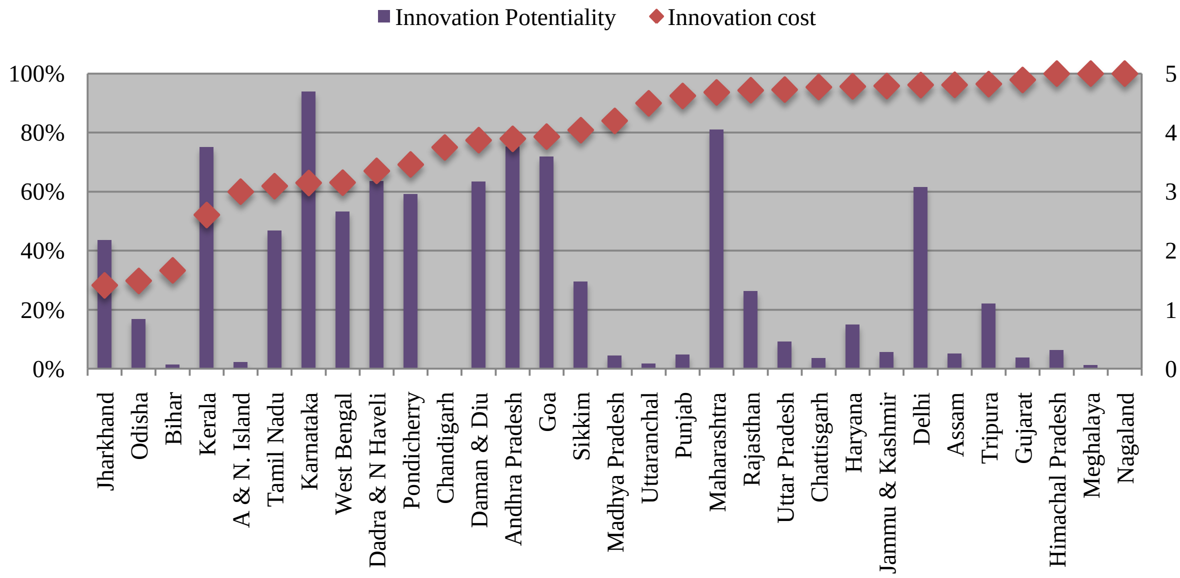
Note: Right hand axis measures innovation potentiality

Figure 8.28: Finance from outside sources as barrier to innovations



Note: Right hand axis measures innovation potentiality

Figure 8.29: Innovation cost as barrier to innovations



Note: Right hand axis measures innovation potentiality

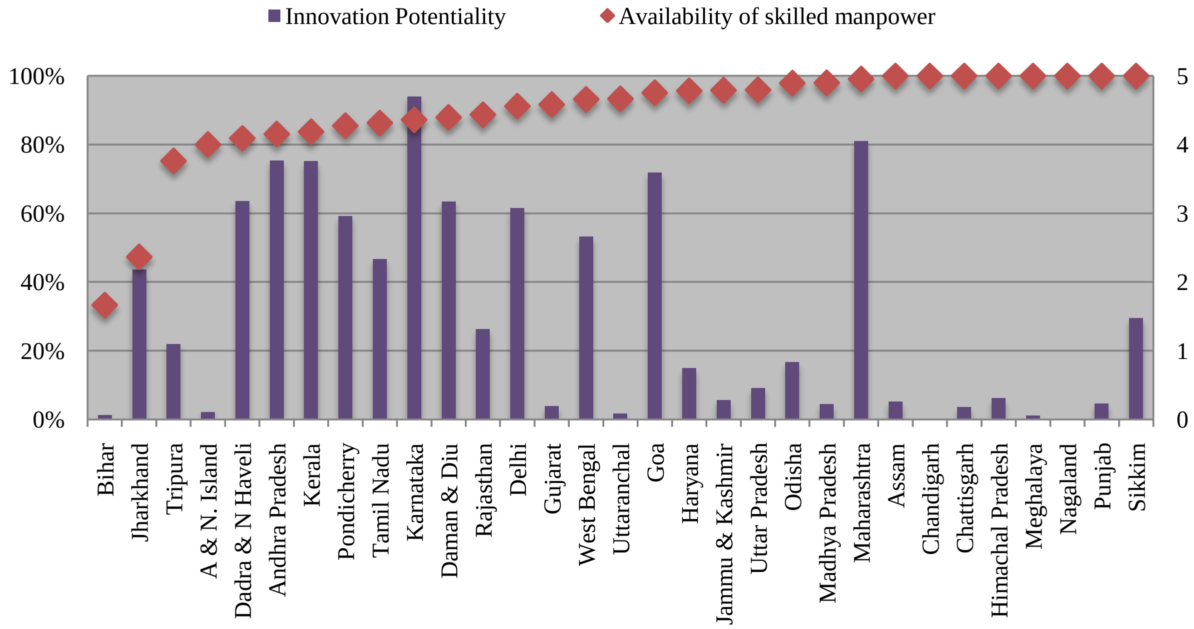
Table 8.1: Cost factor as barrier- correlation coefficient with innovation potentiality

Correlation	Availability of Finance within your enterprise	Availability of Finance from outside sources	Innovation cost
Innovation potentiality	-0.23	-0.56	-0.28

Knowledge factor as barriers to Innovation

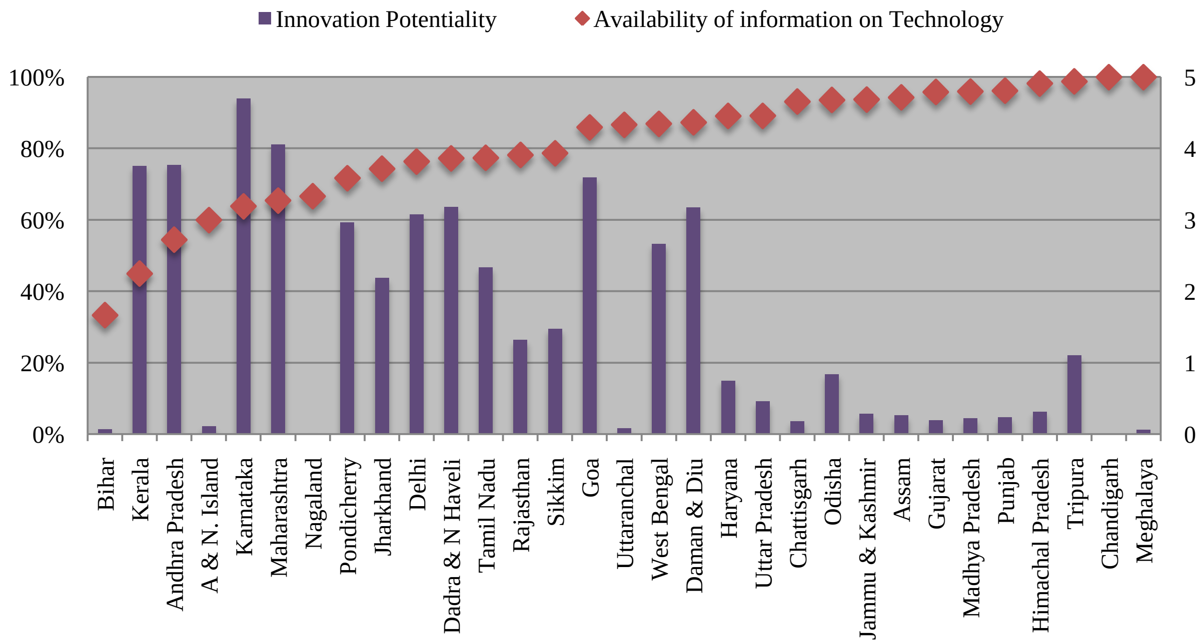
As can be seen from figures 8.30 to 8.32 knowledge factors as barriers to innovation as captured through availability of skilled manpower, information on technology and information on market respectively, do not have much variations with the state level innovation potentialities. In other words most of the respondents from all states consider these barriers as very important irrespective of the innovation potentialities of the states (as also reflected in the correlation coefficients in table 8.2)

Figure 8.30: Skilled manpower as barrier to innovations



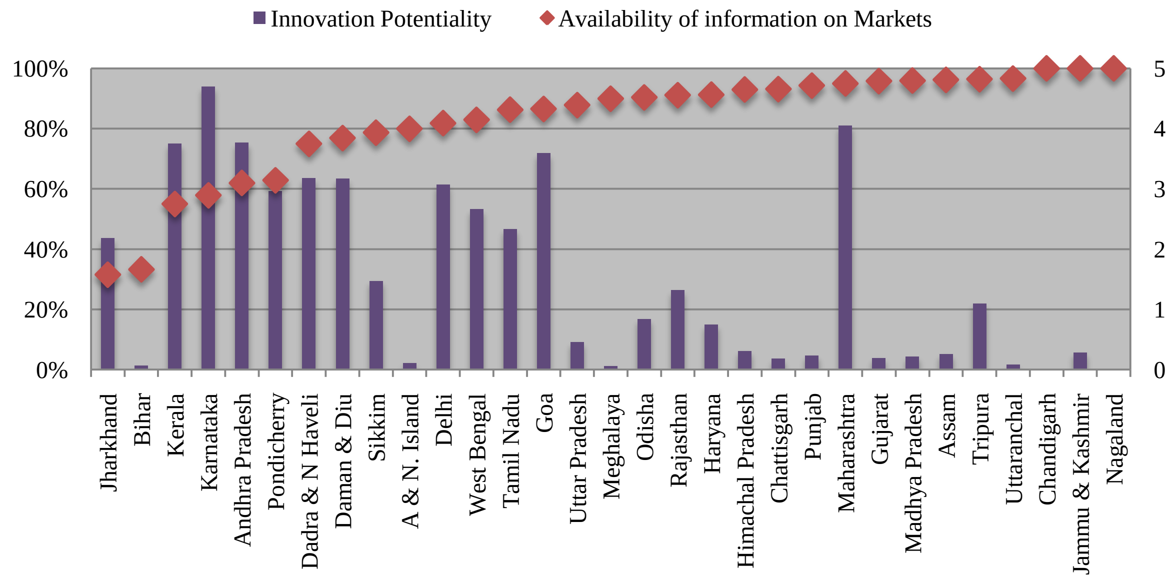
Note: Right hand axis measures innovation potentiality

Figure 8.31: Technology information as barrier to innovations



Note: Right hand axis measures innovation potentiality

Figure 8.32: Information on market as barrier to innovations



Note: Right hand axis measures innovation potentiality

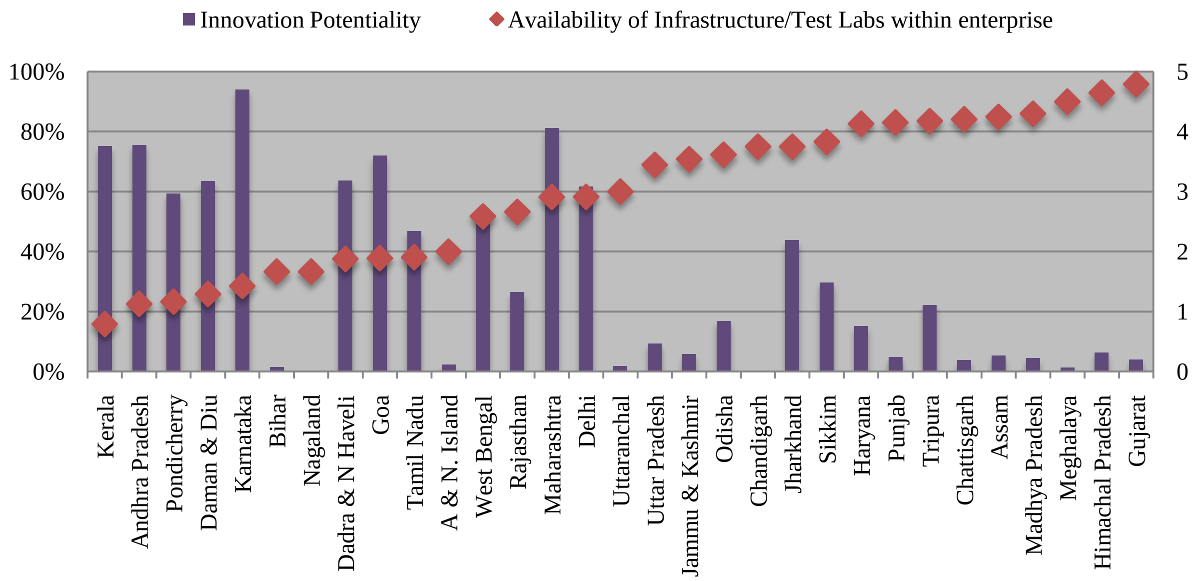
Table 8.2: Knowledge barrier - correlation with innovation potentiality

Correlation	Availability of skilled manpower	Availability of information on Technology	Availability of information on Markets
Innovation potentiality	0.09	0.21	0.01

Infrastructure as barrier to Innovation: State level scenario

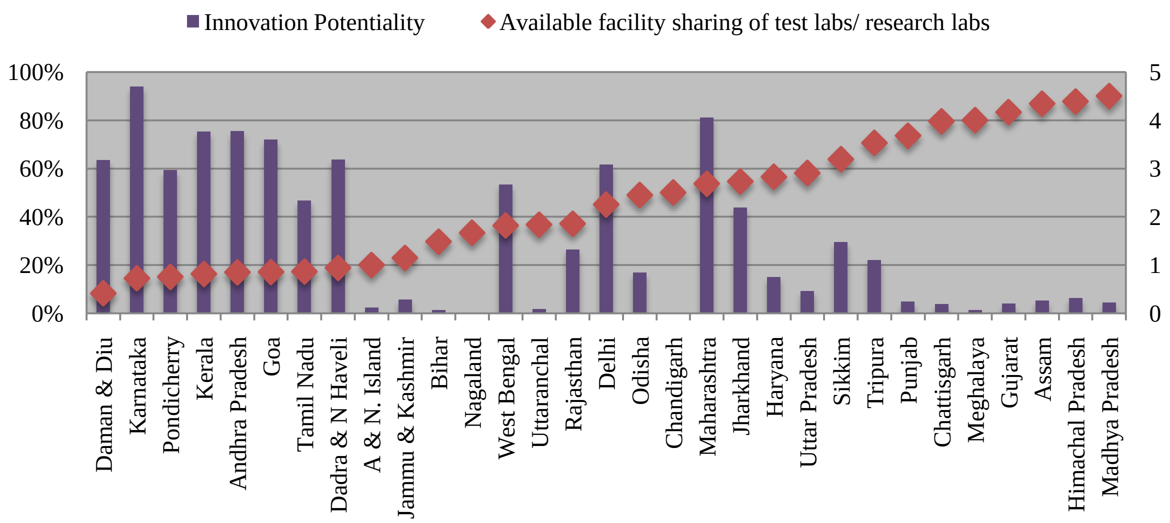
Lower the innovation potentiality of a state higher is the barrier in the form of availability of test laboratory facilities. This is shown in figures 8.33 and 8.34. Table 8.3 shows high negative correlations with innovation potentialities of the states.

Figure 8.33: Infrastructure as barrier to innovations (I)



Note: Right hand axis measures innovation potentiality

Figure 8.34: Infrastructure as barrier to innovations (II)



Note: Right hand axis measures innovation potentiality

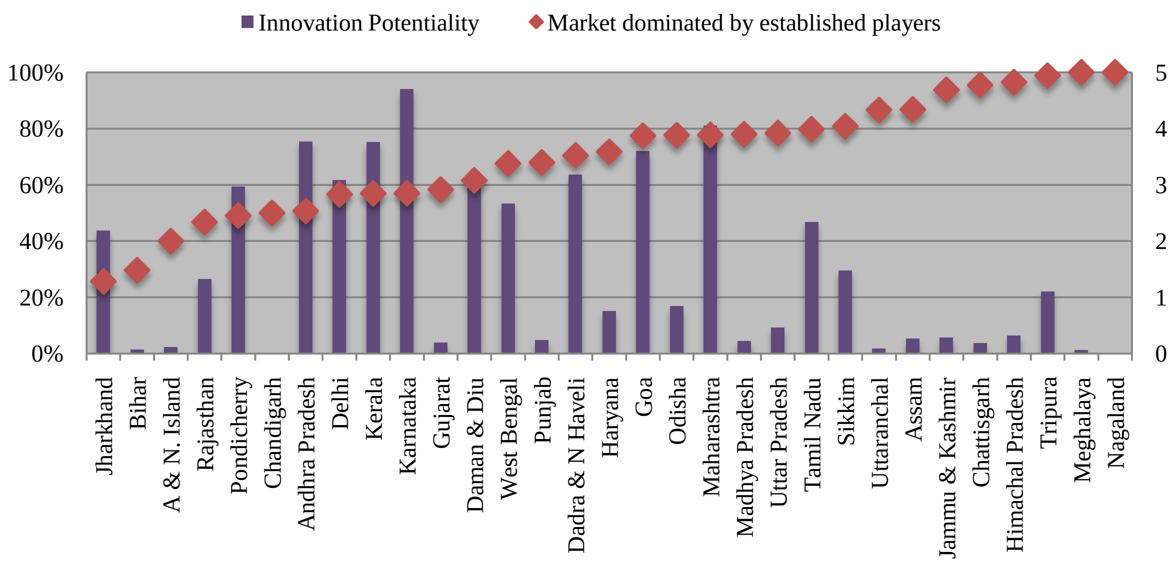
Table 8.3: Infrastructure barrier - correlation with innovation potentiality

Correlation	Availability of Infrastructure/Test Labs within enterprise	Available facility sharing of test labs/ research labs
Innovation potentiality	-0.65	-0.59

Market as barrier to Innovation

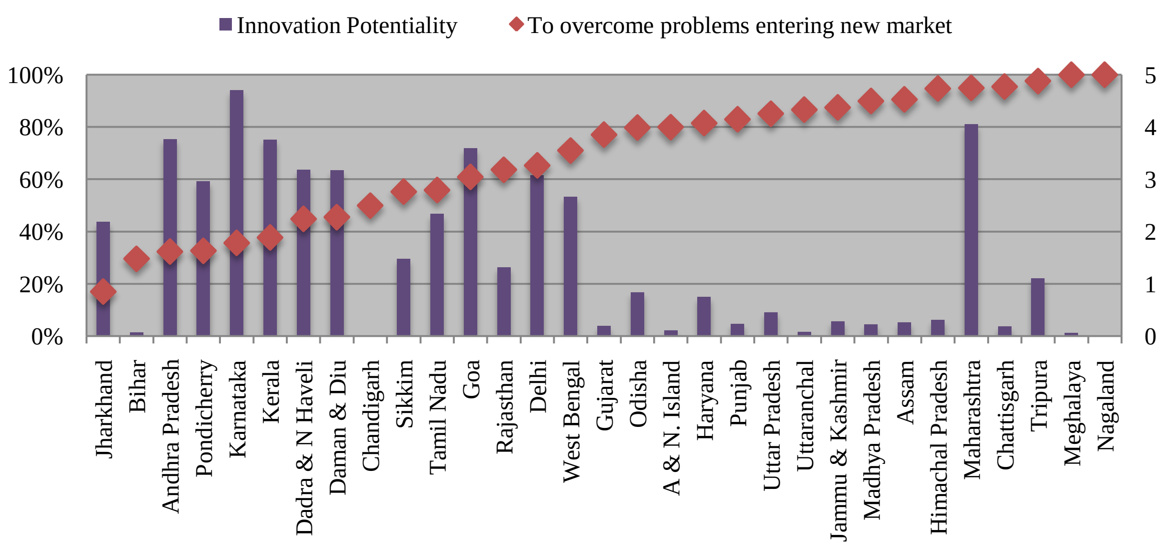
Figures 8.35 to 8.40 capture different market related barriers to innovations. As mentioned earlier six identified barriers are market domination, entry to new market, niche market, new opportunities, protection barrier, and govt. regulatory requirements. In all the cases correlations with innovation potentiality is inverse, highest coefficient being -0.61 for the protection barrier, followed by niche market and new market (table 8.4).

Figure 8.35: Market domination as barrier to innovations



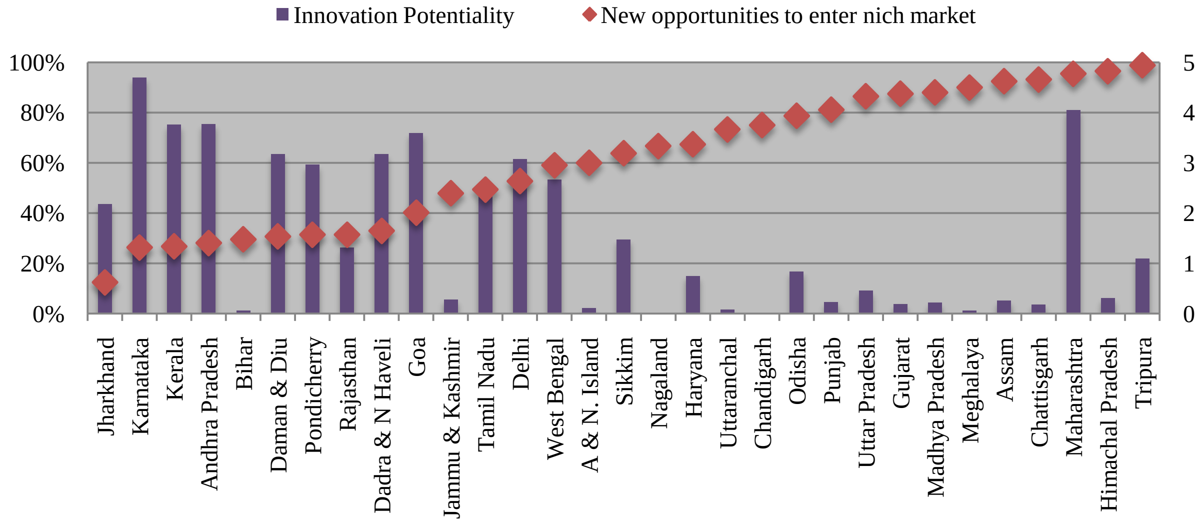
Note: Right hand axis measures innovation potentiality

Figure 8.36: New market as barrier to innovations



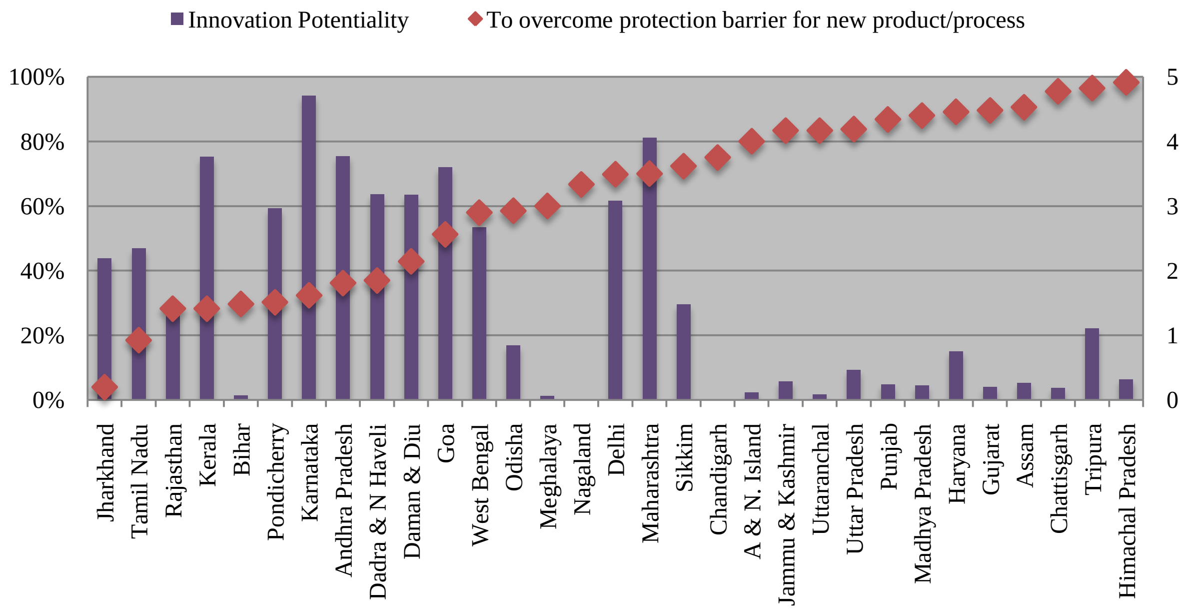
Note: Right hand axis measures innovation potentiality

Figure 8.37: Niche market as barrier to innovations



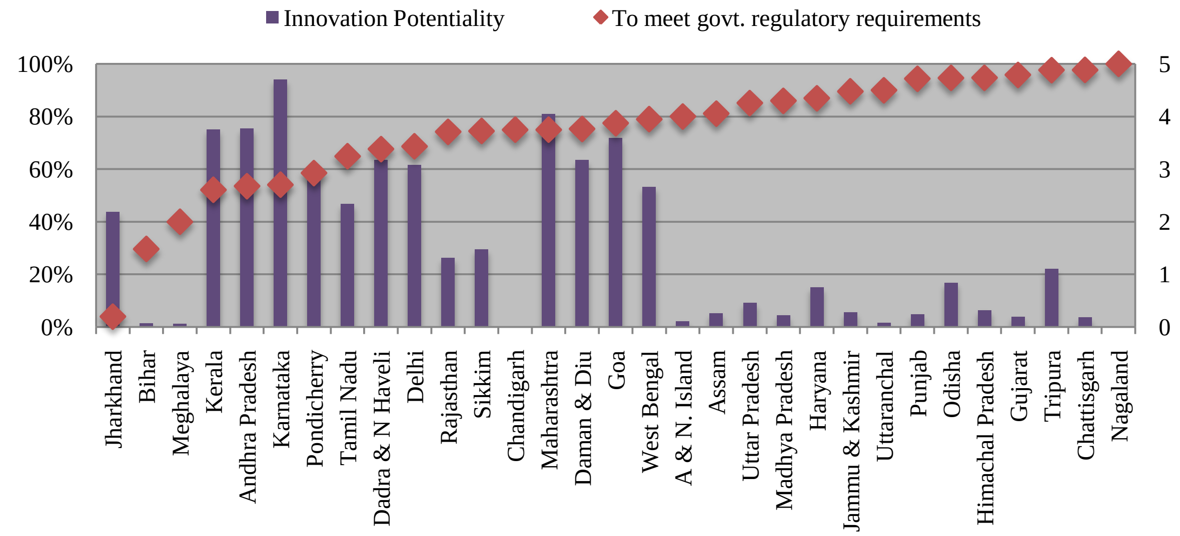
Note: Right hand axis measures innovation potentiality

Figure 8.38: Protection as barrier to innovations



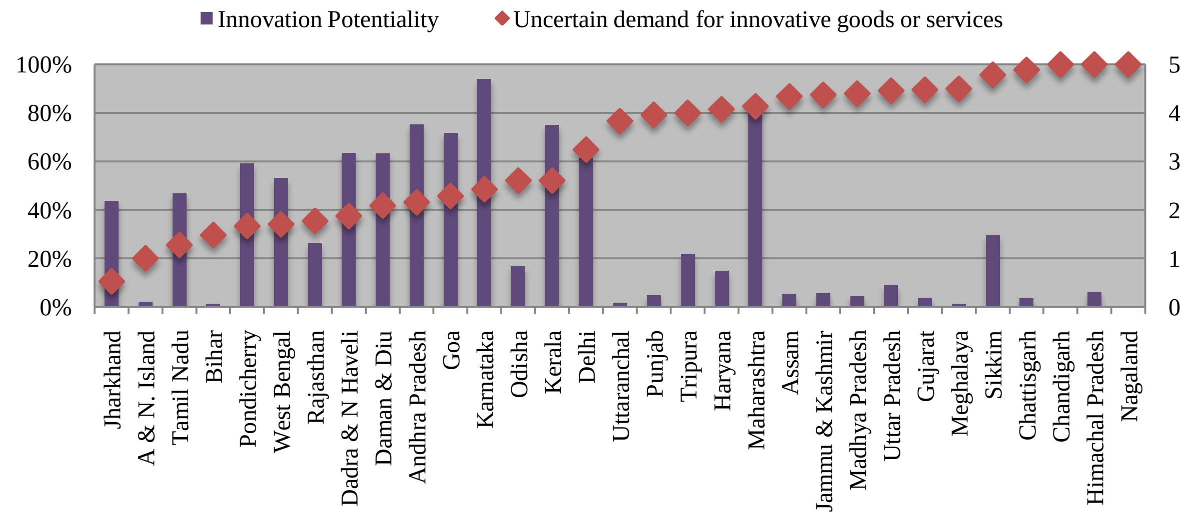
Note: Right hand axis measures innovation potentiality

Figure 8.39: Regulatory requirements as barrier to innovations



Note: Right hand axis measures innovation potentiality

Figure 8.40: Demand as barrier to innovations



Note: Right hand axis measures innovation potentiality

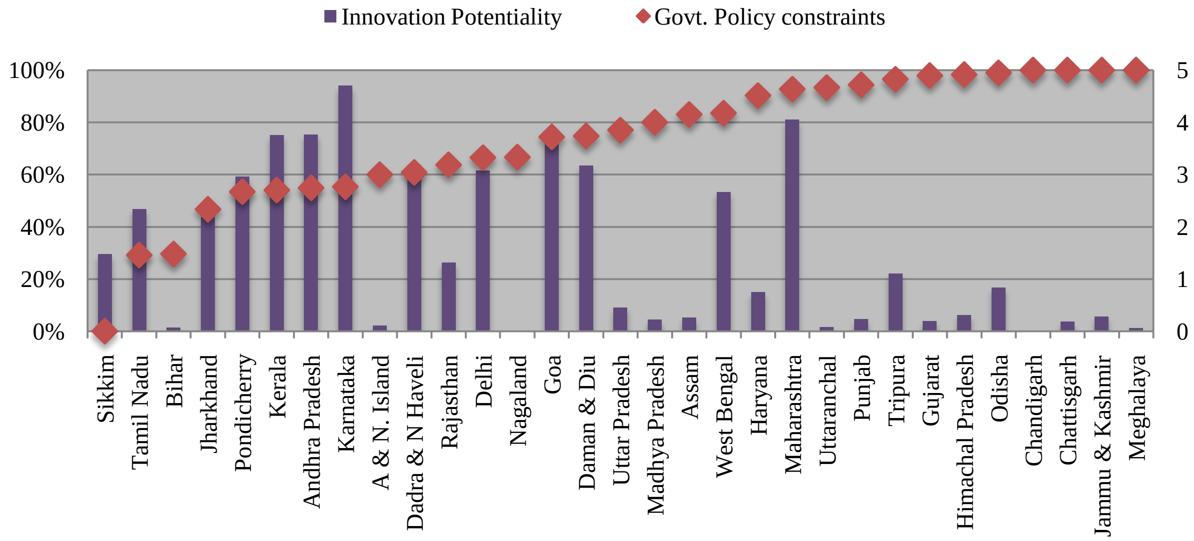
Table 8.4: Market barrier – correlation with innovation potentiality

Correlation	Market dominated by established players	To overcome problems entering new market	New opportunities to enter niche market	To overcome protection barrier for new product/process	To meet govt. regulatory requirements	Uncertain demand for innovative goods or services
Innovation potentiality	-0.30	-0.58	-0.59	-0.61	-0.40	-0.51

Other factors as barrier to Innovation

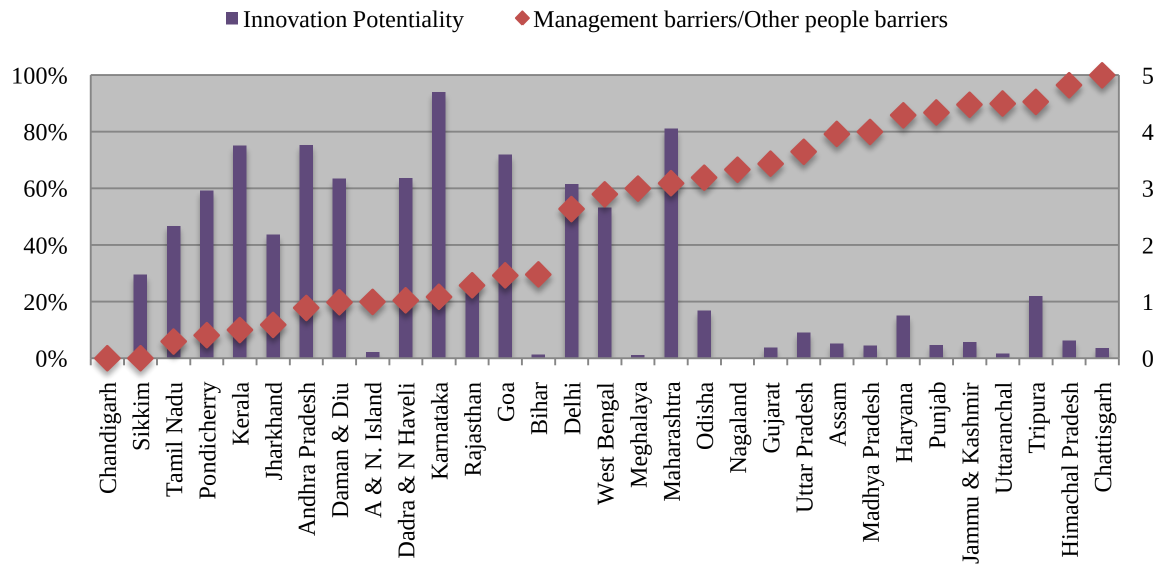
Among the other factors govt. policy constraint and internal management of the firms are taken in to account in figures 8.41 and 8.42 respectively. Internal management issues have very high negative correlations with innovation potentiality of the states (-0.51, refer table 8.5). This implies that low innovation potentialities can be understood as management level inefficiency of the innovative firms.

Figure 8.41: Govt. policy constraint as barrier to innovations



Note: Right hand axis measures innovation potentiality

Figure 8.42: Management as barrier to innovations



Note: Right hand axis measures innovation potentiality

Table 8.5: Other factor barrier – correlation with innovation potentiality

Correlation	Govt. Policy constraints	Management barriers/Other people barriers
Innovation potentiality	-0.37	-0.53

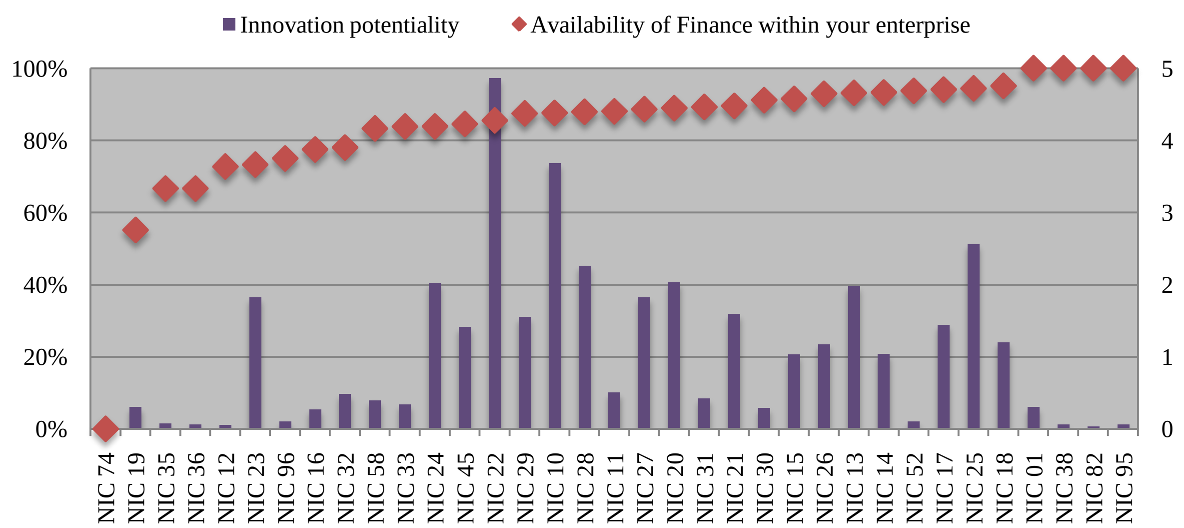
Barriers to Innovation: Sector level scenario

As mentioned earlier sectors are defined in line with NIC codes. NIC codes wise sectors are annexed at the end. Sector-wise responses were ranked for the convenience of reading the figures.

Cost factor as barrier

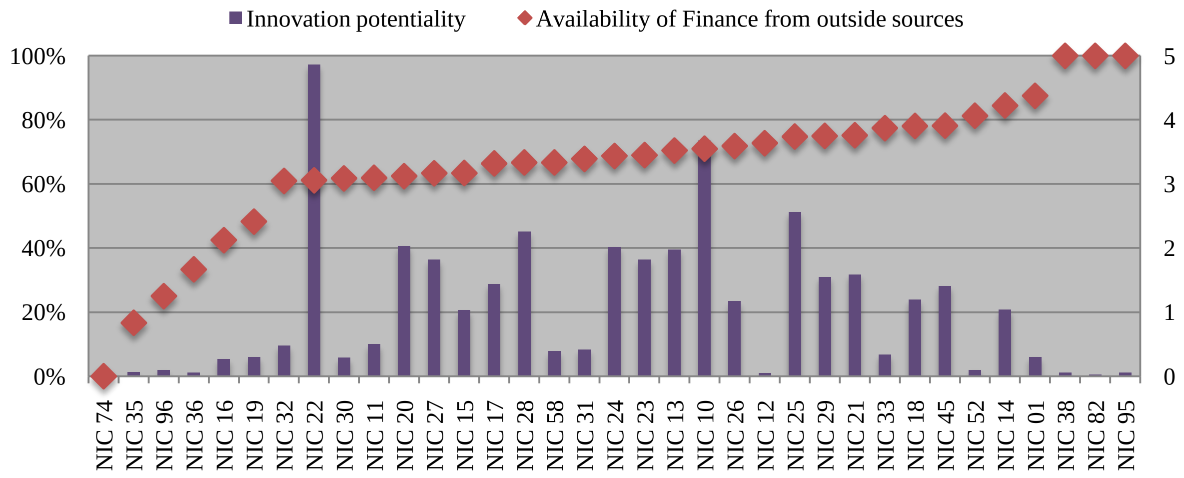
Figures 8.43 to 8.45 shows the relations of the cost factors with innovation potentialities of the sectors. Finance with in the enterprise is remains universal problem for all sectors irrespective of their positions in the innovation potentiality (figure 8.43). This is more or less true for other cost related barriers as well (figure 8.44 and 8.45). Correlations with innovation potentialities of the sectors, therefore, are positive with small magnitude (table 8.6).

Figure 8.43: Finance as barrier to innovations



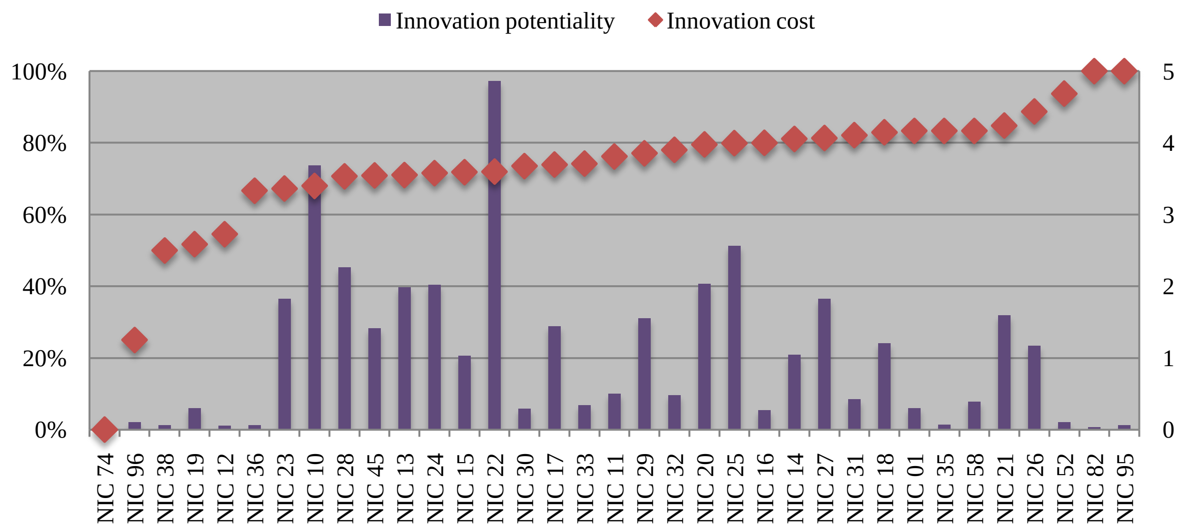
Note: Right hand axis measures innovation potentiality

Figure 8.44: Finance as barrier to innovations



Note: Right hand axis measures innovation potentiality

Figure 8.45: innovation cost as barrier to innovations



Note: Right hand axis measures innovation potentiality

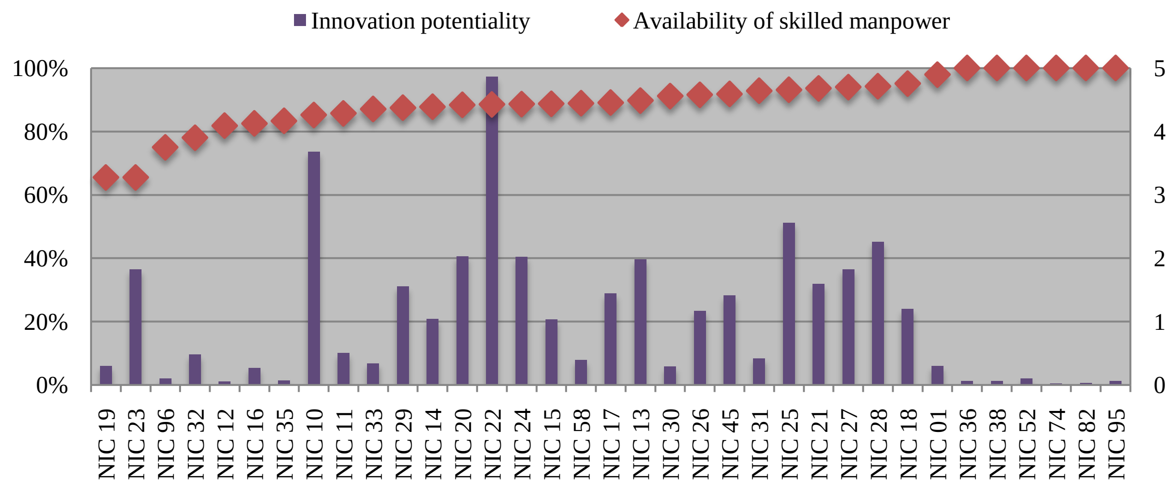
Table 8.6: Cost factor as barrier – correlation with innovation potentiality

Correlation	Availability of Finance within your enterprise	Availability of Finance from outside sources	Innovation cost
Innovation potentiality	0.21	0.13	0.10

Knowledge factor as barrier

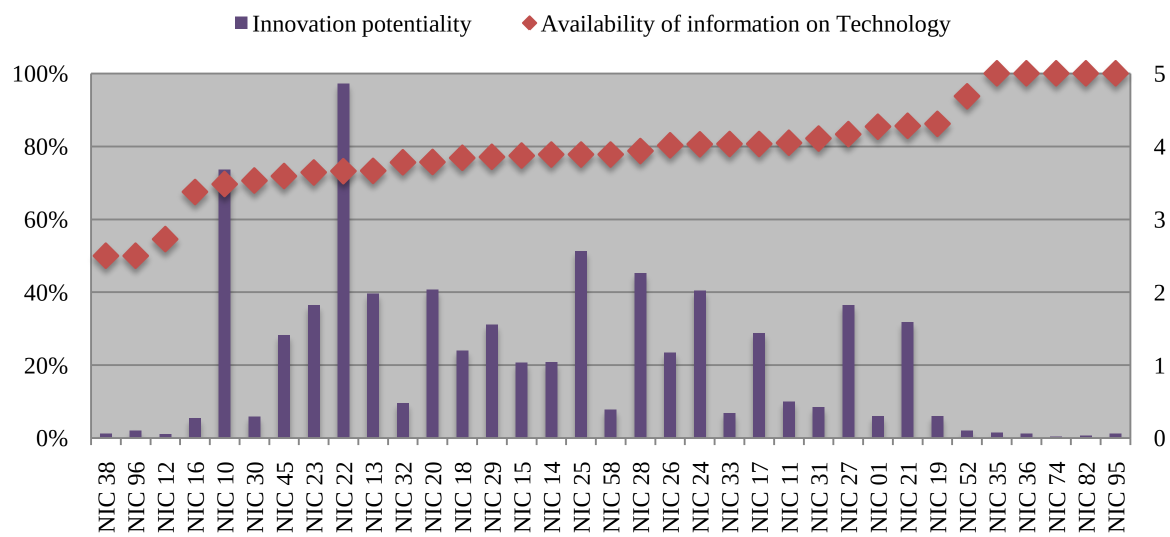
Three knowledge factors related barriers, namely, availability of skilled manpower, information on technology, and information on market also show that they remain major problems for all sectors irrespective of the innovation potentialities (figures 8.46 to 8.48). This is reflected in the very low magnitude of the correlation coefficients (table 8.7).

Figure 8.46: Skilled manpower as barrier to innovations



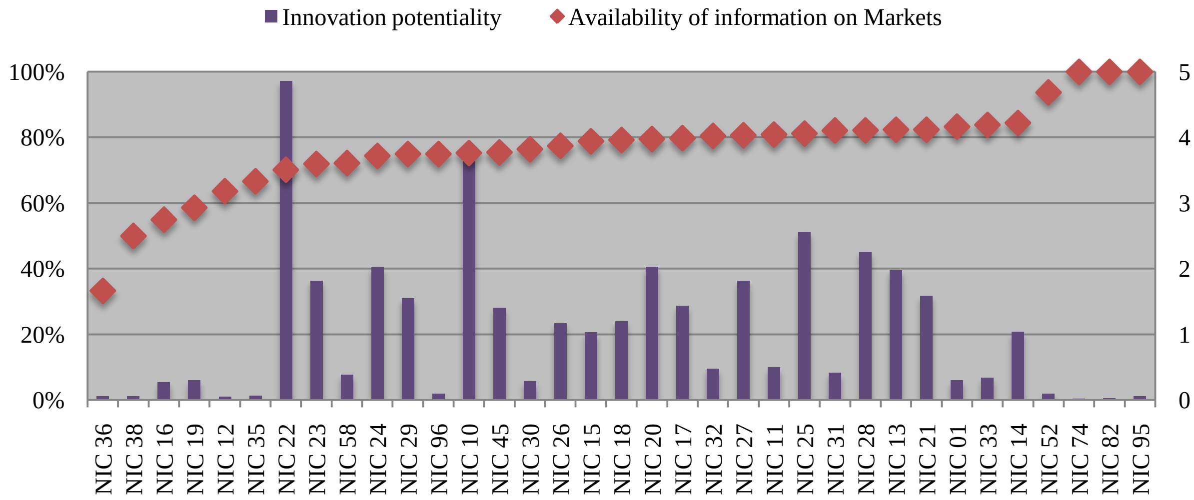
Note: Right hand axis measures innovation potentiality

Figure 8.47: Technology information as barrier to innovations



Note: Right hand axis measures innovation potentiality

Figure 8.48: Market information as barrier to innovations



Note: Right hand axis measures innovation potentiality

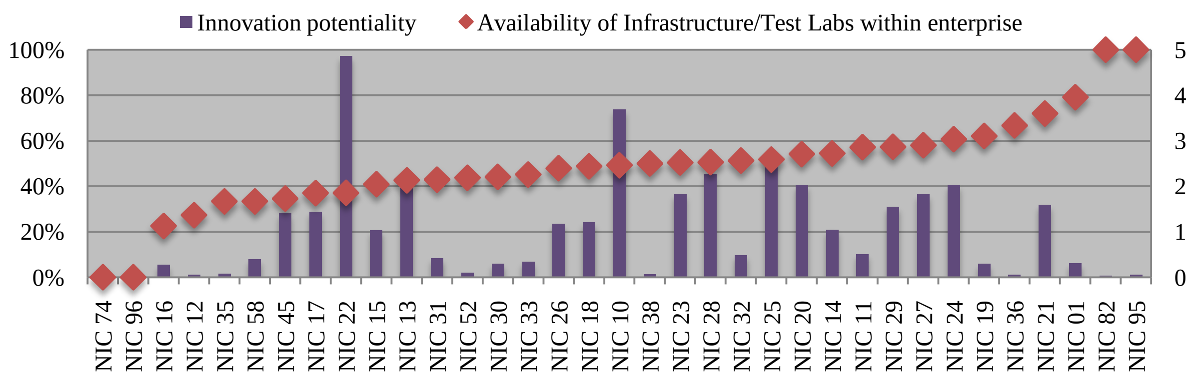
Table 8.7: Knowledge as barrier – correlation with innovation potentiality

Correlation	Availability of skilled manpower	Availability of information on Technology	Availability of information on Markets
Innovation potentiality	-0.08	-0.19	0.03

Infrastructure as barrier

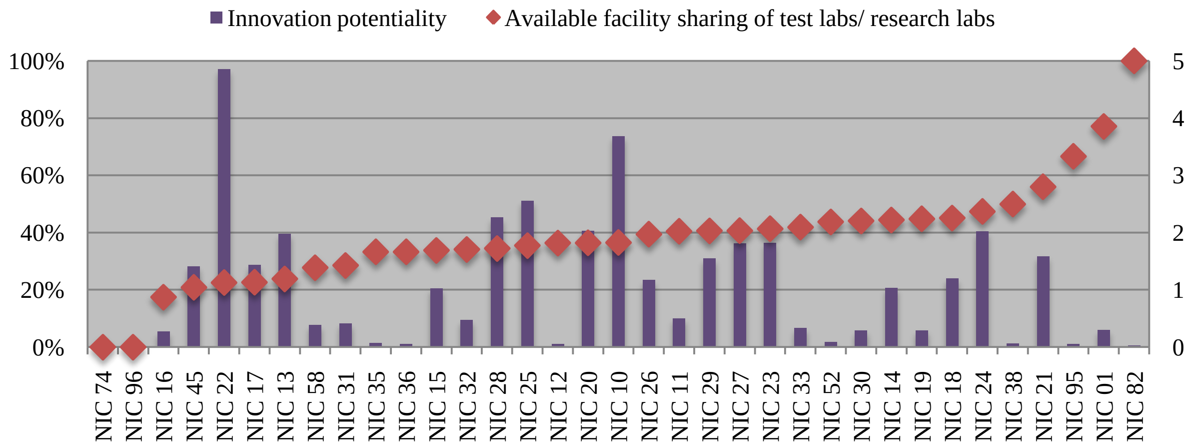
The two closely related issues on infrastructure focusing on laboratory facilities inside and outside the enterprise are shown in figures 8.49 and 8.50. The sectoral responses do not show any strong correlations with innovation potentialities. However, availability of external facility has negative correlations (albeit small) with innovation potentiality (table 8.8) and implies that the sectors not having such facilities have negative impact on innovations.

Figure 8.49: Infrastructure as barrier to innovations



Note: Right hand axis measures innovation potentiality

Figure 8.50: Infrastructure as barrier to innovations



Note: Right hand axis measures innovation potentiality

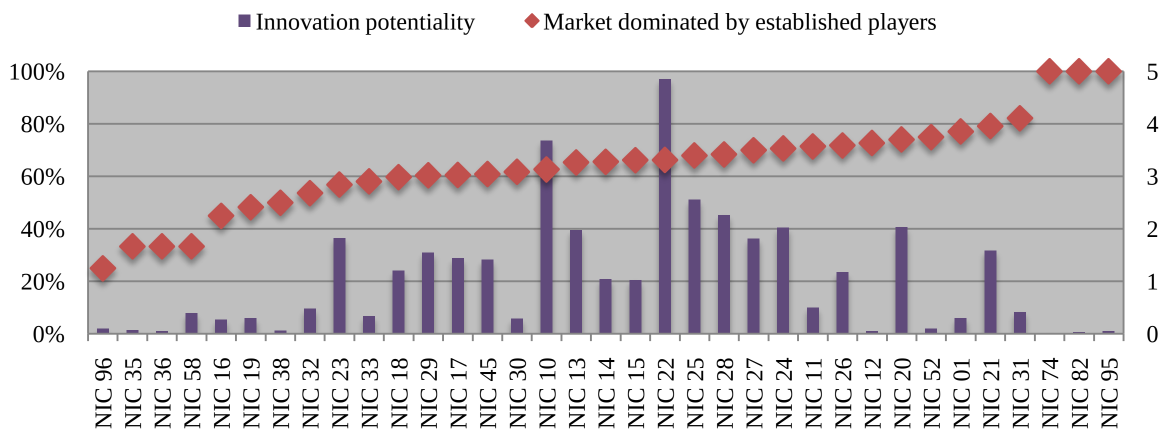
Table 8.8: Infrastructure as barrier- correlation with innovation potentiality

Correlation	Availability of Infrastructure/Test Labs within enterprise	Available facility sharing of test labs/ research labs
Innovation potentiality	0.01	-0.15

Market as barrier

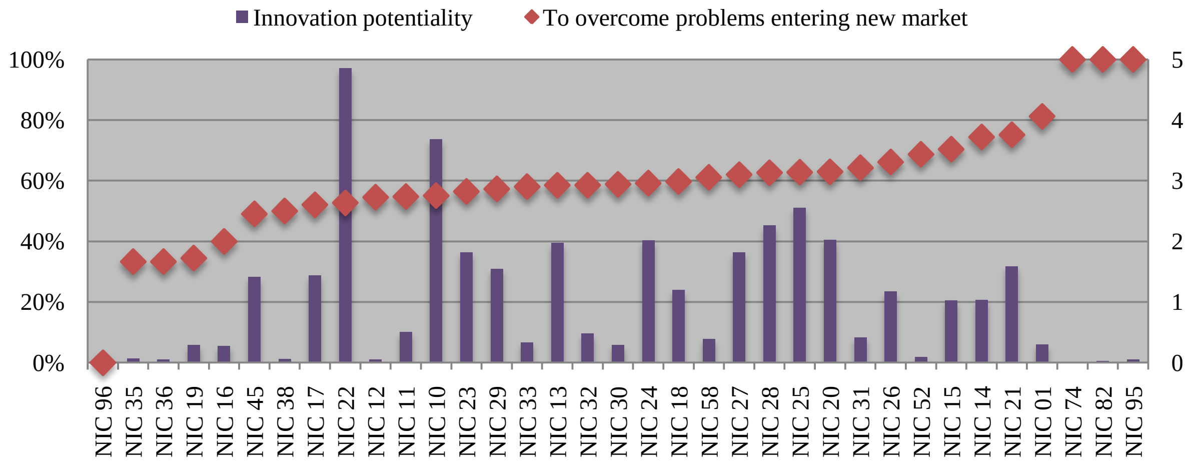
60% to 80% of innovative firms across the 28 sectors consider existing market domination as a barrier (figure 8.51). It is the same for entering the new market (figure 8.52). For new opportunities, and protection as barriers 40% to 60% firms consider it as important barrier (figures 8.53 and 8.54). Similar responses received for other factors like govt. regulation and uncertain demand in the market (figures 8.55 and 8.56). Table 8.9 shows not much correlation between these barriers and innovation potentialities of the sectors.

Figure 8.51: Market factor as barrier to innovations



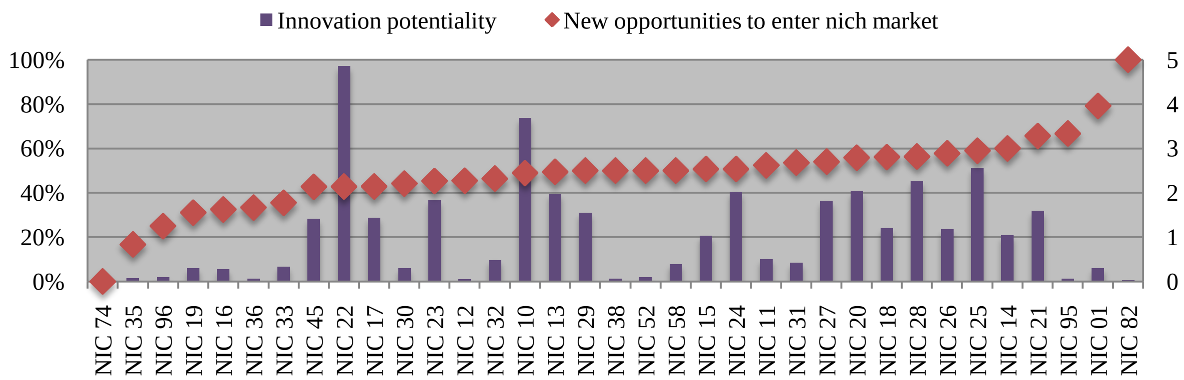
Note: Right hand axis measures innovation potentiality

Figure 8.52: New market as barrier to innovations



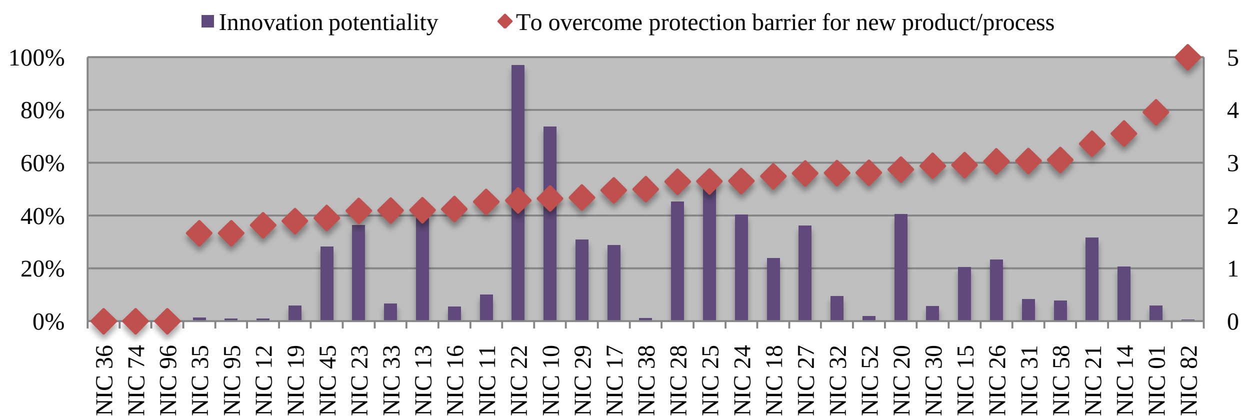
Note: Right hand axis measures innovation potentiality

Figure 8.53: opportunities as barrier to innovations



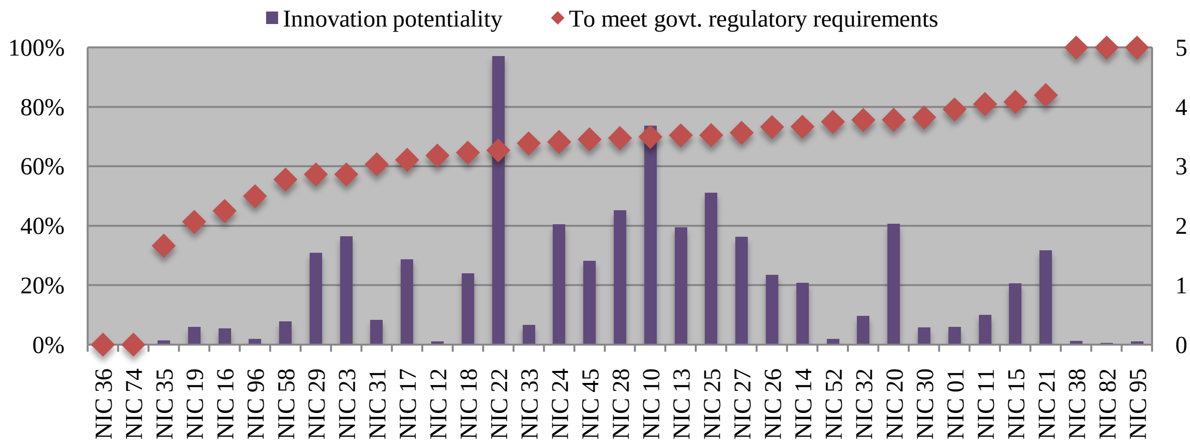
Note: Right hand axis measures innovation potentiality

Figure 8.54: Protection as barrier to innovations



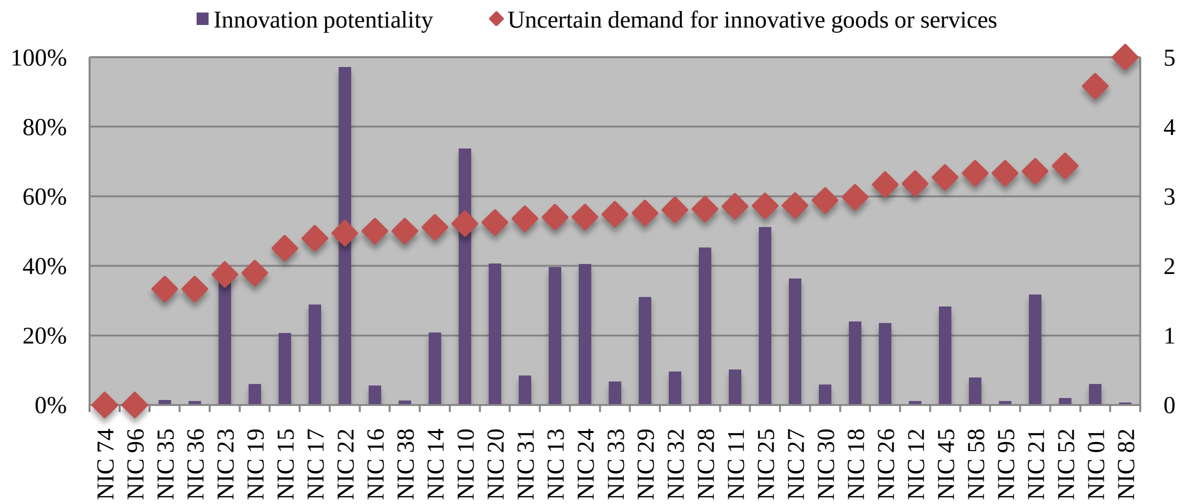
Note: Right hand axis measures innovation potentiality

Figure 8.55: Regulatory requirement as barrier to innovations



Note: Right hand axis measures innovation potentiality

Figure 8.56: Demand factor as barrier to innovations



Note: Right hand axis measures innovation potentiality

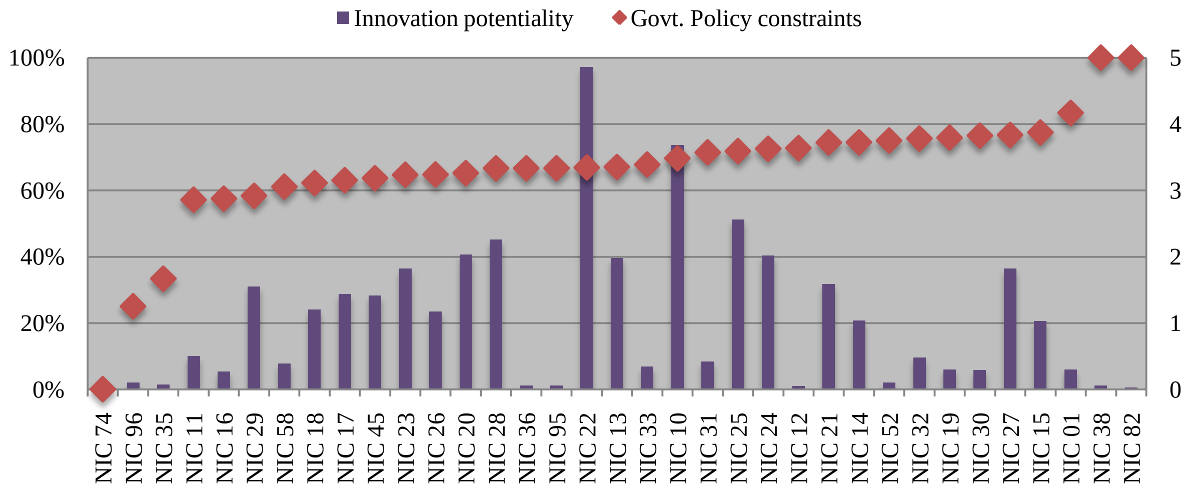
Table 8.9: Market barrier – correlation with innovation potentiality

Correlation	Market dominated by established players	To overcome problems entering new market	New opportunities to enter niche market	To overcome protection barrier for new product/process	To meet govt. regulatory requirements	Uncertain demand for innovative goods or services
Innovation potentiality	0.08	-0.02	0.13	0.14	0.15	0.04

Other factors barriers to Innovation

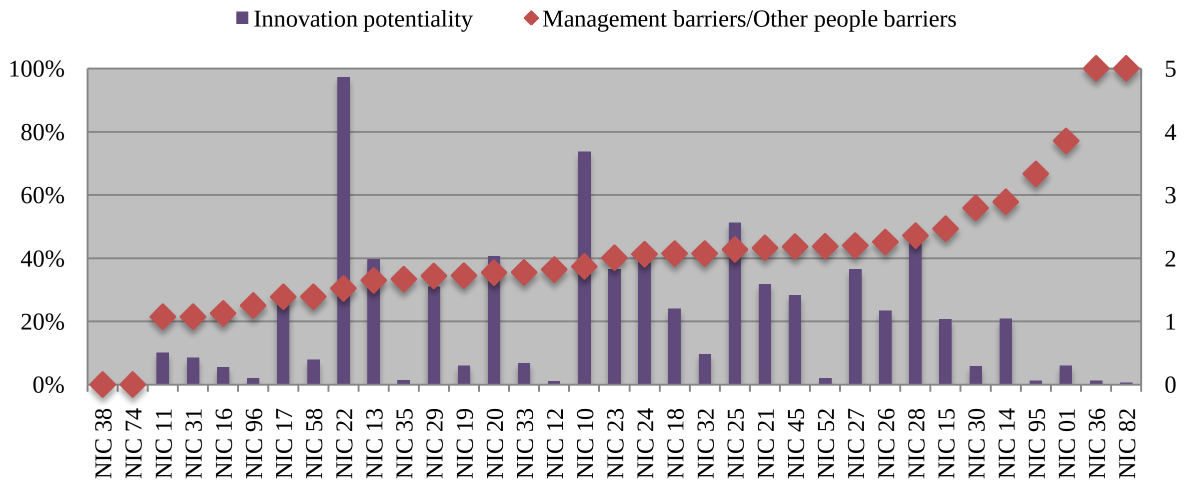
Between policy constraints and internal management problems, the former is seen as major barrier by the innovative firms in most of the sectors (figure 8.57). It is not so in the case of the latter (figure 8.58). Correlation coefficients with innovation potentiality are, however, weak as shown in table 8.10.

Figure 8.57: Govt. policy constraint as barrier to innovations



Note: Right hand axis measures innovation potentiality

Figure 8.58: Management as barrier to innovations



Note: Right hand axis measures innovation potentiality

Table 8.10: Infrastructure as barrier- correlation with innovation potentiality

Correlation	Govt. Policy constraints	Management barriers/Other people barriers
Innovation potentiality	0.09	-0.10

In Nutshell

Access to knowledge/information has been found most important barrier by about 40% of the innovative firms. This is followed by cost factor associated with innovation. When classified in terms of the age of the firms, old and new firms alike consider lack of own resources as most important barrier coupled with high cost of innovation. The same is for ownership pattern-wise.

As for knowledge factor availability of skilled manpower is the most important problem for 88% of the innovators. Problem with access to market information and availability of information technology follow closely. Infrastructure as barrier has been expressed much less percentage of innovative firms. Govt. regulatory requirements have scored highest as market barrier, followed by established players in the market.

Internal resources remain strong barrier for all types of innovations. Innovation cost for ‘product’, ‘process’ and ‘alternative material’ is a barrier as expressed by more than 70% of the innovators. Firms engaged in innovation on alternative material and efficient use of inputs are more prone to availability of lab facilities.

Negative correlations with states’ innovation potentiality imply that higher the innovation potentiality of a state lower is the perceptions of cost as barrier among the innovative firms. Higher the potentiality lesser is the problems with availability of finance, outside or inside. On the other hand knowledge factor as barrier has been the common perception among innovative firms in all the states.

Cost factor is important barrier for all sectors, so is the knowledge factor. Existing market domination has been perceived as an important barrier by innovative firms in most sectors.

IX

States and Innovation by firms

Highlights

- The Survey has covered 26 states and five Union Territories. For inter-state comparison of innovation scenarios we have defined two indicators, namely, Innovation Intensity and Innovation Potentiality. Innovation Intensity is defined as a ratio between number of innovative firms in a state and total number of firms in the respective state. Innovation Potentiality is defined as weighted Innovation Intensity, where weights are share of a state in total innovative firms.
- Total number of innovative firms out of a sample of 9001: 3184. Overall innovation intensity of India: 35.37%. In all states the smallest size category (Below 100) has maximum share of the innovative firms in the state (above 96 % in Maharashtra, whereas 64% is the lowest recorded for Tripura).
- The age groups' share in the total innovative firms in a state show that Bihar, Himachal Pradesh, Uttaranchal, along with other smaller states like Tripura, Sikkim etc. having 'after 2000' firms in the higher share of innovative firms.
- While private enterprises dominate the scene in most of the states, in Punjab it is partnership firms that have as high as 41% share of innovative firms. On the other hand states like Bihar, Tripura and Nagaland have high shares of proprietary firms are highly significant.
- States with much lower innovation potentiality have higher shares of product and process innovation. At all India level most ubiquitous is innovation in the form of introduction of new machines. Correlations with innovation potentiality return coefficients that are small in magnitude and negative for all types. The states that are low in 'new product' type of innovations are comparatively higher in 'new machine' types, and not the other way round. Highest positive correlation is between 'new process technology' and 'saving/more efficient use of inputs'. Again, innovations in 'alternative material' show high correlations with 'new product' and 'new process' innovations.
- Across the states most of the innovations are new to firms. Higher percentage of firms reporting 'new to India' innovation in Himachal Pradesh is due to the presence of Drugs & Pharma and Electrical goods industry.

- It is apparent that acquisition of technology is the most popular way to innovation. Training of the manpower in new technology and in-house R&D has moderate presence in popularity among the innovative firms. It is to be noted that firms in Gujarat tops in all the three indicators
- The external interactions for innovation appear to be low key for the Indian firms. About 80% claim that their innovations are internally sourced (table 9.4). Correlation with innovation potentiality has coefficient 0.44 suggesting that states having higher innovation potentiality do depend more on internal strength of sourcing technological innovation.
- Fund arranged using own sources is the preferred route for the innovative firms. Borrowing fund for sourcing technology is not popular among the innovative firms, at the same time, accessing government fund is rare. Correlations between innovation potentiality of the states and source of fund shows that lower the innovation potentiality more is the dependence on own source of fund. On the other hand states with higher innovation potentiality has higher incidence of sourcing from various sources, namely, borrowing from financial institutions and accessing government schemes.
- Except Gujarat and Sikkim all the states have innovative firms not engaged in R&D activities, intra or extra mural. States like Karnataka, Andhra Pradesh and Tamil Nadu that are high in innovation potentiality have higher percentage of firms not engaged in R&D activities.
- Correlation coefficient between organisational and marketing innovation is as high as 0.75. So, both forms of non-technological innovations go hand in hand, except that marketing innovations have comparatively higher presence in Gujarat, Assam and Tripura. But as the correlation with innovation potentiality shows, organisational innovation has negative relation (small magnitude) whereas positive correlations (of small magnitude) with marketing innovation.
- Most of the innovative firms prefer training in-house. This also does not show much variation over the states as shown in figure. Training in institutions abroad or training with collaborators are rare initiatives. This is also true for accessing sources of funding for training. Rarely innovative firms in states have accessed government or foreign sources for training their employees.
- There is high positive correlation with hardware procurement by states and innovation potentiality. This is true also for software procurement. The purpose of ICT use as shown in figure 9.35 is mostly for ERP and also for R&D and technology management.

States and Innovation by firms

The Survey has covered 26 states and five Union Territories. Table 9.1 shows the details of state-wise population and share in sample. For the present chapter we have defined two indicators, namely innovation intensity and innovation potentiality of the states. The latter indicator has been used for comparative pictures of the states. The chapter is arranged to begin with the observations on innovations and innovators followed by innovation related activities, strategies, human resources and use of information technology.

Innovation Intensity and Innovation Potentiality

For inter-state comparison of innovation scenarios we have defined two indicators, namely, Innovation Intensity and Innovation Potentiality. Innovation Intensity is defined as a ratio between number of innovative firms in a state and total number of firms in the respective state. Innovation Potentiality is defined as weighted Innovation Intensity, where weights are share of a state in total innovative firms.

Overall innovation intensity for India as a ratio between number of innovative firms and total sample is 35.37%. What would be the state and sector level innovation intensity? Table 9.1 shows that Sikkim has 0.05% share in the population (production units as per the ASI 2009-10) and 0.52% (47 in numbers) share in the sample. Compared to Sikkim Andhra Pradesh has 12.12% share in the population and 4.16% (378 in number) share in the total sample. This creates small population and small sample bias, and it is reflected in the fact that Sikkim has 47 innovative firms recording 100% innovation intensity, where as Andhra Pradesh has 56.35% innovation intensity with 213 innovative firms. Again Sikkim has only 1.48% share of the total innovative firms whereas Andhra Pradesh has 6.69% share of the same.

The bias has been normalised by deriving Innovation Potentiality of the states. Comparative positions of different states in terms of innovation intensity and innovation potentiality are shown in the figure 9.1. Figure 9.2 shows comparative positions for states in terms of average innovation potentiality. And ranks of the states in terms of innovation potentiality are shown in figure 9.3

Innovation Intensity is defined as a ratio between number of innovative firms in a state/sector and total number of firms in the respective state/sector.

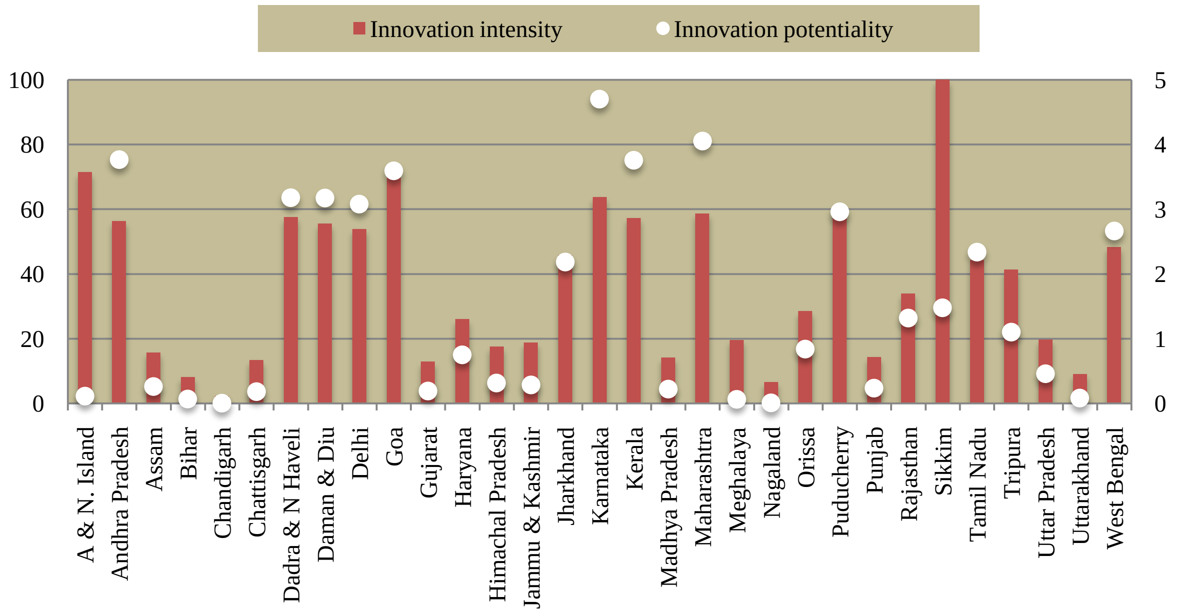
Innovation Potentiality as weghited Innovation Intensity, where weights are share of a state/sector in total innovative firms.

Total number of innovative firms out of a sample of 9001: 3184
Overall innovation intensity of India: 35.37%
Overall innovation intensity of the sectors: 43.54%

Table 9.1: State-wise share in the population, sample base and innovative firms

States	Share in Population (in %)	Share in Sample (in %)	Innovation Intensity (in %)	Innovation potentiality
A & N. Island	0.01	0.08	71.43	0.11
Andhra Pradesh	12.12	4.16	56.35	3.77
Assam	1.24	3.71	15.73	0.26
Bihar	1.13	3.63	8.18	0.07
Chandigarh	0.15	1.91	2.30	0.00
Chhattisgarh	1.14	3.64	13.29	0.18
Dadra & N Haveli	0.72	3.37	57.52	3.18
Daman & Diu	0.95	3.61	55.49	3.17
Delhi	1.94	3.72	53.85	3.08
Goa	0.29	2.59	69.79	3.59
Gujarat	10.04	4.10	12.87	0.19
Haryana	2.84	3.90	25.99	0.75
Himachal Pradesh	1.03	3.58	17.54	0.31
J & K	0.37	2.81	18.82	0.28
Jharkhand	1.16	3.65	45.78	2.19
Karnataka	5.21	4.06	63.69	4.70
Kerala	3.30	4.02	57.26	3.76
Madhya Pradesh	1.99	3.87	14.20	0.22
Maharashtra	13.16	4.13	58.67	4.05
Meghalaya	0.05	0.56	19.61	0.06
Nagaland	0.05	0.51	6.52	0.01
Odisha	1.18	3.63	28.48	0.84
Pondicherry	0.42	2.95	59.33	2.96
Punjab	6.20	4.09	14.25	0.24
Rajasthan	3.81	4.03	33.88	1.32
Sikkim	0.05	0.52	100.00	1.48
Tamil Nadu	17.40	4.17	44.33	2.34
Tripura	0.21	2.27	41.26	1.10
Uttar Pradesh	6.69	4.13	19.73	0.46
Uttaranchal	1.23	3.65	9.04	0.09
West Bengal	3.86	4.02	48.22	2.67

Figure 9.1: Innovation Intensity (in %) and Innovation Potentiality of different states



Note: Right hand axis measures innovation potentiality

Figure 9.2: Innovation Potentiality of different states

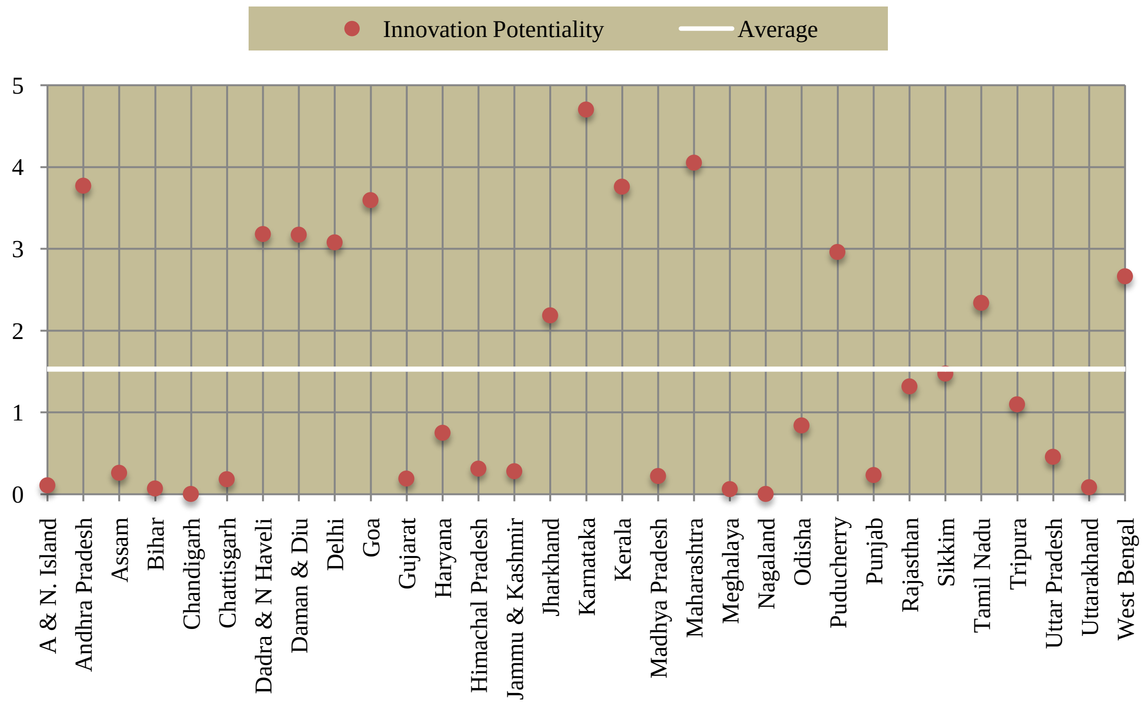
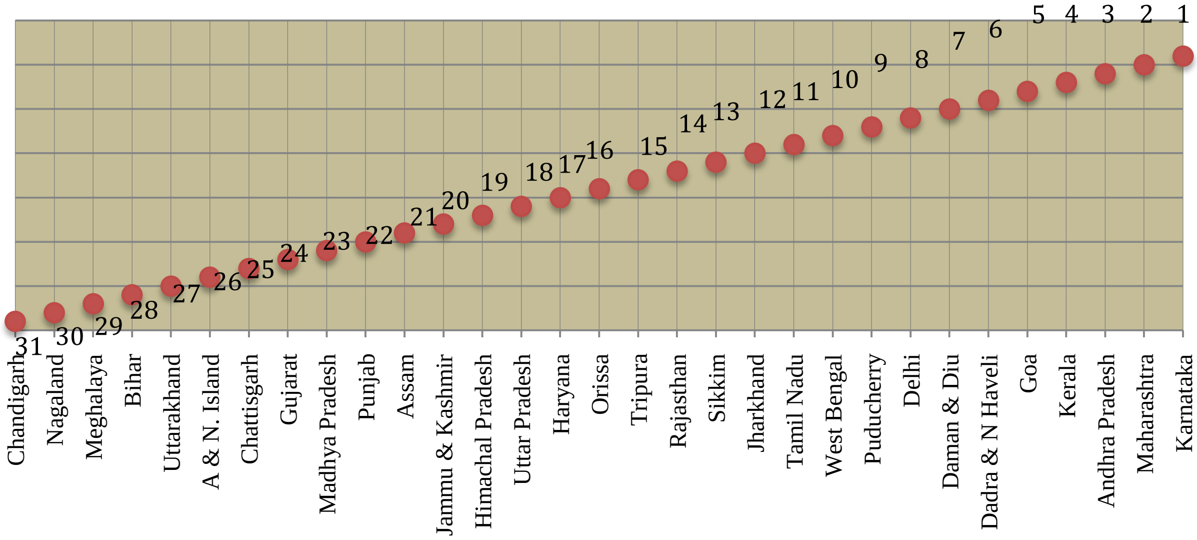


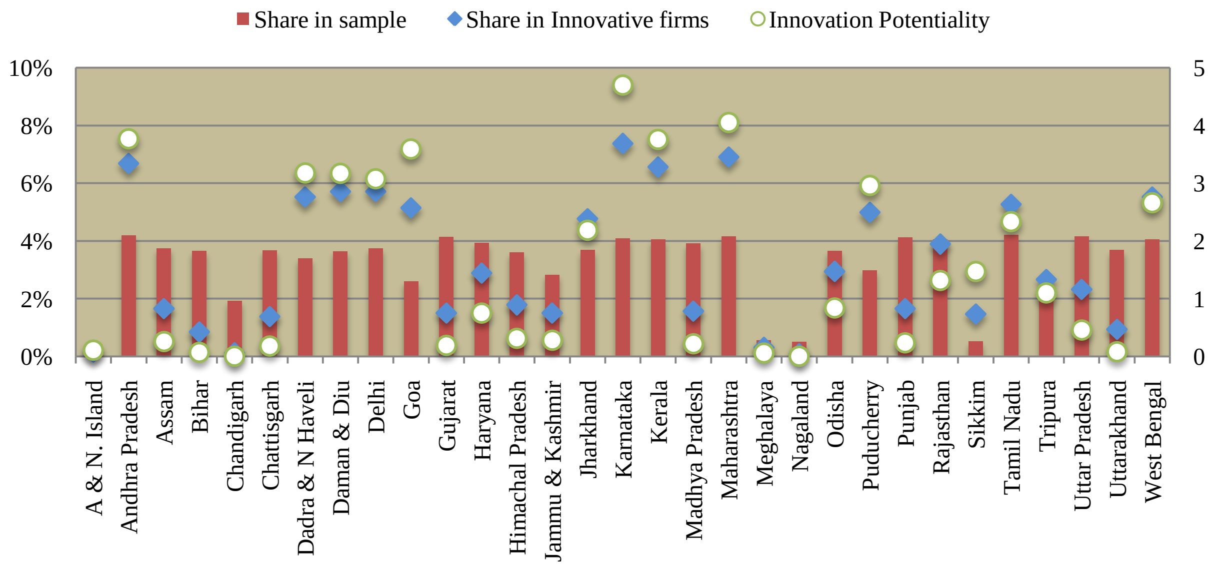
Figure 9.3: Ranking of the states in terms of Innovation Potentiality



Firms and Innovation: State level scenario

Except very small states (both in terms of size and number of industrial units) like Sikkim, Meghalaya, Nagaland etc (Figure 9.4). Most of the states have 3% - 4% share of the total sample (9001). Total innovative firms identified by the Survey stood at 3184. Share of different states in the total innovative firms vary from high 7.5% (Karnataka) to negligible share of Andaman and Nicober. Innovation potentiality of the states and corresponding shares in total innovative firms has strong positive correlation (0.96). The correlation coefficient between states' share in sample and innovative firms is 0.53.

Figure 9.4: States' share in sample and innovative firms with respect to innovation potentiality



Note: Right hand axis measures innovation potentiality

Size of the Innovative firms in States

In a state, which is the firm size that dominates the innovation scenario? Figure 9.5 presents overall scenario in terms of share of different size groups in the innovative firms in a state. It is clear that in all states the smallest size category (Below 100) has maximum share of the innovative firms in the state (above 96 % in Maharashtra, whereas 64% is the lowest recorded for Tripura). Figure 9.6 shows the median values of the distribution of innovative firms over different size groups for all states. So, for the size category 'below 100' the median value is 2.23, and states like Maharashtra, Karnataka, Andhra Pradesh, Delhi are much higher than the median value. Again Andhra Pradesh, Goa, Karnataka have higher than the median value in '100 – 499' size group, where as Andhra, Odisha and West Bengal show higher than median value in the '1000 and above' category.

Figure 9.5: Size of the innovative firms in different states (in %)

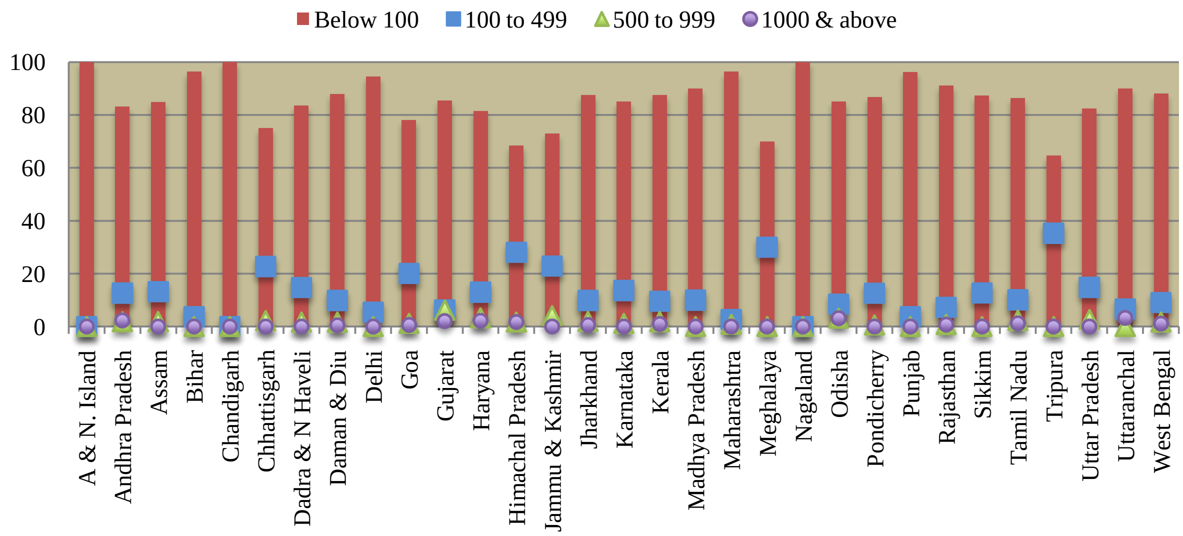
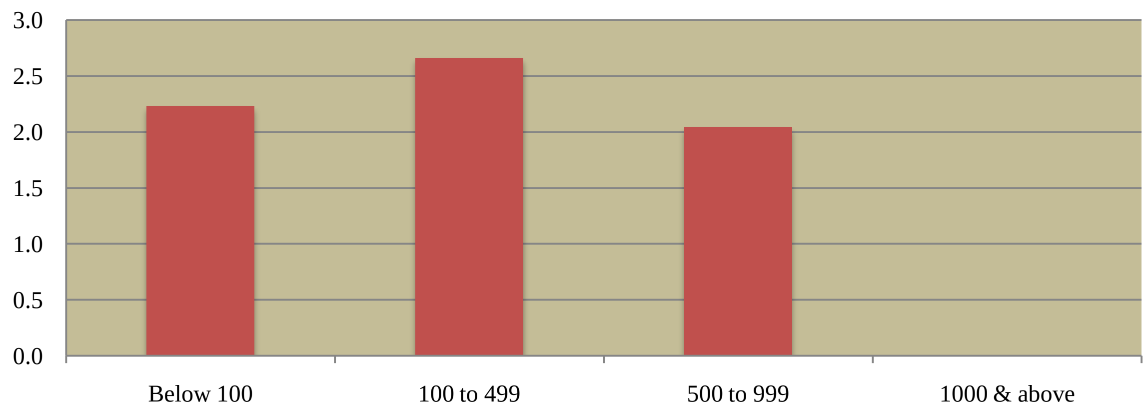


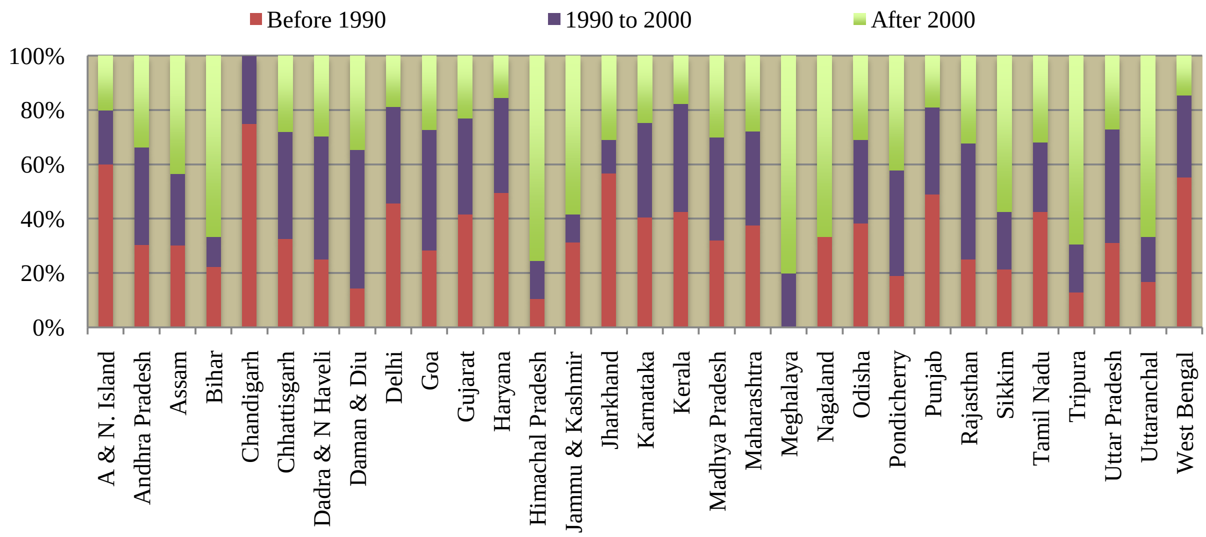
Figure 9.6: All states together the median value of shares for different size groups



Age of the Innovative firms in States

Figure 9.7 shows that Jharkhand, Karnataka and Kerala have lesser share of innovative firms in the 'after 2000' age group. On the other hand Andhra, Maharashtra and Tamil Nadu have more or less similar shares of each age group. The age groups' share in the total innovative firms in a state show that Bihar, Himachal Pradesh, Uttaranchal, along with other smaller states like Tripura, Sikkim etc. having 'after 2000' firms in the higher share of innovative firms. Andhra, Maharashtra and Tamil Nadu have equal shares of all groups (Figure 9.7).

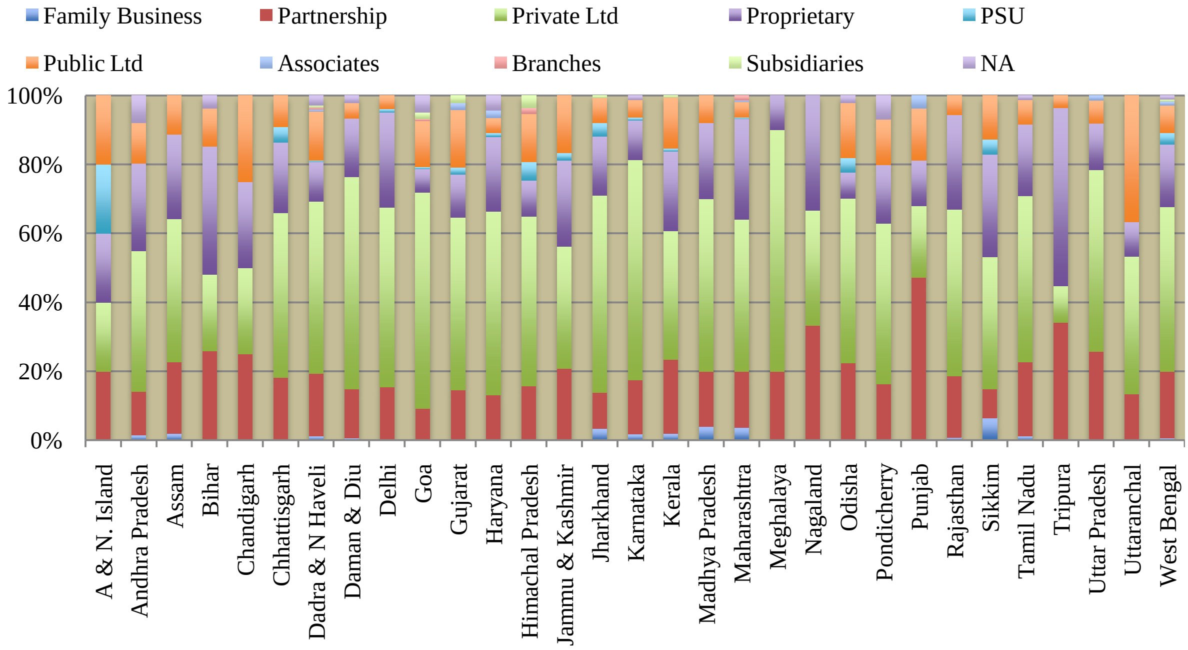
Figure 9.7: Share of the age groups in the total innovative firm in the state



Ownership pattern of the Innovative firms in States

Figure 9.8 shows different ownership group composition in the innovation scenarios of different states. While private enterprises dominate the scene in most of the states, in Punjab it is partnership firms that have as high as 41% share of innovative firms. On the other hand states like Bihar, Tripura and Nagaland have high shares of proprietary firms are highly significant.

Figure 9.8: Share of the group in total innovative firm in a state



Types of innovations in States

Innovation potentiality of firms has been captured by changes initiated by a firm in its production related activities. Broad groups of such activities are – product or/and process innovation, product quality and standard, saving/efficient use of inputs, use of alternative material, introduction of new machines. Total 3184 firms have reported changes in the above-mentioned categories. Table 9.2 shows firms initiating changes in different activity groups. About 68% firms inducted new machines followed by 42% firms focusing on product quality and standard. Product and process innovation are initiated by 33% and 35 % firms respectively. Many firms have more than one type of innovation because of complementary nature among the innovations, particularly between 'new machine' and other types and also between 'product' and 'process' innovation with other type of innovations.

Table 9.2: Types of innovation undertaken by firms

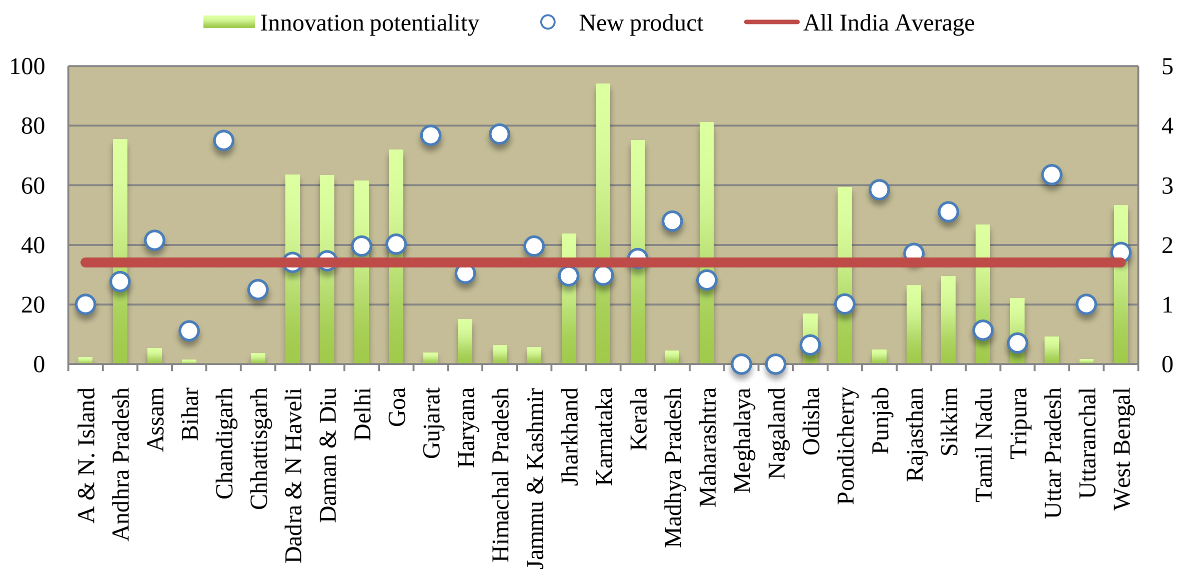
Type of Innovation	No. of firms	% of Innovative firms	Correlation between types of innovation and states' innovation potentiality
New Product	1042	32.73	-0.11
New Process	1102	34.61	-0.13
Product quality and standard	1349	42.37	0.03
Saving/efficient use of inputs	812	25.50	-0.10
Alternative material	456	14.32	-0.30
New machines	2164	67.96	-0.05

State-wise distribution of types of innovations is presented in figures 9.9 to 9.14along with the states' status in innovation potentiality. For product innovation the figure 9.9 shows that states with higher innovation potentiality have more or less similar share of innovative firms (about 30-40%), whereas states with much lower innovation potentiality have higher shares of product innovation. The similar picture emerges for process innovation as well (figure 9.10). Innovations in product quality and standard have recorded 42.37% of innovative firms at the all India level. However, in terms of innovation potentiality of the states no clear pattern is evident (figure 9.11). Innovations in more efficient input use shows negative correlation with innovation potentiality (figure 9.12). On the other hand innovation in alternative material use in production system is not very popular. At all India level only 14.32% of innovative firms have reported the same (figure 9.13). However, it has comparatively stronger negative correlations with innovation potentiality of the states. At all India level most ubiquitous is innovation in the form of introduction of new machines (figure 9.14). Although it shows a small magnitude of negative correlation with innovation potentiality, it is because many of the low innovation potentiality states have higher percentage of innovative firms in this type of innovation. Table 9.2 shows the correlation between innovation potentiality of the states and corresponding share of innovative firms in different types of innovations. While in most of the cases coefficients are small in magnitude and negative, innovation in the 'alternative material' category show comparatively higher magnitude of negative correlation. Another set of correlations have been calculated to check the complementarity if any among the types of innovations. As expected, 'new product' innovations have comparatively higher positive coefficients with other types of innovations, the negative coefficient with 'new machinery' is away from the expectation. A closer look reveals that this is because the states that are low in 'new product' type of innovations are comparatively higher in 'new machine' types, and not the other way round. Highest positive correlation is between 'new process technology' and 'saving/more efficient use of inputs'. Again, innovations in 'alternative material' show high correlations with 'new product' and 'new process' innovations.

Table 9.3: Complementarity among types of innovations

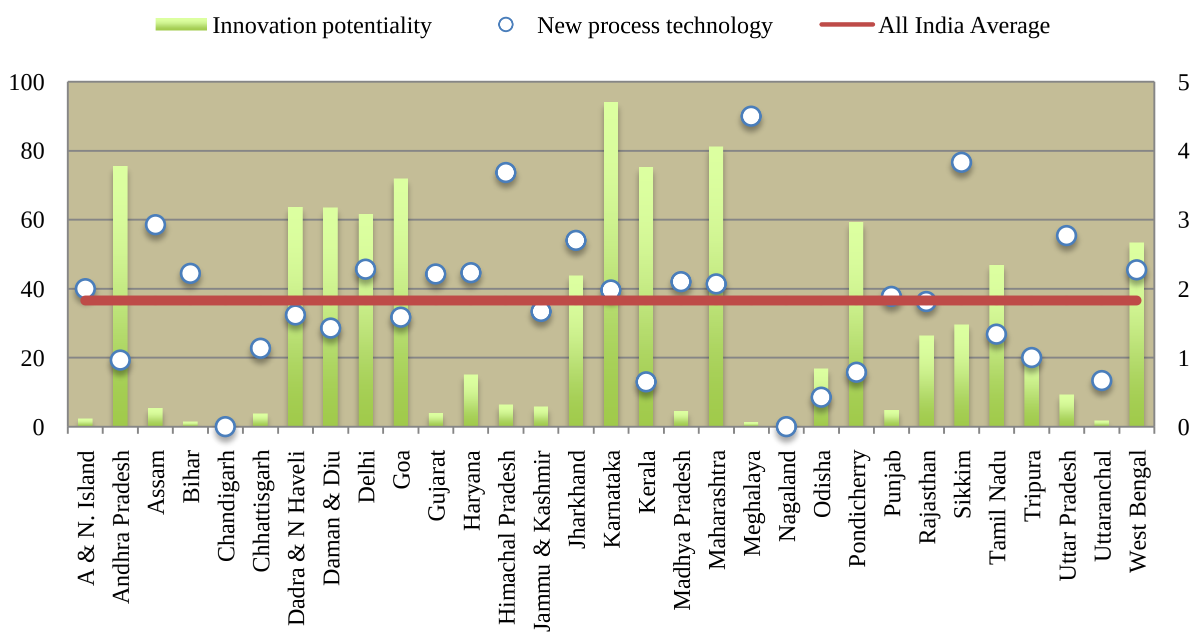
Innovation types	New product	New process technology	Product quality and standard	Saving/ more efficient use of inputs	Alt. material	New machines
New product	1.00	0.25	0.32	0.06	0.48	-0.24
New process technology		1.00	0.27	0.58	0.41	0.12
New machines			0.12	0.25	0.12	1.00

Figure 9.9: Product innovations (in %) in states



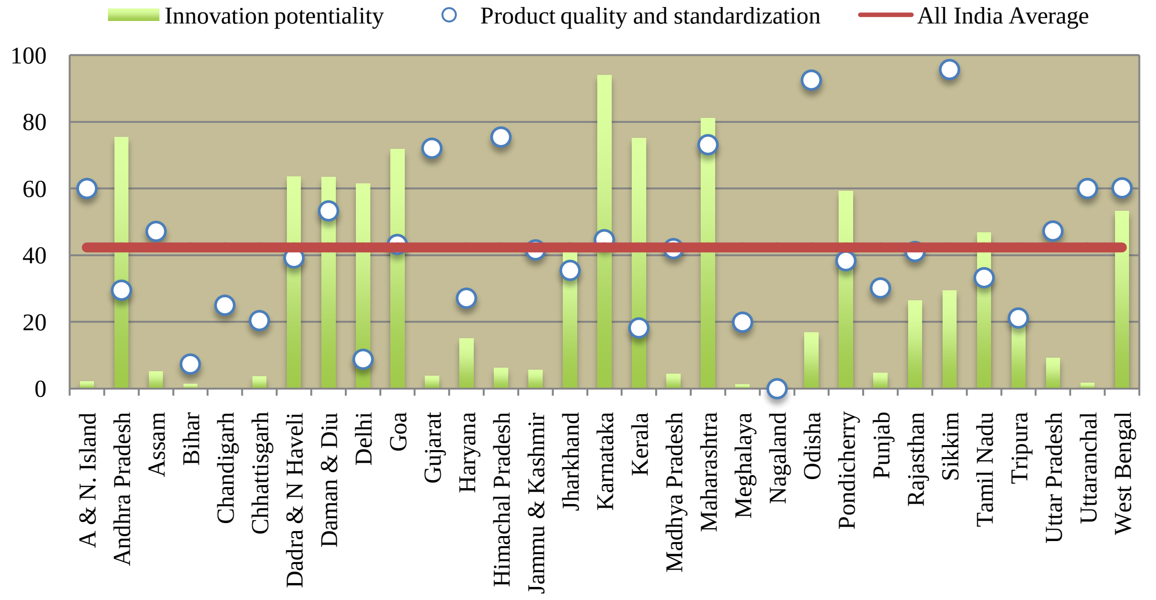
Note: Right hand axis measures innovation potentiality

Figure 9.10: Process innovations (in %) in states



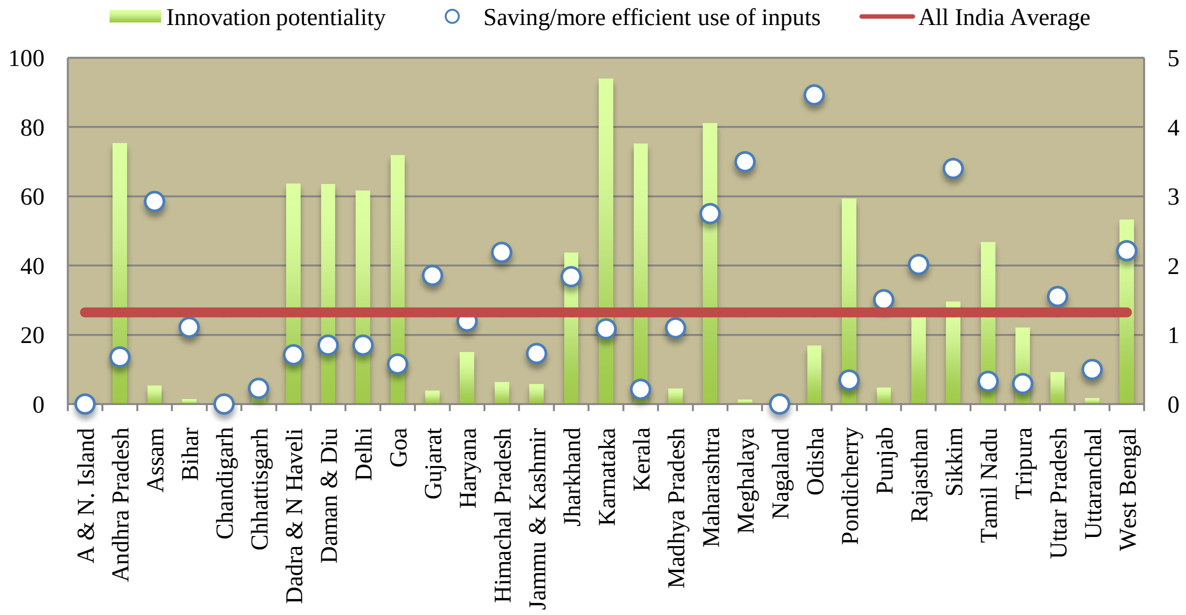
Note: Right hand axis measures innovation potentiality

Figure 9.11: Product quality and standardisation (in %) in states



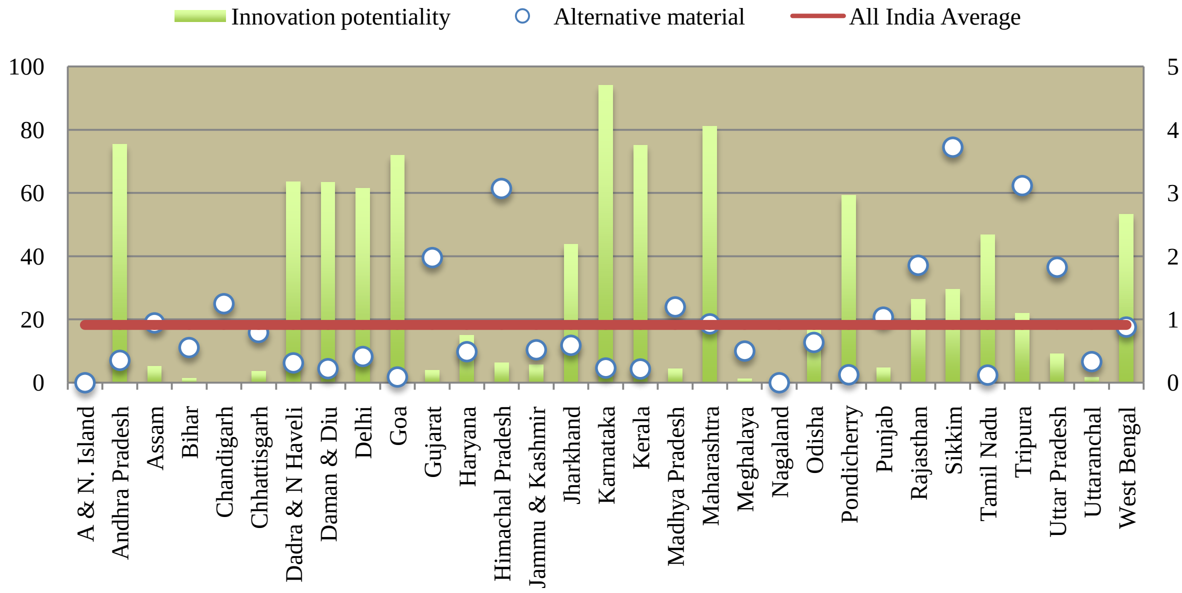
Note: Right hand axis measures innovation potentiality

Figure 9.12: Saving/more efficient use of inputs (in %) in states



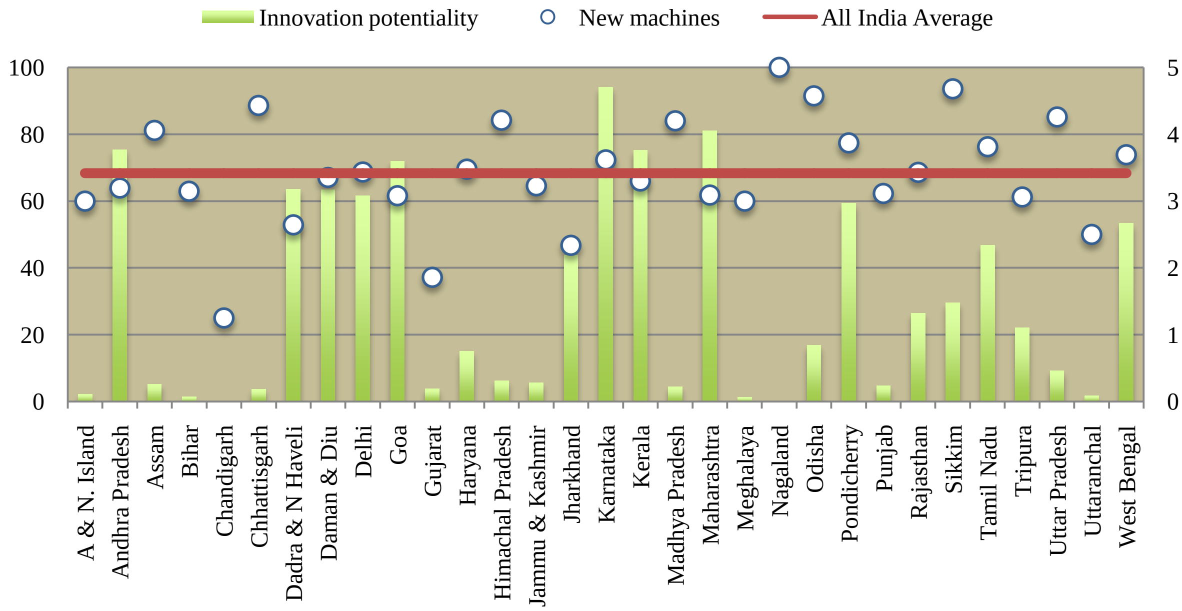
Note: Right hand axis measures innovation potentiality

Figure 9.13: Alternative material (in %) in states



Note: Right hand axis measures innovation potentiality

Figure 9.14: New machines (in %) in states

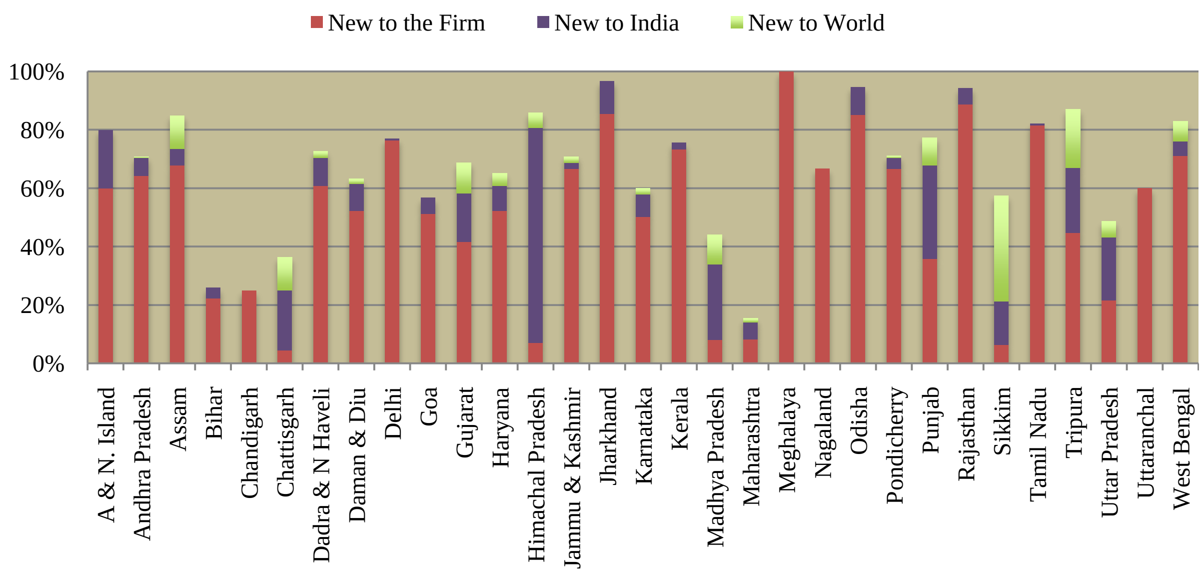


Note: Right hand axis measures innovation potentiality

Novelty of innovations in States

The general nature of innovation by a firm is adaptation of known technological changes in the industry. The figure 9.15 shows that across the states most of the innovations are new to firms. The percentages do not touch 100 because in many cases firms were not sure about this dimension of the status of their innovations. Higher percentage of firms reporting 'new to India' innovation in Himachal Pradesh is due to the presence of Drugs & Pharma and Electrical goods industry. Firms in both these industries survive on product differentiations. Sikkim shows higher percentage of innovative firms claiming innovations 'new to world'. This claim is again from the drug and pharmaceutical industry present in the state. 'New to the world' innovations in Assam and Tripura are essentially in the handcraft and traditional industry segments.

Figure 9.15: Novelty of Innovation in states



Strategies for Innovation (innovation activities)

Innovation strategies of the innovative firms have been captured through the innovation related activities undertaken by these firms. Focus is drawn both on R&D and non-R&D activities. In R&D activities two broad distinctions are made between in-house and extra-mural R&D activities. Rest of the activities are acquiring technology, knowledge etc. training of the personnel, and taking innovation to the market. Table 9.4 shows percentage of innovative firms undertaking innovation related activities. Figures 9.16 and 9.17 present the graphical views. It is apparent that acquisition of technology is the most popular way to innovation. Training of the manpower in new technology and in-house R&D has moderate presence in popularity among the innovative firms. It is to be noted that firms in Gujarat tops in all the three indicators in figure 9.18 followed by Sikkim. The latter is dominated mainly by pharmaceutical industry. Gujarat and Sikkim are way ahead also in other three indicators in figure 9.19. Training is an important part of innovation that is critically dependent on human resources. While about 39.5% firms impart training to their employees, training in the innovative firms in Gujarat is fundamentally different from Nagaland, Meghalaya and Andaman & Nicober. The latter is more related to skill development for enabling self-employment with local resources, the former is more like the industrial training in technology.

Table 9.4: Innovation related activities of the innovative firms

Innovation Activities	Intramural R&D	Extramural R&D	Acquisition of Technology	Acquisition of other external knowledge	Training	Market introduction of Innovation
Innovative Firms (in %)	35.05%	11.43%	67.02%	16.36%	39.20%	16.65%

Figure 9.16: Innovation Activities performed by Innovative firms (I)

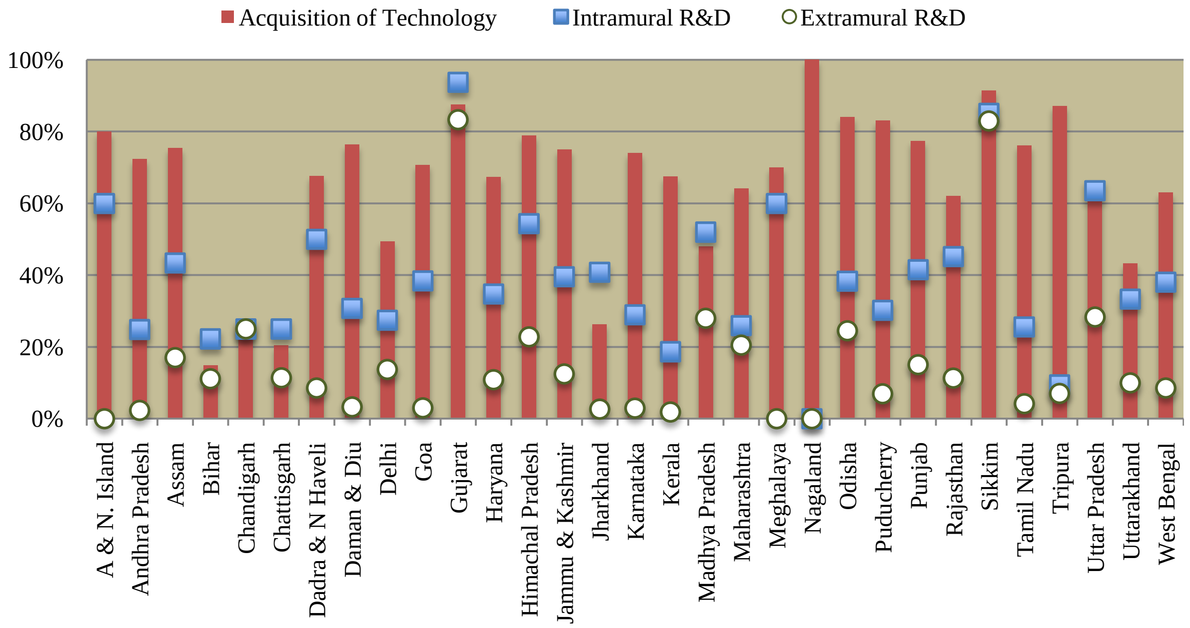
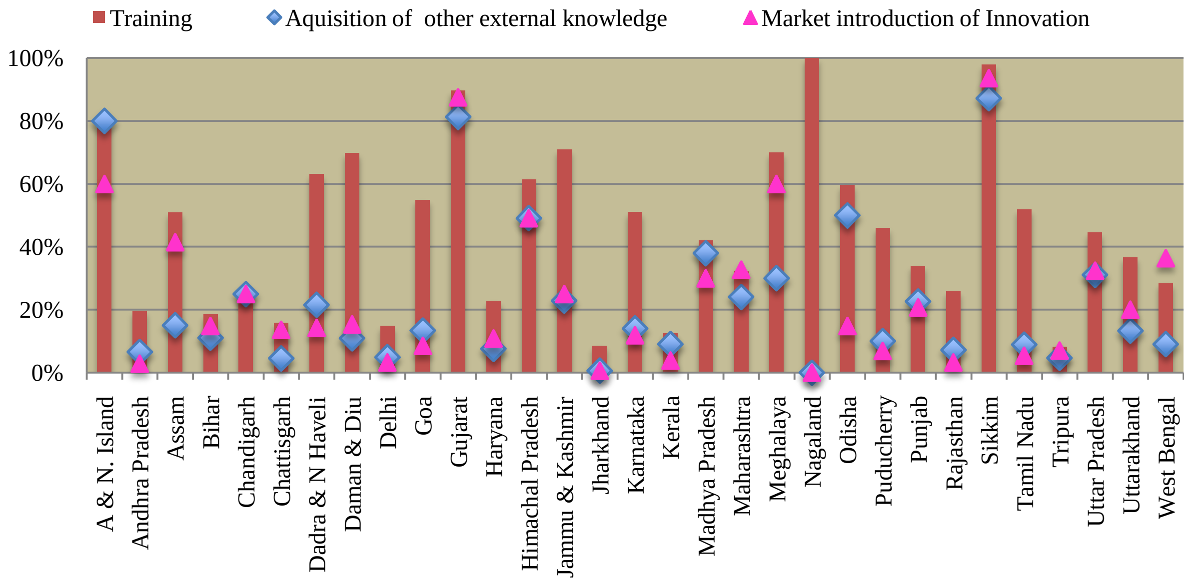


Figure 9.17: Innovation Activities performed by Innovative firms (II)



Sources of technology/Innovation

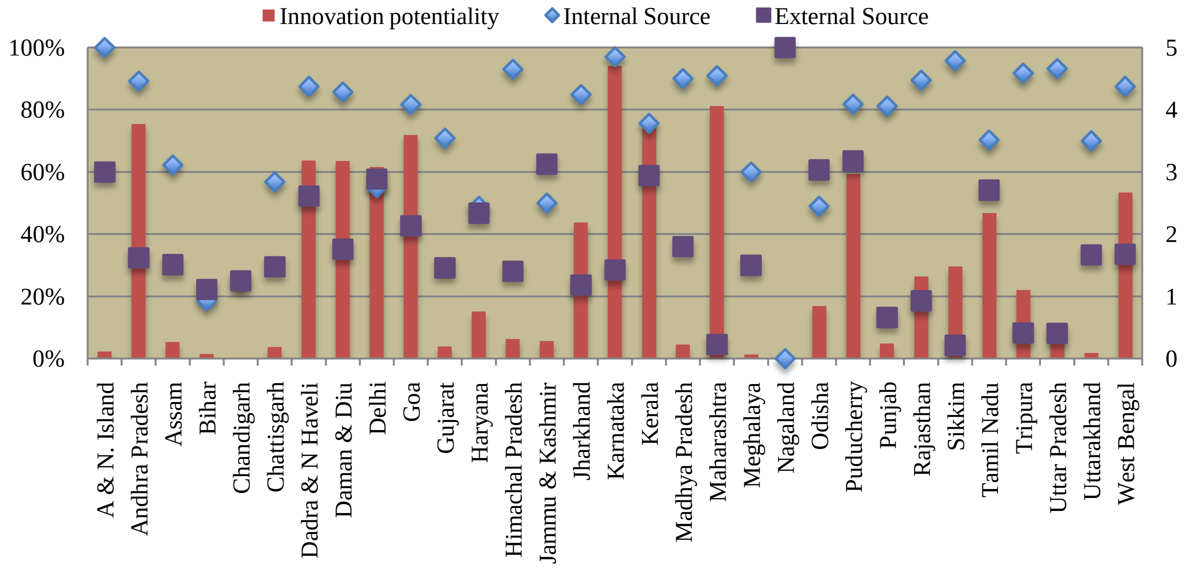
The external interactions for innovation appear to be low key for the Indian firms. About 80% claim that their innovations are internally sourced (table 9.4). State-wise graphical presentation of the same along with innovation potentiality is shown in Figure 9.18. The positive correlation with 0.44 magnitude suggests that states having higher innovation potentiality do depend more on internal strength of sourcing innovation. Thus Karnataka, Maharashtra and Andhra Pradesh who have higher innovation potentiality are generally low on externally sourcing innovations. Figure 9.19 presents different modes of acquiring technology. Three different sources have been Collaborator, domestic market, foreign market. In this case the correlation with Innovation Potentiality is shown in table 9.6. As such Delhi, Goa Chandigarh firms show the presence in foreign market for sourcing technology. Madhya Pradesh and Puducherry have some presence in the category 'from collaborator'. Rest are mostly dependent on the domestic sources. Correlation coefficients with Domestic sources are 0.27 and foreign sources are 0.19. It negative with small magnitude in case of collaborator.

Table 9.5: Innovation related activities of the innovative firms

Source of Innovation	Internal Source	External Source	Other*	NA
As % of Innovative Firms	79.77%	36.59%	2.20%	3.30%
Correlation with innovation potentiality	0.44	0.03		

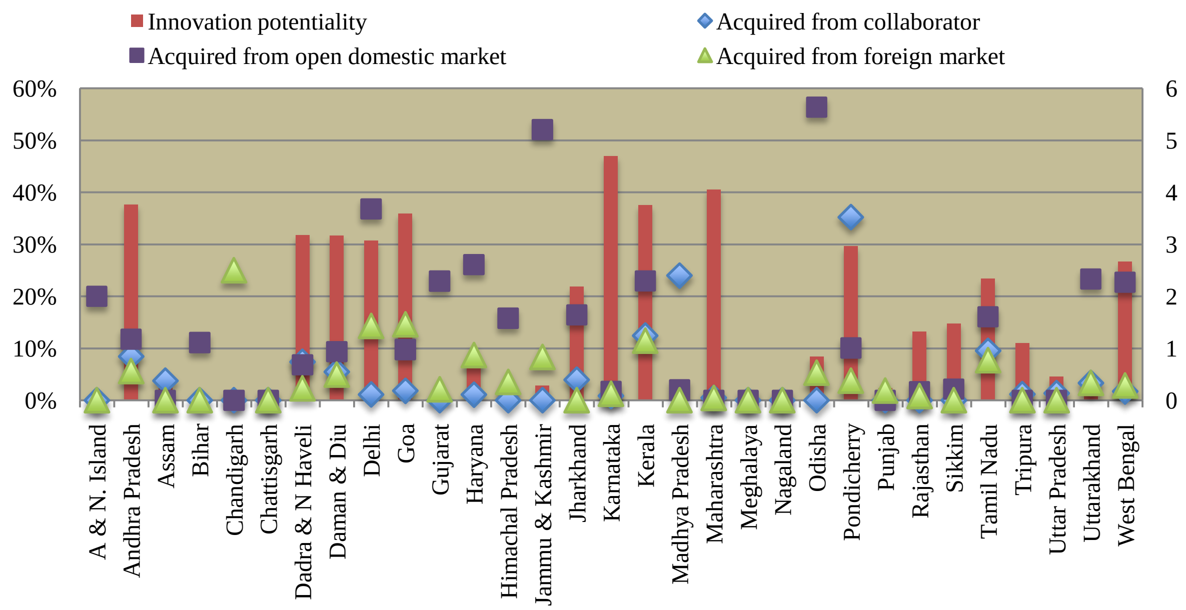
Note: Other* = With other enterprise or institutions (Universities, Govt. Labs)

Figure 9.18: Source of innovation used by innovative firms



Note: Right hand axis measures innovation potentiality

Figure 9.19: Source of Technology acquired



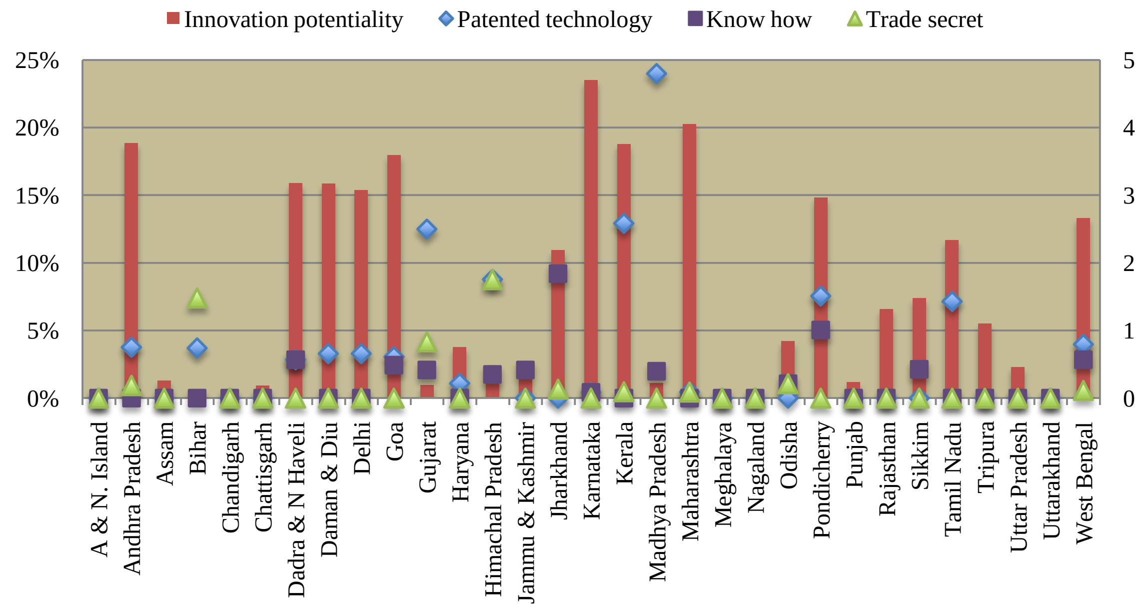
Note: Right hand axis measures innovation potentiality

Table 9.6: Correlation with Innovation potentiality

Correlation	Open domestic market	Collaborator	Foreign market
Innovation potentiality	0.27	-0.01	0.19

Incidence of acquiring patented technology, knowhow or trade secret is quite low among the innovative firms. Madhya Pradesh, Gujarat and Kerala have some presence in sourcing patented technology. Correlation with innovation potentiality is negative with ‘trade secret’, positive with ‘knowhow’ (Table 9.6).

Figure 9.20: Form of technology sourced



Note: Right hand axis measures innovation potentiality

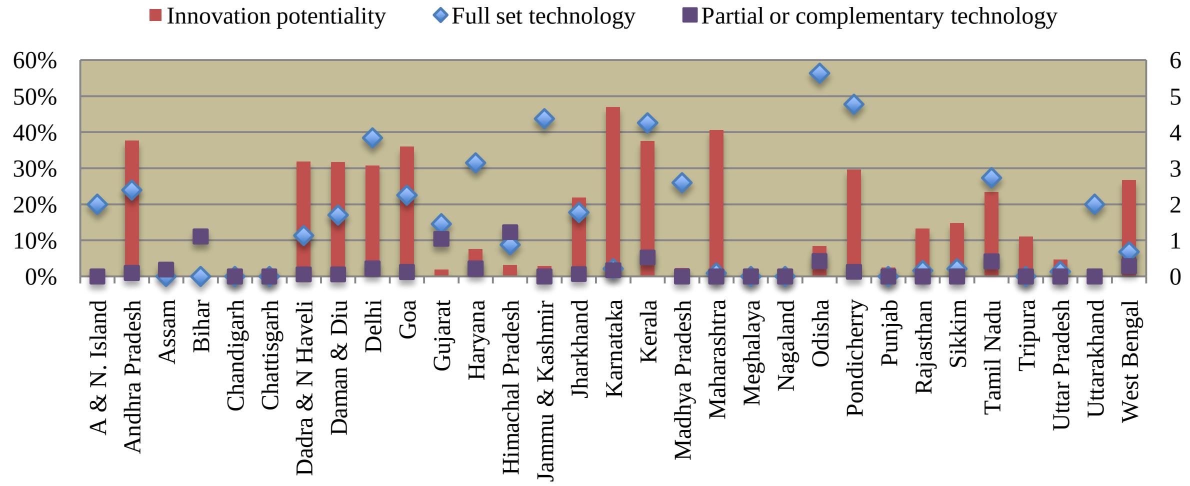
Table 9.7: Correlation between forms of technology and innovation potentiality

Correlation	Patented technology	Knowhow	Trade secret
Innovation potentiality	0.07	0.18	-0.23

Extent of technology

While sourcing technology firms behave according to their internal capabilities. Sourcing full set technology requires cooperation from the technology supplier for making the technology fully functional. On the other hand partial technology requires firms’ confidence on making the complemetarity work. Sourcing full set technology appears to be the main stay of the Innovative firms in India in general (figure 9.21). Table 9.8 shows the correlations with innovation potentiality of the states; positive for full set technology and negative for partial technology.

Figure 9.21: Extent of technology sourced



Note: Right hand axis measures innovation potentiality

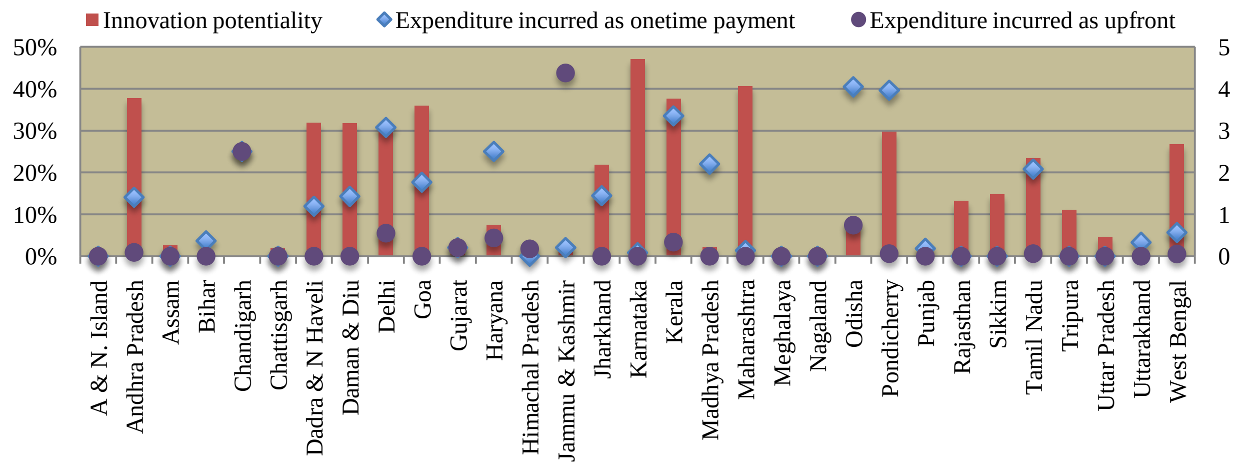
Table 9.8: Correlation between extent of technology and innovation potentiality

Correlation	Full set technology	Partial technology
Innovation potentiality	0.23	-0.10

Nature and source of expenditure incurred for Sourcing technology/knowledge

Mobilisation of financial resources for sourcing technology for innovations is an important strategic initiative for innovative firms. Figure 9.22 shows that for the Indian firms' onetime payment for sourcing technology/knowledge for innovation is the general practice. Upfront payment on the other hand has negative correlations with innovation potentialities of the states (table 9.9). The exceptions are Chandigarh and Jammu and Kashmir.

Figure 9.22: Expenditure for Innovations in states



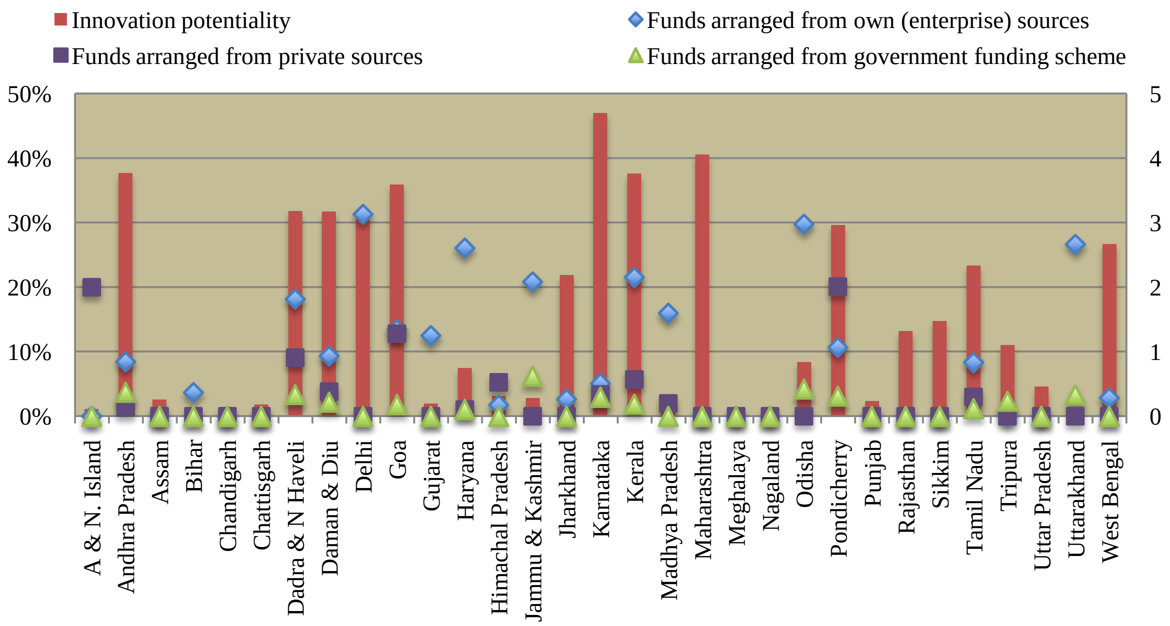
Note: Right hand axis measures innovation potentiality

Table 9.9: Correlation between Nature of expenditure and innovation potentiality

Correlation	Expenditure incurred as onetime payment	Expenditure incurred as upfront
Innovation potentiality	0.33	-0.21

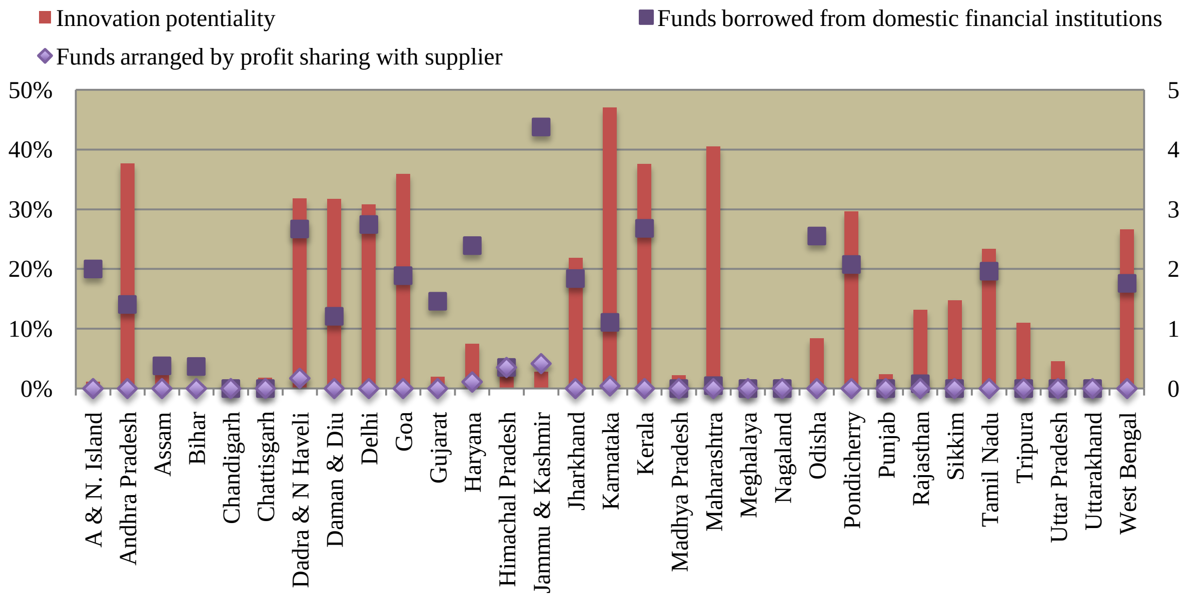
Fund arranged using own sources is the preferred route for the innovative firms. Figure 9.23 and 9.24 show that borrowing fund for sourcing technology is not popular among the innovative firms, at the same time, accessing government fund is rare. At state levels about 20% firms accessed fund from domestic financial institutions. Table 9.9, however, shows interesting correlations between innovation potentiality of the states and source of fund. Lower the innovation potentiality more is the dependence on own source of fund. On the other hand states with higher innovation potentiality has higher incidence of sourcing from various sources, namely, borrowing from financial institutions and accessing government schemes.

Figure 9.23: Arranging finance for sourcing technology for innovations in states (I)



Note: Right hand axis measures innovation potentiality

Figure 9.24: Arranging finance for sourcing technology for Innovations in states (II)



Note: Right hand axis measures innovation potentiality

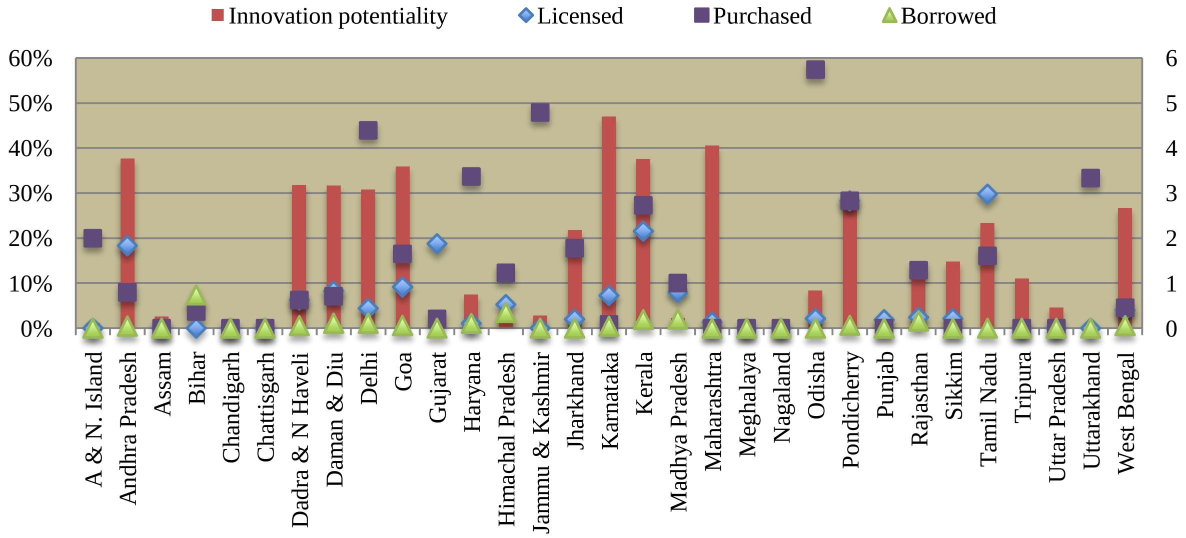
Table 9.10: Correlation between source of fund and innovation potentiality

Correlation	Funds arranged from own (enterprise) sources	Funds arranged from private sources	Funds arranged from government funding scheme	Funds borrowed from domestic financial institutions	Funds arranged by profit sharing with supplier
Innovation potentiality	0.17	0.27	0.30	0.36	0.29

Technology Agreement

Figures 9.25 and 9.26 present the various kinds of agreements that the innovative firms enter into for sourcing technology. Figure 9.25 shows that purchase of technology is generally preferred by the Indian firms followed by licensing. However, licensing technology has high positive correlation with innovation potentiality (table 9.11), which implies that states with higher innovation potentiality have more inclination towards licensing. In most of the cases purchase is coupled with agreement for maintenance, as shown in figure 9.26. Table 9.12 shows high positive correlations with agreement to upgrade as well as training.

Figure 9.25: Agreement on technology for Innovations in states (I)

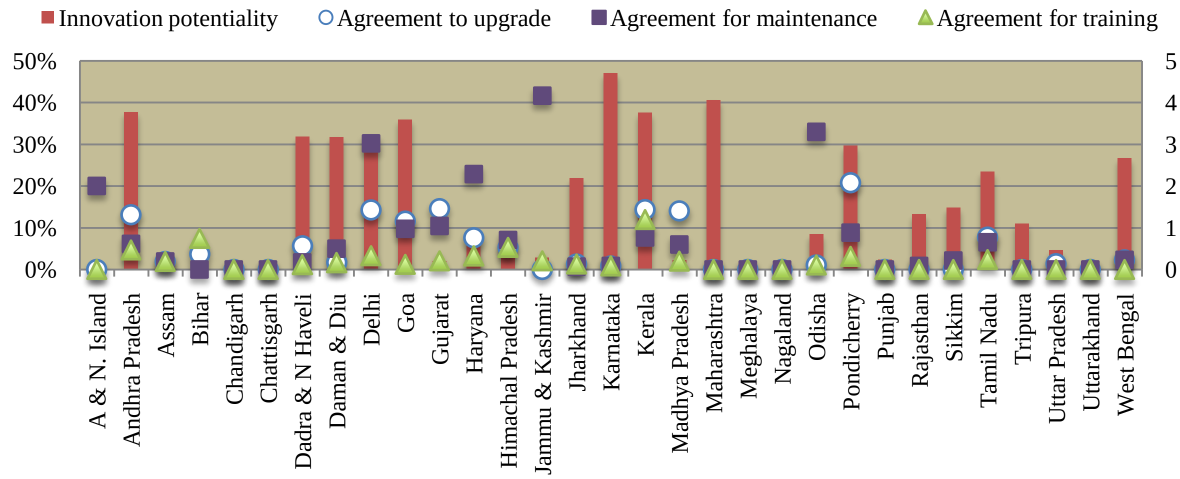


Note: Right hand axis measures innovation potentiality

Table 9.11: Correlation between technology agreement and innovation potentiality

Correlation	Licensed	Purchased	Borrowed
Innovation potentiality	0.48	0.05	-0.07

Figure 9.26: Agreement on technology for Innovations in states (II)



Note: Right hand axis measures innovation potentiality

Table 9.12: Correlation between technology agreement and innovation potentiality

Correlation	Agreement to upgrade	Agreement for maintenance	Agreement for training
Innovation potentiality	0.37	-0.04	0.24

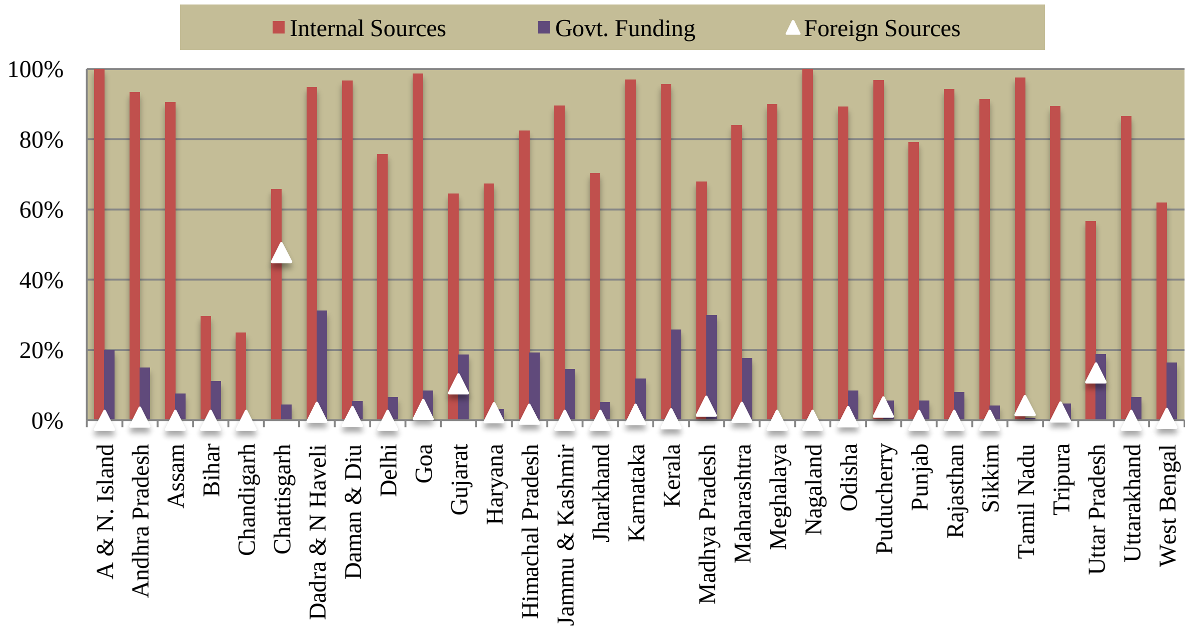
Source of Funds

Innovative firms mostly (86%) source their funds from internal sources. Govt. funding is accessed by only 12% of the innovative firms, as shown in table 9.13. State-wise break-up of the data does not show much variation over the states, except Chandigarh that also shows substantial presence of foreign source (figure 9.27).

Table 9.13: Funds of Innovation Activities

Internal Sources	Govt. Funding	Foreign Sources	NA
86.02%	12.22%	2.54%	11.43%

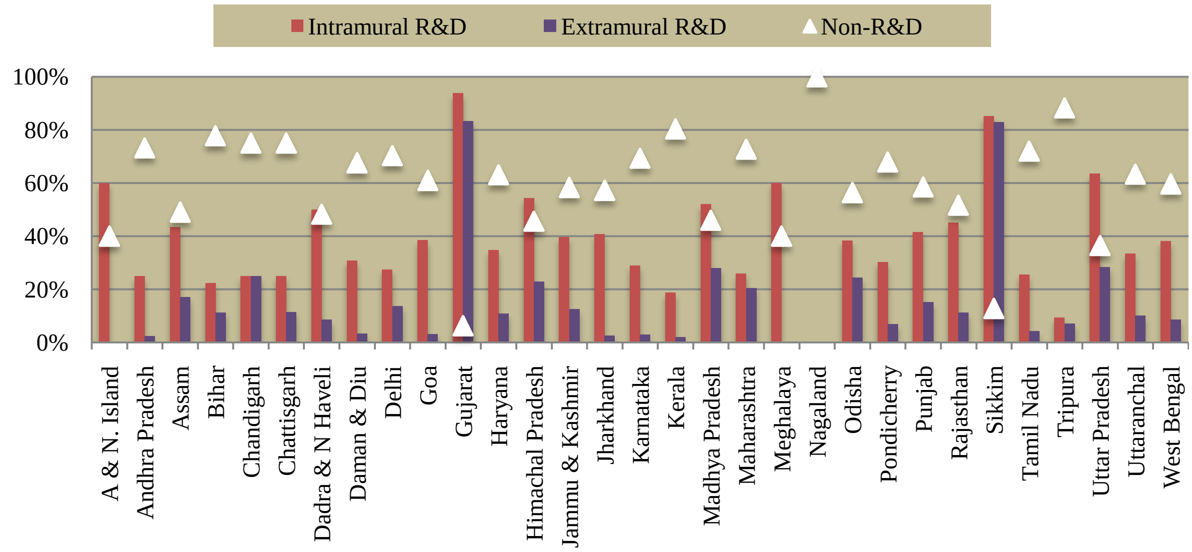
Figure 9.27: sources availed by Innovative firms for Innovation Activities/Expenditure



R&D and Non – R&D innovations

Prevalence of non-R&D mode of innovation is an important aspect of the understanding of innovation in India (Figure 9.28). Except Gujarat and Sikkim all the states have innovative firms not engaged in R&D activities, intra or extra mural. States like Karnataka, Andhra Pradesh and Tamil Nadu that are high in innovation potentiality have higher percentage of firms not engaged in R&D activities.

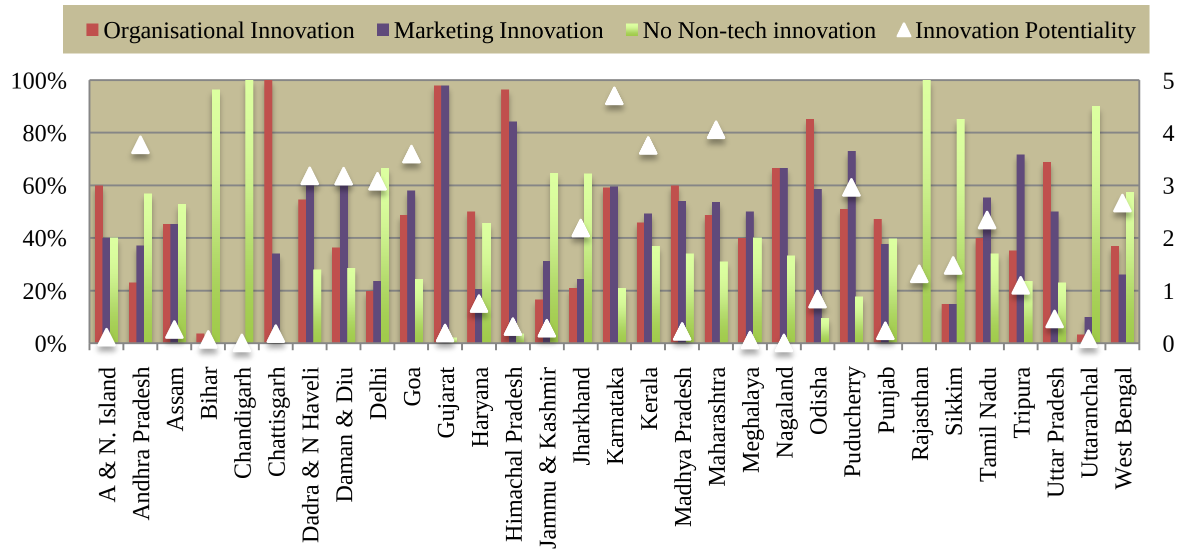
Figure 9.28: Non-R&D innovations in the states



Non – technological innovations

Non-technological innovations have been categorised as organisational innovations and marketing innovations. It is generally believed that non-technological innovations are closely complementary to technological innovations because new technology requires new organisational dynamics and hence new formations within the organisation of an enterprise. Also new innovations need new marketing initiatives for realisation of the investment on innovation in real time. A figure 9.29 shows the initiatives of the innovative firms at the state levels.

Figure 9.29: Non-technological Innovations in states



Note: Right hand axis measures innovation potentiality

Correlation coefficient between organisational and marketing innovation is as high as 0.75. So, both forms of non-technological innovations go hand in hand, except that marketing innovations have comparatively higher presence in Gujarat, Assam and Tripura. But as the correlation with innovation potentiality (table 9.14) shows, organisational innovation has negative relation (small magnitude) whereas positive correlations (of small magnitude) with marketing innovation.

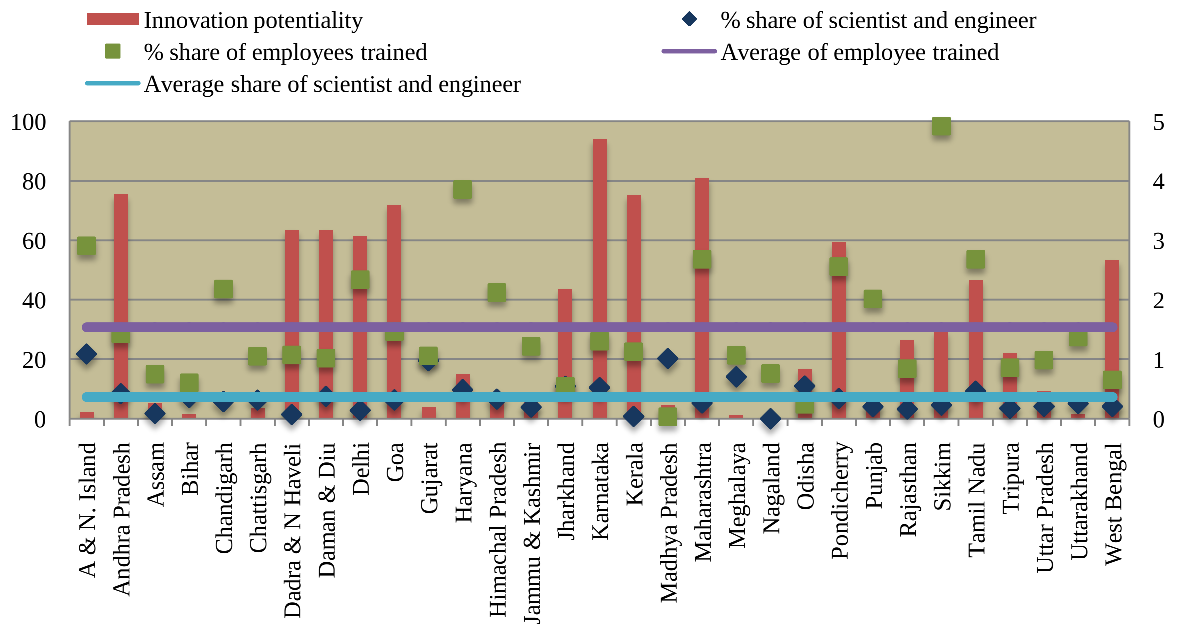
Table 9.14: Correlation between non-technology and innovation potentiality

Correlation	Organizational innovation	Marketing innovation	No non-tech innovation
Innovation potentiality	-0.11	0.17	-0.14

Composition and training of HR for Innovation

Share of highly skilled workers in the total workforce is used for understanding the human resource strength of the innovative firms. Figure 9.30 shows that 30% is the national average of training given to workforce. Ten states figure above average, out of which five states have very low innovation potentiality. Average share of scientist and engineer is about 7%. The share does not vary significantly over the innovation potentiality of the states. Most of the innovative firms prefer training in-house. This also does not show much variation over the states as shown in figure 9.31. Training in institutions abroad or training with collaborators are rare initiatives. This is also true for accessing sources of funding for training. Rarely innovative firms in states have accessed government or foreign sources for training their employees as is shown in figure 9.32.

Figure 9.30: Scientist/Engineers employed and training of employees by Innovative Firms



Note: Right hand axis measures innovation potentiality

Figure 9.31: Accessing sources for training

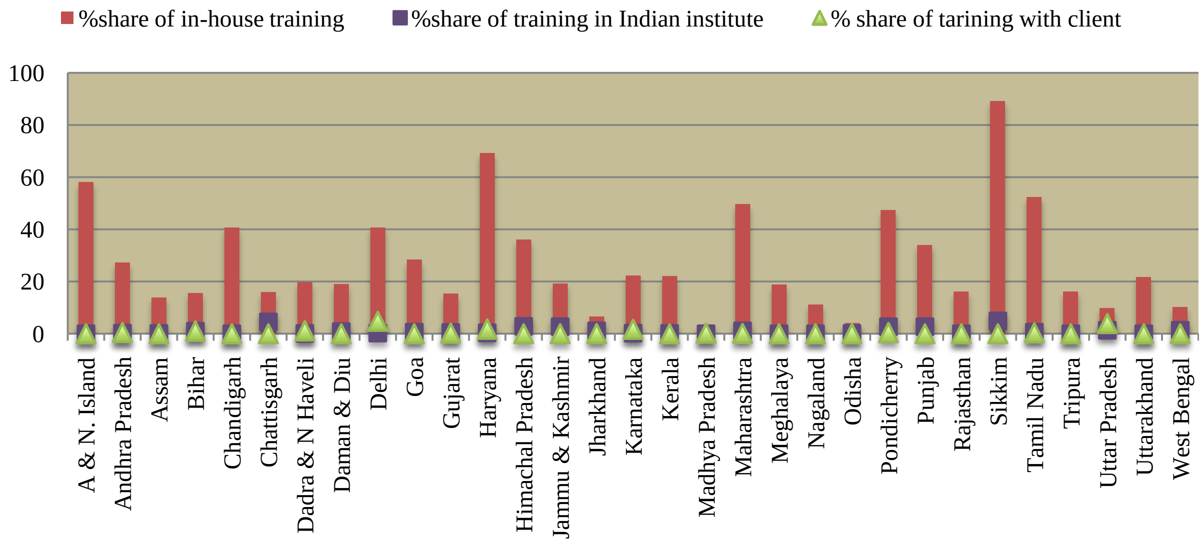
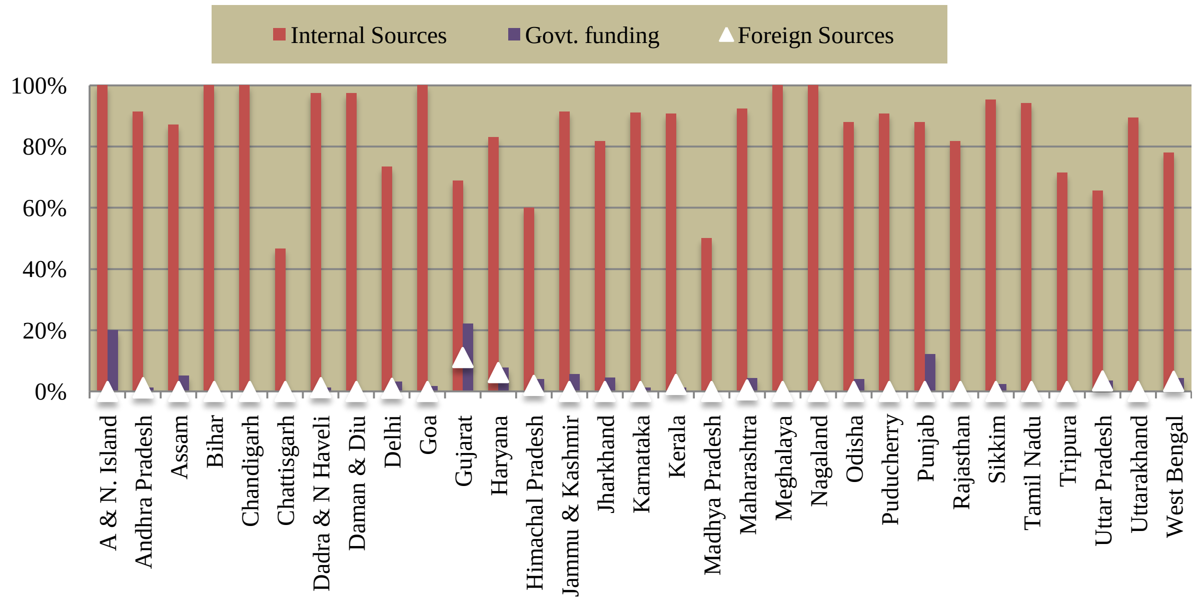


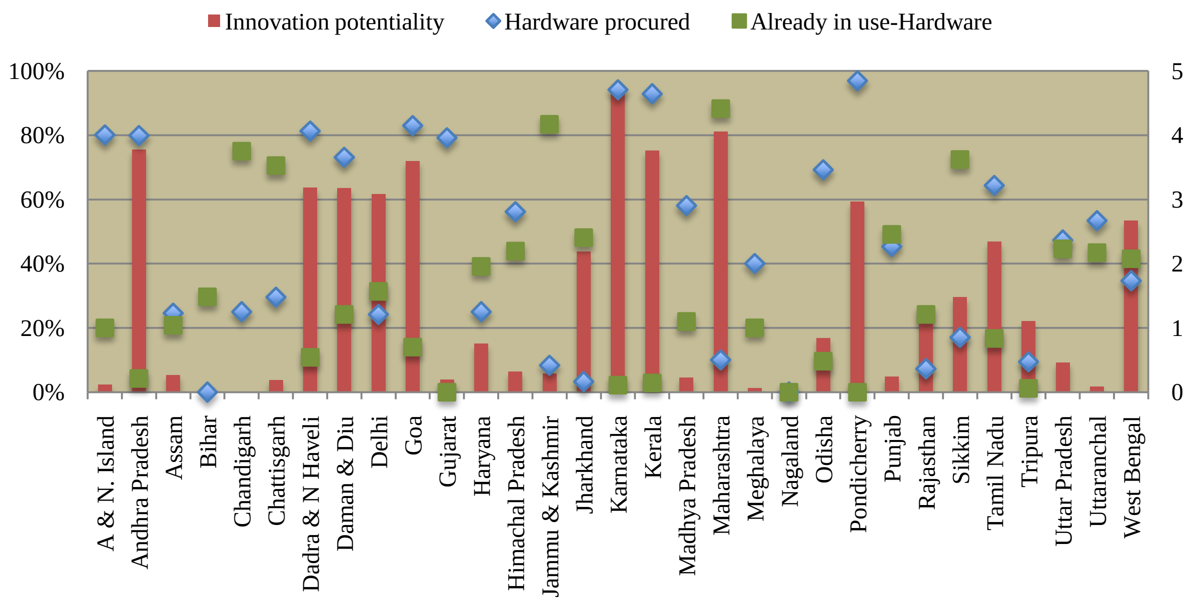
Figure 9.32: Accessing funding sources for training



ICTisation of innovative firms

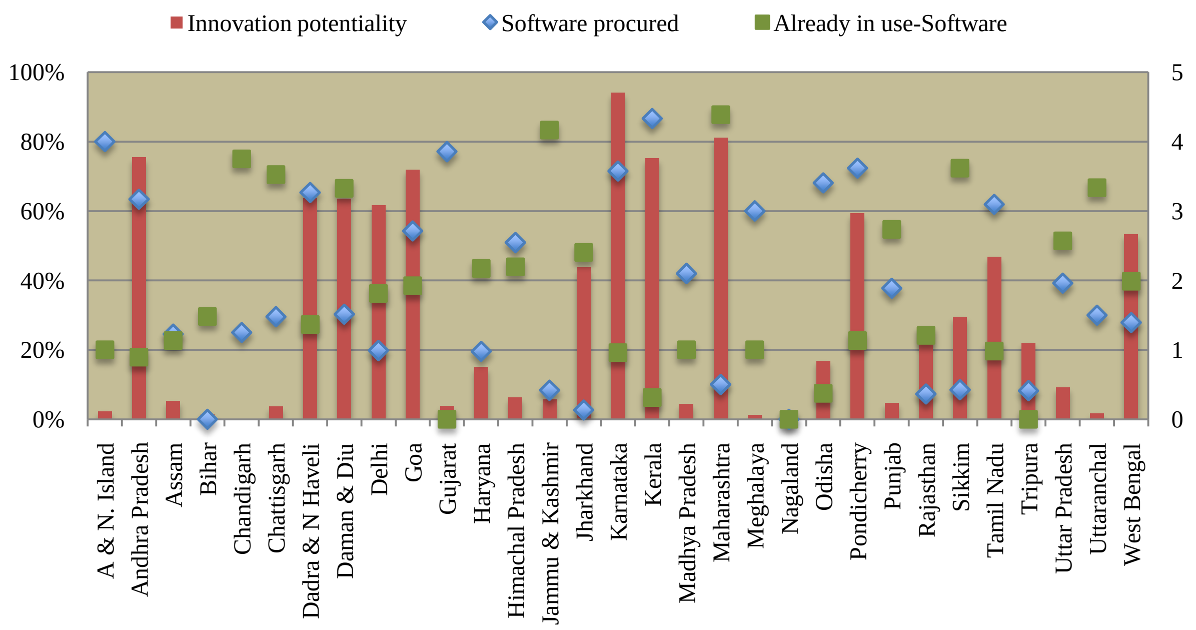
Extent of ICTisation is expected to be higher in states with higher innovation potentiality. Figure 9.33 and 9.34 highlight that in terms of procurement of new hardware and software. The table 9.15 shows high positive correlation with hardware procurement by states with high innovation potentiality. This is true also for software procurement. The purpose of ICT use as shown in figure 9.35 is mostly for ERP and also for R&D and technology management. ICT helps sourcing and processing information from wide variety of sources. It is expected that innovative firms would use ICT for accessing new information and processing the same for choices and strategies. Figure 9.36 and 9.37, however, do not give any definite indication. Table 9.16 shows negative correlations with all external sources and positive correlation of very small magnitude with internal sources.

Figure 9.33: ICT Hardware use by innovative firms in states



Note: Right hand axis measures innovation potentiality

Figure 9.34: ICT Software use by innovative firms in states

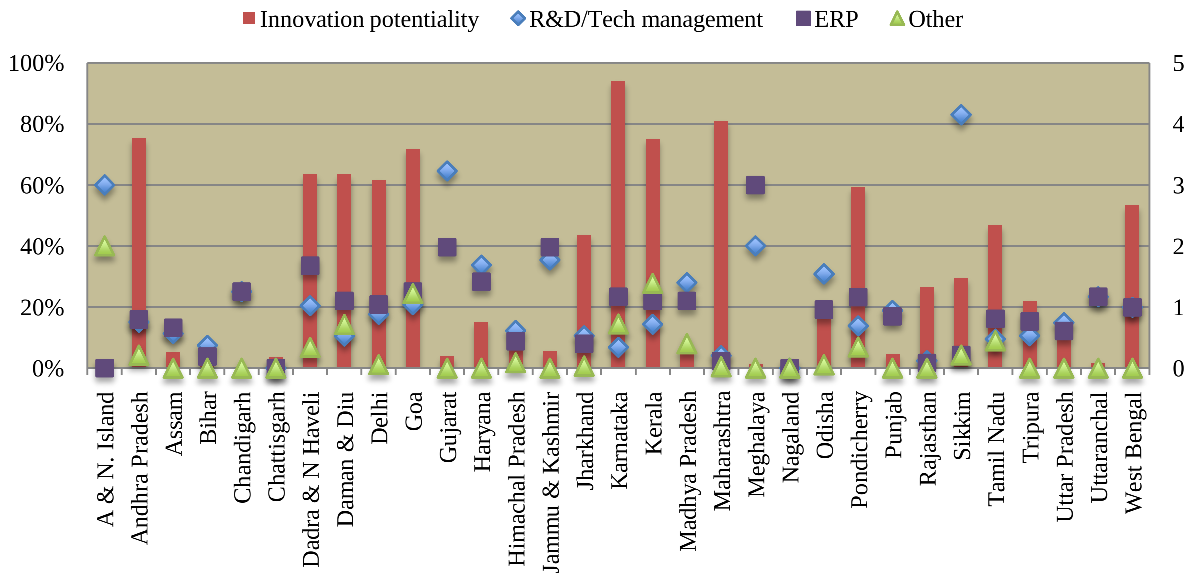


Note: Right hand axis measures innovation potentiality

Table 9.15: Correlation of ICTisation with innovation potentiality

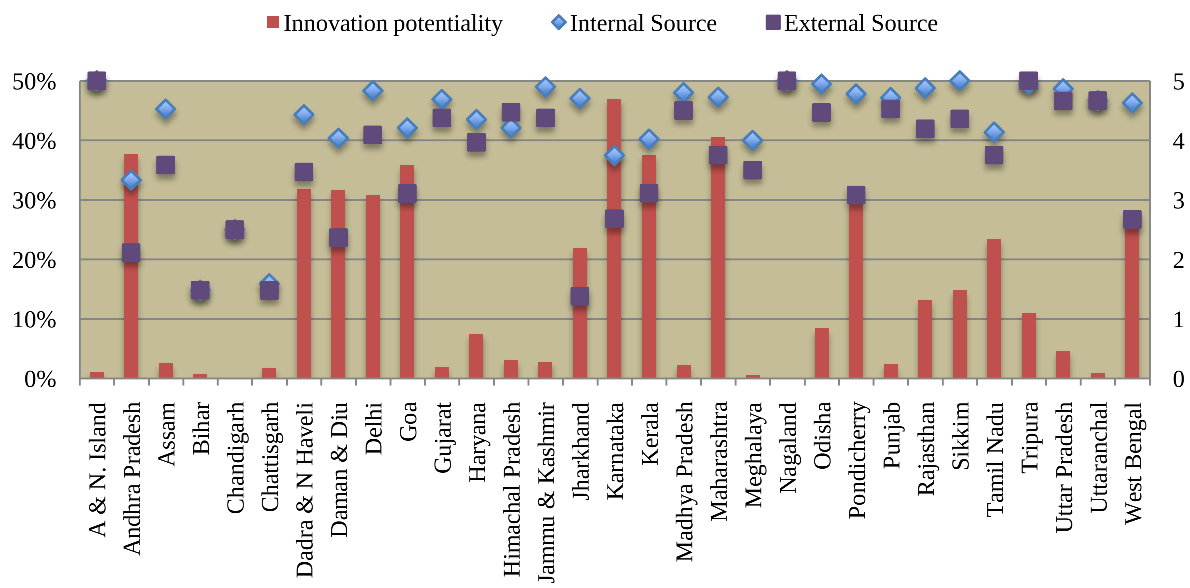
Correlation	Hardware procured	Already in use-Hardware	Software procured	Already in use-Software
Innovation potentiality	0.42	-0.23	0.27	-0.04

Figure 9.35: ICT use by innovative firms



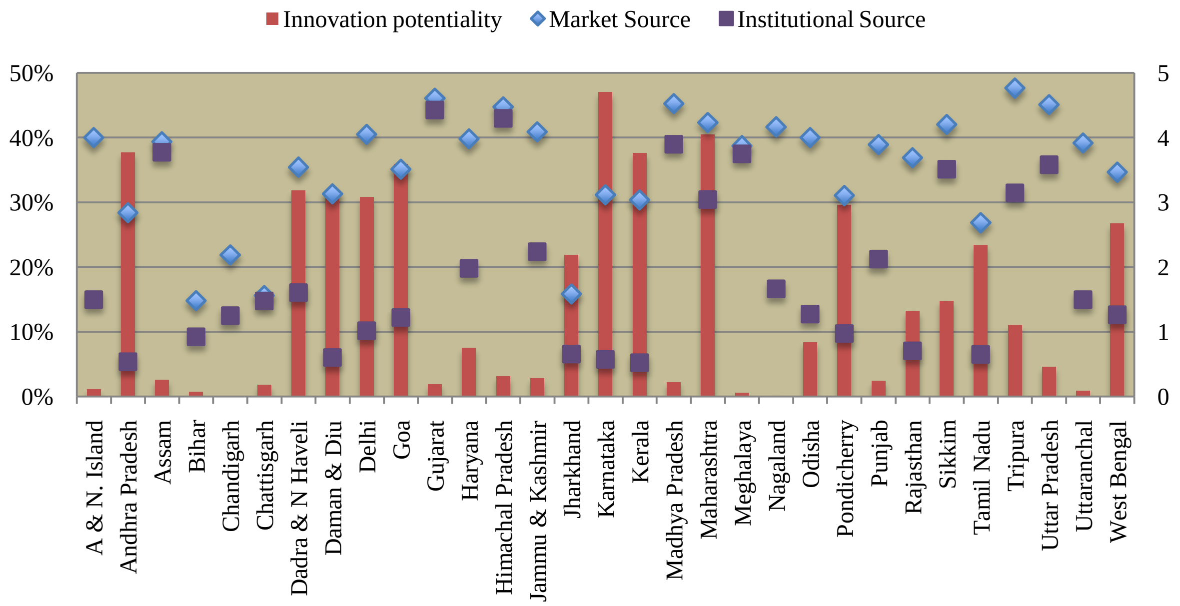
Note: Right hand axis measures innovation potentiality

Figure 9.36: Source of information used by innovative firms (I)



Note: Right hand axis measures innovation potentiality

Figure 9.37: Source of information used by innovative firms (II)



Note: Right hand axis measures innovation potentiality

Table 9.16: Correlations between sources used and innovation potentiality

Correlation	Internal Source	External Source	Market Source	Institutional Source	Other Source
Innovation potentiality	0.06	-0.38	-0.18	-0.50	-0.05

In Nutshell

Comparative innovation potentiality of the states reveal a few interesting charateristics of the innovation dynamics of Indian enterprises. States that are generally considered as backward in terms of the presence of modern industries have more innovative firms in the younger firms category. Again these are the states having higher share of innovations in the product and process innovation categories. On the other hand all the states (comparatively backward or advanced) have reported innovations mostly in the 'new to firm' category. States with higher innovation potentiality depend more on internal sources for innovation. Some of the low potentiality states like Gujarat have better networking with external agencies for source of information, technology and funding. Non-technological innovation attracts lesser attention from firms with high innovation potentiality states. On the other hand ICT use is more prominent in states with higher innovation potentialities.

The correspondence between state level innovation and sector level scenario to understand the innovation in Indian context is attempted in chapter XI.

X

Sectors and Innovation by firms

Highlights

- There are 36 sectors that have shares in identified innovative firms totalling 3184. As it was in the case of states, for sectors also we have defined two indicators, namely, Innovation Intensity and Innovation Potentiality. Innovation Intensity is defined as a ratio between number of innovative firms in a sector and total number of firms in the respective sector. Innovation Potentiality is weghited Innovation Intensity, where weights are share of a sector in total innovative firms.

- Rubber and Plastic product sector (NIC 22) has the highest innovation potentiality and second highest share in innovative firms. Manufacturing of food products (NIC 10), which has second highest innovation potentiality, has the highest share of sample as well as innovative firms. They are followed by fabricated metal products (NIC 25), manufacture of machinery and equipment n.e.c. (NIC 28), basic metals (NIC 24), chemical and chemical products (NIC 20), and tobacco (NIC 13) and have significant shares of total innovative firms.

- Firms with less than 100 workforce dominate the innovation scenario in most of the sectors. Tobacco products (NIC12), wearing apparel (NIC 14), Computer and electronics (NIC 26), transport equipment (NIC 30) and furniture (NIC 31) have significant presence of larger firms with 100 to 499 workforce.

- Sectors having more than average share of product innovations are not those with highest innovation potentiality. In case of process innovation the picture is opposite – negative relation of moderate magnitude with innovation potentiality. Innovations in product quality and standard have recorded 42.37% of innovative firms at the all India level. However, in terms of innovation potentiality of the sectors no clear pattern is evident. Innovations in more efficient input use show negative correlation with innovation potentiality of the sectors. On the other hand innovation in alternative material use in production system is not very popular.

- The nature of expenditure for acquiring innovation related capabilities are managed as one time payment. There is no meaningful correlation with innovation potentiality of the sectors. It means that the behaviourial pattern does not change with the innovation potentiality.

- The sectoral scenario for arranging funds for sourcing technology is generally non-innovative. The sector-wise division of innovative firms do show inclination for using domestic financial sources used as often as internal sources. Except the farming sector internal source remain the most trusted source for innovative firms in all sectors. Accessing govt. funding is rare.

- Most of the sectors have large number of innovative firms who are not engaged in R&D activities, intra or extra mural. NIC 21, which is the pharmaceutical, sector and generally considered as R&D intensive is an exception from the general trend.

- Correlation coefficient between organisational and marketing innovation is as high as 0.56. So, both forms of non-technological innovations go hand in hand, except that marketing innovations have comparatively higher presence in NIC 12 (tobacco product), NIC 38 (waste treatment), NIC 74 (Professional and scientific activities) and NIC 82 (Office administration equipments). But as the correlation with innovation potentiality shows, both forms of non-technological innovations do not have any relation with innovation potentiality.

- Average share of scientist and engineers is about 7%. NIC 22 – rubber and plastic sector has as high as 24% workforce as scientist and engineer. Training of the employees is given mostly in-house and this is the practice across the sectors. Training in institutions abroad or training with collaborators are rare initiatives. This is also true for accessing sources of funding for training. Rarely innovative firms in any sector have accessed government or foreign sources for training their employees.

Sectors and Innovation

Two digit NIC code has been used for the sampling from ASI data. Sample was drawn to represent the NIC two-digit code. The industrial or production sectors represented by the two-digit codes are appended at the end of this chapter. We have considered each two-digit group of production activities as a sector. Any two-digit code not having or having negligible population (very small number of firms) was missed out in the sampling process. Table 10.1 shows that 36 sectors have returned innovative firms. The table shows the details of sector-wise population and share in sample.

Innovation Intensity and Innovation Potentiality

As it was in the case of states, for sectors also we have defined two indicators, namely, Innovation Intensity and Innovation Potentiality. Innovation Intensity is defined as a ratio between number of innovative firms in a sector and total number of firms in the respective sector.

Overall innovation intensity for India as a ratio between number of innovative firms and total sample is 35.37%. What would be the sector level innovation intensity? Refer to the table 10.1 where NIC 10 has 32% innovation intensity with about 16% share in the population,13% in the total sample and 12% share of the total innovative firms. NIC 38, on the other hand, has 100% innovation intensity with 0.06%, 0.02% and 0.06% shares in total population, sample and total innovative firms, respectively.

The bias has been normalised by deriving Innovation Potentiality as weghited Innovation Intensity, where weights are share of a sector in total innovative firms. Comparative positions of different states in terms of innovation intensity and innovation potentiality are shown in the figure 10.1. Figure 10.2 shows comparative positions for sectors in terms of average innovation potentiality. And ranks of the states in terms of innovation potentiality are shown in figure 10.3.

Innovation Intensity is defined as a ratio between number of innovative firms in a state/sector and total number of firms in the respective state/sector.

Innovation Potentiality as weghited Innovation Intensity, where weights are share of a state/sector in total innovative firms.

Total number of innovative firms out of a sample of 9001: 3184
Overall innovation intensity of India: 35.37%
Overall innovation intensity of the sectors: 43.54%

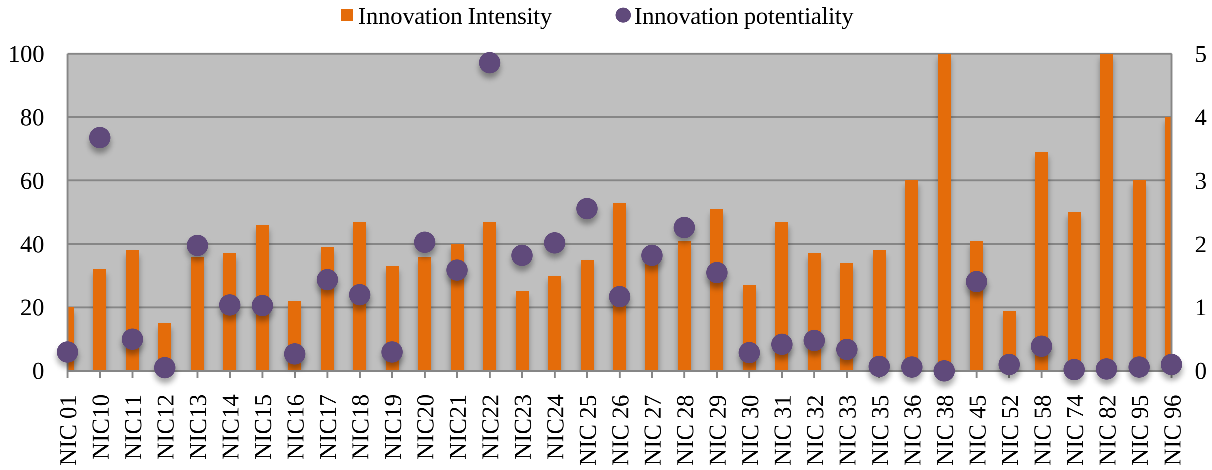
Note: Sectors corresponding NIC codes are appended at the end of the chapter.

Table 10.1: Sector-wise share of population, sample base and innovative firms

NIC code	Share in population (in %)	Share in sample (in %)	Innovation Intensity (in %)	Innovation potentiality
NIC 01	2.73	2.68	20	0.30
NIC 10	15.92	13.11	32	3.68
NIC 11	0.83	1.22	38	0.50
NIC 12	1.87	0.80	15	0.05
NIC 13	9.36	5.47	36	1.98
NIC 14	4.17	2.72	37	1.04
NIC 15	1.95	1.71	46	1.03
NIC 16	1.98	2.03	22	0.27
NIC 17	2.79	3.43	39	1.44
NIC 18	2.01	1.96	47	1.20
NIC 19	0.65	0.99	33	0.30
NIC 20	5.23	5.63	36	2.03
NIC 21	2.14	3.43	40	1.59
NIC 22	5.45	7.92	47	4.86
NIC 23	10.68	10.30	25	1.82
NIC 24	5.37	7.69	30	2.02
NIC 25	7.38	7.47	35	2.56
NIC 26	1.20	1.50	53	1.17
NIC 27	3.13	4.32	39	1.82
NIC 28	5.20	4.67	41	2.26
NIC 29	2.10	2.08	51	1.55
NIC 30	1.19	1.38	27	0.29
NIC 31	0.57	0.66	47	0.42
NIC 32	1.35	1.22	37	0.48
NIC 33	0.60	1.00	34	0.34
NIC 35	0.23	0.18	38	0.07
NIC 36	0.03	0.06	60	0.06
NIC 38	0.06	0.02	100	0.00
NIC 45	2.49	2.99	41	1.41
NIC 52	0.86	0.93	19	0.10
NIC 58	0.20	0.29	69	0.39
NIC 74	0.02	0.02	50	0.02
NIC 82	0.02	0.01	100	0.03
NIC 95	0.05	0.06	60	0.06
NIC 96	0.07	0.06	80	0.10

Note: Sectors corresponding NIC codes are appended at the end of the chapter.
NIC 38, NIC 74 and NIC 82 are either one or two sample sectors. The sectors, therefore, could be outlier for different indicators in the corresponding figures and tables.

Figure 10.1: Innovation Intensity (%) and Innovation Potentiality of different sectors



Note: Right hand axis measures innovation potentiality

Figure 10.2: Innovation Potentiality of different sectors

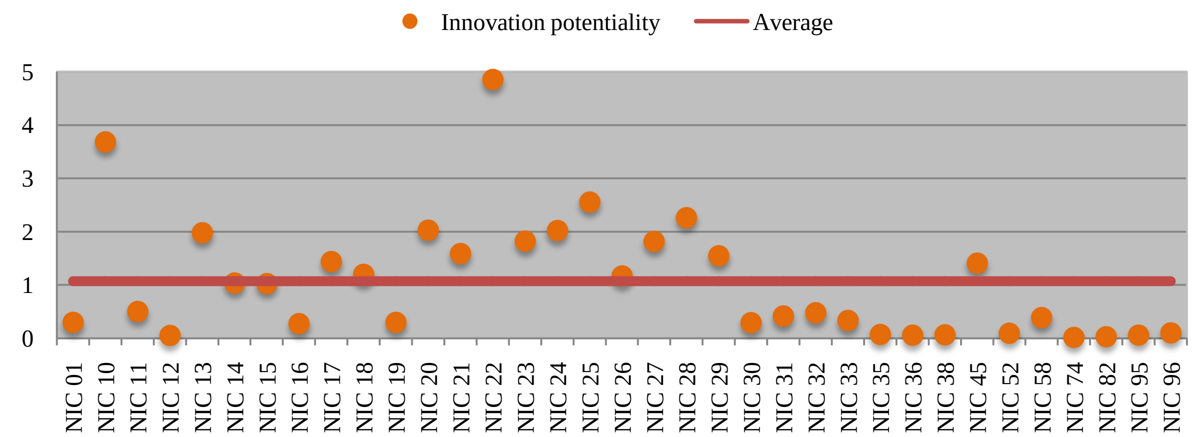
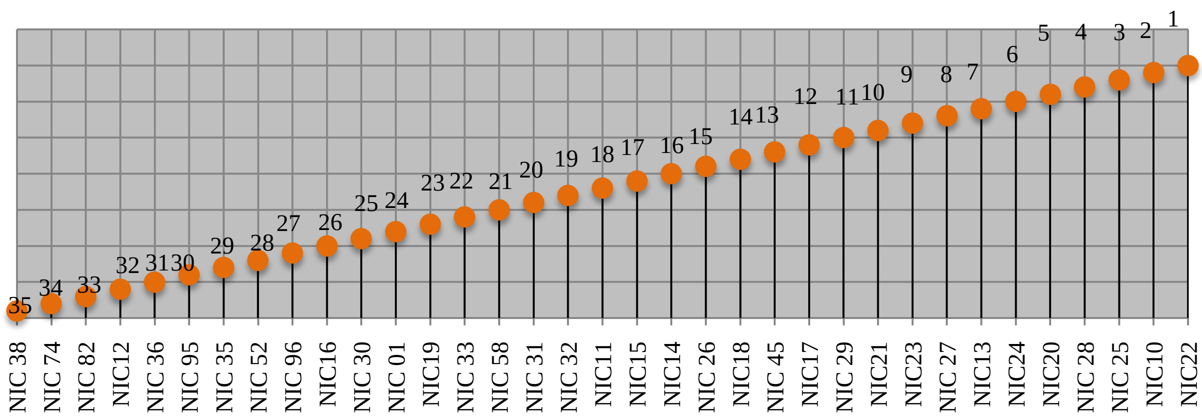


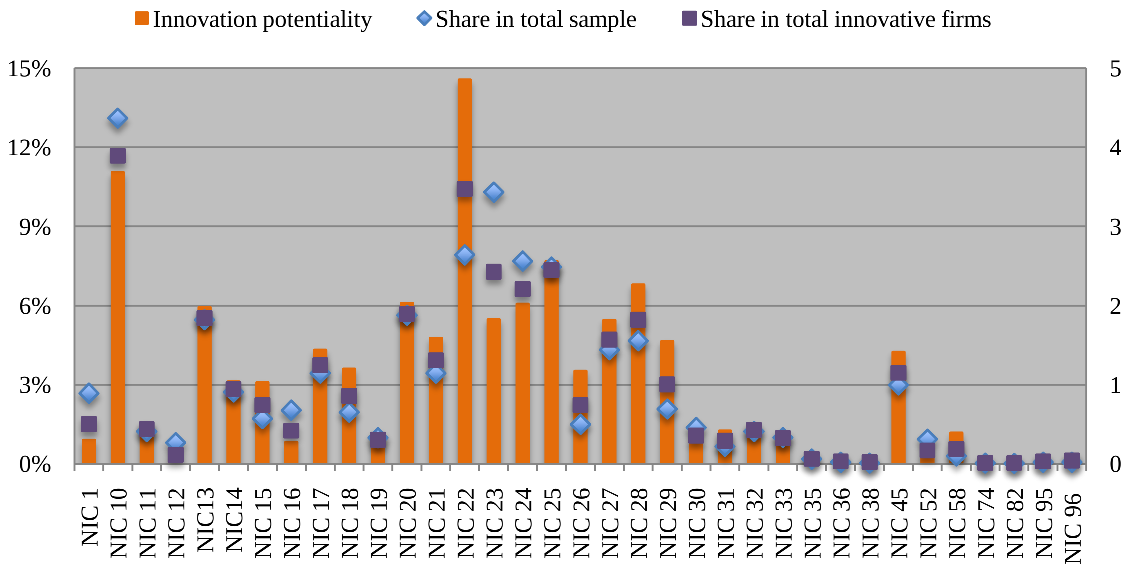
Figure 10.3: Ranking of the sectorss in terms of Innovation Potentiality



Firms and Innovation: Sector level scenario

Manufacturing of food products (NIC 10), which has second highest innovation potentiality, has the highest share of sample as well as innovative firms. Rubber and Plastic product sector (NIC 22) has the highest innovation potentiality and second highest share in innovative firms. They are followed by fabricated metal products (NIC 25), manufacture of machinery and equipment n.e.c. (NIC 28), basic metals (NIC 24), chemical and chemical products (NIC 20), and tobacco (NIC 13) and have significant shares of total innovative firms.

Figure 10.4: Distribution of firms surveyed and Innovative firms with respect to Sectors



Note: Right hand axis measures innovation potentiality

Size of the Innovative firms

As it is evident from figure 10.5, firms with less than 100 workforce dominate the innovation scenario in most of the sectors. Tobacco products (NIC12), wearing apparel (NIC 14), Computer and electronics (NIC 26), transport equipment (NIC 30) and furniture (NIC 31) have significant presence of larger firms with 100 to 499 workforce. The median value of the distribution of innovative firms over different size groups for all sectors together is shown in figure 10.6. So, when the median value of innovative firms in the size group ‘below 100’ is 1.48, sectors like Food (NIC 10), Chemicals (NIC 20), Pharma (NIC 21), Rubber and Plastics (NIC 22), non-metalic mineral products (NIC 23), Basic Metal (NIC 24), Fabricated metal (NIC 25) have shares far higher than the median value.

Figure 10.5: Share of a size group in the innovative firms in different sectors

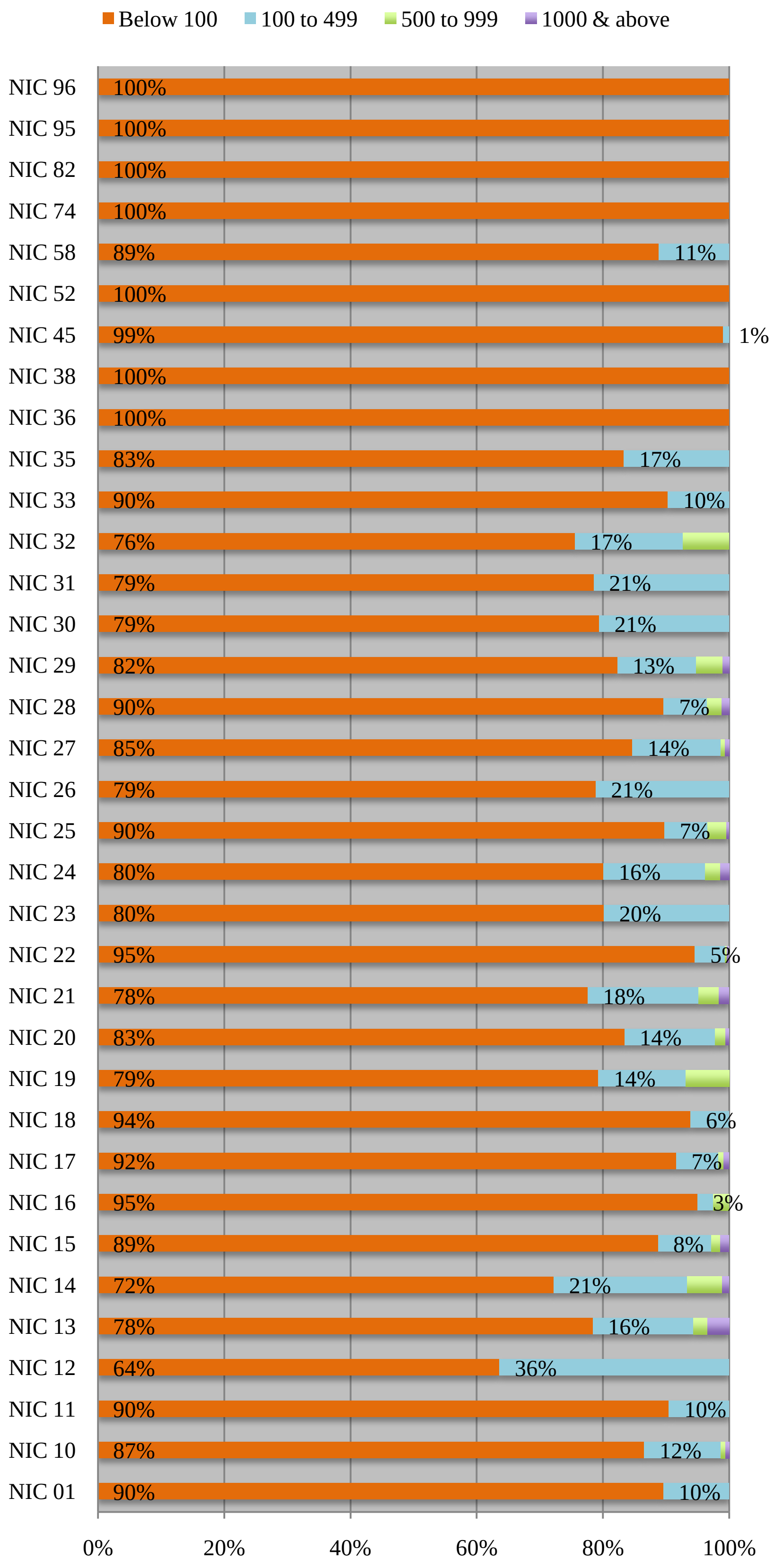
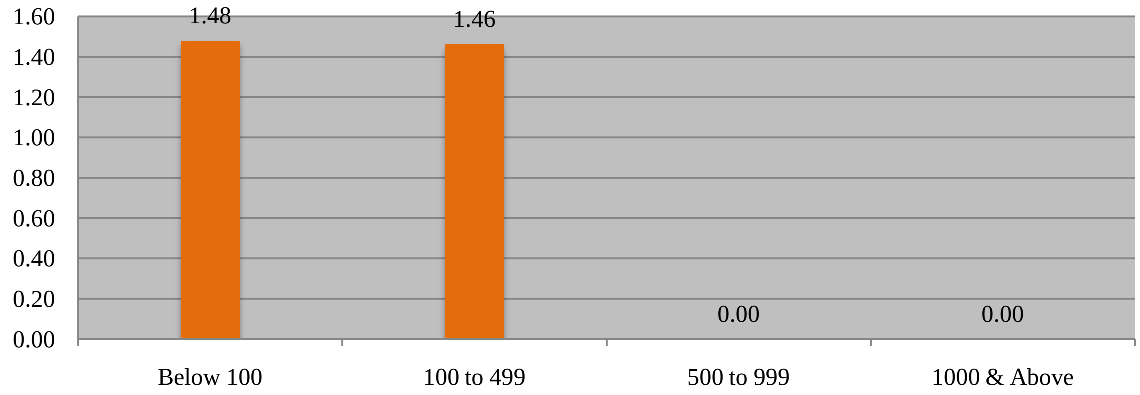


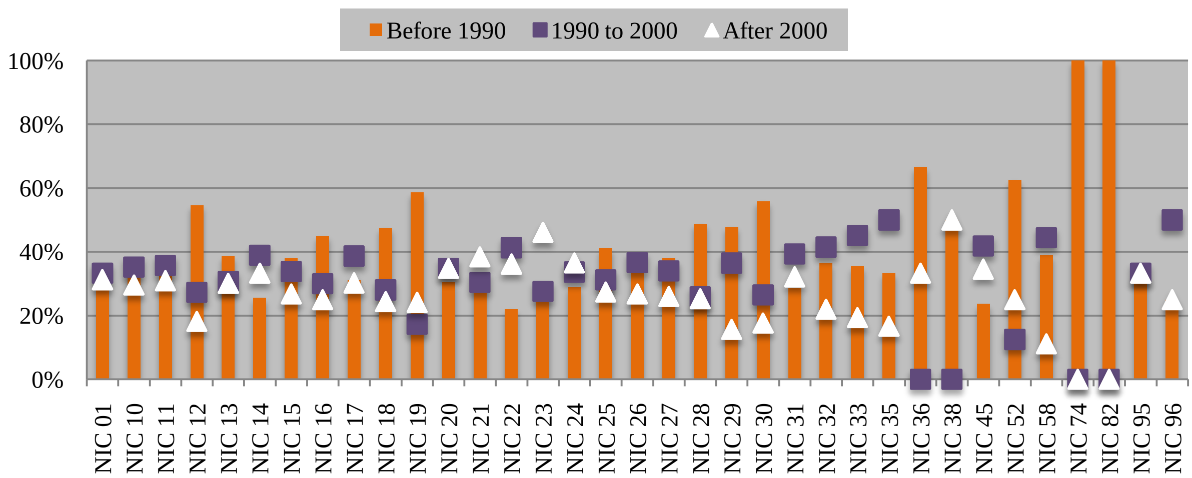
Figure 10.6: All sectors together the median value of shares for different size groups



Age of the innovative firms

What is the age group composition of innovative firms in a sector? In figure 10.7 except a few most of the sectors show more or less equal share of all the groups. NIC 36 (Water treatment etc.) and 38 (Waste treatment etc.) do not have any firms established during 1990 and 2000. Again NIC 74 (Scientific and design activities), and 82 (office administration equipment) have firms only from 'before 1990' group.

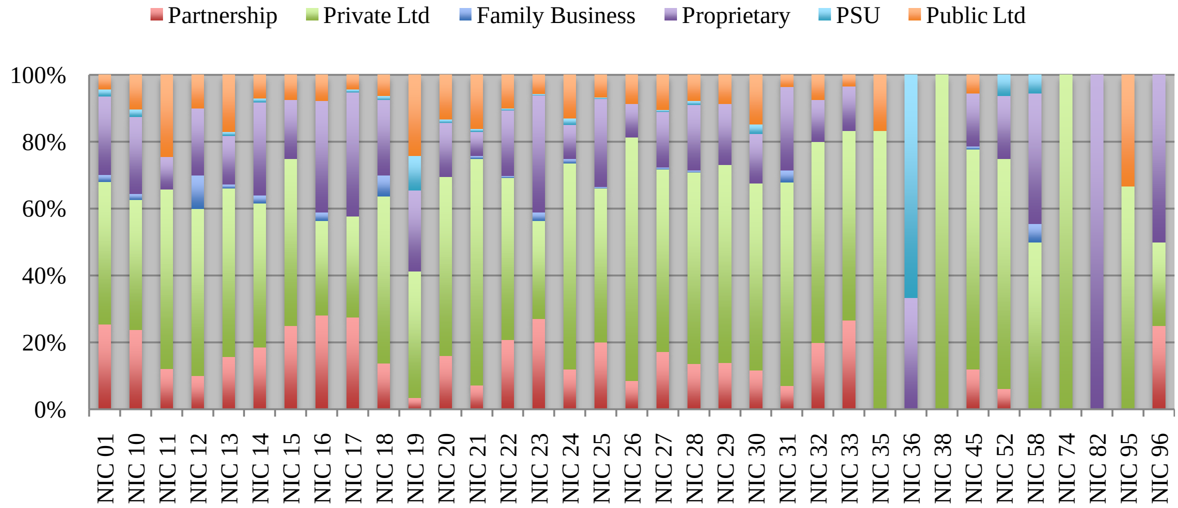
Figure 10.7: Share of the age groups in total innovative firms in the sector



Ownership pattern of the Innovative firms in Sectors

Figure 10.8 shows that although generally private firms dominate the sectors, NIC 82 has only proprietary firms and NIC 36 (water treatment) does not have any private firms.

Figure 10.8: Share of the group in total innovative firm in a sector



Types of innovation in sectors (NIC codes)

Innovation potentiality of firms has been captured by changes initiated by a firm in its production related activities. Broad groups of such activities are – product or/and process innovation product quality and standard, saving/efficient use of inputs, use of alternative material, introduction of new machines. Total 3184 firms have reported changes in the above-mentioned categories. Table 10.2 shows firms initiating changes in different activity groups. About 68% firms inducted new machines followed by 42% firms focusing on product quality and standard. Product and process innovation are initiated by 33% and 35 % firms respectively.

Table 10.2: Types of innovation undertaken by firms

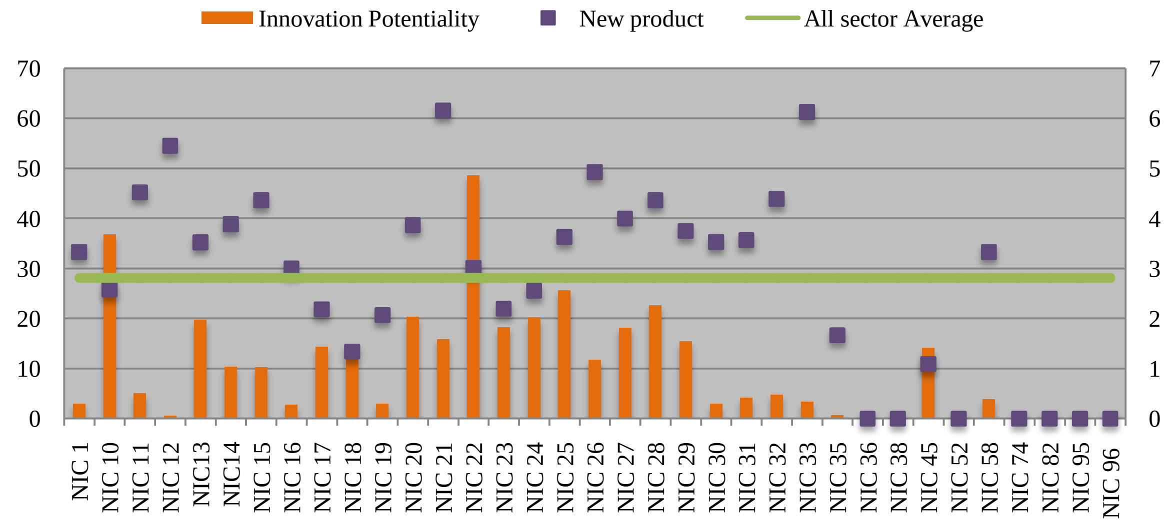
Type of Innovation	No. of firms	% Innovative firms	Correlation between types of innovation and sectors' innovation potentiality
New Product	1042	32.73	0.27
New Process	1102	34.61	-0.25
Product quality and standard	1349	42.37	0.15
Saving/efficient use of inputs	812	25.50	-0.10
Alternative material	456	14.32	-0.19
New machines	2164	67.96	0.06
Other	116	3.64	-0.17

Sector-wise distribution of types of innovations are presented in figures 10.14 to 10.19 along with the sectors' status in innovation potentiality. For product innovation the figure 10.9 shows positive relation of modest magnitude with innovation potentiality. In fact sectors having more than average share of product innovations are not those with highest innovation potentiality. In case of process innovation the picture is opposite – negative relation of moderate magnitude with innovation potentiality (figure 10.10). Innovations in product quality and standard has recorded 42.37% of innovative firms at the all India level. However, in terms of innovation potentiality of the sectors no clear pattern is evident (figure 10.11). Innovations in more efficient input use shows negative correlation with innovation potentiality (figure 10.12). On the other hand innovation in alternative material use in production system is not very popular. At all India level only 14.32% of innovative firms have reported the same (figure 10.13). However, it has comparatively stronger negative correlations with innovation potentiality of the sectors. At all India level most ubiquitous is innovation in the form of introduction of new machines (figure 10.14). It does not show any correlation with innovation potentiality because of the similarity in behaviour irrespective of difference in innovation potentiality. Table 10.2 shows the correlation between innovation potentiality of the sectors and corresponding share of innovative firms in different types of innovations. Another set of correlations have been calculated to check the complementarity if any among the types of innovations (Table 10.3). 'New product' innovations have comparatively higher negative coefficients with 'process innovation' but good positive correlation with 'product quality and standard'. With other types of innovations, the negative coefficient with of moderate magnitude with 'alternative material' and 'saving/effcient use of inputs' is reasonable. As expected 'new process' has high positive correlation with 'new machine', 'alternative material' and 'saving/efficient use of inputs'. 'New machine' has strong positive correlation with 'alternative material' but negative correlations with 'product quality and standard' and 'saving/efficient use of inputs' – away from intutive expectation.

Table 10.3: Complementarity among types of innovations

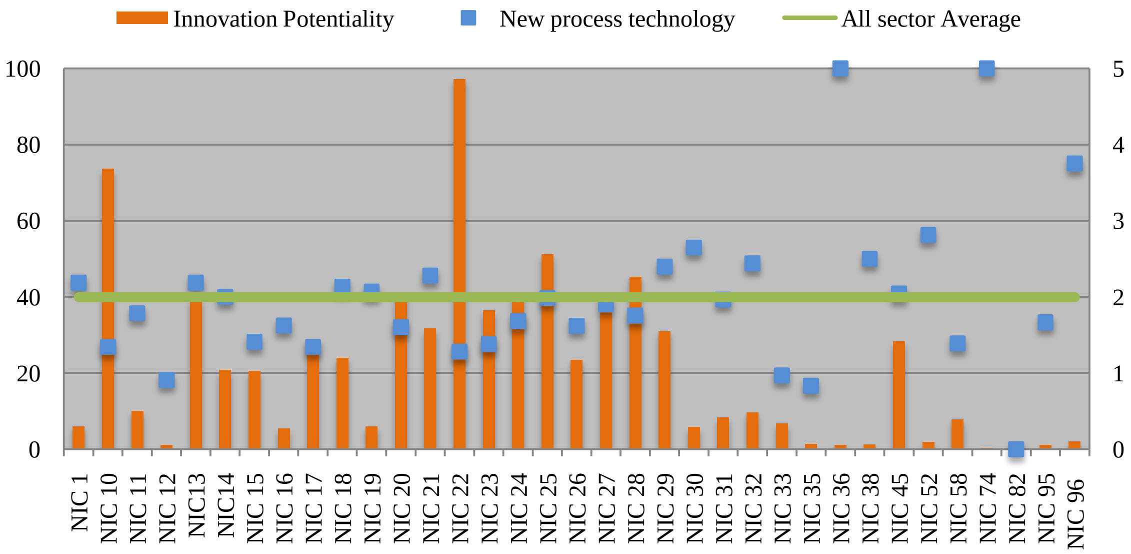
Innovation types	New product	New process technology	Product quality and standard	Saving/ more efficient use of inputs	Alt. material	New machines
New product	1.00	-0.39	0.31	-0.17	-0.22	-0.08
New process technology		1.00	0.09	0.28	-0.34	0.40
New machines			-0.32	-0.41	0.40	1.00

Figure 10.9: Product innovations in sectors



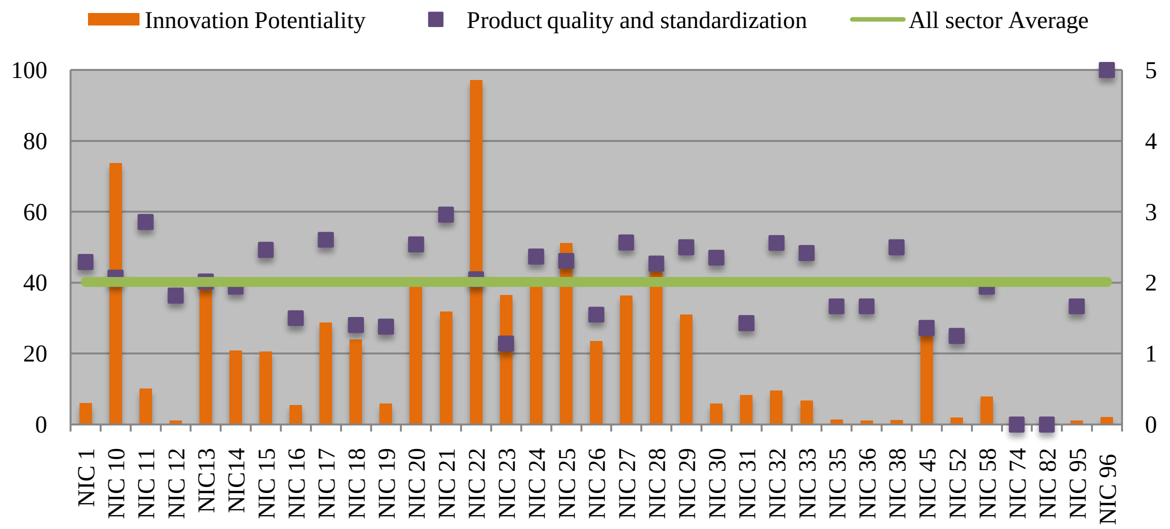
Note: Right hand axis measures innovation potentiality

Figure 10.10: Process innovations in sectors



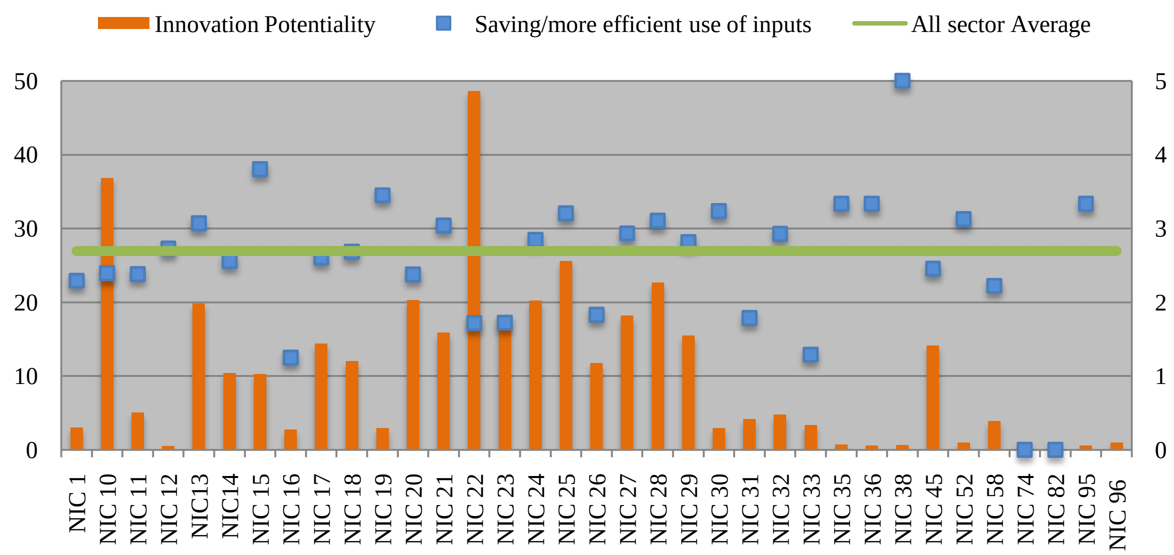
Note: Right hand axis measures innovation potentiality

Figure 10.11: Product quality and standardisation in sectors



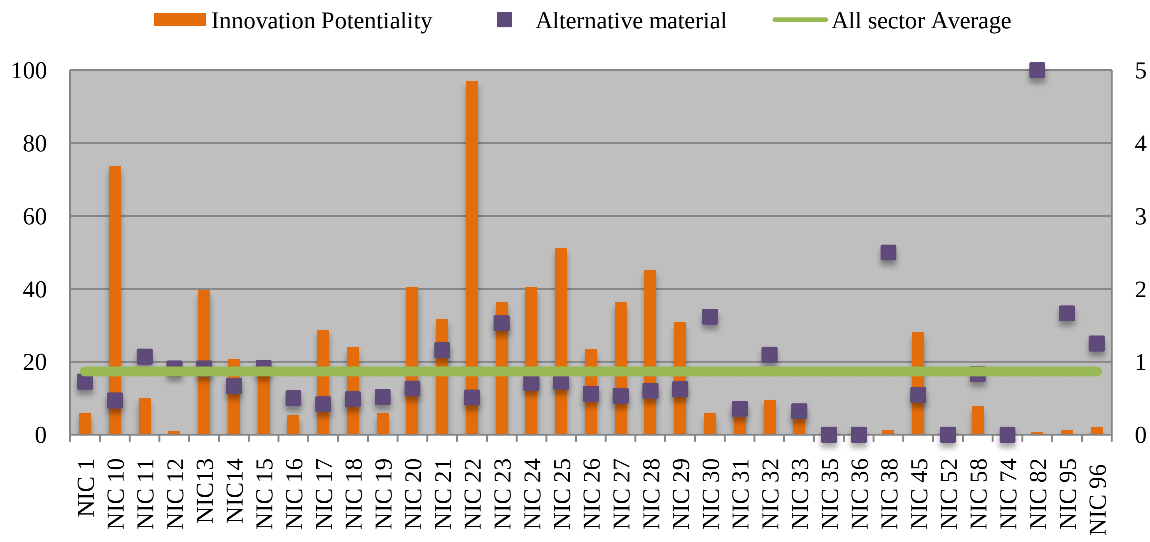
Note: Right hand axis measures innovation potentiality

Figure 10.12: Saving/more efficient use of inputs in sectors



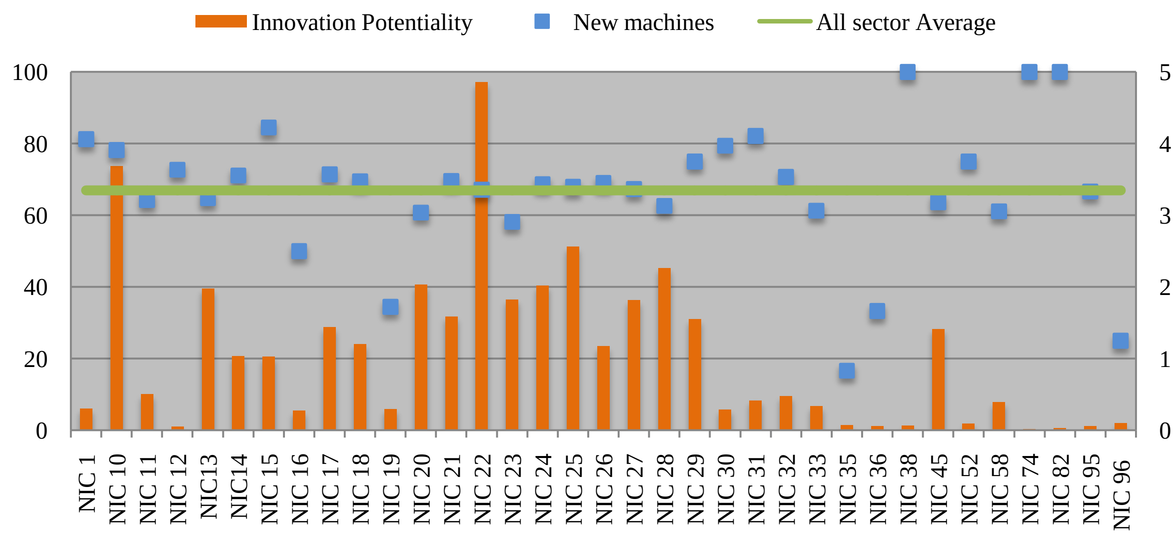
Note: Right hand axis measures innovation potentiality

Figure 10.13: Alternative material in sectors



Note: Right hand axis measures innovation potentiality

Figure 10.14: New machines in sectors

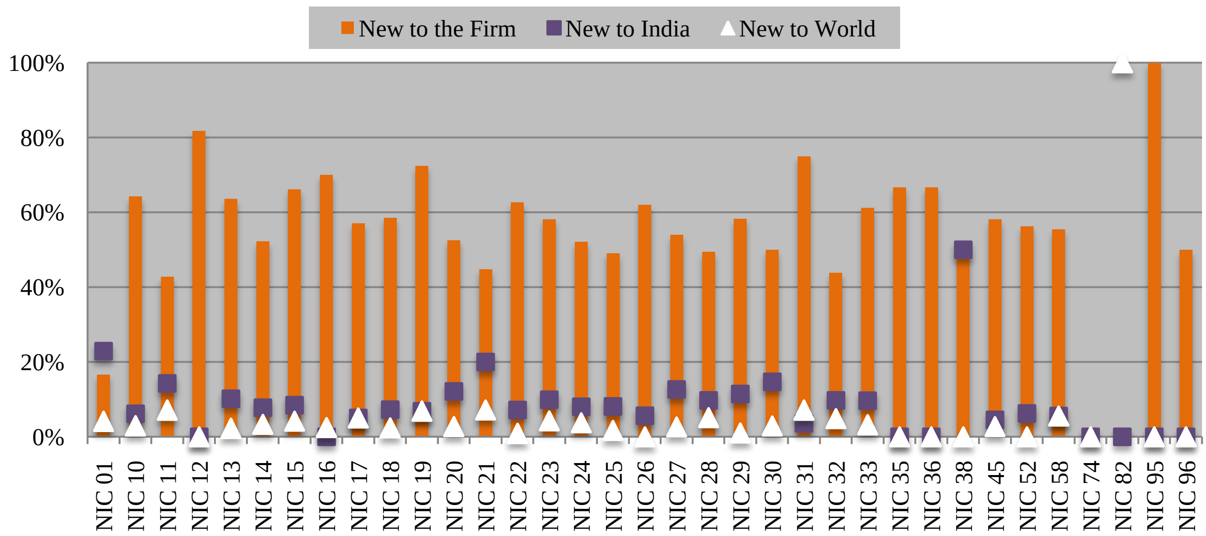


Note: Right hand axis measures innovation potentiality

Novelty of Innovation

Across all the sectors general nature of innovation is adoption of technology in the firm. NIC 38 (Waste Collection, Treatment and Disposal activities, Material recovery) shows innovation 'new to India' by 50% firms. The sector however, has insignificant share in the total sample. Besides that agricultural product (NIC 01), electrical equipment (NIC 27) and pharmaceutical (NIC 21) sectors show notable innovations that are new to India (figure 10.15).

Figure 10.15: Novelty of Innovation in sectors



Strategies for Innovation (innovation activities)

Innovation strategies of the innovative firms have been captured through the innovation related activities undertaken by these firms. Focus is drawn both on R&D and non-R&D activities. In R&D activities two broad distinctions are made between in-house and extra-mural R&D activities. Rest of the activities are acquiring technology, knowledge etc. training of the personnel, and taking innovation to the market. Table 10.4 shows percentage of innovative firms undertaking innovation related activities. Figure 10.16 shows that acquisition of technology is the most commonly adopted practice. Extra mural R&D is not the norm, where as there are innovative firms in each sector that undertake intramural R&D activities. Training of the manpower again is prevalent across the sectors (Figue 10.17).

Table 10.4: Innovation related activities of the innovative firms

Innovation Activites	Intramural R&D	Extramural R&D	Acquisition of Technology	Acquisition of other external knowledge	Training	Market introduction of Innovation	Other Activities
Innovative Firms (in %)	35.05%	11.43%	67.02%	16.36%	39.20%	16.65%	14.86%

Figure 10.16: Innovation Activities performed by Innovative firms

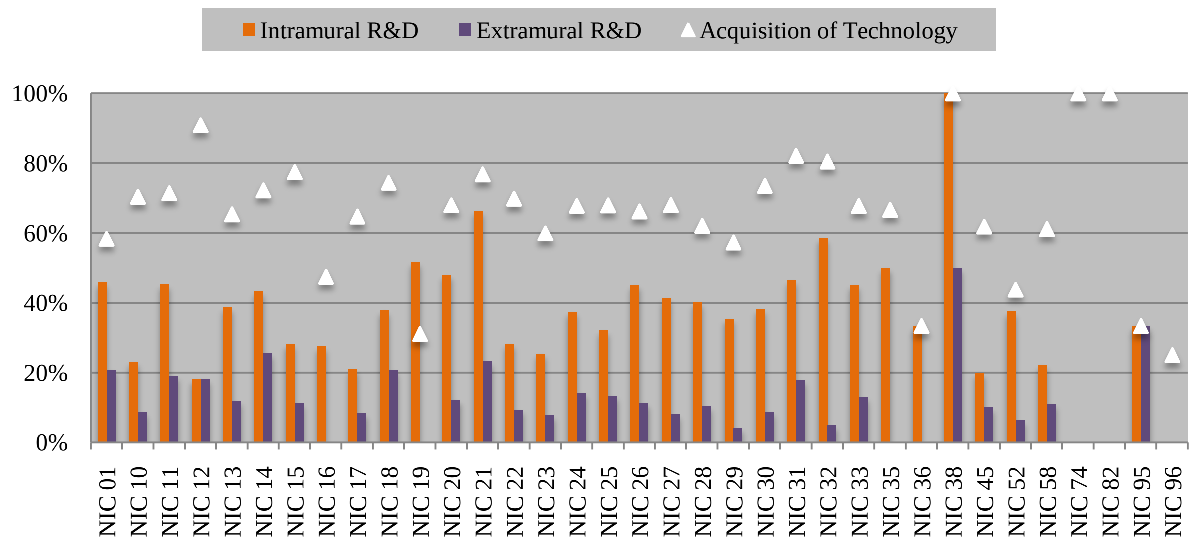
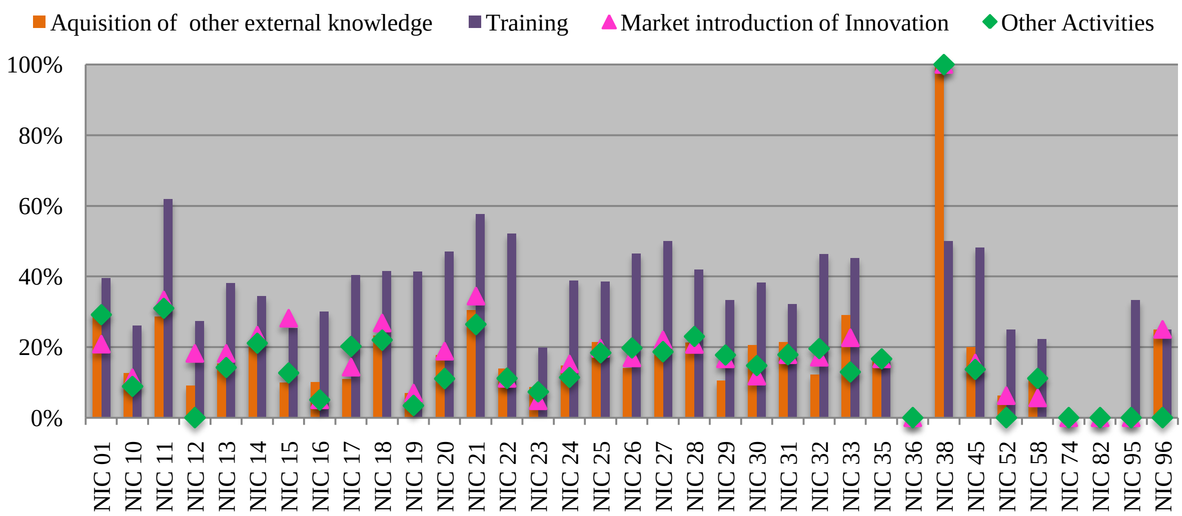


Figure 10.17: Innovation Activities performed by Innovative firms



Sources of technology/Innovation

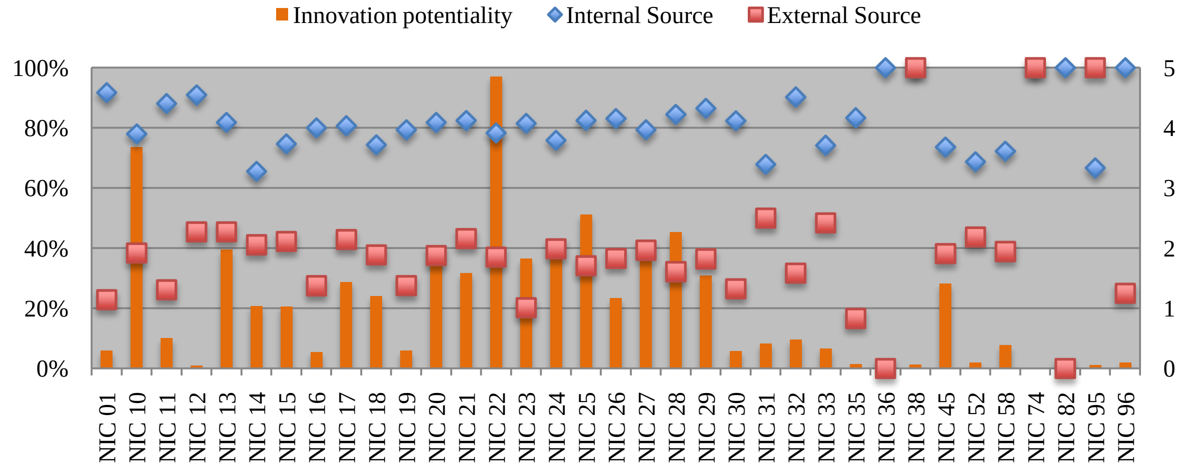
Across the sectors firms are generally dependent on internal sources for innovation related activities irrespective of the innovation potentiality of the sectors (figure 10.18). Sectors that shows higher in external source usage have negligible shares in the sample and mainly of service industry types, namely, computer repair (NIC 95), professional and scientific activities (NIC 74) and waste treatment (NIC 38). Table 10.5 shows correlation of source use by the innovative firms with the innovation potentiality of the sectors. There is somewhat indication that higher the innovation potentiality lesser is the dependence on internal sources. Figure 10.19 shows that domestic market is the main source of technology although there is practice of sourcing technology from the collaborators. Table 10.6 shows interesting correlations with innovation potentiality of the sectors – that higher the potentiality higher is the incidence of sourcing from collaborator.

Table 10.5: Innovation related activities of the innovative firms

Source of Innovation	Internal Source	External Source	Other*	NA
As % of Innovative Firms	79.77%	36.59%	2.20%	3.30%
Correlation with innovation potentiality	-0.25	-0.09		

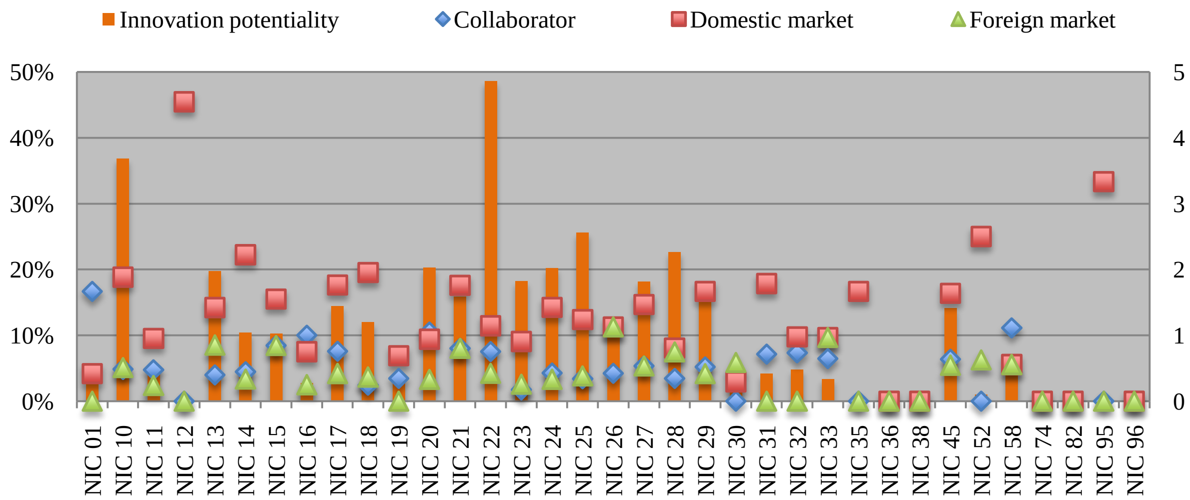
Note: Other* = With other enterprise or institutions (Universities, Govt. Labs)

Figure 10.18: Source of innovation used by innovative firms



Note: Right hand axis measures innovation potentiality

Figure 10.19: Source of Technology acquired



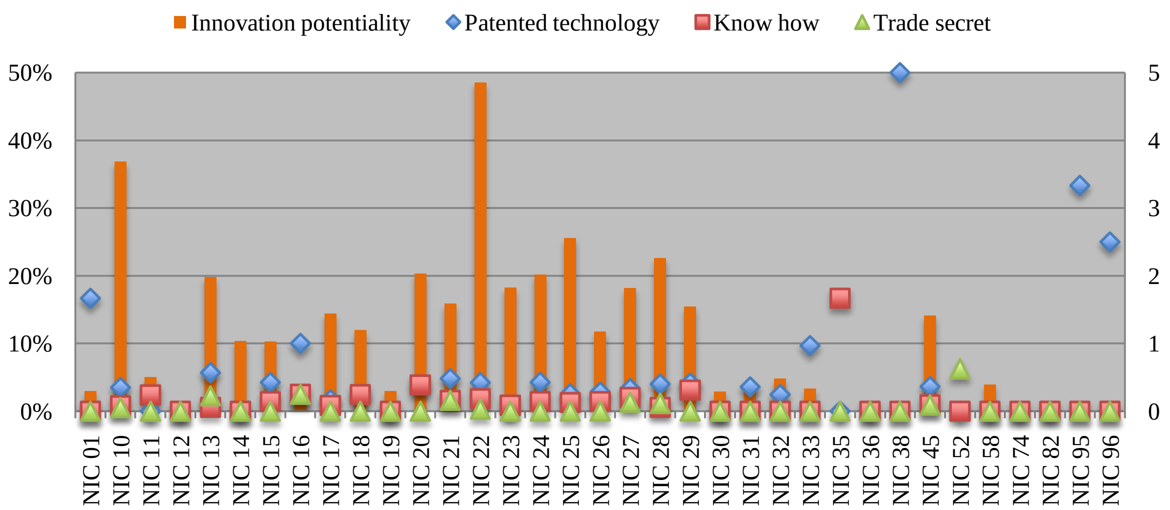
Note: Right hand axis measures innovation potentiality

Table 10.6: Correlation with Innovation potentiality

Correlation	Collaborator	Open domestic market	Foreign market
Innovation potentiality	0.25	0.09	0.40

The form in which technology is sourced there is some presence of accessing patented technology (figure 10.20) although it shows negative correlation with innovation potentiality (table 10.7).

Figure 10.20: Form of technology sourced



Note: Right hand axis measures innovation potentiality

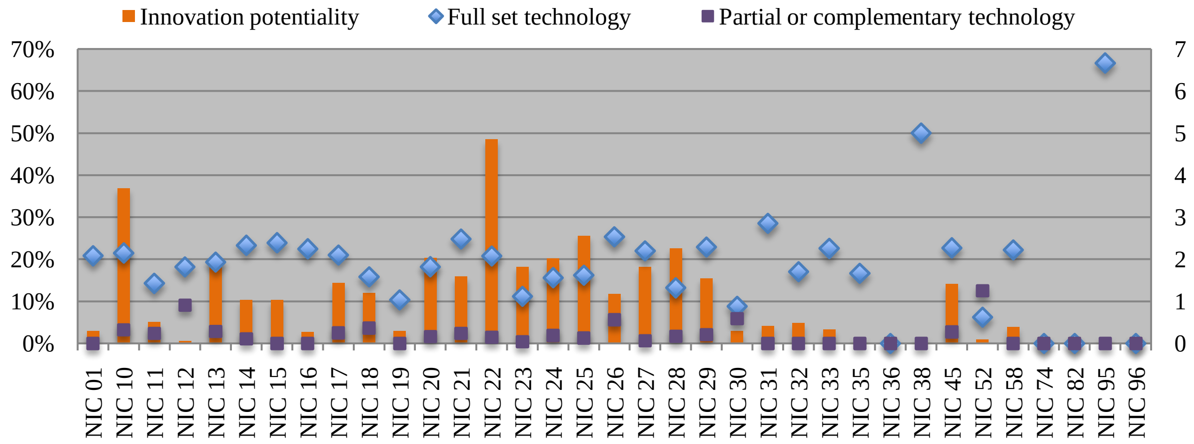
Table 10.7: Correlation between forms of technology and innovation potentiality

Correlation	Patented technology	Knowhow	Trade secret
Innovation potentiality	-0.21	0.03	0.00

Extent of technology

While sourcing technology firms across the sectors behave according to their internal capabilities. Sourcing full set technology requires cooperation from the technology supplier for making the technology fully functional. On the other hand partial technology requires firms' confidence on making the complemetarity work. Sourcing full set technology appears to be the main stay of the Innovative firms in India in general (figure 10.21) . Table 10.8 does not show any meaningful correlation with innovation potentiality of the sectors.

Figure 10.21: Extent of technology sourced



Note: Right hand axis measures innovation potentiality

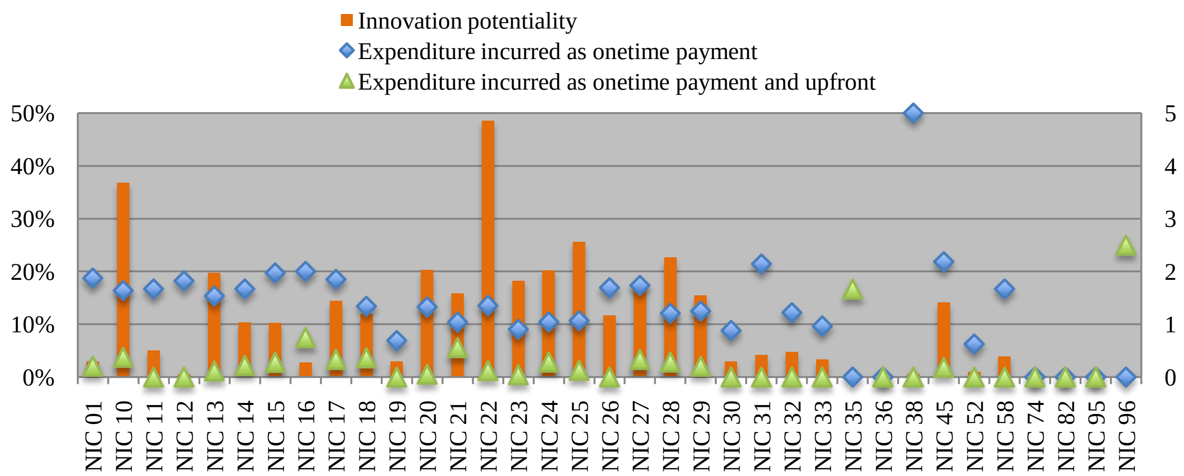
Table 10.8: Correlation between extent of technology and innovation potentiality

Correlation	Full set technology	Partial technology
Innovation potentiality	0.04	0.03

Nature and source of expenditure incurred for Sourcing technology/knowledge

As figure 10.22 shows the nature of expenditure for acquiring innovation related capabilities are managed as one time payment. There is no meaningful correlation with innovation potentiality of the sectors. It means that the behaviourial pattern does not change with the innovation potentiality.

Figure 10.22: Expenditure for Innovations in sectors



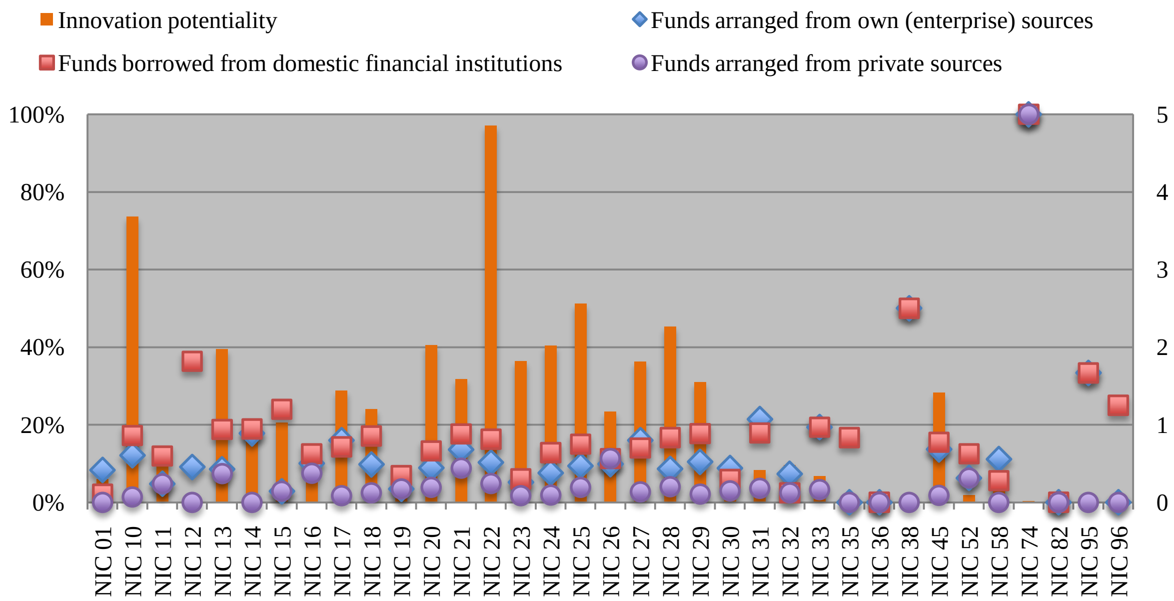
Note: Right hand axis measures innovation potentiality

Table 10.9: Correlation between Nature of expenditure and innovation potentiality

Correlation	Expenditure incurred as onetime payment	Expenditure incurred as one time payment and upfront
Innovation potentiality	0.12	-0.08

The sectoral scenario for arranging funds for sourcing technology is generally non-innovative. The sector-wise division of innovative firms do show inclination for using domestic financial sources used as often as internal sources (figure 10.23). Negative correlations with innovation potentiality, however, gives a confusing picture of negative correlations with all sources.

Figure 10.23: Arranging finance for sourcing technology for innovations by sectors



Note: Right hand axis measures innovation potentiality

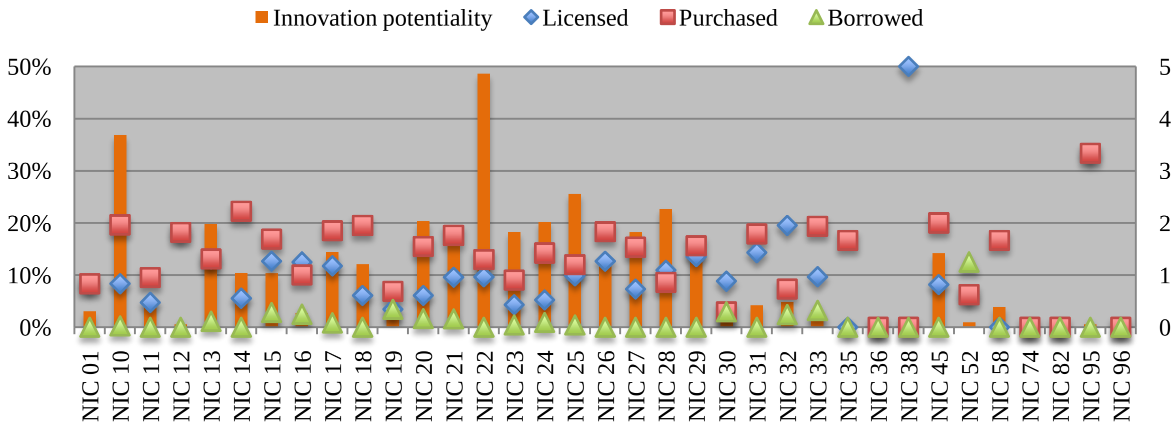
Table 10.10: Correlation between source of fund and innovation potentiality

Correlation	Funds arranged from own (enterprise) sources	Funds arranged from private sources	Funds borrowed from domestic financial institutions
Innovation potentiality	-0.16	-0.12	-0.15

Technology Agreement

Outright purchase of technology is the most chosen path with some preference for licensing (figure 10.24). The positive correlation (table 10.11) between purchase and innovation potentiality indicate the preference of innovative firms. Sectoral preference for aggreement, however, appears to have favour for maintenance and to some extent for training (Figure 10.24 and table 10.12).

Figure 10.24: Agreement on technology for Innovations in sectors (I)

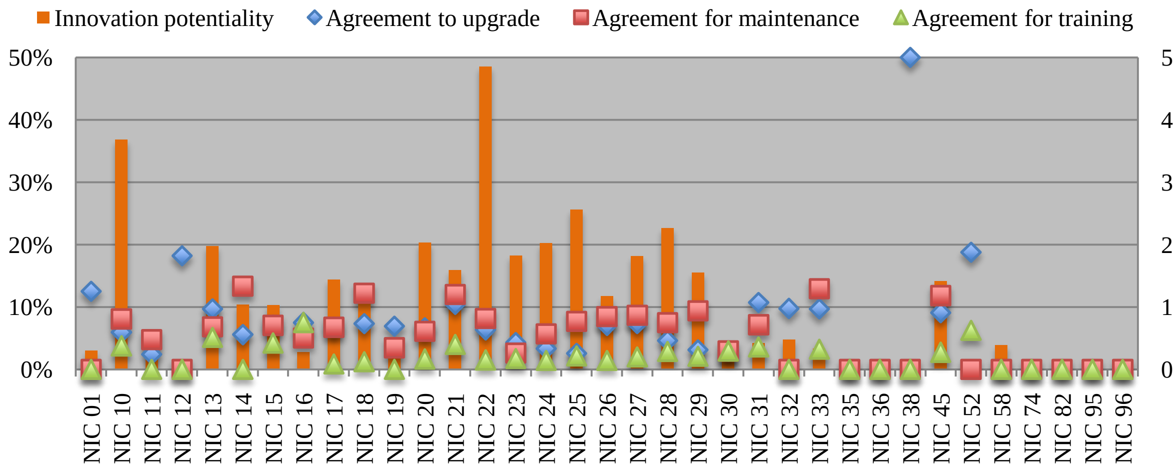


Note: Right hand axis measures innovation potentiality

Table 10.11: Correlation between technology agreement and innovation potentiality

Correlation	Licensed	Purchased	Borrowed
Innovation potentiality	-0.07	0.26	-0.19

Figure 10.25: Agreement on technology for Innovations in sectors (II)



Note: Right hand axis measures innovation potentiality

Table 10.12: Correlation between technology agreement and innovation potentiality

Correlation	Agreement to upgrade	Agreement for maintenance	Agreement for training
Innovation potentiality	-0.12	0.54	0.24

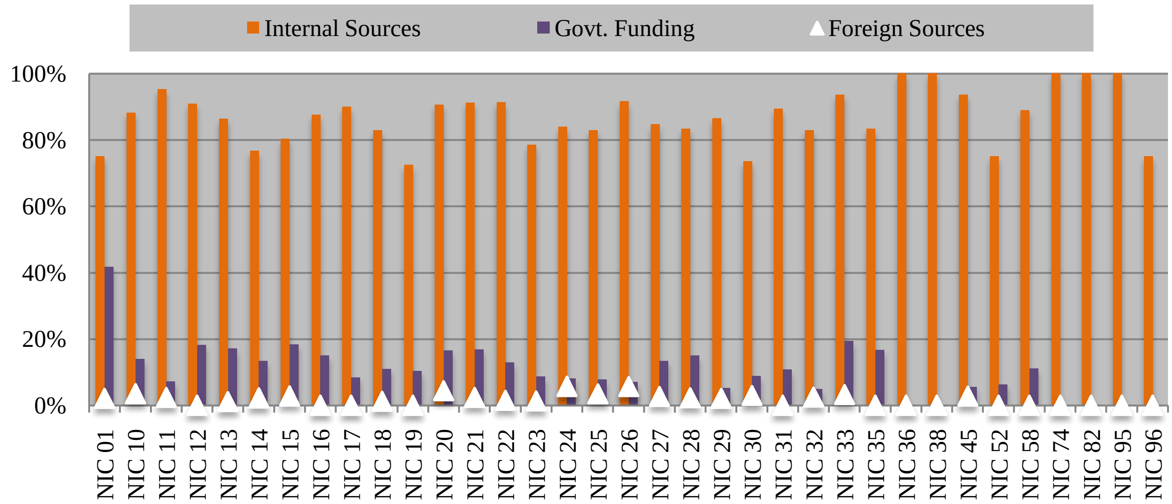
Source of Funds

Except the farming sector internal source remain the most trusted source for innovative firms in all sectors. Accessing govt. funding is rare (figure 10.26 and table 10.13).

Table 10.13: Funds of Innovation Activities

Internal Sources	Govt. Funding	Foreign Sources	NA
86.02%	12.22%	2.54%	11.43%

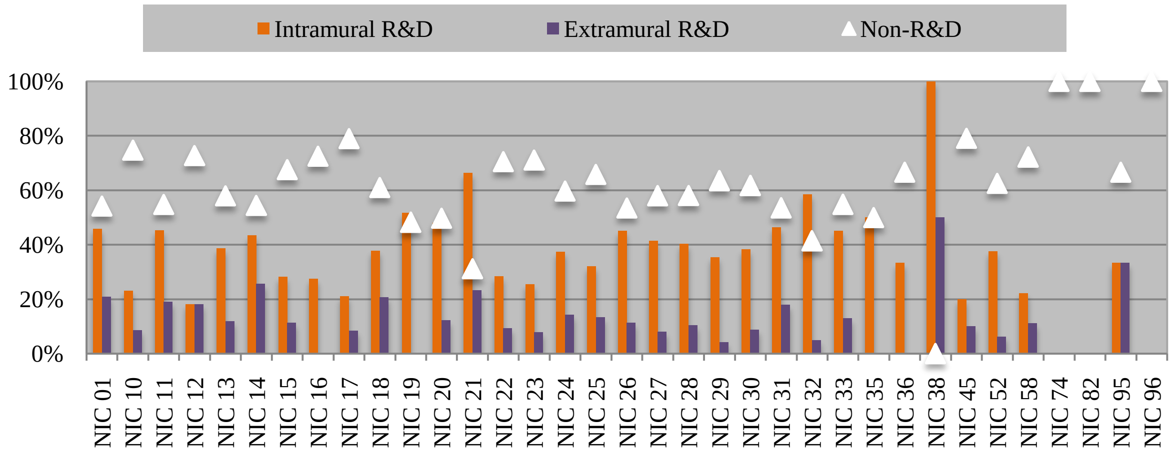
Figure 10.26: sources availed by Innovative firms for Innovation Activities/Expenditure



R&D and Non – R&D innovations

Sector level scenario of non-R&D innovation is similar to state level scenario. Most of the sectors have large number of innovative firms not engaged in R&D activities, intra or extramural (Figure 10.27). NIC 21 which is the pharmaceutical sector and generally considered as R&D intensive is an exception from the general trend.

Figure 10.27: Non-R&D innovations in the sectors

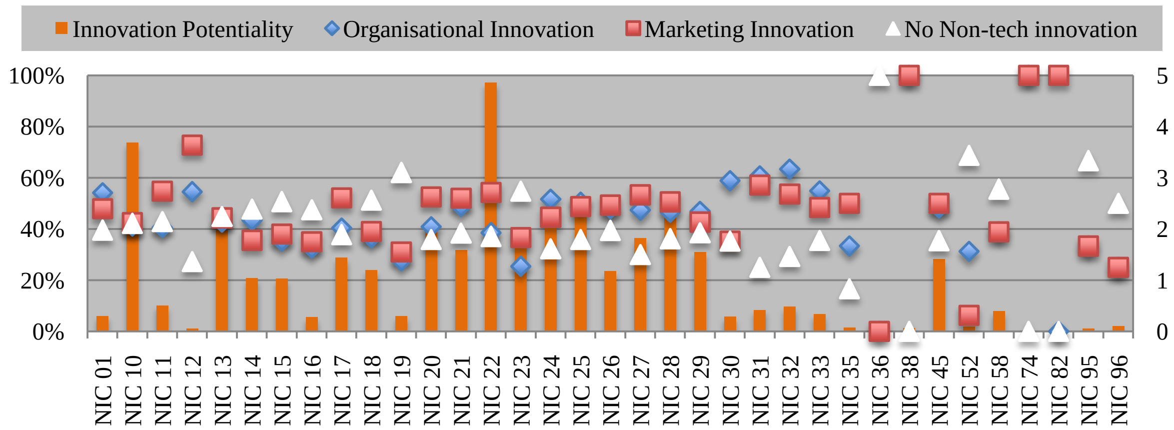


Non – technological innovations

Non-technological innovations have been categorised as organisational innovations and marketing innovations. It is generally believed that non-technological innovations are closely complementary to technological innovations because new technology requires new organisatonal dynamics and hence new formations within the organisation of an enterprise. Also new innovations need new marketing initiatives for realisation of the investment on innovation in real time. Figures 10.28 shows the initiatives of the innovative firms at the sector level.

Correlation coefficient between organisational and marketing innovation is as high as 0.56. So, both forms of non-technological innovations go hand in hand, except that marketing innovations have comparatively higher presence in NIC 12 (tobacco product), NIC 38 (waste treatment), NIC 74 (Professional and scientific activities) and NIC 82 (Office administration equipments). But as the correlation with innovation potentiality (table 10.14) shows, both forms of non-technological innovations do not have any relation with innovation potentiality.

Figure 10.28: Non-technological Innovations in sectors



Note: Right hand axis measures innovation potentiality

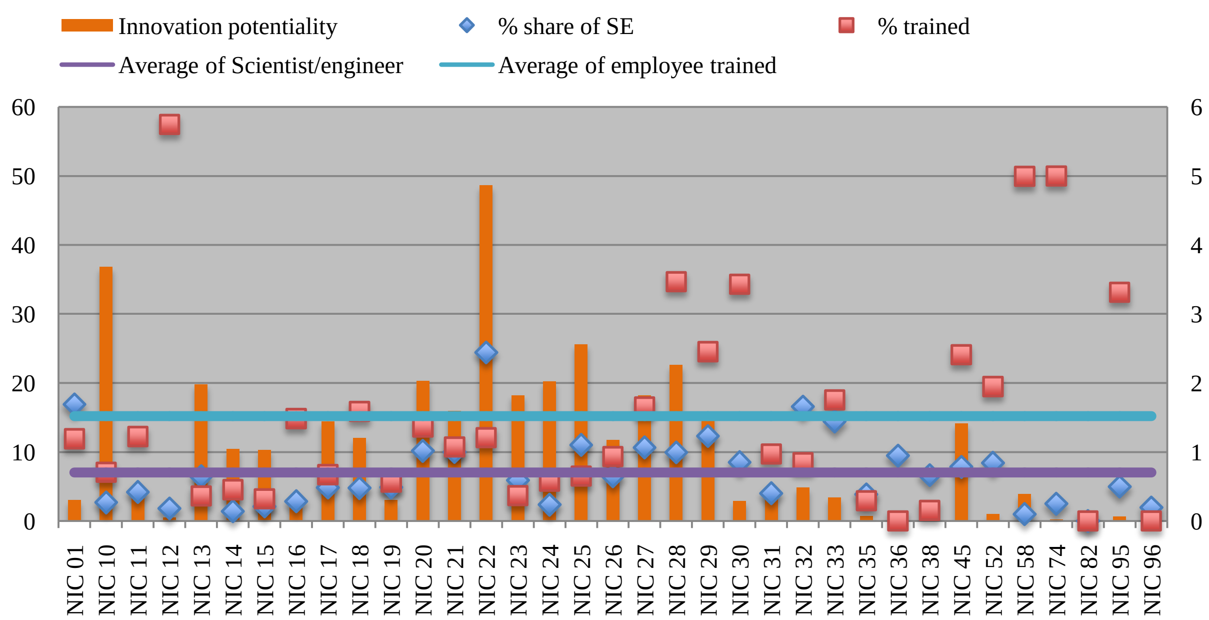
Table 10.14: Correlation between non-technology and innovation potentiality

Correlation	Organisational Innovation	Marketing Innovation	No Non-tech innovation
Innovation Potentiality	-0.03	-0.03	0.00

Composition and training of HR for Innovation

Figure 10.29 shows that sector-average of percentage of workforce trained is about 15%. There are 9 sectors that are above average and most of them have very low innovation potentiality. Average share of scientist and engineers is about 7%. NIC 22 – rubber and plastics sector has 24% workforce in the form of scientist and engineer which is highest among all sectors. Employees are mostly trained in-house Training of the employees is given mostly in-house and this is the practice across the sectors (Figure 10.30). Training in institutions abroad or training with collaborators are rare initiatives. This is also true for accessing sources of funding for training. Rarely innovative firms in any sector have accessed government or foreign sources for training their employees as is shown in figure 9.31.

Figure 10.29: Scientist/Engineers employed and training of employees by Innovative Firms



Note: Right hand axis measures innovation potentiality

Figure 10.30: Accessing sources for training

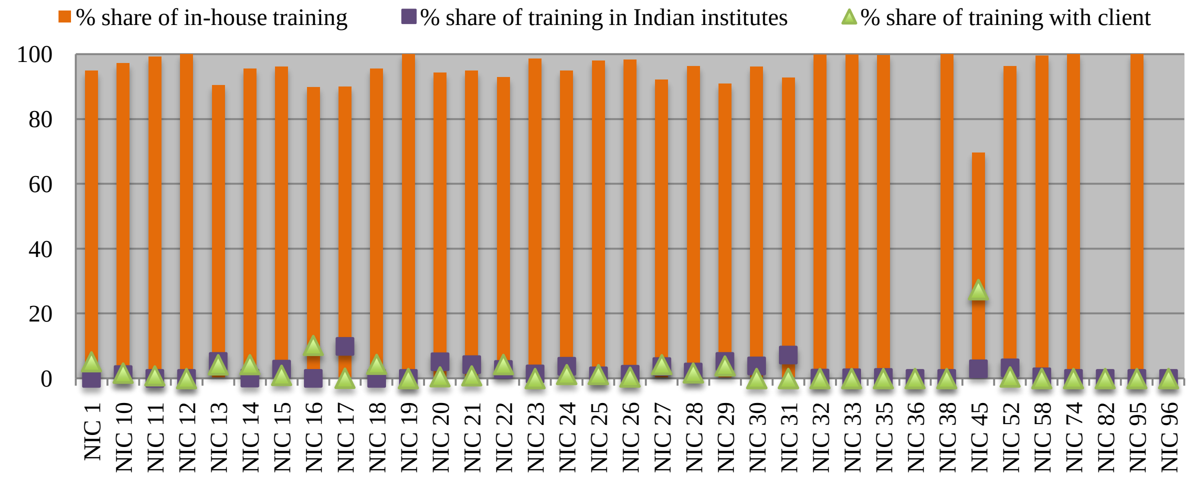
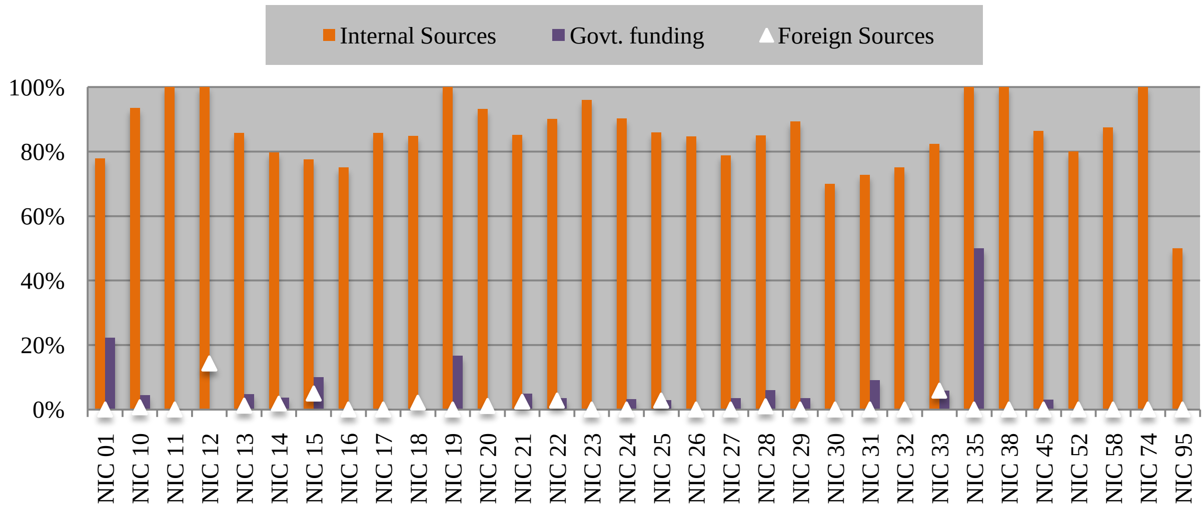


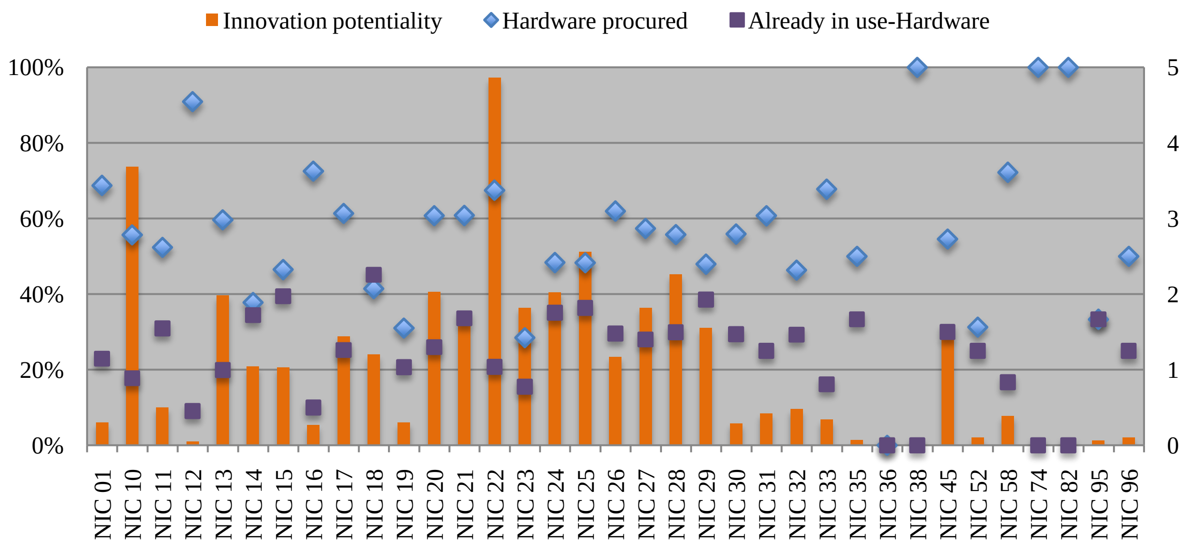
Figure 10.31: Accessing funding sources for training



ICTisation of innovative firms

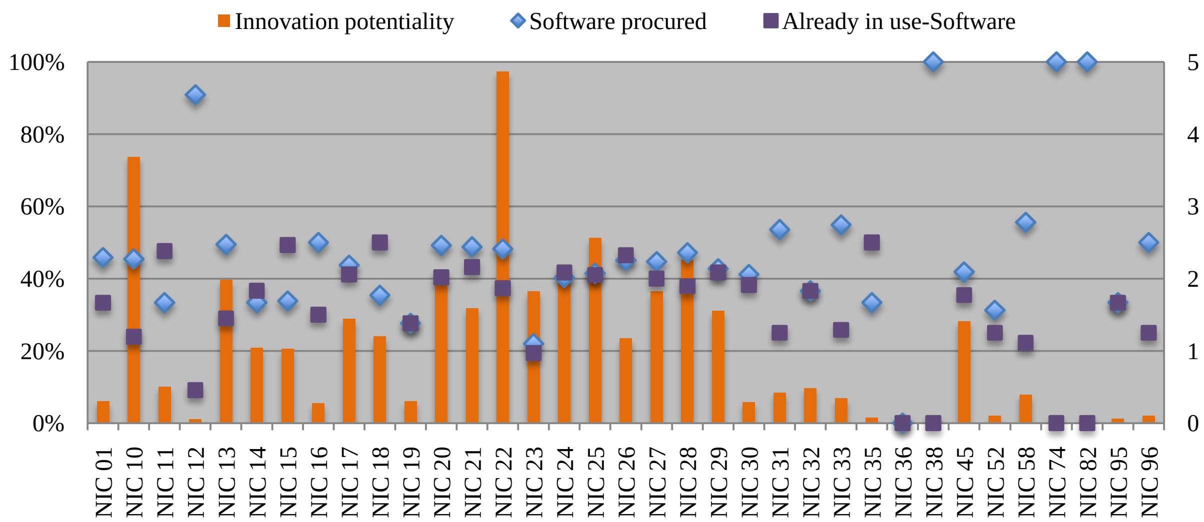
Extent of ictisation is expected to be higher in sectors with higher innovation potentiality. Figure 10.32 and 10.33 highlight that in terms of procurement of new hardware and software. The table 10.15 shows high positive correlation with hardware and software in use by sectors with innovation potentiality but negative relation with hardware and software procured. ICT helps sourcing and processing information from wide variety of sources. It is expected that innovative firms would use ICT for accessing new information and processing the same for choices and strategies. Figure 10.34 and 10.35, however, do not give any definite indication. Table 10.16 shows negative correlations with all sources except positive correlation of small magnitude with market sources.

Figure 10.32: ICT Hardware use by innovative firms in sectors



Note: Right hand axis measures innovation potentiality

Figure 10.33: ICT Software use by innovative firms in sectors

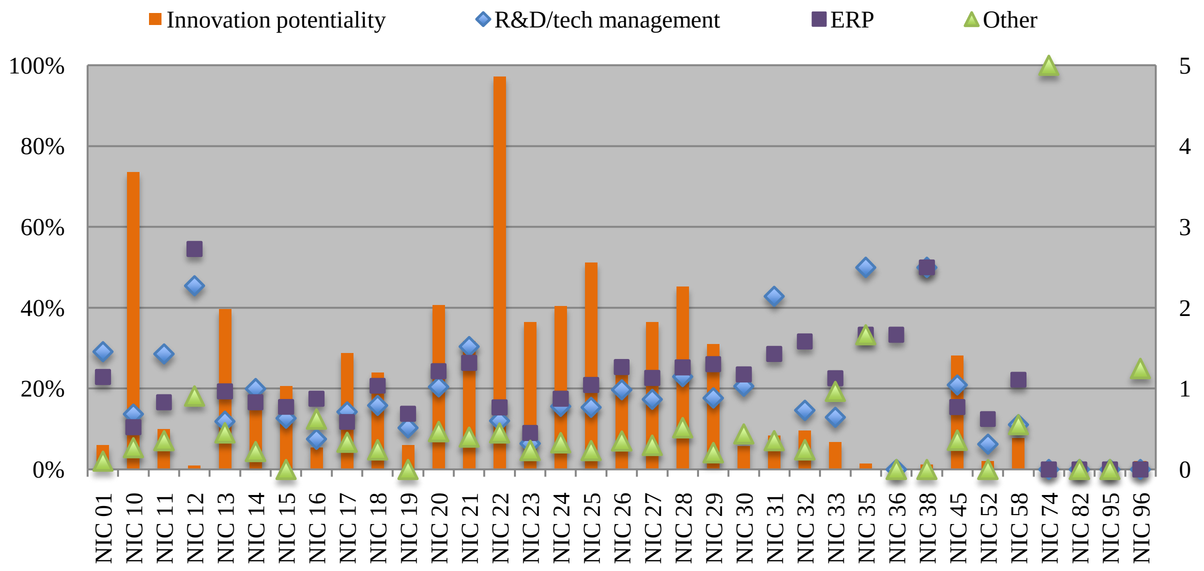


Note: Right hand axis measures innovation potentiality

Table 10.15: Correlation of ICTisation with innovation potentiality

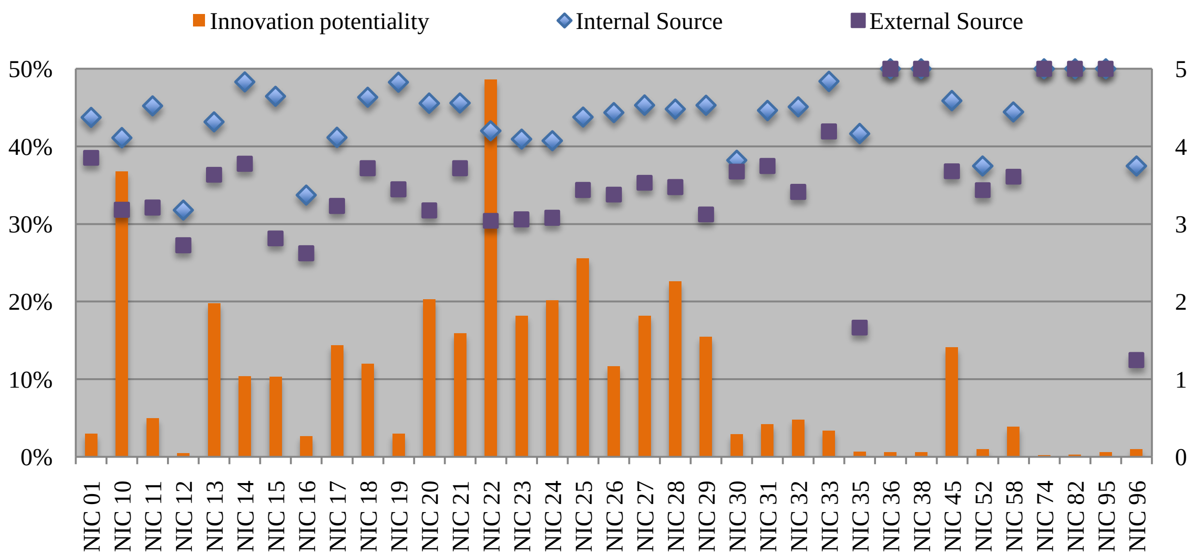
Correlation	Hardware procured	Already in use-Hardware	Software procured	Already in use-Software
Innovation potentiality	-0.08	0.28	-0.17	0.36

Figure 10.34: ICT use by innovative firms



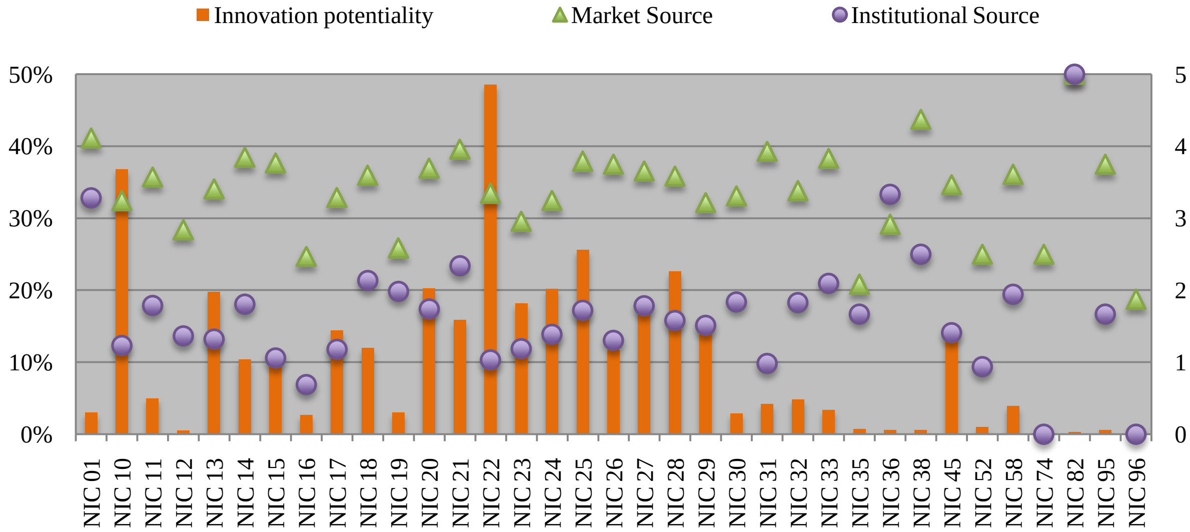
Note: Right hand axis measures innovation potentiality

Figure 10.35: Source of information used by innovative firms (I)



Note: Right hand axis measures innovation potentiality

Figure 10.36: Source of information used by innovative firms (II)



Note: Right hand axis measures innovation potentiality

Table 10.16: Correlations between sources used and innovation potentiality

Correlation	Internal Source	External Source	Market Source	Institutional Source	Other Source
Innovation potentiality	-0.09	-0.21	0.13	-0.20	0.04

In Nutshell

Sector level scenario is quite similar to that of states. Comparative innovation potentiality shows Rubber and Plastic product sector (NIC 22) at the top in innovation potentiality with second highest share in innovative firms. Manufacturing of food products (NIC 10), which has second highest innovation potentiality, has the highest share of sample as well as innovative firms. It is to be noted that these are the old established industrial activities. The new generation of industries do not have much presence in the innovation scenario. Small firms dominate in all sectors. Tobacco products (NIC12), wearing apparel (NIC 14), Computer and electronics (NIC 26), transport equipment (NIC 30) and furniture (NIC 31) have significant presence of larger firms with 100 to 499 workforce.

Sectors with lower innovation potentiality has higher share of product innovation. Sectors with better network with external agencies for sourcing technology, information training and funding are those having negligible share in the total sample and mainly from computer repair (NIC 95), professional and scientific activities (NIC 74) and waste treatment (NIC 38). There is somewhat indication that higher the innovation potentiality lesser is the dependence on internal sources.

The correspondence between sector level innovation and state level scenario to understand the innovation in Indian context is attempted in chapter XI.

Appendix

Industrial Classification as per the NIC code 2008	NIC08
Crop and animal production, hunting and related service activities	01
Other Mining and Quarrying (stone, sand and clay)	08
Manufacture of food products	10
Manufacture of beverages	11
Manufacture of tobacco products	12
Manufacture of textiles	13
Manufacture of wearing apparel	14
Manufacture of leather and related products	15
Manufacture of wood and products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	16
Manufacture of paper and paper products	17
Printing and reproduction of recorded media	18
Manufacture of coke and refined petroleum products	19
Manufacture of chemicals and chemical products	20
Manufacture of pharmaceuticals, medicinal chemical and botanical products	21
Manufacture of rubber and plastics products	22
Manufacture of other non-metallic mineral products	23
Manufacture of basic metals	24
Manufacture of fabricated metal products, except machinery and equipment	25
Manufacture of computer, electronic and optical products	26
Manufacture of electrical equipment	27
Manufacture of machinery and equipment n.e.c.	28
Manufacture of motor vehicles, trailers and semi-trailers	29
Manufacture of other transport equipment	30
Manufacture of furniture	31
Other manufacturing	32
Repair and installation of machinery and equipment	33
Electricity, gas, steam and air conditioning supply	35
Water collection, treatment and supply	36
Waste Collection, Treatment and Disposal activities, Material recovery	38
Wholesale and retail trade and repair of motor vehicles and motorcycles	45
Warehousing and support activities for transportation	52
Publishing Activities(books, periodicals and other publishing activities	58
Other Professionals, Scientific and Technical activities (specialized design and photographic activities)	74
Office administrative, Office Support and other business support activities	82
Repair of computers and personal and household goods	95
Other personal service activities	96

XI
Understanding Innovation

Highlights

- Innovation Systems are institutional responses to the demand for innovation support from the production system. The organisational arrangements for extending support (the supply system) to innovation can be defined as the constituents of NIS, RIS and SIS.

- A close examination identifies disconnect between the supply and demand system. So far the NIS is concerned it has been seen that accessing institutional facilities for technological support to innovation is quite high in a few states, like, Assam, Gujarat, Madhya Pradesh, Meghalaya etc. But for states like Karnataka, Kerala and Tamil Nadu – states that are known to be innovation leaders – have poor records in accessing institutional support system for technological knowledge and information.

- Accessing institutional sources of finance is very rare among the innovative firms. Similarly institutional training programme for human resource development is also rarely accessed. There is, however, no correlation between states accessing support systems and the overall incidence of 'novelty of innovation', which is overwhelmingly burdened with 'new to firm' category of innovation.

- The RIS on the other hand has high positive correlation with innovation potentiality of the states. States ranked lower in RIS also have poor innovation potentiality. Weak RIS leads to ineffective innovation eco-system.

- Innovation potentiality has negative correlation with Comparative Status of Sectoral Innovation (CSSI) and high positive correlation with Innovation Alignment of Sectors (IAS). These indicate that the presence of the sector that has high innovation potentiality can improve the innovation eco-system of the states.

Understanding Innovation

Firms, as production units where innovations are to happen, have been the focus of the survey. Overall status of innovative activities in the production system of a region is the result of the dynamics of the production system itself in one side and the technological and non-technological support available to the enterprises on the other. Together they create innovation eco-system. The system is constituted of demand and supply side. An innovative production dynamics creates demand on the state for appropriate technological and non-technological support to facilitate and augment its own initiatives towards innovation. Such types and nature of demands depend on the overall economic status of the region/state, industrial policy, historical pattern of growth of different sectors (path dependence of technological development), entrepreneurship development etc. Institutional arrangements for addressing such demands are done at the national level as well as at the regional/state levels. These arrangements have three interconnected facets. Some of the arrangements are activated through national government at the national level and become one of the components of the National Innovation System (NIS). Another set is created at the regional/state level by the state authority according to the states own planning for economic development and industrialization. Let us call it Regional System of Innovation (RIS). There are also sectoral specificities of innovation. Different sectors have different innovation dynamics. Under a particular economic, industrial and policy environment certain sectors might show more dynamism towards innovation compared to other sectors. Such sectors develop their own systems of Innovation and innovation dynamics. In many cases such sectors grow in clusters that create a new innovation dynamics. Let us call it Sectoral Innovation System (SIS). It is, therefore, possible to witness higher innovation intensity in a region even in the absence of strong RIS and NIS but in the presence of strong SIS and clusters.

An effective innovation system would require large number of institutions extending various types of technological and non-technological inputs for promotion of innovation. In India, there are several initiatives through national level organizations/institutions engaged in technology generation, technology diffusion and marketing, technological consultancy, tools equipment and prototype development, common facilities and testing centres, raw material, machine and equipment supply, finance and refinance, infrastructure development, training and skill development, entrepreneurship development etc. Many of these organizations function through the corresponding departments under state government for extending services at the state and district levels. Such arrangement can be called network of Indian National System of Innovation (NIS).

While at the state level state government is the main agent of activating the NIS, on its part state government also creates its own institutions for providing technological and financial services to enterprises. The most important role played by the state government is to guide and build the industrial structure of the state, create physical infrastructure (roads and transport, power etc.) and create education and health infrastructure for human resource development. This arrangement is a part of RIS. Clusters come into existence in various ways. It could be location advantage for certain industrial sectors, or it also could be led by industrial policy of the state. It may also because of a set of historical reasons. Both NIS and RIS do contribute to the growth of clusters and development of a particular sector in a particular region. But important distinctive factor is its own dynamics of growth and innovation, which might get complemented by RIS and NIS. The figure 11.1 presents the innovation support system as part of NIS across the country. It is to be noted that the support system covers almost all areas that touch innovation. Also to be noted that there are large number of organisations for technology generation, but comparatively few for dissemination. Another side of the system is as we go down from the national to the local levels, organisations for support system become rarer.

Table 11.1: Innovation support system

Jurisdiction Activity	National	State	District	Local	Firm level
Technology Generation	RDI (611), CMTI TDC (8) TDC hand tools (1)	RDI (918), SIRO (490), Univ (282)			In-house R&D, MNCs' R&D centres
Technology diffusion/ Marketing	NRDC, MSMEDO, IDEMI	MSMEDI, State Khadi Board	DIC		
Technology Consultancy	CMTI, IDEMI	TCOs	DIC		
Tools, equipment, prototype development	CMTI, IDEMI, CMTI	Central tool room (10), Dir of Inds.			Collaboration with Danish, German, Swiss
Common facilities/ testing centres	Testing centres (4); Field testing stations (7), CMTI	TDI (30) Workshops (42)			
Raw material, Machine and equipment supply	NSIC, Khadi Board	State Khadi Board, MSMEDI	DIC		
Finance, refinance	SIDBI, NABARD	State Fin Cor.	Lead bank	MFI	
Infrastructure development	MSMEDO, RISC	State Dir of Inds. MSMEDI			
Training and skill development	TI (2), CMTI CAPART, IDEMI, NIMSME, Khadi Board	MSMEDI, ITI, Khadi Board	DIC	SHG, CSR, DRDA, BDO, Coop, NGO	Donor Agencies
Entrepreneurship development	EDI, IIT, TDI, NIT, NIESBUD, IIE	MSMEDI		SHG, CSR	

Note: Full form of the abbreviations is appended at the end of the chapter.

Reach of the NIS, RIS and SIS

The survey indicates broad understanding of the reach of NIS, RIS and SIS as presented in table 11.2, to 11.7. Table 11.2 shows that accessing institutional facilities for technological support to innovation is quite high in a few states, like, Assam, Gujarat, Madhya Pradesh, Meghalaya etc. But for states like Karnataka, Kerala and Tamil Nadu – states that are known to be technology leaders – have poor records in accessing institutional support system for technological knowledge and information. Accessing institutional sources of finance is very rare among the innovative firms. Similarly institutional training programme for human resource development is also rarely accessed. There is, however, no correlation between states accessing support systems and the overall incidence of 'novelty of innovation', which is overwhelmingly burdened with 'new to firm' category of innovation.

Table 11.2: Access of NIS by the innovative firms (%)

State	Source of knowledge(Educational institution)	Source of knowledge(R&D institution)	Institutional Source of finance	Training in institutions	Novelty of innovation
Andhra Pradesh	6.1	15.49	14.08	0.47	64% new to firm
Assam	71.7	79.25	5.66	7.69	67% new to firm
Bihar	19	19	1	20	93% new to firm
Chhattisgarh	29.55	29.55	0	20	55% new to market
Delhi	19.78	20.88	6.59	2.2	76% new to firm
Goa	12.2	36.59	8.54	3.66	51% new to firm
Gujarat	89.58	87.5	2.27	16.67	81% new to firm
Haryana	11.01	11.29	1.41	3.39	78% new to firm
Himachal Pradesh	25.85	25.23	6.15	16	75% new to firm
Jammu & Kashmir	45.83	43.75	14.58	6.25	66% new to firm
Jharkhand	3.31	4.82	1.51	15.06	88% new to firm
Karnataka	4.33	18.61	0.43	3.9	58% new to firm
Kerala	4.78	16.27	0	1.16	78% new to firm
Madhya Pradesh	76	80	30	0	72% new to market
Maharashtra	59.55	62.27	17.73	12.27	19% new to market
Meghalaya	80	70	0	0	100% new to firm
Nagaland	33.33	33.33	0	0	66% new to firm
Odisha	18.09	32.98	0	10	94% new to firm
Punjab	37.74	47.17	5.66	7.55	52% new to market
Rajasthan	15.32	12.9	8.06	0.81	88% new to firm
Sikkim	63.83	76.6	0	18.6	59% new to market
Tamil Nadu	2.64	4.49	1.32	0.05	84% new to firm
Tripura	45.88	80	0	0	49% new to market
Uttar Pradesh	67.57	75.68	18.92	2.7	69% new to

					market
Uttarakhand	30	30	6.67	0	60% new to firm
West Bengal	22.86	28	14.29	9.89	77% new to firm
A & N. Island	0.00	60.00	0.00	0.00	60% new to firm
Chandigarh	25.00	25.00	0.00	0.00	25% new to firm
Dadra & N Haveli	17.14	47.43	1.14	1.28	61% new to firm
Daman & Diu	6.04	18.13	1.10	5.26	52% new to firm
Puducherry	16.35	22.64	0.63	6.90	66% new to firm

Table 11.3: Indicative factors of Regional System of Innovation (RIS)

State	NSDP Per capita (Rs) at Constant Prices	Industry Share in NSDP	Highways Per 100 Sq Km	Health Centers/100 Village	Educational institute/million population	Power Generation/million population	RIS Rank	Innovation potentiality rank	HDI
Andhra Pradesh	36345	12.83%	1.65	51.30	316.68	1040.30	9	3	21
Assam	20279	13.68%	3.62	21.47	23.32	161.99	27	21	22
Bihar	11558	4.63%	0.08	25.78	193.00	145.4	29	28	27
Chhattisgarh	25835	31.74%	3.99	27.75	220.89	2486.22	6	25	29
Delhi	89037	6.10%	4.86	29.70	139.42	733.04	13	8	3
Goa	98807	30.98%	7.27	55.43	371.01	238.19	1	5	10
Gujarat	49030	27.87%	11.74	46.71	191.41	1285.98	2	24	17
Haryana	55214	18.21%	0.09	43.59	356.00	869.70	5	17	15
Himachal Pradesh	40690	11.77%	0.05	12.88	770.00	2378.00	16	19	9
Jammu & Kashmir	26739	9.81%	0.56	35.88	170.15	1127.30	20	20	16
Jharkhand	22780	35.82%	0.10	13.72	277.00	210.50	22	12	25
Karnataka	37464	17.56%	13.00	36.25	323.08	671.00	3	1	18
Kerala	46511	9.58%	12.69	412.10	189.28	325.65	10	4	1
Madhya Pradesh	19736	15.87%	1.52	18.70	178.33	802.46	24	23	26
Maharashtra	57458	20.99%	1.36	29.18	242.44	861.88	11	2	13
Meghalaya	29656	15.42%	3.61	9.01	36.05	111.26	26	29	12
Nagaland	20971	3.24%	2.98	41.23	22.91	129.65	28	30	12
Odisha	24098	17.28%	5.66	15.97	255.26	942.64	14	16	28
Punjab	43539	20.53%	3.09	27.82	191.76	976.85	12	22	11
Rajasthan	23669	16.68%	1.63	31.63	264.96	520.18	18	14	23
Sikkim	36075	8.69%	0.87	38.05	33.28	5487.65	17	13	8
Tamil Nadu	46823	17.43%	0.11	61.85	296.00	876.30	7	11	14
Tripura	33503	4.86%	3.81	82.99	23.07	416.35	21	15	12
Uttar Pradesh	16182	14.66%	2.81	23.01	108.60	531.16	25	18	24
Uttarakhand	41126	22.51%	3.82	12.24	298.49	1152.03	8	27	20
West Bengal	30504	10.28%	6.27	28.47	115.77	540.69	19	10	19
A & N. Island	54830	2.64%	3.64	25.05	28.92	631.75	23	26	5

Chandigarh	90051	6.54%	21.05	79.17	17.54	0.00	15	31	2
Dadra & N Haveli	-	-	0.00	81.43	19.96	-	-	6	7
Daman & Diu	-	-	0.00	134.78	20.23	-	-	7	6
Pondicherry	69704	28.16%	11.06	86.96	32.43	232.98	4	9	4

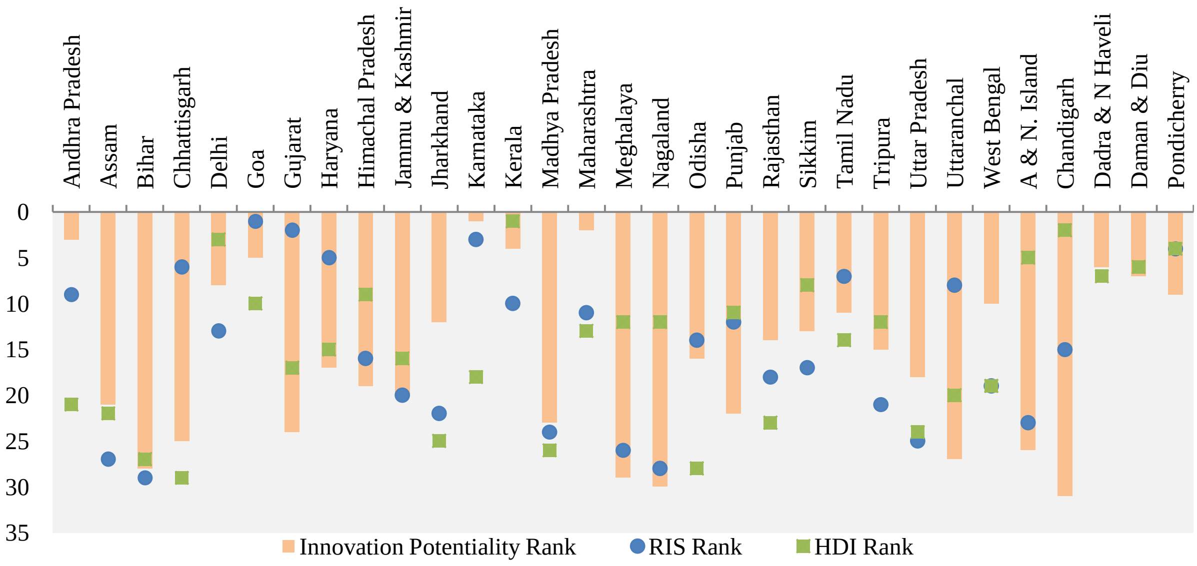
Source: Handbook of Statistics on Indian Economy 2010-2011; Ministry of Road Transport and Highways; Indiastat database; Ministry of Human Resource Development; Ministry of Health and Family Welfare; Gendering Human Development Indices: Recasting the Gender Development Index and Gender Empowerment Measure for India, Ministry of Women and Child Development

For RIS state level infrastructure (road. Power etc), human resource generation (health and education) along with extent of industrialisation and per capita NSDP (Net State Domestic Product) have been used. The table 11.3 presents the state level comparative positions in selected state level indicators. States were ranked separately under each column and assigned the rank value 31 for the lowest and 1 for the highest scores. Rank values were added (unweighted) laterally to derive overall rank values, as shown in the column 8 (RIS rank), and followed by the rank of the states in terms of Innovation Potentiality and HDI for comparative scenarios. Figure 11.1 presents the comparative status of all the three indicators for the states. Table 11.4 shows the correlations among RIS, HDI and innovation potentiality of states. Strong positive correlation between innovation potentiality and RIS is noteworthy. For other two the coefficients are positive with smaller magnitude.

Table 11.4: Correlation among RIS, HDI and innovation potentiality of states

Correlation	RIS and Innovation potentiality	HDI and innovation potentiality	RIS and HDI
Innovation Potentiality	0.48	0.21	0.21

Figure 11.1: Rank correspondence of different indicators



How influential is the Sectoral Innovation System (SIS)? We construct two indicators using sector level innovation potentiality as defined at the outset.

a) **Innovation Alignment of Sectors (IAS) of the states:** Given the innovation potentialities of the sectors we examine the industrial activities of the state (distribution of sample firms over different sectors in a state) and assess the alignment of the same with the overall innovation potentiality of different sectors. If we see that a particular sector has very high over all innovation potentiality but a state has very small share of firms in that sector we can say that industrial activities of the state is not aligned with the **IAS**, or in other words the state has weak Sectoral Innovation System (SIS). We use the correlation coefficients between overall innovation potentiality of a sector and states' shares (number of firms) in different sectors as the measure of IAS.
b) **Comparative Status of Sectoral Innovation (CSSI) in a state:** The other measure is a sector's share in state in the total innovative firms in the state. We calculate the Skew value of the sectoral distribution of innovative firms in the states. Higher skew value indicates innovation activities only in a few sectors.

Indicators 'a' and 'b' together depict the comparative innovation scenario of the states in terms of the performance of various sectors. Table 11.5 presents the comparative scenario in this regard. Table 11.6 presents the correlation coefficients between Innovation potentiality and respective IAS and CSSI of the states. Table 11.6 shows the strong positive correlation between IAS and innovation potentiality indicating that better the alignment of sectors in a state with the innovation potentiality of the sector higher is the overall innovation potentiality of the state. Again the moderately strong negative coefficient between CSSI and innovation potentiality indicates that higher the skew value of the distribution of the innovative firm over the sectors in a state lower is the innovation potentiality of the state.

Table 11.5: Sectoral strength of innovation of the states

States	IAS	Innovation potentiality of states	CSSI
A & N Islands	0.11	0.11	1.87
A. P.	0.74	3.77	3.66
Assam	0.65	0.26	4.06
Bihar	0.14	0.07	5.12
Chandigarh	0.18	0.00	5.15
Chhattisgarh	0.41	0.18	4.03
D & N Haveli	0.69	3.18	2.87
Daman and Diu	0.70	3.17	1.94
Delhi	0.50	3.08	1.49
Goa	0.71	3.59	1.05
Gujarat	0.70	0.19	1.88
Haryana	0.63	0.75	1.31
HP	0.42	0.31	3.43
J & K	0.61	0.28	2.6
Jharkhand	0.39	2.19	2.44
Karnataka	0.75	4.70	2.83
Kerala	0.73	3.76	2.46
M. P.	-0.01	0.22	5.33
Maharashtra	0.65	4.05	2.44
Meghalaya	0.23	0.06	4.3
Nagaland	0.24	0.01	4.86
Odisha	0.74	0.84	3.57
Puducherry	0.79	2.96	2.71
Punjab	0.64	0.24	3.02
Rajasthan	0.46	1.32	2.91
Sikkim	0.39	1.48	4.56
TN	0.76	2.34	1.52
Tripura	0.27	1.10	2.17
U. P.	0.63	0.46	1.15
Uttarakhand	0.62	0.09	0.68
W.Bengal	0.57	2.67	2.49

Table 11.6: Correlation among IAS, CSSI and innovation potentiality of states

Correlation	IAS	CSSI
Innovation potentiality of states	0.57	-0.33

Relative performance of NIS, RIS and SIS

Innovation, as an intended act of the firm, accesses various types of technological and non-technological inputs. This constitutes the demand for innovation support system. The organisational arrangements for extending support (the supply system) to innovation can be defined as the constituents of NIS, RIS and SIS. How the supply and demand side interact in the Indian innovation eco-system is the question explored in the chapter.

The disconnect between the supply and demand system is apparent. So far the NIS is concerned it has been seen that accessing institutional facilities for technological support to innovation is quite high in a few states, like, Assam, Gujarat, Madhya Pradesh, Meghalaya etc. But for states like Karnataka, Kerala and Tamil Nadu – states that are known to be innovation leaders – have poor records in accessing institutional support system for technological knowledge and information. Accessing institutional sources of finance is very rare among the innovative firms. Similarly institutional training programme for human resource development is also rarely accessed. There is, however, no correlation between states accessing support systems and the overall incidence of ‘novelty of innovation’, which is overwhelmingly burdened with ‘new to firm’ category of innovation.

The RIS on the other hand has high positive correlation with innovation potentiality of the states. States ranked lower in RIS also have poor innovation potentiality. Weak RIS leads to ineffective innovation eco-system.

Innovation potentiality has negative correlation with Comparative Status of Sectoral Innovation (CSSI) and high positive correlation with Innovation Alignment of Sectors (IAS). These indicate that the presence of the sector that has high innovation potentiality can improve the innovation eco-system of the states.

XII

International Comparison

Highlights

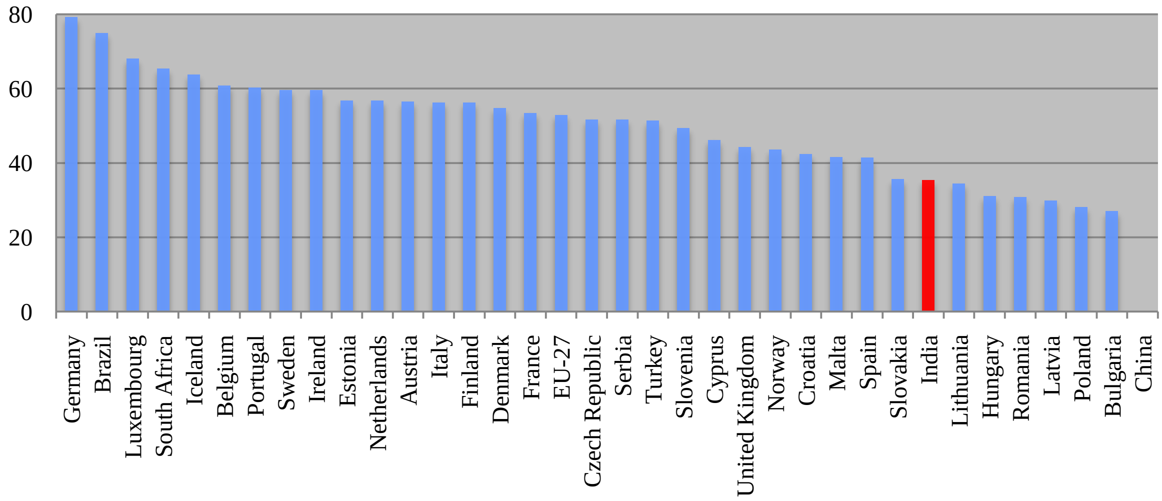
- In terms of percentage of innovative firms, India is close to the eastern European countries such as Slovakia, Lithuania and Hungry at the bottom of the list.
- India earns similar status for product and process innovation.
- India figures at the bottom in introduction of new or improved products in the market.
- In innovation related activities India is far behind the developed countries in intra-mural R&D, but compares well with countries like Poland, but at the same time compares poorly for extra-mural R&D and acquisition of external knowledge.
- Acquisition of machinery, equipment and software has been observed as one of the most important innovation activity accessed by many countries including BRICS countries.
- Indian firms, compared to innovative firms in other countries, widely use external sources such as Suppliers of equipment, materials, components or software, clients or customers feedback etc. for information and knowledge.
- Indian innovative firms are more forthcoming claiming all round outcomes of innovations.
- For non-technological innovations India figures in the top along with those in Cyprus.

International Comparison

The survey results presented above are compared with the available findings from other countries. The surveys in different countries differ on emphases on different indicators. The present comparison is based on the common set of indicators with Indian survey.

Figure 12.1 presents the comparative share of innovative firms. Germany tops with about 80% firms reported to be innovative. Eastern European countries are at the bottom having innovative firms only around 30%. India at 35.37% is closer to East European countries.

Figure 12.1: Percentage of innovative firms in different countries (% percentage of innovative firms)

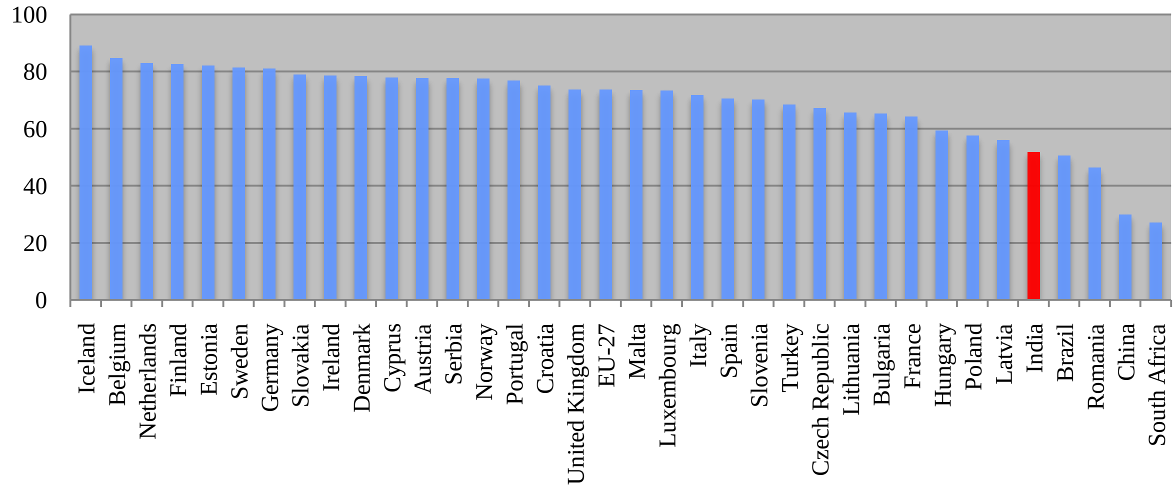


Source: This Graph was constructed through data sourced from Eurostat, South Africa Innovation Survey Main Results 2008 and UNESCO Institute for Statistics (UIS) results of the 2011 Pilot Data Collection of Innovation Statistics.

Considered to be superior to other innovations, product and process innovations hold special positions in the general basket of innovations, because such innovations also indicate the innovation capabilities of the firm. Figure 12.2 shows relative performance of different countries in these types of innovations. Iceland tops the list with more than 89.11% firms doing product and process innovations. Germany is at 80.99% and India is close to the bottom at 51.85%.

Note: Data for European countries is from Eurostat, Innovation Statistics, CIS 7. For South Africa data was collected South Africa Innovation Survey Main Results 2008. Data for Brazil and China was collected from UNESCO Institute for Statistics (UIS) results of the 2011 Pilot Data Collection of Innovation Statistics. Data collected from UIS is comprised of only Manufacturing enterprises, not all enterprises.

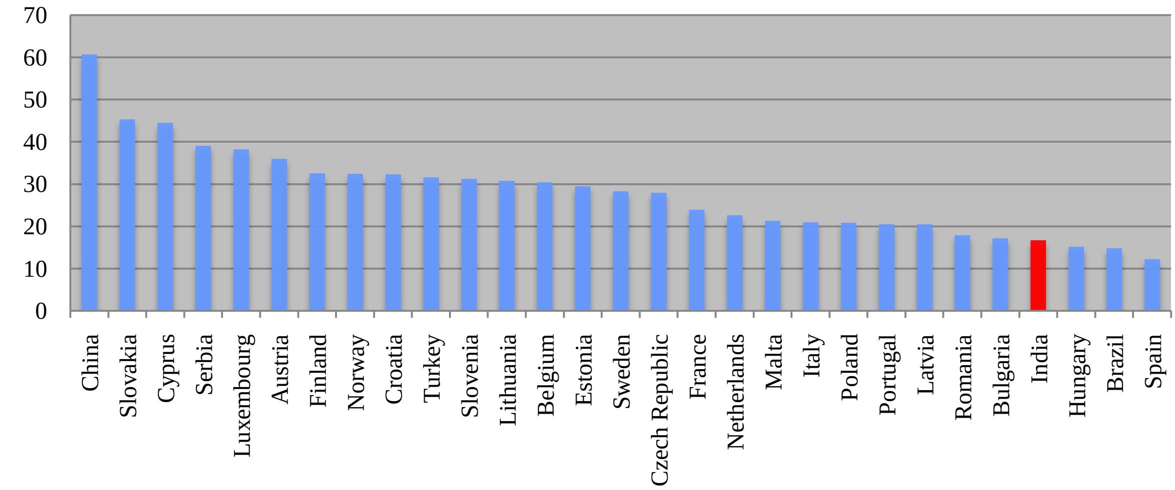
Figure 12.2: Percentage of innovative firms engaged in product and/or process innovations (% of innovative firms)



Source: This Graph was constructed through data sourced from Eurostat, South Africa Innovation Survey Main Results 2008 and UNESCO Institute for Statistics (UIS) results of the 2011 Pilot Data Collection of Innovation Statistics.

Although Iceland tops in product and process innovations, it is China, which is far ahead of all other countries in terms of introduction of new or improved product in the market. In this respect India is seen in the bottom (figure 12.3).

Figure 12.3: Introduction of new or improved product in the market (% of innovative firms)



Source: This Graph was constructed through data sourced from Eurostat, South Africa Innovation Survey Main Results 2008 and UNESCO Institute for Statistics (UIS) results of the 2011 Pilot Data Collection of Innovation Statistics.

Innovation related activities of the innovative firms in different countries are shown in the Table 12.1. For intra-mural R&D India is comparable with Poland, Luxemburg and even with Austria, but far behind the developed countries like Sweden, Netherlands and Belgium. Acquisition of machinery, equipment and software as an innovation related activity is most predominant in all countries including India, which figures poorly in extra-mural R&D and acquisition of external knowledge.

Table 12.1: Activities related to innovation (% of innovative firms)

Country	Intramural R&D	Extramural R&D	Acquisition of machinery, equipment and software	Acquisition of other external knowledge
Austria	38.20	21.70	63.70	27.70
Belgium	62.00	32.80	71.40	23.60
Brazil	4.70	1.90	34.10	4.80
Bulgaria	13.40	8.60	72.60	19.60
China	63.30	22.10	66.00	28.10
Croatia	58.00	33.60	87.30	27.30
Cyprus	30.80	42.10	99.00	60.40
Czech Republic	51.20	26.70	79.30	26.10
Denmark	48.90	34.90	61.10	33.70
Estonia	33.30	22.10	89.00	24.30
Greece	47.90	23.60	82.20	15.90
Hungary	49.60	19.10	73.70	17.40
India	35.05	11.43	67.02	16.36
Ireland	44.10	13.00	54.40	27.70
Lithuania	45.80	26.70	73.80	26.90
Luxembourg	37.00	30.50	71.10	25.80
Malta	37.90	7.20	51.30	15.40
Netherlands	63.50	29.80	54.30	14.50
Norway	48.00	21.60	:	:
Poland	34.00	21.20	89.70	14.10
Portugal	47.70	28.10	81.90	24.50
Romania	31.60	10.60	76.00	9.90
Russia	18.90	20.00	64.00	12.70
Slovakia	45.70	25.20	82.10	21.10
Slovenia	74.50	34.90	81.60	37.10
South Africa	45.10	17.90	65.70	17.40
Spain	31.80	17.30	36.80	:
Sweden	64.60	26.80	62.20	35.60
Turkey	29.30	10.00	42.00	12.90

Source: This Table was constructed through data sourced from Eurostat, South Africa Innovation Survey Main Results 2008 and UNESCO Institute for Statistics (UIS) results of the 2011 Pilot Data Collection of Innovation Statistics.

Sources of information and knowledge for innovation used by innovative firms in different countries show India either in the top or near the top in all 10 sources, along with Cyprus.

Table 12.2: Sources of information and knowledge used by innovative firms in different countries (% of innovative firms)

Country	1	2	3	4	5	6	7	8	9	10
Austria	60.1	28.0	47.6	20.0	5.1	8.1	4.1	20.0	11.0	8.6
Belgium	53.3	28.2	25.1	9.6	6.1	4.0	2.6	9.6	6.1	6.2
Brazil	10.0	38.3	46.0	22.7	10.8	6.3	4.9	na	Na	na
Bulgaria	32.2	28.3	27.5	16.6	7.4	5.0	2.7	16.6	13.6	7.9
China	49.4	21.6	59.7	29.6	17.1	8.9	24.7	26.7	12.0	14.8
Croatia	43.6	27.7	35.2	15.3	4.8	3.5	2.0	15.3	11.3	4.5
Cyprus	92.6	80.5	49.5	35.7	54.4	12.7	15.0	35.7	34.7	19.7
Czech	37.4	24.8	33.7	15.9	5.1	2.9	1.5	15.9	6.1	2.5
Estonia	31.0	24.6	17.5	8.9	3.7	2.1	0.9	8.9	4.5	2.5
Greece	7.3	12.7	16.1	25.9	15.1	9.3	8.6	25.9	20.3	21.5
Hungary	40.5	21.5	33.9	19.8	9.3	7.6	2.4	19.8	7.4	4.2
India	86.7	77.5	84.9	69.6	43.4	25	34.6	68.1	49.2	62.1
Lithuania	29.9	22.1	24.4	8.5	11.1	8.1	0.4	8.5	12.4	2.7
Luxembourg	65.5	33.0	36.5	21.8	9.6	5.8	5.7	21.8	17.0	17.0
Malta	39.5	23.1	25.6	14.4	5.1	2.6	1.5	14.4	5.6	1.5
Netherlands	42.9	18.7	26.7	8.3	3.1	2.4	2.3	8.3	3.5	3.5
Poland	53.0	20.0	29.3	17.9	6.2	4.1	6.1	17.9	13.4	5.5
Portugal	46.0	26.9	32.8	13.5	5.8	4.7	2.4	13.5	10.7	10.1
Romania	41.8	34.0	33.0	19.3	6.1	3.5	2.8	19.3	22.3	5.7
Russia	32.9	14.1	34.9	11.3	1.7	1.9	Na	7.4	12.0	4.1
Slovakia	44.0	23.0	28.7	12.7	5.0	1.1	0.9	12.7	7.7	0.9
Slovenia	57.1	29.8	44.8	20.1	7.3	5.8	2.1	20.1	10.0	6.0
South Africa	41.7	21.3	41.2	11.4	4.6	2.1	1.5	13.3	10.1	5.6
Spain	43.4	25.1	16.5	8.8	5.7	3.2	4.4	8.8	4.6	3.8
Turkey	46.3	29.8	36.6	18.2	9.3	5.6	4.4	18.2	15.3	9.5

Source: This Table was constructed through data sourced from Eurostat, South Africa Innovation Survey Main Results 2008 and UNESCO Institute for Statistics (UIS) results of the 2011 Pilot Data Collection of Innovation Statistics.

Note: Numbers used as column heading refers to the following

1. Sources within your enterprise or enterprise group; 2. Suppliers of equipment, materials, components or software; 3. Clients or customers Feedback; 4. Competitors or other enterprises in your sector; 5. Consultants, commercial labs or private R&D institutes; 6. Universities, Engineering. Colleges and Institutes, Polytechnics; 7. Government or public research institutes; 8. Conferences, trade fairs, exhibitions; 9. Scientific journals and Trade/technical publications; 10. Professional and Industry associations.

Outcome of innovation is claimed by innovative firms in different countries is shown table 12.3. Indian firms again either in the top or near top the list in all indicators along with Cyprus.

Table 12.3: Outcome of innovation claimed by innovative firms (% of innovative firms)

Country	1	2	3	4	5	6	7	8	9
Austria	39.4	33.7	48.7	30.0	27.8	11.9	9.7	13.4	18.5
Bulgaria	38.2	30.1	38.9	21.0	21.7	15.9	13.2	20.9	25.3
Croatia	39.1	32.8	52.3	34.5	32.2	19.9	15.1	18.0	31.5
Cyprus	45.4	38.0	57.5	69.8	62.4	29.2	19.9	38.0	56.1
Czech Rep.	39.3	28.8	38.2	25.4	26.1	18.2	14.2	13.8	7.2
Denmark	18.6	15.8	16.6	15.3	18.8	11.5	7.3	5.3	9.2
Estonia	29.8	25.7	27.2	20.0	20.5	14.3	7.8	8.4	6.8
Finland	16.5	15.5	17.0	14.4	15.3	10.7	5.2	7.2	9.6
Greece	9.1	11.6	5.8	8.3	9.2	26.2	20.7	12.9	11.3
Hungary	32.4	26.2	37.2	21.9	22.3	6.2	7.2	13.6	19.8
India	71.5	52.5	77.9	57.8	65.2	50.9	50.8	54.3	52.8
Latvia	27.9	15.8	26.6	16.4	17.3	6.2	5.4	6.3	13.9
Lithuania	32.4	28.0	34.4	25.0	30.5	10.7	8.5	9.9	25.2
Luxembourg	57.7	45.1	62.1	35.2	33.6	12.9	6.8	12.9	28.5
Malta	27.7	15.9	31.3	21.0	18.5	11.8	7.7	8.7	20.0
Netherlands	44.8	38.8	44.0	31.8	31.6	16.6	10.5	11.7	14.6
Poland	36.1	26.9	38.1	20.8	25.7	13.8	11.6	18.5	24.7
Portugal	34.1	25.4	44.3	31.2	36.5	22.4	15.0	24.1	25.6
Romania	37.0	29.4	41.7	28.2	34.1	18.3	14.8	23.7	20.9
Slovakia	38.1	23.1	41.6	28.5	27.2	8.0	10.8	13.8	13.4
South Africa	31.2	17.0	30.7	15.8	25.6	8.9	11.5	6.3	15.7
Spain	25.2	18.6	33.5	22.6	27.4	12.9	8.5	13.4	19.8
Sweden	32.9	24.3	34.2	18.4	23.1	17.0	:	14.0	17.8
Turkey	38.3	32.6	49.5	39.4	39.4	18.0	10.2	21.6	28.8

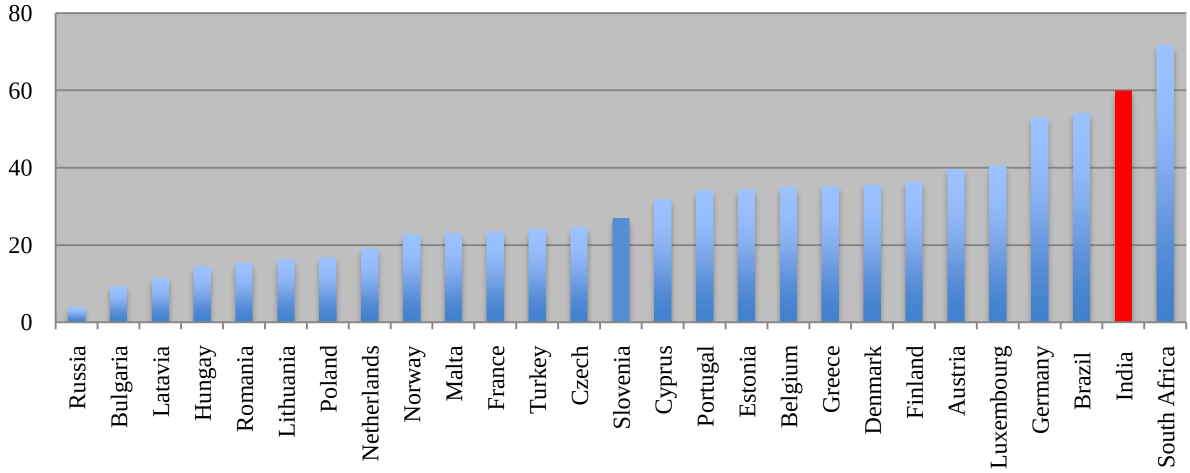
Source: This Table was constructed through data sourced from Eurostat, South Africa Innovation Survey Main Results 2008 and UNESCO Institute for Statistics (UIS) results of the 2011 Pilot Data Collection of Innovation Statistics.

Note: Numbers used as column heading refers to the following

1. Increased range of goods or services; 2. Entered new markets or increased market share; 3. Improved quality of goods or services; 4. Improved flexibility of production or service provision; 5. Increased capacity of production or service provision; 6. Reduced labour costs per unit output; 7. Reduced materials and energy per unit output; 8. Reduced environmental impacts or improved health and safety; 9. Met governmental regulatory requirements

It is non-technological innovations in which India figures much higher in the list, above Germany – the most innovative country. Bulgaria, the most active in product and process innovations, on the other hand is at the bottom (figure 12.4).

Figure 12.4: Non-technological innovation by the innovative firms (% of innovative firms)



Source: This Graph was constructed through data sourced from Eurostat, South Africa Innovation Survey Main Results 2008 and UNESCO Institute for Statistics (UIS) results of the 2011 Pilot Data Collection of Innovation Statistics.

Barrier to innovations have been seen from three different ways, namely, cost factor, knowledge factor and market factor. Tables 12.4 to 12.6 give international scenario in these respects. In case of India the cost factors (availability of finance) is overwhelmingly high compared to other countries for which such survey data is available (table 12.4). Table 12.5 refers to knowledge factors as barriers, which are again much higher in India compared to other countries. Market factors as barriers are no different from other two factors. As shown in table 12.6 India is much above other countries having market factors as major barrier to innovation.

Table 12.4: Cost factor as barrier to innovation

Country	Lack of funds within your enterprise or group	Lack of finance from sources outside your enterprise	Innovation costs too high
Brazil	na	17.5	21.6
China	na	na	na
Colombia	42.1	33.8	na
Egypt	28.6	28.6	21.8
Ghana	47.4	28.2	38.6
Indonesia	46.0	44.0	46.0
Israel	26.5	11.1	21.4
Malaysia	29.3	40.3	41.3
Philippines	19.1	10.2	20.9
Russia	39.8	n.a.	27.8
South Africa	38.0	23.5	33.5
Uruguay	n.a.	24.8	n.a.
EU-27	n.a.	n.a.	n.a.
Eurostat min	11.0	4.4	9.6
Eurostat max	42.1	36.6	44.0
India	87.37	68.84	74.50

Source: This Table was constructed through data sourced from UNESCO Institute for Statistics (UIS) results of the 2011 Pilot Data Collection of Innovation Statistics.

Table 12.5: Knowledge factor as barrier to innovation

Country	Lack of qualified personnel	Lack of information on technology	Lack of information on markets	Difficulty in finding cooperation partners for innovation
Brazil	16.2	5.9	4.4	7.1
China	28.0	n.a.	n.a.	n.a.
Colombia	41.5	42.3	41.3	31.2
Egypt	29.4	36.1	37.0	27.7
Ghana	14.1	7.0	8.8	17.5
Indonesia	36.0	29.0	29.0	36.0
Israel	14.1	7.0	8.8	17.5
Malaysia	16.0	5.5	4.5	6.3
Philippines	11.7	8.2	10.0	5.6
Russia	5.3	1.8	2.9	1.6
South Africa	23.0	11.9	11.7	13.1
Uruguay	32.4	7.3	11.3	16.4
EU-27	n.a.	n.a.	n.a.	n.a.
Eurostat min	8.1	2.0	1.6	2.5
Eurostat max	26.6	35.0	36.4	23.4
India	87.75	76.44	77.10	n.a.

Source: This Table was constructed through data sourced from UNESCO Institute for Statistics (UIS) results of the 2011 Pilot Data Collection of Innovation Statistics.

Table 12.6: Market factor as barrier to innovation

Country	Market dominated by established enterprises	Uncertain demand for innovative goods or services	Innovation is easy to imitate
Brazil	n.a.	n.a.	n.a.
China	n.a.	n.a.	12.3
Colombia	n.a.	44.5	34.7
Egypt	26.1	29.4	n.a.
Ghana	19.3	12.3	n.a.
Indonesia	37.0	31.0	n.a.
Israel	10.7	6.2	n.a.
Malaysia	30.7	21.5	n.a.
Philippines	14.7	9.9	n.a.
Russia	n.a.	9.1	n.a.
South Africa	17.5	15.5	n.a.
Uruguay	n.a.	n.a.	n.a.
EU-27	n.a.	n.a.	n.a.
Eurostat min	5.3	4.5	n.a.
Eurostat max	26.0	24.3	n.a.
India	65.55	53.89	n.a.

Source: This Table was constructed through data sourced from UNESCO Institute for Statistics (UIS) results of the 2011 Pilot Data Collection of Innovation Statistics.

In Nutshell

Complementarity between technological and non-technological innovations is more pronounced among the innovative firms in India compared to the same in other countries, particularly developed economies. It is possible that in the developed countries where innovation eco-system is more matured, non-technological innovations are well in place with the innovative firms. Innovation as an intended act being at nascent stage in Indian firms, the imperative of non-technological innovation is more visible. The inconsistency in observations regarding innovation activities and sources of innovation among the innovative firms in India is quite conspicuous. While higher percentage of Indian firms claims to use all important sources of innovation, compared to the developed countries, they also show very little presence in extra-mural research and acquisition of external knowledge compared to developed counterparts. The apparent inconsistency is to be understood from the fact that very few Indian firms acquire knowledge in the form of patent, knowhow etc., which is more common among innovative firms in other countries. For Indian firms initiatives are more in terms of getting information on state of the art practices and status of technology and aligning the firms' activities accordingly.

XIII

Summary, discussion and policy implication

Summary

A sample survey based on ASI 2009 -10 database of 2,08,415 firms in 26 states (out of 28) and 5 (out of 7)Uninon Teritorries covering 96 industrial sectors as per NIC two digit classification. A sample of 9,001 firms studied using pre-designed questionnaire.

The Survey identified total 3,184 (35.37%) firms as innovative firms conforming to the guidelines set in the questionnaire. The innovative firms were studied in terms of the firm level characteristics like age, ownership and size (total workforce) in one hand and types of innovations, gains from innovations, outcome of innovations, extent of innovations etc. Innovative firms and their innovations have been further examined in terms of innovation activities, strategies, human resources, sourcing and acquisition and extent of ICT use.

Innovative firms identified by the survey are predominantly small firms (86%), privately owned, but equally distributed among three broad periods (pre 1990, 1990 – 2000, 2000 and after). Most of the innovations are 'new to firm' category. Acquisition of machinery is the major form of innovation activity. Sourcing technology or kanowledge through patent or knowhow is marginal. Information and knowledge are sources mostly from the domestic market. Non R&D based innovation is most prevalent. Technology is generally purchased on down payment mode, and financed through internal sources and sometimes through domestic financial institutions. Scientist and engineers do not form the backbone of the human resources of the innovative firms. Workforces are given skill developemnt training in-house using in-house resources. ICT use is significant and growing, and about 15% firms claim to use for enterprise resource planning and technology management. Cost factors and availability of skilled manpower are considered as important barrier to innovation.

The state level scenario mirrors the overall picture. Innovation potentiality of the states place Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra as the most innovative states.

States with much lower innovation potentiality have higher shares of product and process innovation. At all India level most ubiquitous is innovation in the form of introduction of new machines. Correlations with innovation potentiality return coefficients that are small in magnitude and negative for all types. The states that are low in 'new product' type of innovations are comparatively higher in 'new machine' types, and not the other way round. Highest positive correlation is between 'new process technology' and 'saving/more efficient use of inputs'. Again, innovations in 'alternative material' show high correlations with 'new product' and 'new process' innovations.

Correlations between innovation potentiality of the states and source of fund shows that lower the innovation potentiality more is the dependence on own source of fund. On the other hand states with higher innovation potentiality has higher incidence of sourcing from various sources, namely, borrowing from financial institutions and accessing government schemes.

States having higher innovation potentiality do depend more on internal strength of sourcing innovation. Except Gujarat and Sikkim all the states have innovative firms not engaged in R&D activities, intra or extra mural. States like Karnataka, Andhra Pradesh and Tamil Nadu that are high in innovation potentiality have higher percentage of firms not engaged in R&D activities.

Total 36 sectors have been identified as having innovative firms. Sector level innovation potentiality shows that Rubber and Plastic product sector (NIC 22) has the highest innovation potentiality and second highest share in innovative firms. Manufacturing of food products (NIC 10), which has second highest innovation potentiality, has the highest share of sample as well as innovative firms. They are followed by fabricated metal products (NIC 25), manufacture of machinery and equipment n.e.c. (NIC 28), basic metals (NIC 24), chemical and chemical products (NIC 20), and tobacco (NIC 13) and have significant shares of total innovative firms.

Sectors having more than average share of product innovations are not those with highest innovation potentiality. In case of process innovation the picture is opposite – negative relation of moderate magnitude with innovation potentiality. Innovations in product quality and standard have recorded 42.37% of innovative firms at the all India level. However, in terms of innovation potentiality of the sectors no clear pattern is evident. Innovations in more efficient input use show negative correlation with innovation potentiality of the sectors. On the other hand innovation in alternative material use in production system is not very popular.

There is somewhat indication that higher the innovation potentiality lesser is the dependence on internal sources. The nature of expenditure for acquiring innovation related capabilities are managed as one time payment. There is no meaningful correlation with innovation potentiality of the sectors. It means that the behaviourial pattern does not change with the innovation potentiality.

Average share of scientist and engineers is about 7%. NIC 22 – rubber and plastic sector has as high as 24% workforce as scientist and engineer. Training of the employees is given mostly in-house and this is the practice across the sectors. Training in institutions abroad or training with collaborators are rare initiatives. This is also true for accessing sources of funding for training. Rarely innovative firms in any sector have accessed government or foreign sources for training their employees.

Correlation coefficient between organisational and marketing innovation is as high as 0.56. So, both forms of non-technological innovations go hand in hand, except that marketing innovations have comparatively higher presence in NIC 12 (tobacco product), NIC 38 (waste treatment), NIC 74 (Professional and scientific activities) and NIC 82 (Office administration equipments). But as the correlation with innovation potentiality shows, both forms of non-technological innovations do not have any relation with innovation potentiality.

Observations extended to NIS, RIS and SIS level scenario building reveal a few interesting aspects of innovation eco-system in India. There is wide network of innovation support system covering all aspects of innovation, both technological and non-technological. It has been observed that most of the innovative firms identified by the survey had rarely used the support system. On the other hand a strong positive correlation between RIS and innovation potentiality of the states indicates that RIS plays significant role in promoting innovation. At the sectoral level the study indicate that sectoral level dynamics can impart big push needed for triggering innovation activities in a state.

Discussion

Overall a dichotomous innovation system is decipherable from the observations of the survey. Small firms have largest share of the total innovative firms, as they have largest share in the sample. Their innovations are restricted to 'new to firm' category' and corresponding innovation activities are acquiring new machines using internal resources. As far as possible these firms avoid external dealings, be it financial resources acquiring new knowledge/technology, financial support or human resource development. Most of them do not access the available wide network of innovation support system offered by various govt. agencies. The scenario indicates weak and uncertain market potential of the cost associated with innovations. This is reflected in their views on barrier to innovations wherein cost of innovation, availability of skilled manpower and market figure most prominently. R&D as the source of innovation remain prerogative of the large firms. Some of these firms do access the support system and also do acquire new technology/knowledge etc. from the market.

The following observation will further strengthen the argument stated above as we have observed that acquistion of machinery, equipment and software emerged as the most important innovation related activity not only in India but also in other European countires like Austria, Belgium, Bulgaria Greece etc. and also in BRICS countries. This shows the importance of acquiring new machines as a part of innovation activities across the globe.

Policy implications

When seen from the perspective of NIS, RIS and SIS, a macro level scenario emerges where the innovations systems require to be rejigged to be more inclusive to accommodate small firms. At the NIS level the disconnect between the innovation support system and innovators (particularly small firms) require to be addressed more effectively. One way to introduce the outcome audit of the fund aloctaed spent for various programmes related to innovation support. The purpose would be to assess the return on the money spent for such purposes. The return may be enumerated as the number of firms accessed the support and the gains accrued to the firm through the support.

At the RIS level the survey reveal the same textbook wisdom. The infrastructure, physical, educational and health related, has the ultimate role on innovation dynamics of a state. The SIS can provide a short-cut route to trigger innovation by initiating high-tech high-innovation led indutries at the states.

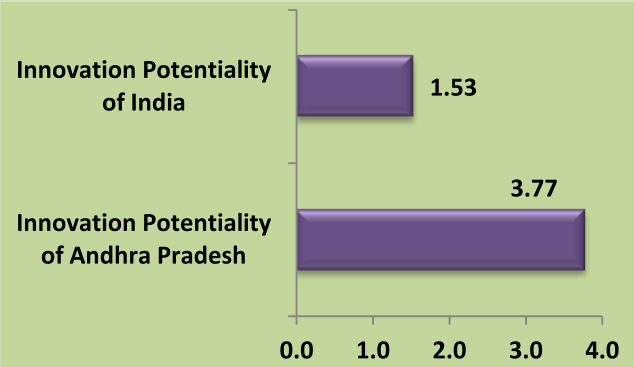
Areas for Further investigations

Innovation is human capital dependent. Skilled manpower, access to knowledge etc are seen as important barriers to innovations. Innovation surveys have hitherto neglected the working conditions of the human resources, their training opportunities for skill development, and approach to overall human resource development planning. In the context of developing economies like India aspiring to be at the helm of technology leadership, an assessment of the state of human resources in the enterprises and ways and means to elevate the overall standard requires to be examined. Such studies can be undertaken for the firms with and without R&D activities, for sectors that have high innovation potentialities, states that require attention for elevation of their innovation potentialities and for the rural industries and technologies used in rural production system.

Annexure I

STATE PROFILE

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 36345
Industry Share in NSDP: 12.83%
Highways: 1.65 *per 100 Sq Km*
Health Centres: 51.30 *per100 village*
Educational institute: 316.68 *per million population*
Power Generation: 1040.30 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

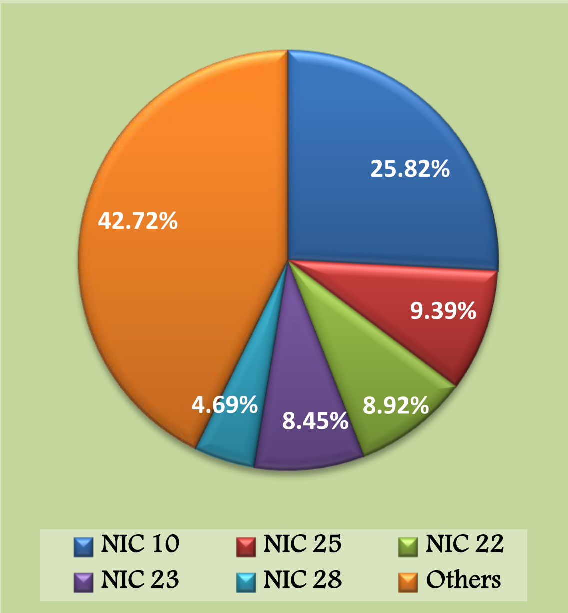
Human Development Index: 21st

Regional Innovation System: 9th

Innovation Potential: 3rd

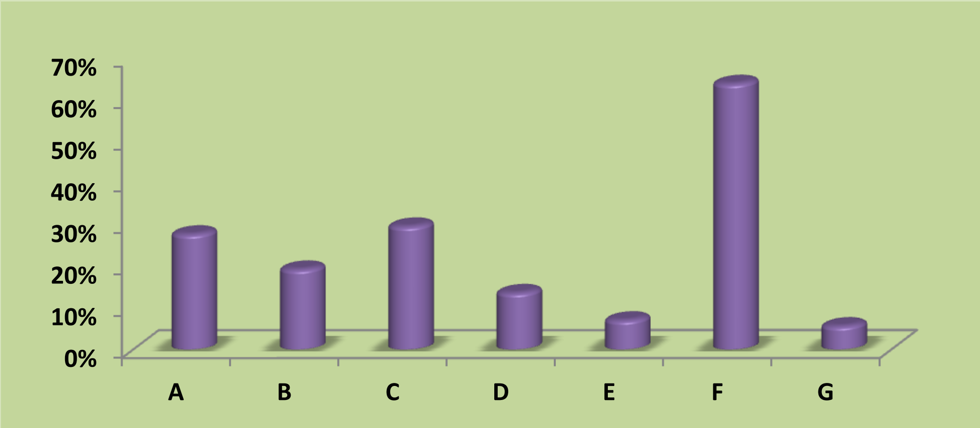
Share of the state in total firms surveyed in India: 4.20%
Share of the state in total Innovative firms in India: 6.69%

Top Five Innovative Sectors



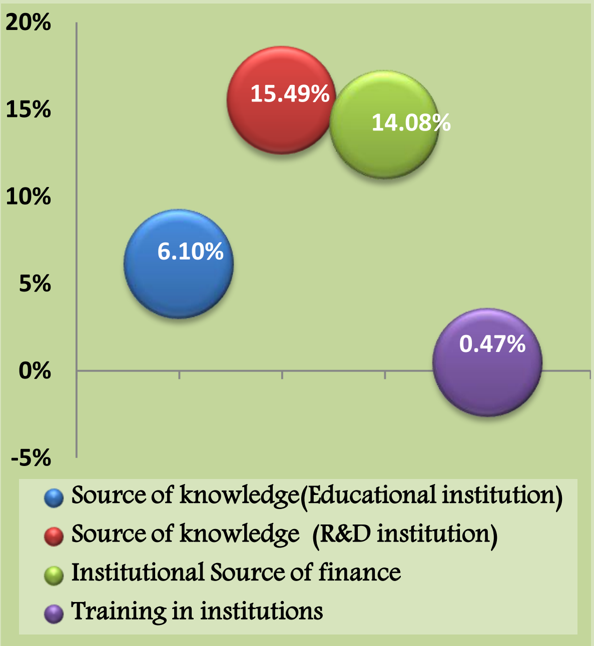
NIC 10 - *Manufacture of food products.*
NIC 25 - *Manufacture of fabricated metal products, except machinery and equipment.*
NIC 22 - *Manufacture of rubber and plastics products.*
NIC 23 - *Manufacture of other non-metallic mineral products.*
NIC 28 - *Manufacture of machinery and equipment n.e.c.*

Types of Innovation

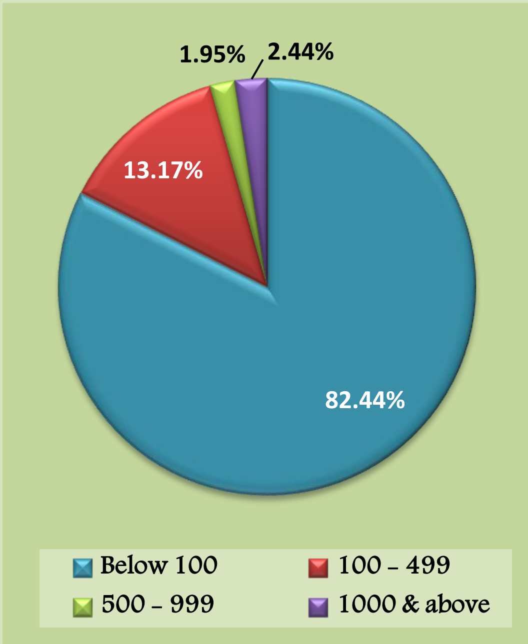


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



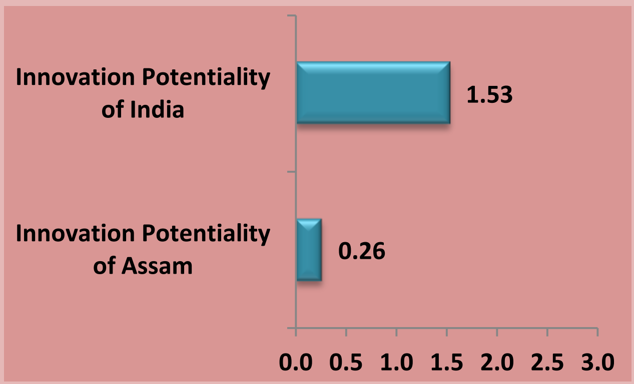
Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 64% of the innovative firms innovations are only new to the firm

Net state domestic product (NSDP) per capita at Constant Prices 2009-10: Rs. 20279
Industry Share in NSDP: 13.68%
Highways: 3.62 *per 100 Sq Km*
Health Centres: 21.47 *per100 village*
Educational institute: 23.32 *per million population*
Power Generation: 161.99 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

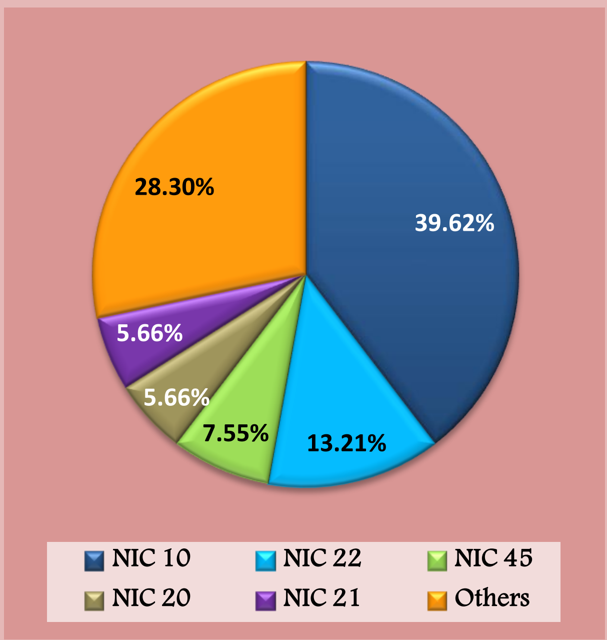
Human Development Index: 22nd

Regional Innovation System: 27th

Innovation Potential: 21st

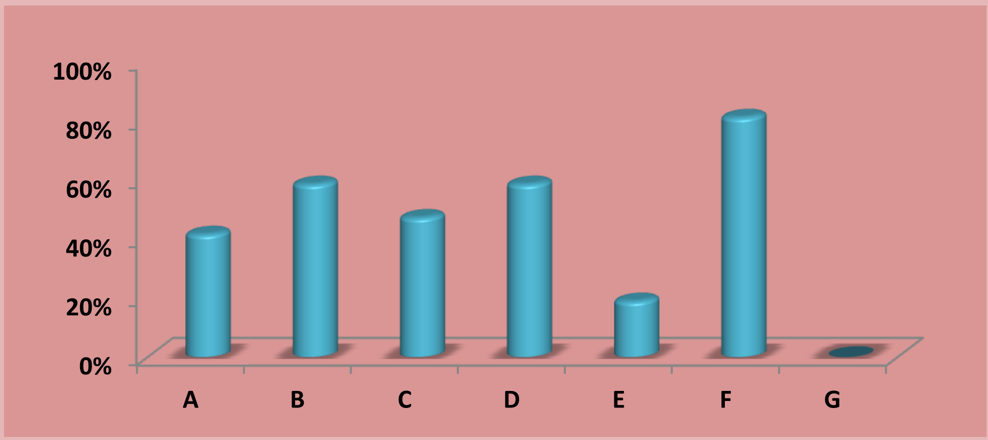
Share of the state in total firms surveyed in India: 3.74%
Share of the state in total Innovative firms in India: 1.67%

Top Five Innovative Sectors



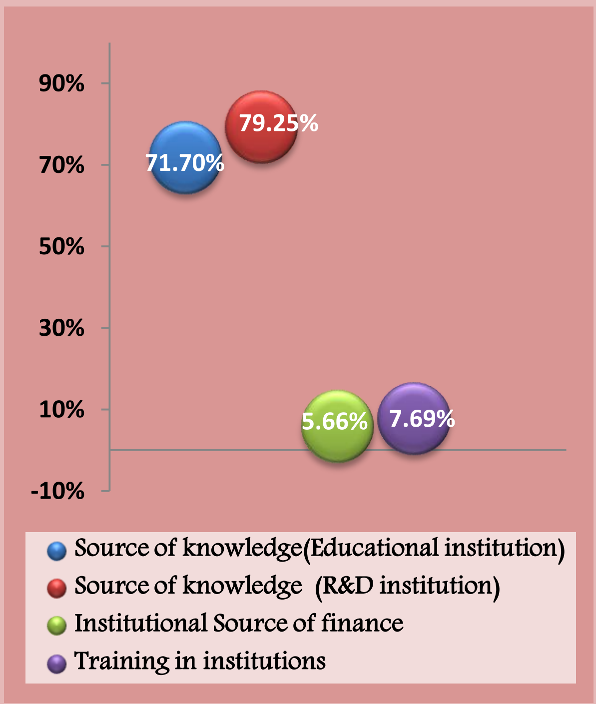
NIC 10 - *Manufacture of food products.*
NIC 22 - *Manufacture of rubber and plastics products.*
NIC 45 - *Wholesale and retail trade and repair of motor vehicles and motorcycles.*
NIC 20 - *Manufacture of chemicals and chemical products.*
NIC 21 - *Manufacture of pharmaceuticals, medicinal chemical and botanical products.*

Types of Innovation

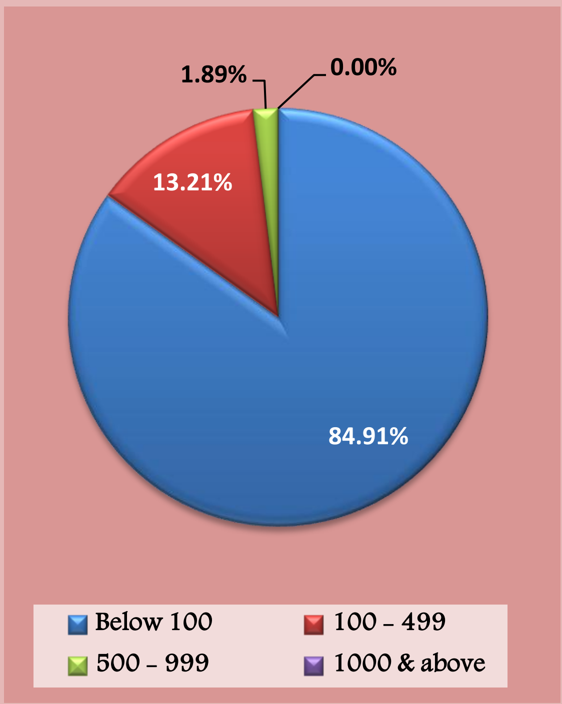


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



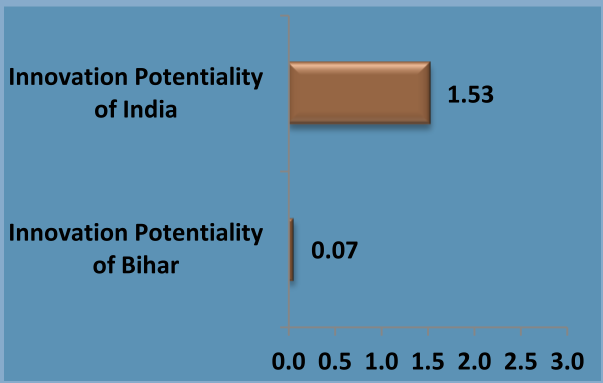
Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 67% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 11558
Industry Share in NSDP: 4.63%
Highways: 0.08 *per 100 Sq Km*
Health Centres: 25.78 *per100 village*
Educational institute: 193 *per million population*
Power Generation: 145.4 *million units per million population*



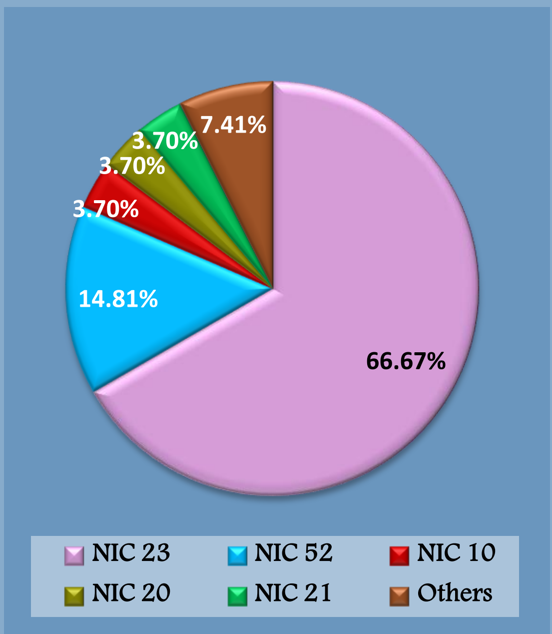
RANK OF THE STATE vis-a-vis OTHER STATES

Human Development Index: 27th

Regional Innovation System: 29th

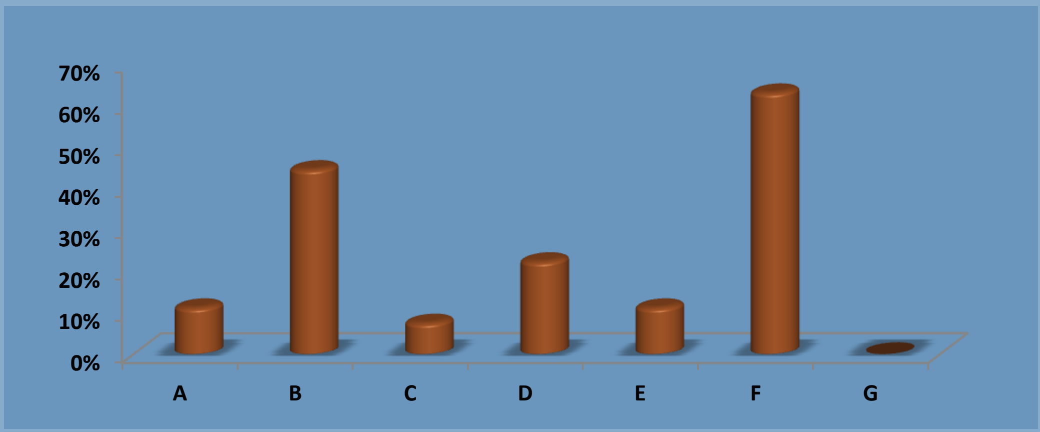
Innovation Potential: 28th

Share of the state in total firms surveyed in India: 3.67%
Share of the state in total Innovative firms in India: 0.85%



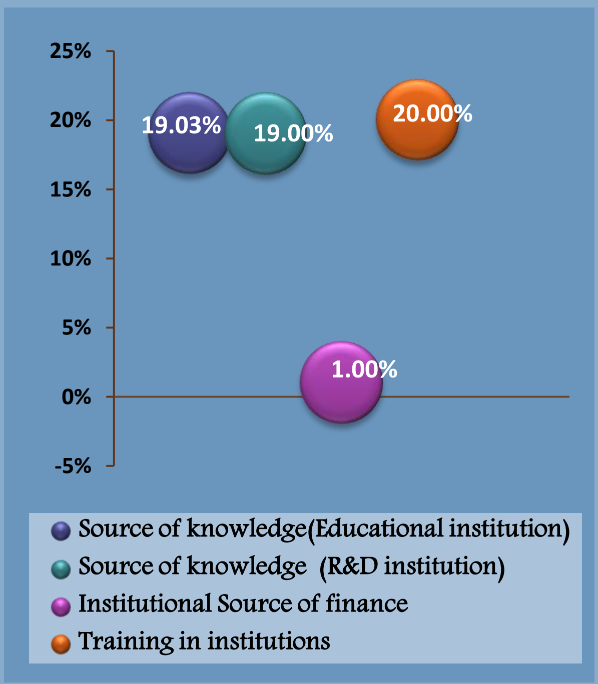
NIC 23 - *Manufacture of other non-metallic mineral products.*
NIC 52 - *Warehousing and support activities for transportation.*
NIC 10 - *Manufacture of food products.*
NIC 20 - *Manufacture of chemicals and chemical products.*
NIC 21 - *Manufacture of pharmaceuticals, medicinal chemical and botanical products.*

Types of Innovation



A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

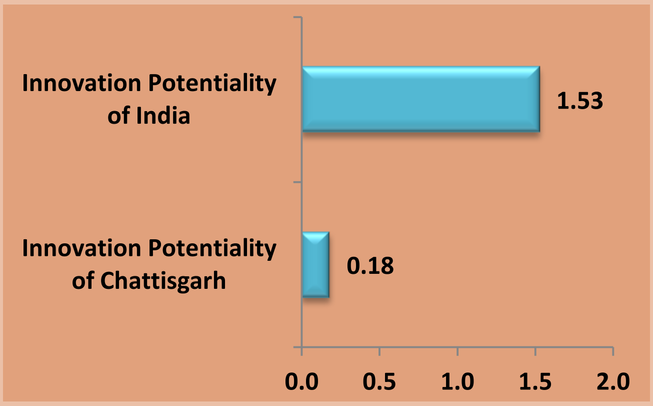
Accessing Innovation Support System



Firm Size (workforce) and corresponding share in innovative firms
below 100 : **96.3%**
between 100- 499: **3.7%**

Novelty of Innovation
For 93% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 25835
Industry Share in NSDP: 31.74%
Highways: 3.99 *per 100 Sq Km*
Health Centres: 27.75 *per100 village*
Educational institute: 220.89 *per million population*
Power Generation: 2486.22 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

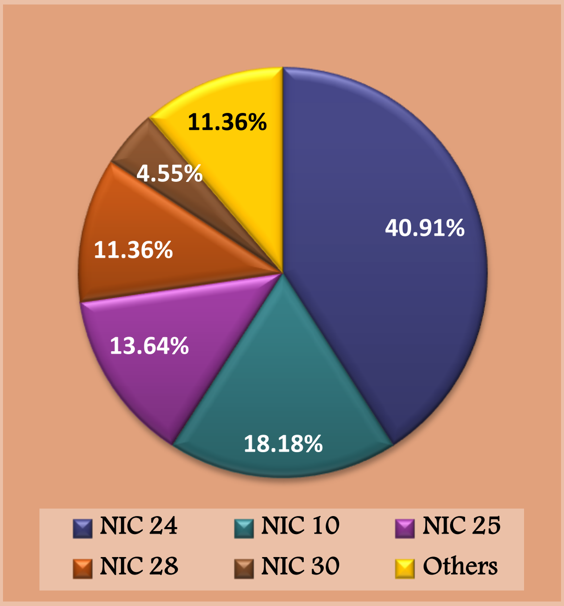
Human Development Index: 29th

Regional Innovation System: 6th

Innovation Potential: 25th

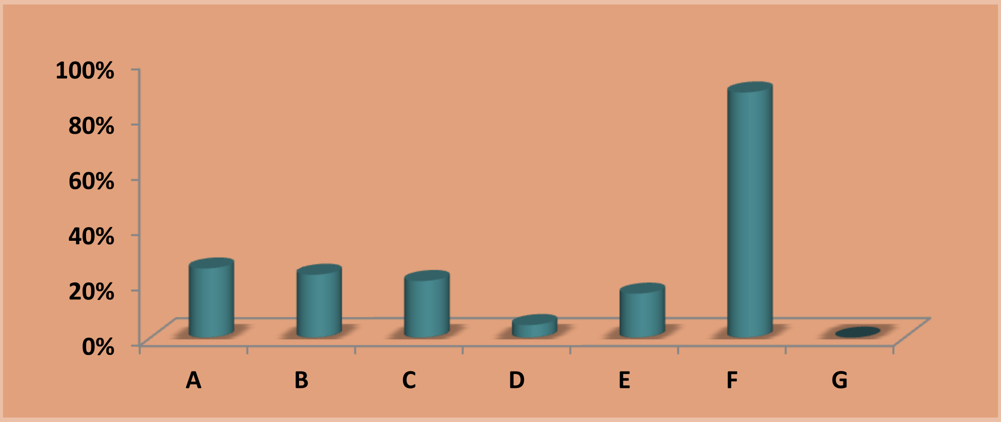
Share of the state in total firms surveyed in India: 3.68%
Share of the state in total Innovative firms in India: 1.38%

Top Five Innovative Sectors



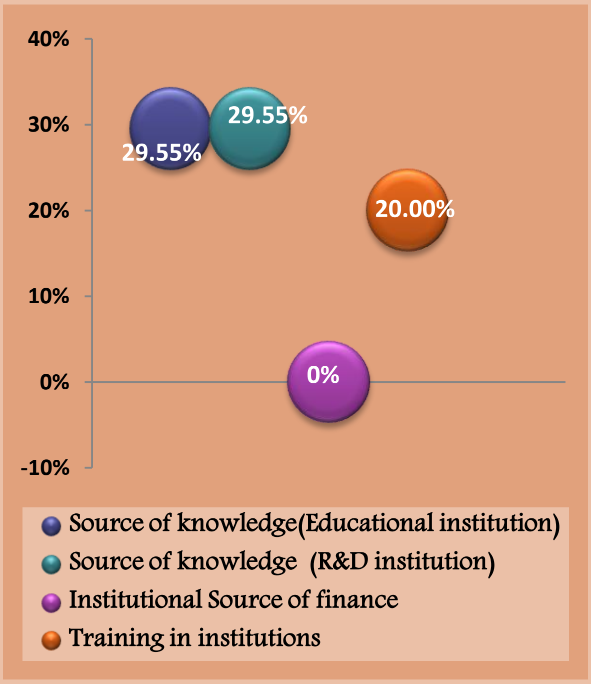
NIC 24 - *Manufacture of basic metals.*
NIC 10 - *Manufacture of food products.*
NIC 25 - *Manufacture of fabricated metal products, except machinery and equipment.*
NIC 28 - *Manufacture of machinery and equipment n.e.c.*
NIC 30 - *Manufacture of other transport equipment.*

Types of Innovation

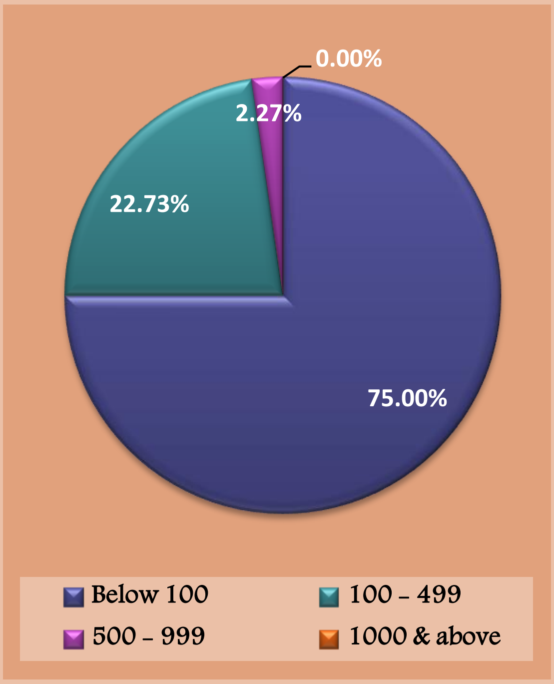


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



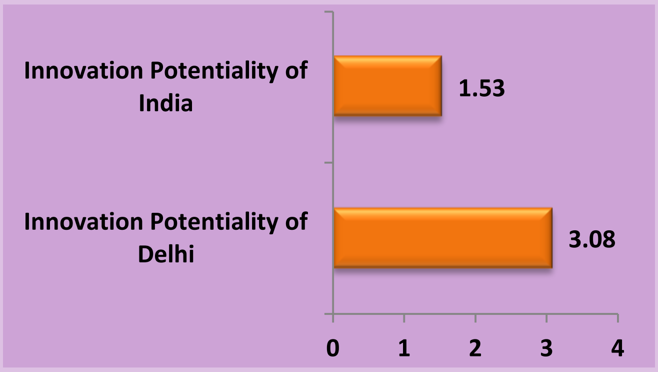
Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 55% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 89037
Industry Share in NSDP: 6.10%
Highways: 4.86 *per 100 Sq Km*
Health Centres: 29.70 *per100 village*
Educational institute: 139.42 *per million population*
Power Generation: 733.04 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

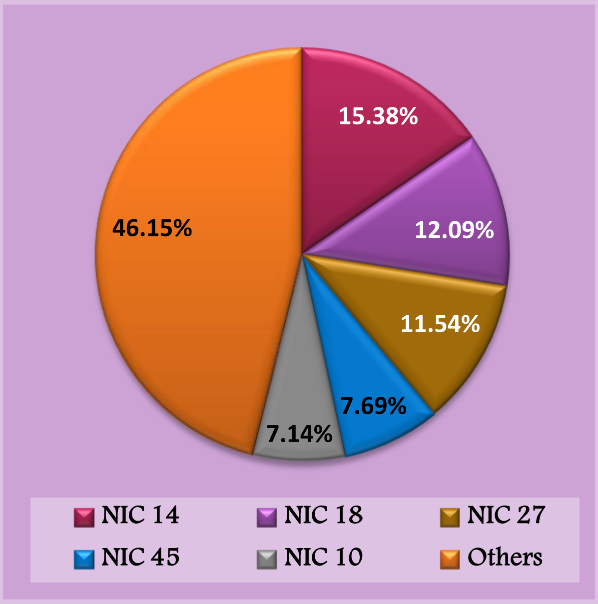
Human Development Index: 3rd

Regional Innovation System: 13th

Innovation Potential: 8th

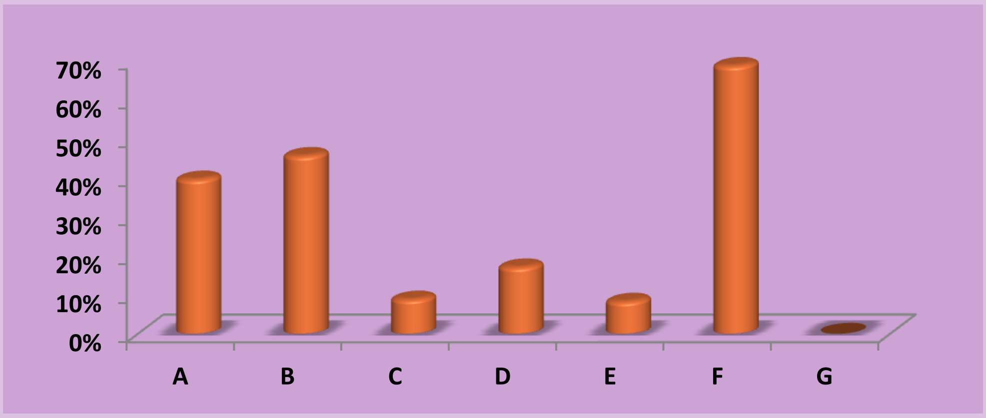
Share of the state in total firms surveyed in India: 3.76%
Share of the state in total Innovative firms in India: 5.72%

Top Five Innovative Sectors



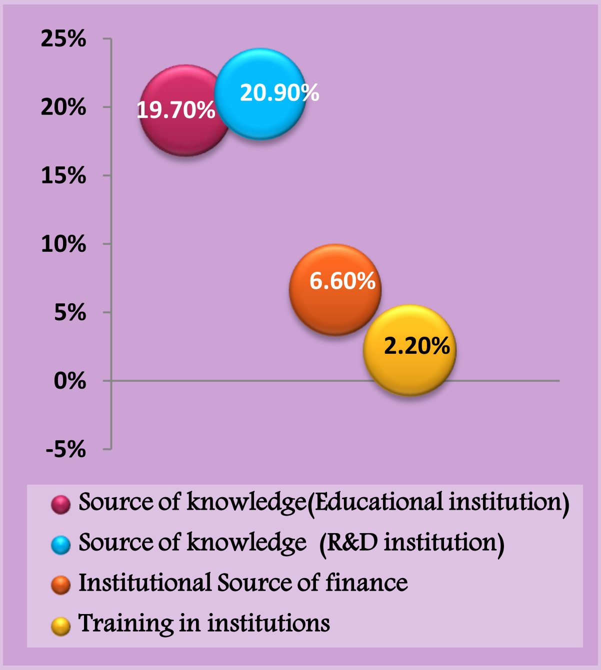
NIC 14 - *Manufacture of wearing apparel.*
NIC 18 - *Printing and reproduction of recorded media.*
NIC 27 - *Manufacture of electrical equipment.*
NIC 45 - *Wholesale and retail trade and repair of motor vehicles and motorcycles.*
NIC 10 - *Manufacture of food products.*

Types of Innovation



A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

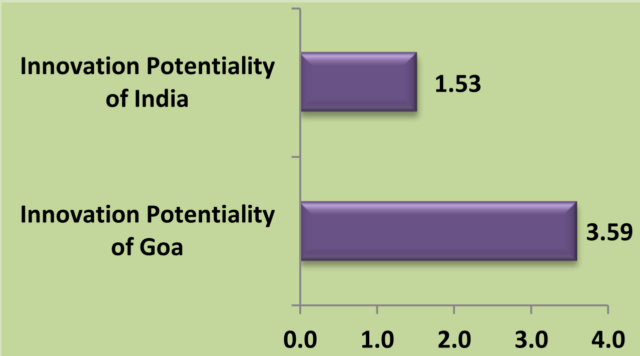
Accessing Innovation Support System



Firm Size (workforce) and corresponding share in innovative firms
below 100 : **94.38%**
between 100- 499: **5.62%**

Novelty of Innovation
For 76% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 98807
Industry Share in NSDP: 30.98%
Highways: 7.27 *per 100 Sq Km*
Health Centres: 55.43 *per100 village*
Educational institute: 371.01 *per million population*
Power Generation: 238.19 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

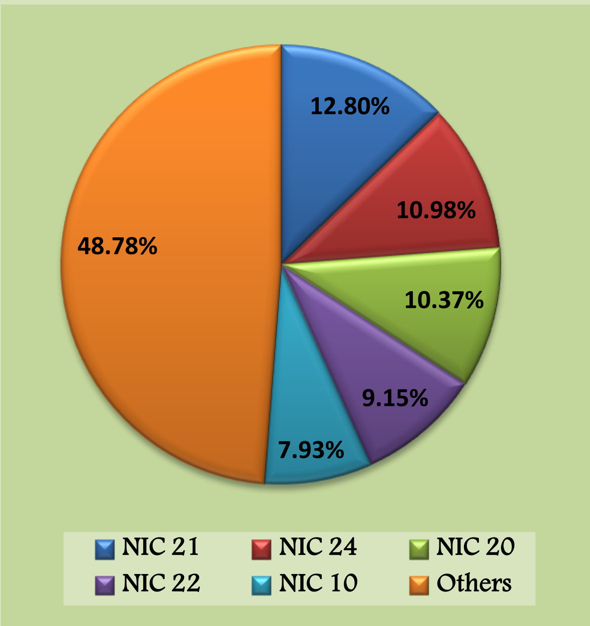
Human Development Index: 10th

Regional Innovation System: 1st

Innovation Potential: 5th

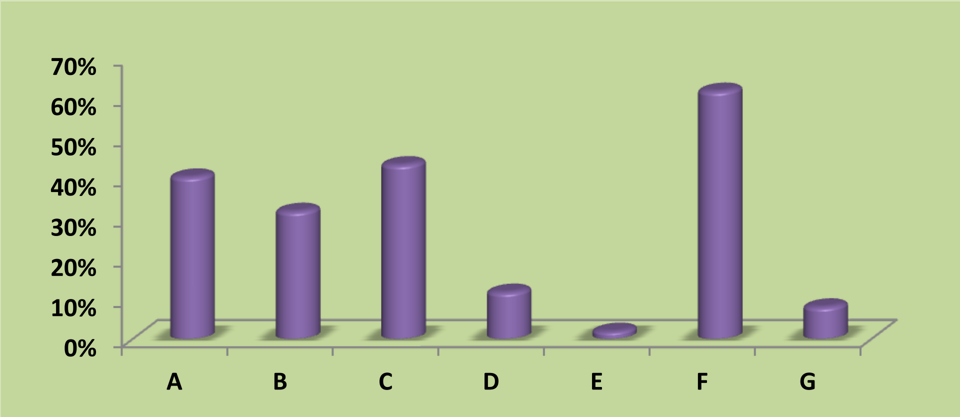
Share of the state in total firms surveyed in India: 2.61%
Share of the state in total Innovative firms in India: 5.15%

Top Five Innovative Sectors



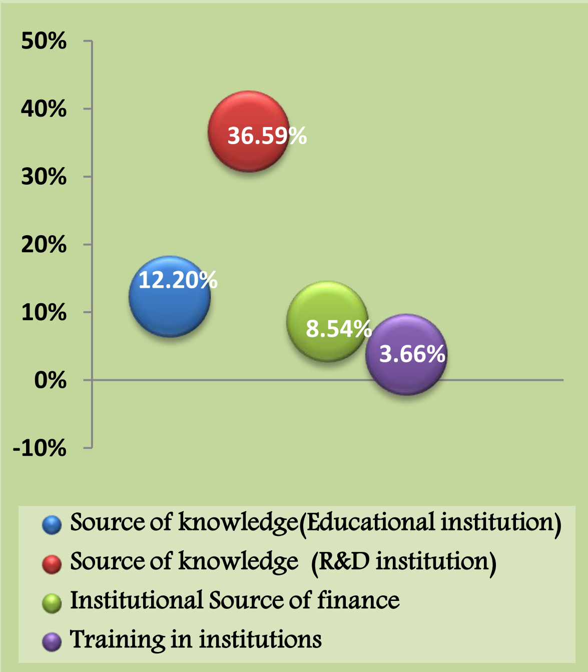
NIC 21 - *Manufacture of pharmaceuticals, medicinal chemical and botanical products.*
NIC 24 - *Manufacture of basic metals.*
NIC 20 - *Manufacture of chemicals and chemical products.*
NIC 22 - *Manufacture of rubber and plastics products.*
NIC 10 - *Manufacture of food products.*

Types of Innovation

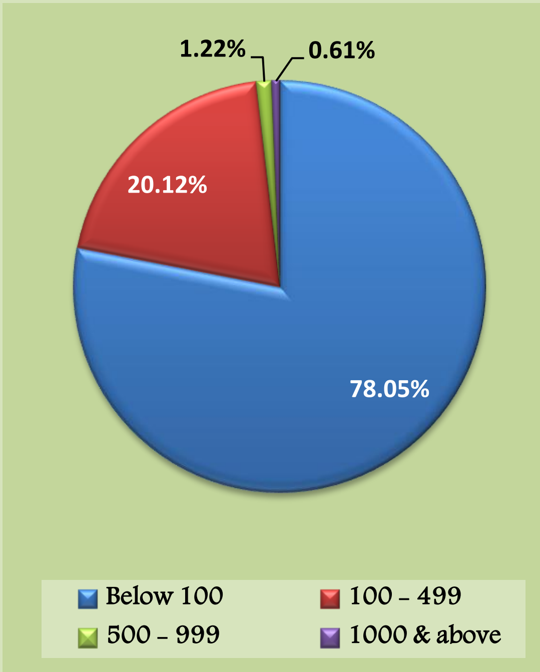


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



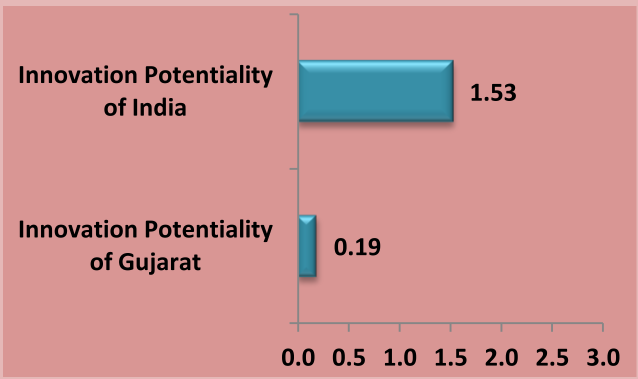
Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 51% of the innovative firms innovations are only new to the firm

Net State Domestic product (NSDP) per capita at Constant Prices 2009-10: Rs. 49030
Industry Share in NSDP: 27.87%
Highways: 11.74 *per 100 Sq Km*
Health Centres: 46.71 *per100 village*
Educational institute: 191.41 *per million population*
Power Generation: 1285.98 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

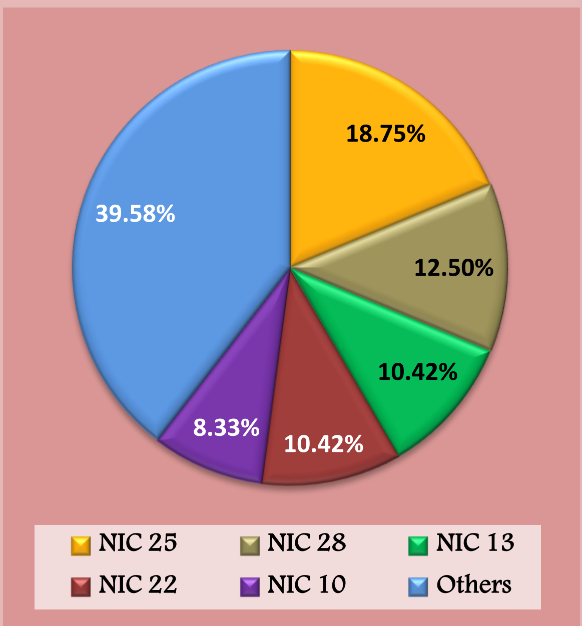
Human Development Index: 17th

Regional Innovation System: 2nd

Innovation Potential: 24th

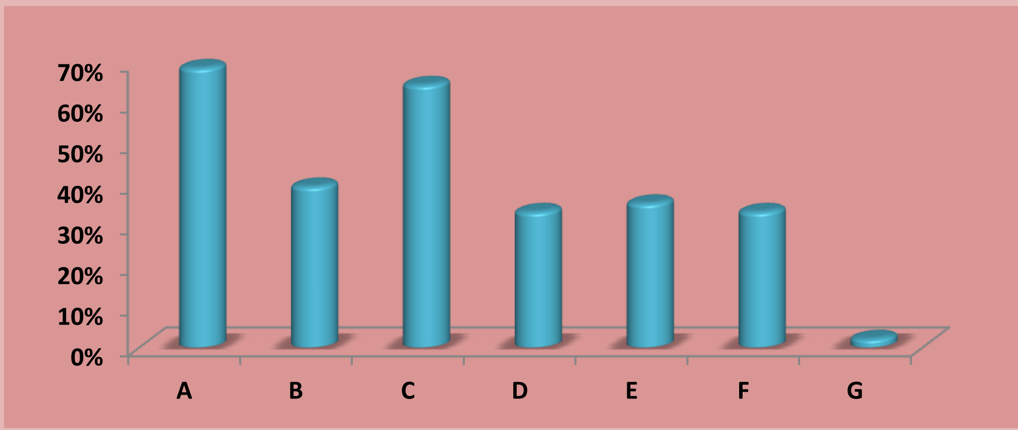
Share of the state in total firms surveyed in India: 4.14%
Share of the state in total Innovative firms in India: 1.51%

Top Five Innovative Sectors



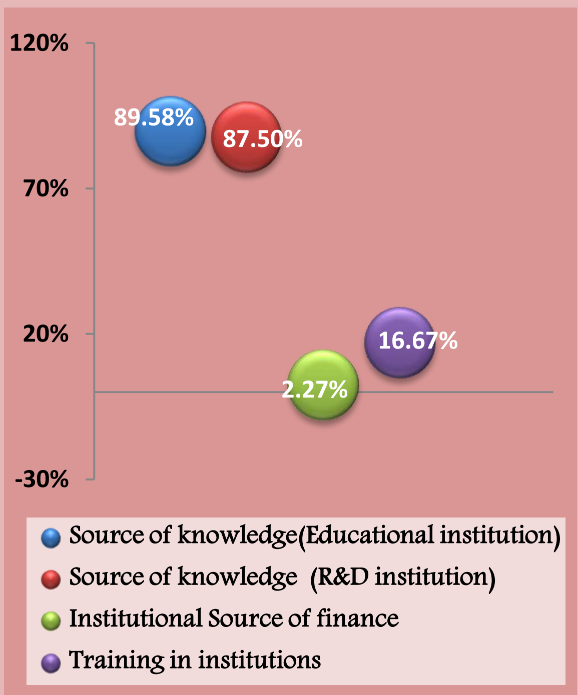
NIC 25 - *Manufacture of fabricated metal products, except machinery and equipment.*
NIC 28 - *Manufacture of machinery and equipment n.e.c.*
NIC 13 - *Manufacture of textiles*
NIC 22 - *Manufacture of rubber and plastics products.*
NIC 10 - *Manufacture of food products.*

Types of Innovation

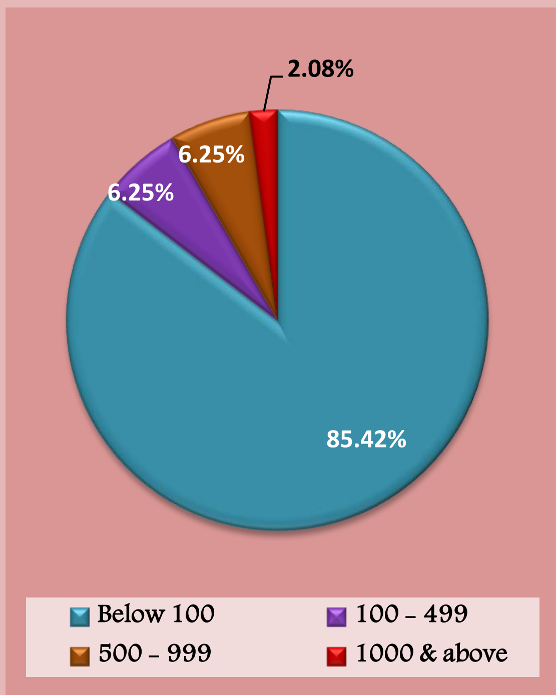


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



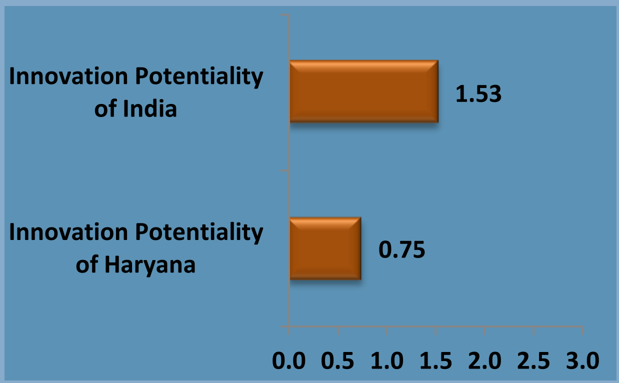
Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 81% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 55214
Industry Share in NSDP: 18.21%
Highways: 0.09 *per 100 Sq Km*
Health Centres: 43.59 *per100 village*
Educational institute: 356 *per million population*
Power Generation: 869.7 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

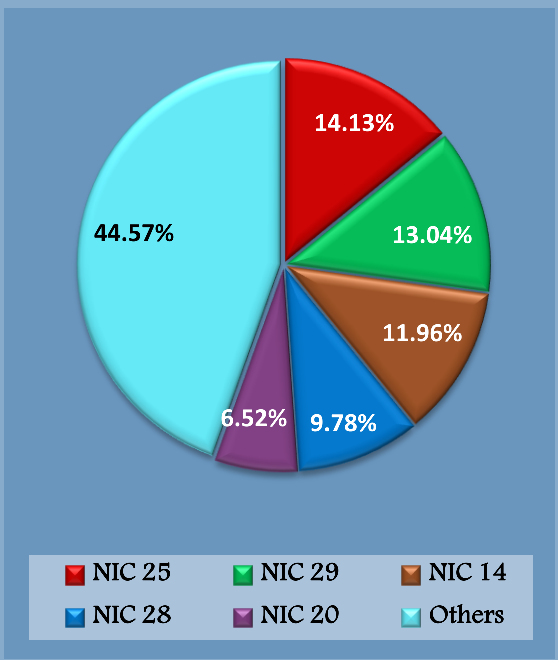
Human Development Index: 15th

Regional Innovation System: 5th

Innovation Potential: 17th

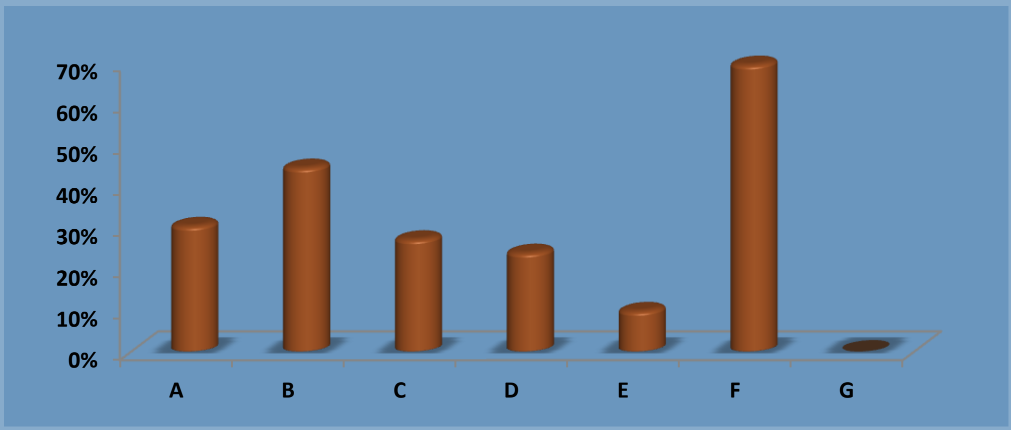
Share of the state in total firms surveyed in India: 3.93%
Share of the state in total Innovative firms in India: 2.89%

Top Five Innovative Sectors



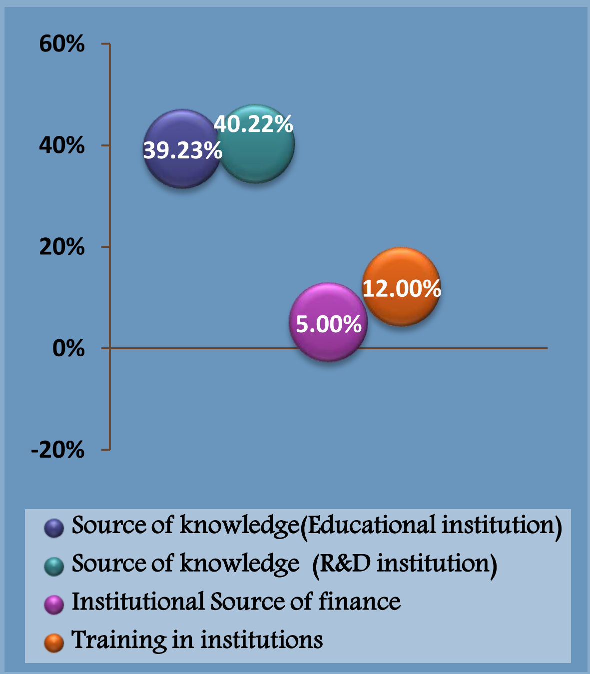
NIC 25 - *Manufacture of fabricated metal products, except machinery and equipment.*
NIC 29 - *Manufacture of motor vehicles, trailers and semi-trailers.*
NIC 14 - *Manufacture of wearing apparel.*
NIC 28 - *Manufacture of machinery and equipment n.e.c.* .
NIC 20 - *Manufacture of chemical and chemical products.*

Types of Innovation

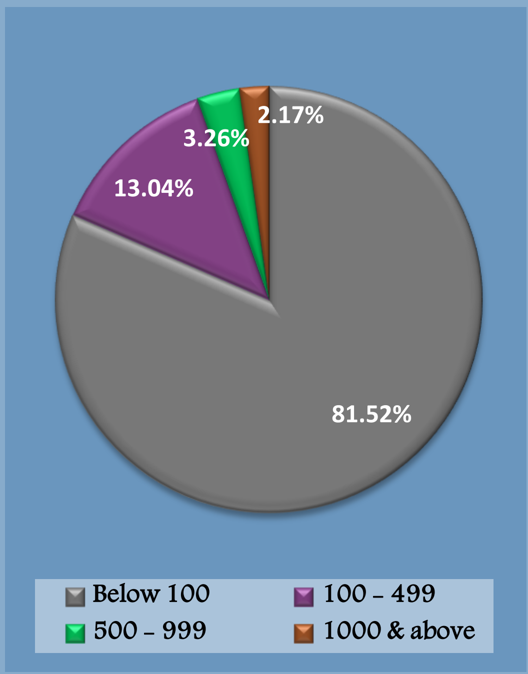


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



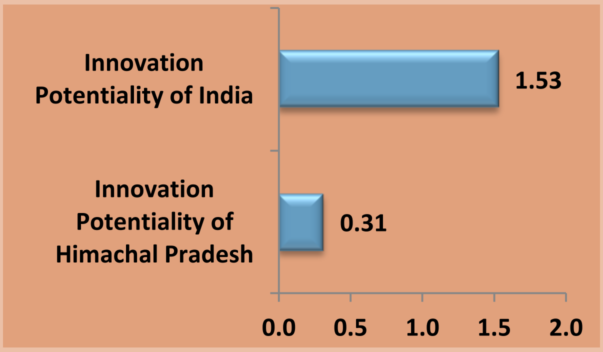
Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 78% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) Per capita at Constant Prices 2009-10: Rs. 40690
Industry Share in NSDP: 11.77%
Highways: 0.05 *per 100 Sq Km*
Health Centres: 12.88 *per100 village*
Educational institute: 770 *per million population*
Power Generation: 2378 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

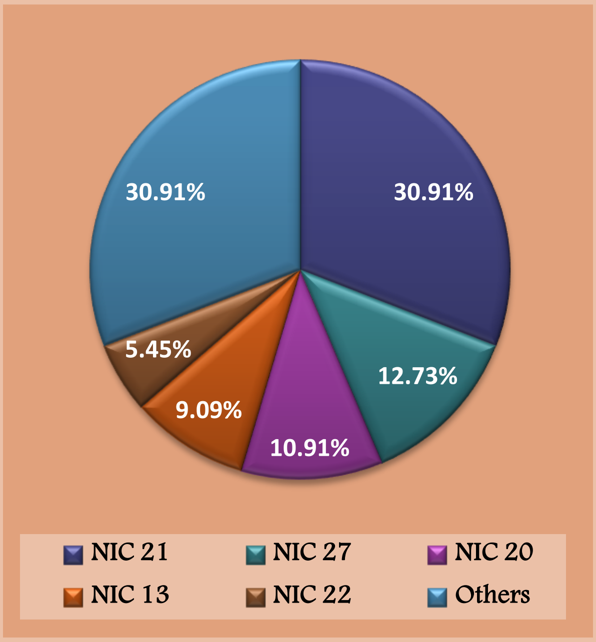
Human Development Index: 9th

Regional Innovation System: 16th

Innovation Potential: 19th

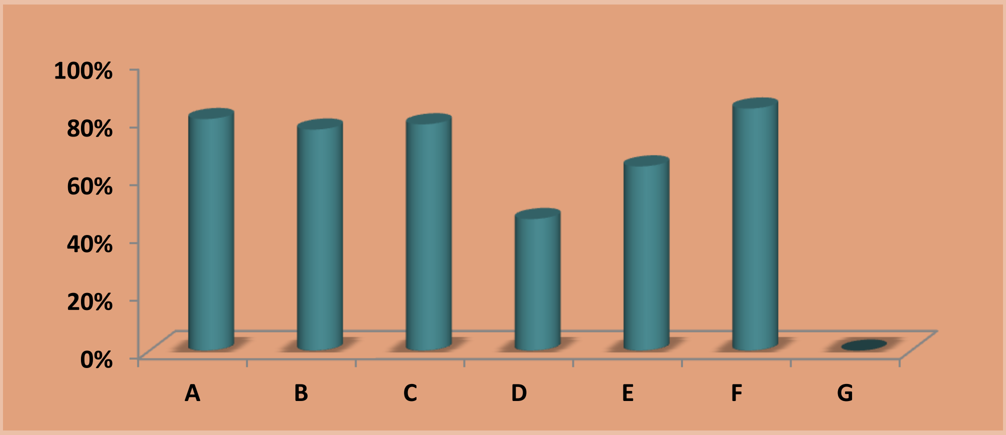
Share of the state in total firms surveyed in India: 3.61%
Share of the state in total Innovative firms in India: 1.79%

Top Five Innovative Sectors



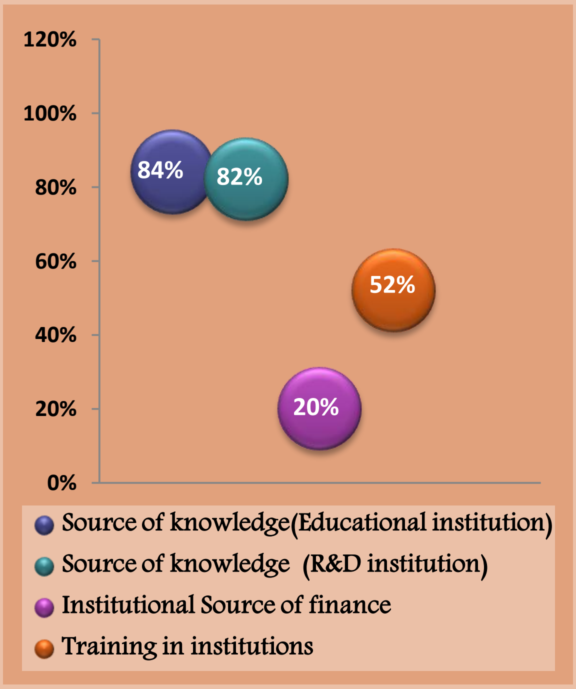
NIC 21 - *Manufacture of pharmaceuticals, medicinal chemical and botanical products.*
NIC 27 - *Manufacture of electrical equipment.*
NIC 20 - *Manufacture of chemicals and chemical products.*
NIC 13 - *Manufacture of textiles.*
NIC 22 - *Manufacture of rubber and plastics products.*

Types of Innovation

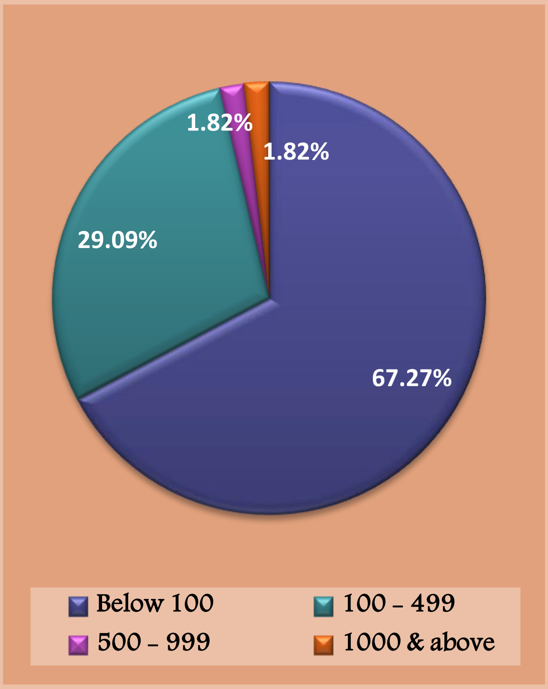


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



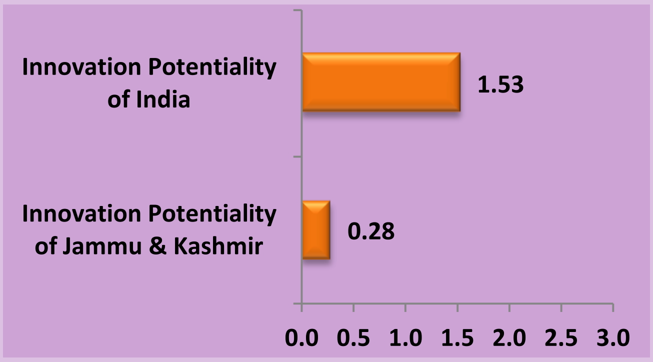
Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 75% of the innovative firms innovations are only new to the market.

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 26739
Industry Share in NSDP: 9.81%
Highways: 0.56 *per 100 Sq Km*
Health Centres: 35.88 *per100 village*
Educational institute: 170.15 *per million population*
Power Generation: 1127.30 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

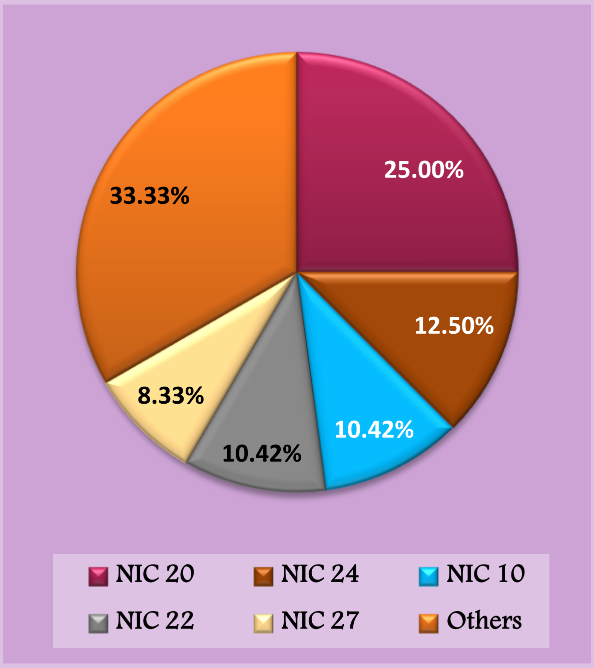
Human Development Index: 16th

Regional Innovation System: 20th

Innovation Potential: 20th

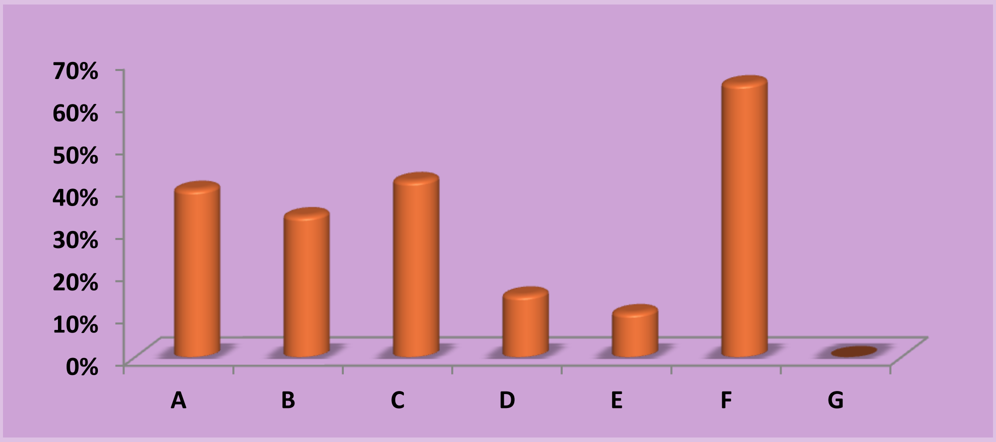
Share of the state in total firms surveyed in India: 2.83%
Share of the state in total Innovative firms in India: 1.51%

Top Five Innovative Sectors



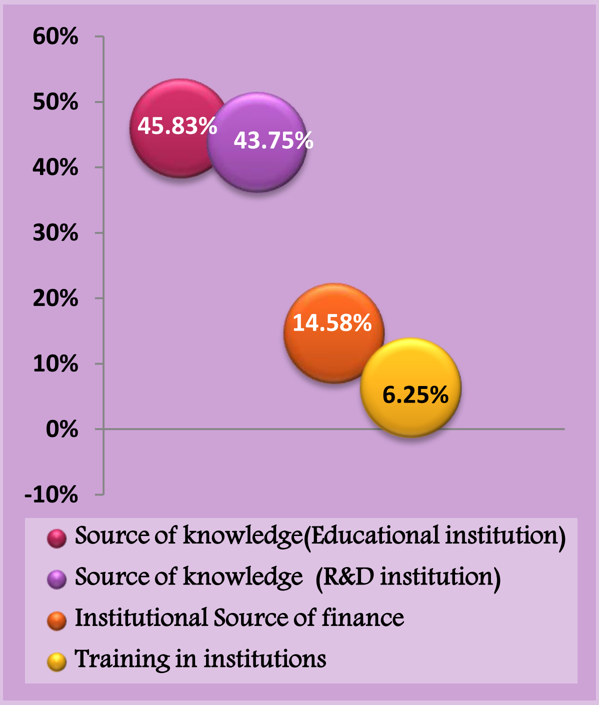
NIC 20 - *Manufacture of chemicals and chemical products.*
NIC 24 - *Manufacture of basic metals.*
NIC 10 - *Manufacture of food products.*
NIC 22 - *Manufacture of rubber and plastics products.*
NIC 27 - *Manufacture of electrical equipment.*

Types of Innovation

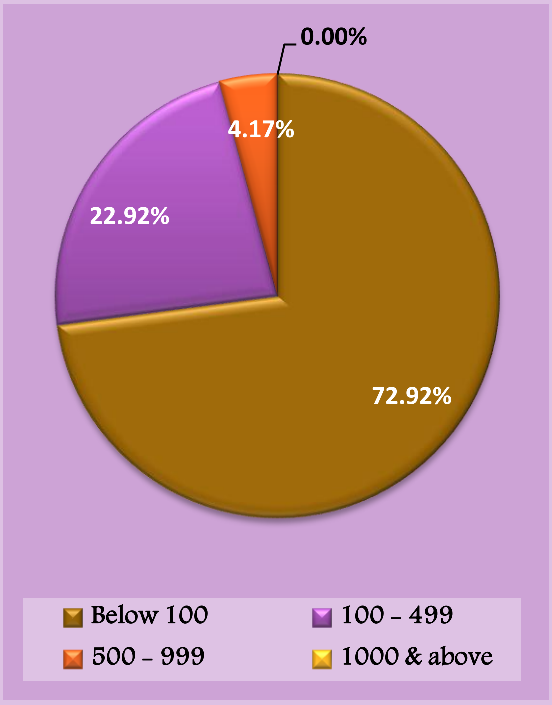


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



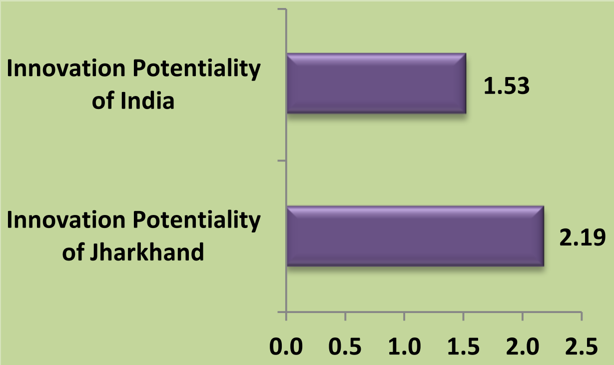
Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 66% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 22780
Industry Share in NSDP: 35.82%
Highways: 0.10 *per 100 Sq Km*
Health Centres: 13.72 *per100 village*
Educational institute: 277 *per million population*
Power Generation: 210.5 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

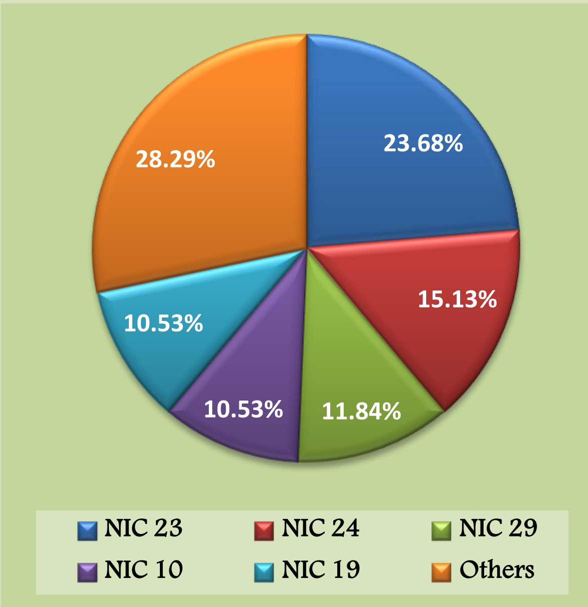
Human Development Index: 25th

Regional Innovation System: 22nd

Innovation Potential: 12th

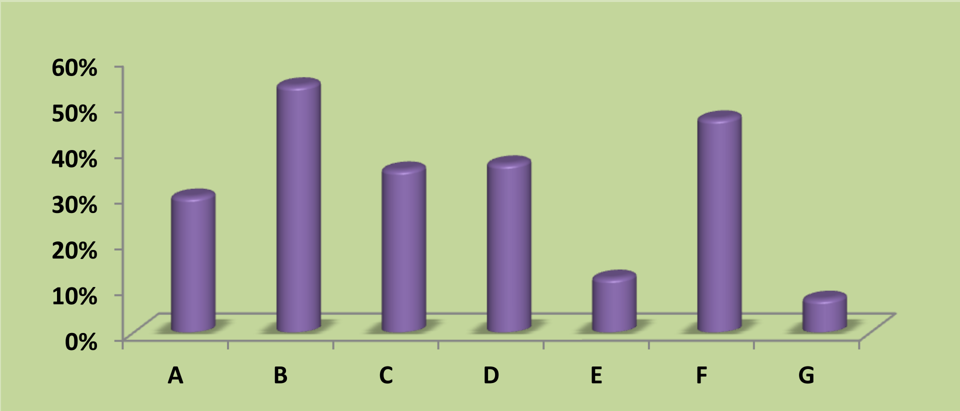
Share of the state in total firms surveyed in India: 3.69%
Share of the state in total Innovative firms in India: 4.77%

Top Five Innovative Sectors



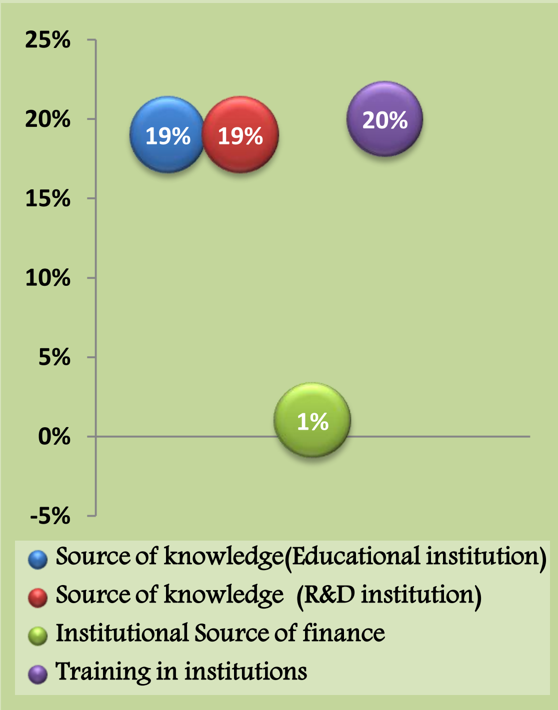
NIC 23 - *Manufacture of other non-metallic mineral products.*
NIC 24 - *Manufacture of basic metals.*
NIC 29 - *Manufacture of motor vehicles, trailers and semi-trailers.*
NIC 10 - *Manufacture of food products.*
NIC 19 - *Manufacture of coke and refined petroleum products.*

Types of Innovation

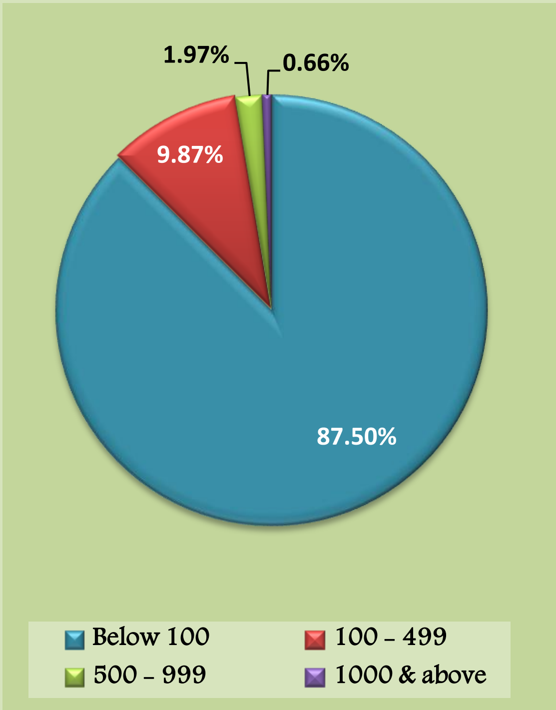


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



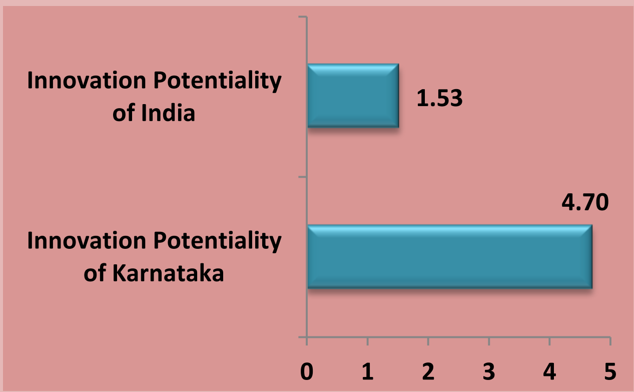
Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 93% of the innovative firms innovations are only new to the firm

Net State domestic product (NSDP) per capita at Constant Prices 2009-10: Rs. 37464
Industry Share in NSDP: 17.56%
Highways: 13.00 *per 100 Sq Km*
Health Centres: 36.25 *per100 village*
Educational institute: 323.08 *per million population*
Power Generation: 671.00 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

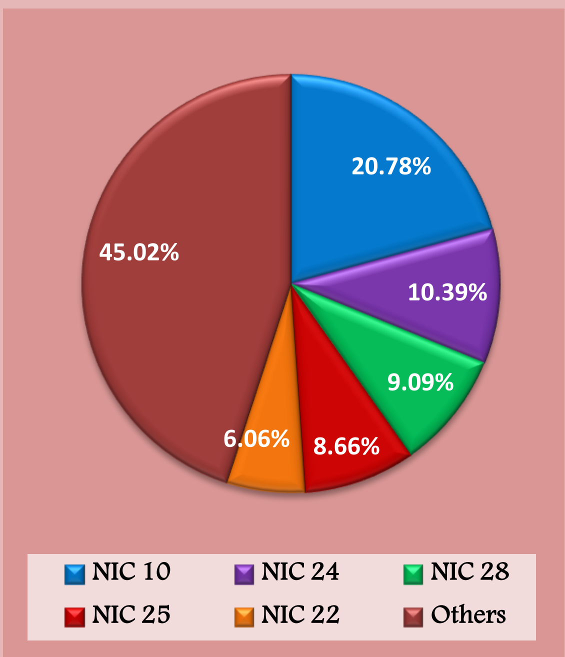
Human Development Index: 18th

Regional Innovation System: 3rd

Innovation Potential: 1st

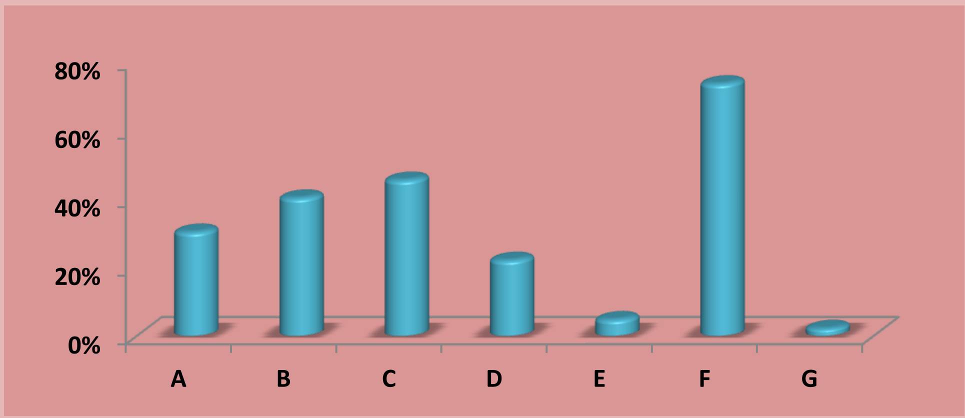
Share of the state in total firms surveyed in India: 4.10%
Share of the state in total Innovative firms in India: 7.38%

Top Five Innovative Sectors



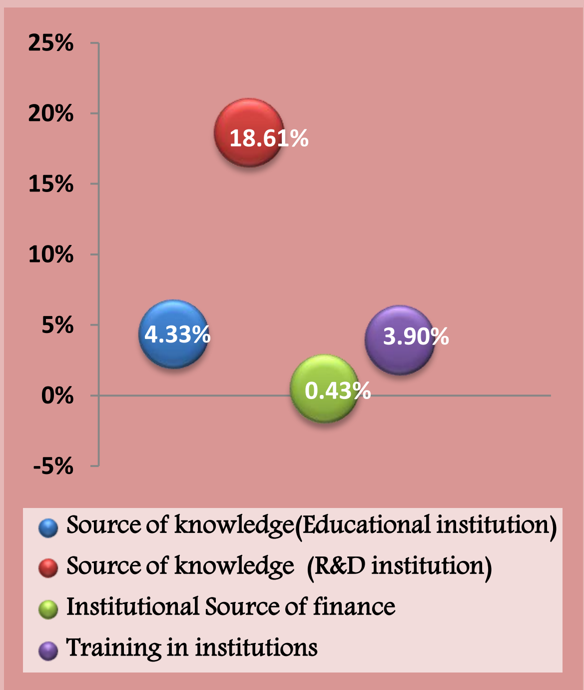
NIC 10 - *Manufacture of food products.*
NIC 24 - *Manufacture of basic metals.*
NIC 28 - *Manufacture of machinery and equipment n.e.c.*
NIC 25 - *Manufacture of fabricated metal products, except machinery and equipment.*
NIC 22 - *Manufacture of rubber and plastics products.*

Types of Innovation

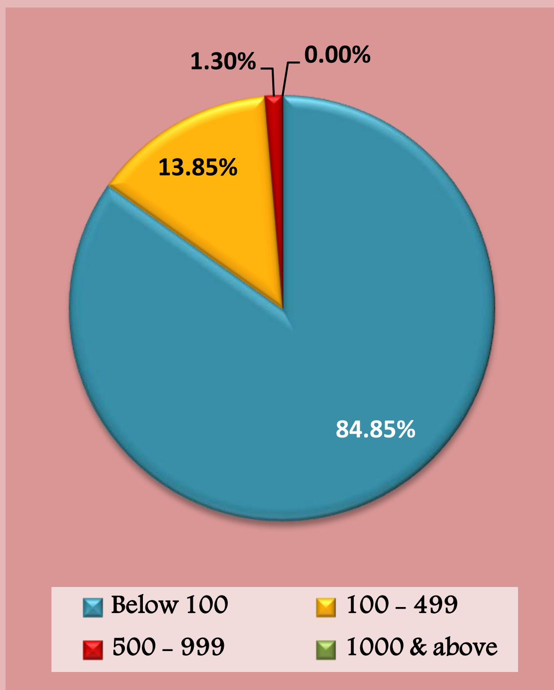


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



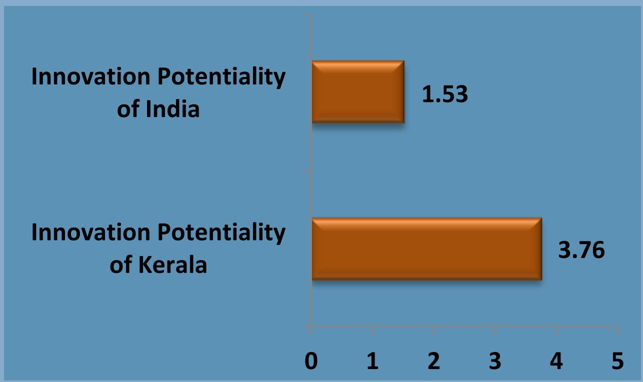
Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 58% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 46511
Industry Share in NSDP: 9.58%
Highways: 12.69 *per 100 Sq Km*
Health Centres: 412.10 *per100 village*
Educational institute: 189.28 *per million population*
Power Generation: 325.65 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

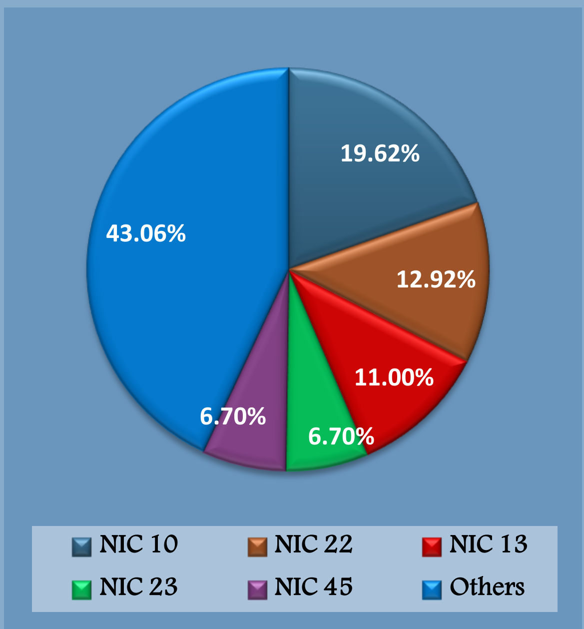
Human Development Index: 1st

Regional Innovation System: 10th

Innovation Potential: 4th

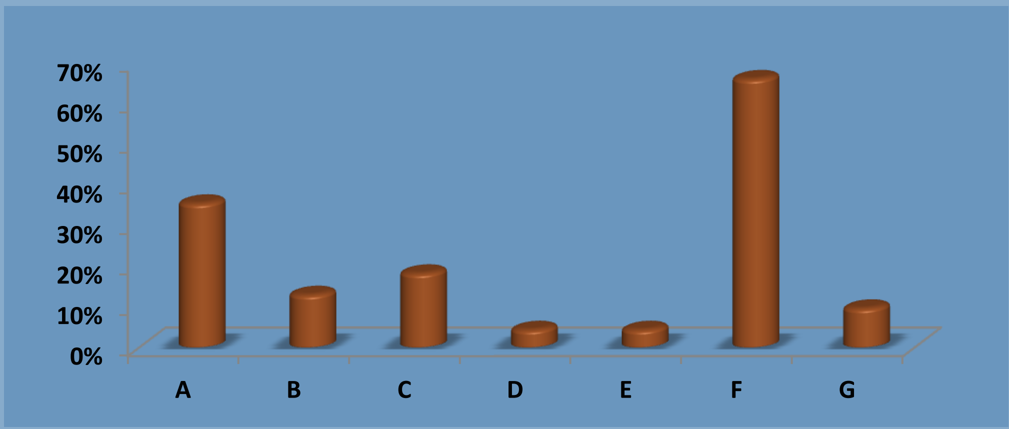
Share of the state in total firms surveyed in India: 4.06%
Share of the state in total Innovative firms in India: 6.56%

Top Five Innovative Sectors



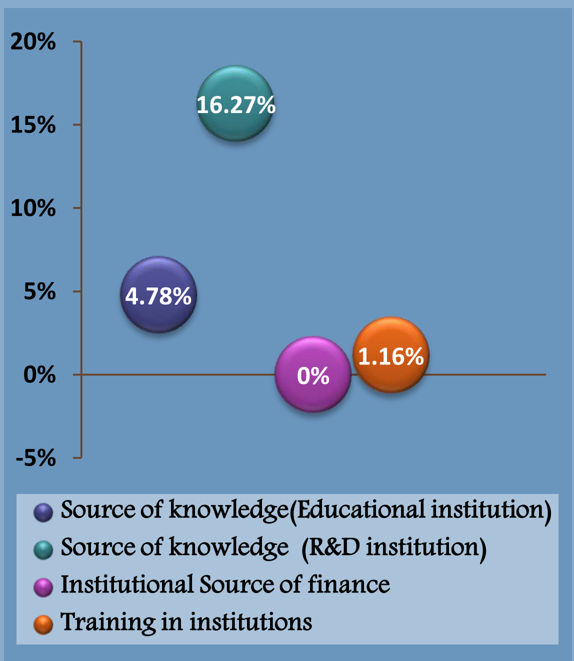
NIC 10 - *Manufacture of food products.*
NIC 22 - *Manufacture of rubber and plastics products.*
NIC 13 - *Manufacture of textiles*
NIC 23 - *Manufacture of other non-metallic mineral products.*
NIC 45 - *Wholesale and retail trade and repair of motor vehicles and motorcycles.*

Types of Innovation

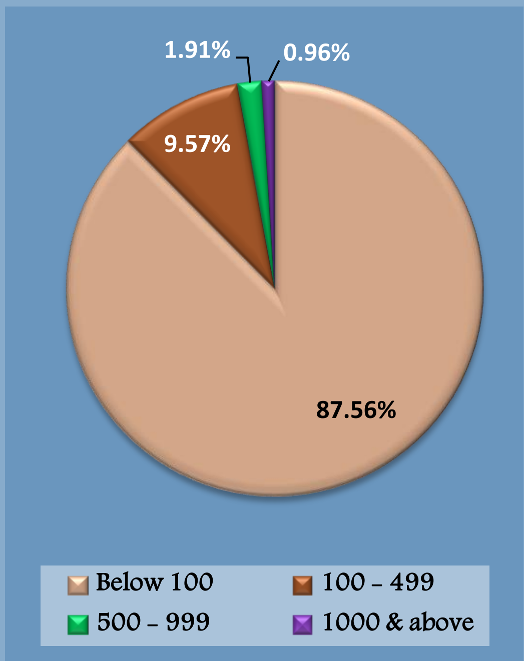


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



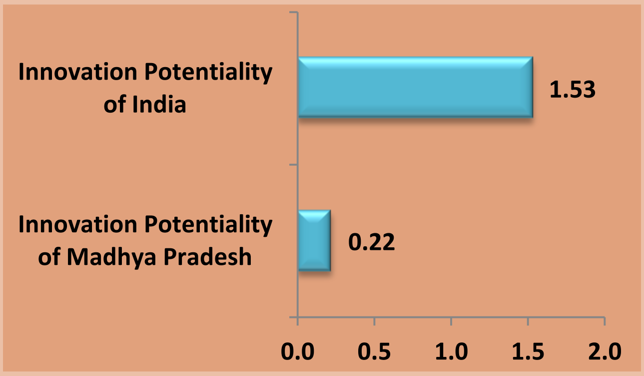
Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 78% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 19736
Industry Share in NSDP: 15.87%
Highways: 1.52 *per 100 Sq Km*
Health Centres: 18.7 *per100 village*
Educational institute: 178.33 *per million population*
Power Generation: 802.46 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

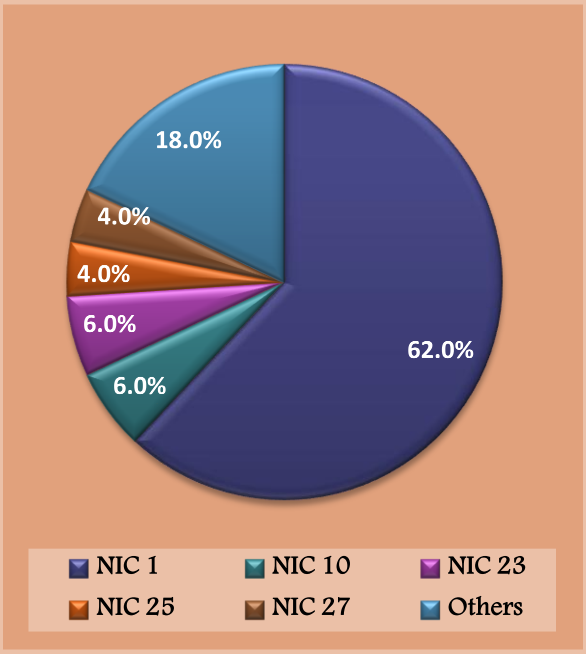
Human Development Index: 26th

Regional Innovation System: 24th

Innovation Potential: 23rd

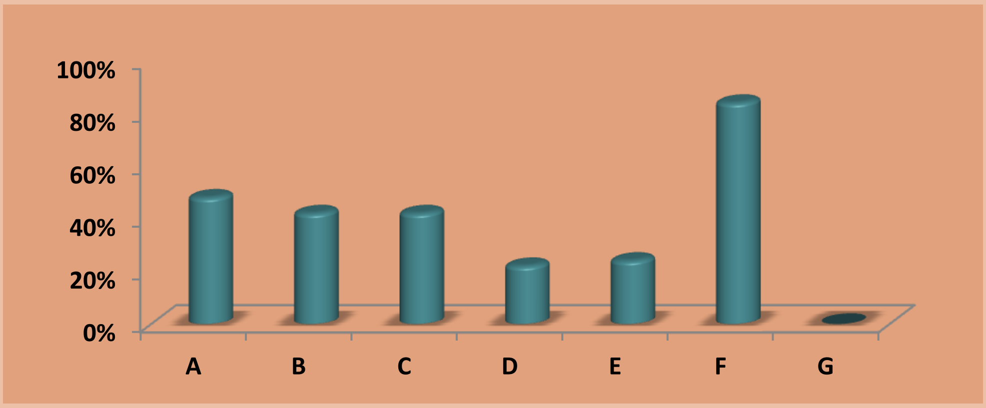
Share of the state in total firms surveyed in India: 3.91%
Share of the state in total Innovative firms in India: 1.57%

Top Five Innovative Sectors



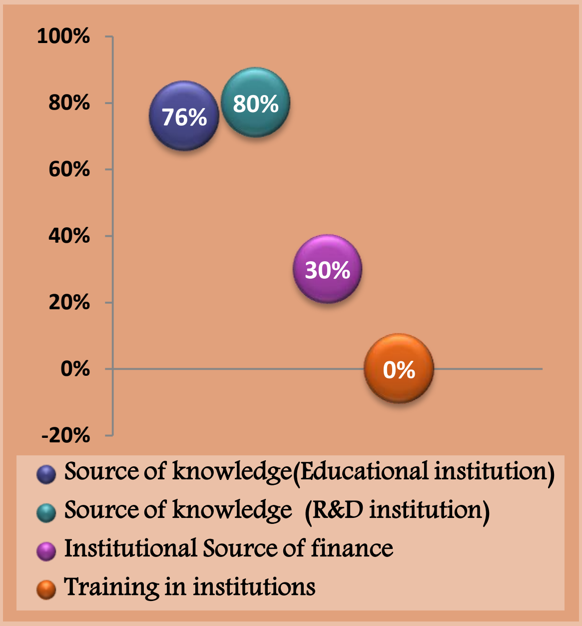
NIC 1 - *Crop and animal production, hunting and related service activities.*
NIC 10 - *Manufacture of food products.*
NIC 23 - *Manufacture of other non-metallic mineral products.*
NIC 25 - *Manufacture of fabricated metal products, except machinery and equipment.*
NIC 27 - *Manufacture of electrical equipment.*

Types of Innovation



A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

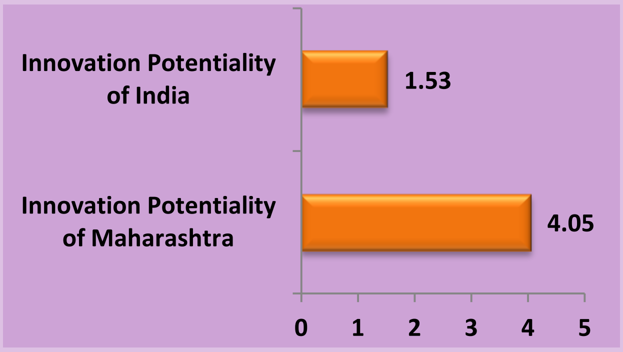
Accessing Innovation Support System



Firm Size (workforce) and corresponding share in innovative firms
below 100 : **90%**
between 100- 499: **10%**

Novelty of Innovation
For 72% of the innovative firms innovations are only new to the market.

Net State Domestic Product (NSDP) Per capita at Constant Prices 2009-10: Rs. 57458
Industry Share in NSDP: 20.99%
Highways: 1.36 *per 100 Sq Km*
Health Centres: 29.18 *per100 village*
Educational institute: 242.44 *per million population*
Power Generation: 861.88 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

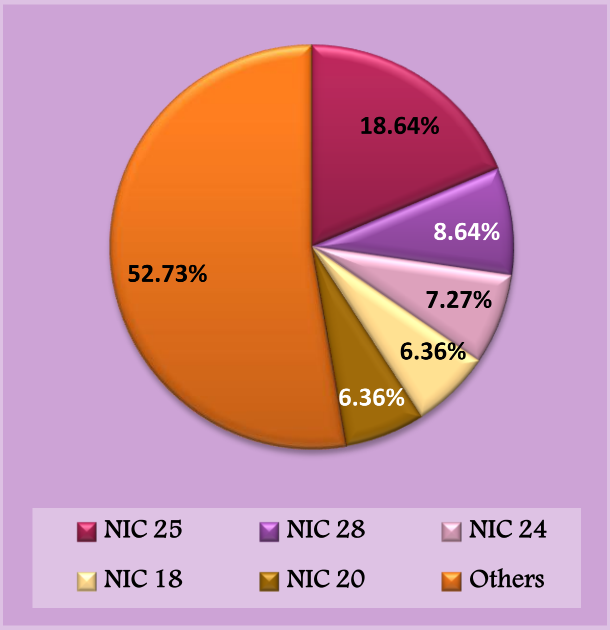
Human Development Index: 13th

Regional Innovation System: 11th

Innovation Potential: 2nd

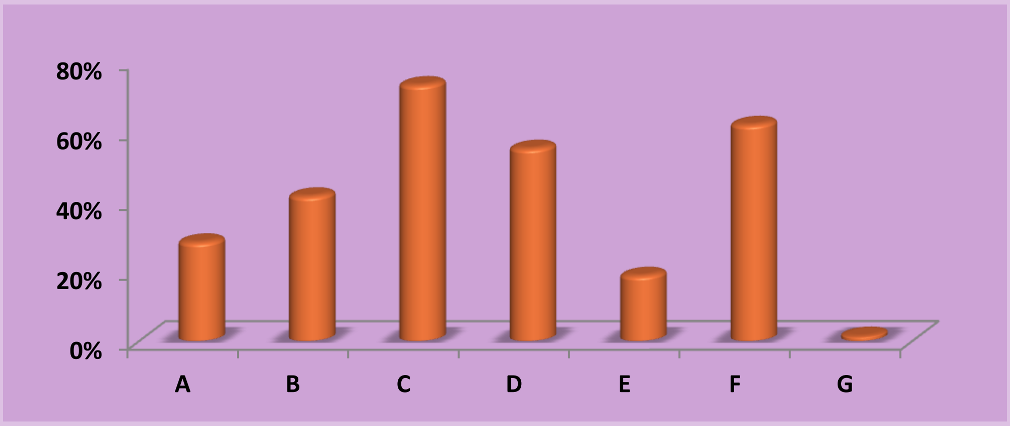
Share of the state in total firms surveyed in India: 4.17%
Share of the state in total Innovative firms in India: 6.91%

Top Five Innovative Sectors



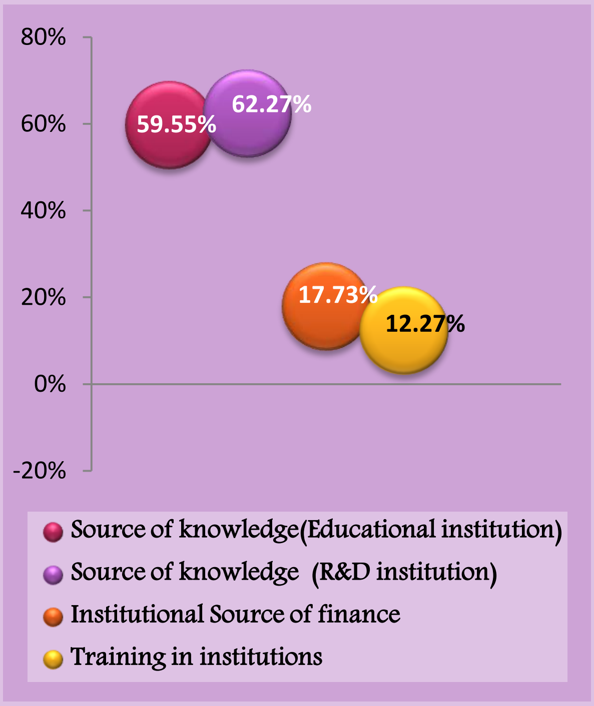
NIC 25 - *Manufacture of fabricated metal products, except machinery and equipment.*
NIC 28 - *Manufacture of machinery and equipment n.e.c.*
NIC 24 - *Manufacture of basic metals.*
NIC 18 - *Printing and reproduction of recorded media.*
NIC 20 - *Manufacture of chemicals and chemical products.*

Types of Innovation

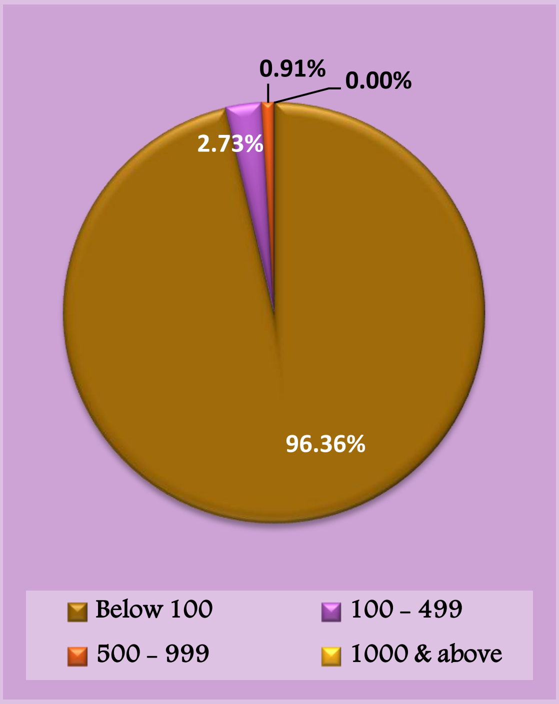


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



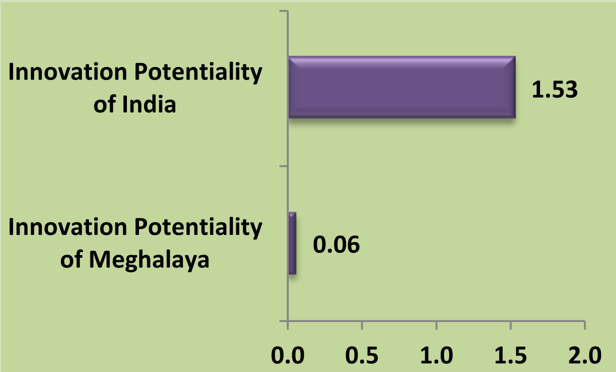
Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 58% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 29656
Industry Share in NSDP: 15.42%
Highways: 3.61 *per 100 Sq Km*
Health Centres: 9.01 *per100 village*
Educational institute: 36.05 *per million population*
Power Generation: 111.26 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

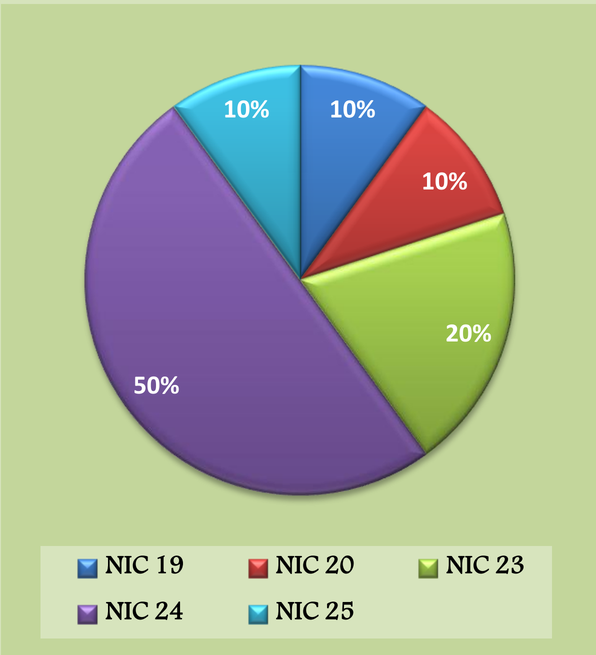
Human Development Index: 12th

Regional Innovation System: 26th

Innovation Potential: 29th

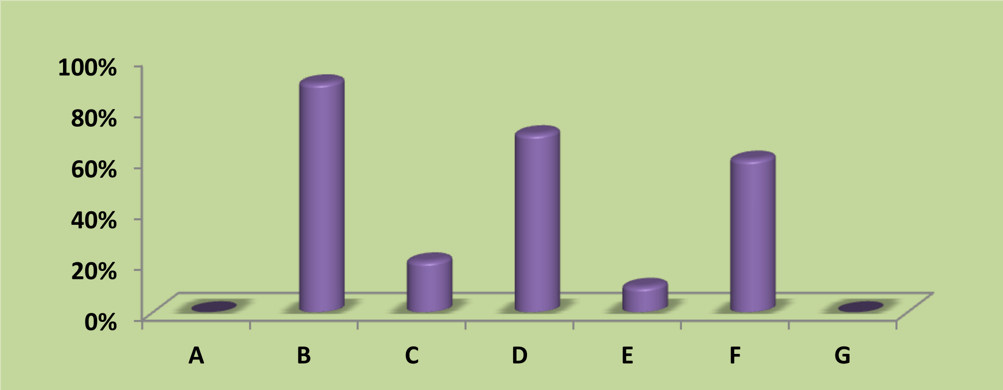
Share of the state in total firms surveyed in India: 0.57%%
Share of the state in total Innovative firms in India: 0.31%

The Innovative Sectors



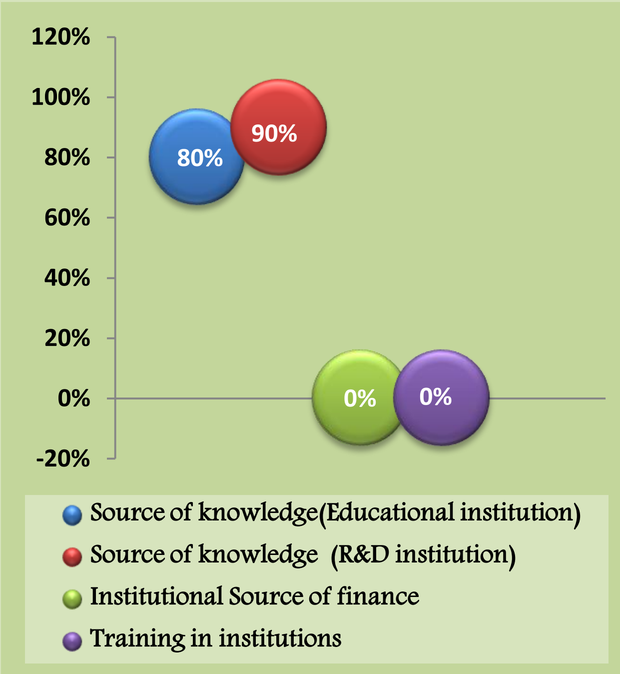
NIC 24 - *Manufacture of basic metals.*
NIC 23 - *Manufacture of other non-metallic mineral products.*
NIC 25 - *Manufacture of fabricated metal products, except machinery and equipment.*
NIC 19 - *Manufacture of coke and refined petroleum products.*
NIC 20 – *Manufacture of chemicals and chemical products.*

Types of Innovation



A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

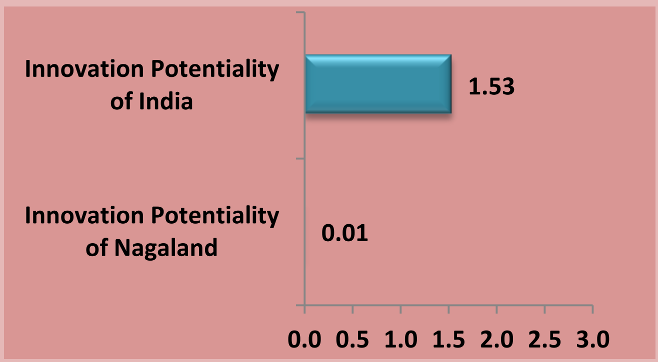
Accessing Innovation Support System



Firm Size (workforce) and corresponding share in innovative firms
below 100 **: 70%**
between 100- 499**: 30%**

Novelty of Innovation
For 100% of the innovative firms innovations are only new to the firm

Net State Domestic product (NSDP) per capita at Constant Prices 2007-08: Rs. 20971
Industry Share in NSDP: 3.24%
Highways: 2.98 *per 100 Sq Km*
Health Centres: 41.23 *per100 village*
Educational institute: 22.91 *per million population*
Power Generation: 129.65 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

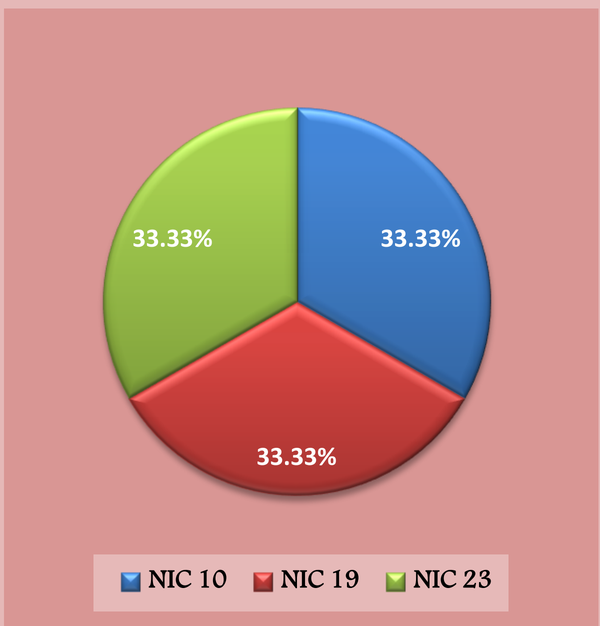
Human Development Index: 12th

Regional Innovation System: 28th

Innovation Potential: 30th

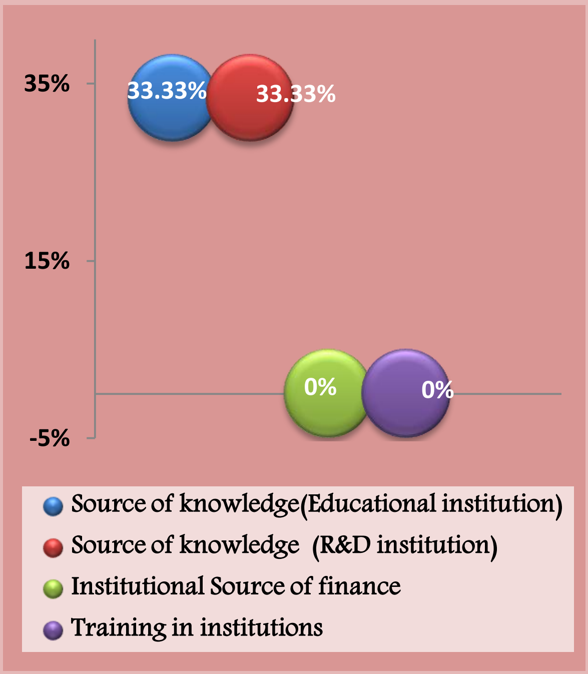
Share of the state in total firms surveyed in India: 0.51%
Share of the state in total Innovative firms in India: 0.09%

The Innovative Sectors



The state has reported innovations only in three sectors namely;
NIC 10 - *Manufacture of food products.*
NIC 19 - *Manufacture of coke and refined petroleum products*
NIC 23 - *Manufacture of other non-metallic mineral products.*

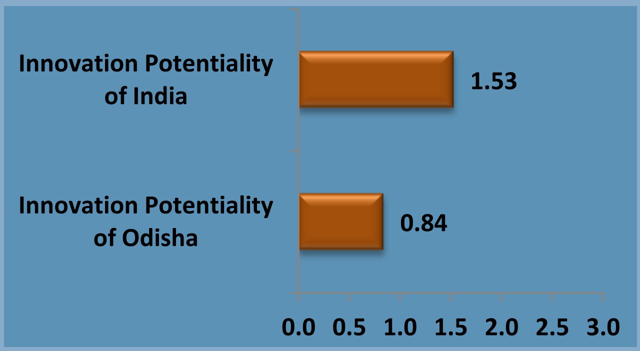
Accessing Innovation Support System



Type of innovation is only ***Introduction of new machines***
The innovative firms belongs to ***below 100 firms Size (workforce)***

Novelty of Innovation
For 66% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 24098
Industry Share in NSDP: 17.28%
Highways: 5.66 *per 100 Sq Km*
Health Centres: 15.97 *per100 village*
Educational institute: 255.26 *per million population.*
Power Generation: 942.64 *million units per million population.*



RANK OF THE STATE vis-a-vis OTHER STATES

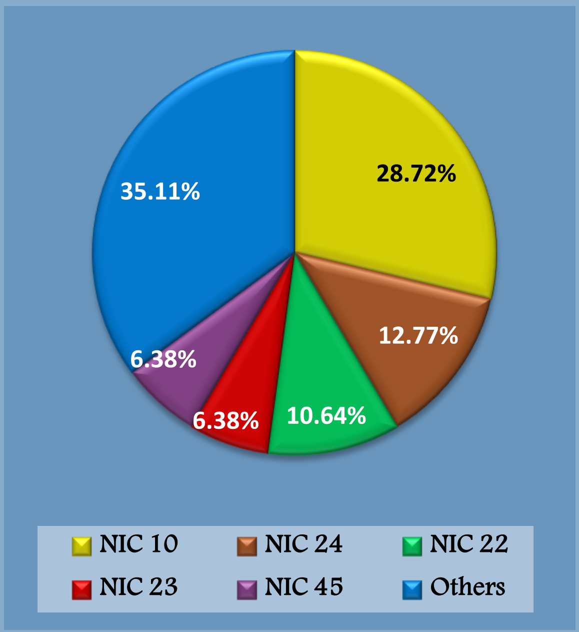
Human Development Index: 28th

Regional Innovation System: 14th

Innovation Potential: 16th

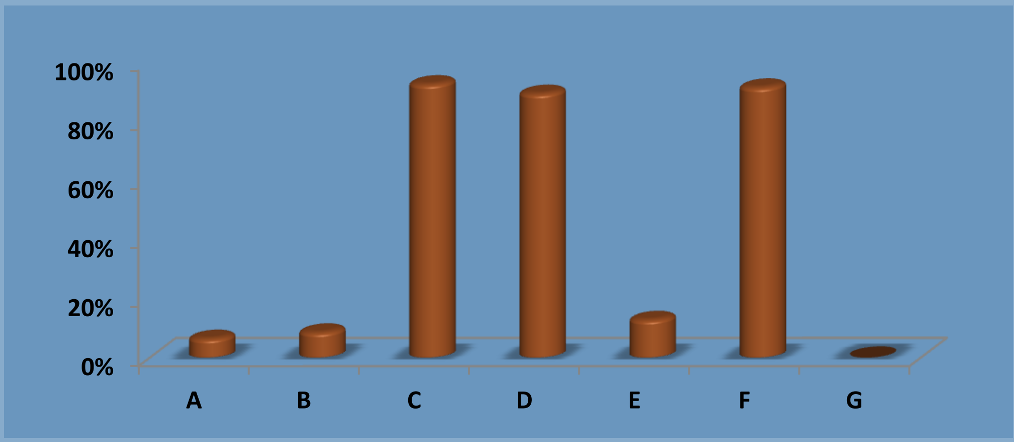
Share of the state in total firms surveyed in India: 3.67%%
Share of the state in total Innovative firms in India: 2.95%

Top Five Innovative Sectors



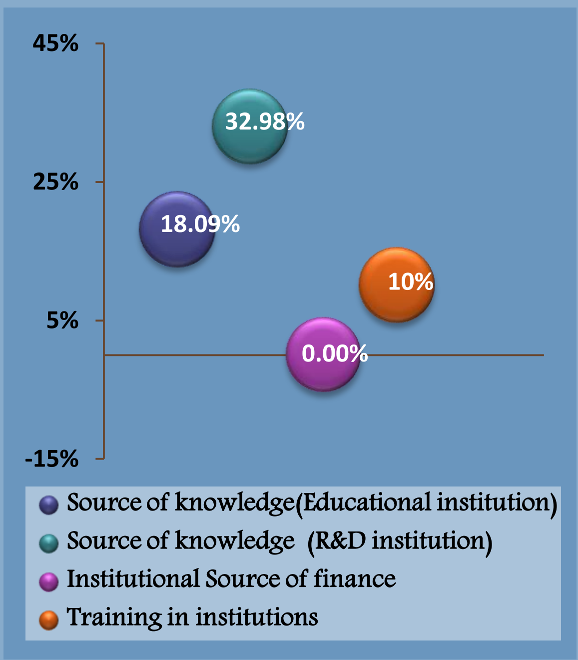
NIC 10 - *Manufacture of food products.*
NIC 24 - *Manufacture of basic metals.*
NIC 22 – *Manufacture of rubber and plastics products.*
NIC 23 - *Manufacture of other non-metallic mineral products.*
NIC 45 - *Wholesale and retail trade and repair of motor vehicles and motorcycles*

Types of Innovation

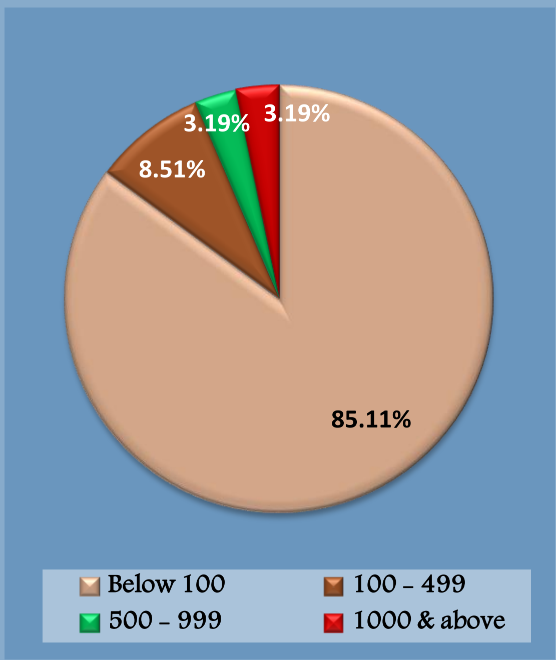


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



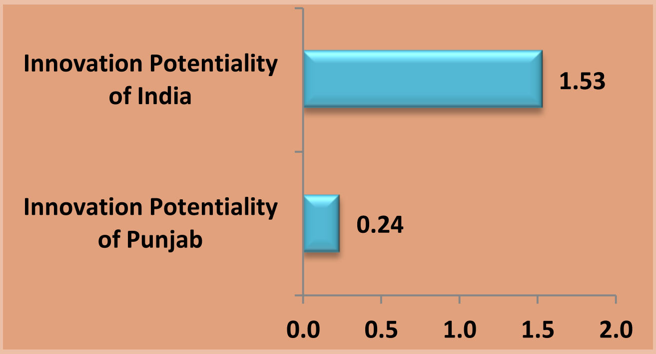
Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 94% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 43539
Industry Share in NSDP: 20.53%
Highways: 3.09 *per 100 Sq Km*
Health Centres: 27.82 *per100 village*
Educational institute: 191.76 *per million population*
Power Generation: 976.85 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

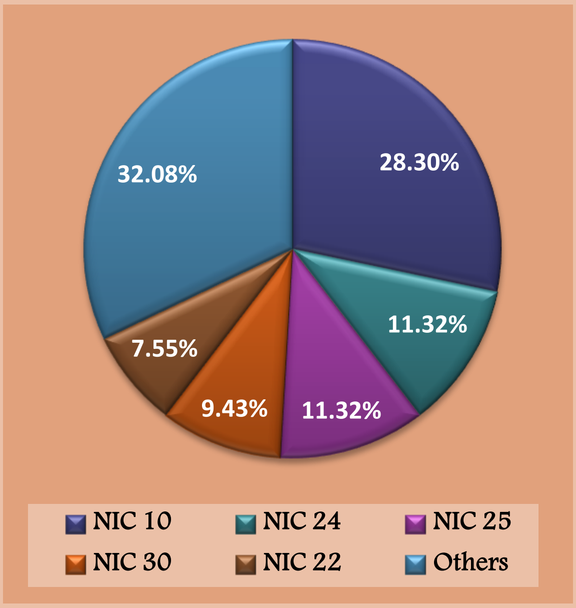
Human Development Index: 11th

Regional Innovation System: 12th

Innovation Potential: 22nd

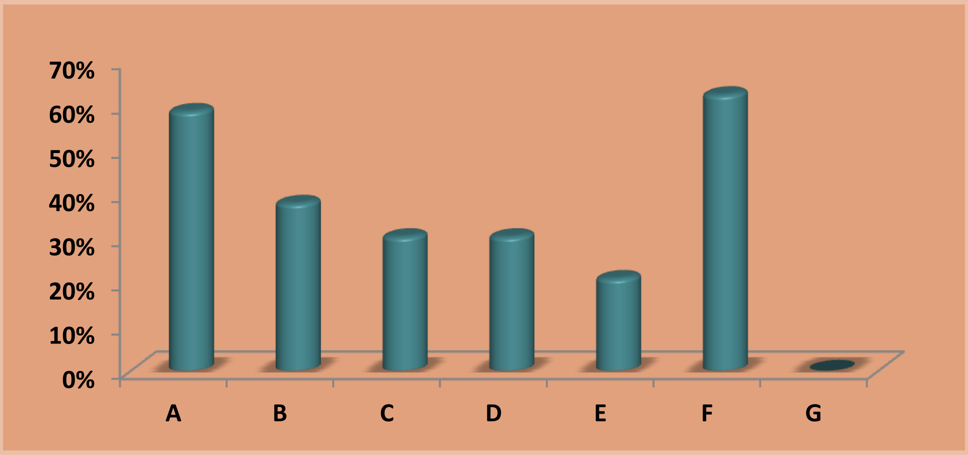
Share of the state in total firms surveyed in India: 4.13%
Share of the state in total Innovative firms in India: 1.67%

Top Five Innovative Sectors



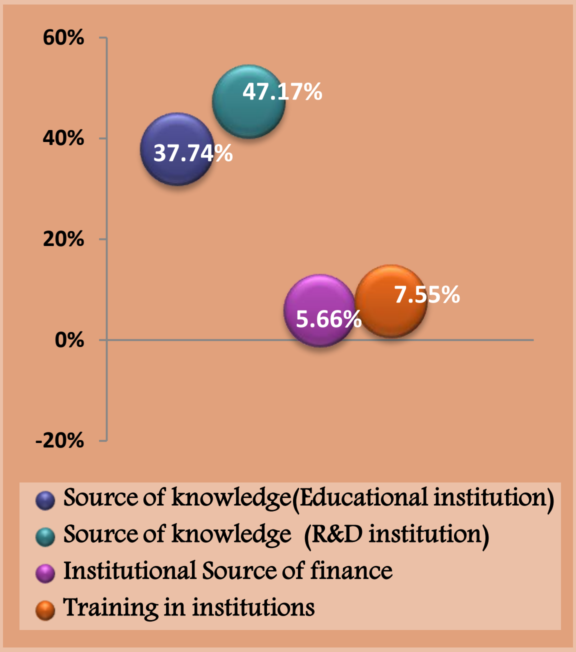
NIC 10 - *Manufacture of food products.*
NIC 24 - *Manufacture of basic metals.*
NIC 25 - *Manufacture of fabricated metal products, except machinery and equipment.*
NIC 30 - *Manufacture of other transport equipment.*
NIC 22 – *Manufacture of rubber and plastics products.*

Types of Innovation



A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

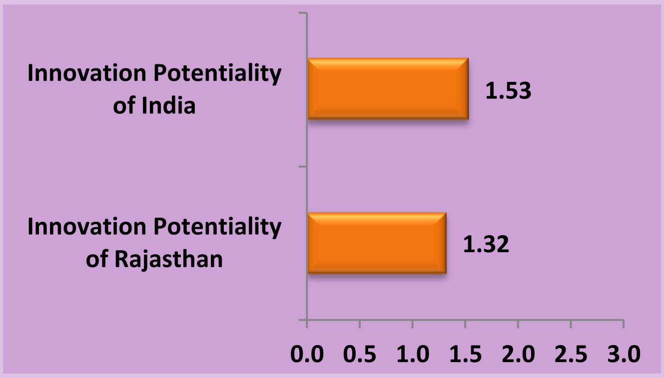
Accessing Innovation Support System



Firm Size (workforce) and corresponding share in innovative firms
below 100 : **96.23%**
between 100- 499: **3.77%**

Novelty of Innovation
For 52% of the innovative firms innovations are only new to the market.

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 23669
Industry Share in NSDP: 16.68%
Highways: 1.63 *per 100 Sq Km*
Health Centres: 31.63 *per100 village*
Educational institute: 264.96 *per million population*
Power Generation: 520.18 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

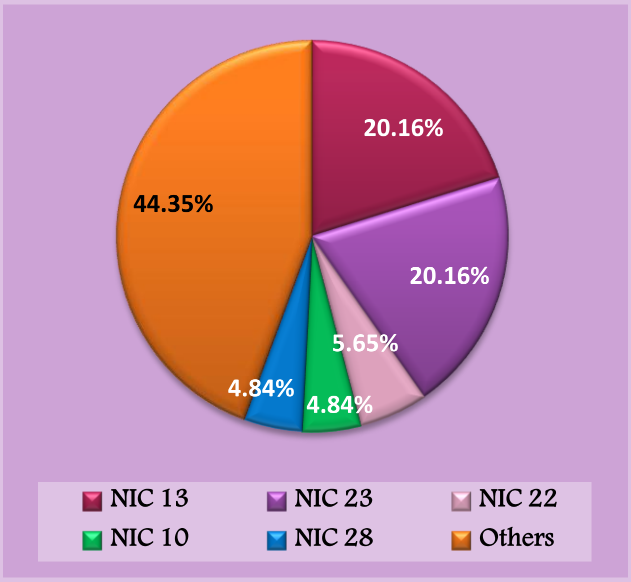
Human Development Index: 23rd

Regional Innovation System: 18th

Innovation Potential: 14th

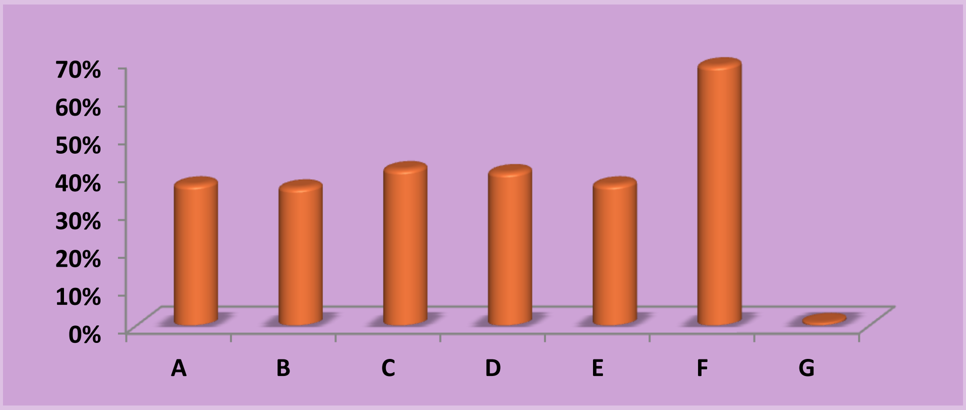
Share of the state in total firms surveyed in India: 4.07%
Share of the state in total Innovative firms in India: 3.89%

Top Five Innovative Sectors



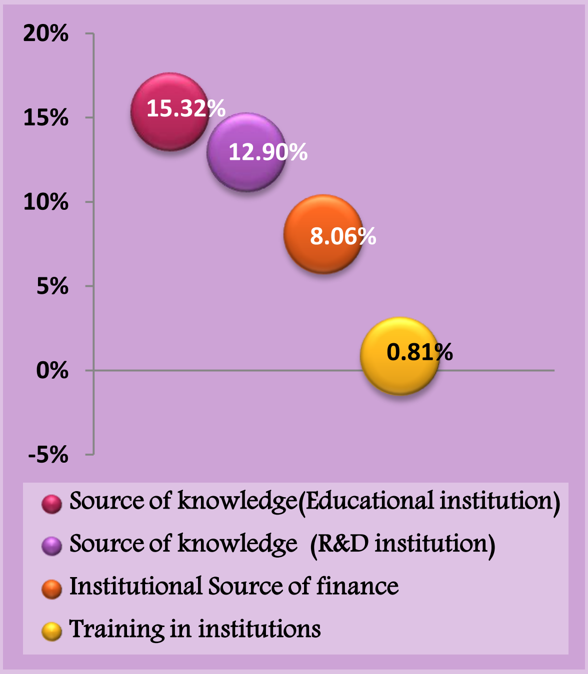
NIC 13 - *Manufacture of textiles*
NIC 23 - *Manufacture of other non-metallic mineral products.*
NIC 22 - *Manufacture of rubber and plastics products.*
NIC 10 - *Manufacture of food products.*
NIC 28 - *Manufacture of machinery and equipment n.e.c.*

Types of Innovation

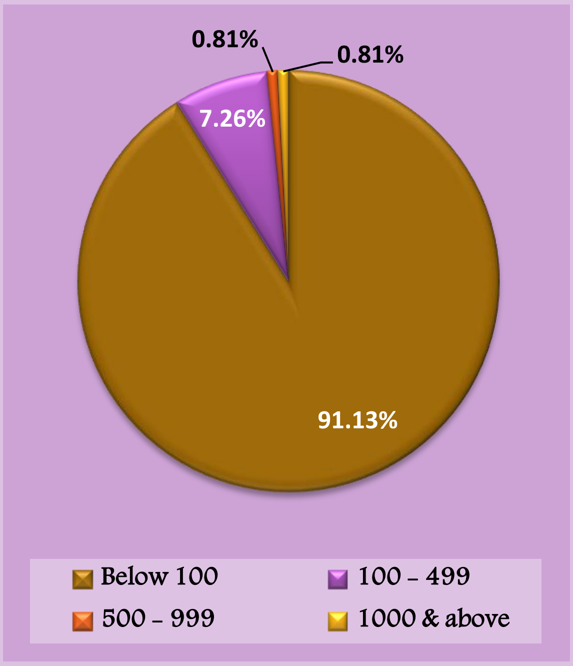


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



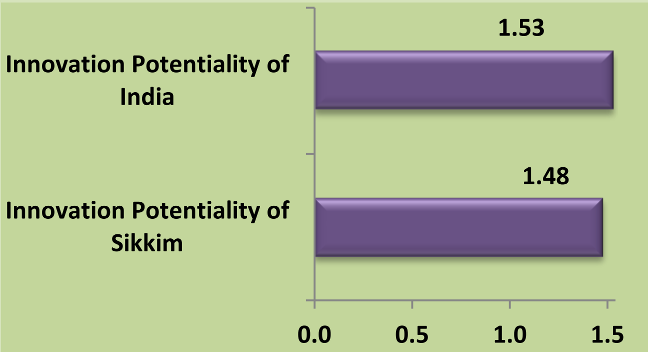
Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 88% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 36075
Industry Share in NSDP: 8.69%
Highways: 0.87 *per 100 Sq Km*
Health Centres: 38.05 *per100 village*
Educational institute: 33.28 *per million population*
Power Generation: 5487.65 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

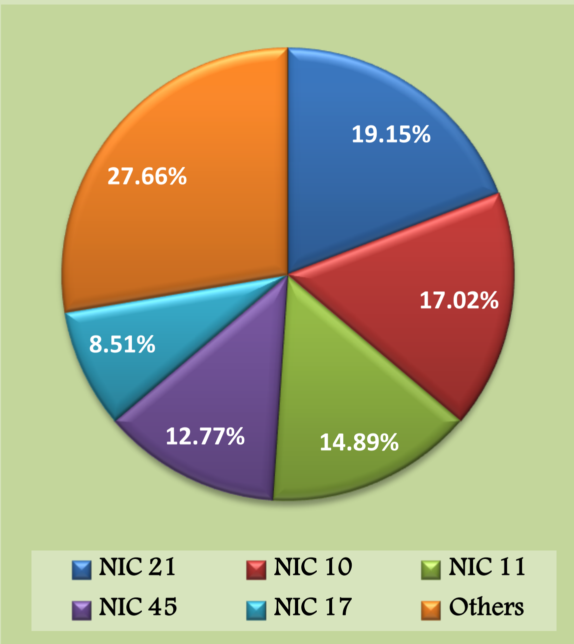
Human Development Index: 8th

Regional Innovation System: 17th

Innovation Potential: 13th

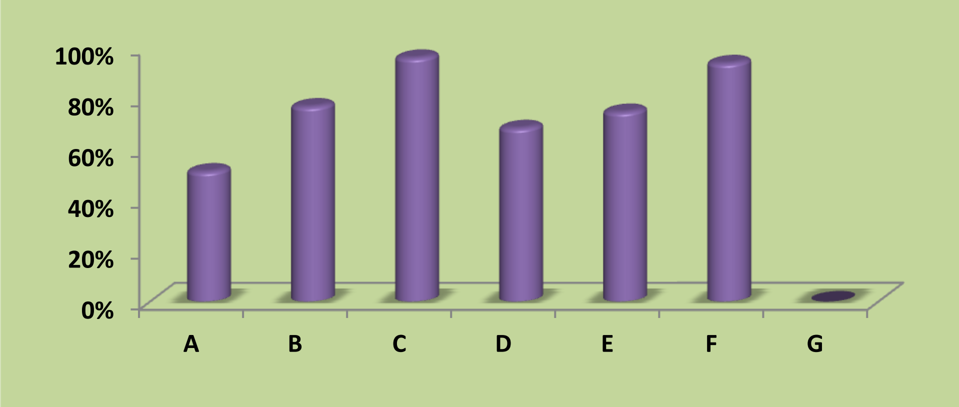
Share of the state in total firms surveyed in India: 0.52%
Share of the state in total Innovative firms in India: 1.48%

Top Five Innovative Sectors



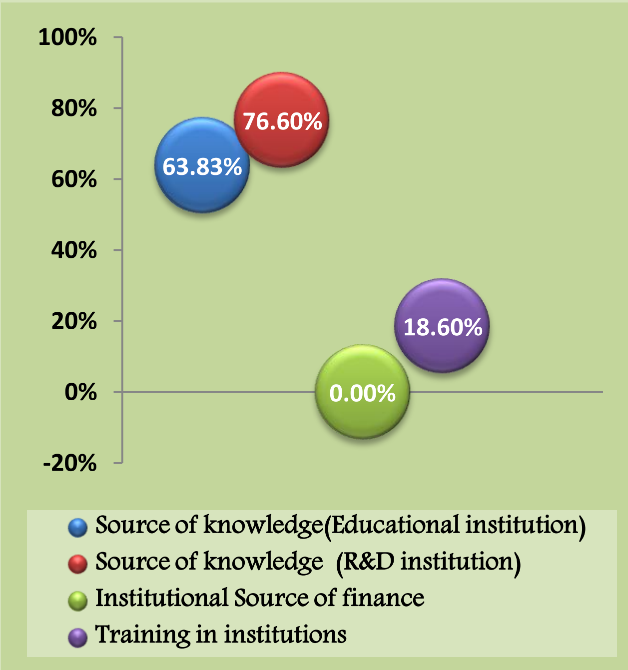
NIC 21 - *Manufacture of pharmaceuticals, medicinal chemical and botanical products.*
NIC 10 - *Manufacture of food products.*
NIC 11 – *Manufacture of beverages.*
NIC 45 - *Wholesale and retail trade and repair of motor vehicles and motorcycles.*
NIC 17 - *Manufacture of paper and paper products.*

Types of Innovation



A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

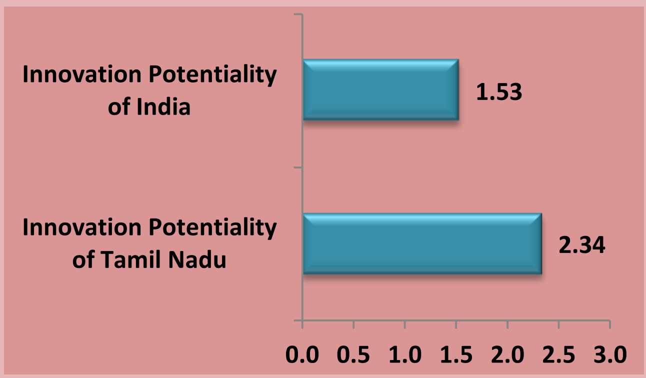
Accessing Innovation Support System



Firm Size (workforce) and corresponding share in innovative firms
below 100 : **87.23%**
between 100- 499 : **12.77%**

Novelty of Innovation
For 100% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) Per capita at Constant Prices 2009-10: Rs. 46823
Industry Share in NSDP: 17.43%
Highways: 0.11 *per 100 Sq Km*
Health Centres: 61.83 *per100 village*
Educational institute: 296 *per million population.*
Power Generation: 876.30 *million units per million population.*



RANK OF THE STATE vis-a-vis OTHER STATES

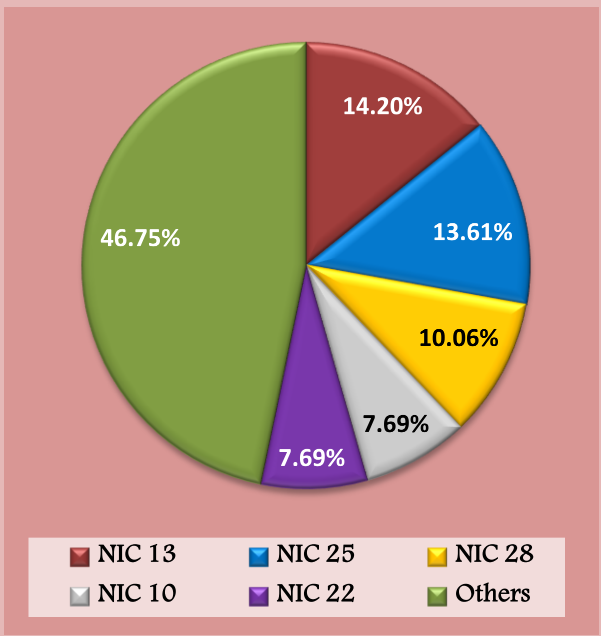
Human Development Index: 14th

Regional Innovation System: 7th

Innovation Potential: 11th

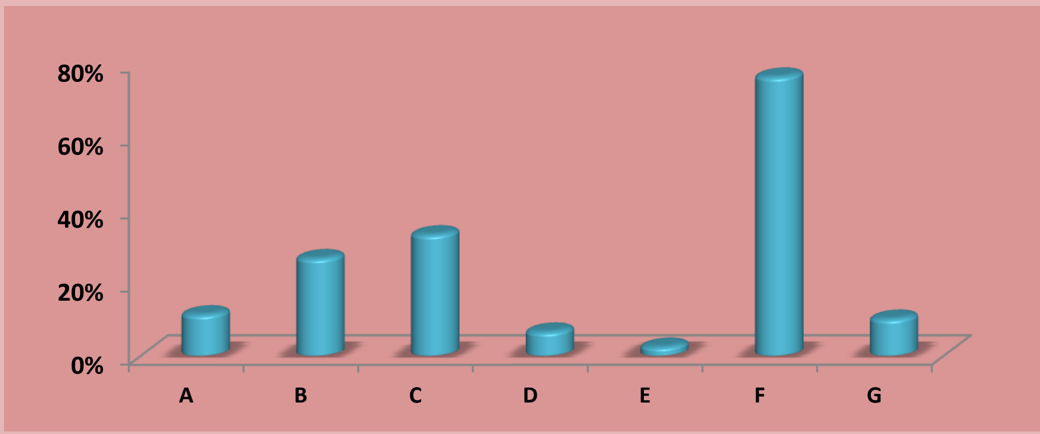
Share of the state in total firms surveyed in India: 4.21%
Share of the state in total Innovative firms in India: 5.28%

Top Five Innovative Sectors



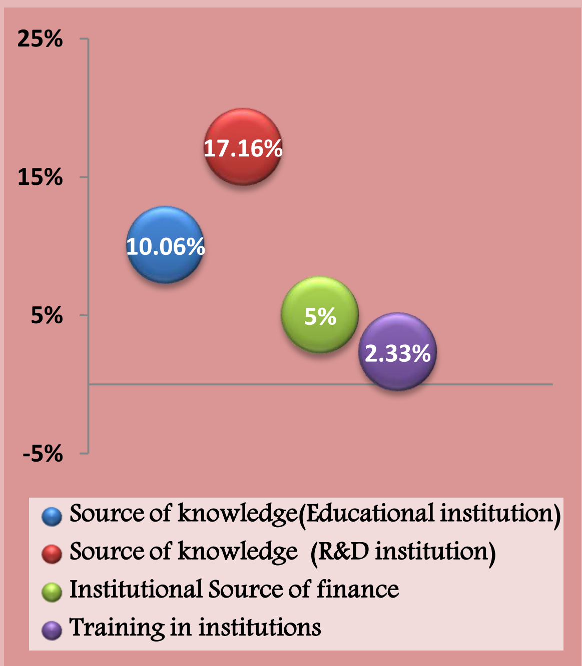
NIC 13 - *Manufacture of textiles*
NIC 25 - *Manufacture of fabricated metal products, except machinery and equipment.*
NIC 28 - *Manufacture of machinery and equipment n.e.c.*
NIC 10 - *Manufacture of food products.*
NIC 22 - *Manufacture of rubber and plastics products.*

Types of Innovation

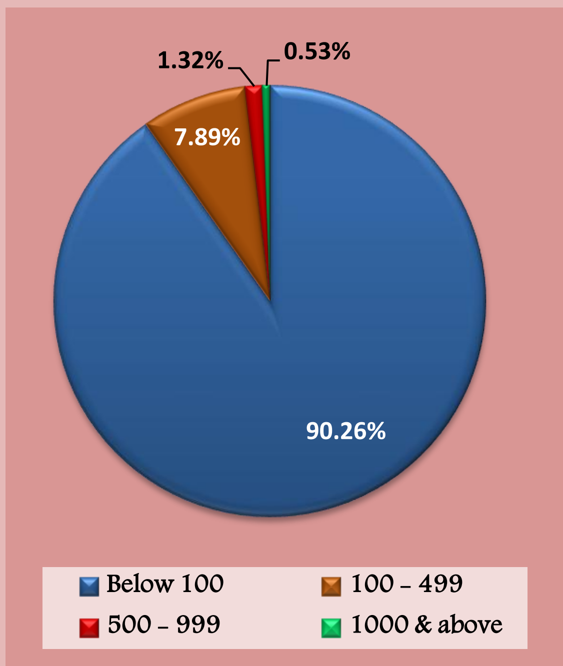


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



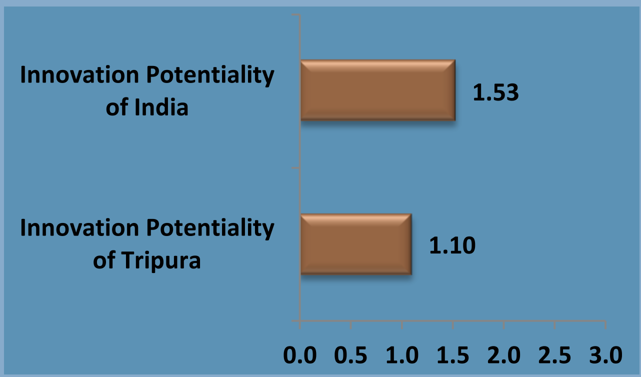
Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 84% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 33503
Industry Share in NSDP: 4.86%
Highways: 3.81 *per 100 Sq Km*
Health Centres: 82.99 *per100 village*
Educational institute: 23.07 *per million population*
Power Generation: 416.35 *million units per million population.*



RANK OF THE STATE vis-a-vis OTHER STATES

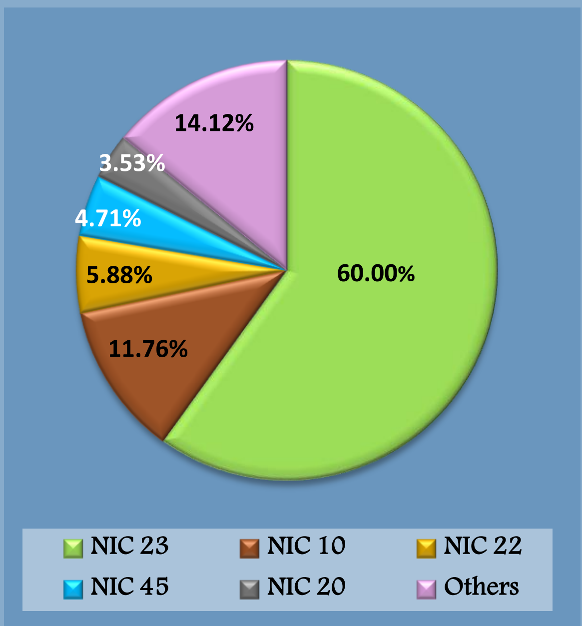
Human Development Index: 12th

Regional Innovation System: 21st

Innovation Potential: 15th

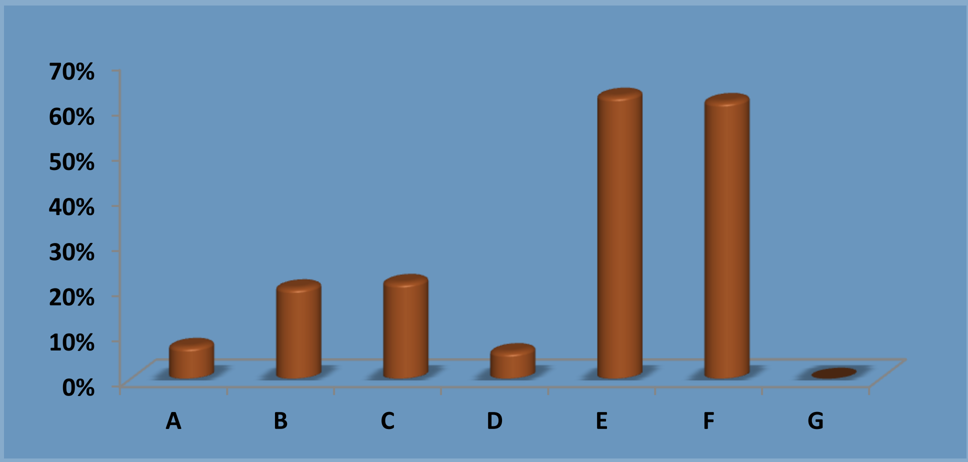
Share of the state in total firms surveyed in India: 2.29%
Share of the state in total Innovative firms in India: 2.67%

Top Five Innovative Sectors



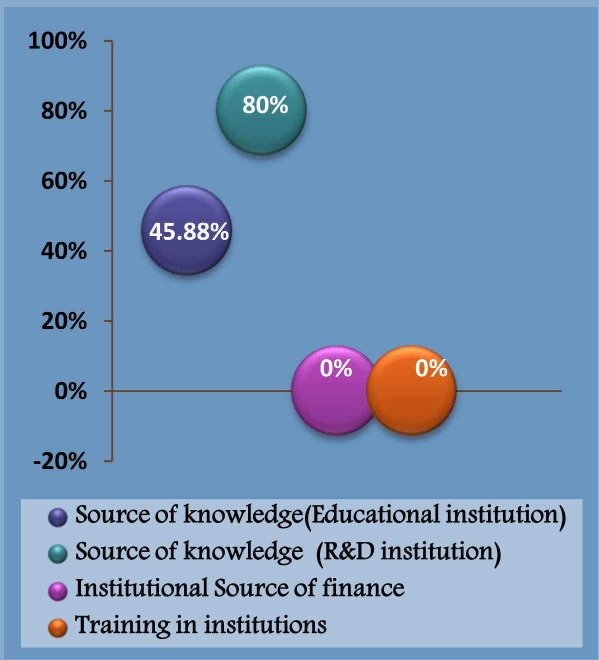
NIC 23 - *Manufacture of other non-metallic mineral products.*
NIC 10 - *Manufacture of food products.*
NIC 22 - *Manufacture of rubber and plastics products.*
NIC 45 - *Wholesale and retail trade and repair of motor vehicles and motorcycles.*
NIC 20 – *Manufacture of chemicals and chemical products.*

Types of Innovation



A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

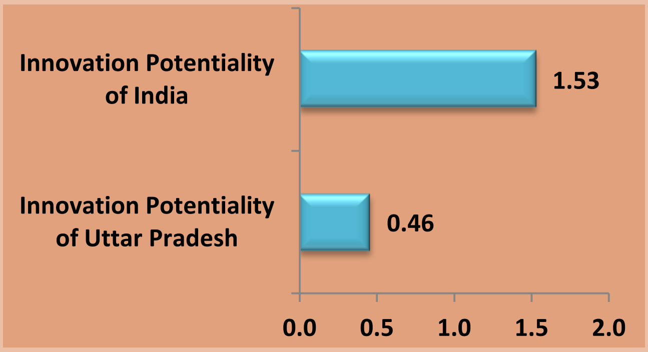
Accessing Innovation Support System



Firm Size (workforce) and corresponding share in innovative firms
below 100 : **64.71%**
between 100- 499: **35.29%**

Novelty of Innovation
For 49% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 16182
Industry Share in NSDP: 14.66%
Highways: 2.81 *per 100 Sq Km*
Health Centres: 23.01 *per100 village*
Educational institute: 108.60 *per million population*
Power Generation: 531.16 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

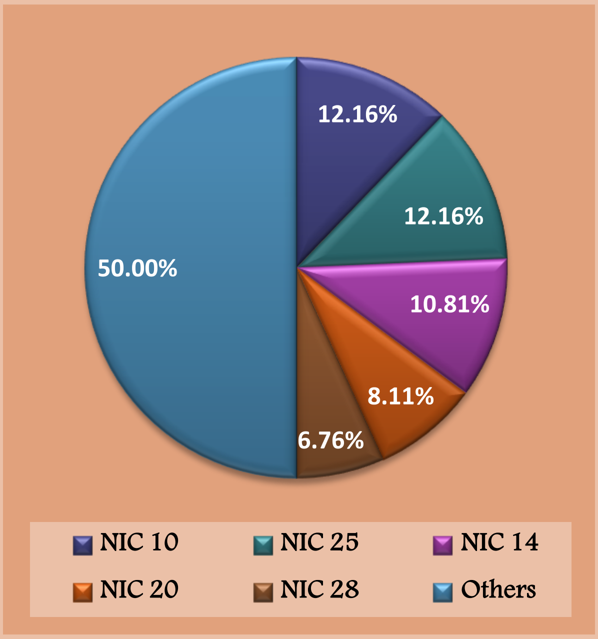
Human Development Index: 24th

Regional Innovation System: 25th

Innovation Potential: 18th

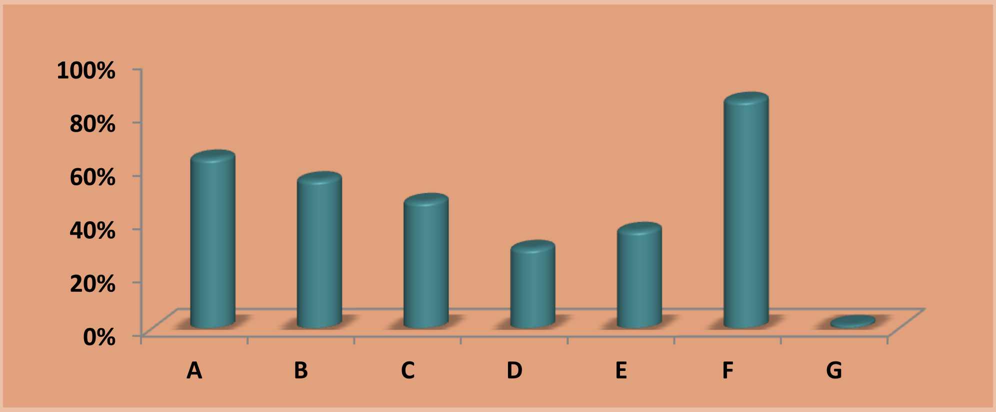
Share of the state in total firms surveyed in India: 4.17%
Share of the state in total Innovative firms in India: 2.32%

Top Five Innovative Sectors



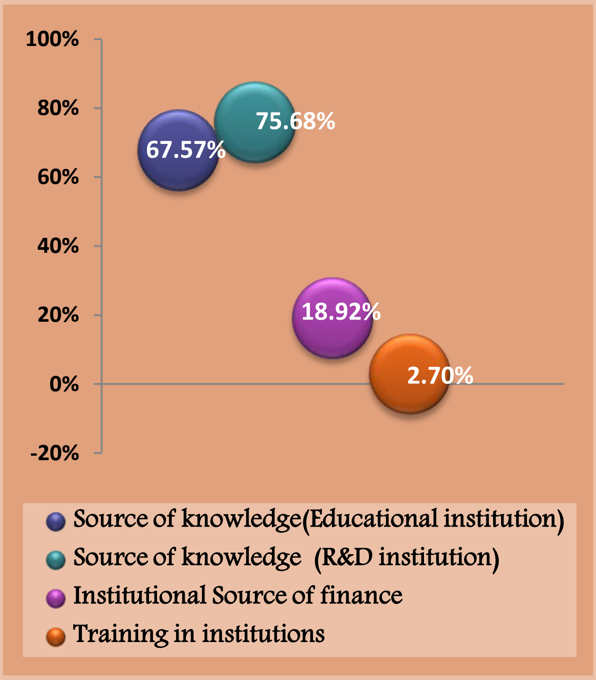
NIC 10 - *Manufacture of food products.*
NIC 25 - *Manufacture of fabricated metal products, except machinery and equipment.*
NIC 14 – *Manufacture of wearing apparel.*
NIC 20 - *Manufacture of chemicals and chemical products.*
NIC 28 - *Manufacture of machinery and equipment n.e.c.*

Types of Innovation

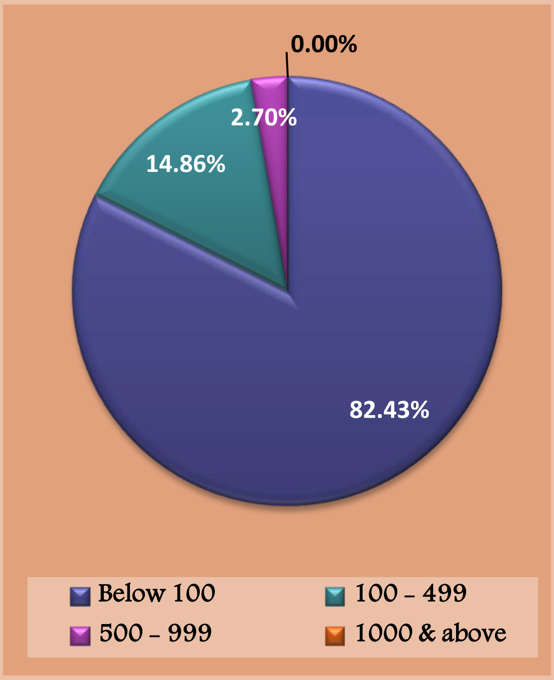


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



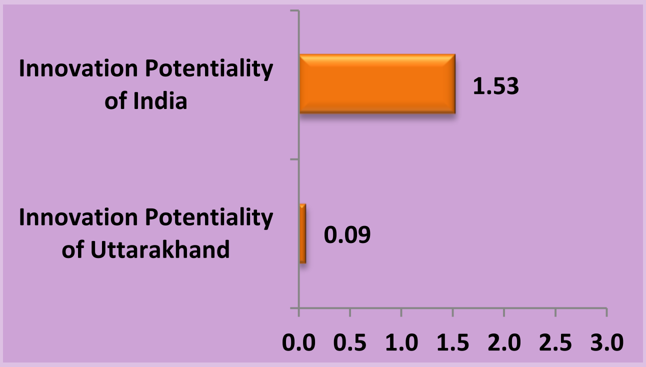
Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 69% of the innovative firms innovations are only new to the market.

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 41126
Industry Share in NSDP: 22.51%
Highways: 3.82 *per 100 Sq Km*
Health Centres: 12.24 *per100 village*
Educational institute: 298.49 *per million population*
Power Generation: 1152.03 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

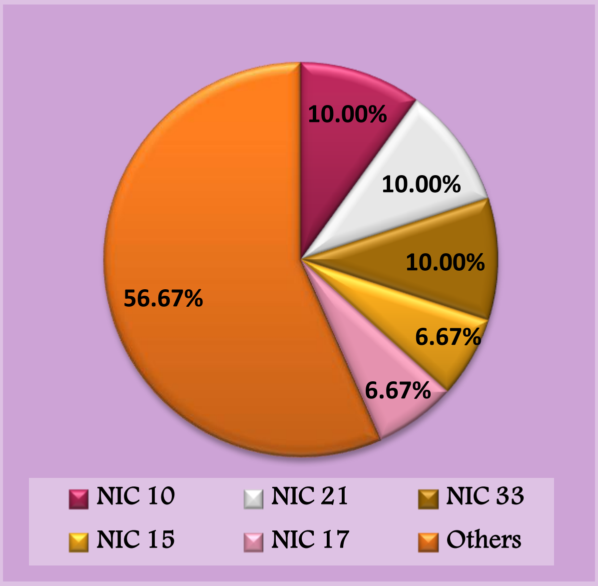
Human Development Index: 20th

Regional Innovation System: 8th

Innovation Potential: 27th

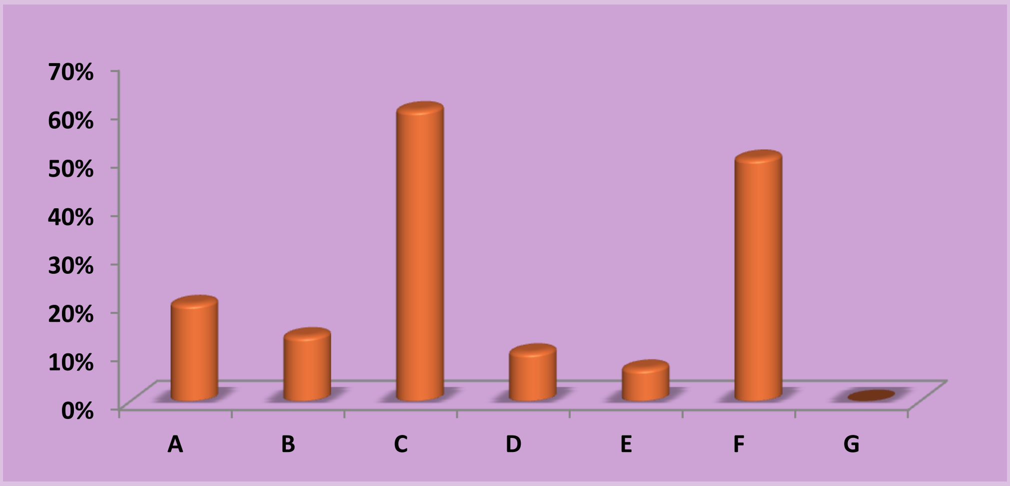
Share of the state in total firms surveyed in India: 3.69%
Share of the state in total Innovative firms in India: 0.94%

Top Five Innovative Sectors



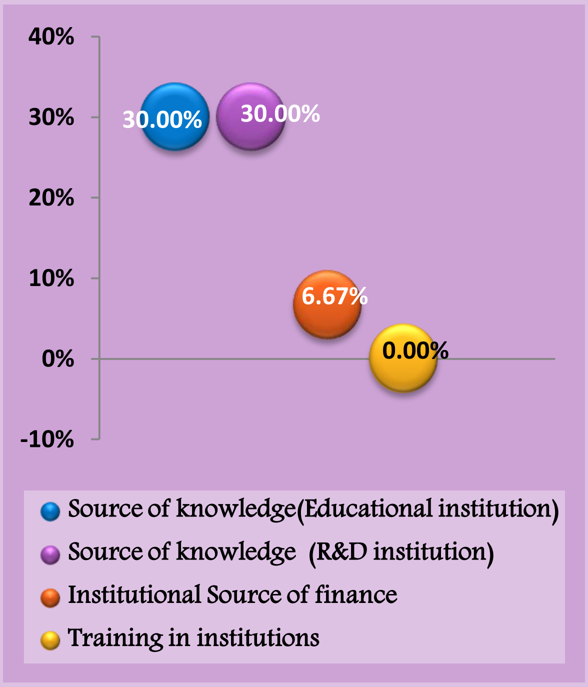
NIC 10 - *Manufacture of food products.*
NIC 21 - *Manufacture of pharmaceuticals, medicinal chemical and botanical products.*
NIC 33 - *Repair and installation of machinery and equipment.*
NIC 15 - *Manufacture of leather and related products*
NIC 17 - *Manufacture of paper and paper products*

Types of Innovation

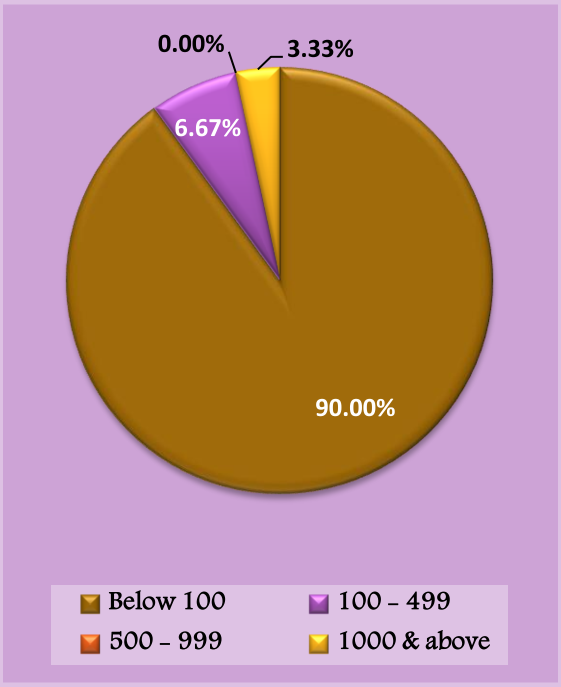


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



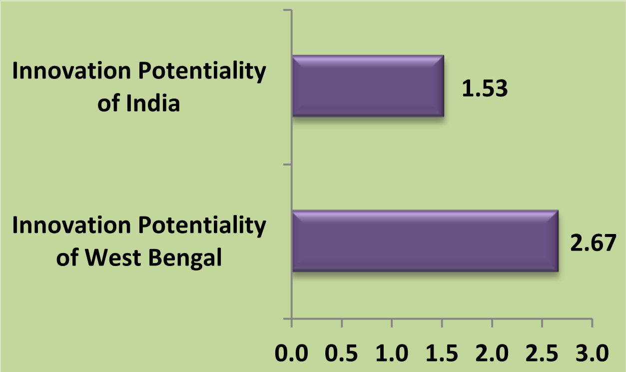
Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 60% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) Per capita at Constant Prices 2009-10: Rs. 30504
Industry Share in NSDP: 10.28%
Highways: 6.27 *per 100 Sq Km*
Health Centres: 28.47 *per100 village*
Educational institute: 115.77 *per million population*
Power Generation: 540.69 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

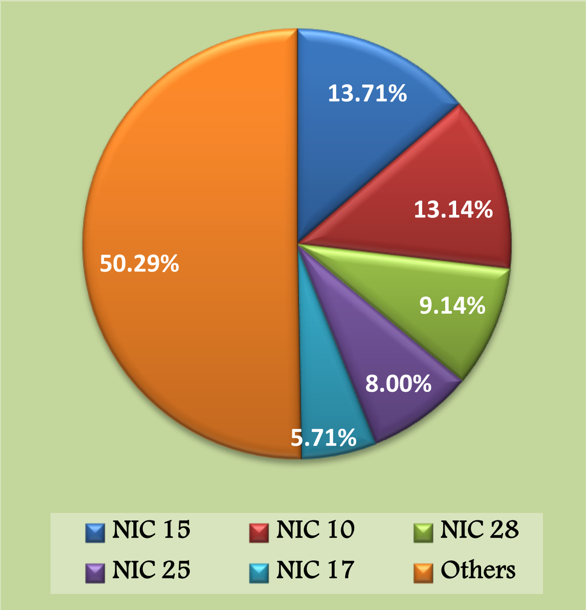
Human Development Index: 19th

Regional Innovation System: 19th

Innovation Potential: 10th

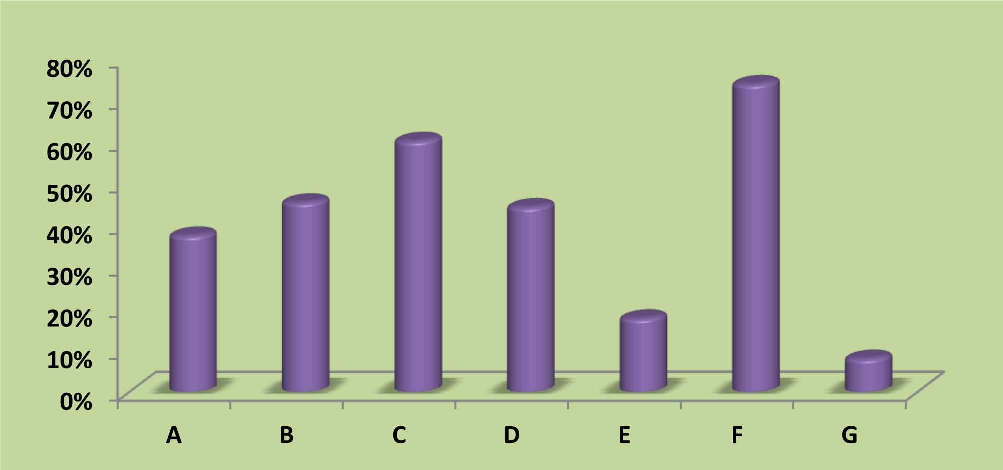
Share of the state in total firms surveyed in India: 4.06%
Share of the state in total Innovative firms in India: 5.53%

Top Five Innovative Sectors



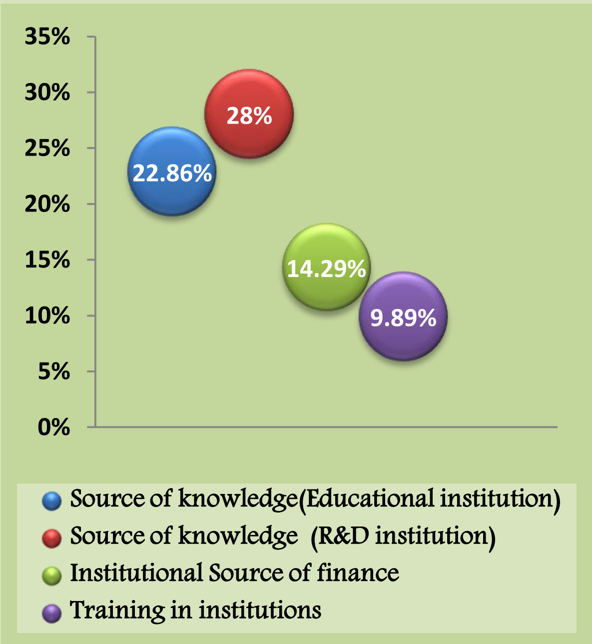
NIC 15 – *Manufacture of leather and related products.*
NIC 10 - *Manufacture of food products.*
NIC 28 - *Manufacture of machinery and equipment n.e.c.*
NIC 25 - *Manufacture of fabricated metal products, except machinery and equipment.*
NIC 17 - *Manufacture of paper and paper products.*

Types of Innovation

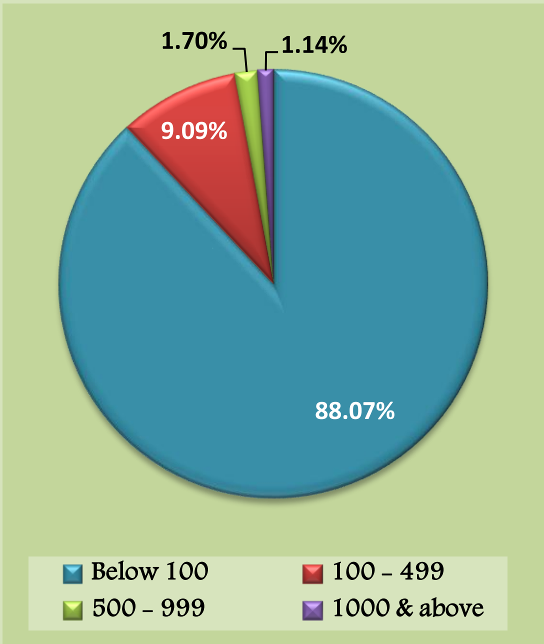


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



Firm Size (workforce) and corresponding share in Innovative firms

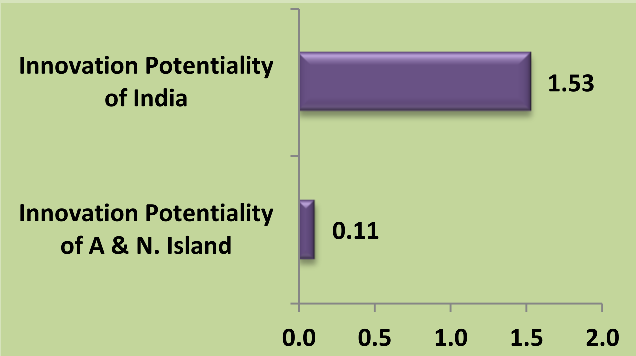


Novelty of Innovation

For 77% of the innovative firms innovations are only new to the firm

UNION TERRITORY PROFILE

Net State Domestic Product (NSDP) Per capita at Constant Prices 2009-10: Rs. 54830
Industry Share in NSDP: 2.64%
Highways: 3.64 *per 100 Sq Km*
Health Centres: 25.05 *per100 village*
Educational institute: 28.92 *per million population*
Power Generation: 631.75 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

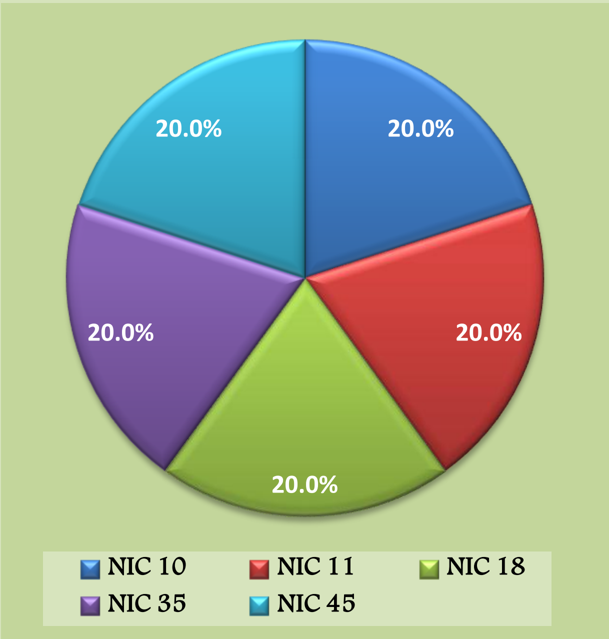
Human Development Index: 5th

Regional Innovation System: 23rd

Innovation Potential: 26th

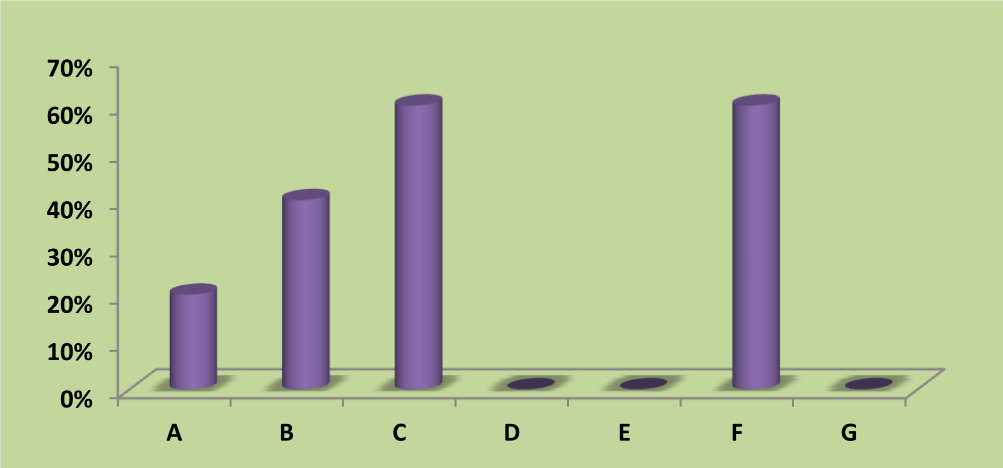
Share of the state in total firms surveyed in India: 0.08%
Share of the state in total Innovative firms in India: 0.16%

The Innovative Sectors



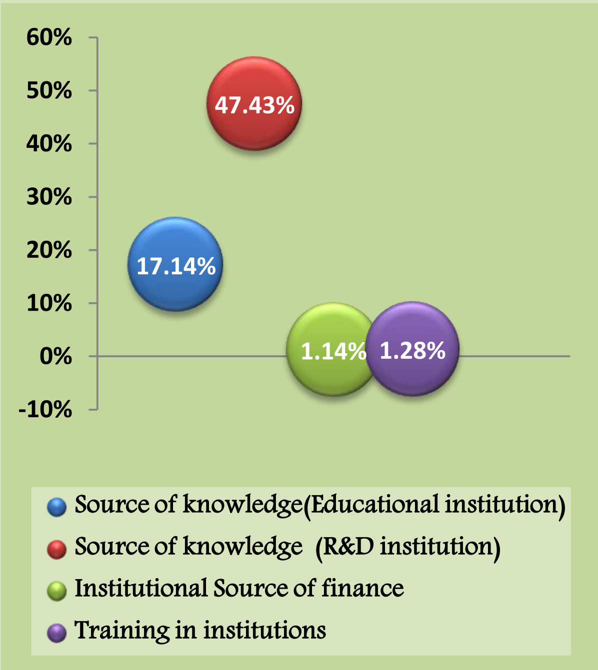
NIC 10 - *Manufacture of food products.*
NIC 11 – *Manufacture of beverages.*
NIC 18 - *Printing and reproduction of recorded media.*
NIC 35 - *Electricity, gas, steam and air conditioning supply.*
NIC 45 - *Wholesale and retail trade and repair of motor vehicles and motorcycles.*

Types of Innovation



A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

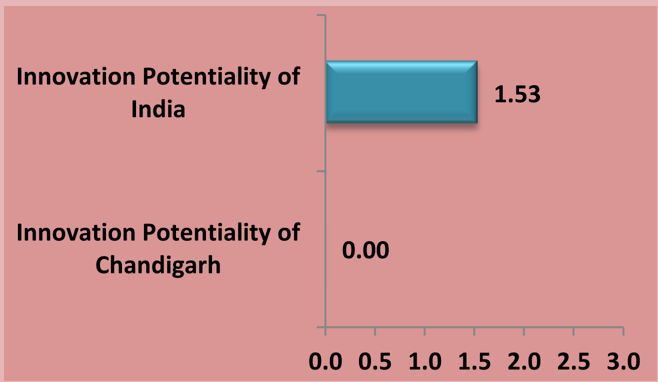
Accessing Innovation Support System



All the innovative firms belong to ***below 100 firm size (workforce).***

Novelty of Innovation
For 61% of the innovative firms innovations are only new to the firm

Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 90051
Industry Share in NSDP: 6.54%
Highways: 21.05 *per 100 Sq Km*
Health Centres: 79.17 *per100 village*
Educational institute: 17.54 *per million population*
Power Generation: 0.00 *million units per million population*



RANK OF THE STATE vis-a-vis OTHER STATES

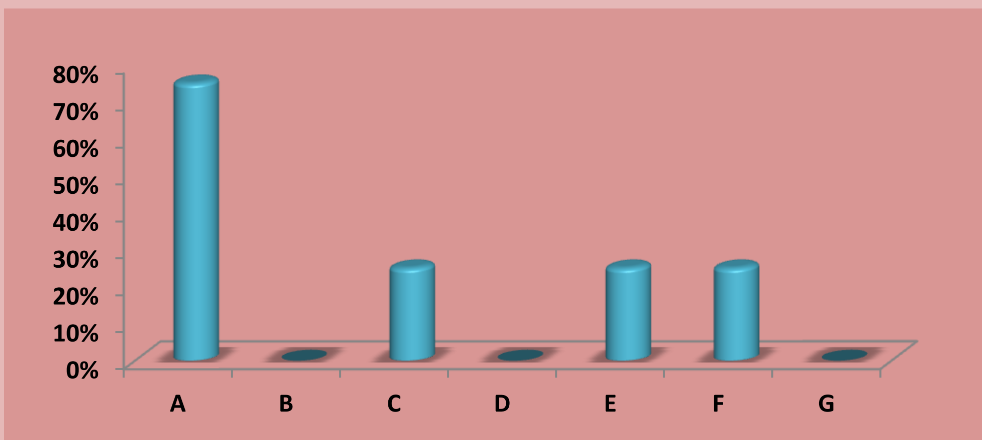
Human Development Index: 2nd

Regional Innovation System: 15th

Innovation Potential: 31st

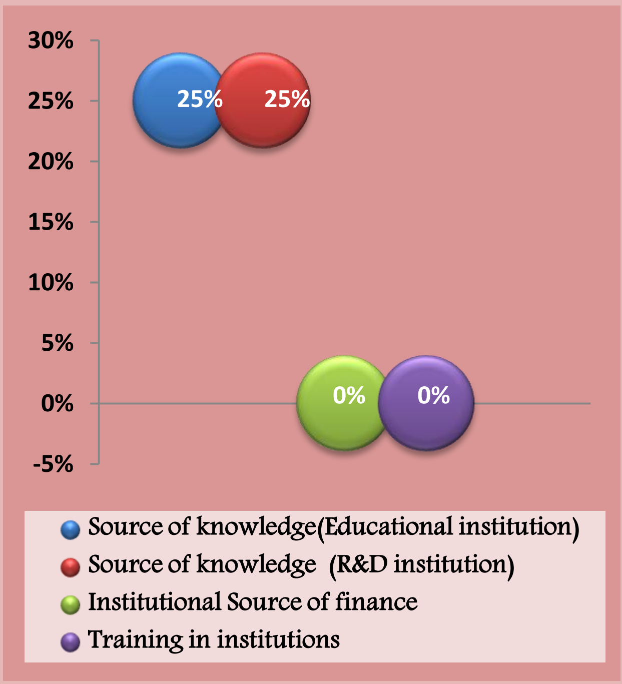
Share of the state in total firms surveyed in India: 1.93%
Share of the state in total Innovative firms in India: 0.13%

Types of Innovation



A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

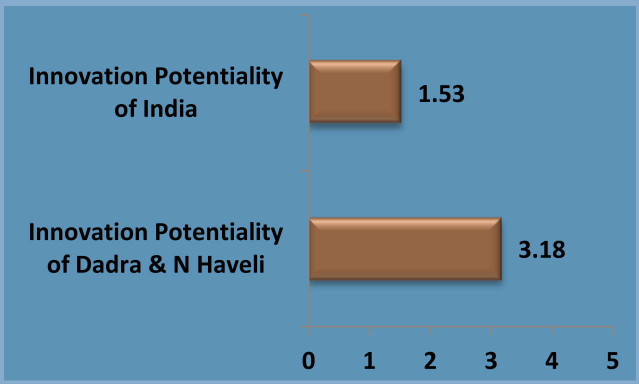
Accessing Innovation Support System



The state has reported innovations only in two sectors namely;
NIC 25 - *Manufacture of fabricated metal products, except machinery and equipment.*
NIC 27 - *Manufacture of electrical equipment.*
The innovative firms belongs to ***below 100 firms Size (workforce)***

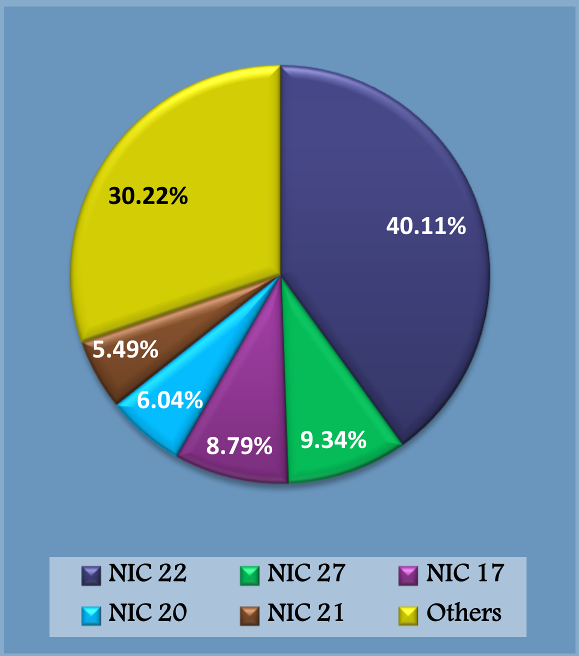
Novelty of Innovation
For 25% of the innovative firms innovations are only new to the firm

Health Centres: 81.43 *per100 village*
Educational institute: 19.96 *per million population*
Rank of the state vis-a-vis other states
Innovation Potential: 6th
Human Development Index: 7th



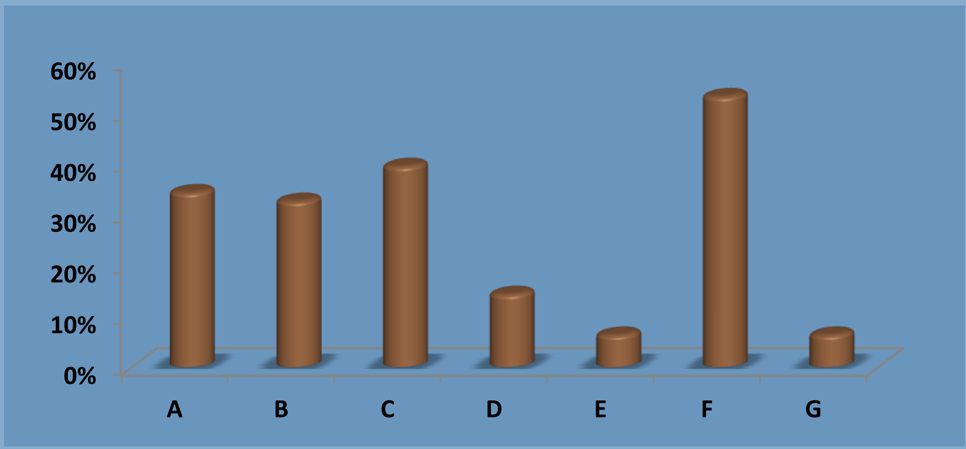
Share of the state in total firms surveyed in India: 3.40%
Share of the state in total Innovative firms in India: 5.53%

Top Five Innovative Sectors



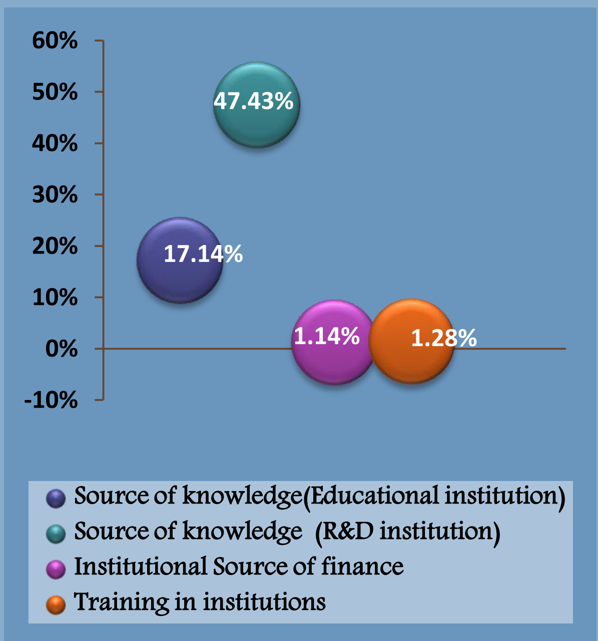
NIC 22 - *Manufacture of rubber and plastics products.*
NIC 27 - Manufacture of electrical equipment.
NIC 17 – *Manufacture of paper and paper products*
NIC 20 – *Manufacture of chemicals and chemical products.*
NIC 21 - *Manufacture of pharmaceuticals, medicinal chemical and botanical products*

Types of Innovation

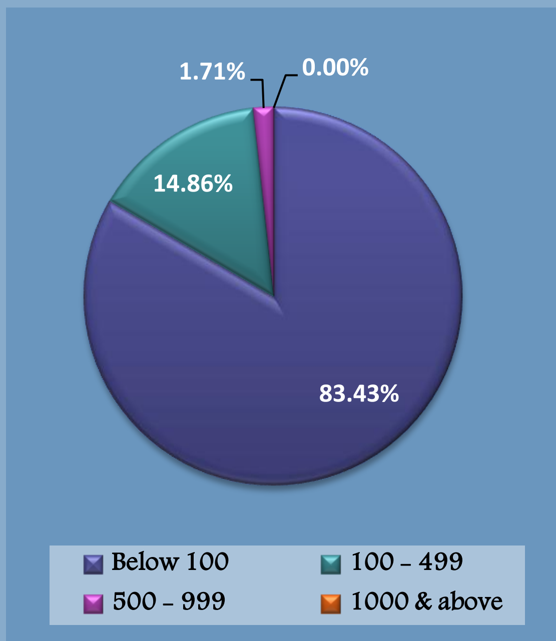


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System

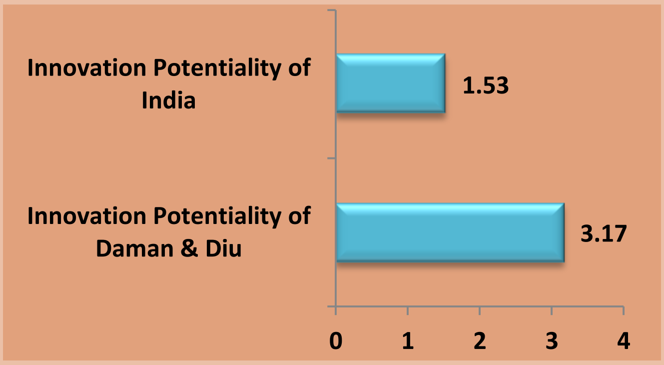


Firm Size (workforce) and corresponding share in Innovative firms



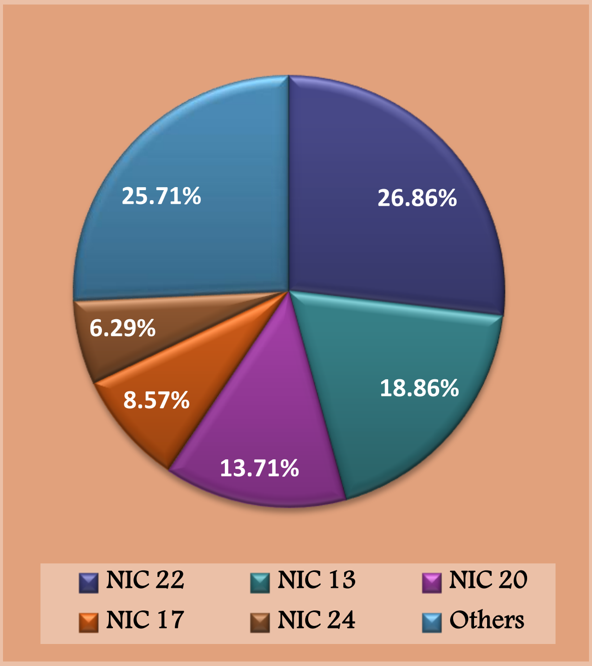
Novelty of Innovation
For 61% of the innovative firms innovations are only new to the firm

Health Centres: 134.78 *per100 village*
Educational institute: 20.23 *per million population*
Rank of the state vis-a-vis other states
Innovation Potential: 7^{th}
Human Development Index: 6^{th}



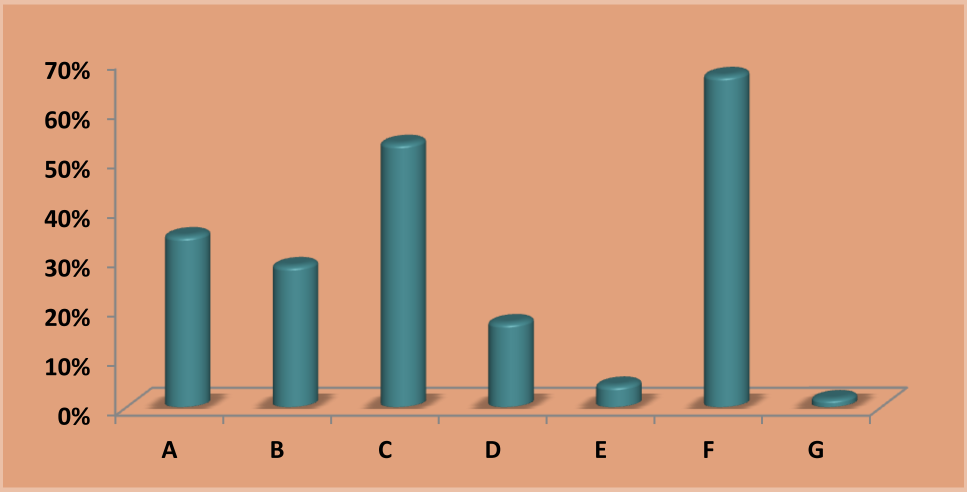
Share of the state in total firms surveyed in India: 3.64%
Share of the state in total Innovative firms in India: 5.72%

Top Five Innovative Sectors



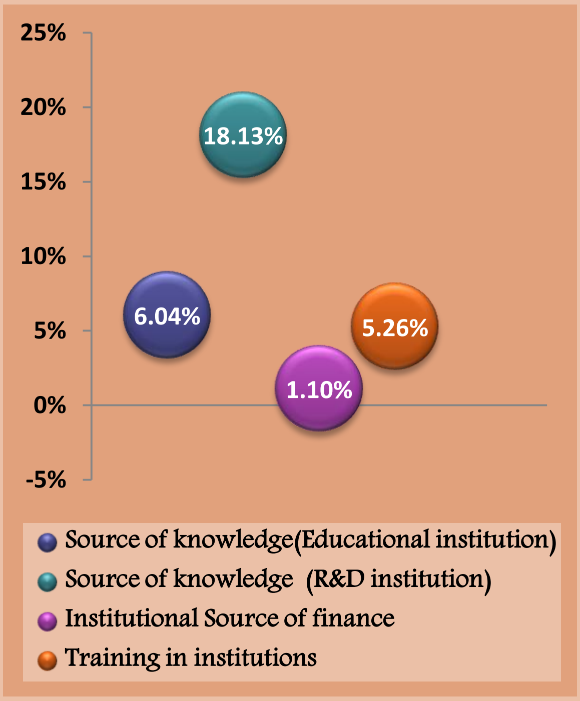
NIC 22 - *Manufacture of rubber and plastics products.*
NIC 13 - *Manufacture of textiles.*
NIC 20 – *Manufacture of chemicals and chemical products.*
NIC 17 – *Manufacture of paper and paper products*
NIC 24 - *Manufacture of basic metals*.

Types of Innovation

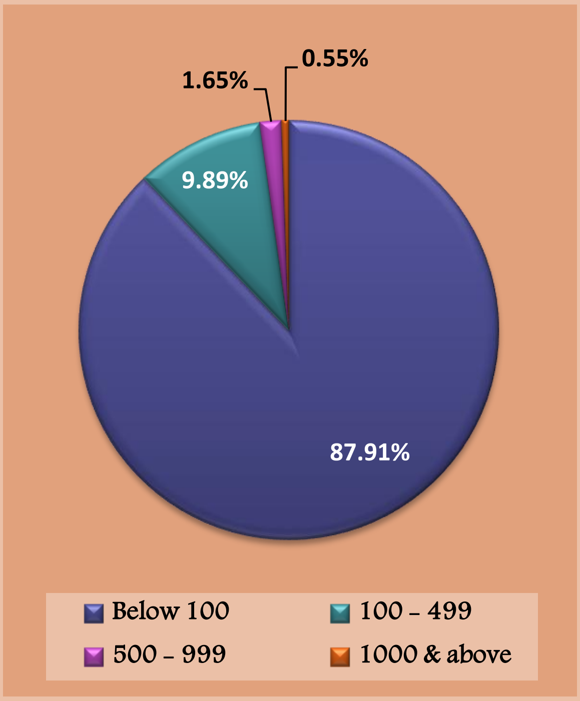


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System

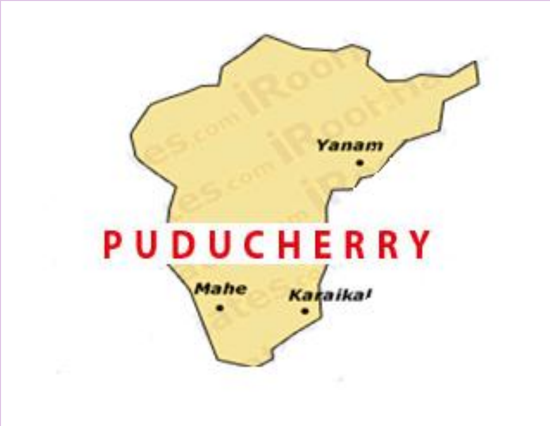


Firm Size (workforce) and corresponding share in Innovative firms

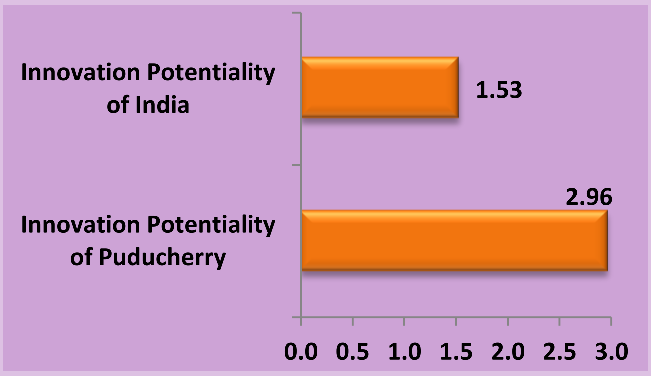


Novelty of Innovation

For 52% of the innovative firms innovations are only new to the firm



Net State Domestic Product (NSDP) per capita at Constant Prices 2009-10: Rs. 69704
Industry Share in NSDP: 28.16%
Highways: 11.06 *per 100 Sq Km*
Health Centres: 86.96 *per100 village*
Educational institute: 32.43 *per million population*
Power Generation: 232.98 *million units per million population.*



RANK OF THE STATE vis-a-vis OTHER STATES

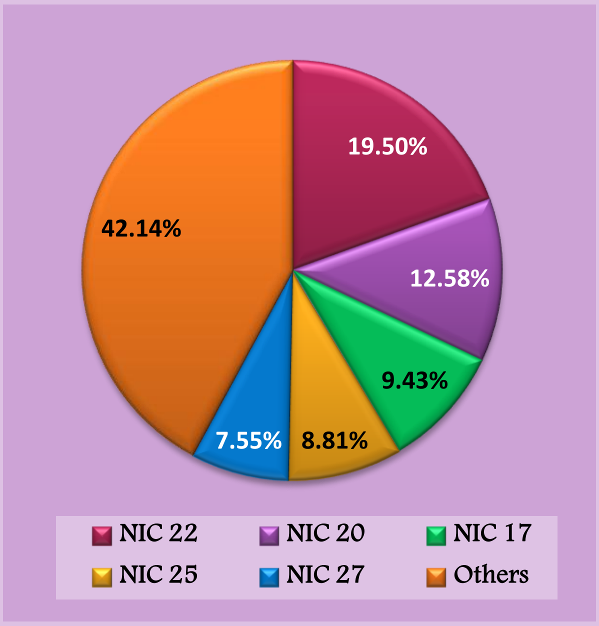
Human Development Index: 4th

Regional Innovation System: 4th

Innovation Potential: 9th

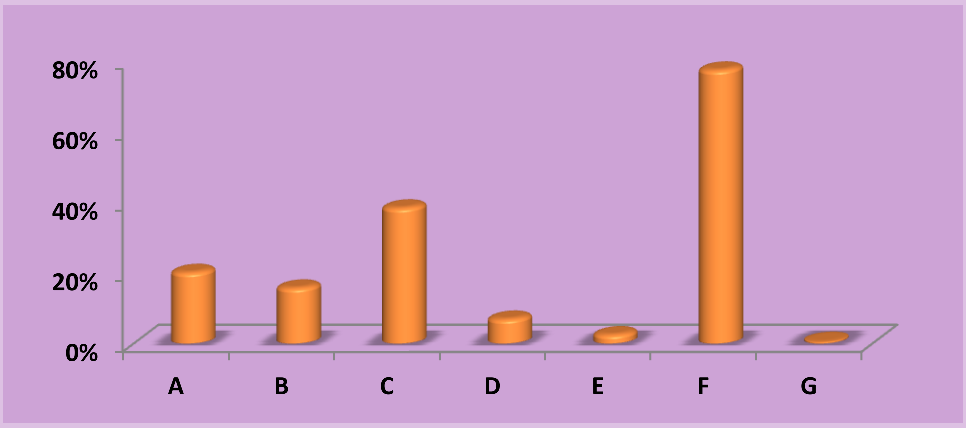
Share of the state in total firms surveyed in India: 2.98%
Share of the state in total Innovative firms in India: 4.99%

Top Five Innovative Sectors



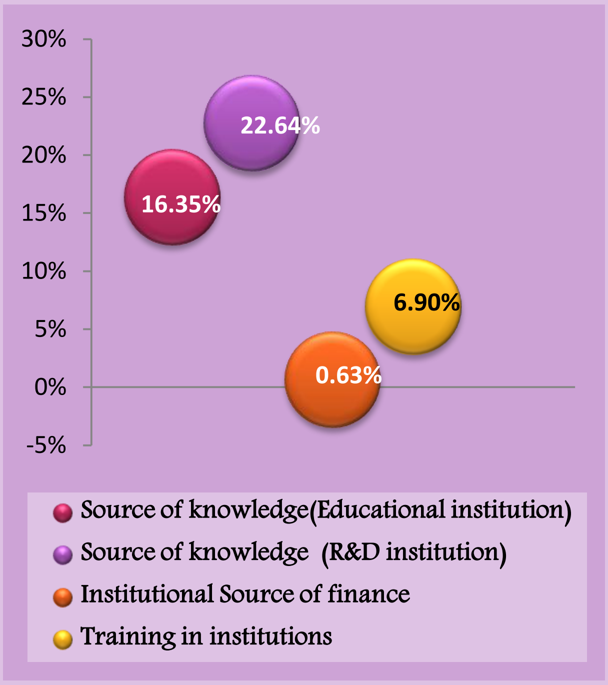
NIC 22 - *Manufacture of rubber and plastics products.*
NIC 20 – *Manufacture of chemicals and chemical products.*
NIC 17- *Manufacture of paper and paper products*
NIC 25 - *Manufacture of fabricated metal products, except machinery and equipment*
NIC 27 - *Manufacture of electrical equipment*

Types of Innovation

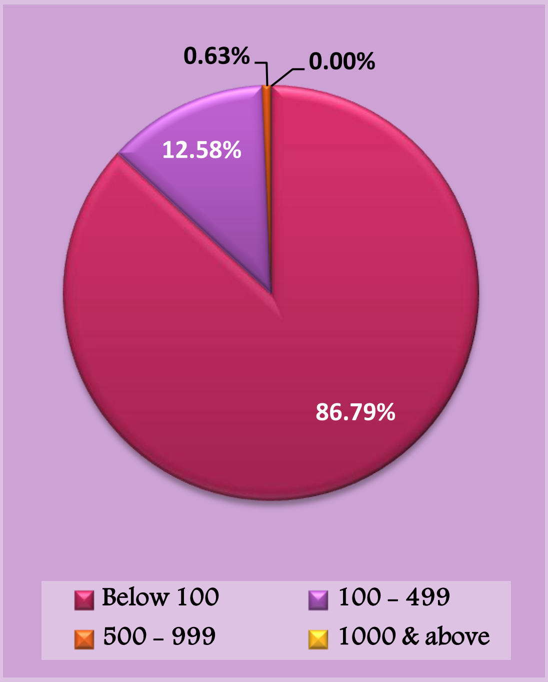


A-New product
B- New process technology
C-Product quality and standardization
D- Efficient use of inputs
E-Alternative material
F-Introduction of new machines
G-Other

Accessing Innovation Support System



Firm Size (workforce) and corresponding share in Innovative firms



Novelty of Innovation

For 66% of the innovative firms innovations are only new to the firm

Annexure II

Data Sources and Methodology of the Survey

Population

For the total population of the survey we have used the Annual Survey of Industries [ASI – (2009-10)] database of the registered enterprises in the three sectors (agriculture, industry, and service) across 26 states and 6 union territories. Mizoram and Arunachal Pradesh (states), and Lakshadweep (UT) are not included in the ASI database. Total 2,08,415 firms (constituted of 5,689 firms in the agriculture sector, 1,94,925 in the industrial sector and 7,801 firms in the service sector) constituted the ASI 2009-10 database. The ASI database also provides information on the size of the enterprise in terms of the workers employed.

Table 1 presents the number of states/UTs distributed across sectors on the basis of number of firms they have of various sizes. Following characteristics of the population can be derived from Table 1:

Table – 1 Distribution of Population & Labour Size over the States

Sector	Number of Firms → / Firm Size (Labour) ↓	Nil	1 - 50	51 - 100	101 - 500	501 - 1000	1001 & above
Agriculture	99 or less	21	2	1	4	2	2
	100-499	25	6	0	1	0	0
	500-999	31	1	0	0	0	0
	1000 and above	30	2	0	0	0	0
Industry	0-99	0	1	4	3	2	22
	100-499	0	6	3	14	5	4
	500-999	4	16	4	8	0	0
	1000 and above	6	16	3	7	0	0
Services	0-99	1	12	7	7	3	2
	100-499	9	22	1	0	0	0
	500-999	28	4	0	0	0	0
	1000 and above	28	4	0	0	0	0

Note: Each cell represents number of states with the given number of firms of a particular firm size based on employment base
Source: Constructed from ASI database 2009-10

Agriculture

- In Agricultural sector, most of the states have no firms of any of the stated size. South Indian states and a few west and north-west Indian states have some firms in this sector. It indicates absence of organised farming in northern and eastern part of India.
- Even among the states where agricultural firms exist, only two states have big enterprises dealing with agricultural produce.
- Again there are no small firms in the agricultural sector in 21 out of 26 states, 2 states have firms ranging numbers from 1 to 50, 1 state has firms ranging from 51 to 100, 4 states have firms ranging from 101 to 500, 2 states have firms ranging from 501 to 1000 and 2 states have firms more than 1000.

Industry

- The industrial sector shows unique feature of large number of small size firms. In most of the states (22), number of firms of small labour size i.e. 99 and less, is in 'more than 1000' group.
- When we move to firms of larger employment base i.e. 500 to 999 and 1000 & above, number of firms goes down to 1 to 50 in most states.
- In case of firms of labour size 100 to 499, number of firms ranges from 101 to 500 in 14 states. There are only 4 states where firms in this category figure in 'more than 1000' group.

Services

- Firms of small size are prevailing in most of the states. As we move to firms with larger employment base i.e. 500 and more, we find in most of the states there are no firms in those groups.
- In case of medium size firms of labour size 100 to 499, the number of firms ranges from 1 to 50 in 22 states. Whereas in small firms of labour size 99 or less, 12 states have firms between 1 to 50, 7 have 51 to 100, other 7 states have 101 to 500 and 5 states have more than 500 firms.

Sampling Plan

States have their own industry development policies and programmes, and also states differ in social, political and cultural practices. It is, therefore, expected that innovation dynamics also would differ across the states. The sampling plan, therefore, was to stratify the population over states. We apply sampling statistics to obtain sample size (number of enterprise to be surveyed) for each state). The ASI database has three broad sectors, namely, agriculture, industry and service sectors. The second stratification is based on the three basic sectors and their respective sub-sectors as shown separately. It is expected that the nature of innovative activities would significantly differ over the sectors. Sample size of a State is distributed proportionately across these three sectors and their sub-sectors in a State. The third level of stratification was done to accommodate the general understanding that innovation activities widely vary over the size of the enterprises. The survey has used the ASI data on the size of the enterprise measured in terms of the labour force engaged in the enterprise. The size class of the enterprises, used for sampling, are 99 or less, 100 – 499, 500 – 999, 1000 & above. The sample size of a sector is proportionately distributed over the size class.

Sectors and Sub-sectors are –

1. **Agriculture**

2. **Industry**
    1) Mining & Quarrying
    2) Manufacturing
    3) Electricity, gas, steam and air conditioning supply + Water supply; sewerage, waste management and remediation activities
    4) Construction

3. **Services**
    1) Wholesale and retail trade; repair of motor vehicles and motorcycles + Transpiration and storage + Accommodation and Food service activities + Information and communication
    2) Financial and insurance activities + Real estate activities + Professional, scientific and technical activities
    3) Administrative and support service activities + Public administration and defense; compulsory social security + Education + Human health and social work activities + Arts, entertainment and recreation + Other service activities

Procedure adopted for sampling is detailed below:

1. Sampling Method Used

Sampling method used in the survey is Stratified Random Sampling (SRS).

Stratified Random Sampling: In SRS the population is divided into smaller homogeneous groups (Strata) and then random samples are drawn within each stratum. It is quite similar to a weighted average; this method of sampling produces characteristics in sample that are proportional to overall population.

Advantages:

- It captures key characteristics in samples
- It is useful where population has variety of attributes

2. Defining Stratum:

We have obtained the population (number of production units) from Annual Survey of Industries (ASI) for each state. Then production units of each state are classified according to NIC code. Further, production units under a given sector are divided according to the size of labour employed, which are as follows –

0 – 99, 100 – 499, 500 – 999, 1000 and above, not specified

And then we selected required number of production units from each labour size according to random sampling.

While defining stratum it is to be ensured that members/observations within any stratum are homogeneous with regard to characteristics under investigation, although between strata there may be any amount of heterogeneity. It should be clear that near-homogeneity will be enough in practical situations.

Procedure followed in sampling

A. Identifying and Defining Population:

Organized production units in a particular state are identified as population for the survey; they must belong to agriculture or industrial sector to be considered as a member of population. Service sector is discarded from the survey due to the complications of measuring/identifying innovation in service sector.

B. Determining the desired sample size

Desired sample size from a particular state which will represent the population (total production units), is calculated through the formula developed by Cochran (1963)

$$n_0 = \frac{Z^2 * p * q}{c^2}$$

where,

Z= value of confidence level at 95% (1.96) in normal distribution.

c= Confidence Interval (5% or 0.05)

p= the estimated proportion of an attribute that is present in the population (0.5) in other words it is the probability that a particular observation will be selected in the sample, in the worst case it is 0.5 (50%), meaning every observation has an equal chance of being selected in the sample

q= (1-p)

Confidence Interval (Level of Precision) – is the range in which the true value of the population is estimated to be. This range is often expressed in percentage points. In other words the estimation from sample is expected to vary from the true value up to this range. It is also called sampling error.

We have used 5% confidence interval which suggests that sample value may vary from the true value by ±5%, for example 80% of the production units in Maharashtra are innovative this 80% can vary by ±5% i.e. between 75% and 85% of production units in Maharashtra are innovative.

Confidence Level – It is the proportion of sample, which will represent the population, given the level of precision or confidence interval.

We have taken 95% level of confidence, which shows that 95 out of every 100 samples will have true population value within the level of precision.

Finite Population Correction for Proportions

If the population is small then the sample size can be reduced slightly. This is because a given sample size provides proportionately more information for small a population than for a large population. The sample size obtained for different states is based on the formula –

$$n = \frac{n_0}{1 + \left(\frac{n_0 - 1}{N}\right)}$$

where, N is the number of production units in a state (finite population)

C. **<u>Identifying subgroups (Strata) for equal representation</u>**

Firstly, the population (production units in a state) is divided between two categories – agriculture and industry, as per the NIC codes, then all the production units are further categorized according to their labour size (already mentioned).

D. **<u>Random selection</u>**

Finally for selecting the units to be surveyed, random number calculator is used. Random selection is to be done on without replacement basis.

Example:

According to ASI data (2007-08) Karnataka has 10,855 number of production units.

We have already calculated Sample Size (representative sample for proportions) through Cochran formula, where Z=1.96 (at 95%) p = q = 0.5 and C =0.05

$$n_0 = \frac{Z^2 * p * q}{c^2}$$

Which comes out to be 384.16, so by approximation we are using n_0 = 384

Now for calculating the Sample size according to a finite population, we will use the formula below

$$n = \frac{n_0}{1 + \left(\frac{n_0 - 1}{N}\right)}$$

Where N (population, i.e. number of production units in the state) = 10,855 and n_0 is already calculated, so the required sample size i.e. n = 371,

That means we need to survey the 371 production units of Karnataka as whole.

Now question arises which 371, if we apply random selection here only, then we may end up surveying 371 units of a particular Sector either Agricultural or Industry or Services. This will not be the true representation of population, so before applying random selection we classify the units in Agriculture, Industry and Service sector and their respective sub-sectors and then finally with their labour size. Classification according to labour size is important because through this role of labour size i.e. firm size in innovation will be addressed.

The table 2 shows the actual no. of production units (population) and the number of sample to be taken from each sector (along with their respective sub-sectors) with respect to their labour size. This will give us the clear process to be followed while taking sample and maintaining its true representation towards the population.

We know that Karnataka has 10,855 production units and required sample size from Karnataka is 371, considering true representation of population, these 371 samples will represent the 10,855 production units.

So the proportion of each production unit in total sample would be $= \frac{371}{10855}$ or 0.0342

To get the required sample size of a particular category the actual number (population) will be multiplied by this proportion.

This method gives us that 345 production units are needed to be surveyed of which, 8 from Agriculture and 18 from services. Further, of these 345 to be surveyed from Industry, 342 (10,013 X 0.0342) should belong to Manufacturing- a sub-sector under Industry.

After this, firms are further classified with their respective labour size and hence the sample size also gets further distributed as per the labour size. Now 342 firms which we need to survey from Manufacturing (sub-sector of industry), 296 (8677 X 0.0342) should belong to labour size 0-99 and 33 (959 X 0.0342) from labour size 100-499 and so on to have population truly represented in the sample size according to sector then sub-sector and then finally respective labour size. A complete and detailed table for all three sectors is given below (table 2).

<u>Rounding a zero to one</u> - Another interesting thing is that in some of the categories there exist an actual number but when we multiply it with proportion the number comes out to be approximately zero. So to represent that category we survey any one of the production units, so that it gets represented in the sample.

Table 2: Population and Sample Size of Karnataka

Sectors		**Labour Size**	**Population**	**Sample**
Agriculture	Total		241	8
Agriculture (A)		0-99	239	8
		100-499	2	0
		500-999		
		1000 and above		
Industry	Total		10,100	345
	Mining & Quarrying (B)	Sub-total	0	0
		0-99		
		100-499		
		500-999		
		1000 and above		
	Manufacturing (C)	Sub-total	10,013	342

Sectors		Labour Size	Population	Sample
		0-99	8,677	296
		100-499	959	33
		500-999	210	7
		1000 and above	167	6
	(D)+(E)	Sub-total	87	3
		0-99	83	3
		100-499	2	0
		500-999	1	0
		1000 and above	1	0
	Construction (F)	Sub-total	0	0
		0-99		
		100-499		
		500-999		
		1000 and above		
Services	Total		514	18
	(G)+(H)+(I)+(J)	Sub-total	466	16
		0-99	440	15
		100-499	20	1
		500-999	1	0
		1000 and above	5	0
	(K)+(L)+(M)	Sub-total	11	1
		0-99	11	1
		100-499		
		500-999		
		1000 and above		
	(N)+(O)+(P)+(Q)+(R)+(S)	Sub-total	37	1
		0-99	35	1
		100-499	2	0
		500-999		
		1000 and above		
	Grand Total		**10,855**	**371**

Abbreviation used in Table

A – Agriculture
B – Mining & Quarrying
C – Manufacturing
D – Electricity, gas, steam and air conditioning supply
E – Water supply; sewerage, waste management and remediation activities
F – Construction
G – Wholesale and retail trade; repair of motor vehicles and motorcycles
H – Transpiration and storage

I – Accommodation and Food service activities
J – Information and communication
K – Financial and insurance activities
L – Real estate activities
M – Professional, scientific and technical activities
N – Administrative and support service activities
O – Public administration and defense; compulsory social security
P – Education
Q – Human health and social work activities
R – Arts, entertainment and recreation
S – Other service activities

Characteristics of Sample

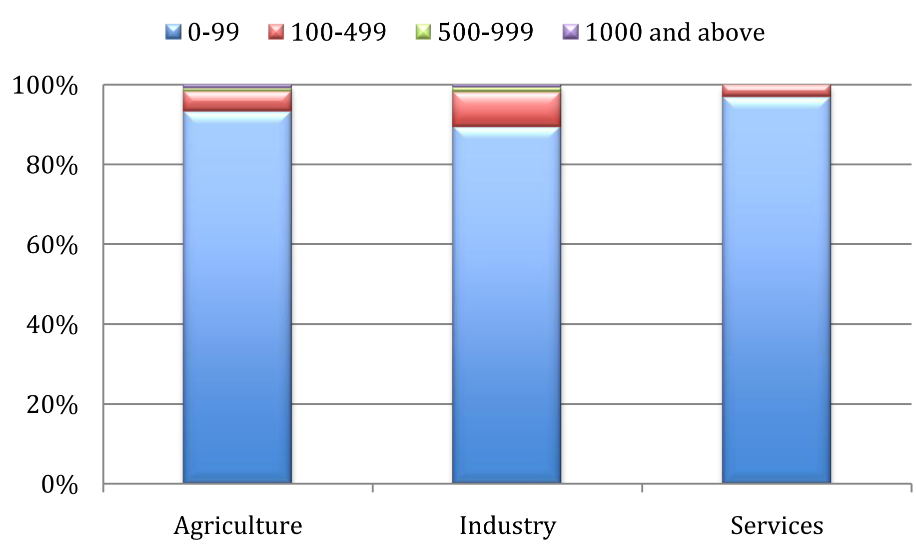
- Our sample is skewed as is the population. Large numbers of firms belongs to the industrial sector and that too in manufacturing.
- So far as smaller size of firms are concerned (0-99 labour size), we find states have varied number of firms in every sector. But when we move ahead to large sized firms (of labour size 100 – 499, 500 – 999 and 1000 & above) we find, in case of agriculture and services, most of states have no firms.
- Due to less number of firms in Agriculture and Services sector, moreover less number of firms of larger employment base (i.e. 500 & above), we find more firms representing Industry and that too smaller firms.
- In all the three sectors almost 90% of units belong to the stratum of 0-99 labour size; however the percentage share of units belonging to this stratum is highest in Services sector (97%), followed by Agriculture (93%) and Industry (89%) respectively (see fig. 4).
- **Agriculture –**
  - Only 11 states have firms of 0 to 99 labour size. Among them 4 states have firms counting between 101 to 500
  - If firms of larger employment base are considered, only 7 states have such firms among which 6 have firms between 1 to 50
  - There is only 1 state with number of firms between 1 to 50 of size 500 to 999 labour
  - And only 2 states with number of firms around 1 to 50 of size 1000 & above labour.

- **Industry –**
  - Since there is large number of small firms in this sector in the population, we find 11 states having 301 & above firms, 12 states having 201 to 300 firms of 0 to 99 labour size in the sample.
  - In other strata of labour size (firm size) we find most of the states have firms around 1 to 50 in the sample.

- **Service –**
  - Again, due to skewed nature of population most of the samples are the smaller labour size of firms. In case of firms of 0 to 99 labour size 30 states have firms around 1 to 50 in the sample.
  - In case of firms of labour size 100 to 499, 10 states have firms around 1 to 50 in the sample.
  - There is no firm of 500 & above labour size in the sample from any state.

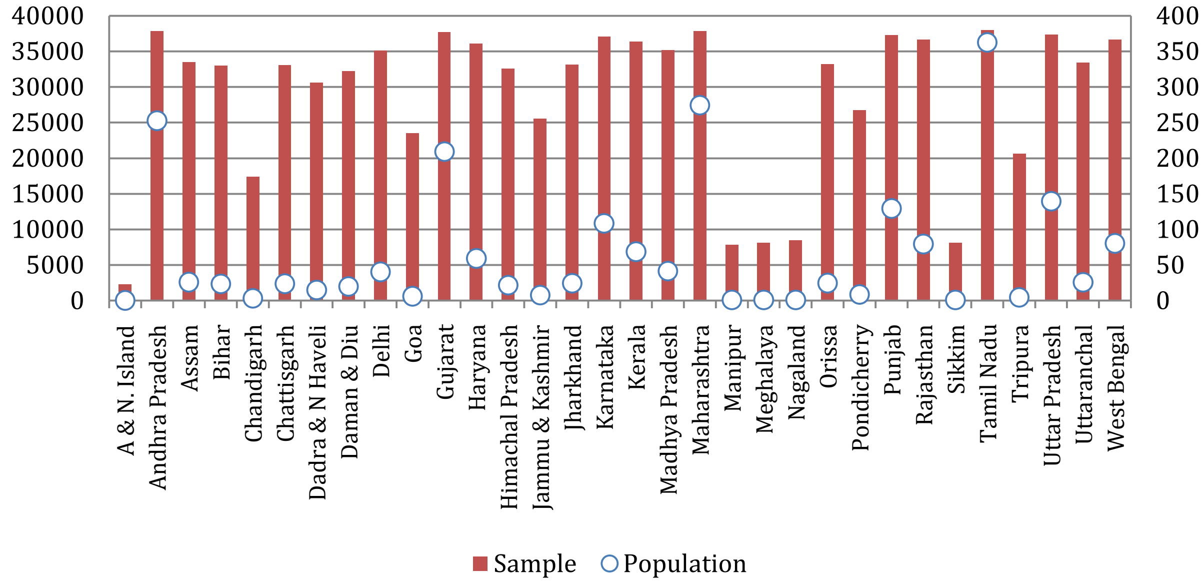
Figure 1 shows sector-wise sample share in different firm size category.

Figure 1: Sample size over different firm size



Distribution of population and sample across states and UTs is shown in figure 2. Horizontal primary axis shows the population and the horizontal secondary axis shows sample. Northeastern states of India have lesser number of firms in the sample. Table 3 shows example of sampling for a few states.

Figure 2: Population and sample size across states



Note: Right hand axis indicates sample size

Table 3: Example of sampling of some states

No. of Production Units Belonging to Different Categories	States --->		Andhra Pradesh		Delhi		Gujarat		Nagaland		West Bengal	
Sectors		Labour Size	Population	Sample	Population	Sample	Population	Sample	Population	Sample	Population	Sample
	Total		1120	17	0	0	652	12	0	0	0	0
Agriculture (A)		0-99	1079	16			632	11				
		100-499	41	1			20	1				
		500-999										
		1000 and above										
Industry	Total		23382	349	3705	322	19807	357	103	80	7520	343
	Mining & Quarrying (B)	Sub-total	14	0	0	0	64	1	0	0	2	0
		0-99	13	0			47	1			1	
		100-499	1	0			16				1	
		500-999					1					
		1000 and above										
	Manufacturing (C)	Sub-total	23208	347	3702	322	19656	354	103	80	7506	342
		0-99	22158	331	3465	301	18218	328	100	78	6861	313
		100-499	799	12	187	16	1108	20	2	1	498	23
		500-999	130	2	33	3	213	4	1	1	71	3
		1000 and above	121	2	17	2	117	2			76	3
	(D)+(E)	Sub-total	160	2	3	0	87	2	0	0	12	1
		0-99	145	2	3		77	2			7	1
		100-499	14	0			8				5	0
		500-999	1	0			1					
		1000 and above					1					
	Construction (F)	Sub-total	0	0	0	0	0	0	0	0	0	0
		0-99										
		100-499										
		500-999										
		1000 and above										
Services	Total		753	11	330	29	460	8	5	4	517	24
	(G)+(H)+(I)+(J)	Sub-total	738	11	319	28	444	8	4	4	478	22
		0-99	685	10	302	26	438	8	4	4	463	21
		100-499	51	1	17	2	6				15	1
		500-999	1	0								
		1000 and above	1	0								
	(K)+(L)+(M)	Sub-total	0	0	0	0	13	0	0	0	4	0
		0-99					13				4	
		100-499										
		500-999										
		1000 and above										
	(N)+(O)+(P)+(Q)+(R)+(S)	Sub-total	15	0	11	1	3	0	1	0	35	2
		0-99	15	0	11	1	2		1		34	2
		100-499					1				1	
		500-999										
		1000 and above										
Grand Total			25255	377	4035	351	20919	377	108	84	8037	367

Annexure III

INNOVATION SURVEY: A BRIEF INTRA AND CROSS-COUNTRY COMPARISON

The first innovation survey (popularly known as the Community Innovation Survey of EU) was conducted in twelve European countries in 1993 (Godin, 2008). The survey was based on Oslo Manual (see box 1), which the OECD countries adopted in 1992. It was a comprehensive survey, which was second of its kind following the international survey of 1963 on research and development (Frascati Manual, see box 2). In fact, it marked the beginning of standardization of innovation measurement. Indicators for the survey were designed on the basis of outputs generated from innovative activities, viz. measuring the products, processes and services.

Box 1: Oslo Manual

The first version of the Oslo Manual was issued in 1992 by the Organization for Economic Co-Operation and Development as a document "The Measurement of Scientific and Technological Activities, Proposed Guidelines for Collecting and Interpreting Technological Innovation Data". It contains guidelines for collecting and using data on industrial innovation.

The salient features of the manual are,

- the manual covers innovation in the business enterprise sector only;
- it deals with innovation at the level of the firm;
- it concentrates on technological product and process (TPP) innovation, with optional guidelines for other forms such as organizational change;
- it covers diffusion up to "new to the firm".

Initially, the survey focused on technological innovation. Firms are considered as the major engines of technical change in bringing out innovative outcomes (Kline and Rosenberg, 1986). It worked well in case of advanced economies, as contrast to developing countries, where institutional differences widened the platform of technological innovation more in terms of social context/local capabilities (refer Bogota Manual, see box 3), where ‘not everything is the same’ (Lorentzen, 2009; Lall, 1992). Specially, in poor countries capabilities of individuals and communities matter outside and independent of firms. Adaptation takes place faster when local institutional arrangements and social capital facilitate more extensive indigenous communication and innovation (Dixon, 2005).

Box 2: Frascati Manual

Frascati manual is the first official version of the Proposed Standard Practice for Surveys of Research and Development developed by OECD and national experts on research and development statistics in June 1963.

The salient features of the manual are,

- It sets standardized methodology for collecting statistics about research and development and interpretation of established R&D data.
- It sets forth basic definitions for basic research, applied research and Research and Development.
- It also deals with measuring the resources devoted to R&D – expenditure and personnel – in the performing sectors.

Keeping the consideration of these conceptual and methodological differences (Lorentzen and Mohamed, 2010), the focus of the innovation survey in the recent years has shifted from outputs to activities. Thus, the third revision of the Oslo Manual (OECD and Eurostat, 2005) included marketing and organizational innovations (Bloch, 2007) to capture incipient capability accumulation in an evolutionary context as opposed to an ‘objective’ measure of newness. Besides, it shaped innovation to be studied as a process where creation and utilization of knowledge takes place as a part of technological learning and upgrading (RICYT et.al, 2001).

Countries both from developed as well as developing economies have carried out innovation surveys in the recent past. A comparative table has been prepared in this regard that highlights some of the salient features of the surveys in different countries (see Table 1). Table 2 presents a comparative structure of the questionnaire adopted in different surveys, with reference to one adopted by the present Indian National Innovation Survey (NIS).

Box 3: Bogota Manual

Latin American researchers were the first to table a systematic discussion on the contextualization of traditional innovation indicators in this Manual (RICYT et.al. 2001), held in Bogota in 1997 and 2000.

The manual listed broader definition of innovation, which includes not only R&D efforts, but also efforts regarding "design, installation of new machinery, industrial engineering, acquisition of embodied and disembodied technology, organizational modernization and marketing"

According to the manual the Latin American indicators should measure the following,

- The Concept of Technological Capabilities.
- Innovation as a social and interactive process.
- External Sources and Endogenous Technological Effort.
- Organizational Innovations.
- Training.
- Quality management, environmental management and innovation capabilities.

C.F.Carter and B.R. Williams of Great Britain pioneered the worldwide survey of innovation in late 1950s for advancement of science.

Table 1: Innovation survey in the world: Highlights from six countries' experience

Countries ⇒ Issues ⇓	South Africa	Canada	Malaysia	Colombia*	EU	
					Germany	Netherlands
% of innovative firms	51.7% of firms are Innovative	65% of firms were innovative	Out of 4000, only 19% responded, of which 35% indicated to be innovative.	6,670 firms out of which 6,172 firms responded of which 72% talk about innovative product	65% of firms are innovation active, 89% of large firms are innovative compared to 74% and 60% for medium and small firms.	34% of firms are engaged in innovation activities while 27% are involved in organisational innovation.
Product innovation	11.9% of firms introduced product innovation only. 51.3% of which developed mainly by enterprise themselves, and 23% were from collaboration with other enterprise or institution.	15% of Manufacturing firms introduced product innovation only. In actual 47.6% of manufacturing firms introduced product innovations.	72% of innovating companies are involved in both product and process innovation.	6% of firms introduced a product new for the national and international market, 30% introduced a product new for the national, but not for the international one, while the 40% simply imitated, by adopting a product already existing into the national market.	The share of newly introduced products amounts to 18% of the total turnover for new-to-firm products, and 8 % for new-to-market products.	8% of total turnover is contributed by new products.
Process innovation	11.9% of firms were process innovators only. 24.8% of them introduced new or significantly improved methods of manufacturing or producing goods or services.	17.4% of Manufacturing firms were process innovators only. 41.4% of them introduced new or significantly improved methods of manufacturing or producing goods or services. In actual 50% of manufacturing firms introduced process innovations.	-do-	27% introduced the new process, 10% generated the new process through R&D. The major part of process innovation is either through adoption of outside developed technology or, for a smaller part, through non-formalized research, exploiting the tacit		

				knowledge of the internal sources.		
Funding	6.5% of innovative firms received public funding for their innovation activities	61% of innovative Manufacturing Firms got funded by at least one govt. sponsored programme	Lesser presence of government funding (4%).	Higher presence of government funding (32%).	14% of all innovative firms had access to public funds. 28% of large firms receive public funds against 12% of small firms.	38% of innovative enterprises have received public funding. 1% of total turnover is spent on innovation expenditure.
Source of information	Internal - Almost 50% of all innovative enterprises rated sources of information within the enterprise as highly important for innovation activities. External - 35% of innovative enterprises rated Clients and customers as highly important external market source.	Internal - 45.8% of firms give R&D staff as highly important source of information (internally) External - 51.9% of firms give Clients or customers as highly important source of information (externally)	Market, Government support, R&D labs.	Internal sources, clients, public financing.	16% participation to innovation cooperation activities.	39% have participated in innovative activities.
Effect of innovation	46% of Innovative enterprises rated Improved quality of goods and services as highly important.	Meeting the requirements of existing clients was the market impact of innovation was identified by innovative manufacturing plants (57.7%) as having high importance.	Increase in market share, extension of product range.	Quality improvement, increase in the range of products/new markets/productive capacity/ flexibility, reducing labour cost.	20% of innovative enterprises have applied for patent in 2004 and 19% of them have registered trademarks.	47% of innovative enterprises have improved the quality of their goods & services. 14% of the innovative enterprises have applied for a patent and 17 % have registered trademarks.
Factors hampering innovation	Lack of funds within their enterprise or group was chosen by majority of Innovative industrial enterprises.	Lack of funds within the plant or firm for innovation (28.7%)	High cost of innovation, lack of skilled personnel/information on technology.	Innovation cost, lack of internal resources/ external financing/human resources/information on technology/markets/		

				demand.		
Source: Compiled from various literature survey.						

* All innovation surveys implemented so far in Latin America have adopted a “subject” approach where the unit of analysis is the firm and its innovation behaviour as opposed to an “objective” approach where the unit of analysis is based on innovation output in case of other countries.

Table 2: Questionnaire adopted in different surveys with reference to NIS, India

Particulars of NIS Questionnaire	European Community Innovation Survey	Canada	Malaysia	Colombia	South Africa	Unique Question/s in NIS	Unique Question/s in Other's questionnaire	Similar Question with Different Domain	Remarks
General Information (Total 13)	7	5	7	9	6	• Geographic Export Markets	• Value of Imports, Investment and Productive Assets	• Changes in Production Facilities and Installed Capacity • Though, Questions on Competitive Environment in other's questionnaire is unique in this section but similar question is asked in NIS regarding Status of the enterprise in different section	
Innovation Activities and Human Resources (Total 10)	2	4	2	4	2	• External sources of technology & funding • Innovation new to firm or market • Orientation of training (avg/ year) • Sources of funds for training	• Employees by level of education • Cooperation and Alliance in R&D • How IPRs are Protected & rating of protection type • Whether firms do Technology transfer to Others	• The question whether Innovations were developed by internal source of external source is similar to the question of cooperation and alliance in R&D of other's	• In other's questionnaire this Section is bifurcated into 3 parts, one part belongs to first section and the other two to the second section
information Sources and Innovation Activities (Total 11)	10	10	10	10	10	• Other Sources like Professional and Industry Associations			• Various information sources of innovation were clubbed into 4 sub-parts in other's questionnaire
Effects (Outcomes) of Innovation	0	1	0	1	1				• In NIS questionnaire this question has 12 different options, which is clubbed under one head in the other's questionnaire • And Quantitative impact

Particulars of NIS Questionnaire	European Community Innovation Survey	Canada	Malaysia	Colombia	South Africa	Unique Question/s in NIS	Unique Question/s in Other's questionnaire	Similar Question with Different Domain	Remarks
									which is there in other's questionnaire is asked in 2nd section of NIS questionnaire
Factors Influencing Innovation Activities (Total 19)	9	7	10	0	9	• Status of enterprise vis-à-vis others in the industry • 7 unique factors are provided as possible barriers to innovation in NIS questionnaire	• One factor as obstacle to Innovation is recent recession • Market Introduction time as an obstacle to innovation	• Questionnaire of given countries factors out economic risks which says cost-benefit analysis shows doubtful results where as NIS questionnaire directly gives a factor as availability of finance within enterprises as broader term	• Some questions are asked in terms of numbers in the given countries' questionnaire which is not in same pattern in NIS • In NIS questionnaire broad numbers of factors influencing innovation activities are mentioned which are less detailed in others' questionnaire.
Wider Innovation (Total 4)	0	1	1	2	1				• Questions related to IPR of the firms, ICT infrastructure & its usage level, marketing and organisational innovation were asked in this section in NIS questionnaire. Though some questions were asked related to above issues in the questionnaire of given countries but not in the broader sense (such as Organisational and Marketing Innovation) as in the NIS.