

UNDERSTANDING INNOVATION

THE INDIAN CONTEXT



A Bulletin Initiated by



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



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

ISSN 2277-9299



Understanding Innovation

The Indian Context

Contents

	Key observations	3
1	Introduction	4
2	Sample and Innovative firms	5
3	The Innovators	10
4	Innovations and Actions for Innovation	12
5	Gains from Innovation	15
6	Inputs to Innovation	17
7	Factors Influencing Innovation	22
8	Understanding Innovation	23
9	India Aggregated	27
10	Industrial Classification as per the NIC code 2008	30

Editors

Pradosh Nath
Parveen Arora

Research & Editorial Team

Abhishek Kumar
Praveen Rawat
Debanjana Dey

Technical Support
Cover Design

Roshan Kumar & Sanjay Kumar
Debasish Mukherjee

Field Survey Conducted by

Market Insight Consultants
A 72, Sector 34
NOIDA 201307 (U.P), India
www.marketinsightconsultants.com

Zinnov Management Consulting Pvt. Ltd.
69, Pratibha Complex
4th 'A' Cross Koramangala Ind. Layout
Koramangala 4th Block, Bangalore – 560095
www.zinnov.com

Key Observations

Total 2133 firms, chosen through sampling, have been studied in Kerala, Karnataka, Gujarat, Chhattisgarh, Odisha, and West Bengal.

State-wise proportions of innovative firms are Kerala 57.26%, Karnataka 62.60%, Gujarat 12.87%, Chhattisgarh 13.29%, Odisha 28.48% and West Bengal 47.95%. These ratios have been used as innovation intensity of the respective states. The sectoral distributions of industrial units are highly skewed in Chhattisgarh and Odisha, and least in Gujarat and West Bengal. There is also a wide variation in sectoral intensity of innovation.

Most of the firms in the sample belong to the size category below 100 workforces, so do innovative firms. Firms are mostly under private ownership or proprietary firms and also share most of the innovative firms. In Chhattisgarh and Odisha larger numbers of firm (sample and innovative) were established after 2000. Gujarat has equal share of enterprises born before 1990 and between 1990 and 2000. In other states (particularly in West Bengal) higher percentage of firms were established before 1990 sharing higher percentage of innovative firms. Most of the innovations are 'new to firm' to remain competitive in the market.

Innovative firms have fairly clear understanding of the gains from innovations. Most of the innovative firms see themselves either at par or ahead of the other firms in their respective industries. Most of the gains appear to be in production process and quality of products. This is indicative of the main trends of innovation activities.

Accessing the institutional arrangements for various types of support to innovations is rare among the innovative firms. Resources for technological information, training, and finance are managed internally. Development of capabilities of the human resources does not seem to be a priority concern for the innovative firms.

Examining the survey findings in the light of the National Innovation System (NIS), Regional Innovation System (RIS) and Sectoral Innovation system (SIS), it appears that innovative firms in most of the states, except those in Gujarat, do not access the support system under NIS. There is correspondence between overall innovation intensity of a state and the state of RIS. It is SIS that largely influences the innovation intensity of a state. For the six states the survey observes:

- It appears that the National Innovation System (NIS), presently in place, is not popularly accessed by the production system (firms). A general awareness programme on the services rendered by the large number of institutions required to be taken up.
- West Bengal, Odisha and Chhattisgarh require special attention for rejuvenating industrial activities through strengthening RIS. One way could be to create a sector led push to the innovative intensity of these states.
- It appears that states having better RIS also could take the advantage of SIS, as it is evident from the cases of Karnataka and Gujarat. On the other hand only sectoral push or sector led innovation activities may not carry the state very far unless the RIS is strengthened, as it is evident from the cases of Kerala.

1 Introduction

This is the third issue in the series of the Bulletin on understanding innovation in the Indian context. This issue presents broad observations on six states, namely, Kerala, Karnataka, Gujarat, Chhattisgarh, Odisha, and West Bengal. As in the earlier issues the main focus of this issue of the Bulletin is the status of innovation activities at the firm level (for sample firms) in these six states.

The structure of the Bulletin is as follows.

The second section is on the sample and innovative firms of the six states. Sampling of the firms for the survey was done for proportionate representation of the 2-digit NIC code, called sectors in the Bulletin. The survey, therefore, identifies sector-wise proportionate share of the innovative firms for each 6 states. The third section elaborates the identities of the innovative firms with reference to the size, ownership types and year of establishment. For size of the firm we have used number of workers in a firm. The fourth section throws light on types of innovations undertaken by the innovative firms. This section also reports on the activities pertaining to innovations undertaken by the innovative firms. What are the firms' perceptions of gains from innovations? This question has been briefly dealt in section five. Three different groups of inputs to innovations have been chosen for further exploration in section six. These inputs are – technological and non-technological information pertaining to innovation, financial inputs, and inputs for human resource development. Since there is a substantial institutional arrangement to provide such inputs to the innovative firms, the survey throws light on the innovative firms' access to such arrangements. Section seven gives a broad view on the factors that come in the way of innovation related

activities of the firms studied. The eighth section presents the understanding of innovation that can be built around the results drawn from the survey for the six states. The understanding has been woven around the concept of National Innovation System (NIS), Regional Innovation System (RIS), and Sectoral Innovation System (SIS) essentially to examine the relative influence of the systems.* The ninth section is a new addition in the present edition of the bulletin. The section introduces the aggregative scenario of India for overall distribution of sample and innovative firms including innovation intensity over the states and sectors (NIC codes). Tenth section gives the industrial classification as per the NIC codes 2008.

The observations reported in the Bulletin cannot be generalized for overall Indian scenario, which would be developed based on comprehensive analysis of all the states taken together.

* Innovation System - is the arrangement of interactions among the production system, knowledge generating system (R&D and educational institutions) and the executing agencies of the government (for policy led incentives) for strengthening the initiatives towards innovation. Innovation systems are identified at national level (NIS), Regional or state level (RIS) and sectoral level (SIS).

Innovativeness of a firm is the technological (product diversification, new product, quality, production process etc.) and non-technological (organizational, managerial, marketing strategies etc.) changes initiated by a firm.

Innovation intensity of a state- is the % of innovative firm in the total sample population of the state.

Sectoral innovation intensity - is the % of innovative firms in the total (6 states together) sample firms in a sector.

2 Sample and Innovative Firms

Total 2133 firms were surveyed in the selected six states. State-wise distribution of sample is – Kerala 365, Karnataka 369, Gujarat 373, Chhattisgarh 331, Odisha 330, and West Bengal 365. As per NIC code the industrial activities in the 6 chosen states are spread over 37 two digit industrial segments or sectors (refer to Figure 1). Six states have quite diverse industrial activities as shown by the skewness (presented in Figure 2). Industrial scenario (in terms of number of enterprises in different sectors) in Odisha (skew 4.08) is highly skewed followed by Chhattisgarh (skew 3.09) and Karnataka (skew 2.87). Manufacturing of basic metals (NIC 24) and food products (NIC 10) constitute more than 60% of the industrial activities (percentage share of number of enterprises) of Chhattisgarh. In case of Odisha, manufacturing of non-

metallic mineral products (NIC 23) when added to food products and basic metal together constitute 60% of the economic activities. Food product has large share (22%) of the economic activities also in Karnataka. Manufacturing activities in Kerala (skew 2.30) too are dominated by food products, rubber and plastics (NIC 22) and textiles industry (NIC 13). Gujarat (skew 1.64) and West Bengal (skew 1.34) have similar production activities and lower skew values. Dominant activities in Gujarat are machinery and equipment (NIC 28), fabricated metal products (NIC 25) and basic metals (NIC 24), these together sharing about 36% of the enterprises. In West Bengal food products share about 14% of the enterprises followed by fabricated metal products (11.23%), basic metal (10.14%) and machinery and equipment (9.32%).

Figure 1: Share of industrial segments in total sample

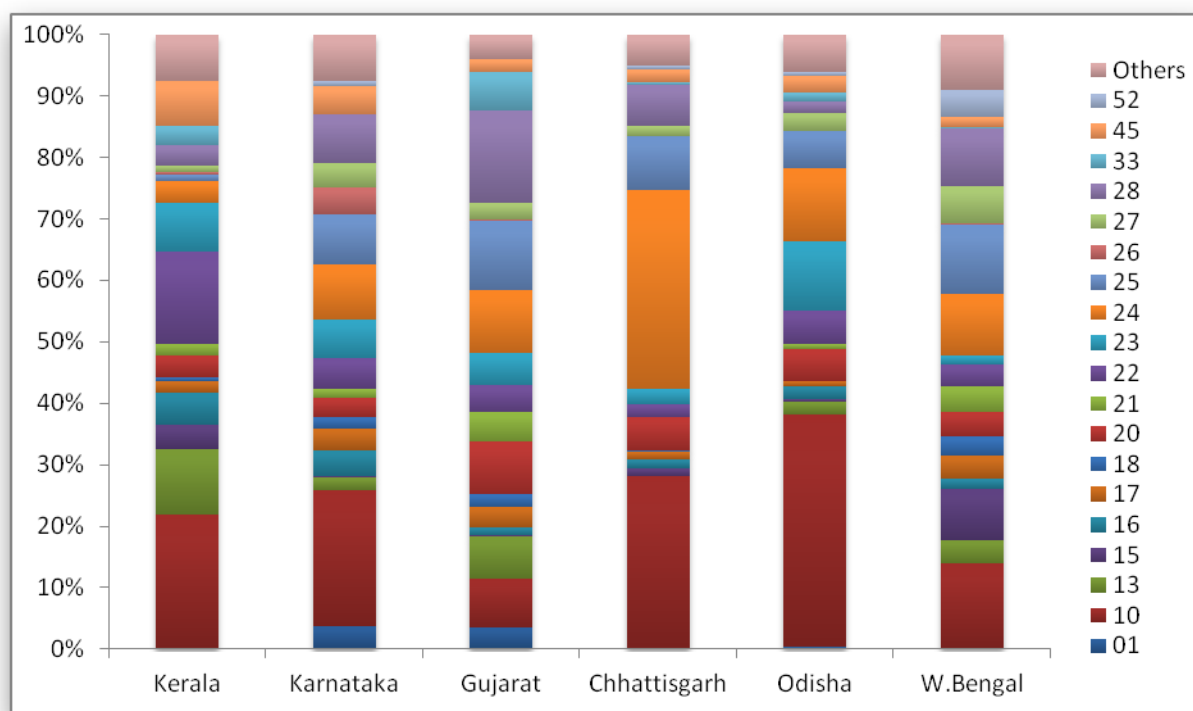
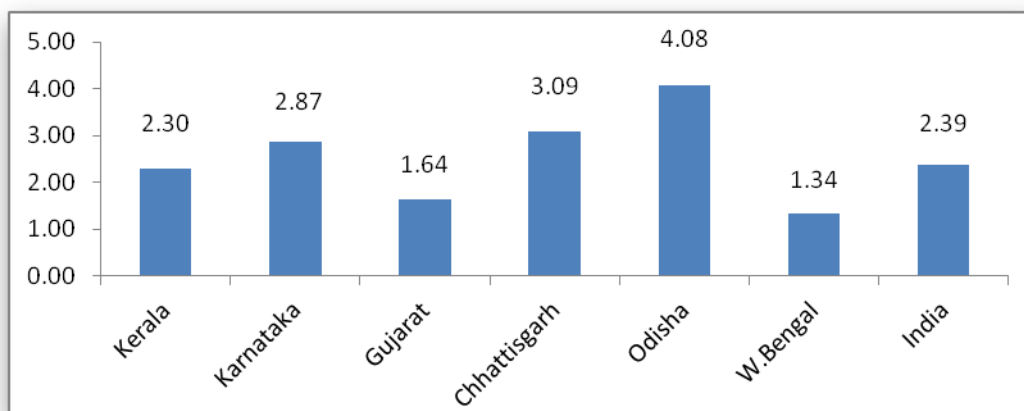
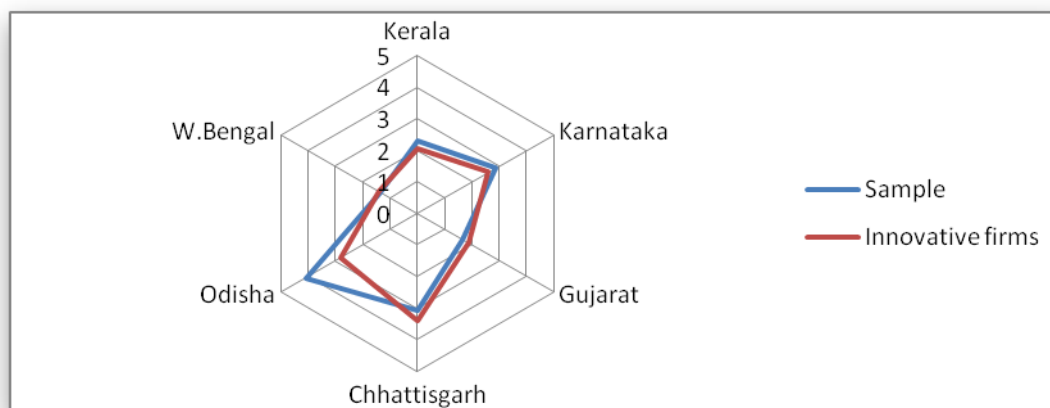


Figure 2: Skewed industrial activities over the sectors

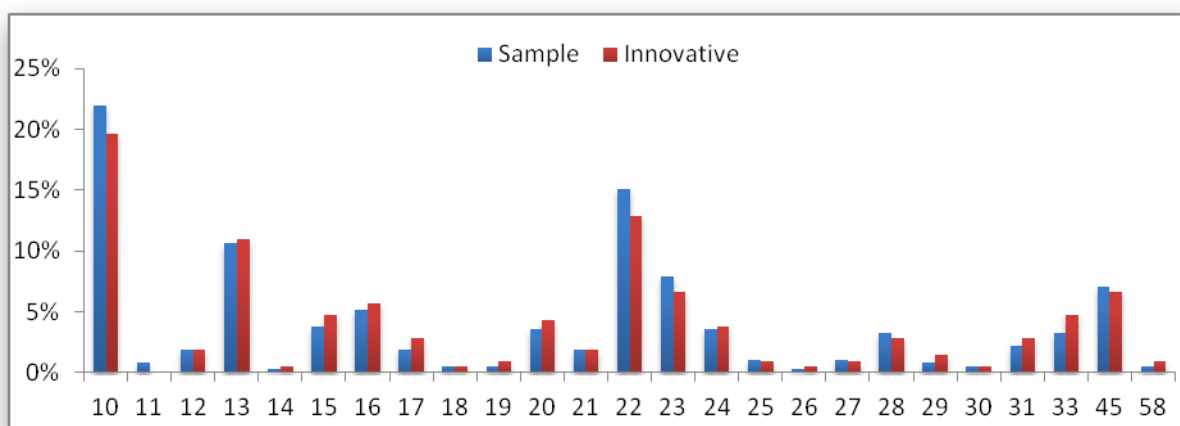
The survey aimed at identifying innovative firms and their innovation related activities from the sample firms. Sector-wise distribution of innovation activities (% of firms) is highly skewed in case of Chhattisgarh. In general skew values for innovation follow more or less the same

pattern as in the case of nature of industrialization (Figure 2) except the rank swapping between Odisha and Chhattisgarh (Figure 3). Figure 4 - 9 show the state-wise percentage of innovative firms in different sectors. Samples were drawn proportionate to the size (number of firms) of a sector.

Figure 3: Skewness of distribution of innovative and sample firms over the sectors

Observation Innovation intensities of the six states are: Kerala 57.26%, Karnataka 62.60%, Gujarat 12.87%, Chhattisgarh 13.29%, Odisha 28.48% and West Bengal 47.95%. Food and beverages industry returned highest percentage of innovative firms for all six states. This could be the direct result of the government policies and incentives for promotion of this industrial segment.

Figure 4: Distribution of sample and innovative firms in different industry segments (Kerala)

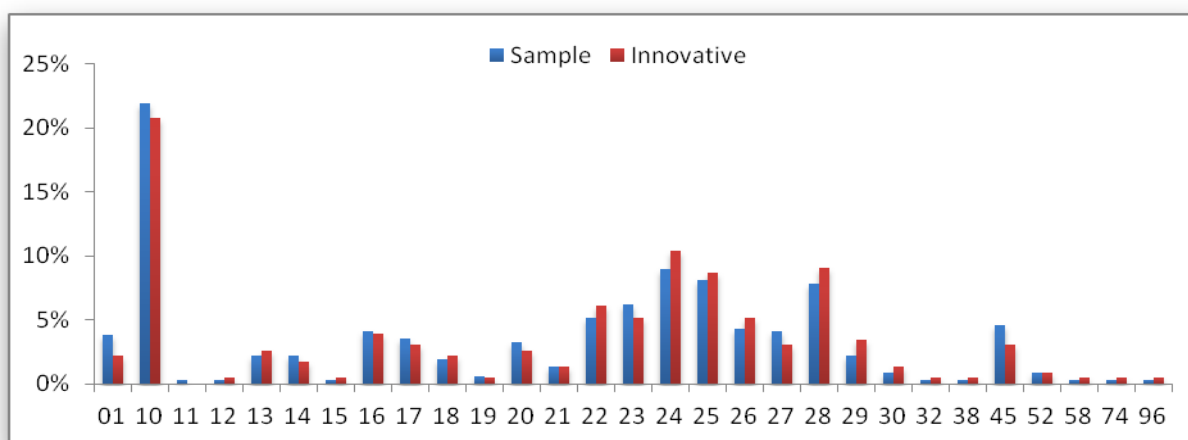


Out of 37 industrial segments, Kerala has presence in 25 sectors and has reported innovative firms in 24 segments; total 209 firms out of 365 (i.e. 57.26%) have reported innovation related activities. The largest industrial segment (NIC 10 constituted of food products manufacturing firms) has reported highest percentage of innovative firms - about 19.62%, which is followed by manufacture of rubber and plastic products

(NIC 22), and manufacture of textiles (NIC 13). See figure 4.

Karnataka is also dominated by the food product industry, which also has the largest share of innovative firms (20.78%). This is followed by basic metal industry (NIC 24) that has about 9% of the industrial activities and 10% of the innovative firms. Karnataka has returned 231 firms out of a sample of 369, or 62.60% firms as innovative. See figure 5.

Figure 5: Distribution of sample and innovative firms in different industry segments (Karnataka)



Gujarat has most intriguing results. The industrial activities are quite well spread across the 37 sectors, but have returned only 48 (12.86%) firms out of a sample of 373 firms as innovative. Higher percentage of innovative firms (18.75) have been reported by fabricated metal product industry (NIC 25), 12.5% in manufacturing of machine and equipment (NIC 28), 10.42% each for rubber and plastic products (NIC 22) and textile industry (NIC 13). Gujarat being known as industrially progressive state the survey finding requires close look at the innovative activities of the state. See figure 6.

Industrial scenario of Chhattisgarh is dominated by metal and related industries. Basic metal (NIC 24) industry has as high as 41% innovative firms, followed by fabrication of metal (NIC 25) at 14% and machine and equipment manufacturing (NIC 28) at 11% (figure 7). However, food product industry (NIC 10), which also has a prominent share of industrial activities, has about 18% of the innovative firms. Overall, Chhattisgarh has returned 44 innovative firms out of a sample of 331 firms or 13.29% across the sector.

Figure 6: Distribution of sample and innovative firms in different industry segments (Gujarat)

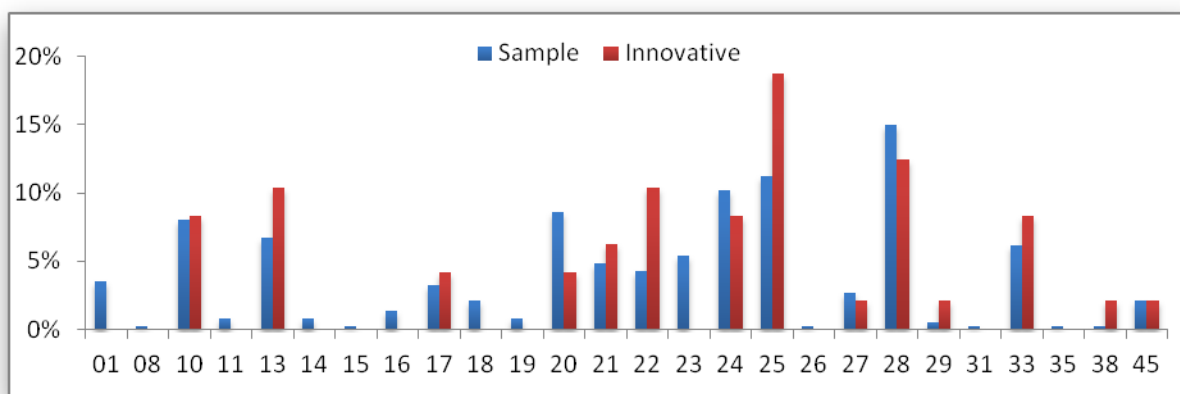
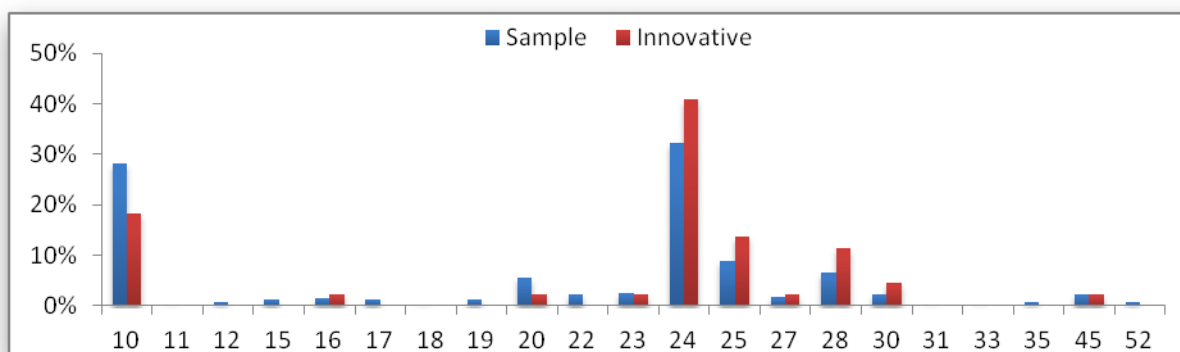


Figure 7: Distribution of sample and innovative firms in different industry segments (Chhattisgarh)



Odisha has 94 innovative firms out of a sample of 330 firms, taking the percentage to 28.48%, much better than Gujarat and Chhattisgarh. Innovative firms are mostly in the food products industry (NIC 10) sharing 29% of the innovative firms followed by the basic metal industry (NIC 24) sharing 13% and rubber and plastic product industry (NIC 22) having a share of 11%. See figure 8.

Innovation scenario is better spread out in West Bengal. Food products (NIC 10) and leather products (NIC 15) have a share of about 13% each of the innovative firms. Innovative firms are also present in the machinery and equipment sector (NIC 28) and metal fabrication (NIC 25) sharing 9% and 8% respectively as shown in figure 9. Overall the state has returned 175 firms out of 365 samples or 47.95% of innovative firms.

Figure 8: Distribution of sample and innovative firms in different industry segments (Odisha)

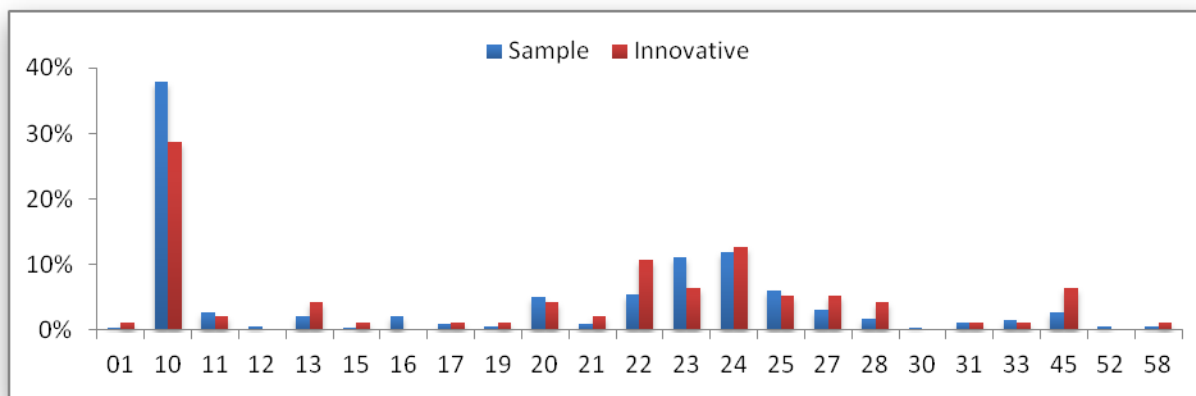
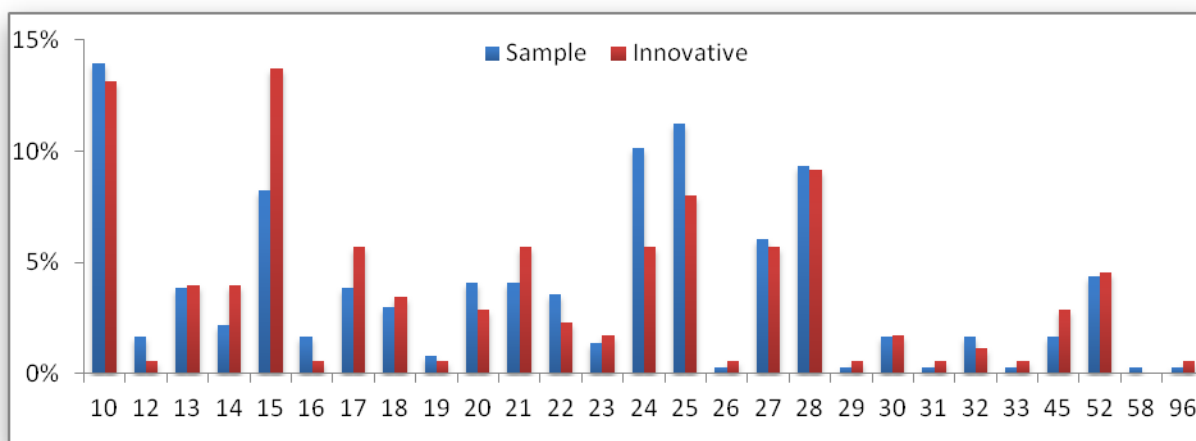


Figure 9: Distribution of sample and innovative firms in different industry segments (West Bengal)

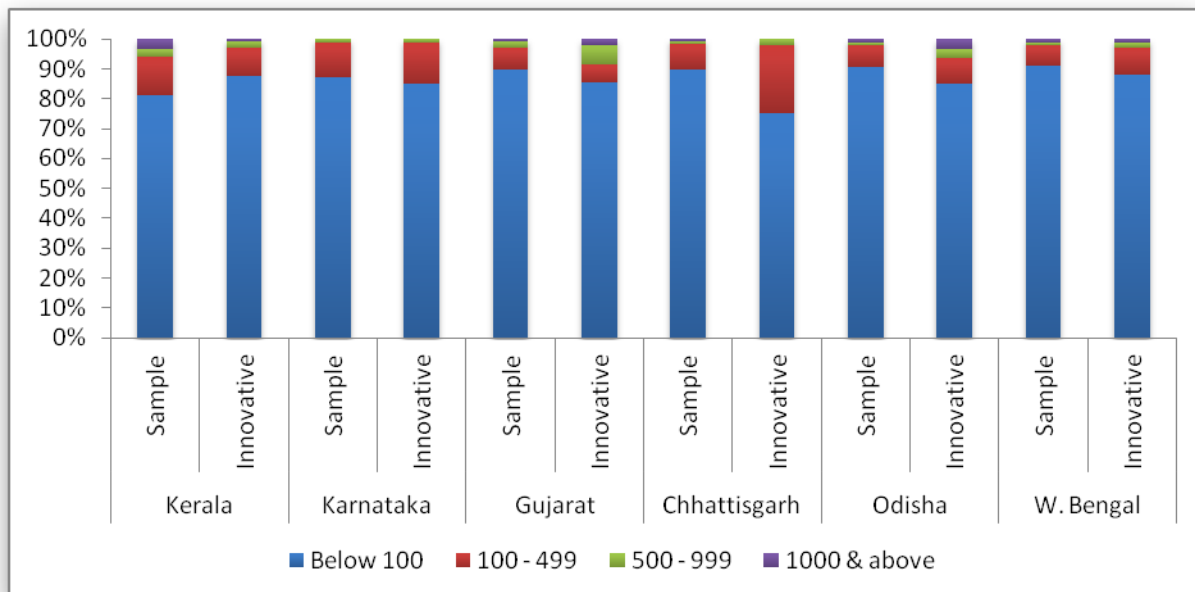


3 The Innovators

The innovative enterprises are identified by their size, types of ownership and year of establishment. In the absence of reliable data on the turnover of the firms we have used the information on employment for size of the enterprise. As shown in Figure 10, 80% to 90% (and above) of the sample firms in these six states have less than 100 workforces. In case of Odisha and West Bengal the percentage is above 90%. About

85% of the innovative firms in these two states belong to this (below 100 workforce) size of the firms. The scenario does not change much in the cases of Karnataka. Gujarat and Kerala, however, show comparatively higher percentage of firms in the higher levels of firm size (500-999) and (1000 and above) respectively. On the other hand Chhattisgarh has about 23% innovative firms in the size category of 100 - 499 workforces.

Figure 10: Distribution of Sample and Innovative firms according to the Size (workforce)



Observation

Most of the firms in the sample belong to the size category below 100 workforces. So do innovative firms. *Firms are mostly under private ownership or proprietary firms* and also share most of the innovative firms. In Chhattisgarh and Odisha larger numbers of firm (sample and innovative) were established after 2000. Gujarat has equal share of enterprises born before 1990 and between 1990 and 2000. In other states (particularly in West Bengal) higher percentage of firms are established before 1990 sharing higher percentage of innovative firms.

Ownership patterns of the sample and innovative firms are shown in the Figure 11. Kerala has about 39% firms privately owned and they share about 37% of the innovative firms. The numbers are higher for Karnataka having 53% of the privately owned enterprises sharing 64% of the innovative firms. While private enterprises are predominant ownership types in all states, Chhattisgarh has 31% share of proprietary firms among whom 21% are innovative. Kerala and Odisha, on the other hand, have a share of about 22% partnership firms and similar percentage of innovative firms among them.

Are the new firms more innovative than the older ones? We have made three broad categories – before 1990, between 1990 and 2000, and after 2000. Refer to figure 12. West Bengal has largest share (54%) of firms established before 1990 and 52% of these firms are innovative. Kerala and Karnataka also have around 45% firms born before 1990. Chhattisgarh and Odisha have about 40% firms born after 2000, and, about the same percentage claim innovative activities in the enterprises. Gujarat has about equal share of firms before 1990 and between 1990 and 2000 categories.

Figure 11: Distribution of Sample and Innovative firms according to the Ownership Type

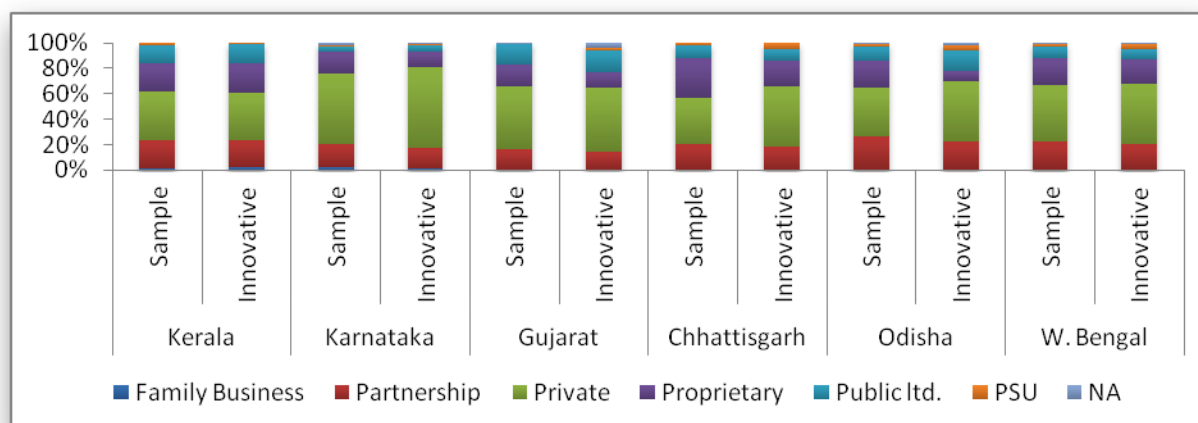
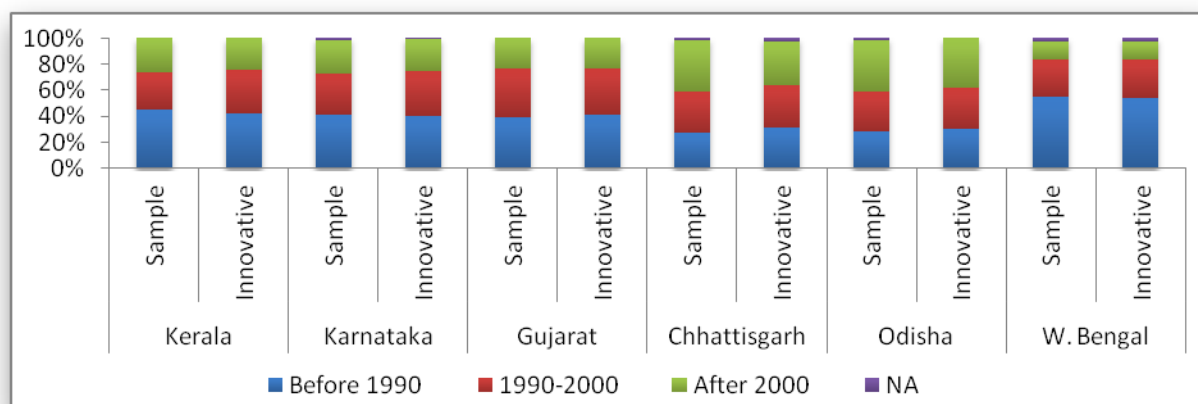


Figure 12: Distribution of Sample and Innovative firms according to their year of establishment.



4 Innovations and Actions for Innovation

Innovative firms were identified based on the responses on changes initiated by these firms in different categories like introducing new product, quality/standard improvement of the existing product, process innovation if any, changes in the input use, use of new/alternative material, introduction of new machine etc. Although not necessarily, it was expected that many of the above mentioned innovations would result to expansion of production capacity or/and installed capacity. Many innovative firms reported such changes further corroborating the act of innovations.

Figure 13 shows the types of innovations carried out by the innovative firms in the

sample firms. Numbers refer to the percentage of total innovative firms engaged in particular types of innovation. Many innovative firms have reported more than one type of innovations, but process innovation and innovations through introduction of new machines are most common types of innovation. Odisha has equal weight on efficient use of inputs. It is to be noted that quality and standard related activities have become visible agenda in the innovation activities. To recapitulate, percentages of innovative firms in the six states are – Kerala (57.26%), Karnataka (62.60%), Gujarat (12.87%), Chhattisgarh (13.29%), Odisha (28.48%) and West Bengal (47.95%).

Figure13: Types of Innovations

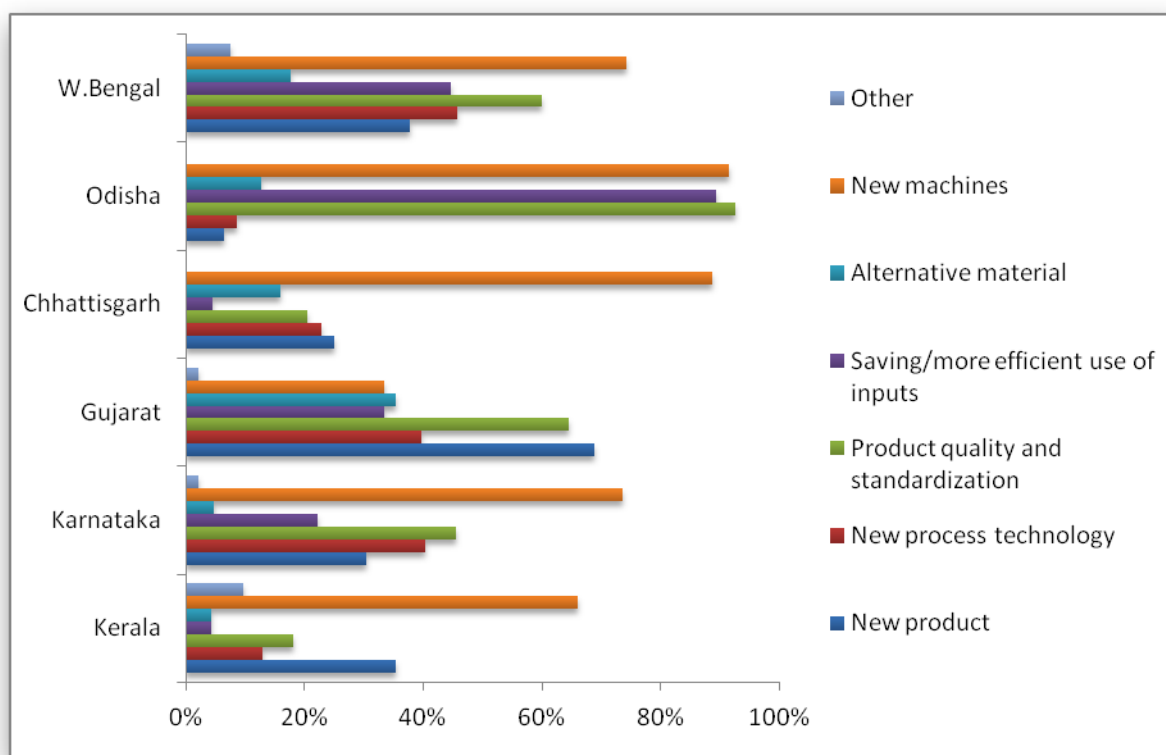


Table 1 shows the engagement or involvement of the innovative firms in these activities. Firms in Gujarat have leads in all categories, followed by Odisha. Other states are mainly active in acquisition of machine, equipment and software.

It is interesting to note that Gujarat having lower innovation intensity, innovative firms here are actively engaged in all activities related to innovations. On the contrary Kerala and Karnataka which show higher innovation intensity are mostly engaged in innovation activities related to acquisition of machine, equipment and software. In

this respect the high innovation intensity states are not much different from comparatively lower innovation intensity states like West Bengal.

Figure 13 further explores the market extent of innovations undertaken by the firms. The market extent of innovation has been captured by the novelty or newness of the innovations done by a firm. Most of the firms are engaged in innovations to be at par with the market. Innovations that are new to Indian or world market are rare and claimed mainly by a few firms in Gujarat and Chhattisgarh.

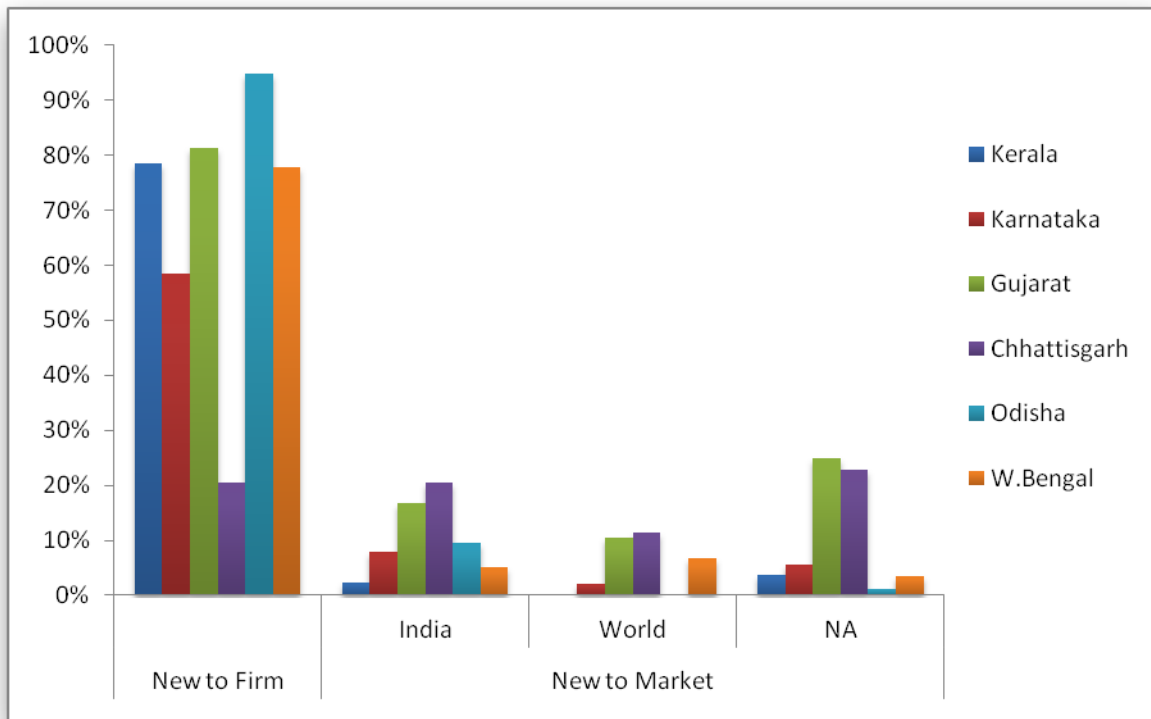
Table 1: Involvement of firms in activities pertaining to innovation (%)

Activities	Kerala	Karnataka	Gujarat	Chhattisgarh	Odisha	W.Bengal
Intramural R&D	18.66	29.44	93.75	25.00	38.30	37.14
Extramural R&D	1.91	3.03	83.33	11.36	24.47	8.57
Acquisition of Machinery, Equipment and Software	67.46	74.03	87.50	20.45	84.04	64.00
Acquisition of other external Knowledge	9.09	13.85	81.25	4.55	50.00	9.14
Training	12.44	50.22	89.58	15.91	59.57	28.00
Market Introduction of Innovation	3.83	11.69	87.50	13.64	20.21	37.14
Other Activities	2.87	11.69	83.33	2.27	19.15	17.14

Observation

Many innovative firms have reported more than one type of innovations, but *process innovation and innovations through introduction of new machines* are most common types of innovation. Quality and standard are important components of innovation activities.

Figure 14: Extent of Innovation

**Observation**

Innovations are mostly adoption of the market trend in terms of product quality, machine etc. Except Chhattisgarh, which does not claim much as innovation activities, rest of the states show more or less similar types of innovations.

5 Gains from Innovation

Did the firm gain from innovations? What are the natures of gains? Has the innovating firm gained in competitive position in the market? These are the issues that explore the justification of innovation and verify the claims of innovation.

Figure 15 shows the percentage of innovative firms expressing the various types of gains from innovations undertaken. Firms in Gujarat and Odisha claim all round gains from innovations. Firms in other states are discrete and selective about the gains.

While achieving what they achieved through innovations how do the innovative firms perceive themselves vis-à-vis their competitors? Table 2 presents the perceptions of the innovative firms in this regard. Most of the innovative firms in the states under consideration claim themselves to be at par with the best in their respective industries. In this, West Bengal seems to be lagging behind the firms in other states. Again, firms in Kerala, Odisha and West Bengal are particularly lagging behind in technology in-licensing, FDI inflow and foreign collaborations.

Figure15: Gains from Innovation

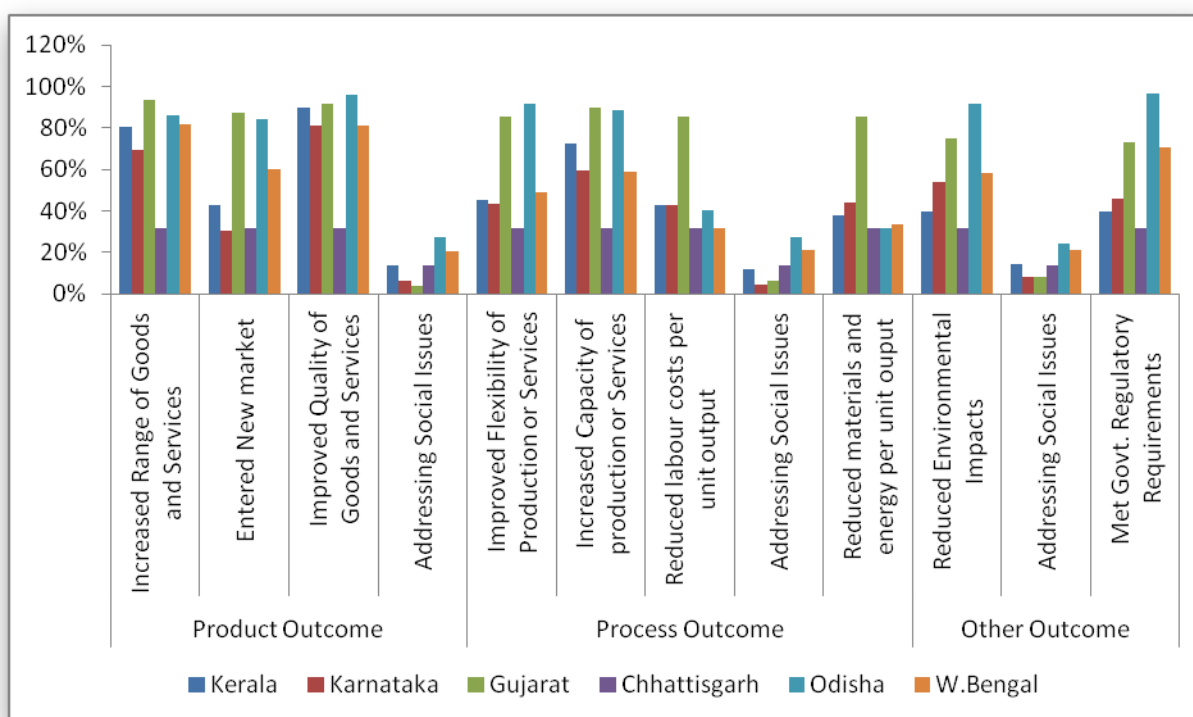


Table 2: Competitive status of the innovative firms (%)

Status	Kerala	Karnataka	Gujarat	Chhattisgarh	Odisha	W.Bengal
R&D Activities	35.41	45.45	100.00	97.73	37.23	54.86
Quality of Manpower Employed	80.86	89.18	100.00	100.00	96.81	93.14
Technology in-licensing	48.80	74.89	93.75	95.45	48.94	64.57
New Collaborations	14.83	25.97	75.00	84.09	11.70	12.57
FDI	9.57	21.21	70.83	77.27	2.13	11.43
Sourcing of raw material and other inputs	93.78	83.98	97.92	97.73	95.74	76.57
Efficient cost management	94.74	90.04	97.92	97.73	95.74	80.57
Quality of machine and equipment	94.74	94.81	95.83	100.00	96.81	88.57
Efficient organizational practice	93.30	83.12	89.58	97.73	91.4	78.86
Efficient marketing arrangement	88.04	86.15	95.83	95.45	91.49	78.29
Better information management	89.95	78.79	97.92	100.00	93.62	76.00
Successful brand development	84.69	74.46	95.83	97.73	89.36	66.86

Observation

Innovative firms have fairly clear understanding of the gains from innovations. Most of the innovative firms see themselves either at par or ahead of the other firms in their respective industries. Most of the gains appear to be in production process and quality of products. This is indicative of the main trends of innovation activities.

6 Inputs to Innovation

How much do firms access resources from sources external to the firm? Or in other words, how well networked a firm is for accessing resources? By resources we mean inputs that contribute to strengthening of innovative activities. Such inputs are technological, managerial, financial etc. and generally would be in the form of soft inputs (information and knowledge) and hard inputs (machines and equipment).

Table 3 captures the extent of external sourcing accessed by the identified

innovative firms. Firms in Gujarat and Odisha access both external and internal sources for generating innovation related information. The same is much less pronounced in other states, including high innovation intensity states like Kerala and Karnataka. Market sources, like suppliers and customers are most preferred channels of information. Engaging consultant for access to information is not a popular means. Except Gujarat, firms in other states do not access the educational and R&D institutes as source of information. Professional and industry association appears to be important sources.

Figure 16: Information source and innovation activity

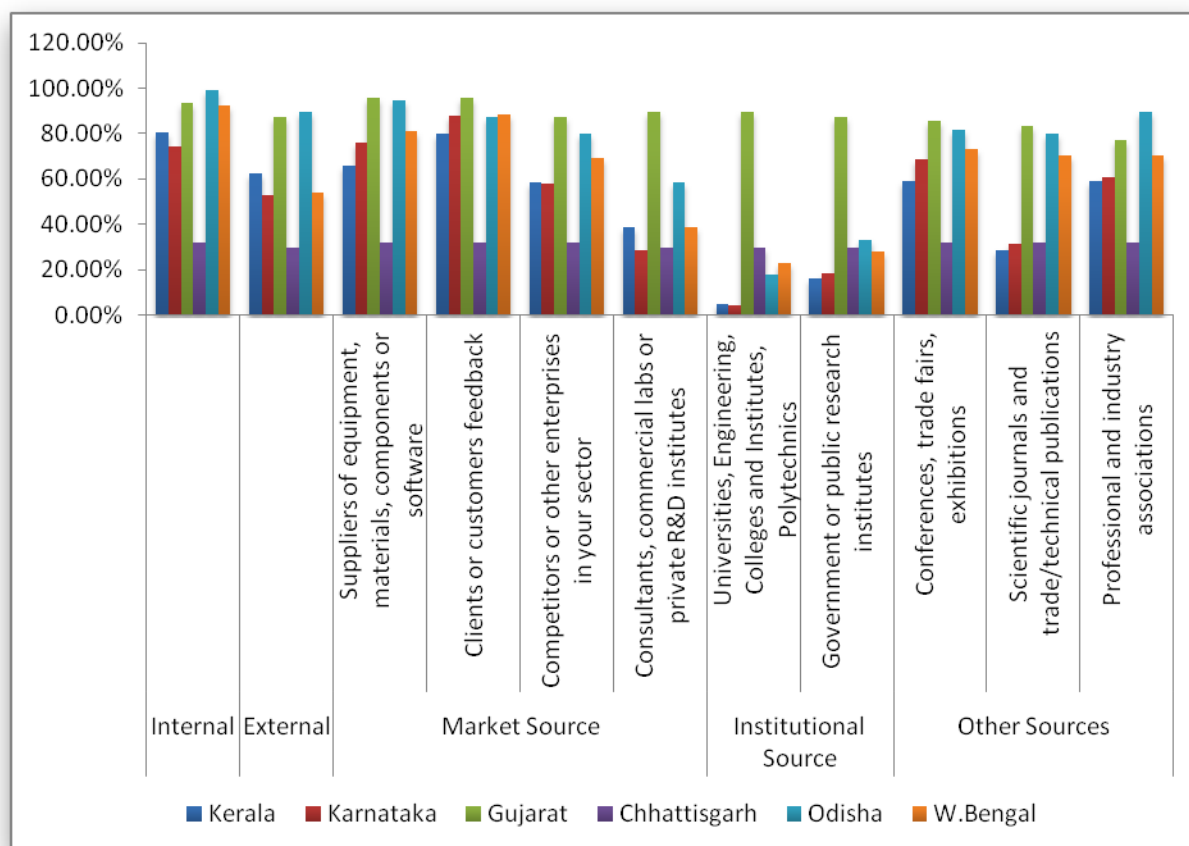


Table 3: Information Source & Innovation Activities (%)

Sources of Information		Kerala	Karnataka	Gujarat	Chhattisgarh	Odisha	W.Bengal
Internal Source		80.38	74.46	93.75	31.82	98.94	92.57
External Source		62.20	52.81	87.50	29.55	89.36	53.71
Market Source	Suppliers of equipment, materials, components or software	66.03	75.76	95.83	31.82	94.68	81.14
	Clients or customers feedback	79.90	87.88	95.83	31.8	87.23	88.57
	Competitors or other enterprises in your sector	58.37	58.01	87.50	31.82	79.79	69.14
	Consultants, commercial labs or private R&D institutes	38.76	28.57	89.58	29.55	58.51	38.86
Institutional Source	Universities, Engineering, Colleges and Institutes, Polytechnics	4.78	4.33	89.58	29.55	18.09	22.86
	Government or public research institutes	16.27	18.61	87.50	29.55	32.98	28.00
Other Sources	Conferences, trade fairs, exhibitions	59.33	68.40	85.42	31.82	81.91	73.14
	Scientific journals and trade/technical publications	28.71	31.60	83.33	31.82	79.79	70.29
	Professional and industry associations	59.33	60.61	77.08	31.82	89.36	70.29

Availability of fund for innovation is an important aspect of innovation ecosystem. Table 4 reveals that most of the firms depend on their own internal sources. Or, in

other words accessing external sources for financing innovation is not a popular mode among innovative firms.

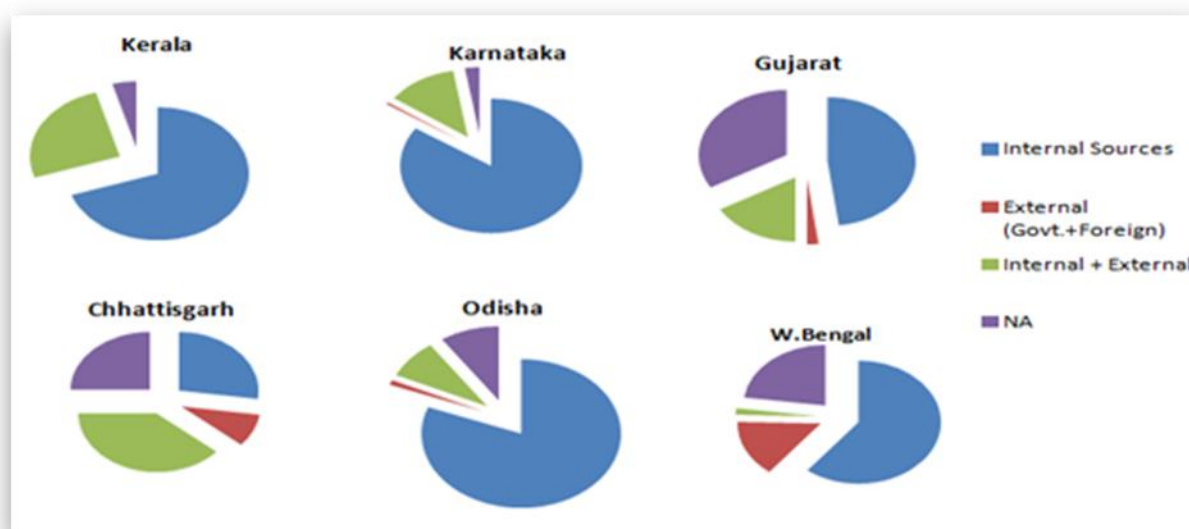
Observation

Innovative enterprises in Gujarat claim close interaction with institutions like universities and R&D institutions for sourcing information for innovative activities. In other states competitors in the market are the most important source of information. It indicates that innovation is more market driven than strategy driven.

Table 4: Source of finance for innovation (%)

Sources	Kerala	Karnataka	Gujarat	Chhattisgarh	Odisha	W. Bengal
Internal Sources	69.86	84.42	47.92	27.27	89.36	60.57
External (Govt.+Foreign)	0.00	0.43	2.08	9.09	9.57	14.86
Internal + External	25.84	12.55	16.67	38.64	0.00	1.71
NA	4.31	2.60	33.33	25.00	0.00	22.86

Figure17: Source of Funding Innovation



Like information and finance, human resource is the most indispensable component of innovation related activities. Figure 17 shows number of firms as percentage of total firms having different size class (%) of scientists and engineers as total employment.

Most of the firms across the states and industries have less than 10 technical personnel. This is indicative of the fact that innovative activities constitute minor part of the firms' activities. This is reinforced by

the fact, as shown in Figure 18, that most of the firms do not have any major human resource development programme. Gujarat, however, shows that innovative firms do undertake training for human resource development. Again accessing the skill development programmers outside the firm is a rare initiative from the innovative firms (as shown in Figure 19). Most of the training is imparted in-house. So far funding of training and skill development initiatives are concerned, firms access mainly the internal sources, as shown in Figure 20.

Figure 18: Scientist and Engineers (as % of Total Employment)

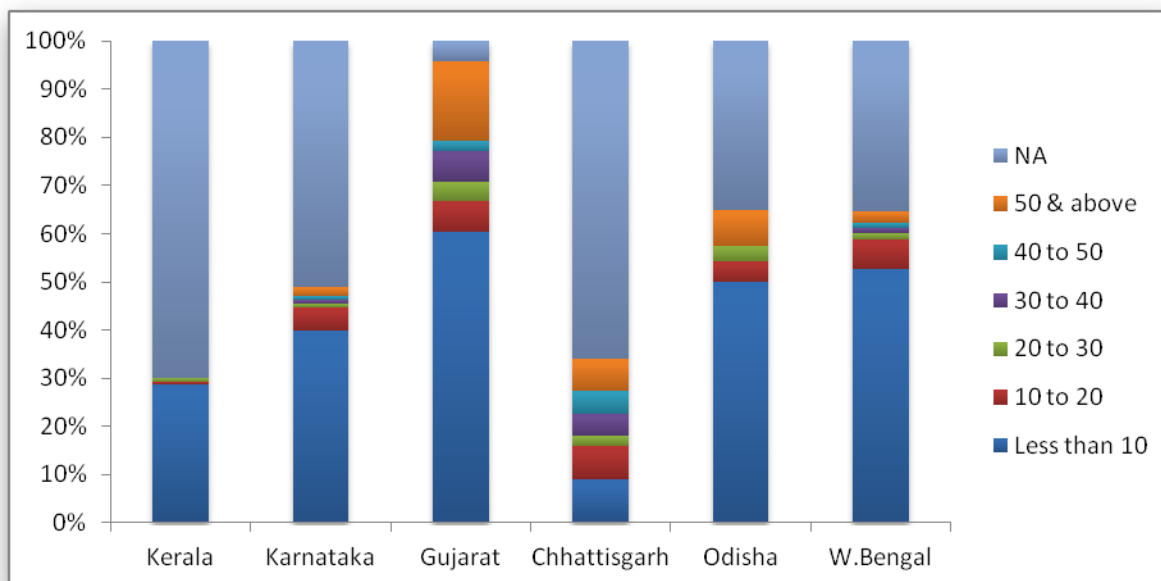


Figure 19: Percentage of Innovative firms providing training

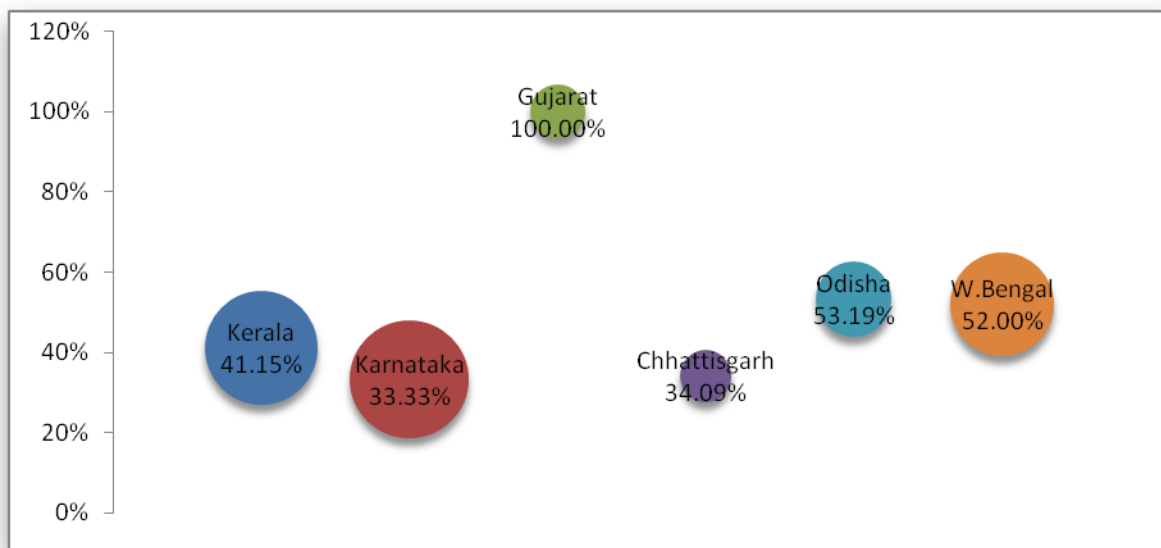
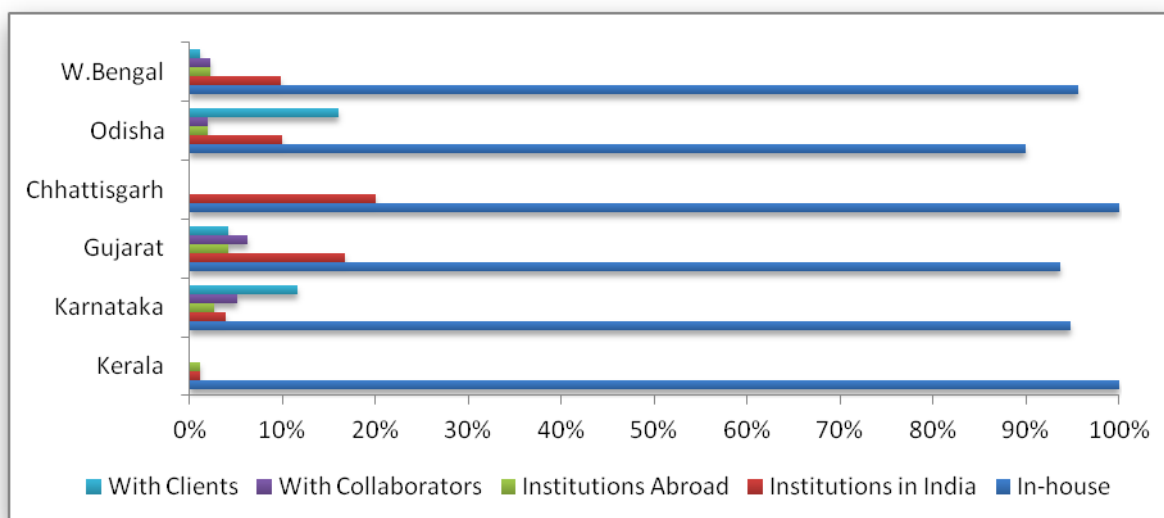
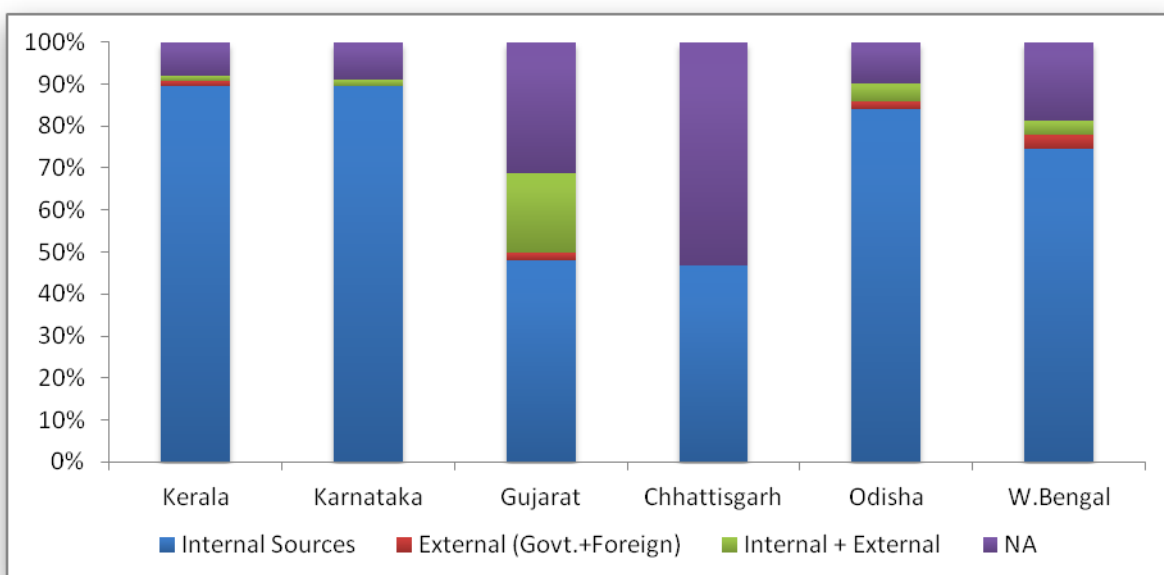


Figure 20: Human Resource Development by Innovative firms**Figure 21: Source of fund for human resource development (training)**

Observation

Human resource development does not seem to be an important activity among innovative firms in most of the states. Innovative firms in Gujarat claim training programmes for its manpower. For finance and training of human resources for skill development innovative firms mainly use internal sources.

7 Factors influencing Innovation

What are the factors that are perceived as critical for promotion of innovation? Responses of the firms show (table 5) that (innovative and non-innovative firms alike), cost and access to new knowledge of

innovation are considered as most important factor that is required to be strengthened. It is interesting to note that firms in Gujarat and Chhattisgarh lay similar importance on all the factors. Same is true for Kerala and Karnataka and also for West Bengal and Odisha.

Table 5: Factors important for influencing innovation (%)

Factors		Kerala	Karnataka	Gujarat	Chhattisgarh	Odisha	W. Bengal
Cost Factors	All firms	30.78	31.53	44.64	48.19	32.63	39.73
	Innovative firms	32.22	32.32	48.96	47.73	34.93	37.14
Knowledge Factors	All firms	29.50	34.24	44.59	47.38	44.75	42.74
	Innovative firms	30.62	34.63	47.22	47.73	46.99	43.81
Infrastructure Factors	All firms	7.88	9.28	45.51	42.15	22.20	20.41
	Innovative firms	8.01	10.71	44.79	40.91	30.32	22.14
Market Factors	All firms	18.08	19.83	42.74	48.64	30.03	30.25
	Innovative firms	21.17	21.25	41.49	47.92	36.79	30.76
Others	All firms	169.86	17.07	38.87	49.32	37.05	31.58
	Innovative firms	191.39	19.48	42.19	50.00	40.69	35.29

Reflections from interviews

Common hindrances in innovation activities encountered by the firms,

- Shortage of Power supply.
- Labour trouble and labour shortage.
- Unavailability of raw materials.
- Lack of proper infrastructure.

8 Understanding Innovation

The survey shows that Karnataka (62.60%) has highest percentage of innovative firms closely followed by Kerala (57.26%) and West Bengal (47.95%). Odisha (28.48%), Chhattisgarh (13.29%) and Gujarat (12.87%) are far behind. The nature of innovation differs from one state to the other in terms of sectoral pattern, types and nature of innovations. These factors together create the overall innovativeness of the state. Let's call the percentage of innovative firms in a state, as mentioned above, as the innovation intensity of a state. They differ substantially from each other.

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 demands 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 create 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 survey indicates broad understanding of the reach of NIS, RIS and SIS as presented in table 6. Accessing institutional sources of finance is a rare action by the innovative

firms. Even in case of Karnataka where sectors like IT and other hi-tech industries are located and have shown higher level of innovative activities, institutional sources of finance does not appear to be a popular mode of funding innovation. Accessing institutional facilities for technological and non-technological support to innovation is quite limited in general except in Gujarat where innovative firms do access external sources for knowledge.

For RIS at the state level a comparative status of the six states are shown in table 7. States were ranked separately under each column and assigned the rank value 6 for the lowest and 1 for the highest scores. Rank values were added (unweighted) laterally to derive overall rank values. Interesting relations to be noted are: Kerala low in RIS, high in HDI high in innovation intensity. Opposite is Gujarat – high in HDI and RIS but low in innovation intensity. In case of other states low RIS and HDI do explain low innovation intensity. In case of West Bengal – a state having the history of high industrialization, but fatigued at present, shows moderately high innovation intensity despite very low RIS and HDI (see figure 22).

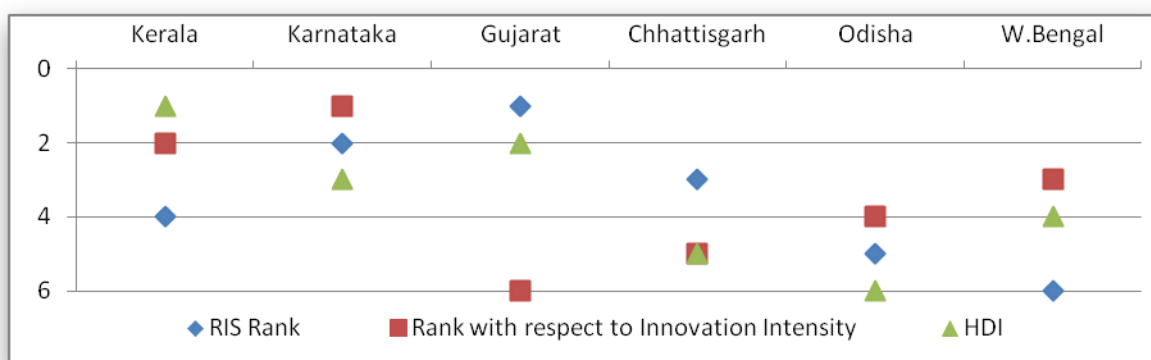
Table 6: Access of NIS by the innovative firms (%)

NIS components	Kerala	Karnataka	Gujarat	Chhattisgarh	Odisha	W. Bengal
Source of knowledge (Educational institution)	4.78	4.33	89.58	29.55	18.09	22.86
Source of knowledge (R&D institution)	16.27	18.61	87.50	29.55	32.98	28.00
Institutional finance	0.00	0.43	2.27	0.00	0.00	14.29
Training in institutions	1.16	3.90	16.67	20.00	10.00	9.89
Novelty of innovation	78% new to firm	58% new to firm	81% new to firm	55% new to market	94% new to firm	77% new to firm

Table 7: Indicative factors of Regional System of Innovation (RIS)

States	NSDP Per capita (Rs) at Constant Prices 2009-10	Industry Share in NSDP	Highways Per 100 Sq Km	Health Centers/100 Village	Educational institute/milli on pop.	Power Generation/ million pop.	RIS Rank	Innovation intensity Rank	HDI Rank
Kerala	46511	9.58%	12.69	412.10	189	325.6	4	2	1
Karnataka	37464	17.56%	12.99	36.25	323	671.0	2	1	3
Gujarat	49030	27.87%	11.73	46.71	191	1286.0	1	6	2
Chhattisgarh	25835	31.74%	3.99	27.75	221	2486.2	3	5	5
Odisha	24098	17.28%	5.65	15.97	255	942.6	5	4	6
W. Bengal	30504	10.28%	6.27	28.47	116	540.7	6	3	4

Figure 22: Rank correspondence of different indicators



How influential is the Sectoral Innovation System (SIS)? We have calculated two indicators. The sectoral variation of innovation intensity indicates that there are some sectors more innovative than other. We define the sectoral intensity of innovation ($SII = IF_s / TF_s$) as the ratio between innovative firms in a sector (IF_s) and total number of firms in that sector (TF_s). So if electrical equipment sector has 50 firms (TF_s) and there are 20 innovative firms in that sector (IF_s), the innovation intensity of the sector will be 40%. Based on this we derive following two indicators for SIS.

a) SII and industrial activities of a state: Given overall sectoral intensity of innovation (% of innovative firms in the total firms in a sector taking 6 states together), we can 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 innovativeness of different sectors. In other words if we see that a particular sector has very high over all innovation intensity but a state (say Kerala) has very small share of firms in that sector we can say that industrial activities of the state is not aligned with the SII. This is done by

calculating the rank correlation between the industrial activities at sectoral level (number of firms in different sectors) and sectoral innovation intensity as shown in table 8. Except West Bengal and Gujarat (marginally positive) other states show negative correlations. This implies that these states' economic activities are mostly different from the sectors that are generally more innovative. These are mostly traditional natural resource based industrial activities in Chhattisgarh, Odisha, Kerala and Karnataka. Gujarat returns highest positive correlation (0.07).

b) Status of sectoral innovation in a state:

The other measure for sectoral innovation intensity in a state (SII_{state}) is the ratio between total innovative firms in a sector in a state ($IF_s, state$) and total innovative firms in the state (TIF_{state}) (in other words the sectoral distribution of innovative firms in a state ($SII_{state}=IF_s(state)/TIF_{state}$)). We examine how skewed is the distribution of innovative firms in a state (refer table 8). The skew value for all sectors together is 2.68; higher (lower) the skew value from the overall value less (more) would be the innovativeness of the state. Chhattisgarh with a value 4.03 is far above the overall skew value 2.49. Chhattisgarh is followed by Odisha. West Bengal and Gujarat have least skewed distribution of the innovative firms

over the sectors followed by Kerala and Karnataka. Rank correlations and skew values when examined together bring out another interesting dimension. Chhattisgarh has highly skewed but negative correlation implying that firms reporting innovative activities are away from the sectors with high innovation intensity. The same is true for Odisha and to a great extent for Kerala and Karnataka. West Bengal and Gujarat have balance between innovative sectors and innovative firms.

The broad understanding that comes out of the survey, therefore, is as follows:

- It appears that the National Innovation System (NIS), presently in place, is not popularly accessed by the production system (firms). A general awareness programme on the services rendered by the large number of institutions required to be taken up.
- West Bengal, Odisha and Chhattisgarh require special attention for rejuvenating industrial activities through strengthening RIS. One way could be to create a sector led push to the innovative intensity of these states.
- It appears that states having better RIS also could take the advantage of SIS, as it is evident from the cases of Karnataka and Gujarat.

Table 8: Indicators for Sectoral Innovation System

States	Indicator 'a'- Rank correlation coefficient	Indicator 'b' (Skew value)
Kerala	-0.074	2.46
Karnataka	-0.069	2.83
Gujarat	0.068	1.88
Chhattisgarh	-0.054	4.03
Odisha	-0.077	3.57
W. Bengal	0.02	1.72
All sectors	1.00	2.68

9 India Aggregated

In this issue we introduce the aggregated picture of the innovation in Indian industries. Aggregated picture required data processed for all the States and Union Territories. The details, therefore, would be presented as per the progress of the data processing. Manipur and Arunachal Pradesh could not be covered by the survey because political unrest made the access to the former difficult, and there was no ASI data available for the latter. Here we present some of the preliminary information on the aggregated innovation scenario of India.

Figure 23 shows the distribution of population and sample over the sectors (NIC codes). The category 'others' include NIC codes (8, 11, 12, 15, 18, 19, 26, 30, 31, 32, 33, 35, 36, 38, 52, 58, 74, 82, 95, 96) having 2% or less share in total sample. For

both population and sample NIC code 10 (manufacture of food products) has the highest share. Besides NIC codes 10, 13 (manufacture of textiles), 20 (manufacture of coke and refined petroleum products), 22 (manufacture of rubber and plastic products), 23 (manufacture of other non-metallic mineral products), 24 (manufacture of basic metals), and 25 (manufacture of fabricated metal products) have 5% or more share in the total sample and population. Figure 24 shows the distribution of sample and innovative firms (share) over the states. Karnataka has the highest share (above 7%) of the innovative firms followed by Maharashtra, Andhra Pradesh and Kerala (above 6% shares). States like Assam, Bihar, Uttar Pradesh, Chhattisgarh, Gujarat, Haryana, Punjab, and Himachal Pradesh have lower share of innovative firm compared to their respective shares in the sample.

Figure 23: Distribution of Population and Sample With respect to NIC

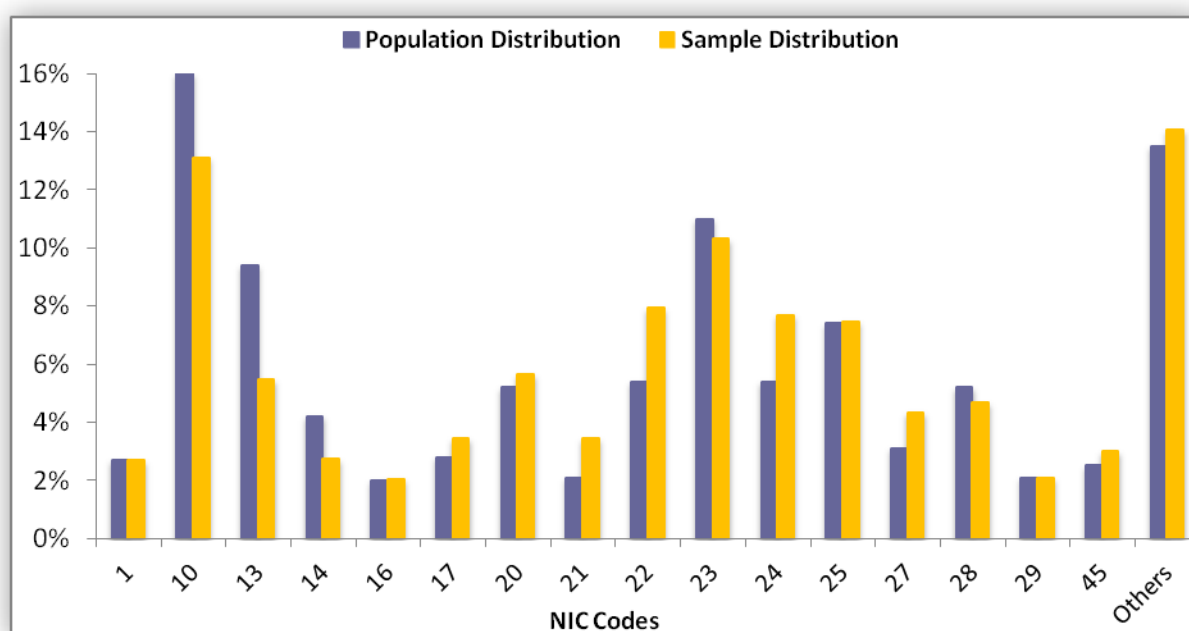


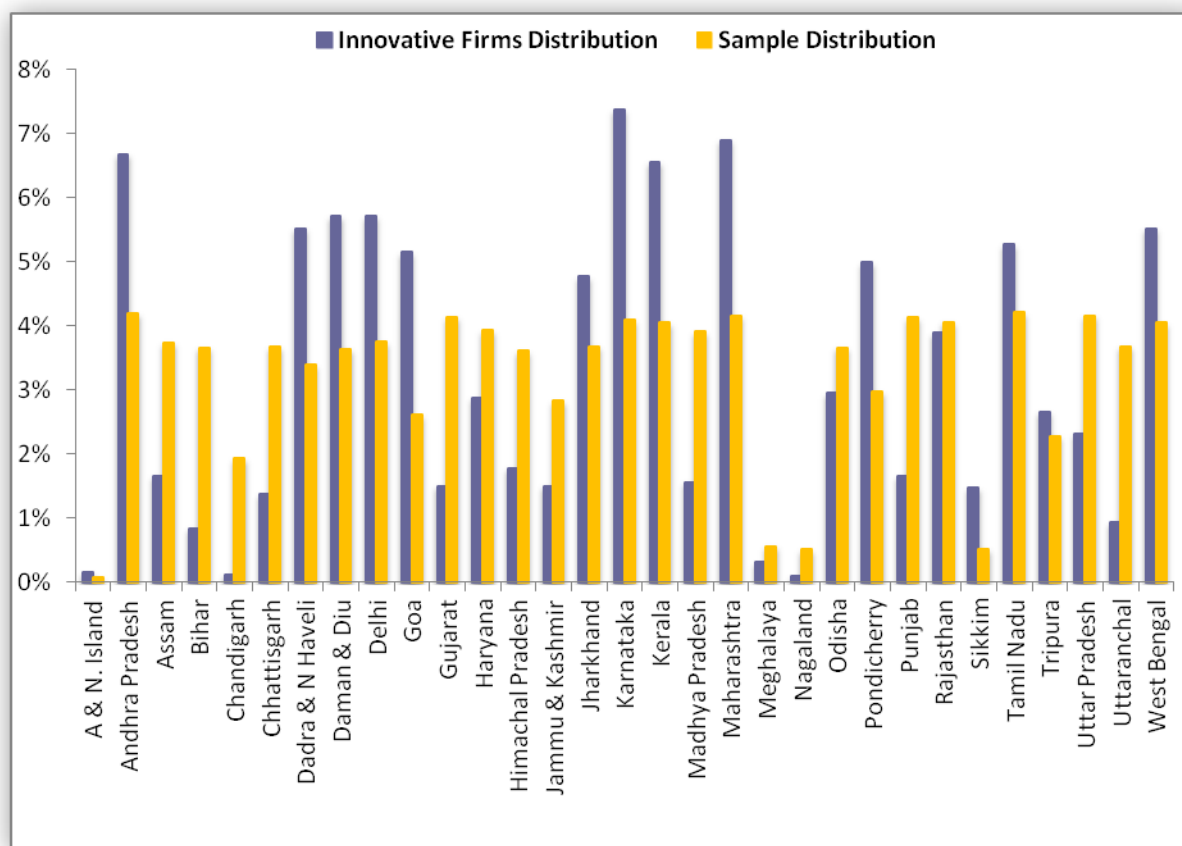
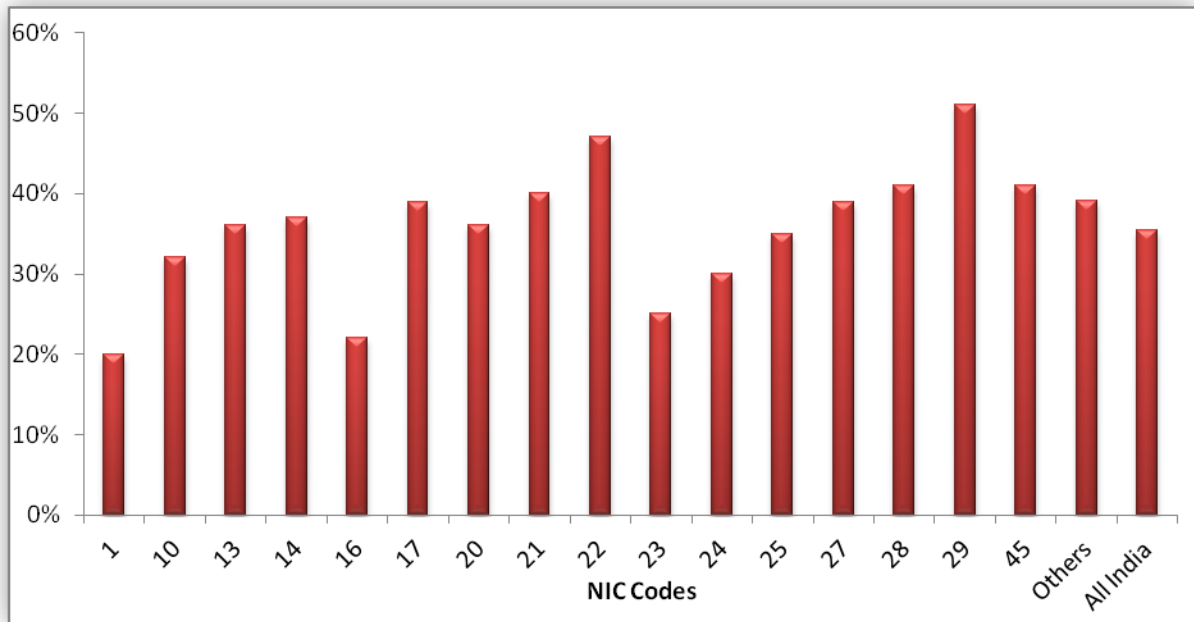
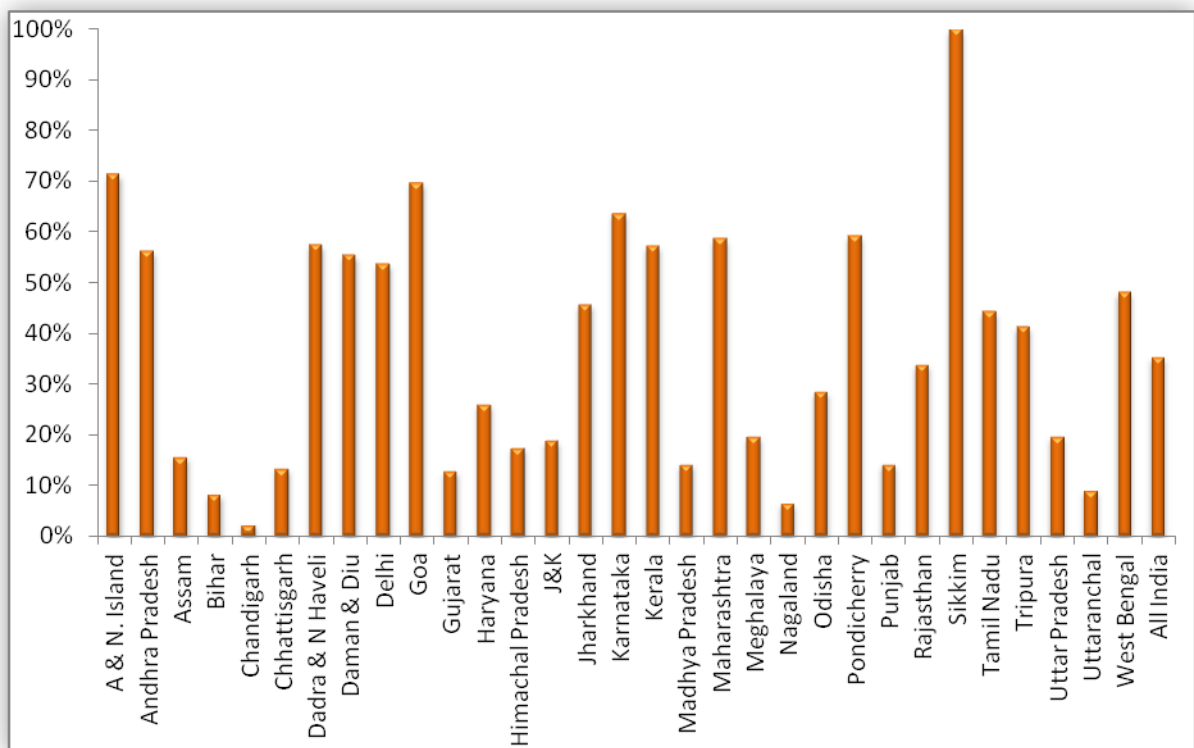
Figure 24: State-wise Population and Sample Distribution

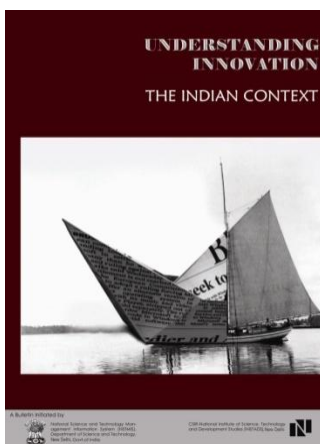
Figure 25 shows innovation intensity of the sectors (NIC codes). NIC code 29 (manufacture of motor vehicles etc.) shows innovation intensity more than 50%. There are four sectors (21, 22, 28, 45) having innovation intensity between 40% and 50%. NIC code 21 refers to pharmaceutical, medicinal chemical and botanical products, whereas 28 refer to machinery and equipment industry, and 45 to repair of motor vehicles and motor cycles. Total eight sectors (NIC codes 10, 13, 14, 17, 20, 24, 25, 27) have innovation intensity in the range of 30%-39%. NIC code 14 refers to wearing apparel, 17 for paper and paper products, and 27 for electrical equipment industry.

Sectors 1, 16 and 23 have innovation intensity in the range of 20% to 29%.

Figure 26 shows innovation intensity for the states. There are 11 states having innovation intensity above 50% level, and 11 states below 20%. States like Bihar, Chandigarh, Nagaland and Uttaranchal have innovation intensity lower than 10%. If we leave out small sample states like Andaman-Nicobar, and Sikkim the states with high innovation intensity are Andhra Pradesh, Karnataka, Maharashtra and Kerala, followed by in the next level states like Delhi, Jharkhand, Tamil Nadu, Tripura and West Bengal.

Figure 25: Innovation Intensity of Sectors (NIC codes)**Figure 26: Innovation Intensity State-wise**

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



Bulletins are downloadable from

http://www.nistads.res.in/images/recentupd/BULLETIN_Nov2011.pdf

<http://www.nistads.res.in/images/recentupd/NISTADSFebruaryBulletin2012.pdf>

http://nationalinnovationsurvey.in/download/BULLETIN_Nov_2011.pdf

<http://www.nationalinnovationsurvey.in/download/NISTADS-February-Bulletin-2012.pdf>

The survey has covered 31 states and UTs. Arunachal Pradesh and Manipur were not covered. The second and third issues have covered total 11 states. The fourth issue will cover 10 more.

CONTACT

Mr. Pradosh Nath, Chief Scientist
CSIR - National Institute of Science Technology
And Development Studies (NISTADS),
Dr. K S Krishnan Marg,
Pusa Campus, New Delhi – 110012
Ph. No. 011 – 25843093
E – mail: nis@nistads.res.in

Dr. Parveen Arora, Director
National Science and Technology
Management Information System
(NSTMIS),
Department of Science and Technology,
Technology Bhavan, New Delhi – 110016
E – mail: parora@nic.in

The Bulletin is available at –

<http://www.nistads.res.in>, <http://www.nstmis-dst.org>, &
<http://www.nationalinnovationsurvey.in>

Recent research output from CSIR-NISTADS***Impact of FDI in R&D on Indian R&D and Production System – N. Mrinalini, et al. (supported by TAIFAC-DST Govt. of India)***

The Report identifies and prepares a list of the firms bringing in FDI in India, and look at their R&D expenditure and activities. Total 706 MNCs were identified with detailed of the investment for R&D during 2003-2009. The Software and IT sector has a share of 50.30% of the total FDI in R&D, followed by the Auto industry 9.88% and Pharma-Biotechnology sector 9.24%. Software and IT sector has a share of 74.17% of the total employment created. Among other sectors, Auto industry has a share of 5.29% and Pharma-Biotechnology has a share of 3.31%.

A comparative study on S&T, Innovation and Development Strategies of China, South Korea vis-a-vis India – G. D. Sandhya et al. (supported by Office of the Principal Scientific Advisor, Govt. Of India)

The study examines the performance of National S&T through select indicators in India, China & South Korea. A comparative analysis of post reform S&T, Innovation and Development policies of China & South Korea is done to highlight the structural and organizational changes in the arrangement for Innovation and organisation of S&T. The study undertakes performance evaluation of select sector/technology of China and Korea and draws lessons for India.

Development policy and S&T: Research policy for Indian agriculture – Rajeswari S. Raina (supported by NCAP-ICAR)

The study addresses the question - does India need a policy framework for agricultural S&T? The relationship between development policy and S&T was analysed using two cases (i) integrated pest management and (ii) pulse production. A policy change framework, with three analytical categories where S&T was evident in the initial problem statement, assessment of policy alternatives and choice of policy instruments, was used. There is evidence that agricultural S&T does need a well articulated policy framework, with capacities for iterative policy learning.

India, Science and Technology: 2010 -2011

(http://www.nistads.res.in/indiasnt2010-1/index_India_S&T_2010-11.php)

India S&T Report 2010-11 is organised under following five themes: (i) S&T and Human Resources, (ii) S&T and Innovation Support System, (iii) S&T and Industry, (iv) S&T Outputs and Patents, and (v) S&T and Rural Development Strategies. Innovation occupies the central stage in each of these themes.

India, Science and Technology: 2008 (<http://www.nistads.res.in/indiasnt2008/>)

The report is the first of its kind from this country. It is targeted at a wide readership ranging from policy makers and advisors to academic readers as well as the common person.

Printed at

CSIR – National Institute of Science Communication and Information Resources (NISCAIR),
Dr. K S Krishnan Marg, Pusa Campus, New Delhi – 110012