

UNDERSTANDING INNOVATION

THE INDIAN CONTEXT



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Key Observations

Total 3378 firms, chosen through sampling, have been studied in Andhra Pradesh, Delhi, Goa, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Uttar Pradesh and Uttarakhand.

State-wise proportions of innovative firms are – Andhra Pradesh (56.35%), Delhi (53.85%), Goa (69.79%), Jammu & Kashmir (18.82%), Madhya Pradesh (14.2%), Maharashtra (58.67%), Punjab (14.25%), Rajasthan (33.88%), Uttar Pradesh (19.73%) and Uttarakhand (9.04%). These ratios have been used as innovation intensity of the respective states. The sectoral distributions of industrial units are highly skewed in Madhya Pradesh, Rajasthan and Andhra Pradesh followed by Punjab, Delhi, Jammu & Kashmir and Rajasthan and least in Goa, Uttarakhand and Uttar Pradesh. There is also a wide variation in sectoral intensity of innovation.

Most of the sample firms as well as innovative firms belong to the size category below 100 workforces. Firms are mostly under private ownership, partnership or proprietary firms and also share most of the innovative firms. In Uttarakhand and Jammu & Kashmir larger numbers of firm (sample and innovative) were established after 2000. Delhi and Punjab has largest share of firms established before 1990 sharing higher percentage of innovative firms. Most of the innovations are 'new to firm' to remain competitive in the market.

Gains from the innovations mainly include increased product and process outcomes. Most of the innovative firms see themselves either at par or ahead of the other firms in their respective industries. 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. Human resources development does not seem to be a priority concern for the innovative firms except for Delhi and Maharashtra.

Examining the survey findings in the light of the National Innovation System (NIS), Regional Innovation System (RIS) and Sectoral Innovation system (SIS) for the ten states it is observed that:

- As in the cases of states in earlier Bulletins, NIS is not very popularly accessed by the enterprises. In the cases of present ten states situation appears to be better. In Delhi, Goa, Madhya Pradesh and Uttar Pradesh there are higher incidence of accessing NIS for sourcing knowledge. Andhra Pradesh and Maharashtra have higher incidence of accessing financial support systems.
- Goa and Uttarakhand are at the top in RIS ranking with opposite result on Innovation Intensity. While Goa is at the top in innovation intensity, Uttarakhand is at the bottom. It appears that a sectoral push would be required for raising the innovation intensity in the state. Both Madhya Pradesh and Jammu & Kashmir are poor in terms of RIS and innovation intensity. Even a sector led push would require a better RIS in these states. Maharashtra belongs to the top order in innovation intensity overcoming the inadequate RIS.

1 Introduction

This is the fourth issue of the Bulletin in the series. This issue presents broad observations on ten states, namely, Andhra Pradesh, Delhi, Goa, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Uttar Pradesh and Uttarakhand. 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 ten states.

The structure of the Bulletin is as follows. The second section is on the sample and innovative firms of the ten 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 10 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 last section presents the understanding of innovation that can be built around the results drawn from the survey for the ten 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 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 (organisational, 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 (10 states together) sample firms in a sector.

2 Sample and Innovative Firms

Total 3378 firms were surveyed in the selected ten states. State-wise distribution of sample is – Andhra Pradesh (A.P.) 378, Delhi 338, Goa 235, Jammu & Kashmir (J&K) 255, Madhya Pradesh (M.P.) 352, Maharashtra 375, Punjab 372, Rajasthan 366, Uttar Pradesh (U.P.) 375 and Uttarakhand 332. The ten states have

quite diverse industrial activities as shown by the skewness (presented in Figure 1). As per NIC code the industrial activities in the 10 states are spread over 31 two digit industrial segments or sectors. Refer to Figure 2 (In the figure only those sectors which have at least 5% share in any state are shown).

Figure 1: Skewed industrial activities over the sectors

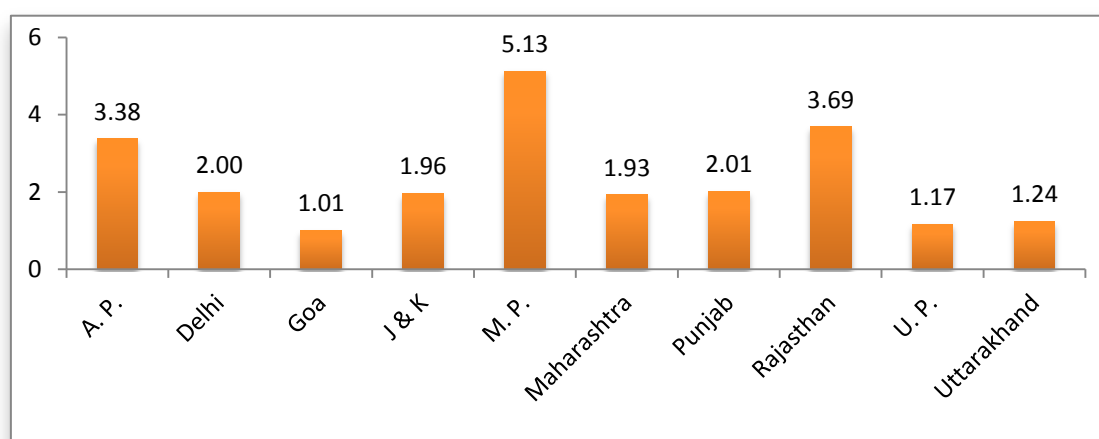
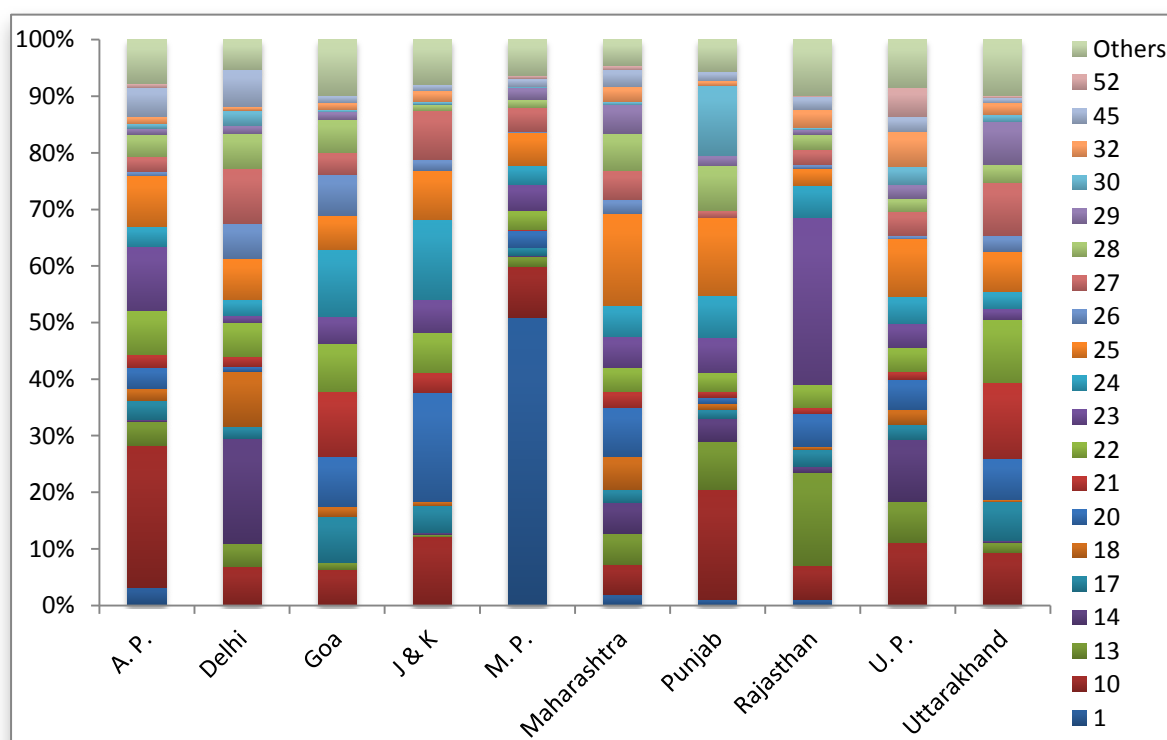


Figure 2: Share of Industrial Segments in total sample

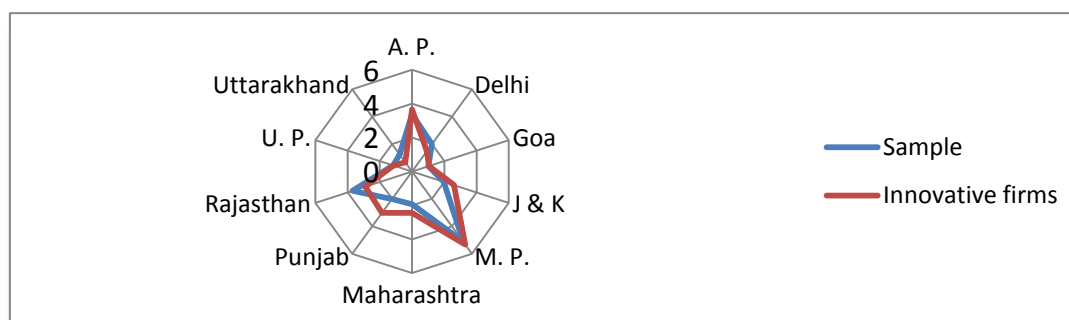


Industrial scenario (in terms of number of enterprises in different sectors) in M.P. (skew 5.13) is highly skewed followed by Rajasthan (skew 3.69), A.P. (skew 3.38) and Punjab (skew 2.01). Crop and animal production (NIC 1) and manufacturing of food products (NIC 10) constitute 60% of industrial activities (percentage share of number of enterprises) of M.P. In case of Rajasthan manufacture of non metallic mineral products (NIC 23) and textile (NIC 13) alone constitute about 45% of industrial activities. In A.P. manufacturing of food products (NIC 10) together with manufacturing of non metallic mineral products and fabricated metal products (NIC 25) constitute about 45% of the economic activities. Industrial activities of Punjab too are dominated by manufacturing of food products (19.35%), fabricated metal products (13.71%) and other transport material (NIC 30) 12.37%. Manufacturing activities in Delhi (skew 1.99) are dominated by wearing apparels (NIC 14) 18.64%, electrical equipment (NIC 27) and printing and reproduction of recorded media (NIC 18) each sharing 9.76% of industrial activities. Manufacturing of chemicals and chemical products (NIC 20), manufacturing of basic metals (NIC 24) and food products together constitute about 45% of industrial activities in J&K (skew 1.95). Maharashtra with a skew value 1.93 shows more even distribution of industrial

activities over the sectors with 16.27% share of fabricated metal products and about 5% share each in ten different sectors. In Uttarakhand manufacturing of pharmaceuticals (NIC 21) is quite dominating (13.55%) followed by manufacture of rubber and plastics products (NIC 22- 11.14%). The industrialization in Uttarakhand, U.P. and Goa are less skewed with skew value 1.24, 1.17, 1.01 respectively. In U.P., manufacturing of food products, wearing apparels and fabricated metal products constitute 31% of its industrial activities. Similarly in Goa manufacturing of basic metals share about 11.9% of the enterprises followed by pharmaceuticals (11.5%), chemicals and chemical products (9%) and rubber and plastic products (8.5%).

The survey had 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 M.P. The skew value for innovation activities in Delhi, U.P., Uttarakhand and Rajasthan is lower than that for nature of industrialization (Figure 1) whereas in the rest of the states the skewness it is higher (Figure 3). Figure 4 - 13 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



In A.P. out of 31 industrial segments, only 28 sectors co-exist and has reported innovative firms in all except one; total 213 firms out of 378 (i.e. 57.35%) have reported innovation related activities. The largest industrial segment (NIC 10 constituted of food products manufacturing firms) has contributed highest percentage of innovative firms (about 25.82%), followed by manufacture of fabricated metal products (NIC 25 - 9.39%) and manufacture of rubber and

plastics products (NIC 22 - 8.92%). See figure 4.

The distribution of innovative firms in Delhi follows more or less the same pattern as the nature of industrialization in the state. Out of 338 firms, 182 reported to be innovative (53.85%). Manufacturing of wearing apparel (NIC 14) has the highest share of 15.38% followed by printing and reproduction of recorded media (NIC 18) with 12.09% and manufacture of electrical equipment (NIC 27) with 11.54%. See figure 5.

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

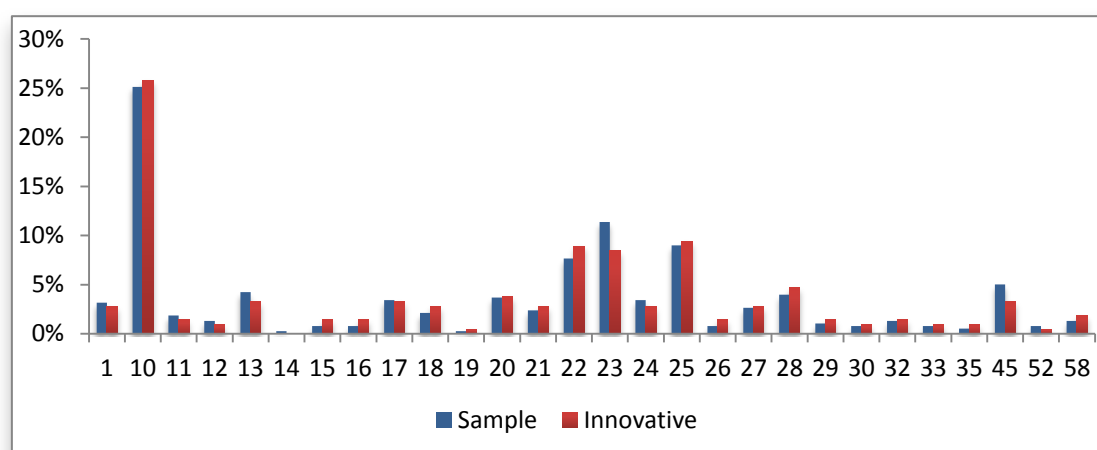
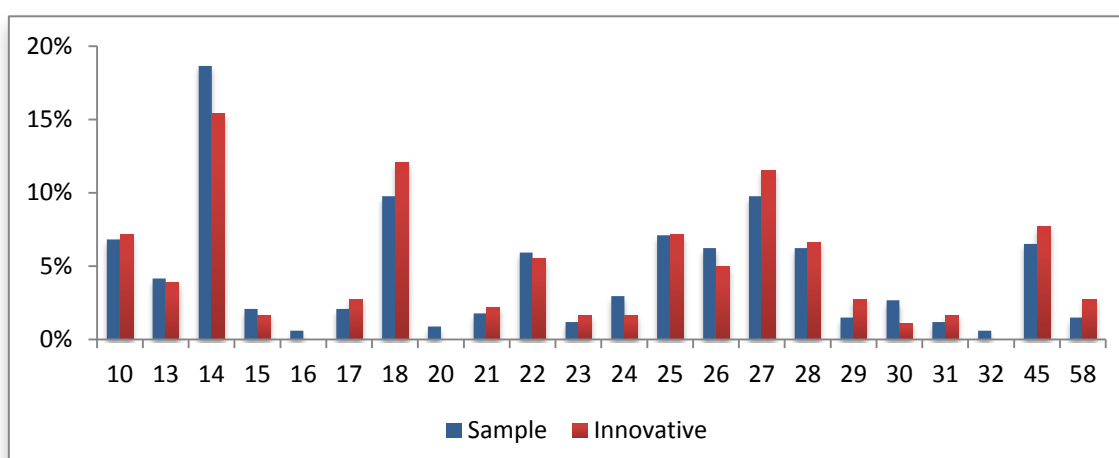


Figure 5: Distribution of sample and innovative firms in different industry segments (Delhi)



Goa has 164 innovative firms out of a sample of 235 firms, taking the percentage to 69.79%, which happens to be the best among the ten states. Innovative firms are mostly in the manufacture of pharmaceuticals (NIC 21) sharing 12.80% of the innovative firms followed by the basic metal industry (NIC 24) sharing 10.98% and chemical and chemical product industry (NIC 20) having a share of 10.37% (refer to figure 6). In J&K, 28 sectors are present and of them

15 sectors have reported innovation related activities. Total 48 out of 255 firms (i.e. 18.82%) are involved in innovation activities. Manufacturing of chemicals and chemical products (NIC 20) with a share of 25% followed by manufacturing of basic metals (NIC 24) with 12.5%, rubber and plastics products (NIC 22) and food products (NIC 10) each with 10.42% are the dominant sectors which have contributed maximum percentage of innovative firms (refer figure 7).

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

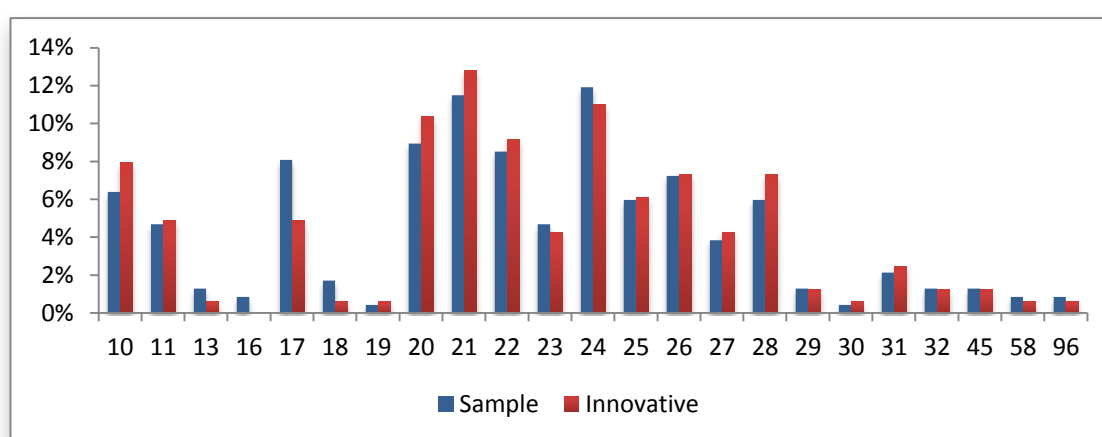


Figure 7: Distribution of sample and innovative firms in different industry segments (Jammu & Kashmir)

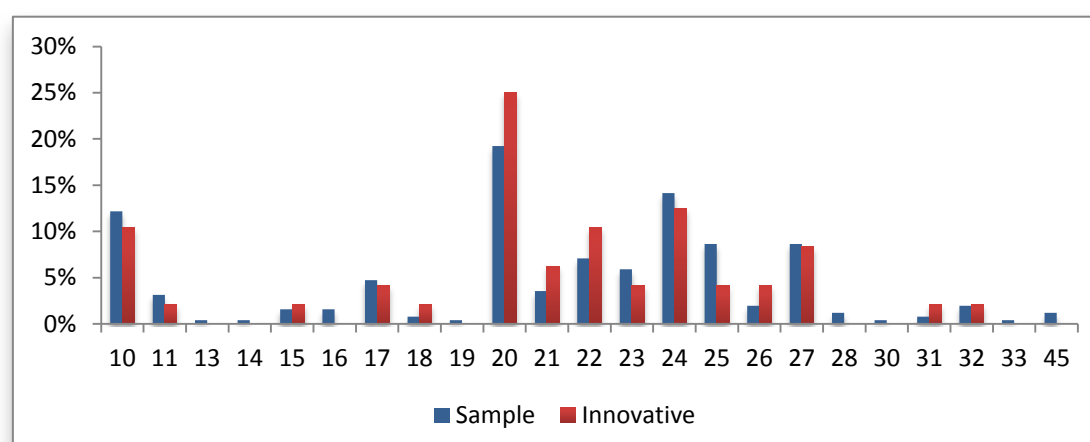
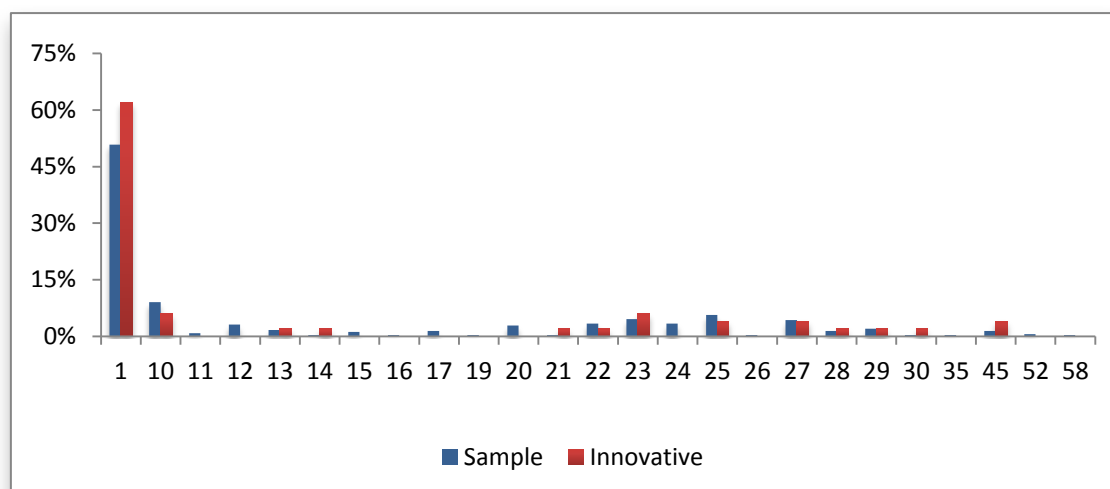


Figure 8: Distribution of sample and innovative firms in different industry segments (Madhya Pradesh)



Industrialization in M.P. is highly skewed. It is mainly dominated by Crop and animal production and to some extent food products. Crop and animal production (NIC 1) has as high as 62% innovative firms, followed by food products (NIC 10) at 6% (refer figure 8). Overall, M.P. has returned 50 innovative firms out of a sample of 352 firms or 14.2% across the sectors.

Innovation scenario is better spread out in Maharashtra. Metal fabrication (NIC 25) has a share of about 18.64% of the innovative firms. Innovative firms are also present in the machinery and equipment sector (NIC 28) and basic metals (NIC 24) sharing 9% and 7% respectively (refer figure 9). Overall the state has returned 220 firms out of 375 samples or 58.67% of innovative firms.

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

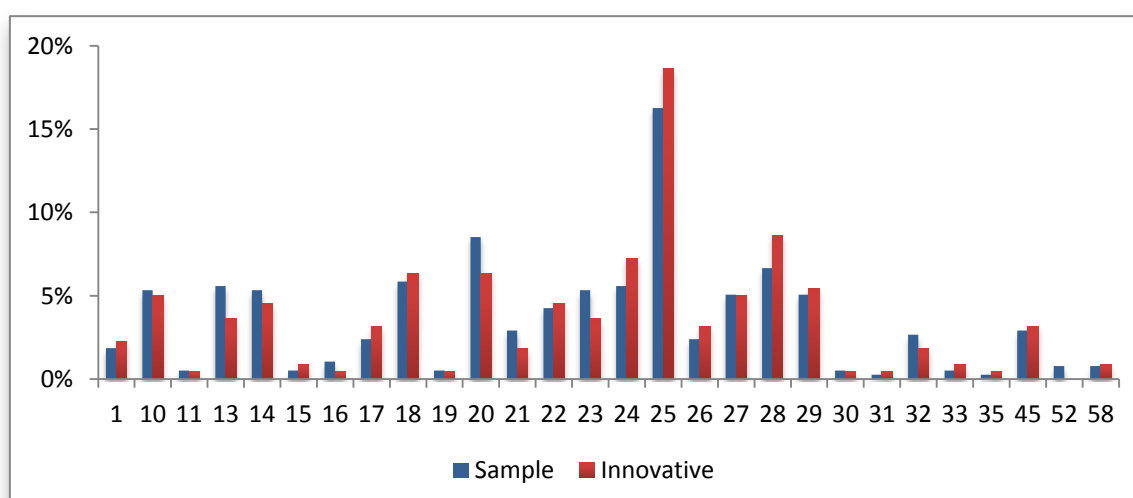
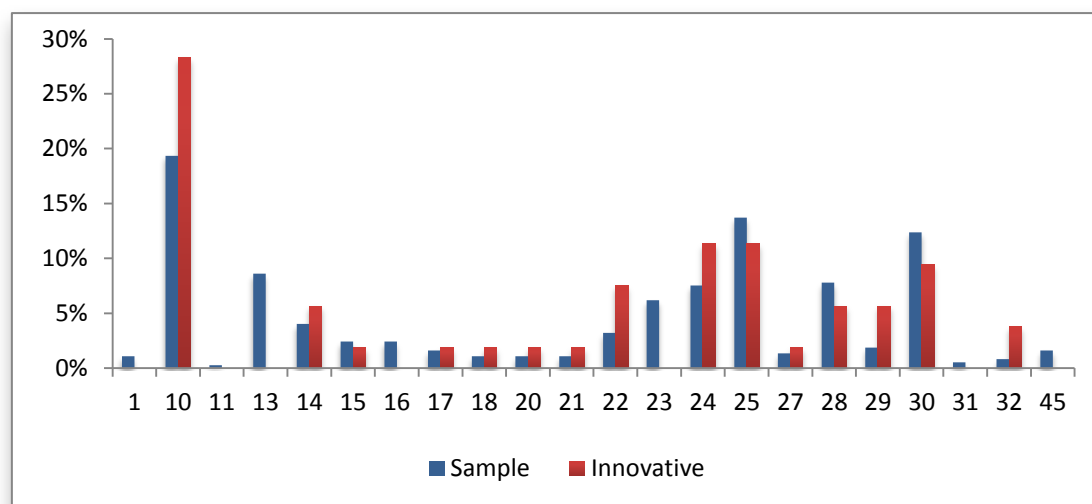


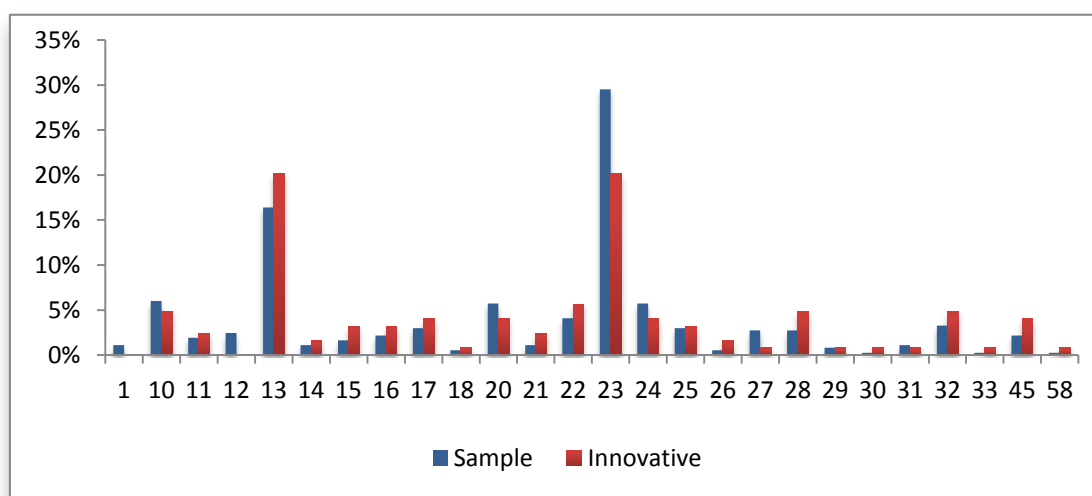
Figure 10: Distribution of sample and innovative firms in different industry segments (Punjab)



Punjab has presence in 22 sectors and 15 of them have reported of innovation activities; total 53 firms out of 372 (i.e. 14.25%) are innovative. The distribution of innovative firms is more skewed than that of the sample firms. Food products has 28.3% share followed by basic metals and fabricated metal products each with 11.3% share (refer figure 10).

In Rajasthan 124 firms out of 366 are involved in innovation activities. The innovative firms are spread around 24 sectors out of 26 industrial sectors present in the state. Manufacturing of textiles (NIC 13) and non-metallic minerals (NIC 23) have a share of about 20% each of the innovative firms (refer figure 11).

Figure 11: Distribution of sample and innovative firms in different industry segments (Rajasthan)



U.P. has 74 innovative firms out of a sample of 375 firms. Distribution of innovative firms in the state is less skewed. Food products industry (NIC 10) and fabricated metal products (NIC 25) constitute about 12.2% each of the innovative firms followed by wearing apparels (NIC 14) with 10.8% (refer figure 12).

The industrial activities in Uttarakhand are spread across 25 sectors, but have only 30 (9.04%) firms out of a sample of 332 firms as innovative (refer figure 13). Higher percentage of innovation (10% each) has been contributed by food products industry (NIC 10), manufacture of pharmaceuticals (NIC 21) and repair and installation of machinery and equipment (NIC 33).

Figure 12: Distribution of sample and innovative firms in different industry segments (Uttar Pradesh)

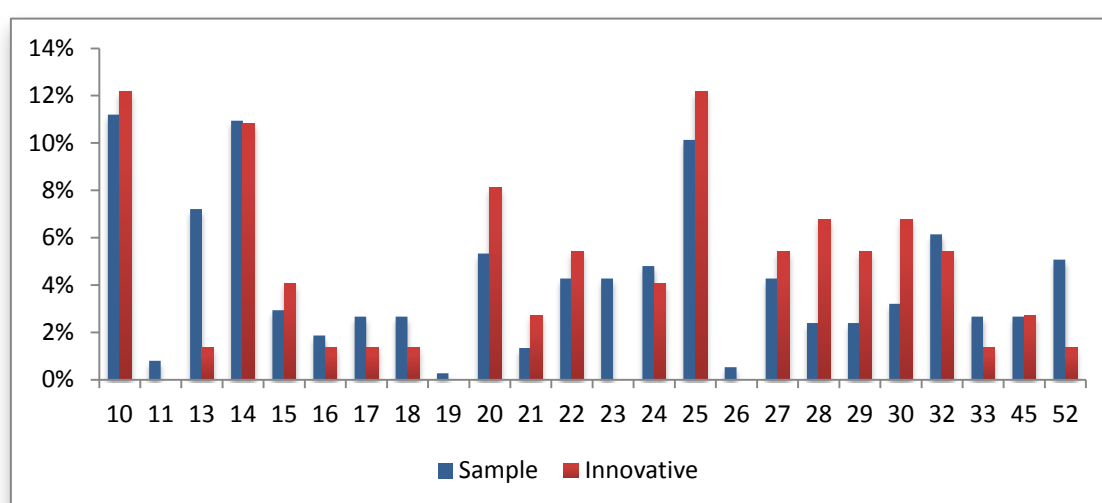
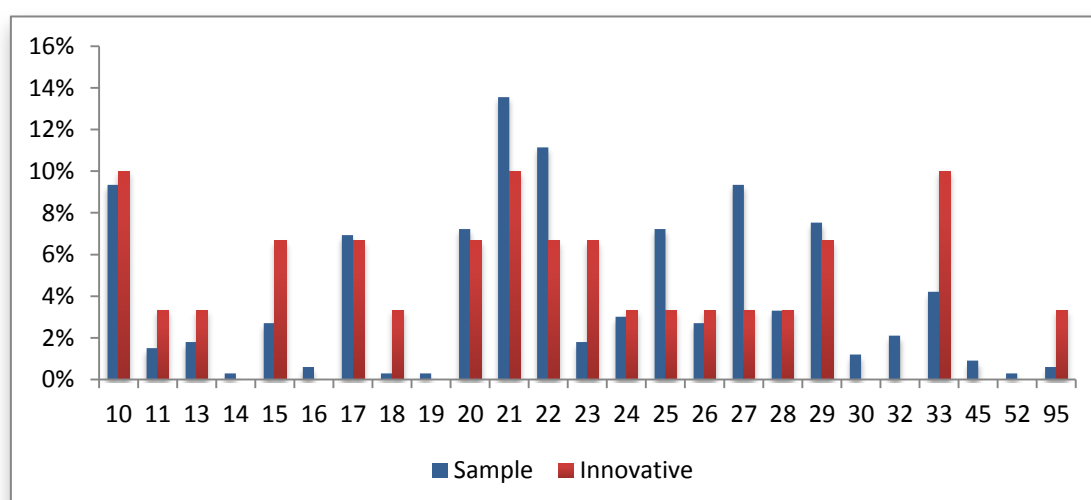


Figure 13: Distribution of sample and innovative firms in different industry segments (Uttarakhand)

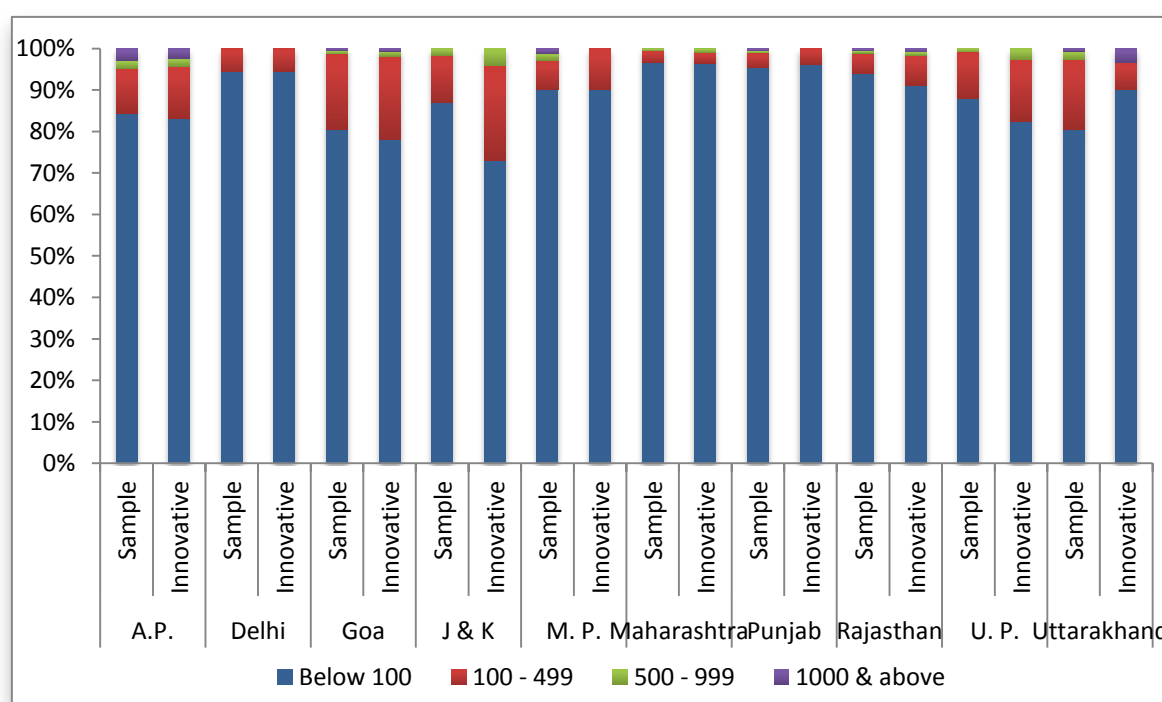


3 The Innovators

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 14, 80% to 90% (and above) of the sample firms in these ten states have less than 100 workforces. In case of Delhi, M.P., Maharashtra, Punjab and Rajasthan the percentage is above 90% and a similar proportion of the innovative firms in these five states belong to this firm size (below 100 workforce). For the other five states (A.P., Goa, J&K, U.P. and Uttarakhand) the scenario does not change much, about 80% to 90% of the firms are from less than 100 workforce and 10-20% of the firms are in the size category of 100-499

workforce. On the other hand A.P. has about 3% firms (which is highest among all the states) in the higher level of firm size (1000 & above). Ownership patterns of the sample and innovative firms are shown in the Figure 15. Private enterprises are predominant ownership types in all states. Goa and M.P. each have about 55% - 60% firms privately owned and they share about 50% to 60% of the innovative firms. Punjab has 37% share of partnership firms among which 47% are innovative. On the other hand Maharashtra and Rajasthan each has a share of more than 30% proprietary firms and about 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 16.

Figure 14: Distribution of Sample and Innovative firms according to the Size (workforce)



Delhi and Punjab has largest share (46% and 55% respectively) of firms established before 1990 – and about same percentage of these firms are innovative. Goa and Rajasthan have 45% firms each born

between 1990 and 2000. Uttarakhand has 74% firms born after 2000 – and 67% claim innovative activities in the enterprises. J&K also has 42% firms born after 2000 of which 58.3% are innovative.

Figure 15: Distribution of Sample and Innovative firms according to the Ownership Type

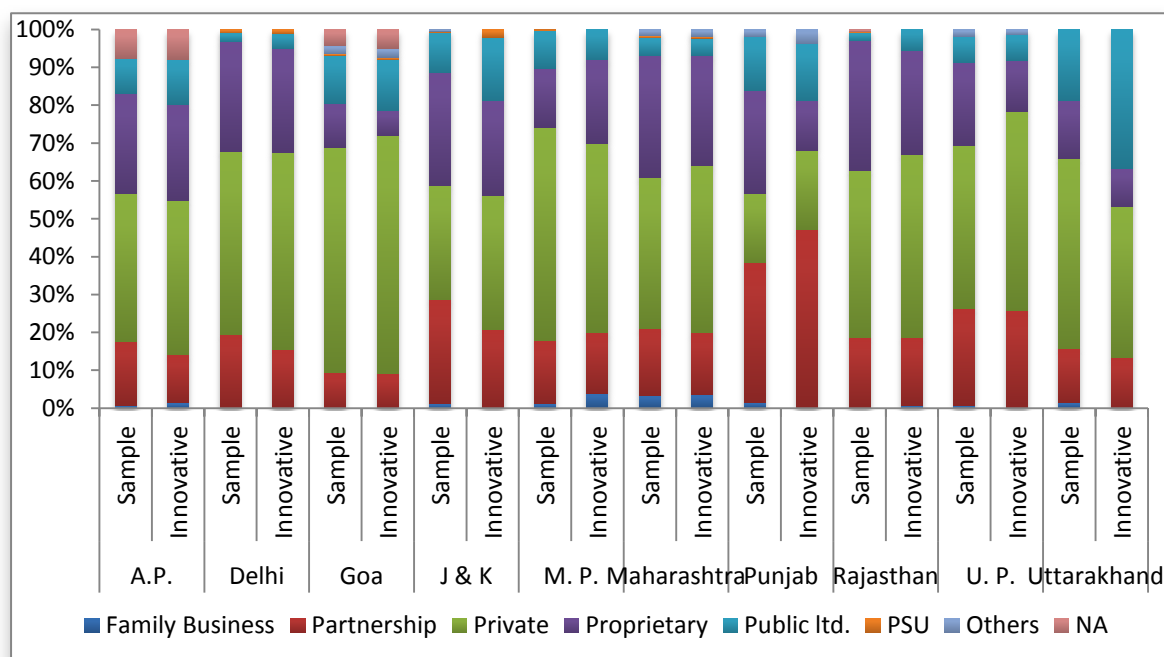
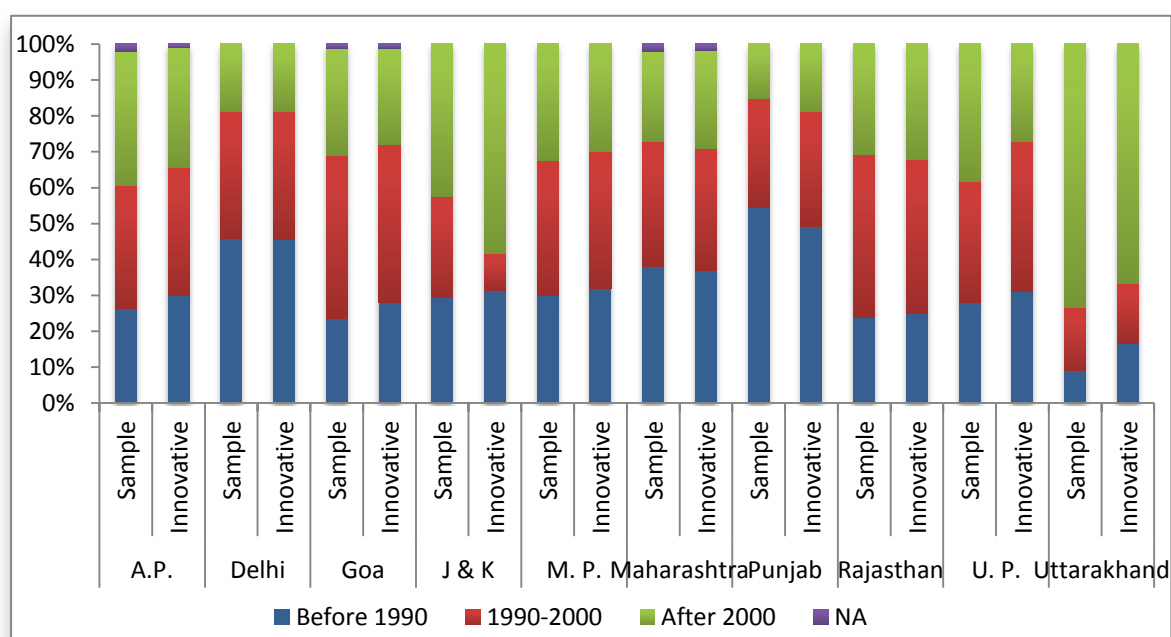


Figure 16: Distribution of Sample and Innovative firms according to the year of establishment



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 17 shows the types of innovations carried out by the innovative firms in the sample firms. Figures 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 innovation through introduction of new machines is the most common type of innovation. Maharashtra reporting highest number of innovations has most innovations in product quality and standard related activities. It is to be noted that quality and standardization activities have become visible agenda in the innovation activities. Introduction of new product and new process technology also seems to be quite common among the states. To recapitulate, percentages of innovative firms in the ten states are – A.P. (56.35%), Delhi (53.85%), Goa (69.79%), J&K (18.82%), M.P. (14.2%), Maharashtra (58.67%), Punjab (14.25%), Rajasthan (33.88%), U.P. (19.73%) and Uttarakhand (9.04%).

Figure17: Types of Innovations

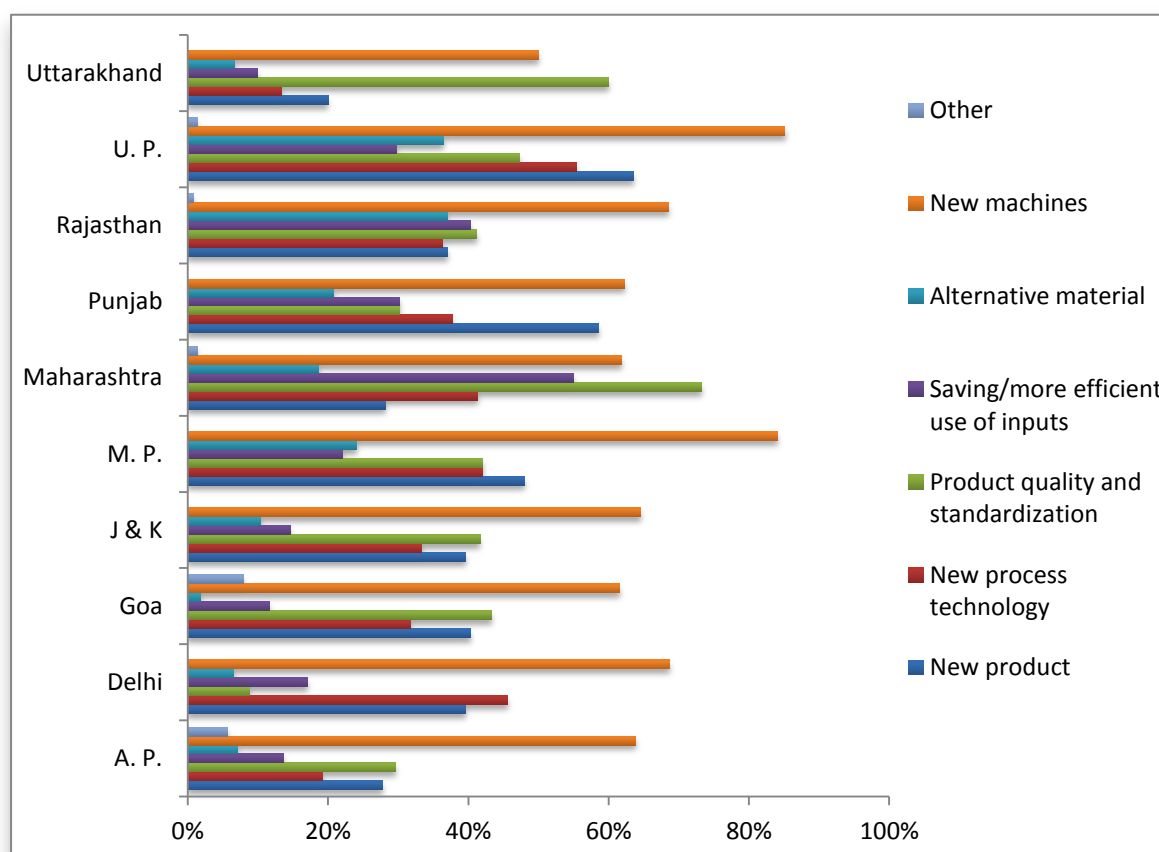


Table 1 shows the engagement or involvement of the innovative firms in various types of innovative activities. It is observed that involvement of firms in the innovation activities in the ten states is quite diverse except the fact that all the states are mainly active in acquisition of machine, equipment and software. It is interesting to note that innovative firms in U.P. and M.P. (states at the bottom in terms of innovation intensity) are actively engaged in most of the activities related to innovations. In-house R&D is more visible in the firms of U.P. and M.P. On the contrary states with higher innovation intensities like Goa, A.P. and Delhi are mostly engaged in innovation activities

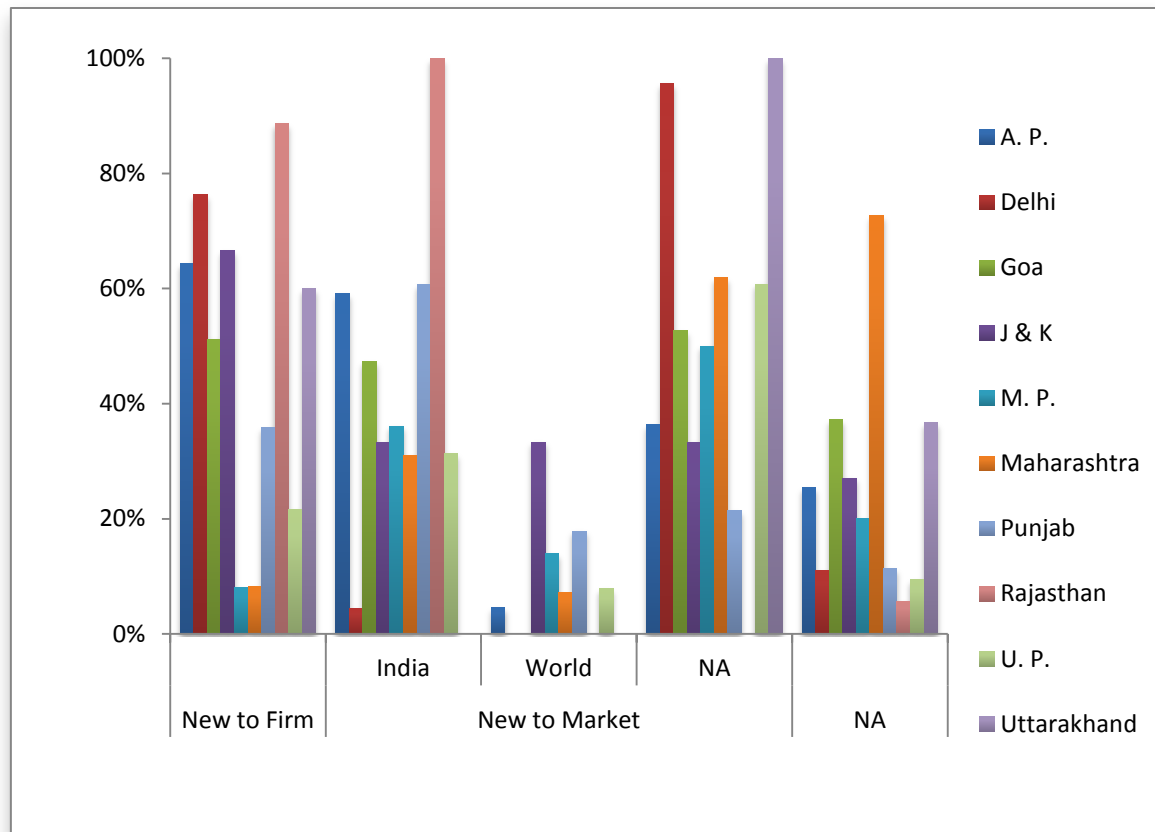
related to acquisition of machine, equipment and software.

Figure 18 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. General picture is that innovation is venturing into new things at firm level i.e new to the firm. A few firms mentioned about introducing their innovations to the Indian market. M.P., Maharashtra and Punjab are widely different in this respect. Firms in these states have claimed their innovations to be new to Indian as well as World's market.

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

Activities	A. P.	Delhi	Goa	J & K	M. P.	Maharashtra	Punjab	Rajasthan	U. P.	Uttarakhand
Intramural R&D	24.9	27.5	38.4	39.6	52.0	25.9	41.5	45.2	63.6	33.3
Extramural R&D	2.4	13.8	3.1	12.5	28.0	20.5	15.1	11.3	28.4	10.0
Acquisition of Machinery, Equipment and Software	72.3	49.5	70.8	75.0	48.0	64.1	77.4	62.1	60.9	43.3
Acquisition of other external Knowledge	6.6	4.9	13.4	22.9	38.0	24.1	22.6	7.3	31.1	13.3
Training	19.7	14.8	54.9	70.8	42.0	32.3	33.9	25.9	44.6	36.7
Market Introduction of Innovation	2.8	3.3	8.5	25.0	30.0	32.7	20.8	3.2	32.4	20.0
Other Activities	2.6	0.6	8.5	22.9	34.0	45.5	20.8	0.8	25.7	3.3

Figure 18: Extent of Innovation

**Observation**

Many innovative firms have reported more than one type of innovations, but *innovations through introduction of new machines and product innovation are most common types of innovation*. Quality and standard are important components of innovation activities. Innovations are mostly adoption of the market trend in terms of process technology, product quality, machine etc. at a firm level.

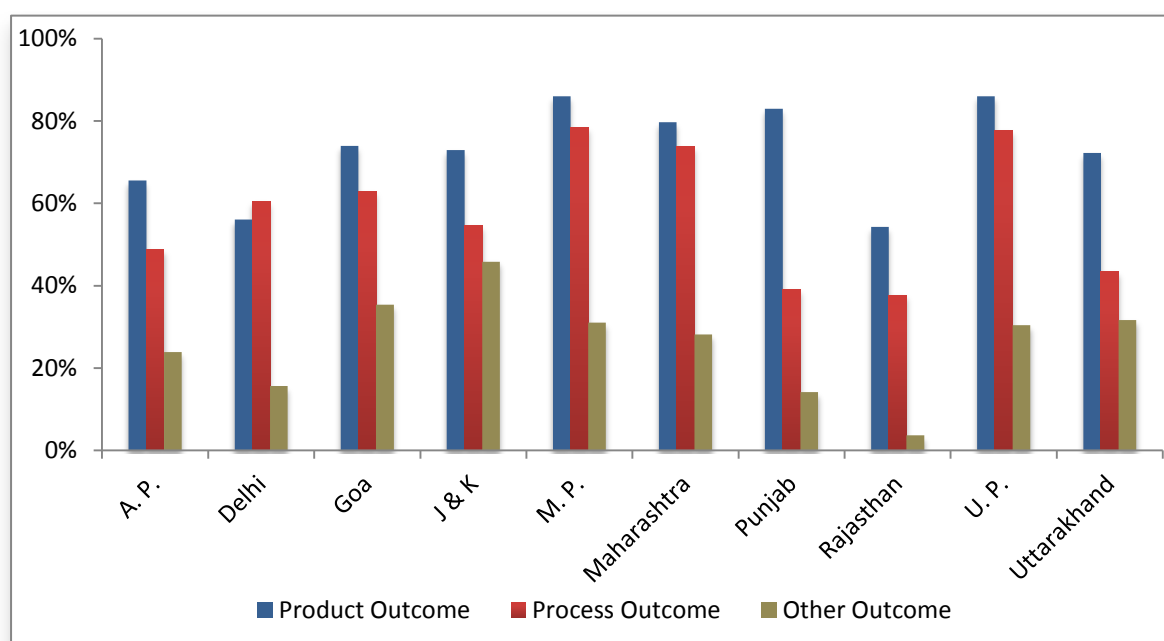
5 Gains from Innovation

This section highlights certain issues such as 'gains from the innovation', 'nature of the gains', 'competitive position of the innovating firms in the market'- to explore the justification of innovation and verify the claims of innovation.

Figure 19 shows the percentage of innovative firms expressing the various types of gains from innovations undertaken. Firms in M.P., Maharashtra U.P. and Delhi claim gains from both product and process innovations whereas 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, Rajasthan and A.P. are particularly lagging behind in certain aspects like technology in-licensing, new collaboration and FDI than the firm in other states.

Figure19: Gains from Innovation



Note: In figure 19. product outcome includes increased range of goods and services, product entered new market and improved quality of goods and services; process outcome includes improved flexibility of production or services, increased capacity of production or services, reduced labour cost per unit output and reduced materials and energy per unit output; other outcome includes reduced environmental impacts and met Govt. Regulatory Requirements

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

Factors	A. P.	Delhi	Goa	J & K	M. P.	Maharashtra	Punjab	Rajasthan	U. P.	Uttarakhand
R&D Activities	51.6	79.1	76.2	75.0	68.0	82.7	62.3	86.3	94.6	73.3
Quality of Manpower Employed	84.1	95.6	95.7	91.7	96.0	98.2	92.5	92.7	95.9	90.0
Technology in-licensing	50.7	69.8	84.8	87.5	96.0	90.5	88.7	25.0	85.1	76.7
New Collaborations	29.1	30.8	39.0	72.9	68.0	80.9	52.8	14.5	70.3	63.3
FDI	18.7	17.0	44.5	54.2	48.0	77.7	35.8	8.9	55.4	53.3
Sourcing of raw material and other inputs	87.8	91.8	90.9	93.8	90.0	94.1	92.5	94.4	95.9	90.0
Efficient cost management	93.9	94.5	96.3	91.7	96.0	95.9	94.3	86.3	98.6	80.0
Quality of machine and equipment	94.3	96.2	97.6	93.8	96.0	95.5	92.5	91.9	98.6	96.7
Efficient organizational practice	79.8	94.5	97.0	93.8	90.0	93.6	94.3	63.7	91.9	90.0
Efficient marketing arrangement	84.5	96.2	92.7	87.5	90.0	96.4	88.7	83.9	98.6	90.0
Better information management	73.2	94.5	92.1	87.5	90.0	96.4	94.3	48.4	97.3	90.0
Successful brand development	69.4	91.2	95.1	97.9	92.0	87.3	90.6	44.4	93.2	83.3

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 on increased range of goods and services as outcome of the product innovation and improved flexibility of production or services as outcome of the process innovation. This is indicative of the main trends of innovation activities.

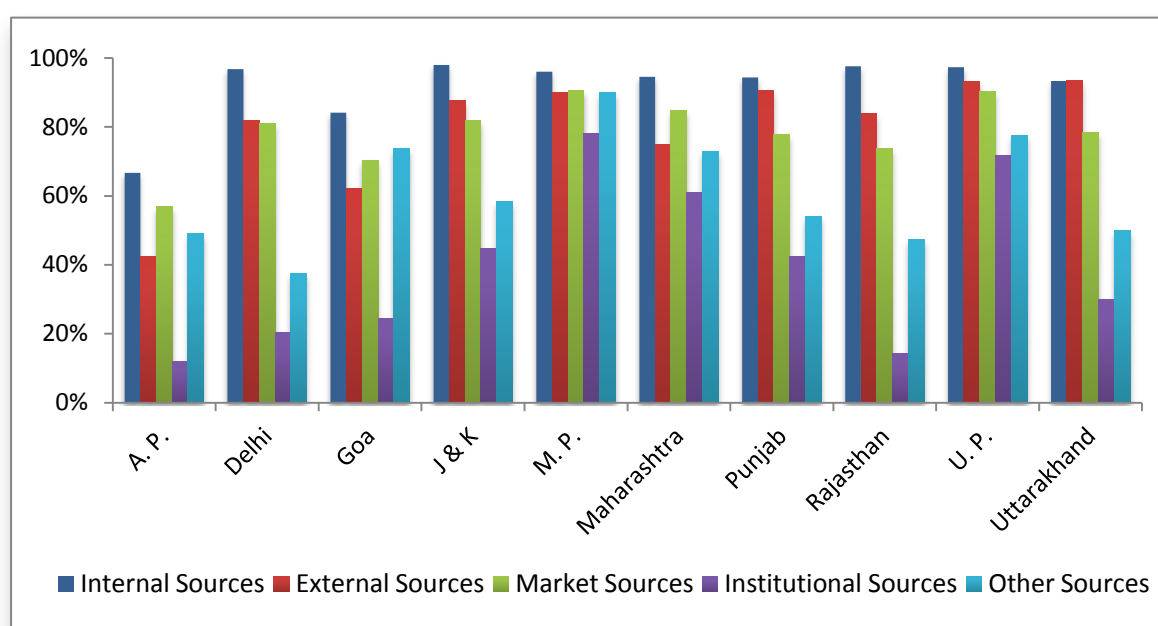
6 Inputs to Innovation

How much a firm accesses 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).

Figure 20 captures the extent of external sourcing accessed by the identified

innovative firms. Firms in all the states appear to be very dynamic in accessing both external and internal sources for generating innovation related information except for A.P. and Goa which have high innovation intensity but are much less pronounced in accessing the same. Market sources like suppliers, clients and even competitors are quite preferred channels of information for the firms. Except for M.P. and to some extent Maharashtra, other states do not access the educational and R&D institutes as source of information.

Figure 20: Information Source & Innovation Activity



Note: In figure 20, Market Sources include suppliers of equipments, materials, components or software; customer's feedback; competitors or other enterprises in the same sector; consultant, commercial labs or private R&D institutes. Universities, Engineering colleges, polytechnics and Government or public research institutes together represent Institutional Sources and Other Sources include conferences, trade fairs, exhibition; scientific journals and technical publications; professional and Industry associations.

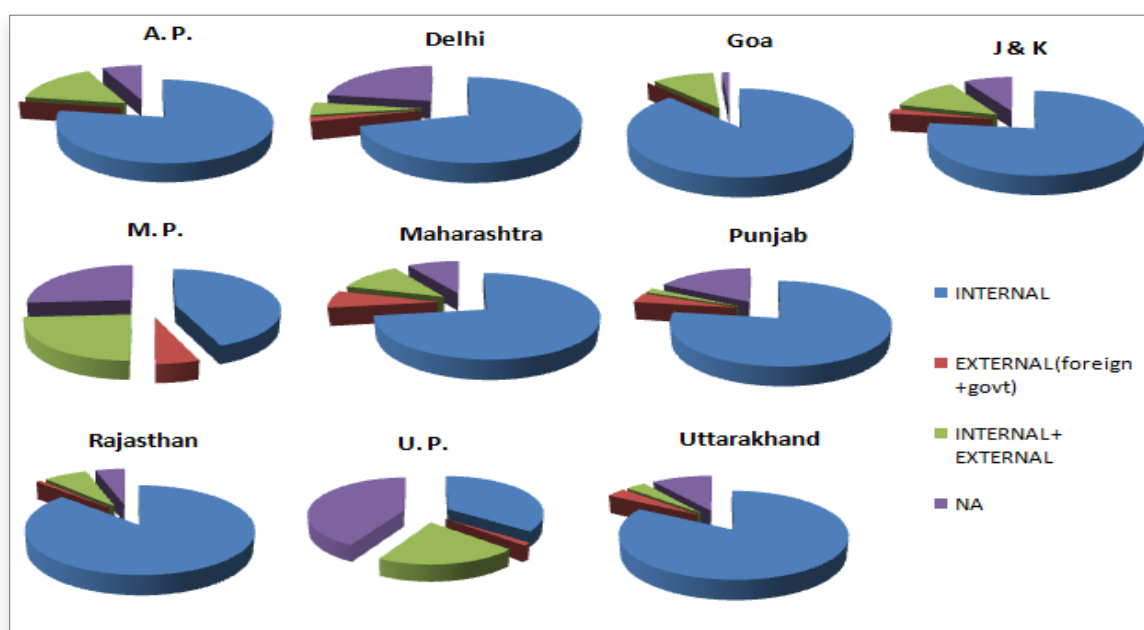
Availability of fund for innovation is an important aspect of innovation ecosystem. Table 3 reveals that most of the firms depend on their own internal

sources. Or in other words accessing external sources for financing innovation is not a popular mode among innovative firms (refer figure 21).

Table 3: Source of finance for innovation (in %)

Sources	A. P.	Delhi	Goa	J & K	M. P.	Maharashtra	Punjab	Rajasthan	U. P.	Uttarakhand
INTERNAL	78.4	70.87	88.41	77.08	44.0	72.73	77.36	87.1	35.14	83.33
EXTERNAL (foreign +govt)	0.00	1.65	0.00	2.08	6.0	6.82	3.77	0.81	1.35	3.33
INTERNAL+ EXTERNAL	15.02	4.95	10.37	12.50	24.0	11.36	1.89	7.26	21.62	3.33
NA	6.57	22.53	1.22	8.33	26.0	9.09	16.98	4.84	41.89	10.00

Figure 21: Source of Funding Innovation



Observation



Innovative enterprises in Maharashtra 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.

Like information and finance, human resource is the most indispensable component of innovation related activities. Figure 22 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 23, that most of the firms do not have any major human resource development programme.

Figure 22: Scientist and Engineers (as % of Total Employment)

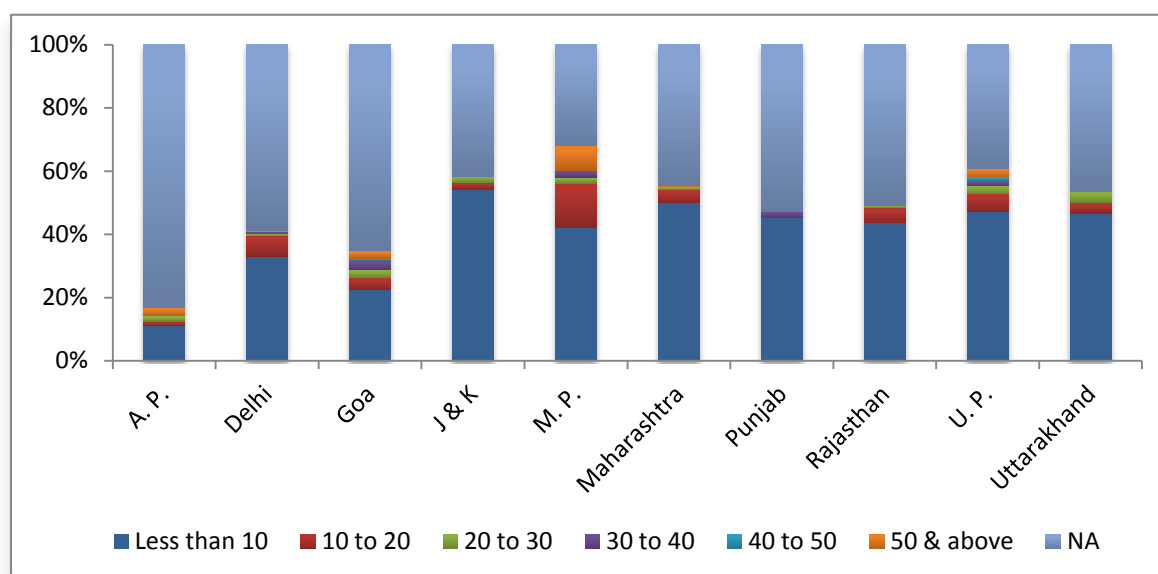
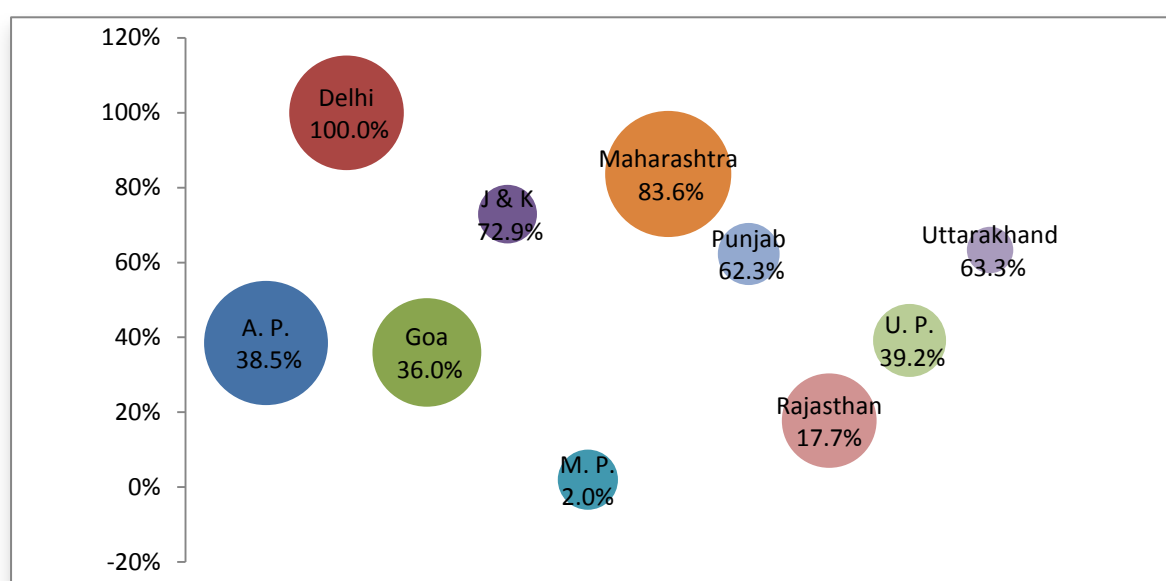


Figure 23: Percentage of Innovative firms providing training



Delhi and Maharashtra however, shows that innovative firms do undertake training for human resource development. In Delhi all the innovative firms provide training for human resource development. Again accessing the skill development programmes outside the

firm is a rarity among the innovative firms. Most of the training imparted is in-house (as seen in figure 24). So far funding of training and skill development initiatives are concerned, firms access mainly the internal sources, as shown in Figure 25.

Figure 24: Human Resource Development by Innovative firms

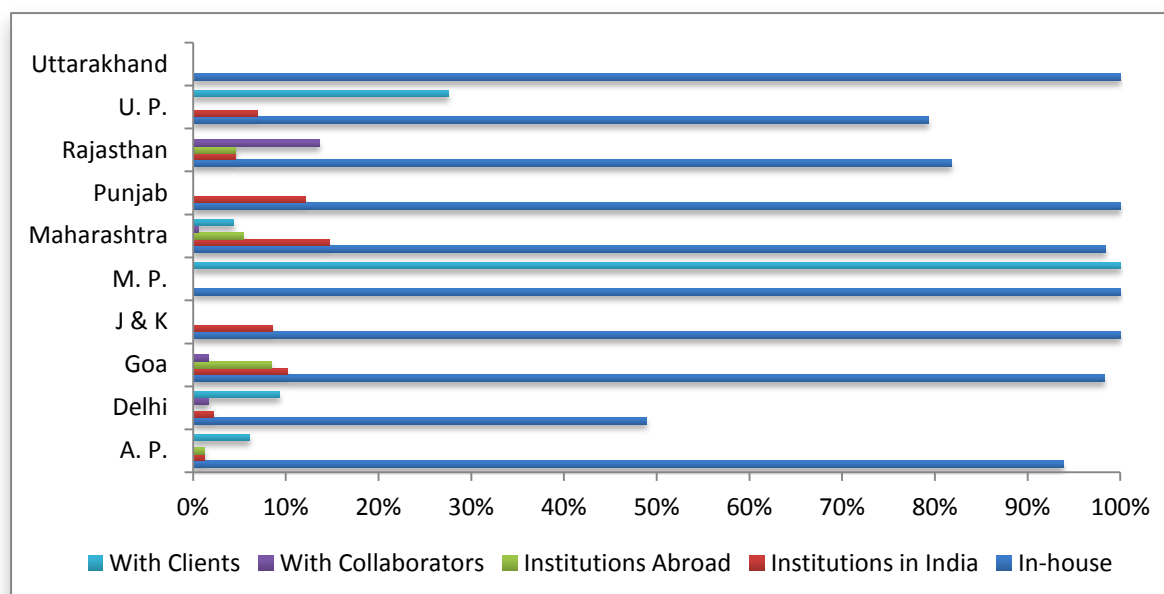
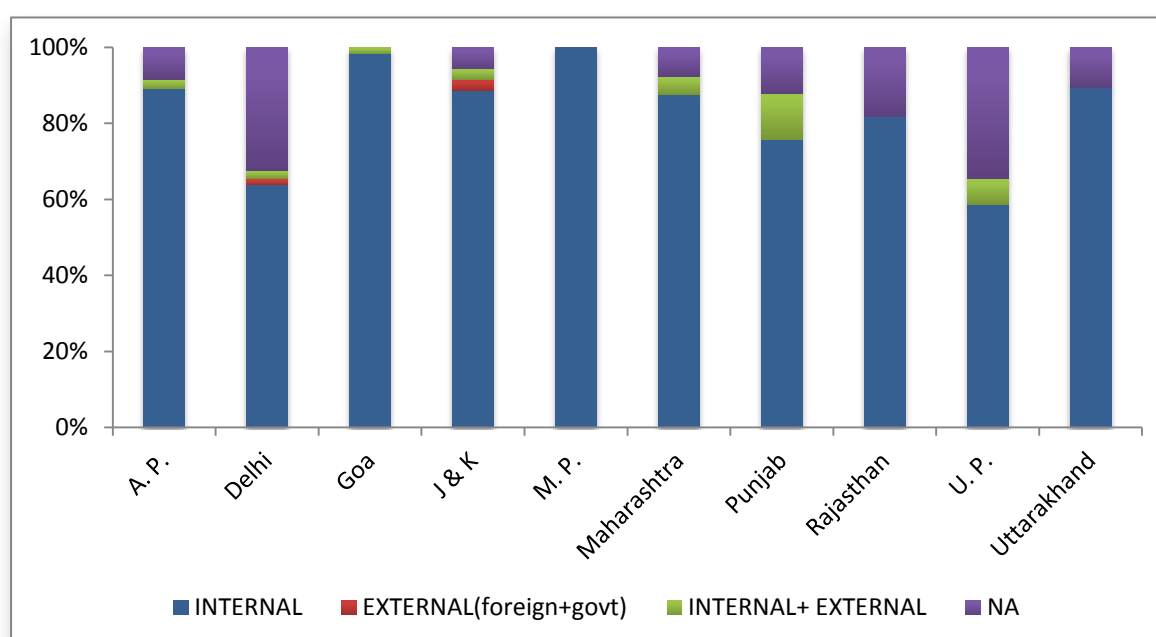


Figure 25: Source of fund for human resource development (training)



7 Factors influencing Innovation

What are the factors that are perceived as critical for promotion of innovation? Responses of the firms show that (table 4) innovative and non-innovative firms alike, cost and access to new knowledge of innovation considered as most important

factors that required to be strengthened. It is interesting to note that firms in M.P. lay similar importance on all the factors. Same is also true for Maharashtra, Punjab and U.P.

Table 4: Factors important for influencing innovation (in %)

Factors		A. P.	Delhi	Goa	J & K	M. P.	Maharashtra	Punjab	Rajasthan	U. P.	Uttarakhand
Cost Factor	All firms	35.4	47.0	37.0	44.7	42.9	41.6	43.3	45.9	47.7	47.0
	Innovative	36.1	47.8	37.8	47.9	46.0	45.0	47.2	47.6	47.3	46.7
Knowledge Factor	All firms	33.6	40.2	43.8	43.9	43.8	41.6	45.7	41.8	46.1	47.3
	Innovative	33.7	41.2	44.5	47.9	48.0	43.2	49.1	42.7	45.9	46.7
Infrastructure Factor	All firms	7.4	25.4	12.3	27.5	42.6	41.6	33.6	21.6	32.3	17.8
	Innovative	10.2	25.8	14.0	22.9	44.0	28.2	39.6	22.6	32.4	23.3
Market Factor	All firms	18.5	32.0	28.1	37.6	42.0	41.6	38.7	21.6	44.8	41.3
	Innovative	21.0	31.3	29.3	41.7	44.0	41.4	41.5	23.4	41.9	40.0
Others	All firms	14.8	30.5	23.0	43.1	43.5	41.6	44.1	23.0	44.5	47.3
	Innovative	18.5	29.7	26.2	47.9	40.0	38.6	45.3	22.6	37.8	46.7

Reflections from interviews

Common hindrances in innovation activities encountered by the firms,

- Unavailability of Skilled Manpower
- Inadequate infrastructure
- Discontinuous Power supply.
- Less State sponsored financial help for small organizations.

8 Understanding Innovation

The survey shows that Goa (69.79%) has highest percentage of innovative firms closely followed by Maharashtra (58.67%), Andhra Pradesh (56.35%) and Delhi (53.85%). Rajasthan (33.88%) occupies the middle position in terms of innovative firms while Uttar Pradesh (19.73%), Jammu & Kashmir (18.82%), Punjab (14.25%), Madhya Pradesh (14.20%) and Uttarakhand (9.04%) 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 5, 6 & 7. Table 5 shows that accessing institutional sources of finance is a rare action by the innovative firms. Accessing institutional facilities for technological and non-technological support to innovation is significant in UP followed by M.P. and Delhi. Firms in Goa show more active in accessing information/knowledge from R&D institutions. Accessing institutional training programme for human resources is also rare. It is to be noted both U.P. and M.P. is at the bottom and Goa at the top in innovation intensity among ten states.

Table 5: Access of NIS by the innovative firms (%)

NIS components	A. P.	Delhi	Goa	J & K	M. P.	Maharashtra	Punjab	Rajasthan	U. P.	Uttarakhand
Source of knowledge (Educational institution)	6.1	19.7	12.2	45.8	76.0	59.6	37.7	15.3	67.6	30.0
Source of knowledge (R&D institution)	15.5	20.9	36.6	43.8	80.0	62.3	47.2	12.9	75.7	30.0
Institutional Source of finance	14.0	6.6	8.5	14.5	30.0	17.7	5.7	8.1	18.9	6.7
Training in institutions	0.5	2.2	3.7	6.3	0.0	12.3	7.6	0.8	2.7	0.0
Novelty of innovation	64% new to firm	76% new to firm	51% new to firm	66% new to firm	72% new to market	19% new to market	52% new to market	88% new to firm	69% new to market	60% new to firm

For RIS at the state level comparative statuses of the 10 states are shown in table 7. States were ranked separately under each column and assigned the rank value 10 for the lowest and 1 for the highest scores. Rank values were added (unweighted) laterally to derive overall rank values. M.P. is at the bottom in all

the parameters, where as Goa is at the top. A.P. ranked low in HDI shows better in RIS and Innovation Intensity ranking. U.P., on the other hand, shows higher innovation intensity even being lowly ranked for HDI and RIS. Punjab, at higher rank in HDI and RIS, figure at the bottom in innovation intensity.

Table 6: Indicative factors of Regional System of Innovation (RIS)

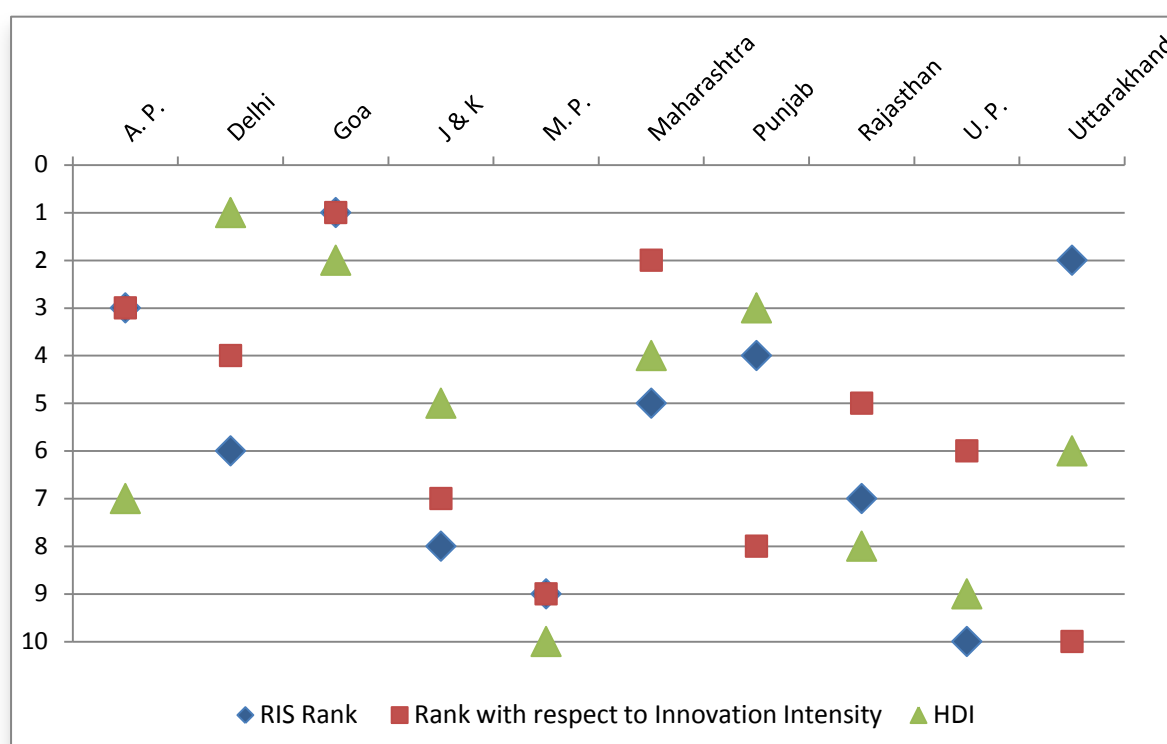
States	NSDP Per capita (Rs) at Constant Prices 09-10	Industry Share in NSDP (in %)	Highways Per 100 Sq Km	Health Centers/100 Village	Educational institute/million pop.	Power Generation/milli on pop.	RIS Rank	Innovation intensity Rank	HDI Rank
A. P.	36345	12.83	1.65	51.30	317	1040.3	3	3	7
Delhi	89037	6.10	4.86	29.70	139	733.0	6	4	1
Goa	98807	30.98	7.27	55.43	371	238.2	1	1	2
J & K	26739	9.81	0.56	35.88	170	1127.3	8	7	5
M. P.	19736	15.87	1.52	18.70	178	802.5	9	9	10
Maharashtra	57458	20.99	1.36	29.18	242	861.9	5	2	4
Punjab	43539	20.53	3.09	27.82	192	976.8	4	8	3
Rajasthan	23669	16.68	1.63	31.63	265	520.2	7	5	8
U. P.	16182	14.66	2.81	23.01	109	531.2	10	6	9
Uttarakhand	41126	22.51	3.82	12.24	298	1152.0	2	10	6

Observation



Although M.P. and U.P. are better in accessing NIS components as compared to other states, they seem to fail in reflecting it in their innovation intensity, this is also indicative of the fact regarding the states poor RIS. Corroborating that NIS alone may not be sufficient always; we need a better combination of NIS, RIS and SIS.

Figure 26: Rank correspondence of different indicators



How influential is the Sectoral Innovation System (SIS)? We have calculated two indicators. The sectoral variation of innovation intensity is quite skewed. This indicates that there are a few sectors that are much more innovative than other sectors which have very few innovative activities. 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%. This can be calculated separately for states and for all states together (in case of present Bulletin for 6 states). Based on this we derive following two indicators for SIS.

- a) **SII and industrial activities of a state:** If we have overall sectoral intensity of innovation (% of innovative firms in the total firms in a sector taking 10 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 M.P.) 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 Delhi and Goa all other states show negative correlations, strongest negative correlations for U.P., Rajasthan and Maharashtra. While Maharashtra is at the top in

innovation intensity, other two states rank in the middle. Negative rank correlations mean that the states do not benefit from the SIS. In case of Maharashtra, higher level of industrialization appears to have helped overcoming weak SIS. On the other hand, the positive correlations (although not very significant) for Goa and Delhi suggest comparative better match between industrial activities and SIS.

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 ($IF_s \text{ state}$) and total innovative firms in the state (TIF_{state}) (in other words the sectoral distribution of innovative firms in a state ($SII_{state} = IF_s \text{ (state)} / TIF_{state}$)). We examine how skewed is the distribution of innovative firms in a state (refer table 7).

Table 7: Indicators for Sectoral Innovation System

States	Indicator 'a' (Rank correlation coefficient)	Indicator 'b' (Skew value)	Innovation Intensity
A. P.	-0.22	3.66	56.35%
Delhi	0.20	1.49	53.85%
Goa	0.17	1.05	69.79%
J & K	-0.12	2.60	18.82%
M. P.	-0.40	5.33	14.20%
Maharashtra	-0.08	2.44	58.67%
Punjab	-0.27	3.02	14.25%
Rajasthan	-0.41	2.91	33.88%
U. P.	-0.42	1.15	19.73%
Uttarakhand	-0.10	0.68	9.04%
All sectors	1.00	1.05	34.04%

Sectoral distribution of innovative firms in M.P. is highly skewed compared to other states. As shown earlier much of the industrial activities and innovation activities in M.P. are limited to agro-based activities (NIC 01). Uttarakhand has the lowest skew value. It also has the lowest innovation intensity. Delhi, Goa and U.P. show innovation activities well spread across the sectors. Rank correlations and skew values when examined together bring out another interesting dimension. In case of M.P. high skew value of innovation and negative rank correlation (indicators 'a' and 'b') together suggest that firms reporting innovative activities are away from the sectors with higher innovation intensity. On the other hand, U.P. has low skew but high negative correlation indicating innovation activities hindered by factors related to RIS. Delhi and Goa have low skew and positive rank correlations indicating innovation activities aligned to sectors with higher innovation intensities.

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

- As has been observed in the cases of states in earlier

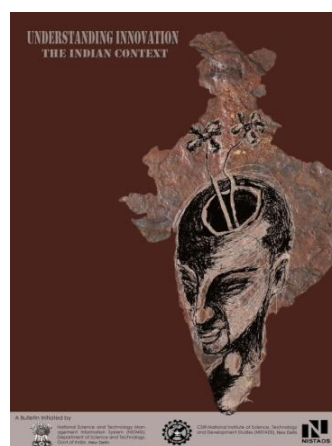
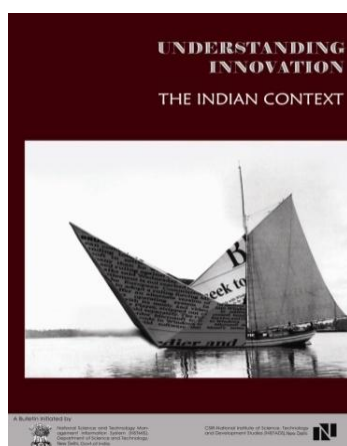
Bulletins, NIS is not very popularly accessed by the enterprises. In the cases of present ten states situation appears to better. In Delhi, Goa, Madhya Pradesh and Uttar Pradesh there are higher incidence of accessing NIS for sourcing knowledge. Andhra Pradesh and Maharashtra have higher incidence of accessing financial support systems.

- Goa and Uttarakhand are at the top in RIS ranking with opposite result on Innovation Intensity. While Goa is at the top in innovation intensity, Uttarakhand is at the bottom. It appears that a sectoral push would be required for raising the innovation intensity in the state. Both Madhya Pradesh and Jammu & Kashmir are poor in terms of RIS and innovation intensity. Even a sector led push would require a better RIS in these states. Maharashtra belongs to the top order in innovation intensity overcoming the inadequate RIS.

Observation

Rank correlation and skew value together show the presence of innovative sectors in a state. Delhi and Goa have low skew value and positive rank correlations indicating innovation activities aligned to sectors with higher innovation intensities. In case of M.P. high skew value of innovation and negative rank correlation together suggest that firms reporting innovative activities are away from the sectors with higher innovation intensity. On the other hand, U.P. has low skewness but high negative correlation indicating innovation activities hindered by factors related to RIS.

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



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The survey has covered 31 states and UTs. Arunachal Pradesh and Manipur were not covered. The second, third and fourth issues have covered total 21 states. The fifth issue will cover 10 more.

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Department of Science & Technology
(National Science & Technology Management Information System Division)**

Call for Research Proposals under the NSTMIS Programme

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*The division sponsors research projects/studies to interested investigators/organizations under the NSTMIS Scheme. The broad areas of financial support for research / studies are **S&T investment, S&T infrastructure, S&T output, S&T databases, S&T manpower, R&D productivity/efficiency** etc.*

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2. S&T Indicators: Input, Output, Impact etc.
3. Manpower studies in the S&T areas.
4. Gender related studies in the field of S&T.
5. Scientometric studies in S&T areas.
6. Quantification of R&D in Social Sciences.
7. Commercialization of Patents.
8. Studies on growth of various S&T areas and need assessment of future professions.
9. Linkages between Industry, Technology and S&T policies.
10. Out-turn of S&T personnel.
11. R&D in Services.
12. Innovation in Public Research Organisations.

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Technology Bhawan, New Mehrauli Road, New Delhi – 110 016**