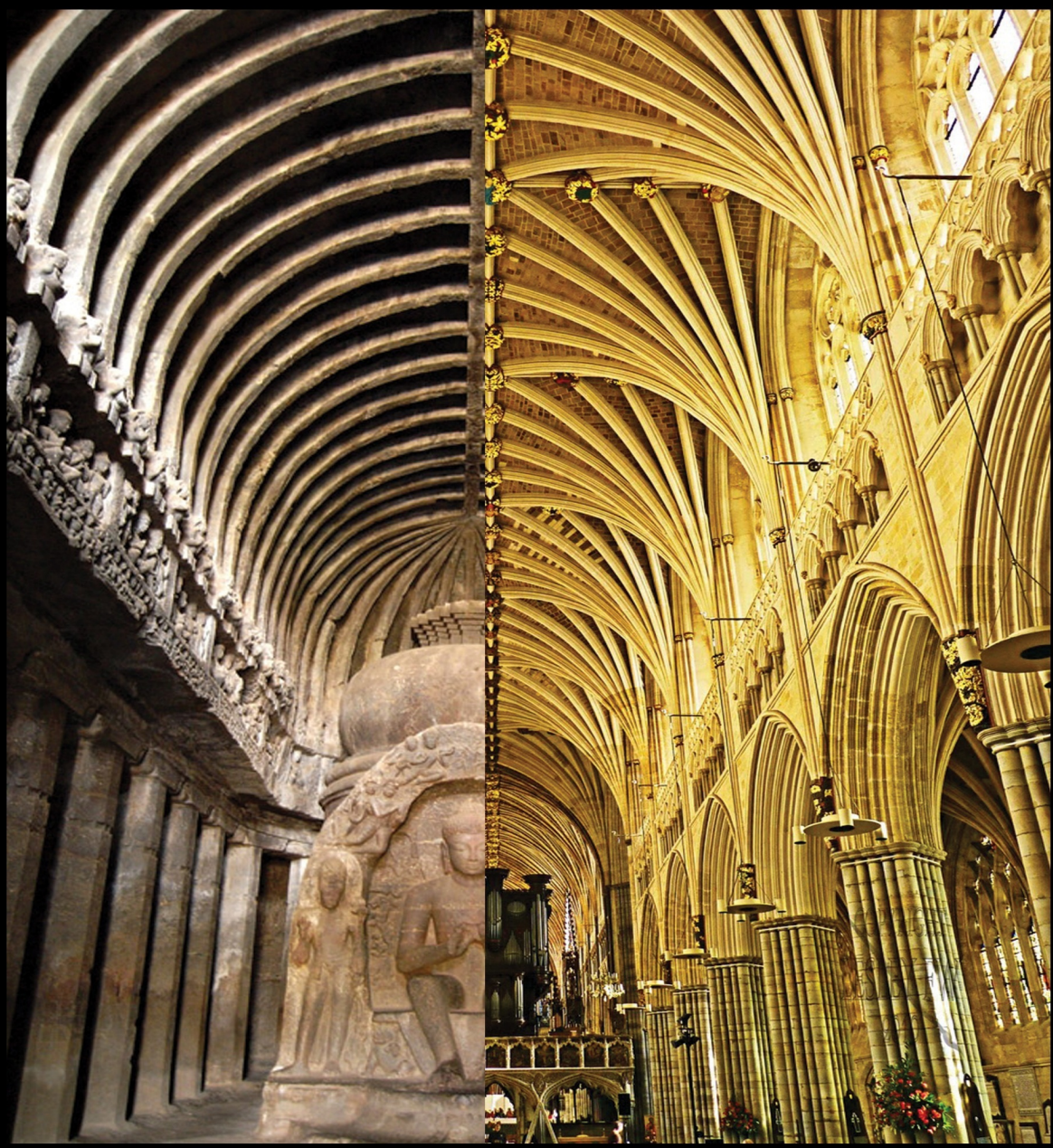
UNDERSTANDING INNOVATION

THE INDIAN CONTEXT



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Key Observations

Total 1770 firms, chosen through sampling, have been studied in Assam, Andaman & Nicobar Island, Chandigarh, Dadra & Nagar Haveli, Daman and Diu, Meghalaya, Nagaland, Puducherry (Pondicherry), Sikkim and Tripura.

State-wise proportions of innovative firms are Assam (15.73%), Andaman & Nicobar Island (71.43%), Chandigarh (2.30%), Dadra & Nagar Haveli (57.19%), Daman and Diu (55.49%), Meghalaya (19.61%), Nagaland (6.52%), Puducherry (59.33%), Sikkim (100%), and Tripura (41.26%).

The survey shows that Sikkim has highest percentage of innovative firms followed by A&N Island, Puducherry D&N Haveli and Daman & Diu. Tripura occupies the middle position in terms of innovative firms while Meghalaya, Assam, Nagaland, and Chandigarh are the laggards.These ratios have been used as innovation intensity of the respective states. The sectoral distributions of industrial units are highly skewed in Tripura, Assam, Daman and Diu and Meghalaya. 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 and are mostly under private ownership, partnership or proprietary firms. Meghalaya, Daman & Diu, D&N Haveli and Puducherry has largest share of firms (61%, 55%, 49% & 45% respectively) privately owned and about same percentage of the firms are innovative. A&N Island has about 43% share of proprietary firms among which 20% are innovative. On the other hand Nagaland, Tripura and Chandigarh each has a share of more than 30% of partnership firms and about similar percentage of innovative firms among them.

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 and 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 (UT's) it is observed that:

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 and UT's the situation is bit different. In cases of Assam, Meghalaya and Sikkim the firms reported of accessing knowledge from outside sources as well. But even in these states accessing other support systems is rare. Sikkim claims innovation for new market – mainly due to the presence of the pharmaceuticals firms. Tripura also claims the same mainly from food processing and handicraft industries.

Chandigarh and Puducherry ranks first and second in RIS ranking. Chandigarh, however, rank low in innovation intensity mainly because the UT was designed not as an industrial area. Assam shows consistent ranking for RIS, innovation intensity and HDI.

1 Introduction

This is the fifth issue of the Bulletin in the series. This issue presents broad observations on five states and five union territories (UT's) namely, Assam, Andaman & Nicobar Island, Chandigarh, Dadra & Nagar Haveli, Daman and Diu, Meghalaya, Nagaland, Puducherry (Pondicherry), Sikkim, and Tripura.

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 and UT's.

The structure of the Bulletin is as follows. The second section is on the sample and innovative firms of the ten states (UT's). 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 (UT's). 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 and would be reported in the National report expected to be available by December 2012.

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* 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 (5 states together) sample firms in a sector.

2 Sample and Innovative Firms

Total 1770 firms were surveyed in the selected ten states (UT's). State-wise distribution of sample (in alphabetical order) is – Andaman & Nicobar Island (A &N Island) 7, Assam 337, Chandigarh 174, Dadra & Nagar Haveli (D&N Haveli) 306, Daman and Diu 328, Meghalaya 51, Nagaland 46, Puducherry 268, Sikkim 47 and Tripura 206. The ten states (UT's) 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 (UT's) are spread over 32 two digit industrial segments or sectors. Refer to Figure 2 (in the figure others include those sectors which have less than 1% share in all the states).

Figure 1: Skewed industrial activities over the sectors

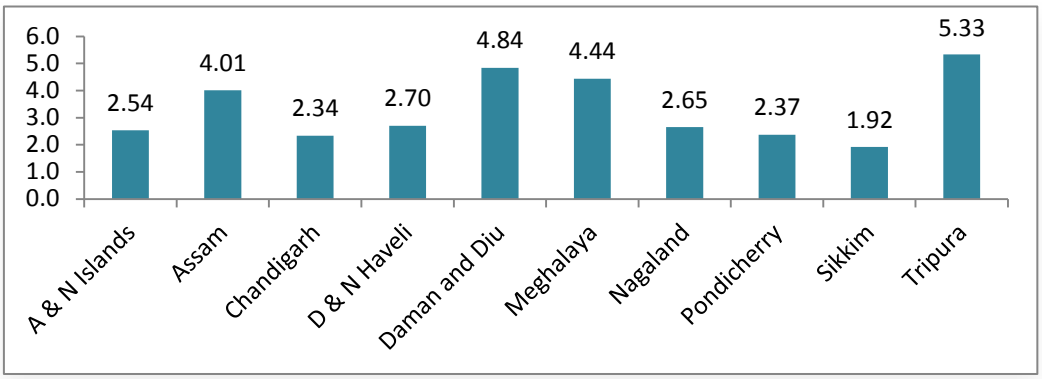
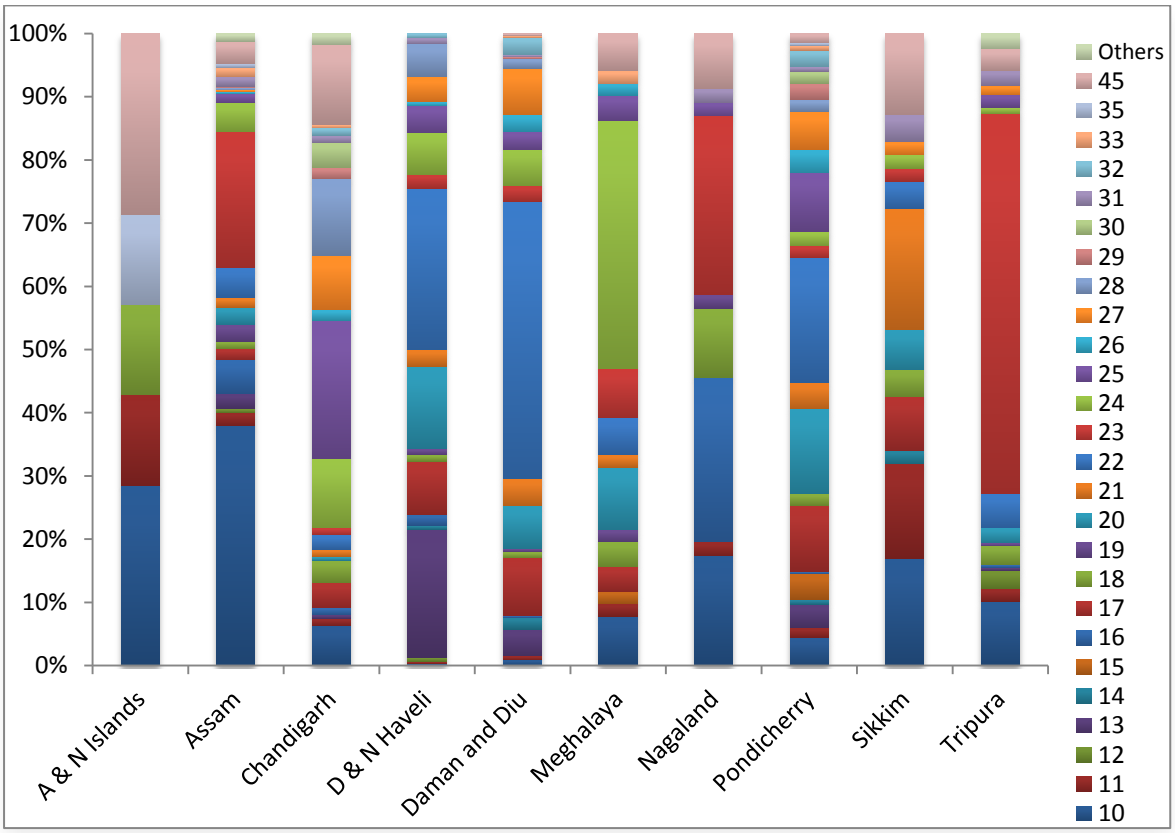


Figure 2: Share of Industrial Segments in total sample



The ten states (UT's) have quite diverse industrial activities (in terms of number of enterprises in different sectors) as shown by skewness. Industrial scenario in Tripura is highly skewed (skew 5.33) followed by Daman & Diu (skew 4.84), Meghalaya (skew 4.44) and Assam (4.01). Manufacturing of other non-metallic mineral products (NIC 23), mainly brick manufacturing, alone constitute 60% of industrial activities (percentage share of number of enterprises) of Tripura followed by manufacturing of food products (NIC 10) and Wholesale and retail trade and repair of motor vehicles and motorcycles (NIC 45) which constitute 10.19% and 3.40% respectively. In case of Daman & Diu manufacture of rubber and plastic products (NIC 22) and paper and paper products (NIC 17) together constitute about 53% of industrial activities. In Meghalaya manufacturing of basic metals (NIC 24) and manufacturing of chemical and chemical products (NIC 20) constitute about 49% of the economic activities followed by manufacturing of other non metallic mineral products (NIC 23) and food products (NIC 10) which constitute about 8% each. Industrial activity of Assam is mainly dominated by manufacturing of food products (37.98%) and manufacturing of other non metallic mineral products (21.66%). Manufacturing activities in D&N Haveli (skew 2.70) are dominated by rubber and plastic products (NIC 22 - 25.49%), textiles (NIC 13 - 20.26%) and chemical and chemical products 13.07%. In Nagaland (skew 2.65) manufacturing of other non metallic mineral products and manufacturing of wood and products of wood (NIC 16) are prominent with share of 28.3% and 26.1% respectively followed by manufacturing of food products and printing and reproduction of recorded media (NIC 18) which together constitutes 28.26%. Manufacturing of food products and Wholesale and retail trade and repair of motor vehicles and motorcycles each constitute 28.6% of industrial activities in A&N Island (skew 2.54). Chandigarh and Puducherry with same skew value 2.37 shows an even spread of industrial activities across the sectors. Manufacturing of fabricated metal products (NIC 25) has a share of 21.84% in Chandigarh followed by Wholesale and retail trade and repair of motor vehicles and motorcycles (12.64%) and manufacturing of machinery and equipment (NIC 28 - 12.07%). In Puducherry manufacture of rubber and plastic products, chemical and chemical products and paper and paper products together constitutes 43.66% of its industrial manufacturing.

The industrialization scenario of Sikkim is less skewed (skew 1.92) in comparison to other states and UT's. The prominent sectors are manufacturing of pharmaceuticals (NIC 21 - 19.15%), food products (17.02%), beverages (14.89%) and Wholesale and retail trade and repair of motor vehicles and motorcycles (12.77%).

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 Tripura. In general skew values for innovation follow more or less the same pattern as in the case of nature of industrialization except for Chandigarh and A&N Island. Innovation related activities in Chandigarh are more skewed while in A&N Island it is less than the industrialization pattern (refer 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

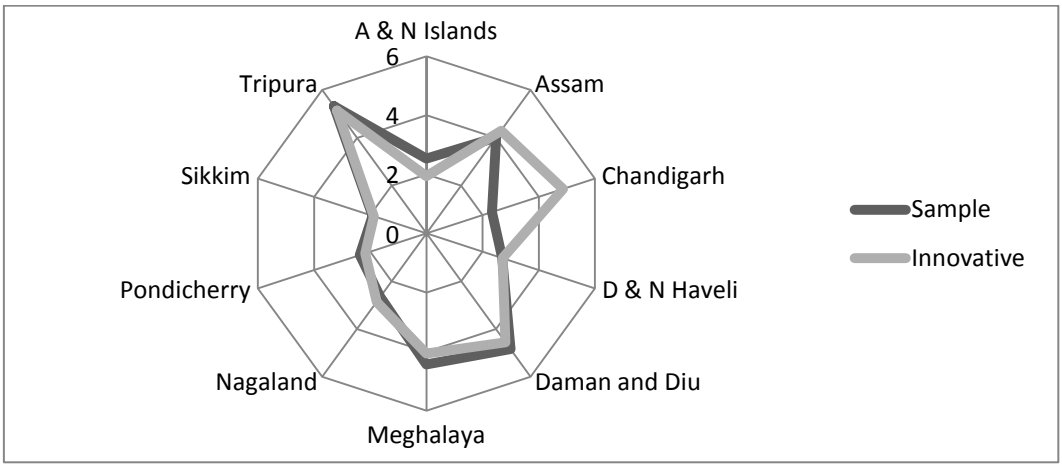


Figure 4: Distribution of sample and innovative firms in different industry segments (A & N Islands)

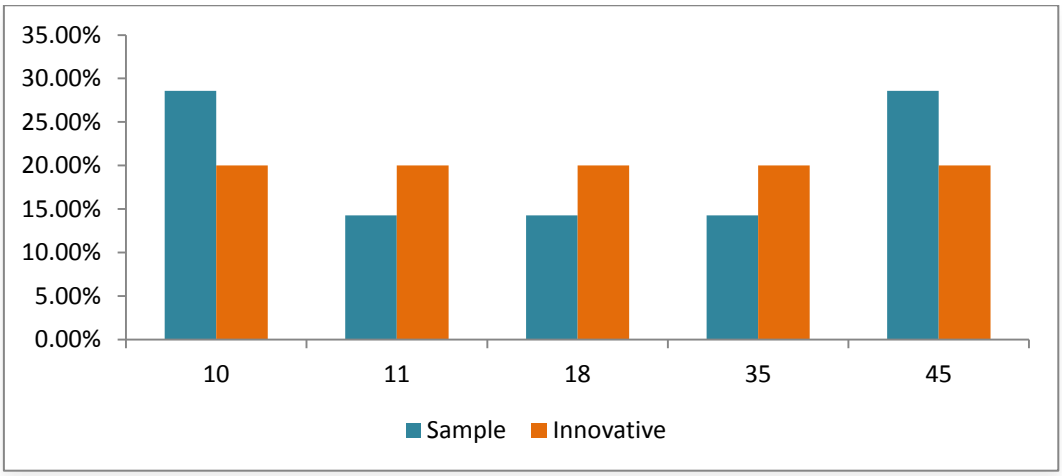
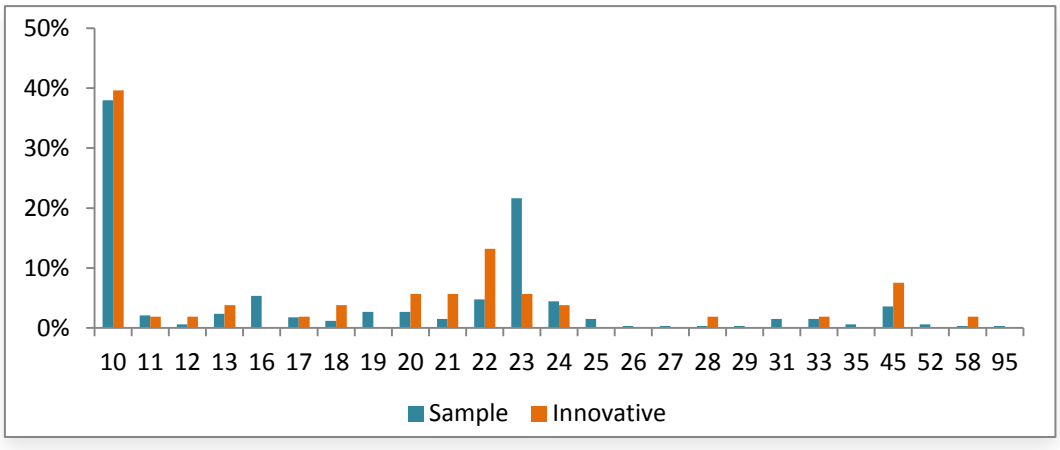


Figure 5: Distribution of sample and innovative firms in different industry segments (Assam)



In A&N Islands only 5 out of 32 industrial segments are present and has reported innovative firms in all the five sectors; a total of 5 firms out of 7 (71.43%) have reported innovation related activities. See figure 4.

Industrial activities in Assam is dominated by food product industry (NIC 10) and has as high as 40% innovative firms followed by rubber and plastics (NIC-22; 13.21%) and Wholesale and retail trade and repair of motor vehicles and motorcycles (NIC-45; 7.55%). Refer figure 5. Overall, Assam has returned 53 innovative firms out of a sample of 337 firms with a percentage of 15.73% across the sectors.

Chandigarh on the other hand presents a picture different form other states. As shown in figure 6 the UT does not have many industrial units. Basic metal (NIC 24 share 11% of sample), fabricated metal products (NIC 25 share 22% of sample), machinery and equipment (NIC 28 share 12% of the sample), motor vehicle repairing (NIC 45 share 13% of the sample) are the major industrial activities. But the electrical equipment industry (NIC 27) that has about 9 % of the sample is the home for 75% of the innovative firms in the industry.

The distribution of innovative firms in D&N Haveli (figure 7) follows more or less the same pattern as the nature of industrialization in the state. Out of 306 firms, 175 reported to be innovative (57.19%). Manufacturing of rubber and plastics (NIC 22) has the highest share followed by textiles (NIC 13) and chemical and chemical products (NIC 20).

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

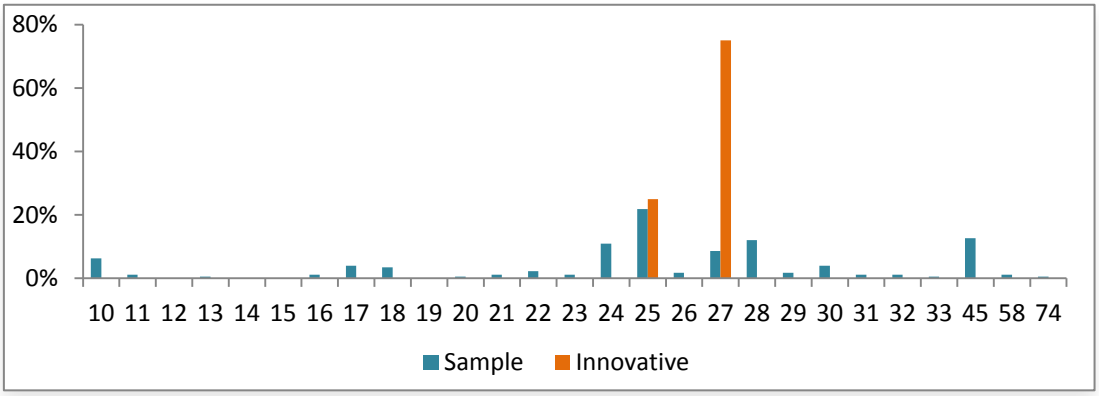
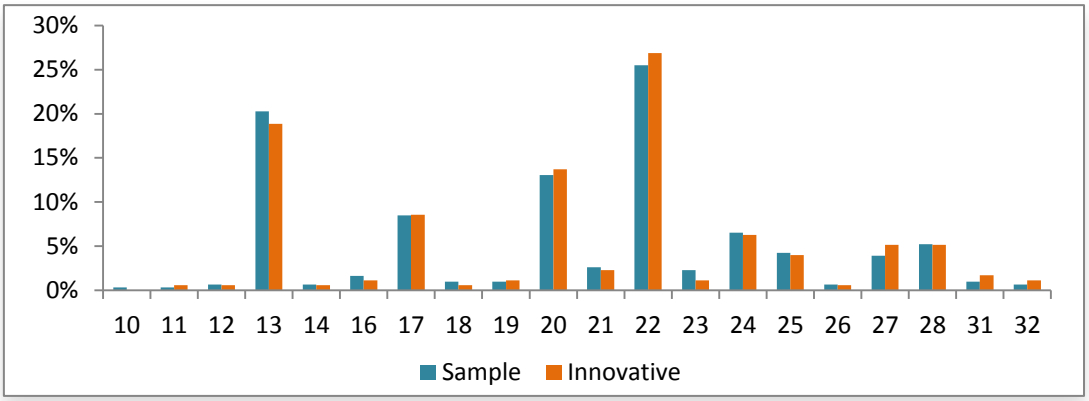


Figure 7: Distribution of sample and innovative firms (D & N Haveli)



In Daman & Diu (figure 8), 22 sectors are present out of the total industrial segments and of them 20 have reported innovation related activities. Total 182 firms out of 328 (i.e 55.49%) are involved in innovation activities. Manufacturing of chemicals and chemical products (NIC 20) followed by manufacturing of basic metals (NIC 24), rubber and plastics products (NIC 22) and food products (NIC 10) have reported maximum percentage of innovative firms.

In Meghalaya 10 firms out of 51 are involved in innovation activities. Manufacture of basic metals (NIC 24) has 50% share of the innovative firms and non-metallic minerals (NIC 23) have a share of 20 % of the innovative firms (refer figure 9).

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

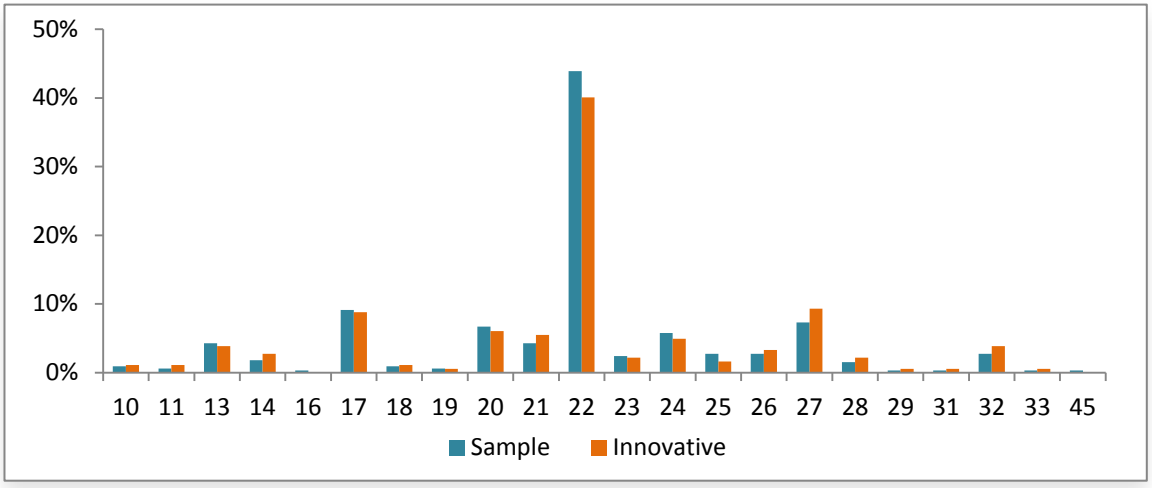


Figure 9: Distribution of sample and innovative firms in different industry segments (Meghalaya)

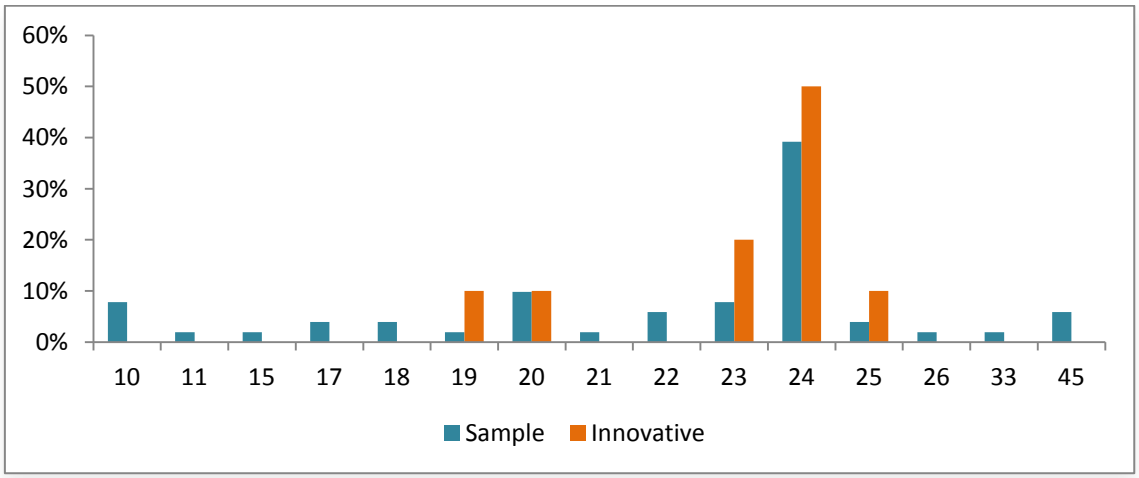


Figure 10: Distribution of sample and innovative firms in different industry segments (Nagaland)

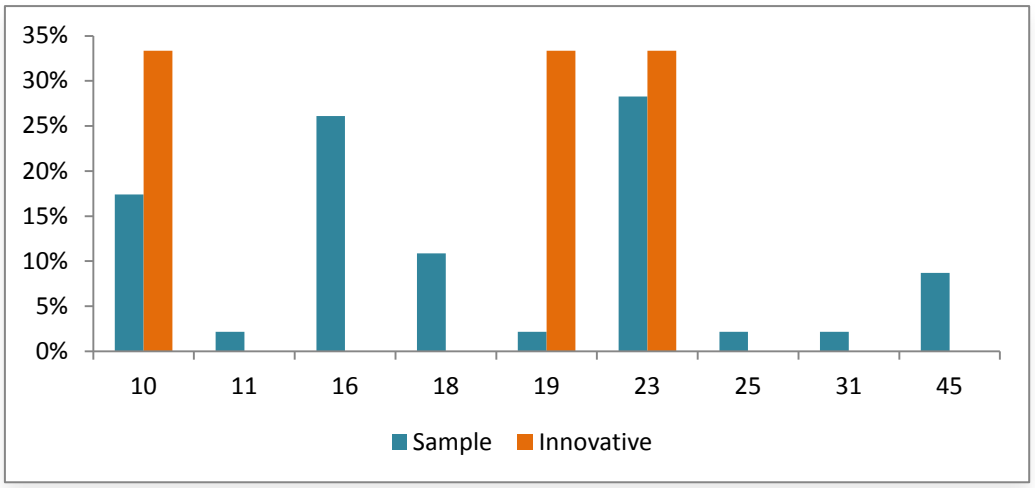
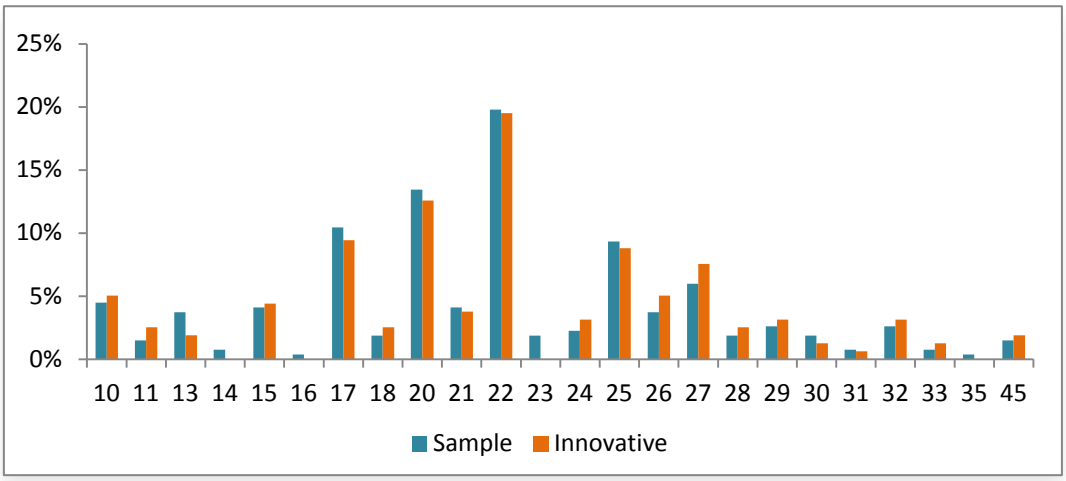


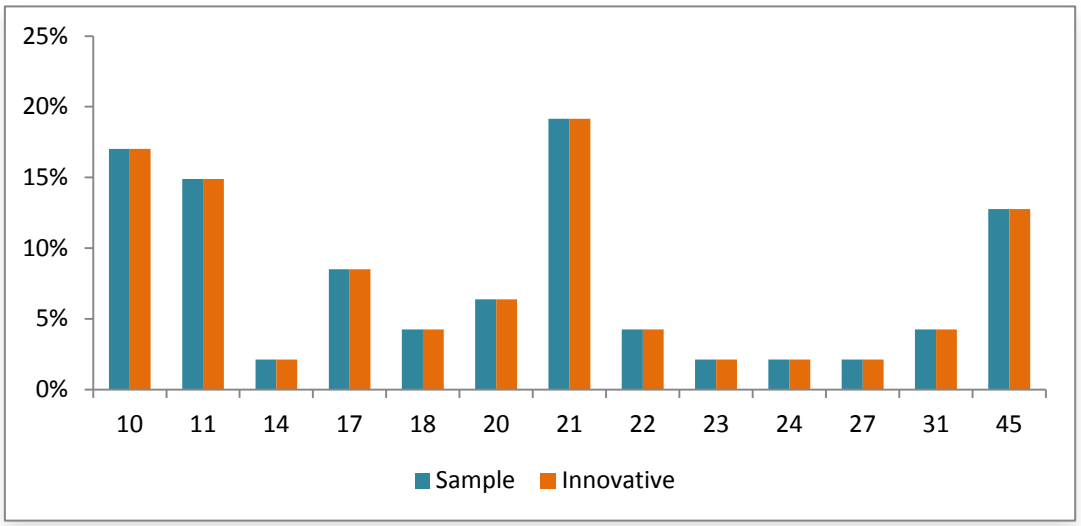
Figure 11: Distribution of sample and innovative firms in different industry segments (Puducherry)



The industrial activities in Nagaland are quite sparse (see figure 10). Industries in the state are restricted to only 9 sectors. Only 3 firms out of a sample of 46 (6.52%) have reported innovation related activities, which belong to food products, coke and refined petroleum products and non-metallic mineral product industry.

In Puducherry on the other hand has a better spread out innovation scenario. Rubber and Plastic industry (NIC 22) has major contribution sharing about 19.5% of the innovative firms. Innovative firms are also present in the chemical and chemical product sector (NIC 20) and paper and paper products (NIC 17) sharing 12.6% and 9.4% respectively (refer figure 11). Overall the state has returned 159 firms out of 268 samples or 59.33% of innovative firms.

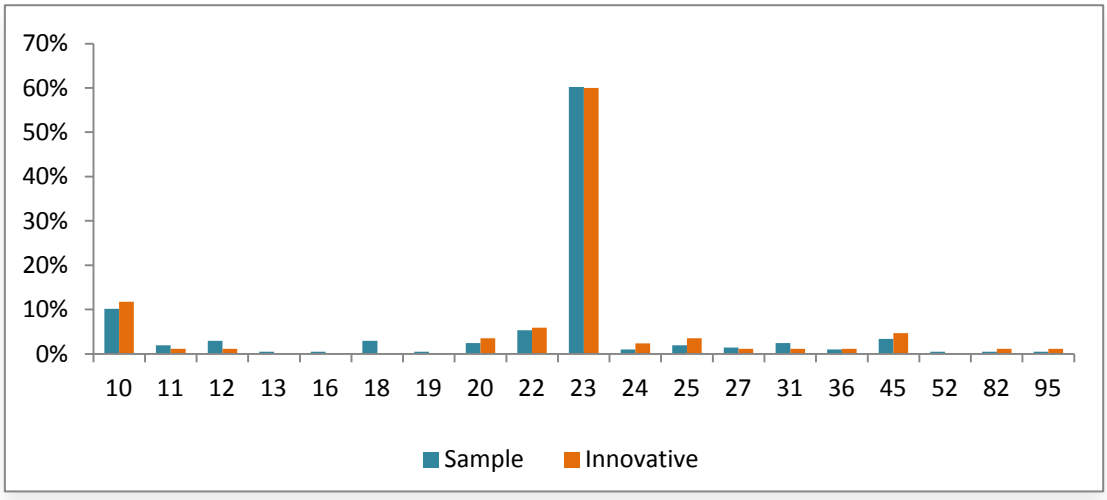
Figure 12: Distribution of sample and innovative firms in different industry segments (Sikkim)



Sikkim has 47 innovative firms out of a sample of 47, taking the percentage to 100%, which happens to be the unique among the ten states /UT's. All the firms surveyed have reported some innovation related activities. The state has presence in 13 sectors and manufacture of pharmaceuticals (NIC 21), food products (NIC 10) and beverages (NIC 11) together has a share of 50% of sample as well as innovative firms. See figure 12.

Industrialization in Tripura is highly skewed. It is mainly dominated by manufacture of non-metallic mineral products and to some extent food products. Non-metallic mineral products (NIC 23) have as high as 60% of the innovative firms, followed by food products (NIC 10) with a share of 11.8% (refer figure 13). Overall, Tripura has returned 85 innovative firms out of a sample of 206 firms or 41.26% across the sectors.

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



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 (UT's) have less than 100 workforce. In case of Nagaland and Chandigarh the percentage is above 90% and all the innovative firms in these states (UT) belong to this firm size (below 100 workforce). All the sample firms in A&N Island also belong to this firm size. For the other states/UT's (Assam, D&N Haveli, Daman & Diu, Meghalaya, Puducherry, Sikkim) 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 except for Tripura which has 30% to 40% of its firm in 100-499 workforce. On the other hand in D&N Haveli and Daman & Diu about 1% to 2% firms (which is highest among all the states) belongs to the higher level of firm size (1000 & above).

Figure 15 represents the ownership patterns of the sample and innovative firms in the ten states and UT's.
Private, partnership and proprietary enterprises are the predominant ownership types in all states. Meghalaya, Daman & Diu, D&N Haveli, and Puducherry has largest share of firms (61%, 55%, 49% & 45% respectively) privately owned and about same percentage of the firms are innovative. A&N Island has about 43% share of proprietary firms among which 20% are innovative. On the other hand Nagaland, Tripura and Chandigarh each has a share of more than 30% of partnership firms and about similar percentage of innovative firms among them.

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

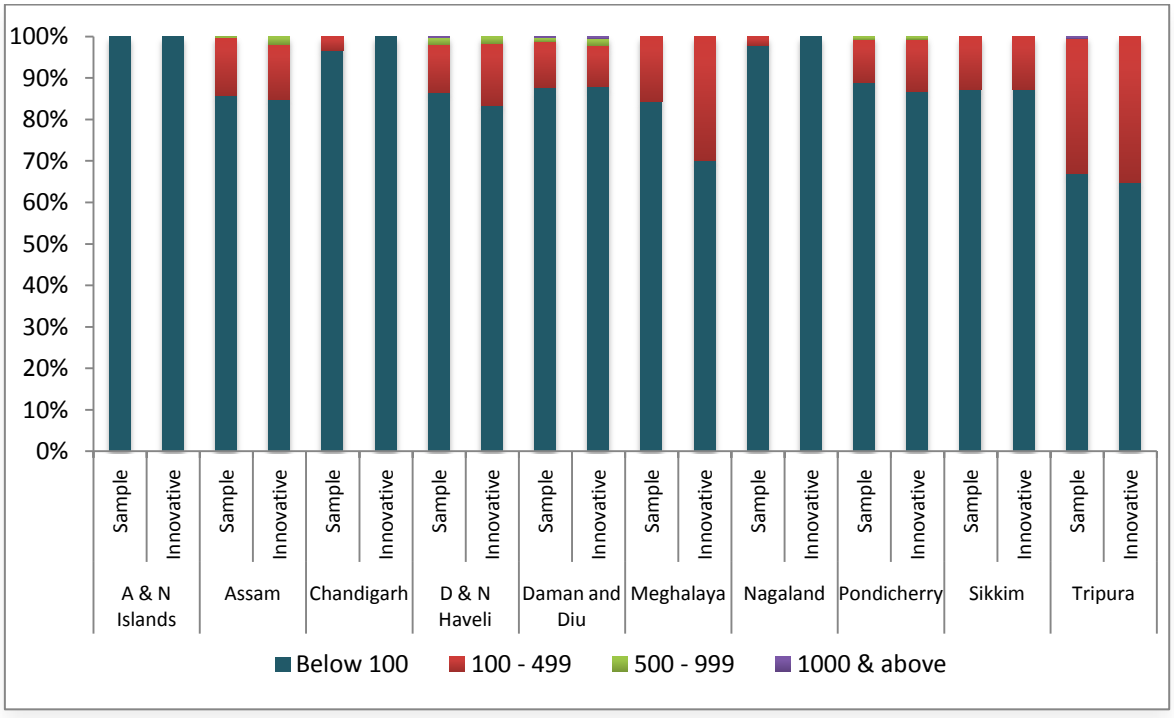


Figure 15: Distribution of Sample and Innovative firms according to the Ownership Type

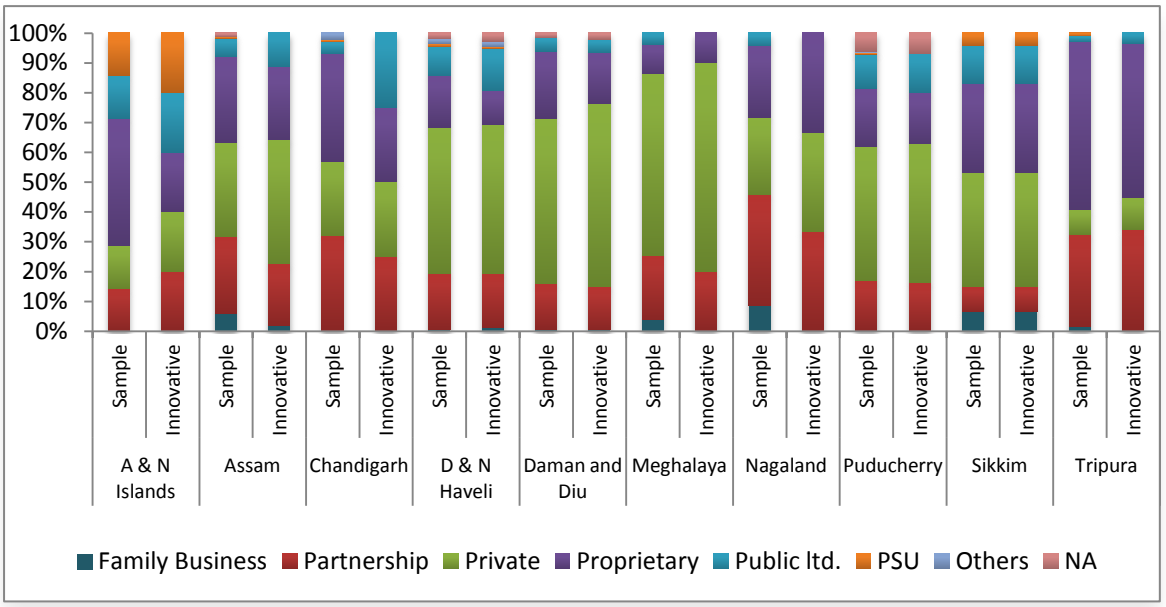
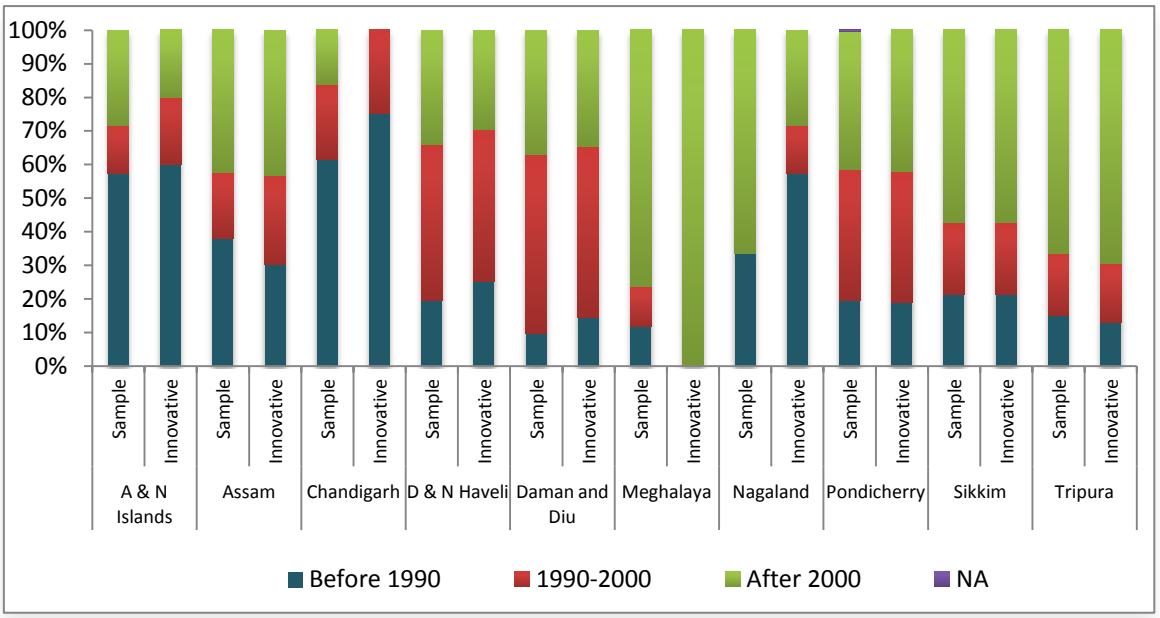


Figure 16: Distribution of Sample and Innovative firms according to the year of establishment



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. Chandigarh and A&N Island each has a share of about 61% and 57% of firms established before 1990 – and about same percentage of these firms are innovative. Daman & Diu, D&N Haveli and Puducherry have about 40% to 50% firms born between 1990 and 2000. Most of the firms (about 65% to 75%) in Meghalaya, Nagaland, Sikkim and Tripura were born after 2000 – and about the same share of them claim innovation related activities.

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. Daman & Diu reporting highest number of innovations has most innovations in introduction of new machines. The second most common type of innovation reported is product quality and standardization activities. Introduction of new product and new process technology also seems to be quite familiar among the states(UT's). To recapitulate, percentages of innovative firms in the ten states(UT's) are – A&N Island (71.43%), Assam (15.73%), Chandigarh (2.30%), D&N Haveli (57.19%), Daman and Diu (55.49%), Meghalaya (19.61%), Nagaland (6.52%), Puducherry (59.33%), Sikkim (100%) and Tripura (41.26%).

Figure 17: Types of Innovations

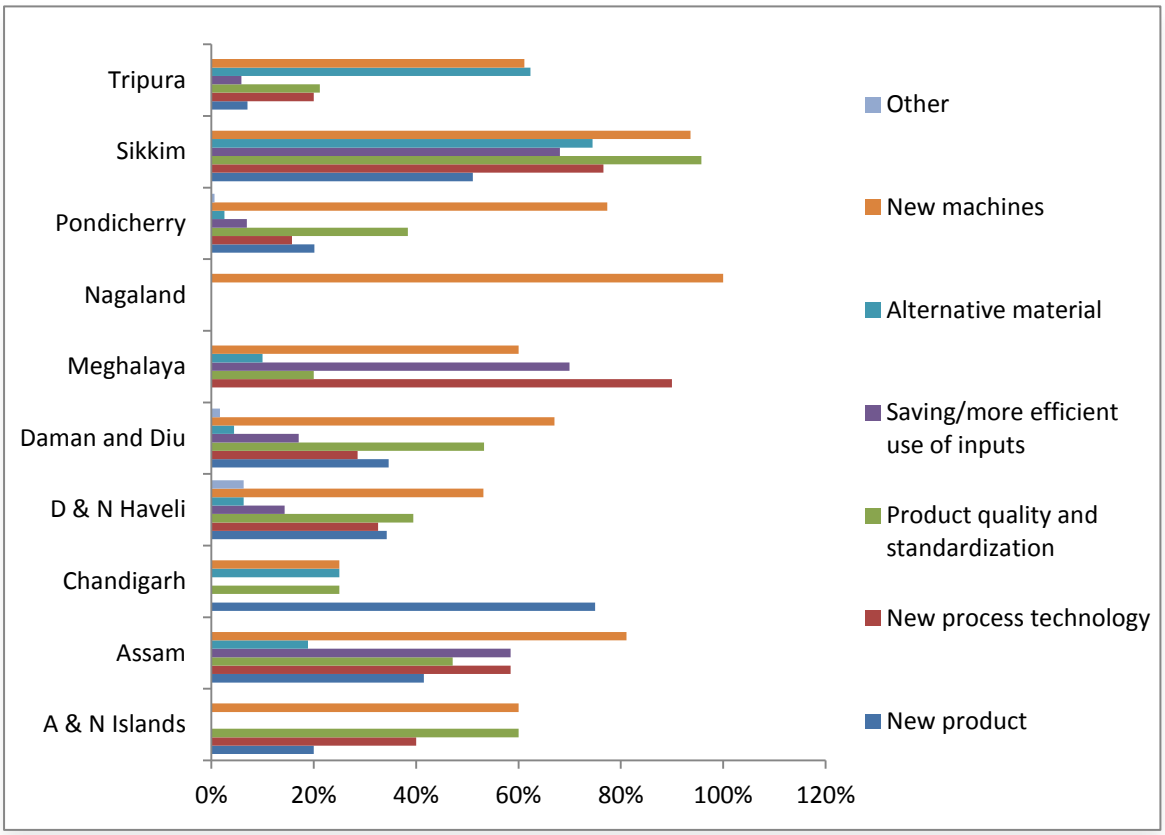


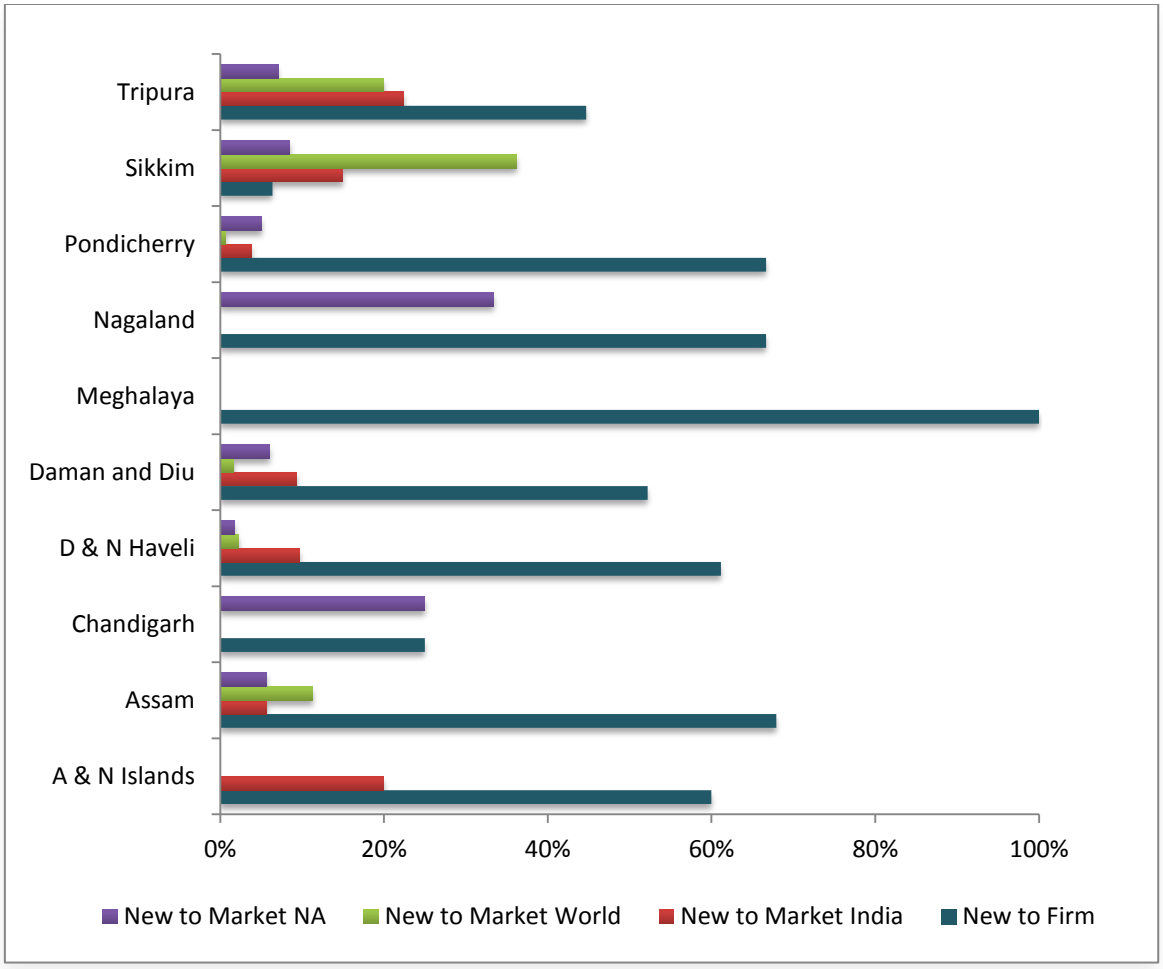
Table 1 shows the engagement or involvement of the innovative firms in various types of activities related to innovation. It is observed that involvement of firms in the innovation activities in the ten states (UT's) is quite diverse except the fact that all the states (UT's) are mainly active in acquisition of machinery, equipment and software. In Sikkim, all firms surveyed had reported innovation related activities taking the innovation intensity of the state to 100%. In terms of involvement of the firms in innovation related activities, the innovative firms in Sikkim are actively engaged in most of the activities related to innovations. States (UT's) with higher innovation intensities like A&N Island, Puducherry, D&N Haveli and Daman & Diu are mostly engaged in innovation activities related to acquisition of machine, equipment and software and also in intramural R&D. On the other hand Nagaland, as expected, with low innovation intensity is involved mainly in acquisition of machinery and providing training.

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 a firm level i.e new to the firm. A few firms mentioned of introducing their innovations to the Indian market.

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

Activities	A & N Islands	Assam	Chandigarh	D & N Haveli	Daman and Diu	Meghalaya	Nagaland	Puducherry	Sikkim	Tripura
Intramural R&D	60.00	43.40	25.00	50.29	30.77	60.00	0.00	30.19	85.11	9.41
Extramural R&D	0.00	16.98	25.00	8.57	3.30	0.00	0.00	6.92	82.98	7.06
Acquisition of Machinery, Equipment and Software	80.00	75.47	25.00	68.00	76.37	70.00	100.00	83.02	91.49	87.06
Acquisition of other external Knowledge	80.00	15.09	25.00	21.71	10.99	30.00	0.00	10.06	87.23	4.71
Training	80.00	50.94	25.00	62.86	69.78	70.00	100.00	45.91	97.87	8.24
Market Introduction of Innovation	60.00	41.51	25.00	14.29	15.38	60.00	0.00	6.92	93.62	7.06
Other Activities	60.00	9.43	25.00	15.43	19.23	10.00	0.00	5.66	78.72	1.18

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 quality standardisation are most common types of innovation*. Innovations are mostly adoption of the market trend in terms of process technology, product quality, machine etc. at firm level, though innovative firms in Sikkim and Tripura have claimed their innovations to be new to the market.

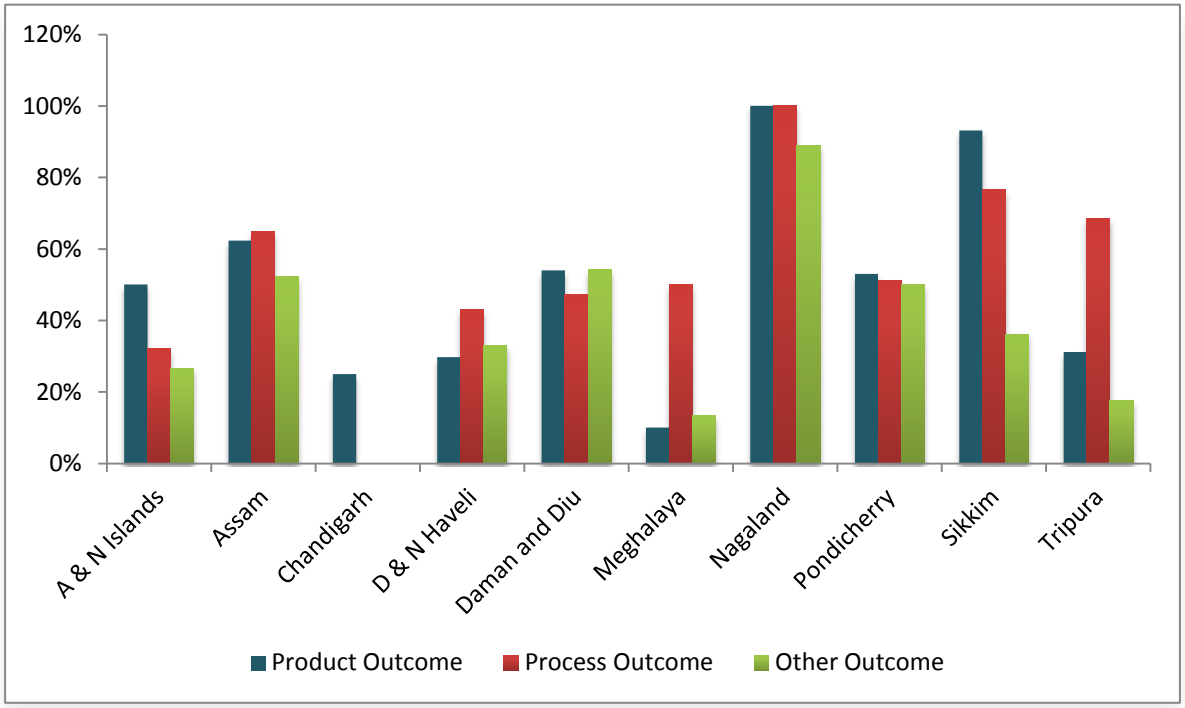
5 Gains from Innovation

This section highlights certain issues such as 'gains from the innovation', 'nature of the gains', 'competitive position of the innovating firms in the market'- which 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 Assam, Daman & Diu, Nagaland, Puducherry and Sikkim claim gains from both product and process innovations whereas firms in other states(UT's) 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 (UT's) under consideration claim themselves to be at par with the best in their respective industries except in FDI where the firms find themselves lagging behind the others.

Figure 19: 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, incresed 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 & N Islands	Assam	Chandigarh	D & N Haveli	Daman and Diu	Meghalaya	Nagaland	Puducherry	Sikkim	Tripura
R&D Activities	60.0	67.9	25.0	62.9	67.1	100.0	66.7	60.4	85.1	98.8
Quality of Manpower Employed	100.0	92.5	100.0	93.7	96.7	100.0	66.7	98.1	100.0	97.7
Technology in-licensing	60.0	69.8	100.0	75.4	81.9	100.0	66.7	88.1	97.9	95.3
New Collaboration	0.0	35.9	50.0	22.3	46.7	90.0	66.7	39.6	78.7	89.4
FDI	0.0	24.5	25.0	22.3	44.0	50.0	66.7	39.6	2.1	9.4
Sourcing of raw material and other inputs	80.0	92.5	100.0	89.7	91.2	80.0	66.7	97.5	83.0	87.1
Efficient cost management	100.0	86.8	100.0	90.3	92.3	100.0	66.7	95.0	80.9	83.5
Quality of machine and equipment	100.0	94.3	100.0	95.4	96.7	100.0	66.7	95.0	89.4	96.5
Efficient organizational practice	80.0	84.9	100.0	88.0	90.1	90.0	66.7	91.8	76.6	89.4
Efficient marketing arrangement	80.0	92.5	75.0	89.1	90.1	90.0	66.7	88.7	93.6	91.8
Better information management	100.0	86.8	75.0	85.1	87.4	90.0	66.7	82.4	91.5	97.7
Successful brand development	100.0	88.7	75.0	82.3	87.4	100.0	66.7	79.3	95.7	95.3

Observation

Innovative firms mostly reported of reaping the benefits from either product or process innovations. Most of the gains appear to be in increased range of goods and services, increased capacity of production and services and improved flexibility of production or services.

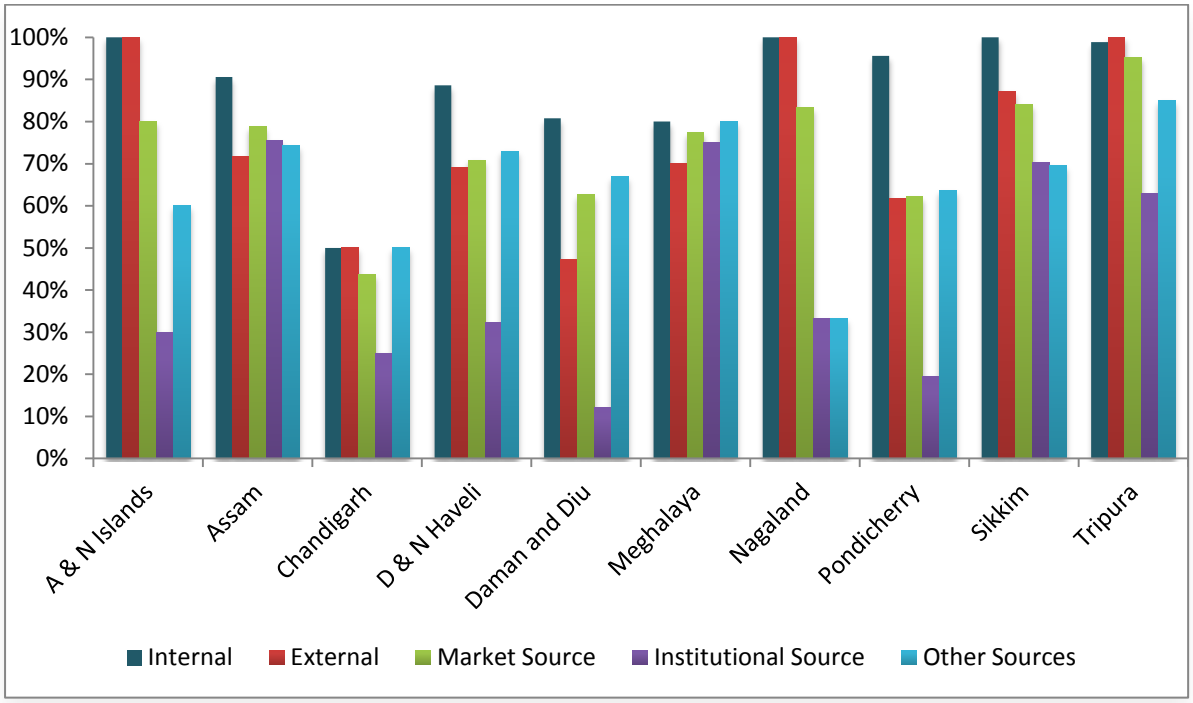
6 Inputs to Innovation

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 varieties of sources 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, while UT's with high innovation intensities like Puducherry and Daman & Diu are less pronounced in accessing external and institutional sources. Market sources like suppliers, clients and even competitors are quite preferred channels of information for the firms.

Availability of fund for innovation is an important aspect of innovation ecosystem. Table 3 represents the financial sources of the firms for augmenting innovations. It 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).

Figure 20: Information Source & Innovation Activity

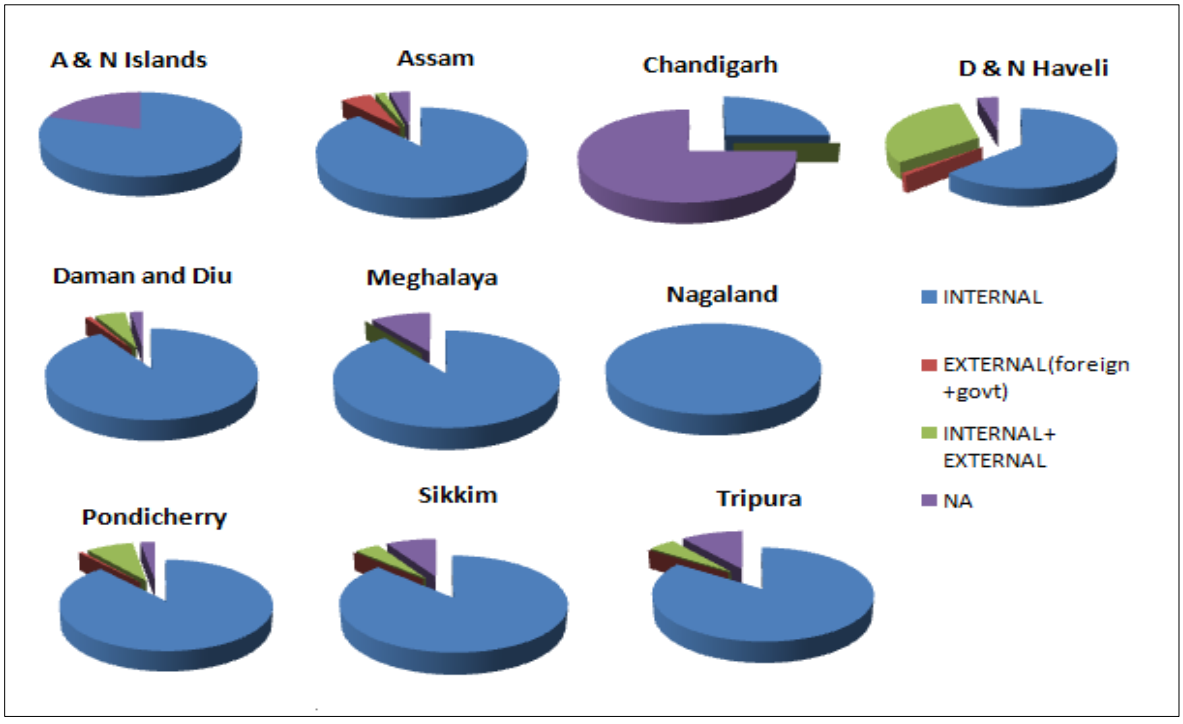


Note: In figure 20, Market Sources include suppliers of equipment, materials, components or software; customer's feedback; competitors or other enterprises in the same sector; consultant, commercial labs or private R&D institutes. Universities, Engineering colleges, polytechnics and Government or public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

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

Sources	A & N Islands	Assam	Chandigarh	D & N Haveli	Daman and Diu	Meghalaya	Nagaland	Puducherry	Sikkim	Tripura
INTERNAL	80.0	88.7	25.0	63.4	91.21	90.0	100.0	88.7	87.2	84.7
EXTERNAL (foreign +govt)	0.0	5.7	0.0	1.2	1.10	0.0	0.0	0.6	0.0	0.0
INTERNAL + EXTERNAL	0.0	1.9	0.0	31.4	5.49	0.0	0.0	8.2	4.3	4.7
NA	20.0	3.8	75.0	4.0	2.20	10.0	0.0	2.5	8.5	10.6

Figure 21: Source of Funding Innovation



Observation

Innovative firms of all the states (UT's) mostly access internal source of finance. Their innovation activities mainly involve carrying out in-house R&D while Sikkim and A&N Island are also involved in extramural R&D and acquisition of other external knowledge.

Like information and finance, human resource is the most indispensible 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 industries in all the states (UT's) have less than 10 technical personnel. This is indicative of the fact that innovation activities constitute minor part of the firms' activities. This is reinforced by the fact, as shown in Figure 23, that a small percentage of firms only provide training. Firms in Meghalaya and Nagaland (states with low innovation intensities) are actively involved in providing training whereas in general most of the firms do not have any major human resource development programme.

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

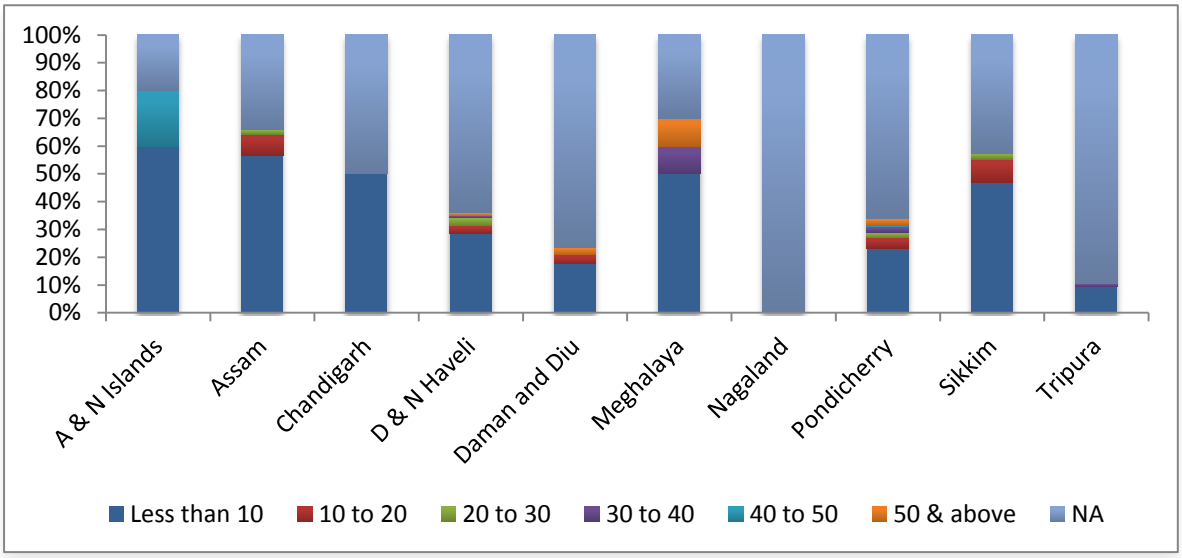
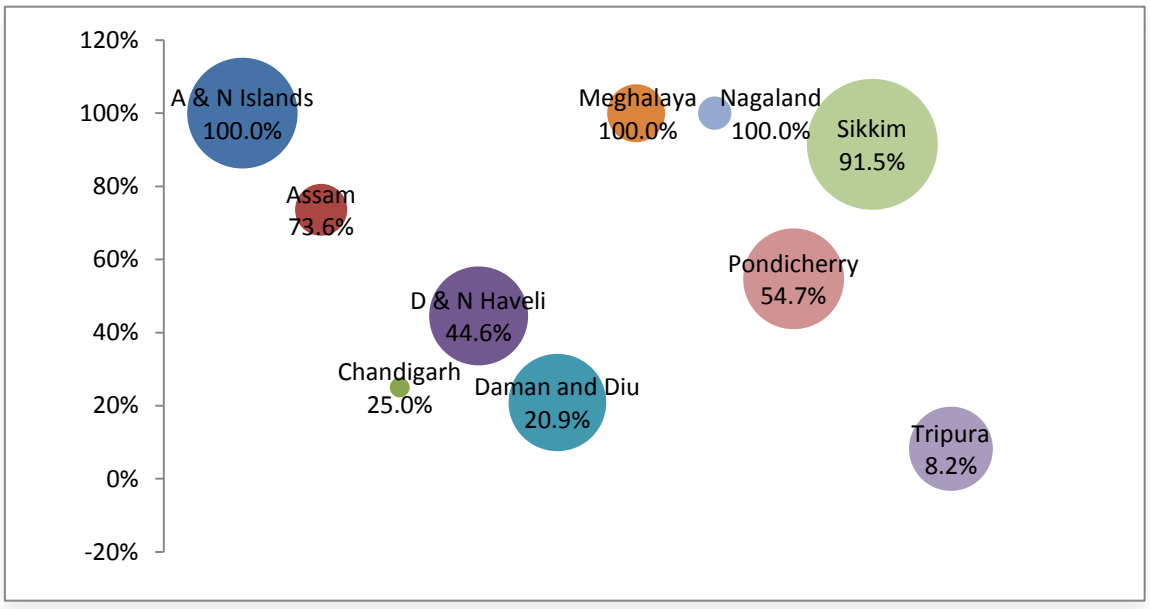


Figure 23: Percentage of Innovative firms providing training



However, in A&N Islands 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

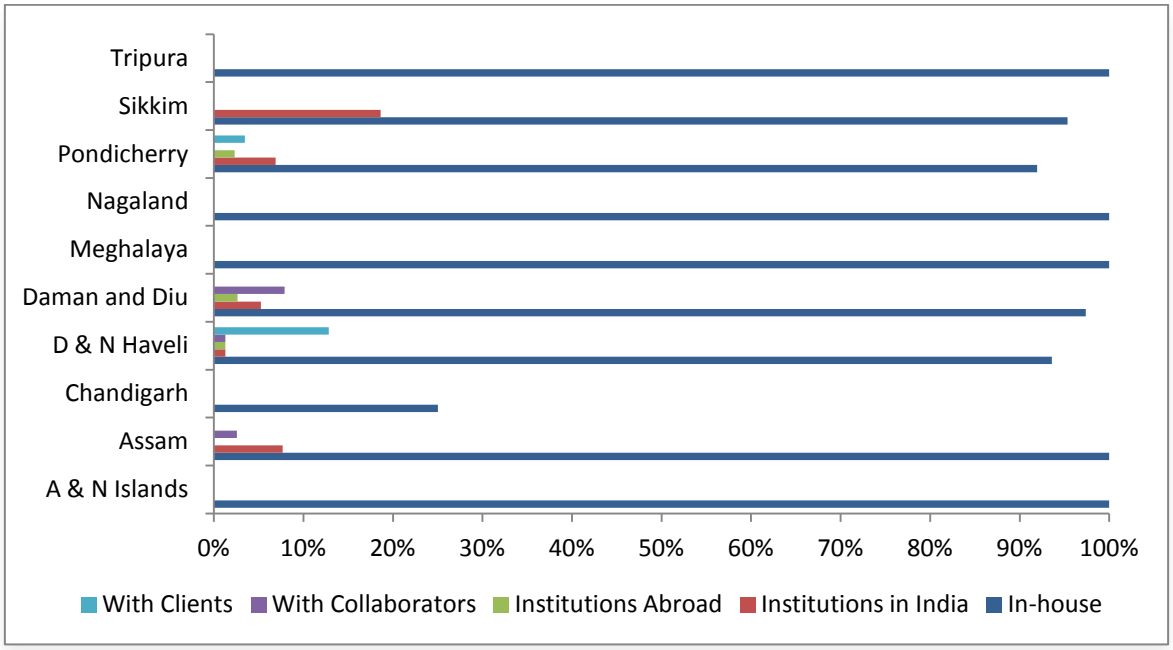
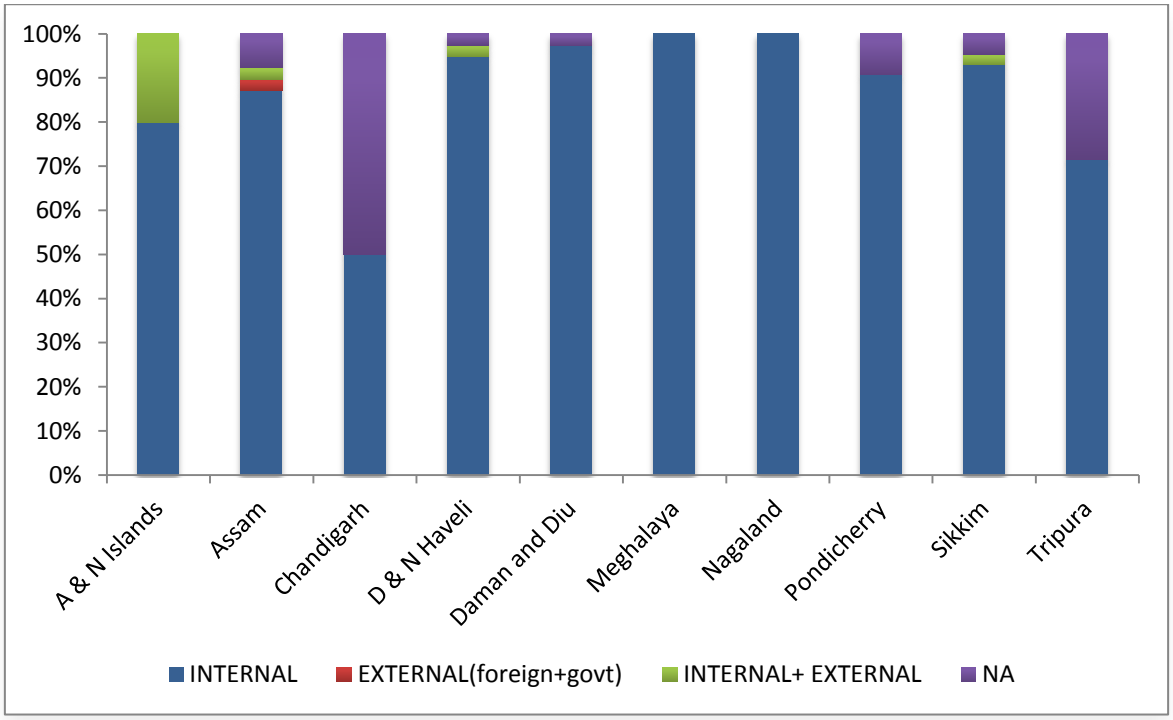


Figure 25: Source of fund for human resource development (training)



7 Factors influencing Innovation

What are the factors that are perceived as critical for promotion of innovation? Table 4 highlights the various factors that are considered important for promoting innovations. Innovative and non innovative firms alike in all the states (UT's) gave a mixed response for the various factors while cost and access to new knowledge of innovation are considered as most important factors that are required to be strengthened.

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

Factors		A & N Islands	Assam	Chandigarh	D & N Haveli	Daman and Diu	Meghalaya	Nagaland	Puducherry	Sikkim	Tripura
Cost Factor	All firms	42.9	43.9	40.2	34.0	32.0	47.1	41.3	34.0	44.7	49.5
	Innovative	28.6	47.1	50.0	35.4	32.4	50.0	33.3	33.3	44.7	49.4
Knowledge Factor	All firms	28.6	43.9	43.7	36.6	39.9	47.1	43.5	34.7	42.6	45.6
	Innovative	28.6	47.1	50.0	38.9	42.3	50.0	33.3	36.5	42.6	44.7
Infrastructure Factor	All firms	14.3	38.2	31.6	12.0	6.7	41.2	8.7	9.3	36.2	37.8
	Innovative	14.3	43.4	25.0	13.7	8.8	40.0	33.3	9.4	36.2	38.8
Market Factor	All firms	28.6	41.8	36.8	22.2	23.1	39.2	41.3	18.7	36.2	47.1
	Innovative	28.6	43.4	25.0	24.0	24.7	40.0	33.3	19.5	36.2	47.1
Others	All firms	28.6	38.0	22.4	18.3	21.0	27.5	37.0	14.2	0.0	46.7
	Innovative	14.3	41.5	25.0	20.6	23.6	40.0	33.3	15.7	0.0	47.1

Reflections from interviews

Common hindrances in innovation activities encountered by the firms,

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

8 Understanding Innovation

The survey shows that Sikkim (100%) has highest percentage of innovative firms followed by A&N Island (71.43%), Puducherry (59.33%), D&N Haveli (57.19%) and Daman & Diu (55.49%). Tripura (41.26%) occupies the middle position in terms of innovation intensity while Meghalaya (19.61%), Assam (15.73%), Nagaland (6.52%), and Chandigarh (2.30%) 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 create demand on the state for appropriate technological and non-technological support to facilitate and augment its own initiatives towards innovation. Such types and nature of demands depend on the overall economic status of the region/state, industrial policy, historical pattern of growth of different sectors (path dependence of technological development), entrepreneurship development etc. Institutional arrangements for addressing such demands are done at the national level as well as at the regional/state levels. These arrangements have three interconnected facets. Some of the arrangements are activated through national government at the national level and 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 facilities for technological and non-technological support to innovation is significant in Meghalaya followed by Assam, Sikkim and Tripura. These states are also active in accessing information/knowledge from R&D institutions. Accessing institutional sources of finance is very rare among the innovative firms. Similarly institutional training programme for human resource development is also rarely accessed.

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

NIS components	A & N Islands	Assam	Chandigarh	D & N Haveli	Daman and Diu	Meghalaya	Nagaland	Puducherry	Sikkim	Tripura
Source of knowledge (Educational institution)	0.0	71.7	25.0	17.1	6.0	80.0	33.3	16.4	63.8	45.9
Source of knowledge (R&D institution)	60.0	79.3	25.0	47.4	18.1	70.0	33.3	22.6	76.6	80.0
Institutional Source of finance	0.0	5.7	0.0	1.1	1.1	0.0	0.0	0.6	0.0	0.0
Training in institutions	0.0	7.7	0.0	1.3	5.3	0.0	0.0	6.9	18.6	0.0
Novelty of innovation	60% new to firm	67% new to firm	25% new to firm	61% new to firm	52% new to firm	100% new to firm	66% new to firm	66% new to firm	59% new to market	49% new to market

For RIS at the state level comparative statuses of the 10 states (UT's) are shown in table 6. 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. Puducherry followed by Chandigarh is at the top in all the parameters, whereas Nagaland is at the bottom. Since data for most of the parameters of D&N Haveli and Daman & Diu are not available; these two Union Territories could not be ranked for RIS (as seen in the table 6). Chandigarh ranked high in HDI and RIS shows poor innovation intensity where as Sikkim which ranks low in HDI and also RIS shows higher innovation intensity.

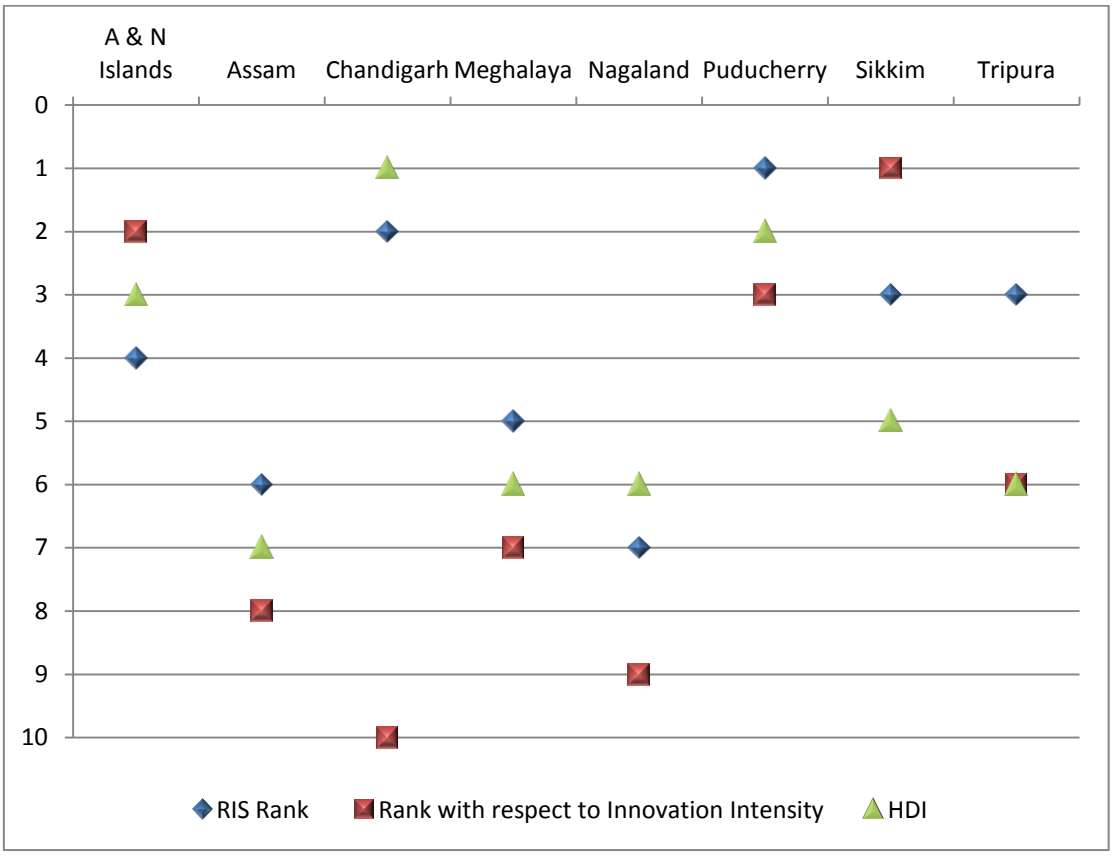
Table 6: Indicative factors of Regional System of Innovation (RIS)

States	NSDP Per capita (Rs) at Constant Prices 09-10	Industry Share in NSDP	Highways Per 100 Sq Km	Health Centers/100 Village	Educational institute/million pop.	Power Generation/ million pop.	RIS Rank	Innovation intensity Rank	HDI Rank
A & N Islands	54830	2.64%	3.64	25.05	29	631.8	4	2	3
Assam	20279	13.68%	3.62	21.47	23	162.0	6	8	7
Chandigarh	90051	6.54%	21.05	79.17	18	0.0	2	10	1
D & N Haveli	-	-	-	81.43	20	-	-	4	5
Daman and Diu	-	-	-	134.78	20	-	-	5	4
Meghalaya	29656	15.42%	3.61	9.01	36	111.3	5	7	6
Nagaland	20971*	3.24%	2.98	41.23	23	129.6	7	9	6
Puducherry	69704	28.16%	11.06	86.96	32	233.0	1	3	2
Sikkim	36075	8.69%	0.87	38.05	33	5487.6	3	1	5
Tripura	33503	4.86%	3.81	82.99	23	416.4	3	6	6

*NSDP per capita at constant price 2007-2008

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

Figure 26: Rank correspondence of different indicators



Note: the figure shows eight states and Union Territories. RIS for D&N Haveli and Daman & Diu could not be calculated due to non availability of data.

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 UT's and for all states (UT's) together (in case of present Bulletin for 10 states (UT's)). 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 out of total firms in a sector taking 10 states/UT's 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 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 7. All the 10 states (UT's) show positive correlations suggesting a better alignment between the industrial activities of the states (UT's) and the 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 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 (UT). (Refer table 7).

Table 7: Indicators for Sectoral Innovation System

States	Indicator 'a' (Rank correlation coefficient)	Indicator 'b' (Skew value)	Innovation Intensity
A & N Islands	0.106	1.87	71.43%
Assam	0.739	4.06	15.73%
Chandigarh	0.087	5.15	2.30%
D & N Haveli	0.709	2.87	57.19%
Daman and Diu	0.772	1.94	55.49%
Meghalaya	0.132	4.30	19.61%
Nagaland	0.346	4.86	6.52%
Puducherry	0.769	2.71	59.33%
Sikkim	0.423	4.56	100.00%
Tripura	0.354	2.17	41.26%
All sectors	1.00	2.87	61.79%

Sectoral distribution of innovative firms in Chandigarh is highly skewed. Also states like Nagaland, Meghalaya and Assam show skewed distribution of innovative firms as compared to other states and union territories. These states also present the lowest innovation intensities. Rank correlations and skew values when examined together brings out the picture that states with high skew value and high positive correlation (like Assam) suggests that firms reporting innovative activities are aligned to the sectors with higher innovation intensity but are constricted within few sectors. On the other hand states (UT's) with low skew value and positive correlation (like Daman & Diu, Puducherry, D&N Haveli) indicates that innovation activities are aligned to sectors with higher innovation intensities. Also states (UT's) like Chandigarh, Meghalaya and Nagaland show high skew value but less positive correlation which indicates that innovation activities are quite sparse and also lack intensity.

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

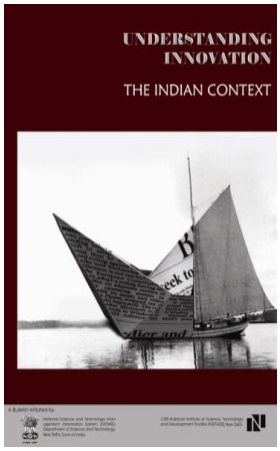
- As has been observed in the cases of states in earlier Bulletins, NIS is not very popularly accessed by the enterprises. In the cases of present ten states and UT's the situation is bit different. In cases of Assam, Meghalaya and Sikkim the firms reported of accessing knowledge from outside sources as well. But even in these states accessing other support systems is rare. Sikkim claims innovation for new market – mainly due to the presence of the pharmaceuticals firms. Tripura also claims the same mainly from food processing and handicraft industries.

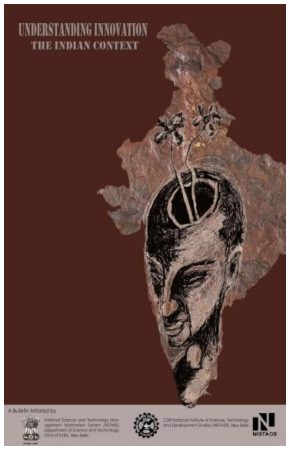
- Chandigarh and Puducherry ranks first and second in RIS ranking. Chandigarh, however, rank low in innovation intensity mainly because the UT was designed not as an industrial area. Assam shows consistent ranking for RIS, innovation intensity and HDI.

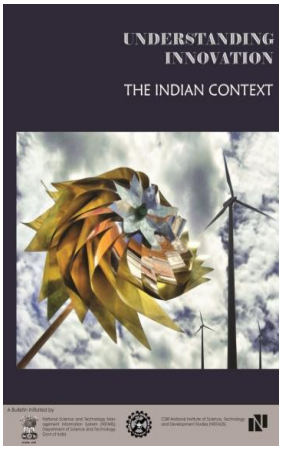
Observation

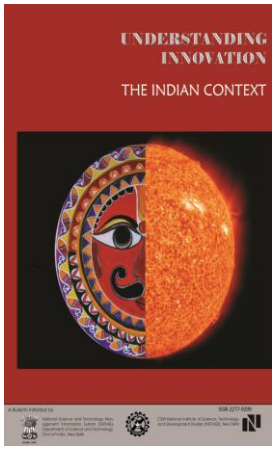
Although Tripura is better better in accessing NIS components as compared to other states, the same is not reflected in their innovation intensity. This is indicative of the poor RIS ranking of the state. It corroborates the fact that the NIS alone may not be sufficient unless combined with RIS and SIS.

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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CENTENARY SESSION OF INDIAN SCIENCE CONGRESS 3-7 JANUARY, 2013, KOLKATA

Science for shaping the future of India

Annual Session of Indian Science Congress has emerged as a major national event. The centenary session scheduled for 3rd – 7th January, 2013 gains historical importance in more than one way. Whereas the themes for all the sessions up the period of 2003 since the first session in 1914 could be grouped under '**Shaping of the Indian Science**', the theme selected for the centenary session is **"Science for shaping the future of India"**. For the first time, Hon'ble Prime Minister of India is the General President of the Indian Science Congress Association during this centenary year.

Science, Technology and Innovation are emerging three pillars from which future societies could not only benefit but also rely for solving social challenges.

Science should emerge as a building block for the future of India. The manner in which the new Science, Technology and Innovation policy 2013 could be implemented would form the central theme of the annual session. A road map for investing science into the development process of India is the main topic for discussion. Various economic sectors like agriculture, housing, energy, environment, health care, water, home land security, communication etc may require new scientific knowledge for shaping their future. The centenary session is expected to serve as a platform for creating coalition among all stake holders of science and society to pave a new path of progress for the country in the emerging global knowledge economy.

The centenary session proposes to engage the attention of the scientific community to discuss, debate and deliberate the best next ways of harnessing science for shaping the future of India. International experts and leaders of many science academies are expected to participate in the centenary session at Kolkata.

Plenary, invited and theme lectures would focus on the theme 'science for shaping the future of India'.

Sessions should be action packed and aim at galvanizing the scientific machinery to deliver new values to the country through science. The lofty goal of the centenary session of the Indian Science Congress during 3rd -7th January 2013 is to make many good things happen in the country through science for shaping the future of India.

University of Calcutta, along with various scientific institutions in Kolkata is hosting this event under the patronage of His Excellency the Governor of West Bengal.

For details, please visit **http://www.isc2013.in**

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