



R&D Activities and Manufacturing Sector: A Study on Gujarat State

Abstract

Theory of structural transformation has stated that few industrial sectors have more importance in production, industrial growth and development of technologies that are used over a wide range of other sectors. Also theories of Regional Innovation System and Sectoral Innovation System have stressed on the importance of various sectors, flows in determining sectoral pattern, investment trend of sectors and intersectoral diffusion of R&D activities. Because of these reasons there are regional imbalances in R&D activities such an imbalances can be seen at sectoral level too. In every economy, there are few sectors that are well developed and occupied the highest share in production and GSDP because of their Regional Innovation System. In case of Gujarat, due to these special characteristics of its Regional Innovation System that sector is manufacturing that occupies the highest industrial production. Manufacturing has been part of Gujarat industrialization and backbone of economy. However, R&D performance of Gujarat's manufacturing sectors is comparatively less than other industrialized states of India, and its necessary to focus on R&D scenario of manufacturing sector at regional level to overcomes hindrances. Based on this issues present article is convinced with studying trend and pattern of R&D activities in manufacturing sector of Gujarat state.

Keywords: *R&D Activities, Manufacturing Sector, Regional Performance*

Introduction

Industrial development is deeply associated with the capacities for carrying out innovations that can compete with rapid technological development. And to create these competencies, a state requires to pass through various phases of learning, creating infrastructure, avail human resources and more importantly inter linkages between these factors (Bhattacharya and Lal, 2008). Porter (1990) has shown how industrial advantages are rapidly concentrated in particular industries and even industry segments, reflecting specific and differing sources of competitive advantages. These competitive advantages are acquired from R&D and its successful transition in industrial development because R&D not only generates knowledge but also contributes to industry's absorptive capacity (Cohen and Levin, 1989). A common feature that separates industrialized economies to other economies is investments in R&D activities, it has been concluded by literature that intensity of R&D investment among various regions shows sharp distinction in their industrial development also investment on R&D activities plays role of induced investment for other industrial activities.

Most of the Indian states spend a fraction of their Gross State Domestic Product (GSDP) on R&D, i.e. less than 1% of their total GSDP (Patil and Biswas, 2014). At individual state level, the top five Indian states, Maharashtra, Tamil Nadu, Gujarat, Karnataka and Andhra Pradesh accounted for more than half of total R&D activities, although these top industrialized Indian states have heterogeneity in R&D performance. The regional disparity in industrial R&D among Indian states is also mirrored in the inter-state distribution of the proportion and the intensity of firms undertaking R&D activities (Pradhan, 2011). Gujarat is one of the top industrialized Indian states. The state contributes around 10 percent of country's total R&D expenditure and up to 0.20 of state's GSDP is being spent on R&D activities. In Gujarat, about 70 to 80 percent of total investments in R&D activities are done by developed industries such as manufacturing and textiles while developing or under developed industries are accounted less than 10 percent total R&D investment (Prowess Database, 2016). However, these trends are not steady and also have downward fluctuations in few years.

There are many reasons why more firms not investing in R&D in Gujarat. Protection policies, fiscal and non-fiscal incentives, small capital, low entities in global market, government controls etc. are the

reasons for Gujarat industries not having the required push for R&D investment. They directly and indirectly affect R&D activities of firms and act as an obstacle for firms to undertake innovation process. However, there has been a significant shift in past few years. Since economic reforms of 1990 and new Science and Technology Policies of state, firm has become more institutionalized and greater integration in global market has taken place. And all over R&D activities scenario have been changing in Gujarat.

R&D Activities: Regional Scenario of Gujarat

Literature on structural transformation has stated that some industrial sectors have more importance in production, industrial growth and development of technologies that are used over a wide range of other sectors. Also theories of Regional Innovation System and Sectoral Innovation System have stressed on the importance of various sectors, flows in determining sectoral pattern, investment trend of sectors and inter sectoral diffusion of R&D activities. Because of these reasons there are regional imbalances in R&D activities in Indian states such an imbalances can be seen at sectoral level too. At regional economy level, there are few sectors that are well developed and occupied the highest share in production and GSDP because of their Regional Innovation System. In case of Gujarat, due to these special characteristics of its Regional Innovation System that is manufacturing that occupies the highest industrial production. However, with technological advancement and developing R&D activities other sectors are also emerging strong eventually. However, industrial development has been usually associated with growth and development of some leading sectors such as manufacturing. These sectors are characterized by sectoral system that differ in their characteristics and dynamics and because of that unbalanced R&D activities can be seen in various industrial sectors of Gujarat. However, the trend has been changing over time. Developing technological independence and a higher share technology usage, growth and spread of more R&D activities and technology clusters etc. factors have been changing sectoral pattern in Gujarat economy eventually, which can prove beneficiary for the balanced growth of sectors other than manufacturing.

Despite of recognized importance of sectoral pattern of R&D investments and use of technology, very few comprehensive studies can be carried out at regional level because of problems in obtaining data especially on particular sectors and on its R&D investment, and use of technology at regional level in India. This article is empirical and theoretical analysis of the nature and dynamics of R&D activities of manufacturing in Gujarat state. The purpose of this study is to analyze trends and patterns of R&D activities in manufacturing sector of Gujarat state. The style of analysis in this chapter is descriptive and inductive. For this study purpose data has been collected from CMIE Prowess, these data included Gujarat based manufacturing firms involved in R&D activities.

Performance of R&D Activities and Manufacturing Sector: Sectoral Profile of Gujarat

Manufacturing sector represents a milestone of many national and regional economies it is crucial sector for structural changes, employment generation and sustainable economic growth. Manufacturing has traditionally played a key role in Indian economic growth. It has been argued that in recent years the importance of manufacturing sector has been changing and restructuring, and resulting in higher investment inflow every year. Literature has also explored that low level of industrialization in developing economies are attributable to long-term changes in the development characteristics of manufacturing sector perspective. Kaldor (1966) considered manufacturing as engine of growth. He said, agriculture being subject to diminishing returns, it is not able to sustain an increasing level of production and income. He concluded that in the developed economies the explanatory variable for the growth of income was the growth of manufacturing. He also attributed it to his theory 'Vardoon's law' (Vardoon, 1949), which concludes that economies of scale are enjoyed by the manufacturing sector. He said that because of economies of scale, there was a tendency for output to grow cumulatively, simultaneously resulting in a rapid growth of productivity.

Manufacturing has been part of Gujarat industrialization and backbone of economy. Also manufacturing sector is emerging as prominent manufacturing investment hub in Gujarat state. Gujarat is among the top five manufacturing investment centres in entire product segments of India.

According to Associated Chamber of Commerce and Industry of India out of total manufacturing investment attracted by India, Gujarat ranked fifth during 2013-15. And the share Gujarat's manufacturing sector in total industrial production has been gradually increasing since past decade. And at regional level manufacturing accounts for about 4/5th of total industrial activity of Gujarat, it is often termed, as the engine of growth besides it's also an affective means of bridging regional disparities in industrialization. That's why seeing strong position of manufacturing sector in Gujarat economy and its influences it is necessary to focus on performance of R&D activities in manufacturing industry for future perspective of industrial growth.

Table 1. shows profile of manufacturing sector of Gujarat i.e. total firms doing R&D activities, its percentage out of total, R&D expenditure and its ratio to sales i.e. R&D intensity. We have already discussed importance and various characteristics of manufacturing sector earlier, although Table 1. gives broad understanding of manufacturing sector profile. Manufacturing sector is major and the most important sector among all in all aspects for Gujarat economy and industrial development. Manufacturing sector has maximum numbers of firms doing R&D and also maximum R&D expenditure but its R&D intensity is comparatively very low and has mixed trends of investment, without any steady increase in R&D expenditure rapid growth of this sector is distance dream. Seeing mixed trend of R&D activities in prime sector like manufacturing more and steady R&D activities is necessity for its sustainable growth.

Table 1. Manufacturing Sector An Overview of R&D Activities

Years	Firms Doing R&D	Percentage of Firms Doing R&D	R&D Expenditure	R&D Intensity
1998	174	54.037	6864.5	0.004
1999	167	51.863	5596.4	0.003
2000	169	52.160	6907.8	0.002
2001	187	57.362	7720.4	0.003
2002	195	59.633	7917.1	0.003
2003	196	59.939	10251.6	0.003
2004	187	57.187	15730.4	0.004
2005	186	56.364	19299.2	0.004
2006	197	59.517	28042.1	0.004
2007	205	61.747	32442.6	0.005
2008	205	61.747	41354.3	0.005
2009	210	63.063	40417.6	0.004
2010	212	63.473	49570.4	0.004
2011	217	64.776	65984.7	0.005
2012	230	68.657	75170.7	0.005
2013	224	66.866	84349.3	0.005
2014	216	64.478	82366.3	0.005
2015	187	55.821	79006.9	0.005

Source: Estimation based on Prowess Database (2015), CMIE

In Gujarat economy manufacturing sector's value added and employment share have been increasing and changing its potentials but that is primarily caused failure of manufacturing potential development because of lack of R&D process and innovations. A real challenge is low level of R&D activities and lack of innovations compared to other industrially developed states in order to resilience Gujarat economy in context of sectoral imbalances and industrial development. A reindustrialization of manufacturing sector in Gujarat state is necessity. This analysis aims to highlights role and hindrances of R&D in manufacturing sector in Gujarat. During the last few years the manufacturing sector has witnessed impressive growth in Gujarat, which has helped the GDP to grow historically on high growth rates. Currently, manufacturing sector is witnessing its longest period of upswing since the 1990s but there is a clear divergence between the performances of different industrial sectors in Gujarat state. Sustaining a rapid growth of manufacturing and achieving

the transition to mass manufacturing requires another major push to the reform agenda and R&D activities can play the role of that big push for manufacturing to sustain rapid development and transition in manufacturing production and demands.

Further related to ownership of manufacturing sector next tables analyze R&D performance according to private domestic and private foreign ownerships of firms in manufacturing sector. First, Table 2 analyses profile of private domestic ownership in manufacturing sector firms for given years. In this ownership of manufacturing sector more than 50 percentages of firms were involved in various R&D activities with the highest of 70 percentages in 2012 and the lowest of 50 percentages in 1999 in given time. While R&D intensity were more than 0.005 percentages since 2003, although since 2009-2012 R&D intensity were about 0.007 which was increased to 0.008 since 2013-2015, that shows mixed trend of R&D intensity with nominal fluctuations but in all ownership of manufacturing private domestic sector has the highest numbers of firms doing R&D with comparatively higher R&D intensity for given years. On the other hand, R&D investment of this ownership also has mixed trends. However it has been increasing since 1999 except minor decrease in years of 2009, 2014 and 2015.

Table 2. Manufacturing Sector Distribution of Ownership: Private Domestic

Years	R&D Expenditure	Firms Doing R&D	Percentage of Firms Doing R&D	R&D Intensity
1998	5416.7	146	52.143	0.007
1999	4494.8	139	49.643	0.005
2000	5851.1	146	51.773	0.004
2001	6582.6	161	56.69	0.004
2002	6583.1	169	59.289	0.004
2003	8880.2	170	59.649	0.005
2004	13995.1	165	57.895	0.006
2005	17848.1	163	56.597	0.006
2006	26563.4	173	59.862	0.007
2007	30544.1	180	62.069	0.008
2008	38646.1	180	62.069	0.008
2009	36645.4	185	63.574	0.007
2010	46109.2	187	64.041	0.007
2011	62689	192	65.529	0.007
2012	71496.9	205	69.966	0.007
2013	80331.3	199	67.918	0.008
2014	78287	192	65.529	0.008
2015	75302.1	167	56.997	0.008

Source: Estimation based on Prowess Database (2015), CMIE

Table 3. shows R&D performance in foreign private ownership of manufacturing firms. In this series total number of firms were around 20 for given years. While R&D expenditure of this private foreign firms showed mixed trends with frequent and major fluctuation. On other hand R&D intensity of these firms was the highest i.e. 0.009 percentages in 1998, and after 1998 it remained less than 0.005 for given years with nominal changes year wise. In private ownership of manufacturing sector firms, total domestic private firms are more than total foreign private firms, which shows strong regional innovation system for firms in private sector. And R&D intensity of private domestic firms are comparatively higher than private foreign firms in most years which also states that domestic private firms are more keen to do R&D compared to foreign firms.

Table 3. Manufacturing Sector Distribution of Ownership: Private Foreign

Years	R&D Expenditure	Firms Doing R&D	Percentage of Firms Doing R&D	R&D Intensity
1998	550.7	21	62.63	0.009
1999	213.8	22	68.75	0.003
2000	247.5	19	59.38	0.003

2001	339.6	21	65.63	0.004
2002	305.9	20	62.50	0.003
2003	391.7	20	62.50	0.004
2004	334.5	16	50.00	0.003
2005	439.5	17	53.13	0.003
2006	553	18	56.25	0.003
2007	568.3	19	59.38	0.002
2008	675	20	62.50	0.003
2009	1114.9	20	62.50	0.004
2010	1164.6	18	56.25	0.004
2011	1192.8	18	56.25	0.004
2012	916.8	18	56.25	0.003
2013	1268.4	18	56.25	0.004
2014	1234.4	17	53.13	0.004
2015	902.7	14	43.75	0.005

Source: Estimation based on Prowess Database (2015), CMIE

Over years the scenario of Gujarat state in field of R&D has changing. Various facilities and advanced technologies to encourage R&D provided by state have been increasing steadily, also government boots R&D infrastructure by applying more and more PPP model in industries. Gujarat government has been steadily increasing amount spent on R&D centres, this is resulted into increasing numbers of R&D institutions with in state every year. There are many state funded R&D institutions in Gujarat for various industries and for various purposes in the field of manufacturing and others such as Institute of Plasma Research (Gandhinagar), Center for Salt and Marine Chemical Research Institute (Bhavnagar), Gujarat Energy Research and Management Institute (Ahmedabad), Institute of Pharmaceutics Education and Research (Ahmedabad), Physical Research Laboratory (Ahmedabad) and Institute of Seismic Research (Gandhinagar) etc. Including this government has its own bodies for promoting research such as Gujarat Innovation Society, Gujarat State Innovation Council etc. And government has been covering vast fields to promote R&D, their aim is covering not only high technology and developed manufacturing sector in R&D field but also low technology and underdeveloped sectors like agriculture, agro products, dairy technology, animal husbandry, ceramic, bidi-tabaco, maize, micro nutrients and grass root etc. These government initiatives for promoting R&D in various industries show positive side for Gujarat state's low R&D activities scenario compare to other states and by these efforts the state can reach sustained level of R&D activities followed by forward and backward linkages of manufacturing sector in various industrial sectors too.

Conclusion

Scherer (1981) and Pavitt (1984) concluded that manufacturing is the core technology sector and prior condition for industrial growth. This conclusion is proven fact for Gujarat state too because Manufacturing is the most influencing sector for industrial development of Gujarat economy which has the highest production share in total industrial production and also occupies the highest R&D activities among all given sectors. Manufacturing sectors is the embodiment of technology that pervades all R&D activities in economy of Gujarat. However, the cluster of R&D activities is more than not straddle these. There are sector of the economy with increasing intensity of R&D activities other than manufacturing, particularly in electrical and diversified sectors which until recent would have considered as less R&D intense and low technology. However in recent time, there have been overall increase sectoral R&D activities and also increasing penetration of intersectoral technologies interdependence other than manufacturing sector in Gujarat. We shall not summarize the main empirical conclusion emerging from this study, since this is done in the abstract at the beginning. We shall instead concentrate on implication for further analysis on this study. This study will be to improve the accuracy and details in characteristics and measurement of sectoral scenario of R&D activities in manufacturing in Gujarat state. Such sectoral analysis will improve economic and technological consequences of research and development needs as whole and also of any particular

sector, including intersectoral differences in productivity trend, input output ratio and in tracking the structural effect through R&D activities in industrial development in Gujarat state.

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Krishna Lala

Research Scholar

Central University of Gujarat

Gandhinagar

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