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Knowledge Production by Indian Biotechnology Parks

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Abstract: Globally knowledge parks are encouraged as a source of economic competitiveness of a region and economy. Following the developed countries model of knowledge parks, many developing countries are also promoting technology parks. In India, central as well as various state governments have encouraged science parks in different locations. This study maps the knowledge production by science parks, particularly the Indian Biotechnology Parks. Publication records from Scopus databases are used to map the growth of publications, major areas of activities, the productive institutions and collaboration patterns among top actors. The result shows that scholarly publications from these parks have increased significantly in the last decade. However, the number is very less in terms of global publication share. The maximum publications are from the physical science areas, followed by life science subjects. Collaboration patterns show that Indian educational institutes are collaborating with the entities located very close by the parks. However, collaborations among industry and academia are very limited.

Key words: Biotechnology Parks, High Technology Parks, Scientometrics, Network Analysis, India.

1. Introduction

The clustering of high-tech firms in Silicon Valley is a unique phenomenon of the 20th century (Cao 2004). The special agglomeration of firms, mainly the high technology firms in a particularly location, is generally known as 'Technology Park' or 'High Technology Parks' or 'Knowledge Park' or 'Science Parks' or 'University Research Parks'. As the concept is

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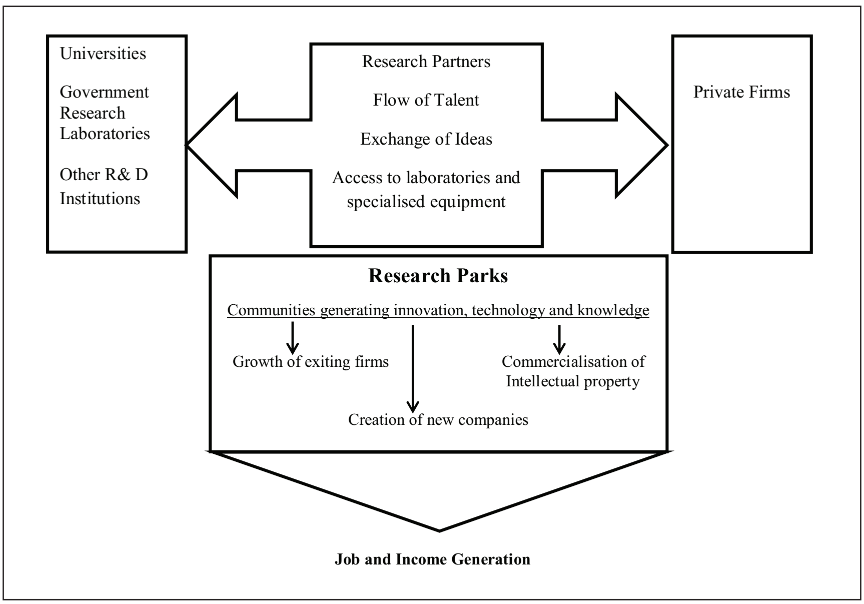
similar, these terms will be used interchangeably throughout this article. The Research Park's concept had emerged about 55 years ago. The first knowledge park called as 'Research Triangle Park' evolved in North Carolina State of USA (Link and Scott 2003). Since then the number of research parks has increased significantly. The maximum growth of research parks in the US was observed during the 1970s and the early 1980s. The maximum growth of research parks during that time was due to the drop in industrial research and development (R&D) spending and a growing need for university-industry collaboration (Link and Scott 2006). Now, Science Parks are among one of the most prominent ingredient of the national innovation system not only in the US but also in various countries around the world (Wessner 2009; Zou and Zhao 2013). Globally, research parks are mushrooming to accelerate economic growth and global competitiveness. These parks are widely considered as a means to boost dynamic innovative cluster of high technology companies. They are also an effective means to generate employment and to increase competitiveness among firms located in a particular location (National Research Council, 2009). Besides, these parks are considered as an important mechanism for the technology transfer form university research to industrial production and knowledge spillovers (Link and Scott 2006).

By definition Research parks are *"real-estate developments in which land and buildings are used to house public and private R&D facilities, high technology and science based companies, and support services. By providing a location where researchers and companies operate in close proximity, research parks create an environment that fosters collaboration and innovation and promotes the development, transfer, and commercialisation of technology"* (Characteristics and Trends in North American Research Parks 2007; p. 3). Globally, the Technology Parks are built around the following ten basic principles: *favorable business rules; knowledge intensity; a high-quality and mobile work force; result-oriented meritocracy; a climate that rewards risk-taking and tolerates failure; an open business environment; universities and research institutes that interact with industry; collaborations among business, government, and non-profit organisations; a high quality of life; and a specialised business infrastructure equipped with venture capital, lawyers, headhunters, accounting firms, and* *consultants* (Cao 2004). Following this model, globally research parks are now evolving as a source of economic competitiveness of a region and economy. Many a times these parks are located in close vicinity of a university or government research institutions (Figure 1). These parks act as a nursery ground for future entrepreneurs. Also for the firms, parks provide high skill talents and suitable collaboration partners from industry and academia. In this way technology parks create conducive environment for collaboration, innovation, technology transfer and commercialisation of technology (Link and Scott 2007). Presently, countries are promoting science parks, with different facilities (for example, tax break and infrastructure facilities) to gain a competitive edge in the global economy.

Figure 1: Research Park Concept



Source: Driving Regional Innovation and Growth: The 2012 Survey of North American University Research Parks, p. 6.

Globally, these kinds of parks are generally promoted by the government of respective countries. There are many success stories of technology parks from Asia to Europe to Latin America (Engardio 2009). A study conducted by Association of University Research Parks (Association of University Research Parks 2007; Vaidyanathan 2008) found that biotechnology and pharmaceuticals (23.8 per cent of companies) and information technology, software in particular (20.2 per cent of companies), are the two most dominant technologies in research parks.

Technology Parks in the developed countries are successful vehicle for innovation and commercialisation of technology. As this model is a success, developing countries are also inspired by this model and adopt the 'park model' as a vehicle for technology-based economic growth and development (Kulkarni 2005). The park model is also proved as success in case of newly industrialised and emerging East Asian countries. These countries (such as Taiwan, South Korea, Hong Kong, and Malaysia) are successful in attracting foreign investment and especially promoting knowledge-based industries. However, there are difference between the developing and developed countries' park model; particularly the Indian technology parks are quite different than the developed countries' parks. Indian high technology parks are different in the following three aspects. Firstly, technology parks in developing countries are industry or sector specific. For example, the Indian parks are specialised in IT or biotechnology industry. Secondly, university-industry linkage is absent or very limited. Majority of the technology parks in India are not closely linked with university or research institutes. Finally, Indian technology parks are export oriented whereas the science parks in the West focus on both export and R&D. However, biotechnology parks in India are in growing stage and it is predicted that they have enough opportunity to grow with the support from both state and central government (Vaidyanathan 2008).

Many studies on various aspects of technology parks are available from different developed countries. Among many, a few famous examples are *Silicon Valley and Route 128* (Saxenian 1996), US science parks and Triangle park (Link and Scott 2003; 2006) and so on. A number of studies have also come up from China (Walcott 2003; Cao 2004; Zou and Zhao 2013; Walcott and Heitzman 2006). Except a few (for example, Vaidyanathan 2008) scholarly research on Indian technology parks, particularly the Indian Biotechnology Parks, are rather limited. This study is an attempt to map the knowledge generation by the entities located in the knowledge parks in India. To map the knowledge production by the entities this study uses scientometrics techniques to map the scholarly literature published from the knowledge parks in India. The article is organised as follows: Section 2 is a brief overview of biotechnology parks in India and their locations, operational status and year of establishment. The sections 3 and 4 discuss the methodology and the limitations of the study. The result section points the findings and in the concluding section policy issues are discussed.

2. Biotechnology Parks in India

After the success of software technology parks in the 1990s, bio tech industry is now seen as the next major player in India's economic growth. Both the central and state government have played significant role in development of Biotech Park in India. Although initially parks including Information Technology (IT) parks were under the control of central government, now many parks are operated even as fully private parks. However, in comparison to developed West, Indian technology parks are still in their infancy with a few operating parks (Vaidyanathan 2008). Among biotechnology parks, '*Genome Valley,'* is the first and perhaps the most successful biotech cluster of India. Beside this, Andhra Pradesh has about five other successful biotech parks. With all these biotech parks Andhra Pradesh is considered to be the leader of biotech industry. The success of Hyderabad cluster is because of the strategic location of "Genome Valley". Hyderabad has a number of world class educational institutes and research laboratories. For example, the Indian Institute of Chemical Technology, National Institute for Nutrition, Center for DNA Fingerprinting and Diagnostics, Center for Cellular and Molecular Biology, L. V. Prasad Eye Institute, University of Hyderabad and so on are located nearby.

At the central level the Department of Biotechnology (DBT) is the main agency responsible for developing biotechnology related infrastructure in India. The DBT has extended its support to set up biotechnology parks in different parts of the country. Beside the central government's initiatives, many state governments' have supported several biotech parks in India. Many state governments have formulated separate policy measures for biotechnology. Among the state governments, Karnataka, considered the leader in IT sector, was also the first to announce a state *biotechnology policy* in 2001. Karnataka government's decision was followed by Andhra Pradesh, Maharashtra, and other states. Biotech policies aim to establish and support bio tech parks to bring together universities, research institutes and firms in one place. Although Karnataka was the first state to have biotechnology policy, Andhra Pradesh was the first state to have a fully operational biotech park. These parks are mainly started to promote small and medium biotech entrepreneurs. In terms of facilities, parks offer various facilities on basis like incubation, pilot plant, tax incentives, venture funding and so on to attract entrepreneurs (Vaidyanathan 2008). Table 1 provides a comprehensive list of current and proposed parks in several Indian states. This list is prepared from different print sources, web resources and from websites of various parks. Information of about 45 already operational and proposed biotechnology parks is available from these sources (Table 1).

Table 1: Biotechnology Parks in India

Organisation	Area (Acre)	Year of Establishment	Place
Agri-Biotech Park	30	2009	Dharwad, Karnataka
Agri-Science Park		2003	Hyderabad, Andhra Pradesh
Alexandria Knowledge Park™ (previously known as Shapoorji Pallonji Biotech Park)	300	2001	Hyderabad, Andhra Pradesh
Animal House (Vivarium)	20	2009	Bidar, Karnataka
Ansal API Biotech Park	20	2010	Lucknow, Uttar Pradesh
Bangalore Helix	100	2009	Bangalore, Karnataka
Bhiwadi Biotech Park	45	Proposed	Bhiwadi, Rajasthan
Bio - Pharmaceuticals SEZ	4000		Hosur, Tamil Nadu
Biotech Incubator	3		Hyderabad, Andhra Pradesh
Biotechnology park	100	2008	Kharagpur, West Bengal
Boranda Biotech Park	30		Jodhpur, Rajasthan

Table 1 Continued...

Table 1 Continued...

Chopanki Biotech Park			Chopanki, Rajasthan
Golden Jubilee Biotech Park for Women Society	20	1997	Kanchipuram, Tamil Nadu
Guwahati Biotech Park (GBP)	35	2008	Guwahati, Assam
Herbal Pharma Biotech Park	183	2003	Betma, Indore, Madhya Pradesh
IKP Knowledge Park (previously known as ICICI Knowledge Park)	200	2000	Hyderabad, Andhra Pradesh
Inspira Infrastructure Biotech Park	250	2004	Aurangabad, Maharashtra
International Biotech Park	110	2003	Pune, Maharashtra
International Pharma & Biotech Park, Ahmedabad	32	2004	Ahmedabad, Gujarat
Jalna-Aurangabad Biotech Park	200	2001	Jalna, Aurangabad, Maharashtra
Jogindernagar Biotech Park		2002	Shimla, Himachal Pradesh
Kinfra Biotech Park	30	2005	Cochin, Kerala
Kinfra Biotech Park	25		Thiruvanantha-puram, Kerala
Kinfra Marine Park		Proposed	Beypore , Kozhikode, Kerala
Kinfra Advance Techhnology park		Proposed	Ramanattukara Kozhikode, Kerala
Kinfra Mega Food Park		Proposed	Wayanad, Kerala
Kinfra Industrial Park		Proposed	Ottapalam, Palakkad, Kerala
Kolkata Biotech Park	30	2011	Kolkata, West Bengal
Konark Knowledge Park	10	2009	Konark, Chandrabhaga, Orissa

Table 1 Continued...

Table 1 Continued...

Mahindra Industrial Park	3200		Chennai, Tamil Nadu
Manesar Biotech Park	1000	2006	Gurgaon, Haryana
Marine Biotech Park	60	2003	Visakhapatnam, Andhra Pradesh
Marine Biotech Park		2009	Mangalore, Karnataka
Marine Biotechnology Park	300	2004	Mahabalipuram, Tamil Nadu
MITCON Biotech Park			Pune, Maharashtra
Neutri/Neutraceutical and Phytopharmaceutical Park (N2P2 Park)	100	2009	Mysore, Karnataka
Pantnagar Biotech Park	500	2008	Pantnagar, Uttaranchal
Peninsula Biotech Park	120	2006	Goa, Goa
Pharma Park	2400	2005	Visakhapatnam, Andhra Pradesh
Punjab Biotechnology Park Ltd. (PBPL)	13	2004	Dera Bassi,Chandigarh, Punjab
Savli Biotech Park/Akruti Biotech Park	700	2007	Vadodara, Gujarat
Sitapura Biotech Park	30		Jaipur, Rajasthan
Solan Biotech Park	35	2010	Solan, Himachal Pradesh
The Techno Park	20	2007	Changodar, Ahmedabad, Gujarat
Ticel Bio Park	3	2004	Chennai, Tamil Nadu

Source: Author's own compilation based on Biospectrum 2009, Kulkarni 2005, Pharmabiz 2003 and websites of various parks.

The state wise distribution of parks shows that Andhra Pradesh and Kerala have maximum number of parks (six parks in each state). The number of parks in the other states is as follows: Karnataka (5), Tamil Nadu (5), Maharashtra (4), Rajasthan (4), Gujarat (3), Himachal Pradesh (2), West Bengal (2), Assam, Goa, Haryana, Madhya Pradesh, Orissa, Punjab, Uttar Pradesh, and Uttaranchal have one park each which is either proposed or already established. The zone wise distribution shows that most of the parks are concentrated in the south zone. Three southern states of India, namely, Andhra Pradesh, Kerala, Karnataka and Tamil Nadu altogether have 22 parks. The western zone (Maharashtra, Rajasthan, Gujarat and Goa) has 12 parks. Northern and Eastern Zones have 6 and 4 parks, respectively. The zone wise distribution has shown that perhaps there are possibilities of opening up of more parks in Northern and Eastern zones. There are many educational centres of excellence and research laboratories that may provide a conducive environment for new park in these areas.

3. Methodology

To map the research output of Biotech parks of India, literature data was downloaded from Scopus database. Elsevier B.V., an academic publishing company, is the owner of this database. It is the largest indexing and abstracting database of peer-reviewed academic literature. Till date, this database covers about 21,195 titles (including journals, books, conference proceedings and so on) and 53 million records from 5,000 publishers globally. A good number of journals (about 534 different titles) are indexed in this database from India. Hence, it is expected that coverage of Indian literature is more than any other indexing and abstracting databases. For this study, Scopus is used to map literature growth, subject areas of research, the affiliation of institutes from where the literature is published and collaboration patterns of different entities. The documents were retrieved from the affiliation search field (affiliation filed or AFFIL in Scopus search). The records were searched till 2013. Searches were carried with the following search string: AFFIL (Biotechnology Park) or AFFIL (Biotech Park) or AFFIL (Biotech Incubator) or AFFIL (Knowledge Park) or AFFIL (Pharma Park) or AFFIL (Techno Park) or AFFIL (Genome Valley) or AFFIL (Pharmaceutical Park) or AFFIL (Special Economic Zone) or AFFIL (Industrial Park)) and PUBYEAR < 2014. The above search strategy yields about 9,891 records from all over the globe. From the whole set of literature data about 397 records was published from India. Further analysis of records shows that some records are not generated from S&T parks of India but are published in collaboration with the Indian entities. These records were removed from the database. The final analysis of research publications of Indian technology parks is based on 384 records.

The literature data is further analysed to trace the literature growth pattern, subject areas where there are maximum number of activities and collaboration network among the prominent actors of technology parks. UCINET 6 and Netdraw software packages are used for social network analysis. This software is developed by Analytic Technologies and is freely available for academic purpose for a limited period (Borgatti *et al.* 2002).

4. Limitations

Significant advances in knowledge happen primarily because of the basic research. Basic research is likely to generate substantial external economies. Although it is socially desirable, private-profit oriented research generally do not draw large quantity of resources into basic research (Nelson 1959). Basic research is costly as well as risky; it cannot be commercialised immediately and is considered as a public good. Scholarly articles are generally considered as an output of basic science. Once the result of basic research is available in the codified form in the open market, anyone can assimilate and use it freely. Due to its freely available nature, firms have relatively little incentive to do basic research (Godin 1996). Normally, industry publishes relatively few scientific papers. Hence, Scientometrics measures are not very well suited indicator to map industrial science. Industries located in the knowledge parks or industrial parks have their focus primarily on technology commercialisation rather than basic research. However, the research parks house mostly high technology firms, particularly biotechnology and information technology firms. These types of firms and entities publish quite good number of articles. Hence, this study focuses on research articles published in the peer-reviewed international scientific and technical journals. These research outputs are the representation of quantifiable research outputs of firms located in these parks. Systemic measurements of research trends can be measured from these articles. In this process, co-authored research papers are assumed to reflect research cooperation, knowledge flows and exchanges among different actors (Calero *et al.* 2007). Another important point to mention here is that if a firm or institution located in the technology parks has not mentioned its ‘park address’, it may be missed in the analysis.

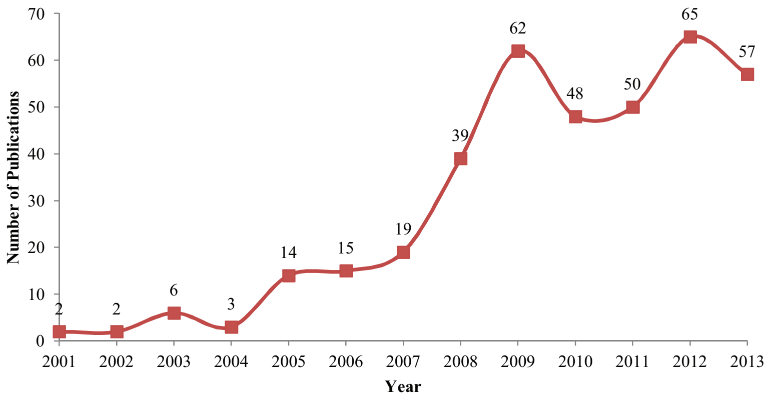
5. Results

The data obtained from the search is further analysed into three broad themes. Firstly, the data is analysed to trace the scholarly literature growth pattern of entities located in the technology parks. Secondly, the subject categorisation is plotted to examine the subject wise distribution of research. Finally, this study traces the top productive institutions and collaboration patterns among the institutes and other entities. However, the study is an indicative trend and it can be further substantiated by the other form of output indicators. The performance measurement through other output indicators, for example, patenting, licensing and so on by the entities located in the technology parks will further validate the propositions.

5.1 Growth of Literature

The scholarly publication pattern shows that globally about 600 scholarly publications per year are originating from technology or science parks. Although scholarly publications from technology parks are quite old phenomenon globally, the publications from Indian technology parks started only from 2001 onwards. In that year two articles were published by John F. Welch Technology Centre and GE India Technology Centre Private Limited located at Export Promotion Industrial Park in Bangalore. One of the articles was published in collaboration with Indian Institute of Chemical Technology, Hyderabad and University of Florida, United States. The second one was published with Materials Science and Technology Division, Thapar Center for Industrial Research and Development, Patiala. After the initial years, a visible growth of scholarly publications is observed from 2004 onwards. From 2004 to 2009, the growth of publications was exponential. After that there was a decline in the growth of publications. Since last couple of years, the Indian technology parks produce about 60 articles per year (Figure 2).

Figure 2: Growth of Publication from Biotechnology Parks in India



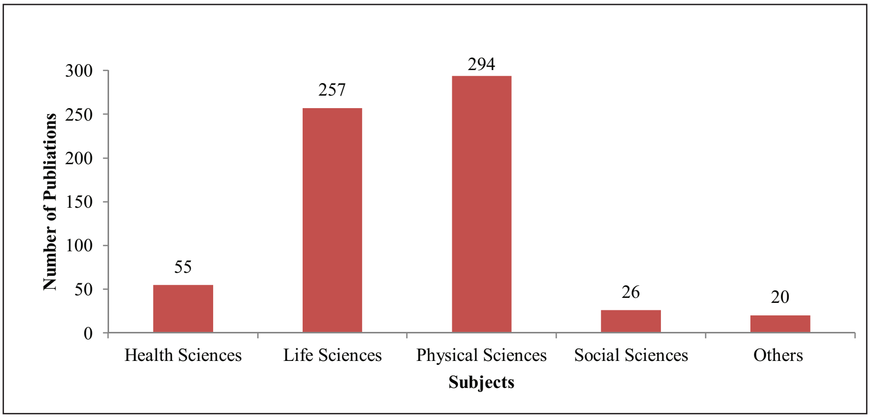
Source: Author's compilation based on Scopus® database, Elsevier B.V.

5.2 Research Areas

Scopus database has broadly categorised the universe of knowledge into four distinct categories. These four categories are physical sciences, health sciences, social sciences and life sciences. These subjects are further classified into 28 subject categories. However, this subject categorisation is very broad, so there are many overlapping of subjects. From Indian biotechnology parks the maximum numbers of publications are from physical science areas. They constitute about 76 per cent of total publications. This group is followed by life sciences and constitutes about 67 per cent of the total Indian publications. The subject area wise break up of publications is shown in Figure 3 and the details are shown in Table 2.

Although this study focuses primarily on the knowledge production in terms of scientific publications from biotechnology parks, a good number of publications are coming from physical science subject areas. Due to the multidisciplinary nature of knowledge, a number of subjects may fall into two different subject categories (Table 2). Also, a number of institutes like the Centre for Development of Advanced Computing (C-DAC), located in C-DAC Knowledge Park, Bangalore and the Institute of Bioinformatics and Applied Biotechnology, located in Biotech Park, Bangalore are working in the multidisciplinary subject areas. C-DAC has about 17 publications from different areas of high performance computing; for example, Cloud computing, grid computing and so on. The Institute of Bioinformatics and Applied Biotechnology is also working on areas overlapping in both biotechnology and information technology.

Figure 3: Subject Areas of Publications



Source: Author's compilation based on Scopus® database, Elsevier B.V.

Table 2: Detail Subject Areas of Publications

Broad Subject Areas	Subject Area Classifications	Number of Publications	Percentage of Total Publication
Health Sciences	Medicine	46	11.9
	Veterinary	5	1.3
	Health Professions	1	0.2
	Dentistry	3	0.7
	Total	55	14.2
Life Sciences	Biochemistry, Genetics and Molecular Biology	115	29.9
	Pharmacology, Toxicology and Pharmaceutics	69	17.9
	Agricultural and Biological Sciences	36	9.3
	Immunology and Microbiology	37	9.6
	Total	257	66.9

Table 2 Continued...

Table 2 Continued...

Physical Sciences	Engineering	56	15.5
	Chemistry	81	21.0
	Physics and Astronomy	31	8.0
	Materials Science	20	5.2
	Computer Science	53	13.8
	Chemical Engineering	18	4.6
	Mathematics	8	2.0
	Environmental Science	18	4.6
	Earth and Planetary Sciences	2	0.5
	Energy	7	1.8
	Total	294	76.5
Social Sciences	Decision Sciences	5	1.3
	Social Sciences	2	0.5
	Business, Management and Accounting	14	3.6
	Psychology	1	0.2
	Economics, Econometrics and Finance	4	1.0
	Total	26	6.7
Others	Multidisciplinary	20	5.2
	Total	20	5.2

Source: Author's compilation based on Scopus® database.

5.3 Productive Institutes

From the authors' address the information of productive institutes are collected. The institutes with 10 or more number of publications are shown in Table 3. Among the productive institutes, the Jawaharlal Nehru Technological University (JNTU), Hyderabad is the most prominent actor. JNTU has about 29 articles (7.5 per cent) with different entities located in the knowledge parks in Hyderabad, SIPCOT Industrial Park, and so on. The second most prominent actor is the Aptuit Laurus Private Limited, located in the ICICI Knowledge Park, Hyderabad. It has produced about 26 (6.7 per cent) collaborative research articles.

Table 3: Top Institutes with more than 10 Articles

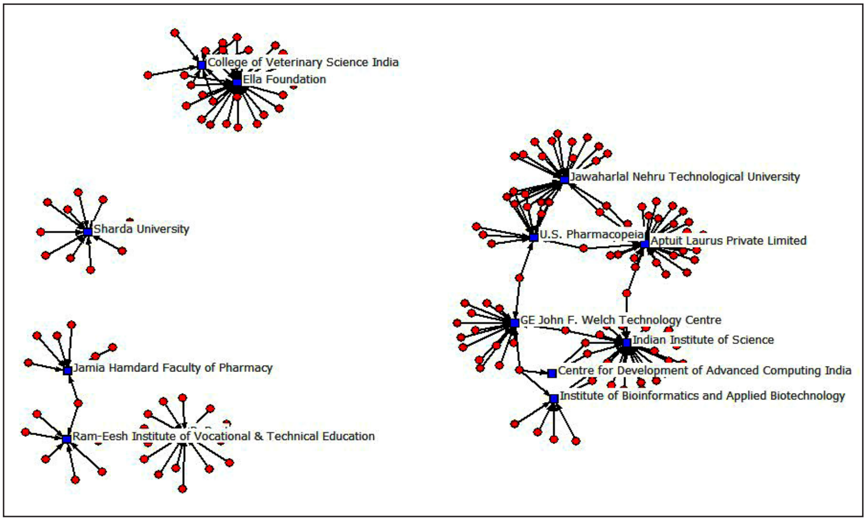
Rank	Name of the Institute	Number of Articles	Percentage
1.	Jawaharlal Nehru Technological University	29	7.5
2.	Aptuit Laurus Private Limited	26	6.7
3.	Centre for Development of Advanced Computing India	17	4.4
4.	Ella Foundation	15	3.9
5.	U.S. Pharmacopeia	15	3.9
6.	Indian Institute of Science	13	3.6
7.	GE John F. Welch Technology Centre	10	2.6

Source: Author's compilation based on Scopus® database, Elsevier B.V.

5.4 Collaboration Pattern

The network map, based on top 15 institutions, is shown in Figure 4. The linkage map is drawn using networking software UCINET and visualisation software Netdraw 2.119. Figure 4 shows that these 15 institutes have created six visible but distinct clusters. These clusters are also geographically distant and there is no linking among these clusters.

Figure 4: Collaboration Patterns of Top Entities with Different Actors



Source: Author's compilation using UCINET 6 for Windows software from Scopus® data.

From the collaboration maps of the institutions, five distinct trends have emerged. Firstly, the collaboration between academic institutions and industries are not very significant in quantitative terms but there is a visible growth in collaborative publications. With this trend, it can be inferred that perhaps the industry academia collaboration will increase in near future. Secondly, Indian firms and entities are banking on Indian academic institutions for their knowledge production. A number of Indian academic and research institutes or organisations are now collaborating partners with the entities in knowledge parks. Thirdly, many foreign firms, for example US Pharmacopeia and GE Healthcare (GE John F. Welch Technology Centre) located in Bangalore technology parks, have started joint research with Indian research institutes. Many foreign firms have a number of collaborative articles with premier Indian research institutes, for example, the Indian Institute of Chemical Technology and Indian Institute of Science. Fourthly, foreign firms are collaborating more with their corporate headquarter rather than the local bodies. Although there are diverse trends of foreign firms' collaboration pattern, foreign firms are more deeply engaged with their corporate headquarters and other global collaboration partners rather than the local Indian partners. Finally, the parks in different locations have developed cluster along with local entities. For example, Biotech Park of Lucknow has a number of collaboration with the institutes located nearby. It has collaboration with the Industrial Toxicology Research Centre, Lucknow, the National Bureau of Fish Genetic Resources, Lucknow, the CSM Medical University, Lucknow, and so on. The Institute of Bioinformatics and Applied Biotechnology in Bangalore has a number of collaborative articles with the Indian Institute of Science, Bangalore. The firms located in these cluster prefer to collaborate with the partners who are close and located nearby.

In today's globalised world, transportation and communications cost has decreased significantly. Henceforth, it is generally argued that the world has become a global village and location has lost its significance. But even in the globalised world, knowledge flows are indeed bounded within geographic limits and geographical localisation of knowledge is still important (Feldman and Schreudeuder 1996; Feldman 1999; Feldman and Kogler 2010). Location still matters in the age of globalisation and in the revolution of Information and Communication Technology.

6. Concluding Remarks

The study is an attempt to map the knowledge generation by entities located in the Indian science and technology parks, particularly in the biotechnology parks. The study maps the scientific publications patterns from Scopus data, a prominent indexing and abstracting database of worldwide scholarly literature. Different key words are used to retrieve the scholarly literature from the Scopus database. The publication pattern shows that there has been a substantial growth of literature after the year 2004. Although the number is not very significant, there is visible growth. During the last couple of years the literature growth is not consistent, but about 60 articles per year are published from the parks. However, the growth is not significant in comparison with the global growth of literature. Globally about 600 articles are published per year from the parks.

The subject wise publication pattern shows that the maximum numbers of publications are in the different areas of physical sciences (76 per cent). Articles published from life science subject areas and from health science areas are about 66 per cent and 14 per cent, respectively. This is because of the interdisciplinary nature of research and also of organisations like the Centre for Development of Advanced Computing (CDAC) located in the knowledge parks.

The collaboration pattern shows that there are collaborative articles published from the science parks. Although there are limited number of collaborative articles between the industry and academic institutions, the number is growing and perhaps will increase in near future. For example, JNTU has a good number of collaborative articles with different Indian as well as foreign firms located in Hyderabad. The collaboration patterns show that entities are more prone to collaborate with the knowledge generating bodies like universities, institutes and government research institutes located nearby. Hence geographical localisation of innovation is still important in present day globalised world. The Government should encourage establishment of more parks in different part of the country where there is research and or educational institutes of excellence exists. For this more conducive policies are required to encourage establishing such parks in different part of the country. Also, to increase industry academia collaboration a suitable policy is required. This may perhaps be possible if more parks are established near the universities or other institutes of excellence all across the country.

However, the above findings are based on the limited number of top actors. Further explorations will perhaps give a clear and broader picture. Perhaps a comparative study involving the technology parks form different developed and newly industrialised countries like China, South Korea and Taiwan will give a better picture of the India's position in technology Parks with respect to others.

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