

The Planning Commission
Endowment Unit in
Development Economics at
Centre for Development Studies,
Trivandrum, Kerala

**Report of activities for the period
September 2005 through March 2009 and
the work plan for 2009-10**

03/02/2009



CENTRE FOR DEVELOPMENT STUDIES

Trivandrum, Kerala, India

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I. Introduction:

The Planning Commission Endowment Unit was established at the Centre during 1997. The main purpose of the unit is to conduct systematic studies on various issues relating to India's economy. The unit has provision for one Professor and one postdoctoral research scholar. Since its inception and until December 2004, Professor K P Kannan occupied the endowment chair. In September 2005, Professor Sunil Mani was appointed to the Chair. In the following we report on the activities for 2007-08 and the work plan for 2008-09. Currently the unit consists of just one Professor and a research assistant. Nevertheless, as can be seen below, the Unit was engaged in the conduct of research, teaching and training activities with a strong focus on analysing and evaluation innovation policies in the Indian context.

II. Main research themes:

Since 2005, Unit has **three main research themes** dealing with innovation and technological change in Indian industrial establishment in a comparative perspective. The *three* themes are:

(i) **Measurement of innovation:** Innovation or the commercial introduction of new processes and products are measured through a series of indicators such as R&D expenditures, patents granted etc. Such conventional indicators are increasingly eschewed as adequate measures of innovations by firms in both developed and developing countries as well. Increasingly the tendency is to talk in terms of innovation activities and expenditures other than mere R&D expenditures and this is covered through innovation surveys. Innovation surveys have now diffused very widely across developing countries. However these surveys suffer from two main problems: (i) poor response rates; (ii) serious measurement errors especially those part of the survey dealing with innovation activities and expenditures. Under the research theme, the Unit is assisting the Department of Science and Technology of Government of India in conducting an innovation survey for India by drawing from the experiences of other developing countries such as Brazil and South Africa.

(ii) **Innovation policy instruments:** Innovation policy consists of a set of instruments and institutions that can together encourage the local development of technology and at the same time also assist in the use of imported technologies. These instruments and institutions can be broadly divided into financial and non-financial. Innovation policy instruments can become effective only if the country in question has a sufficient number of scientists and engineers. Research done under this theme looks at the experience of India in a comparative perspective.

(iii) **Telecommunications industry:** The telecommunications industry is an important component of the Information and Communications Technology industry. The industry has two components or divisions. The first one deals with the manufacturing of telecom equipments while the second one deals with distribution of telecom services. Major technological changes have occurred in this industry affecting both the components. Two

major changes are noteworthy. First, across the world including in India, we see that mobile telephones have overtaken fixed line telephones. Second, the Internet has penetrated into traditional telecommunications so much to say that we now refer to an infocommunication industry. India along with a limited number of developing countries had sought to build local innovation capability in the design and manufacturing of essentially fixed line telephone technology. The changes to this innovation capability consequent to the larger technological changes taking place in the industry worldwide are tracked in this research by employing a sectoral system of innovation perspective. Again the analysis is in a comparative perspective by comparing the Indian experience against Brazil, China and Korea

III. Completed Research Studies

Theme 1: Measuring innovation using new indicators

i. Innovation surveys in developing countries: what can we learn from it for public innovation policies?

Measuring innovation output has been an important preoccupation in the literature. Owing to considerable disenchantment with the conventional indicators of measuring innovation, it is now measured using a variety of new indicators the most prominent of which is the innovation survey. Although it was developed in the context of European countries, the concept of an innovation survey is fast diffusing to developing countries as well. Even India is in the process of launching a national innovation survey. Innovation surveys provide with a variety of indicators that is more comprehensive to measure the health of the National System of Innovation of a country. But both in the developed and developing country contexts, the output of these surveys have hardly been used to design innovation policy instruments. The paper analyses this problem and suggest some solutions from the perspective of improving the quality of decision-making with respect to impacting on the process of generation of innovation and its diffusion in developing countries.

ii. The growth of knowledge-intensive entrepreneurship in India, 1991-2007,

Analysis of its evidence and the facilitating factors

The recent growth performance of India's economy has attracted a fair amount of attention from various constituencies. The country, which has been variously described as a great underachiever of sorts is now being regarded as a knowledge powerhouse well on the way to become an important player in the international technological arena. There is now considerable interest among researchers and policy makers to understand the real factors behind this spectacular economic achievement of the country. Although there is now a fair amount of consensus¹ on the fact that this growth performance can be largely traced to the process of economic liberalization set into motion since 1991, it is also equally agreed that

¹ The fact that the break in the trend growth rate of India's GDP has occurred in 1991 has sparked off a lively debate with some analysts holding the view that this occurred earlier in the 1980s. However after examining the various issues, technical and otherwise, the consensus is for the break to have occurred in 1991 itself. For a succinct summary of this debate see Basu (2008).

India's private corporate sector has responded to the signals provided by the state in a very admirable way. For instance, both the savings and investments of the private corporate sector have really shown significant increases in the period since 2003-04. The sector has become very dynamic and is in the forefront of enabling the globalization of India's economy. There are two indicators of globalization: (i) there has been a significant improvement in the average export intensity of an Indian private sector firm: it increased from about 8 per cent in 1991 to about 25 per cent in 2007; and (ii) Indian firms have made a number of acquisitions abroad and as result the ratio of FDI from India to India now stands at around 0.61 and (iii) a number of knowledge intensive firms have emerged and these firms have become important forces to be reckoned with in their respective field of operations. These firms range from auto components to biotechnology to IT software to wind turbines. See Table 1. Behind the success of each of these "blue chip" companies is the hard work put in by an entrepreneur or a group of entrepreneurs. These "entrepreneurial" firms are different from the conventional enterprises on a number of parameters. But on three traits the 'entrepreneurial firms' stand out from 'conventional firms. They are: (i) corporate governance: the entrepreneurial firms although established by a specific, very often, technically trained entrepreneur, is a listed public limited company with a wide shareholding. Having been listed in both Indian and foreign stock exchanges is subject to more transparent disclosure practices regarding their operations and performance²; (ii) technology-intensive industries: almost all the entrepreneurial firms operate in technology-intensive industries and mostly in service industries where the entry \barriers are low; and (iii): extent of globalization: most of the entrepreneurial firms are highly integrated with the global economy. Exports of these enterprises typically range between 30 to 95 per cent of its total sales. The Indian private corporate sector which did not have a good record during the license-permit Raj phase is now emerging as strong innovation based powerhouse. While there are many factors contributing to this, the key to this success can be traced to successful technology-based entrepreneurship. This entrepreneurship to a certain extent has been nurtured by the emergence of a number of institutional mechanisms, the most important of which is venture capital. Although the absolute level of venture capital investments in India is low, it has been growing at a rate of 90 per cent over the last few years and at this rate of growth, the industry is set to match Europe by 2009 or 2010. Notwithstanding these phenomenal increases in venture capital funding, most Indian companies still finance their growth and expansion through internal resources. A second contributing factor is the availability of technically trained personnel including those trained abroad and willing to return to their homeland to start technical ventures. Apart from the few famous cases of firms, whole industries such as Information Technology, Biotechnology and Aerospace industries have been jump started by the emergence of this knowledge- intensive entrepreneurship. In the context, the purpose of this paper is to understand the growth of knowledge-intensive entrepreneurship in India. Further it identifies the main facilitating factors or the constraints to this process so that public policy can be applied to correct for this as the case may be.

² The recent (cJanuary 2009) self admission of fraud by the founder and former CEO of the fourth largest IT company in India have dented one's faith in this belief of better corporate governance.

The study is structured into five sections. The first section summarises the interest in the study of entrepreneurship in India and elsewhere. The survey is, admittedly, very selective. The second section maps out the background to this study the most important of which is a significant increase in the share of knowledge-intensive production in India's GDP and the rise of innovations in the country. The third section explores the growth of knowledge-based entrepreneurship in the country by employing a variety of macro and micro-level indicators. The macro indicators are supplemented with some micro data based on the characteristics of nearly 600 startups who have applied for being the most innovative start ups in the country. The fourth section analyses five major facilitating factors to this process. Further the fifth section distils out the policy conclusions emanating from the study.

The paper is now published as a CDS Working Paper and is expected to be published as a journal article

Theme 2: Policy instruments for promoting innovations:

(i) Why is the Indian pharmaceutical industry more innovative than its telecommunications equipment industry? A comparative analysis of their sectoral systems of innovation ?.

Abstract: The government in India has attempted to foster the creation of a number of industries during the import-substituting regime, which extended all the way through the early 1990s. Two specific high tech industries that received a special treatment from the government are the Indian pharmaceutical and telecom industries. In both the industries the government intervened through a variety of institutions and instruments to make the industries more innovative and thereby competitive. However at the end of the day (in c2007) when one compares the innovative performance of the two industries on any of the three conventional indicators of innovation (namely: (i) R&D expenditure; (ii) U S patent grants; and (iii) trade balance) one sees that the pharmaceutical industry is much more innovative. For instance, the industry dominates in both the R&D expenditure and the number of patents granted to firms in the Indian industrial establishment and the trade balance of the industry has been positive and continuously increasing. The telecom industry, on the contrary, has had a lack a \square harac performance. Although there has been a tremendous increase in the demand for telecom equipments, the local industry does not have the technological capability to supply any of the new breeds of wireless telecom equipments. Consequent the trade balance of the industry has turned negative and has been increasing. Local enterprises and the number of patents perform hardly any R&D, although growing is almost entirely by affiliates of MNCs operating from India. An explanation for this differential performance is sought to be explained in terms of the constitution of the sectoral systems of innovation. In the pharmaceutical industry research was performed by production enterprises. In other words all the manufacturing enterprises also had strong R&D capability and so transference of the fruits of research to innovative products and processes was not exactly a problem. In addition, the innovative efforts of the manufacturing enterprises were facilitated by an intellectual property regime that was extremely conducive to process innovations. On the contrary, the telecom sectoral system of innovation was characterized by a stand-alone public laboratory that was divorced from the production system. The telecom enterprises themselves did very little R&D and consequently the firms were unable to keep pace with changes in the world frontier in telecom technologies. The laboratory too was not strategically directed by the state. Thus the present study is yet another instance³ to show that a dichotomous relationship between research and production is not very desirable for promoting innovations in the industrial sector.

(ii) Financing of industrial innovations in India, How effective are tax incentives for R&D ?

The paper surveys the instruments that are available for innovation financing in India. It identifies three such instruments, namely research grants and loans, venture capital and tax incentives. The effectiveness of all these instruments are then examined in some general fashion, but one of the instruments, namely tax incentives are subject to a detailed empirical scrutiny in terms of its effectiveness. We have constructed a dataset containing firms belonging to four different industries which have claimed these tax incentives. For these firms we estimated the elasticity of R&D expenditure wrt tax foregone. Our study has shown that there have been improvements in the innovative output of Indian industry during the recent period since economic liberalisation. However this has been restricted to a few industries such as the pharmaceutical industry. India has three different types of financial incentives for R&D: research grants and loans, venture capital and tax incentives. Our analysis showed that the pharmaceutical industry has been a target of most of these financial incentives. There is thus a fine targeting of innovation financing in India. We endeavoured to estimate the coefficient of elasticity of R&D with respect to tax foregone as result of this incentive scheme. The resulting exercise showed that R&D expenditure of the concerned industries was inelastic. We also found that the incentives did not form a significant portion of R&D. It is therefore not prudent to make any comments on the effectiveness of R&D tax incentives. But we see that the size of the firm does appear to be an important determinant of R&D, at least, in the case of some of the industries. Allowing firms to become larger and through that process of growth enabling them to become larger investors in R&D may be a better policy than providing them directly with subsidies. It is also that the total number of firms enjoying these incentives is not too many. It remains to be seen whether this is due to any bureaucratic delays or difficulties in the actual administration of this incentive.

The paper is now published as a CDS Working Paper 405 and is expected to be published as a journal article

iii. Economic implications of skilled migration from India

It is now more or less established that the skill content of migration in the world has increased in the 1990s and beyond compared to the earlier period. The trends from India mirror the world situation: high skilled migration as a percentage of all migration increased from 2.6 per cent in 1990 to 4.2 per cent in 2000. Traditionally the migration of skilled personnel from the developing south to the developed north is referred to as "brain-drain". However, recent experience has shown that high skilled migrants who leave the country very often return for shorter periods at least and so the more appropriate term of "brain circulation" is sometimes used to characterize this phenomenon. With the increased integration of India's economy with rest of the world and with the boom in IT exports, movement of high skilled Indians to jobs and assignment abroad is an inevitable consequence. Traditionally high skilled migration from India was through the education route: students go abroad for higher studies and remain back in those countries by taking up employment. While this remains to be the dominant route for migration (as indicated by the growing education related travel in the current account of India's BoP tables) this traditional route has been supplemented by a new route, namely India's with high skills trained in India taking up employment abroad. The movement of high skilled personnel from India to abroad along these two routes will have both positive and negative implications although in the past we have tended to highlight only the negative aspects or implications of this phenomenon. However our recent experience of increased remittances to the country has shown that while some skills may be temporarily lost, the high skilled migrants are now the dominant reason for the increase in remittances in the current account of our BoP. Further there are evidences from both the IT and life sciences industry

that the Indians abroad are an important source of knowledge and indeed capital for the growth of these two industries in our domestic economy. The paper analyses four separate implications of this phenomena, namely:

- Fiscal implications
- Core human resource in Science and Engineering
- Private transfers and its impact on the current account deficit
- IT exports from India

The study concludes by discussing the policy implications arising from the study. In specific terms, it is argued that the imperative before the government would be to encourage the movement of high skilled personnel from India to abroad along systematic lines so that the country maximizes the beneficial effects of such movements. For these a few suggestions can be considered, notwithstanding the fact that the decision to move abroad, either for studies or for employment in a democratic country experiencing increased integration is a purely private decision. The first suggestion is that the government through its missions may obtain information about employment opportunities for high skilled Indians. Second in return for the information, the Indians who use these information and become successful in finding jobs abroad agree to be a source of information on similar jobs and indeed market for Indian commodities and services for these missions. Third they may also be, on a case by case basis act as visiting researchers/faculty in the Indian institutes where they have undergone their studies.

iv. The Other side of the story, Industrial standards and technological capability building at the industry level, A Study based on Indian Automotive Industry (with M. Parameswaran)

Industrial standards can either encourage or hamper innovative efforts at the firm level. The paper empirically examines this at level of the Indian automotive industry. Two indicators of innovative effort are employed, namely investments in R&D and Total Factor Productivity Growth (TFPG). Both the indicators show an upward movement during the period since the late 1990s. This happened to be also the phase when the industry began to embrace a variety of product, quality and safety standards. Therefore it appears that the innovation promotion efforts of standards are more prominent in this specific case.

The paper has been presented at the 2007 International Globelics Conference at Saratov Technical University and is presently under revision for submission as a journal article.

Theme 3: Telecommunications industry

(i) Growth of Indian telecommunications services Industry: Its implications for telecom equipment manufacturing industry

The phenomenal growth of the IT industry in India has brought to the fore the growing importance of India as a knowledge powerhouse. But this competitiveness is restricted to the services sector. In fact it is the sector that is increasingly contributing to the high growth rate recorded in the country. Despite showing a good growth performance over the last three or four years, the manufacturing sector is still a non-performer although three industries constituting the manufacturing sector, namely auto parts, cotton textiles and pharmaceuticals are showing much dynamism in terms of exports. However India's exports have now diversified to encompass

services. In fact the service sector in general have come to occupy pre eminent position in India's economy in terms of its contribution to overall GDP, exports and as a destination for Foreign Direct Investments. Nevertheless the manufactured exports is still dominated by low and medium technology products although, as stated earlier some high tech products such as pharmaceuticals and certain types of machine tools have crept into India's export basket. But the growth of IT exports and evidences of moving up the value chain in IT, the emergence of other high technology industries such as biotechnology, aerospace etc is enabling India to be in the league of high technology producers from the developing world. The recent growth of R&D outsourcing is yet another illustration of the country's prowess in high technology activities. An interesting dimension of high technology production in India is that this capability is largely in the realm of services rather than in manufacturing. However there are indications that this capability in high tech services is slowly percolating to high tech manufacturing. And an industry where it is very clearly visible is in the area of telecommunication where a revolution of sorts is taking place. In the context, the purpose of the present study is to understand the technological implications of the phenomenal growth of this industry.

The study is structured into five sections. The first section traces the contribution of the telecommunication services sector to the overall growth performance of India's economy and in that process to the catching up of her economy. The second section distils out the various dimensions of the telecom services industry. Seven dimensions of the growth performance are identified and discussed here. The third section identifies at least three disquieting features of this growth performance in terms of the growing digital divide, the increasing dependence on imported equipments for providing these services and the low diffusion of Internet. However there is at least one silver lining in this otherwise dark cloud, namely the possibility that India may soon emerge as a major manufacturing hub for not just mobile handsets but also the manufacturing of semiconductor devices that go into the production of these handsets. A detailed discussion of this tendency and its implication for the economy forms the theme of the fourth section. Finally the fifth and concluding section summarises the main findings of the paper and identifies the policy conclusions that arises from this study.

The paper has since been published in the Economic and Political Weekly

(ii) Explaining Divergent Stories of Catch-up in the Telecommunication Equipment Industry in Brazil, China, India, and Korea (joint with Keun Lee, Seoul National University and Qing Mu, Shanghai University of Economics and Finance, Shanghai)

The telecommunications industry is one of the fastest growing industries in the world characterized by significant technological changes. In most countries of the world mobile communication technologies have sought to replace or overshadow fixed line technology. The industry has two segments or parts: manufacturing of telecom equipments and distribution of telecom services. The technological changes have, in essence, completely altered the landscape of this high tech industry. Given the complexity of its technology and the consequent huge investments that were required the equipment part of the industry has in the past dominated by a handful of MNCs based in the developed world. But the arrival of mobile technology has allowed enterprises from the developing world to enter this otherwise oligopolistic industry based in the North. The distribution segment, on the contrary, is nationally owned, very often by a public telephone and telegraph (PTT) provider. But with the embracing of liberalization and deregulation by most countries, the distribution of telecom services has now been privatized and very often thrown open to private sector competition. The natural monopoly status enjoyed by the PTTs has been eroded. In most developing countries one could find only one part of the industry,

namely the distribution segment while the manufacturing segment was largely based in the developed world with most countries relying on imports of these equipments. However there are notable exceptions. The four countries Brazil, China, India and Korea have sought to build some measure of innovation and manufacturing capabilities in telecommunications equipment. The history of this process could be traced to the late 1970s when Brazil was the first among these four to design a domestic sectoral system of innovation. This was soon followed or imitated by Korea and India in the mid 1980s and by China towards the late 1980s. All the four countries crafted a state led sectoral system of innovation with a government research institute at the core of the system (with the exception of China) which developed the technology which were licensed to public and private sector domestic enterprises which converted this technology to manufacture equipments that in turn were sold to monopoly state-owned service providers. The state thus effectively used public technology procurement as a way of nurturing and supporting this innovation capability. However the recent wave of privatization and deregulation of the industry has completely altered the working of the sectoral system of innovation. In fact we see two broad divergent paths. At one extreme we have the Chinese and Korean systems that have succeeded in coping with the challenges posed by globalization and emerging as major exporters of telecom equipments; while at the other extreme we have Brazil and India which have become increasingly net importers of telecom equipments. Some of the enterprises from the former group have now become important world players and have become MNCs on their own right. On the contrary, none of the latter two countries have any domestic enterprises in the industry worth the name although both of them have become major manufacturing hubs for telecom equipments while the hubs are dominated by affiliates of MNCs. Thus in both the countries we see a passage of innovation capability from public to private foreign enterprises.

While four countries of China, Korea, India, and Brazil correspond to substantial heterogeneity that makes any comparison almost impossible, they share one commonality in technological development. That is, all of these four had once developed more or less 'indigenously' digital telephone switches. While this itself is an interesting phenomenon, probably more interesting thing should be the divergent paths by four after the initial development of the digital telephone switches. In this long term trajectory, China and Korea side together with relatively more success in technological development, while India and Brazil has been going through a similar path. Korea had a telephone service bottlenecks in the 1970s & 80s, and thus tried hard and succeeded in developing its own digital switches in 1981-83 and took over the markets from the imports and MNCs. Its enhanced capabilities in wired telecommunication accumulated over the preceding decades have led to growth of indigenous capabilities in wireless telecommunication, too. China also had serious bottlenecks in telecommunication and used to import all the fixed line digital switches but succeeded in developing its own digital switches in 1991 to take over the markets from the imports and MNCs. It is now moving ahead with confidence for the 3rd generation wireless telecommunication system and it developed and declared its own indigenous standards in 3G wireless telecommunication. Now, in contrast, although Brazil also developed its own digital switches in the 1980s but failed to sustain its capabilities over time. India also had developed its own digital switches in the 1990s by C-DOTs (a Government Research Institute: GRI). But, local production and R&D capabilities are still weak, compared to MNCs both in capabilities and markets and local units failed to make successful transition to mobile telecommunication era.

What can we explain this "common starts with divergent paths afterwards is the central focus of this paper. To tackle this task, we turn to the theoretical framework of the SSI (sectoral innovation system) that has been developed and evolving by a group of scholars following Neo-Schumpeterian tradition. In particular, we resort to Marlerba (2004). The building theoretical blocks of Marlerba's SSI consists of the regimes of knowledge and technologies, demand conditions (or market regimes), actors and networks and coordination among them, and the

surrounding institutions including IPRs, laws, culture and etc. However, the book edited by Marlerba (2004) deals with cases and sectors from the developed countries. This paper, together with other papers in this volume, extends the original SSI framework to the context of catch-up in developing or late-comer countries. Thus, while we will apply the same framework, we expect some modification or adaptations necessary to make it friendlier to the context of the developing countries.

This is to be published as a chapter in a book edited by Franco Malerba and Richard Nelson.

IV. Publications (2005-06 to 2008-09)

Book (already published)

Mani, Sunil, Anjini Kochar and Arun M.Kumar (2006, eds), *Kerala's Economy: Crouching Tiger, Sacred Cows*, Kottayam: D C Books.

Book (to be published during 2009-10)

Malerba, Franco and Sunil Mani (eds., 2009, forthcoming), *Sectoral Systems of Innovation and Production in Developing Countries: Actors, Structure and Evolution*, Cheltenham, UK and Northampton, USA: Edward Elgar.

Book (to be published during (2010-11)

Mani, Sunil (2010, forthcoming), *Innovation Capabilities in Developing Countries, A study of the Telecommunications Industry*, Cheltenham, UK and Northampton, Mass. USA: Edward Elgar.

Journal articles and chapters in books published during 2005-06 through 2008-09

1. 'Mani, Sunil (2005), The Dragon vs. the Elephant: Comparative Analysis of Innovation Capability in the Telecom Industry of China and India', *Economic and Political Weekly*, 40 (39), pp. 4271-83.
2. Mani, Sunil (2005), 'How Governments Can Boost Business R&D', *Science and Development Network*,
<http://www.scidev.net/dossiers/index.cfm?fuseaction=policybrief&dossier=13&policy=66>
3. Mani, Sunil (2005) Innovation capability in India's Telecommunications equipment industry' in A. Saith and M. Vijayabaskar (eds), *ICT's and Indian Economic Development*, New Delhi: Sage Publications, pp. 265-322.

4. Mani, Sunil (2005) 'Charles Cooper: Institution Builder', *Development and Change*, Vol. 36, Number 6, 2005, pp. 1209-1214.

5. Mani, Sunil (2006) 'Growth of new technology-based industries in India, the contrasting experiences of Biotechnology and Information Technology Industries', *International Journal of Technology and Globalization*, Vol.2, Nos: 1 and 2, pp. 200-216

6. Mani, Sunil (2006) Epistemic communities and informed policy making for promoting innovations: the case of Singapore', in Box, Louk and Rutger Engelhard (eds), *Dialogues at the Interface, Science and Technology Policy for Development*, The Hague: Directorate General of International Corporation, pp. 60-71;

7. Mani, Sunil (2006) Government support for sustaining a knowledge-based economy, An examination of India's technology policy initiatives, 1990-2005" in Krishna K L (eds.), *Planning and Development: Institutions and Market*, Delhi: Oxford University Press.

8. Mani, Sunil (2007) 'Keeping pace with globalisation: Innovation capability in Korea's Telecommunications Industry", in Jorg Mahlich and Werner Pascha (eds.), *Innovation and Technology in Korea*, New York: Physica-Verlag, 2007. pp. 254-286.

9. Mani, Sunil (2008) 'Growth of India's telecom services (1991-2007): Can It Lead to Emergence of a Manufacturing Hub, *Economic and Political Weekly*, Vol. XLIII, No: 3, January 19, 2008, pp. 37-46.

V. Seminars/Conferences/Lectures during 2005-06 through 2008-09

1. Presented a paper "Growth of New Technology based industries in India, The Contrasting Experiences of Biotechnology and Information Technology Industries' at the Eleventh General Conference of the European Association of Development Research and Training Institutes, Bonn, Germany, September 20-24, 2005.
2. Presented a paper, "The Dragon vs. the Elephant, Comparative analysis of innovation capability in the Telecom industry of China and India" at the Eindhoven Technical University, The Netherlands, September 26 2005
3. Presented a paper, "The Dragon vs. the Elephant, Comparative analysis of innovation capability in the Telecom industry of China and India" at the 3rd Annual Globelics Seminar at Tshwane University of Technology, Pretoria, South Africa, October 21-November 5 2005

4. Presented a paper, “Presented a paper “Growth of New Technology based industries in India, The Contrasting Experiences of Biotechnology and Information Technology Industries’ at the Workshop on “Development Implications of the Diffusion of Information Technology” Jointly Organised by The Media Development Foundation, The Hindu and The Economic Research Foundation (Supported by IDPAD/ICSSR), November 25 2005.
5. Presented a paper on “ The infocommunication revolution in India: Has Kerala benefited from it?”, at the International Conference on “Kerala in the Global Economy, Opportunities and Challenges”, Stanford Centre for International Development, Asian School of Business and Kerala Global Support Network at Trivandrum, December 13-15 2005
6. Presented two papers, (i.“India’s innovation system in transition” jointly with K J Joseph, Parveen Arora and Sudip Chaudhuri; and ii. “Mapping the labour market, competence profile and working conditions for scientists and engineers”,at the BRICS Project workshop, Aalborg University, Denmark, February 12-15, 2006;
7. Presented a paper on “Performance of India’s National Innovation System” at the India-Israel Workshop on Technology Innovation and Finance, Organised by Indian Institute of Management Bangalore in collaboration with TIFAC and DST at IIM- Bangalore on February 23 2006;
8. Presented a paper, “Innovation Policy in an increasingly border less world: An Examination of India’s Experience” at the National Seminar on Intellectual Property Rights organised by Department of Economics, St Joseph’s College, Devagiri, Calicut, on February 24 2006;
9. Presented a paper, “How integrated is India’s manufacturing sector with rest of the world?”, at the International Conference on “Political Economy of Labour under Globalisation” Academy of Third World Studies, Jamia Millia Islamia, March 6-8, 2006;
10. Participated by video link on the workshop on “Tracking R&D Expenditures” organized by the National Advisory Council on Innovation, Republic of South Africa at Pretoria on March 13 2006.
11. Presented a keynote speech titled” Valuing Innovation Surveys, The International Dimension” at the international workshop on “Measuring Systems of Innovation, Inputs, Flows and Outputs”, National Advisory Council on Innovation, Republic of South Africa at Pretoria during April 24-25, 2006.
12. Presented two lectures, “Policy Instruments for stimulating innovation at the enterprise level in developing countries” and “ Innovation capability in developing countries, A study of the telecommunications Equipment Industry in China and

- India”, at the Globelics Academy 2006, Instituto Superior de Economia e Gestão, ISEG,, Lisbon Technical University, Lisbon, Portugal, May 8-9, 2006
13. Presented a keynote speech titled, “Public policy to enhance national industrial innovation systems” at the International Seminar on “National Innovation Systems”, Indonesian Institute of Science and United Nations Asia Pacific Centre of Transfer of Technology (APCTT), Jakarta, Indonesia, July 19-20 2007.
 14. Conducted a workshop on “ Indicators to evaluate the effectiveness of industrial policy instruments” at Industrial Research and Consultancy Centre, Ministry of Science and Technology, Khartoum, Sudan, August 22 2006.
 15. Presented a paper on “Sectoral systems of innovation of the telecommunications equipment industry, Cases from Brazil, China, India and Korea” at the Sectoral Systems of Innovation and Catch up in Developing Countries Workshop, CESPRI, University of Bocconi, Milan, Italy, September 6-8, 2006
 16. Co-organised and presented a paper, “The incremental innovator Vs the trader, Contrasts between the sectoral systems of innovation of the Indian pharmaceutical and telecommunications industries: at the Fourth Annual Globelics Conference, Trivandrum, October 4-7 2006.
 17. Presented a paper “The Emerging High Tech Competitors from Asia, Contrasts between the innovative activities of China and India “ at the United Nations University-MERIT, Maastricht, the Netherlands, December 13 2006
 18. Co-organised and presented two papers, ‘The Emerging High Tech Competitors from Asia, Contrasts between the innovative activities of China and India’ and ‘The Emergence of an High Technology Industry in India Case of India’s Telecommunications Industry at the International Workshop, Trade, Technology and The Impact Of Globalization, organised by Centre for Public Policy, Indian Institute of Management-Bangalore, Indian Institute of Management-Calcutta, Shastri Indo Canadian Institute at IIM- Bangalore, March 30-31 2007.
 19. Gave two lectures on “Empirical implementation of the National Systems of Innovation Framework” at the “Research and Statistics” branch of the UNIDO at Vienna on 19 April 2007.
 20. Presented three papers at the International Workshop on Comparative Study of the National Innovation Systems of BRICS, Rio de Janeiro, Brazil, 25-27 April 2007,
 21. Presented joint paper with Keun Lee at the workshop on Sectoral Systems of Innovation Workshop at University of Bocconi, Milan, Italy, 4-5 May.

22. Gave two lectures at the Globelics Academy 2007 at the Instituto Superior Técnico (IST), Lisbon, Portugal, 7-9 May 2007
23. Presented a paper on innovation surveys in developing countries at the International Conference on 'Micro evidence on innovation in developing countries', United Nations University- MERIT, Maastricht, The Netherlands, 31 May -1 June.
24. Has been nominated Member, Conference Committee, Globelics 2007 at Saratov, Russia. He is also on the UNIDO Expert Group on Innovation, UNIDO Headquarters, Vienna.
25. Made one of the keynote presentations on "*Reducing the distance to technology frontier, the Role of Technology and Innovation Policies*", at the Sanjaya Lall Memorial Conference on India-Africa Co-operation on Industry, Trade and Investment, organised by UNIDO-UNCTAD-ITC-Ministry of Industry at New Delhi on September 10,2007.
26. Chaired a session, was a discussant and presented his own paper (in collaboration with M.Paramesawaran) titled. .The other side of the story, Industrial standards and technological capability building at the industry level, A study based on the Indian Automotive Industry. at the 5th International Globelics Conference at Saratov State Technical University at Saratov, Russia, September 20-23, 2007.
27. Presented the paper, '*The Growth Performance of India's Telecommunication Services Industry 1991-2006: Can it Lead to the Emergence of a Manufacturing Hub?*' at the Atlanta Conference on Science, Technology, and Innovation Policy 2007, at the School of Public Policy, Georgia Institute of Technology, Atlanta, USA, during October 19-20, 2007.
28. Presented the key note paper on 'Innovation, Learning and Technological Dynamism of Developing Countries' at the United Nations Industrial Development Organisation (UNIDO), Vienna, Austria during October 24-25, 2007.
29. Presented a lecture on the "*Evolving sectoral system of innovation of the Indian Biofuels Industry*" at the German Development Institute, Bonn, on January 16, 2008;
30. Presented a paper on "*Prospects for technological catch-up: India in comparison with China*", Asian Drivers of Global Change: Challenges for Europe' , German Development Institute, Bonn, Germany , January 17-18, 2008.
31. Presented a lecture on , "*The integration of India's economy with rest of the world, Indicators, facilitating factors and its effects*", to the MSc students in International Business and Emerging Markets, The Management School and Economics, University of Edinburgh, Edinburgh, UK, January 22 2008.

32. Presented the 2008 San-Ei Gen Lecture, ‘*India, an emerging high tech giant. But does she have feet of clay?*’; The Management School and Economics, University of Edinburgh, Edinburgh, UK, January 24 2008 .
33. Participated at the Netherlands-India Co-operation Meeting organized by the University of Maastricht, The Netherlands, February 13 2008.
34. Presented the paper, *Explaining Divergent Stories of Catch-up in the Telecommunication Equipment Industry, in Brazil, China, India, and Korea at Catch up Workshop at UNU-MERIT*, Maastricht, The Netherlands, February 14-15, 2008.
35. He taught at the 5th International Ph.D. School on National Systems of Innovation and Economic Development, Globelics Academy, University of Tampere, Finland, June 9-13. He also commented on six PhD dissertations during this time;
36. Presented a paper titled, ‘Financing of industrial innovations in India, How effective are tax incentives for R&D?’ at the Second Conference on Micro Evidence on Innovation in Developing Economies, Center for Applied Statistics, Renmin University, Beijing, and UNU-MERIT, United Nations University and University of Maastricht at Renmin University of China, Beijing, April 21-23 2008
37. Gave a lecture on the ‘Emergence of India as High-tech Giant’ at the Institute of Developing Economies, Tokyo, Japan on July 31 2008.
38. Presented a paper ‘The Sectoral System of Innovation of the Telecommunications Equipment Industry: Contrasts between the Chinese and Indian Cases’ at the International Workshop on *Innovation Systems and the Role of Foreign Capital: A Comparison of China and India*, at the Institute of Comparative Economic Studies, Hosei University, Tokyo, on August 2, 2008;
39. Was a discussant to the paper on ‘Economic Globalisation and Weak States of South Asia’ at the conference *on Weak States and South Asia Insecurity Predicament*, at McGill University, Montreal, Canada, October 4 2008.
40. Participated as a panelist in the round table on ‘Transforming South Asia,’ organised by the McGill Centre for Developing Area Studies and Canadian International Council at McGill University, Montreal, Canada on October 4, 2008.

41. Presented a paper on ‘Growth of Knowledge-intensive Entrepreneurship in India, 1991-2007, An Analysis of its Evidence and Facilitating Factors,’ in the UN-MERIT and UNU-WIDER Research Workshop on Entrepreneurship, Technological Innovation, and Development , UNU-MERIT, Maastricht on 30 and 31 October, 2008.
42. Was keynote speaker (*Challenges of innovations in a developing country context*) at the International Seminar on *Innovations, Enhancing the quality of life*, at Loyola College, Chennai, January 12-13 2009;
43. Presented a paper (*in absentia*) on “The growth of knowledge-intensive entrepreneurship in India, 1991-2007, Analysis of its evidence and facilitating factors” at the AEGIS kick-off meeting at the University of Bocconi, Milan, Italy , January 14-15 2009;
44. Presented a paper with V Santhkumar on “Diffusion of new technologies and productivity in growth in Kerala’s agricultural sector: Coconuts vs Natural Rubber”, at the CDS-McGill conference on “*Role of new technologies in sustainable development: case of Kerala*” at Centre for Development Studies, Trivandrum , January 27-28 2009.
45. Chaired a session on *Specific governance aspects of biotechnology and nanotechnology in India* at the conference on *Emerging technologies in developing countries: Capabilities and governance issues*, The Energy and Resources Institute, New Delhi, February 4 2009.
46. Was external examiner and chaired the viva voce of the Fellow Programme thesis on “Internationalisation of the Indian Pharmaceutical Industry-A study on export performance” at the Xavier Institute of Management, Bhubaneswar, February 19 2009.
47. Invited to deliver the 16th ICSSR-IPE Distinguished Lecture at Institute of Public Enterprise, Hyderabad on “Is India becoming more innovative since 1991? , An analysis of its evidence and some disquieting features” , at Institute of Public Enterprise, Hyderabad, March 20 2009
48. Presented a paper on Technical education in Kerala since liberalization: Has significant increases in enrolments transliterated into actual supply of engineers? at the international Seminar on India's Two Faces: the Haves and The Have-Nots, Trivandrum, CDS-British Northern University’s India Forum (CDS-BNUIF) March 23-24 2009.

49. Invited to present the keynote paper on “The technological dynamism of India’s private corporate sector since 1991” at the national seminar on India’s industrialization at Institute for Studies in Industrial Development, New Delhi, March 27-28 2009.

VI. Conferences organized

Conference organized during 2008-09: The Unit organized an International Conference on “*Role of new technologies in Sustainable development: Case of Kerala*” during January 27-28 2009. This was in collaboration with the Department of Political Science, McGill University, Montreal, Canada, and McGill Centre for Developing Area Studies. The conference was sponsored by the IDRC and the Foreign Affairs and International Trade Canada (DFAIT). The conference was sponsored by the IDRC and the Foreign Affairs and International Trade Canada (DFAIT) and it discussed the nature and extent to which new technologies have diffused in Kerala’s primary, secondary and service sectors through a series of academic type papers, panel discussions and case study presentations. About fourteen such presentations were done spread over two days and there were over 100 participants which included Professor K P Kannan, Professor M A Oommen, Professor Phil Oxhorn, (McGill Centre for Developing Area Studies), Professor Louk de la Rive Box (Rector of ISS, Hague), Professor Pulapre Balakrishnan (Nehru Memorial Museum and Library), Professor Chiranjib Sen (IIM-Bangalore) and Professor Pankaj Chandra (Director, IIM-Bangalore). Of particular mention was the session on the industrial sector where three successful innovators from Kerala’s small but focused industrial establishment made presentations on their own technological activities and how they overcome the many constraints that entrepreneurs in Kerala may normally face. The conference may not be seen end in itself but the as the beginning of a long conversation on the issue of new technology diffusion in the context of Kerala and the theme of the 2010 conference will be ‘knowledge-intensive entrepreneurship from Kerala’ . The conference was co-ordinated by Professor T V Paul (from the McGill University side) and Professor Sunil Mani (from the CDS side).

VII. Teaching programmes:

Two M.Phil level courses were offered: (i) Course 208: Economics of technological change; and (ii) Course 304: India and the global economy.

In addition the unit also offered a 15 lecture course on “Innovation and Technology Policy” at the Post Graduate Programme in Public Managemement and Policy (PGP-PMP) at the Indian Institute of Management, Ahmedabad during February 20-29 2008

VIII. Supervision (M.Phil and PhD) :

- The unit has supervised the M.Phil dissertations of four students during the period. Currently a fifth student is being supervised and he is expected to submit his dissertation in about a month from now.

- The unit is supervising the doctoral dissertation of one candidate during the period **under reporting.**

IX. Training programmes developed and co-ordinated

The Unit has developed and organized three training programmes: first, “Using Internet for Applied Development Research” and second, “Teaching Innovations Programme in Economics for College Teachers”. Further it also co-ordinated a post experience training programme, “Design and evaluation of innovation policy” with United Nations University-MERIT, Maastricht, The Netherlands.

The details of these programmes are as follows:

- **Teaching Innovations Programme in Economics (TIPE) for College Teachers in Kerala**

The Teaching Innovations Programme (TIPE) for college teachers in economics seeks to improve undergraduate education in economics in Kerala by offering the instructors an opportunity to expand their teaching skills and participate in the scholarship of teaching and learning in Economics. The programme will introduce the participants to some of the recent advances in economic theory and pedagogical techniques as well.

The first version of the TIPE programme was offered in July-August 2006 This version was supported by the Ratan Tata Trust and about 15 lecturers from various colleges across the state participated in it. A second version of the programme was offered in June-July 2007 with participation by 20 lecturers and the third version of the programme was offered during June 23 through July 18 2008 and it attracted 20 lecturers from colleges and universities throughout the country.

The Programme has four modules of five working days each. The modules range from topics in economic theory to quantitative techniques to selected issues in Indian economy. The four modules are:

- Module 1: Microeconomics;
- Module 2: Macroeconomics;
- Module 3: Econometrics; and
- Module 4: Selected topics on Indian economy

The participants can choose between various combinations of *at least* two modules. For instance a participant may opt for all the four modules or she may choose various combinations of the modules, say for instance Modules 1 and 2 or Modules 1 and 3 or Modules 1 and 4 and so on. Under each of the modules lectures are conducted in an interactive mode during the morning session. The afternoon session, on the contrary, will be devoted to the examination of various concepts and issues in a workshop mode. All

the modules will also focus on using new technologies such as computer based exercises and the Internet to make the topics livelier and up-to-date. In fact introducing the participants to a whole host of web-based teaching and research resources is an important feature of this programme. Module 1 dealing with selected issues in Indian economy will introduce the participants to the database of Indian economy and also to techniques in data analysis.

The fourth version of the programme will be offered during June 18 through July 10 2009

- **Short Duration Programme on Using Internet for Applied Development Research**

Internet has become a major source of information for social scientists, and users benefit from improved search and other tools that optimise one's use of the Internet. In this context, CDS has developed a short duration training programme on 'Using Internet for Applied Development Research' for research scholars in economics and other social sciences, across colleges and universities in India. It is being organised in collaboration with the [Indian Institute for Information Technology and Management-Kerala \(IIITM-K\)](#)

Given a research topic, after attending the course, the participant should be able to:

- * Prepare a comprehensive but issue-specific bibliography using freely available resources on the www;
- * Identify secondary source datasets;
- * Download the identified datasets in an efficient manner; and
- * Familiarise with different methods of dissemination (of output) and networking

The programme will take the participant through the various stages involved in conducting a applied development research project and will familiarise the participant with the Internet resources which can make that step easier. The topics covered include tools for power browsing, searching, downloading, data analysis, collaborating, and reporting writing etc.

Hitherto four versions of the programme have been offered in 2005,2006, 2007 and 2008 respectively. The fifth version is planned for April 3-5 2009 at the ICSSR Western Regional Centre at Mumbai.

- **Design and Evaluation of Innovation Policy (DEIP) at NISTADS, New Delhi during February 2-7 2009**

The NISTADS, CSIR, New Delhi, The Centre for Development Studies, Trivandrum, Kerala and the United Nations University-MERIT, Maastricht, The Netherlands jointly organized a training programme on the "Design and Evaluation of Innovation Policy" (DEIP) at NISTADS, New Delhi during February 2-7, 2009. The programme was

targeted at senior and middle level officials of institutions involved in the formulation and implementation of science, technology and innovation policies in India, such as the DST, DSIR, CSIR, NRDC, DBT, TIFAC and state science and technology councils and organizations. Personnel from private sector and non-profit organisations involved in innovation strategy formulation and implementation were also eligible for participation. The course took the participants through the nuances of designing innovation policies and evaluating their actual effectiveness, using conventional and non-conventional science, technology and innovation indicators. There were 22 lectures spread over a period of five and half working days and the course attracted a total participation of 48 candidates representing all the major scientific agencies in the country including 6 doctoral research scholars from some of the leading Institutes and Universities such as the IIT, Mumbai and Jawaharlal Nehru University. The course was jointly co-ordinated by Professor Sunil Mani (CDS) and Professor Adam Szirmai (United Nations University-MERIT, Maastricht, The Netherlands).

X. Professional involvement outside Centre (Membership of Committees/Editorial Boards of Journals)

- Member, Expert Committee on Innovation Surveys, [Department of Science and Technology](#), Government of India
- Member, Editorial Advisory Board, [Research Policy](#), (Elsevier Science).
- Member, Editorial Board, [International Journal of Technology and Globalization](#), (Inderscience)
- Member, Editorial Advisory Board, Science, Technology and Society (Sage Publications)
- Member, Editorial Board, [International Journal of Technology, Learning and Development](#), Inderscience
- Instructor, [Globelics Academy](#), Lisbon Technical University (2006-), [TaSTI, University of Tampere \(2008\)](#)
- Member, Organizing/Scientific Committee, [Globelics 2008 at Mexico City, Mexico, Globelics 2007 at Saratov](#), Russia
- Academic co-ordinator, [Stanford Centre for International Development-Kerala Global Support Network- Asian School of Business Seminar Series on Kerala in the Global Economy](#)
- Visiting Faculty, [PGP-PMP, Indian Institute of Management, Ahmedabad](#)
- [San-Ei Gen Visiting Faculty at University of Edinburgh Management School, Scotland, UK \(January 2008\)](#)
- Member, Selection Committee, Centre for Studies in Science Policy, Jawaharlal Nehru University, 2007
- Member, Expert Group on Innovation, UNIDO, Vienna

- Honorary Visiting Professor, Faculty of Economics, University of Ljubljana, Slovenia
- Honorary Visiting Professor, Institute of Public Enterprise, Hyderabad, India

- Referee to : (i) Science and Public Policy, (ii) International Journal of Technology and Globalization; (iii) Industry and Innovation, (iv) Economic and Political Weekly; (v) Edward Elgar ; (vi) Palgrave; and (vii) Netherlands Organization for Scientific Research

- External Examiner to doctoral dissertations at (i) India Gandhi Institute of Development Research (IGIDR), Mumbai; (ii) Xavier Institute of Management, Bhubaneswar.

XI. Work Plan for 2009-10

- **Research:** I will be carrying out the two new research projects:

Project 1: Globalisation of Innovation: Its manifestation, determinants, and implications for the emerging economies of China and India The project is sponsored by IDRC and it has two other members, namely Professor T Jayaraman of Tata Institute of Social Sciences, Mumbai and Professor Rakeshh Basant of Indian Institute of Management, Ahmedabad. The project is on for two years beginning February 23 2009. The project also has a Chinese counterpart housed at Tsinghua University, Beijing. The main objectives of this project are to:

- i. Critically examine the factors that determine China and India as favorite locations for R&D outsourcing; and
- ii. Analyze the impact of this activity on the overall economic performance of both the Chinese and Indian host economies and specifically its role in accelerating the process of local technological development in the two countries

Project 2: Growth of knowledge-intensive entrepreneurship in India: The project is sponsored by the European Union and is on for two years from January 1 2009. The objectives of the project are to:

- (i) To trace the growth of knowledge-intensive entrepreneurship from India since 1991;
- (ii) Understand the factors that may have contributed to this process; and
- (iii) Conduct case studies of knowledge-intensive entrepreneurs.

Three research papers (both these were initiated during 2008-09 or earlier and will be completed during 2009-10):

- (i) **Diffusion of new technologies and productivity growth in Kerala's agricultural sector: Natural Rubber vs Coconuts (with V.Santhakumar):** Coconut and Natural Rubber are two agricultural tree crops that account for more than 50 per cent of the gross cropped area of the state. Their share in Kerala's agricultural output too has increased and now accounts for about 40 per cent of the total agricultural output of the state. India has the highest level of productivity in both the crops, but on a long term basis, within India, Natural Rubber has registered the highest productivity growth among all other agricultural crops, while the productivity of Coconuts has barely increased over time. We seek explanation for this differential performance in terms of the constitution of the relative diffusion of new technologies facilitated by their respective Sectoral Systems of Innovation (SSI). The SSI of NR consists of an articulated regulatory policy mechanism which ensured that the new technologies that were generated by the research arm of the regulatory body itself were adopted by the farmers. In order to take care of the cost of adoption, which was substantial, capital subsidies were put in place. Contrary to this, in Coconuts there appear not much evidence of diffusion of new technologies and its SSI is characterised by a lack of cohesiveness with a multiplicity of actors operating at sub optimal scales. Also the main regulatory body does not have the legal wherewithal nor does it have absolute control over the generation of new technologies. Capital subsidies though available are of much smaller in magnitude. The research system, is also, not very successful in finding solutions to some of the diseases having a deleterious effect on the productivity level of coconuts such as for instance the root wilt disease. However some concerted efforts

have been made over the last ten years or so to develop new technologies and its diffusion among farmers and this has started bearing fruit in the form of increases in productivity, specifically since 1995-96. The study thus reconfirms a recent finding in the literature that the constitution of the SSI is a necessary condition for not only generating new technologies but for its speedy diffusion as well.

A first version of the paper was presented at the CDS-McGill conference at CDS on January 27 2009

(ii)The rising enrolments in technical education in Kerala since 1991, but where have all the engineers gone?: There has been tremendous increase in the student intake at engineering degree courses in Kerala. There is a tendency on the part of commentators, both academic and otherwise, to equate the intake with actual supply of engineers. The present study questions this. The correct indicator for measuring the actual annual flow of engineers is the outturn rates. These are computed by taking into account the drop out rates and the failure rates. Based on data compiled the National Technical Manpower systems, the outturn rates have been computed for the Kerala engineering colleges for the 1991 through 200 cohorts of students enrolling for undergraduate engineering courses in the state. These outturn rates have actually come down significantly and a branch-wide analysis shows that there has been a significant reduction in the rate of outturn in the more popular branches. This “deterioration” in engineering education started during the late 1990s- thus involving the established government-run colleges. Therefore attributing this decline to the arrival of self-financing colleges is, at best, premature. There has been an implicit understanding of the problem in the policy circles, especially in the early part of this decade. This led to the state participating in the World Bank-aided TEQIP project. But the spending on the TEQIP programme has been very tardy. There is going to be a bunching of a large amount of spending on the last six months of the programme. Spending pattern on those aspects dealing directly with qualitative improvements, namely in faculty development, starting of new courses, the actual achievements are far below expected outcomes. On overall performance, the score received by the participating Kerala colleges are far below the national average. Despite the availability of a large amount of data the quality of oversight of the programme leaves much to be desired. In fact the project implementation unit has not even developed indicators for measuring the quality of technical education. All the available indicators such as the numbers on intake and outturn are quantitative indicators.

An open seminar on the topic was presented at CDS on November 9 2007

(iii). Is India becoming more innovative since 1991? Analysis of its evidence and some disquieting features: India is variously described as a knowledge-based economy in the making thanks essentially due to her high economic growth and the role played by knowledge-intensive sectors such as Information Technology in spurring and maintaining this high growth performance. There is also a strong feeling among especially the West that India is becoming very innovative. The study will take the reader through the empirical evidence on whether this is indeed the case since the reform process of 1991. A variety of conventional (in the absence of new indicators such as the results of innovation surveys) are analysed and their movements over the last two decades or so chartered to draw some firm conclusions on this front. The conventional indicators considered are the growth in research intensity, patenting, scientific publications, and technology balance of payments. The study is organised into three parts. In the first part I will discuss certain macro features of the growth performance over the last two decades or so. In the second part a detailed analysis of the conventional indicators are attempted. The ensuing analysis shows that the growth in innovations is not widespread but concentrated in certain specific sectoral systems of innovation such as in the case of the pharmaceutical industry. In the process of analyzing and piecing together this evidence, the third part of the lecture will identify certain disquieting features which can act as limiting factors. Two such factors are identified and analysed: first, the financing of innovation and second, the availability and quality of science and engineering personnel. The study concludes by examining the efforts made by the government to overcome these two constraints through public policy initiatives.

Training Programmes and conferences:

- The fifth version of the short duration training programme, ‘Using Internet for Applied Development Research’ (April 3-5) at the ICSSR Western Regional Centre at Mumbai;
- The fourth version of the “Teaching Innovations Programme in Economics for College Teachers” (TIPE) during June 22- July 10 2009.
- The Second Design and Evaluation of Innovation Policy (DEIP India 2010) in collaboration with United Nations University-MERIT and National Institute of Science, Technology and Development Studies (NISTADS) (yet to be confirmed);
- Member of the Programme Committee of Atlanta Conference on Science and Innovation Policy at Georgia Institute of Technology, Atlanta, Georgia, USA (October 2-3 2009);
- Member of the Scientific Committee of Globelics.
- Contributing a chapter on “Performance of India’s Telecommunications Industry”, *India Development Report 2010*, Delhi: Oxford University Press

Publication Plan for 2009-10 (only book)

Mani, Sunil (2010), *Innovation capability in developing countries. A study of the telecommunications industry*, Cheltenham, UK and Northampton, USA: Edward Elgar.