

# **INDIAN INNOVATION SYSTEM**

## **Perspective and Challenges**

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### **1. INTRODUCTION**

INNOVATION has been one of the key determinants of competitiveness in global firms. This term refers not only to new scientific and technological inventions, but also to system changes and the manner of doing business. Firms that are able to use innovation to differentiate their products and services outperform their competitors, whether this is measured in terms of market share, profitability, growth, or market capitalization. However, quite often innovative and new technologies fail to translate into products and services, making the process of management of innovations challenging.

In an endeavour to enable firms to come out with more and more innovative products and improve the return on investments in innovation and enhance national share in global high technology exports, more and more countries are realizing the need for establishment of formal National Innovation Systems.

### **2. INNOVATION SYSTEM**

#### **2.1 Indian Innovation System and Its Performance**

A typical technological innovation system consists of three broad segments which enables the journey of an idea from human 'mind' to 'market'. The first phase is called the 'Birth Phase', where commercially viable idea gets converted into a workable prototype/process. The next phase is called the 'Survival Phase wherein up-scaling of the prototype to the pilot plant/pre-commercial stage is done. The third phase is called the 'Growth Phase' wherein the pilot production is up-scaled to commercial production. A model of the Indian Innovation System is illustrated in Figure 1. A description of various mechanisms of Indian Innovation System and their performance follows.

#### **MECHANISMS SUPPORTING TRANSFORMATION OF IDEA TO PROTOTYPE**

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### ***2.1.1 Technopreneur Promotion Programme (TePP)***

As a golden jubilee initiative during 1998-99, Ministry of Science & Technology, Government of India launched a novel programme known as “Technopreneur Promotion Programme (TePP)” to tap the vast innovative potential of Indian citizens. The programme is jointly operated by the Department of Scientific and Industrial Research (DSIR) and Technology Information, Forecasting & Assessment Council (TIFAC) of Department of Science & Technology (DST). The programme aims to support individual innovators, from informal knowledge system as well as from formal knowledge system so as to enable them to become technology-based entrepreneurs (technopreneurs). TePP provides financial support to individual innovators to convert an original idea/invention/know-how into a working prototype/process. Under the programme, any Indian citizen, viz. artisan, technician, engineer, architect, doctor, scientist, housewife, student, farmer, etc. having innovative idea could aspire to become technology based entrepreneur (technopreneur). The proposal can be made, either by an individual on his own or jointly with sponsoring/collaborating organization involved in technology development and promotion. The proposals from the owner of ‘start-ups’ are also considered for TePP support, if the annual turnover of the company doesn’t exceed Rs 3.0 million.

During last six years of its operation, the programme has been able to fulfill the dreams of many innovative Indian citizens in their pursuit of becoming technopreneurs. Since its inception, the Government of India under TePP programme has given financial support to over 115 projects. Out of these, around 50 projects have been completed and around 25 projects have been commercialized. The scheme has resulted in grant of domestic patents to more than 10 innovators and US patent to 3 innovators, besides commercialization of the processes/gadgets. Some of the successfully completed/commercialized projects under TePP are tiltable bullock cart, innovative cotton stripper machine (US patented), small 10 H.P. tractor, small sprayer (5 ltr. capacity), design cutting machine, solid bio-mass fired furnace, alkali lignin from dry pine needles, diagonal inverter for operation microscope, protein dialysis device (US patented), on-line time domain moisture measurement, neem oil for non-healing wounds,

novel process for manufacturing heterocyclic chemicals, bus heating system, DC MCBs, manufacturing of grape flakes, etc.

### ***2.1.2 National Innovation Foundation (NIF)***

The Government of India started National Innovation Foundation (NIF) in March, 2000 by providing a corpus fund of Rs 200 million. NIF is an autonomous body under the Department of Science and Technology, Government of India. Its Chairman is Secretary, Department of Scientific & Industrial Research (DSIR). NIF has its headquarters located at Ahmedabad (India). NIF is developing a National Register of Green Grassroots Technological Innovations and Traditional Knowledge. It also seeks to develop a new model of poverty alleviation and employment generation by helping convert grassroots innovations into enterprises.

### ***2.1.3 NGO Mechanisms***

Some of the mechanisms for nurturing innovations are:

- Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI), Ahmedabad
- Gujarat Grassroots Innovations Augmentation Network (GIAN), Ahmedabad
- Sustainable-Agriculture & Environmental Voluntary Action (SEVA)
- Rural Innovations Network (RIN)

## **MECHANISMS SUPPORTING TRANSFORMATION OF PROTOTYPE TO PILOT PLANT**

### ***2.1.4 Technology Development and Demonstration Programme (erstwhile PATSER)***

The Technology Development and Demonstration Programme (TDDP) of DSIR aims at catalyzing and supporting activities relating to technology absorption, adaptation and demonstration including capital goods development by involving industry and R&D organizations.

Under the programme, innovative technologies are up-scaled from the 'proof of concept stage' to 'pilot plant/pre-commercial stage' by the industry. The projects involve research, design, development and engineering and are executed by industry, overseen by experts from university/laboratory.

DSIR has supported over 150 projects so far since inception of the scheme in 1992, when it was called PATSER. More than 65 projects have been completed and 31 companies have started paying lump sum premia/royalty. So far, more than Rs. 35 million royalty/premia have been received. About 15 patents have been filed based on projects supported under the scheme. Some of the successfully completed projects are: Development of Process for Manufacture of Pyrazinamide, Development of Novel Resins for Use in Solid Phase Organic Synthesis and Combinatorial Chemistry, Development of Hand Held Optical Test Equipment, Innovative Microelectronic Packaging Technology, Integrated Pilot Demonstration Plant for Spice Processing, Automatic Brick Making Machine, etc.

### ***2.1.5 Home Grown Technology Programme (HGTP)***

The Home Grown Technology Programme (HGTP), a mechanism of Technology Information Forecasting and Assessment Council (TIFAC) of the Department of Science & Technology, Government of India was started in 1993 following a suggestion from the Planning Commission. The HGTP was started primarily to support the Indian industry for achieving competitive strength through technological innovation. HGTP assists industries/companies for scaling up laboratory/bench scale technology to pilot or pre-commercial stage. The HGTP is intended for bringing about significant improvement in an existing product or process. HGTP is designed to support commercialization of technologies developed by indigenous research and development. HGTP provides soft loan (generally not exceeding 50% of the project cost) for technology development which is repayable in user friendly instalments after the completion of the project. More than 60 projects have been supported so far.

### ***2.1.6 Venture Capital Funding Mechanisms***

Venture Funds are recognized globally as the most suitable form of providing risk capital for the growth of innovative and high technology businesses. Venture capital is an important source of equity for start-up companies. Professionally managed venture capital firms generally are private partnerships or closely-held corporations funded by private and public pension funds, endowment funds, foundations, corporation, wealthy individuals, foreign investors and the venture capitalists themselves.

Traditionally, venture capital in India was an extension of the developmental financial institutions like IDBI, ICICI, SIDBI and State Finance Corporations (SFCs). The first origins of modern Venture Capital in India can be traced to the setting up of a Technology Development Fund (TDF) in the year 1987-88, through the levy of a cess on all technology import payments. TDF was meant to provide financial assistance to innovative and high-risk technological programmes. In 1988, Technical Development and Information Corporation of India (TDICI) (now ICICI Venture) and Gujarat Venture Fund Limited (GVFL) were formed. ICICI bought out UTI's stake in 1988 and ICICI Venture became subsidiary of ICICI.

The Indian Venture Capital Association (IVCA) was set up in 1992, the nodal centre for all venture activity in the country. SIDBI constituted a Venture Capital Fund (VCF) in 1992, with an initial corpus of Rs 100 million. The fund is being utilized for venture capital assistance to SSI units directly as well as for subscription to the corpus of Venture Capital Funds (VCFs) for onward lending to SSI units. This fund is now being managed by SIDBI Venture Capital Ltd. (SVCL), a wholly owned subsidiary of SIDBI. SIDBI is also subscribing to the corpus of other Venture Capital Funds.

A Rs 1,000 million National Venture Capital Fund for Software and IT Industry (NFSIT) has been set up by SIDBI during 1999-2000.

Keeping this in view, that innovative SME units are expected to play a catalytic role in the post-liberalized economic environment in the country, Small Industries Development Bank of India launched a new venture capital fund (SME Growth Fund) dedicated to SME sector in the year 2004 with a large corpus of Rs 5,000 million. The fund is valid for eight years and its objective is to meet the long-term risk capital requirement of innovative and technology oriented units in this sector. The fund will identify unlisted SME entities in various growing sectors such as life sciences, retailing, light engineering, food processing, information technology, infrastructure related to services such as health care, logistics and distributions, etc. The management of Fund has been entrusted to SIDBI Venture Capital Ltd. (SVCL), a wholly owned subsidiary of SIDBI, set up in 1999.

ICICI Venture has become the country's first homegrown private equity investor to touch the \$1 billion mark in terms of total funds under management. ICICI also has Technology Support and Services Programme (TSSP) which has programmes for promotion of collaborative R&D projects like Sponsored Research & Development (SPREAD) programme and Technology Institutions (TI) programme.

### ***2.1.7 Science & Technology Entrepreneurship Parks (STEPs)***

Science Parks help in creating an atmosphere for innovation and entrepreneurship, and promote active interaction between academic institutions and industries for sharing ideas, knowledge, experience and facilities for the development of new technologies and their rapid transfer to the end user.

The major objectives of STEPs are to forge linkages among academic and R&D institutions and industry, to promote entrepreneurship among Science and Technology persons, to provide R&D support to the small-scale industry and to promote innovation based enterprises.

The Science & Technology Entrepreneurship Park (STEP) programme was initiated during 1984 by Department of Science & Technology, Government of India jointly with all India financial institutions (IDBI, IFCI & ICICI), State Governments and the academic institutions. Under this initiative, DST has catalyzed setting up of 15 such STEPs in different parts of the country.

### ***2.1.8 Technology Business Incubators (TBIs)***

Department of Science & Technology (DST), Government of India initiated this scheme during 2000-2001. Under the scheme, grants-in-aid is provided by the Department, both on capital and recurring for a stipulated period. Presently, TBIs are being implemented at 12 locations in various academic institutes.

## **MECHANISMS SUPPORTING TRANSFORMATION OF PILOT PLANT TO COMMERCIAL PRODUCT**

### ***2.1.9 Technology Development Board (TDB)***

Technology Development Board (TDB) was set up by Government of India on 1st September 1996 and the operation of fund was assigned to Department of Science & Technology, Government of India. The Board provides financial assistance in the form of equity, soft loans or grants. TDB's participation in a project generally does not exceed 50 per cent of the project cost. The projects funded by the Board include sectors such as medicine and health, engineering, chemicals, agriculture and transport. Till 31st March 2005, the TDB had handled 141 projects valued at a total cost of Rs 20,438.9 million. Of the TDB's commitment of Rs 6,629.4 million towards these projects, it has already released Rs 5,264.1 million.

### ***2.1.10 Drug Development Programme and Pharma-ceuticals Research and Development Support Fund (PRDSF)***

The Department of Science and Technology (DST) launched a Drug Development Programme during 1994-95 for promoting collaborative R&D in drugs & pharmaceuticals sector involving industries and institutions. Fifty projects have been supported under the Programme involving 22 institutions and R&D establishments and 23 industries. These projects were about development of new chemical entities, new vaccines, assay systems, drug delivery systems and herbal drugs. These projects have resulted in filing of 4 product patents and 12 process patents. The Programme has also led to setting up of eight National Facilities for R&D.

The Government established a Pharmaceuticals Research and Development Support Fund (PRDSF) of Rs. 1,500 million (US\$35 million) in January 2004. The fund will be used for supporting Pharma R&D projects by extending soft loan with 3 per cent p.a. interest rate.

### ***2.1.11 New Millennium India Technology Leadership Initiative (NMITLI)***

The Government of India has recognized the power of innovation and had launched a new initiative during 2000 to enable Indian industry to attain a global leadership position

in a few selected niche areas by leveraging innovation-centric scientific and technological developments in different disciplines.

In a very short span, NMITLI has crafted more than 25 path setting technology projects involving over 50 industry partners and 150 R&D institutions with an estimated outlay of Rs.1,600 million. These projects are setting new global technological paradigms in the areas such as nano material catalysts, industrial chemicals, gene-based new targets for advanced drug delivery systems, bio-technology, bio-informatics, low cost office computers, improved liquid crystal devices and so on. The scheme is being implemented by Council of Scientific & Industrial Research (CSIR).

### **3. BARRIERS AND CHALLENGES FACED IN ADMINISTRATION OF INNOVATION MECHANISMS**

#### **IDEA TO PROTOTYPE PHASE**

- (i) Lack of Proper System for Screening and Evaluation of Ideas*
- (ii) Not Enough Support Mechanisms/Programmes to Nurture Innovative Ideas to Prototype Stage*

#### **PROTOTYPE TO PILOT PLANT PHASE**

- (iii) Lack of Awareness about Funding Mechanisms*
- (iv) Low User Friendliness of Funding Mechanisms*

#### **PILOT PLANT TO COMMERCIAL PHASE**

- (v) Complex and Expensive IPR Protection System*
- (vi) Disputes Regarding Ownership of Intellectual Property Generated*
- (vii) Lack of Adequate Market Information for Innovative Products*

#### **GENERAL**

- (viii) Lack of Synergy between Various Departments and Agencies*
- (ix) Non-availability of Technical Expertise and Testing & Trial Facilities at Affordable Rates*

*(x) No Organized System to Allow Sequential Conversion of Projects from Idea to Prototype to Commercial Stage*

#### **4. SUGGESTIONS TO MEET THE CHALLENGES AND STRENGTHEN THE INNOVATION SYSTEM IN INDIA**

Probable suggestions to overcome the challenges faced and strengthen the Indian Innovation System are given below.

##### **(i) Creation of Expert Panels and a Database on Innovations**

Constitution of subject-wise expert panels in technical institutions around the country can facilitate screening and evaluation of ideas. Evaluation reports from these panels in a standard format could then be processed further for support. Creation of a Database on Innovations which is made accessible to the prospective innovators as well as the expert panels would not only avoid processing of new applications on ideas already considered in the past but would also lead to cross-fertilization of ideas. Such a database would also serve as a tool to the expert panel in proper screening and evaluation of ideas.

##### **(ii) Strengthening and Proliferation of TePP-like Initiatives**

S&T departments of State Governments could be encouraged and supported to evolve and operate TePP- like initiatives in their respective states. Operational aspects of TePP initiative, e.g. screening of applications and project monitoring could be outsourced to universities, technical institutes, NGOs, etc. for speedy implementation.

##### **(iii) Innovation Awareness Campaign**

To make people aware about various funding mechanisms, awareness campaigns could be launched by holding seminars/exhibitions of successful innovators and screening of videos/CDs/documentary films on innovative projects at technical institutes/colleges/schools and industrial clusters in different parts of the country. Also, sensitization camps for innovation awareness, targeted at executives and professionals could be organized. A standard “innovation awareness creation module” could be evolved at the central level, which could be utilized by institutions and NGOs in the country.

#### **(iv) User-Friendly Funding Mechanisms**

The assessment and processing time of proposals in any funding mechanism could be made optimum by evolving well defined parameters in consultation with experts as well as user groups. Terms and conditions of funding could be such that support is liberal and on easy terms, when the risk involved is high, i.e. during the birth and survival phase of innovation and support is partial with appropriate sharing by innovator when risk is relatively less, i.e. during the growth phase of innovation. Also, terms and conditions could be flexible for projects in high priority areas. Further, the adopted mechanisms should conform to internationally accepted benchmarks and best practices, e.g. the “Innovation Evaluation Process (IEP) Model” followed by National Science Foundation, USA.

#### **(v) IPR Infrastructure and Training**

In order to make the filing of patents simple and easier, efforts should be made for setting up more and more extension centres of Patent Offices around the country, e.g. in industry associations and providing linkages amongst them. More and more IPR awareness-cum-training programmes should be organized to mitigate the myths about patents, designs, trademarks and copyrights in the minds of people and also train them in drafting patent claims, filing patent applications, etc. Training is also essential in drafting MoUs/Agreements to avoid IPR related disputes at a later stage.

#### **(vi) Marketing Support System**

Providing a platform to the innovators in national and international exhibitions to exhibit their developments would help in attracting investors for commercialization of innovative products/processes. Internet portals of government departments and industry associations can also play a useful role in providing publicity to the innovative products/processes.

#### **(vii) Coordination through NIF**

National Innovation Foundation (NIF) in the country should play the role of a coordinating body between various departments/agencies operating innovation support mechanisms. NIF should maintain a record of all completed projects, whether they result

into prototype, pilot plant or commercial product and then forward them to other relevant agencies for taking them further in the innovation chain. NIF should also maintain a panel of technical experts and testing laboratories at approved rates, whose facilities could be utilized by innovators/organisations.

## **5. CONCLUSION**

The Indian Innovation System can be viewed as a system that is presently going through an evolution phase. Indian innovation system is continuously adapting itself to the newer ways of conducting R&D and funding the same. It is keen to adopt select features of innovation systems in other countries to improve its effectiveness. In this era of globalization, Indian Innovation System would be keen to participate in a global innovation system, wherein idea is generated in one part of the world, prototype is developed in another and it is commercialized in yet another part of the world for global consumption.

There is an increased thrust on public-private partnership models to nurture and support the entire innovation chain in the country. Government is continuously enhancing the S&T outlays over the five-year plan periods and is allocating higher funds for supporting cutting-edge R&D and innovative projects. For example, the Union Budget 2005 announced enhancement of corpus for Pharmaceuticals Research and Development Support Fund. NGOs in tandem with government are turning enthusiastic to trigger an innovation movement in the country so as to enhance the share of innovative products in country's production and exports and thereby help the country to attain a competitive world ranking. Foreign venture capital institutions and angel investors, e.g. Warburg Pincus, Temasek Holdings and General Atlantic Partners are showing keen interest to support the innovation activity in the country. That India is a global platform for R&D has already been demonstrated by the presence of more than hundred R&D centres of MNCs in India. Now, India is aspiring to establish itself as a manufacturing base for hi-tech products and services. The growth of Indian Innovation System in the coming years is expected to play a crucial role in realization of this dream.

**FIG.1 : INDIAN INNOVATION SYSTEM – MODEL**

