

NATIONAL INNOVATION SYSTEMS: INDIA'S PERSPECTIVE

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I INTRODUCTION

Innovation is defined as a process by which varying degrees of measurable value enhancement is planned and achieved in any commercial activity. This process may be breakthrough or incremental. Famous economist and innovation guru Joseph Schumpeter opined that innovation is an outcome of new combinations made by an entrepreneur, resulting in a new product, a new process, a new source of supply for raw materials or other inputs, a new market, or a new way of organizing business (Schumpeter, 1934). The process of innovation cannot be separated from a firm's strategic and competitive context. Many times, transformation of an idea into commercial product or process becomes difficult, thereby making the process of innovation management a challenging task.

Innovation has two perspectives: financial and entrepreneurial. From the financial perspective, innovation offers cost reduction, provides competitive advantage and assists economy to change as well as comply with national and international regulations. From the entrepreneurial perspective, innovation provides increased efficiency, sustainable development, rejuvenation and value addition.

Indian economy is growing at the rate of 6-8 per cent per year and exports are growing at 30 per cent Compounded Annual Growth Rate (CAGR). Subsequent to such a growth in the economy, innovation is emerging as a key driver.

II INDIAN INNOVATION SYSTEMS

An innovation system consists of three phases in which an idea generated by virtue of human cognition is translated into a product, service or process. The life cycle begins with the birth phase where viable ideas get converted into a prototype or process, thereby heralding the onset of innovation. Second phase is called survival phase where prototype or process generated in the birth phase gets scaled up to pilot or pre-commercialization stage. Final phase or the third stage is the process of growth where pilot scale is further scaled up to commercial production. Several funding mechanisms support the process of innovation.

A. Technopreneur Promotion Programme (TePP)

TePP was launched by the Ministry of Science and Technology (MOST) in 1998-1999. Initially, the programme was operated jointly by the Department of Scientific and Industrial Research (DSIR) and the Technology Information, Forecasting and Assessment Council (TIFAC) of the Department of Science and Technology (DST). Since 2009, it is being operated by DSIR alone. The uniqueness of the programme lies in the fact that individual innovators, be it from informal or formal knowledge system, get financial support without any collateral security. This programme aims at generating prototype or process from the germination of an idea. All Indian citizens are eligible to apply and applications can be made to any of DSIR's 29 outreach centres spanning the length and breadth of the country. Every proposal gets evaluated through experts in the subject field and forwarded to DSIR. Such proposals are placed before a high-level screening committee for final recommendation.

In the idea to prototype/process stage, an entrepreneur could get financial support of Rs 75,000 to Rs 150,000. During the prototype to pre-commercialization stage, the financial aid available is Rs 750,000 to Rs 4.5 million. The amount is available to individual innovators, and no collateral security is required.

The scheme has provision also for financial support to start-up companies, the annual turnover of which does not exceed Rs 4.5 million. In the initial years, the amount released was about Rs 2.5 million per year, but in a span of 12 years it has rocketed to Rs 43.4 million. TePP supports 460 projects, out of which 446 are in Phase I and 14 are in Phase II. The funds released total Rs 228.5 million and to date, 25 projects have been commercialized.

B. National Innovation Foundation (NIF)

NIF was created by DST as an autonomous body in March 2000 by providing a corpus fund of Rs 200 million. NIF's mandate is to scout, spawn and sustain grassroots innovations. It is developing a national register of green grassroots innovations and traditional knowledge for this purpose. The agency addresses the informal sections of the society, and helps them develop and protect their interest in value addition and competitiveness. It also strives to create a model for poverty alleviation and employment generation through conversion of innovation into enterprise.

C. Technology Development and Demonstration Programme (TDDP)

TDDP aims to strengthen the interface between industry, R&D establishments and academic institutions, and to provide catalytic support for the development of innovative product and process technologies, traversing the journey from proof of concept to pilot stage, rendering them fit for commercialization and making them competitive.

The projects could involve research, design, development and engineering and are to be executed by industry. TDDP covers technology risks too. The progress of the projects is overseen by relevant field experts. Over a period of 18 years, TDDP has supported around 200 projects in industrial units and scientific establishments involving a cost of Rs 2.50 billion (DSIR's share Rs 1 billion). Nearly 70 companies have completed their projects and about 35 companies have started paying their royalties. About 15 patents have been filed so far on the projects funded under this scheme.

D. Venture Capital Funding Mechanism (VCFM)

Venture funds are considered to be one of the most suitable forms of providing risk capital for the growth of innovative and high-technology business. It is a source of equity for start-up companies. Professionally managed venture capital firms generally are private, partnership or closely held corporations funded by private and public pension funds, foundations, corporations, wealthy individuals and foreign investors. Traditionally, venture capital in India has been an extension of the developmental financial institutions like Industrial Development Bank of India (IDBI), Small Industries Development Bank of India (SIDBI) and State Finance Corporations.

The first modern venture capital was set up in 1987-1988 as Technology Development Fund through the levy of a cess on all technology imports, to provide financial assistance to innovative and high-risk technology areas. In 1988, Technical Development and Information Corporation of India, now called ICICI Venture, and Gujarat Venture Fund Limited (GVFL) were formed. The Indian Venture Capital Association was set up in 1992. SIDBI constituted a venture capital fund in 1992 with an initial corpus fund of Rs 100 million. This fund, which is utilized to assist small-scale industrial units, is currently being managed by SIDBI Venture Capital Limited (SVCL), a wholly owned subsidiary of SIDBI. SIDBI is also subscribing to the corpus of other venture capital funds. SIDBI set up a Rs 1 billion worth National Venture Capital Fund for Software and IT Industry during 1999-2000.

SIDBI launched a new venture capital fund (SME Growth Fund) for SMEs, as these sectors of industries play a catalytic role in the development of the country during post-liberalized period. This scheme was launched in 2004 with a corpus fund of Rs 5 billion and a focused objective of meeting long-term risk capital requirement of innovative technology-oriented industries. The fund identifies unlisted SMEs in various growth sectors such as life science, light engineering, food processing, information technology, healthcare and logistics. The fund is being managed by SVCL. ICICI Venture has become the first home-grown private equity investor to touch the US\$1 billion mark in terms of total funds under management. It also runs a Technology Support and Services Programme for promoting collaborative R&D projects like Sponsored Research and Development programme and Technology Institution programme.

E. Science & Technology Entrepreneurship Parks (STEPs)

STEPs were initiated by DST in 1984 to forge a linkage between academia, R&D institutes and the industry to promote entrepreneurship skills among science and technology personnel and develop innovative technology-based enterprises. Another aim is to provide support to SMEs. So far, 15 STEPs have been formed across the country, which has generated 788 industrial enterprises with Rs 1.3 billion annual turnover and 5,000 employees.

F. Technology Business Incubators (TBIs)

DST initiated this scheme in 2000-2001 to create technology-based enterprises and businesses. In this scheme, DST provides grants-in-aid both on capital and recurring expenditure to new companies for a fixed period. So far, 12 TBIs have been established in various academic institutions. Information and communications technologies (ICT), biotechnology, nano-materials, agriculture, garment and fashion technology, and servicing and instrumentation are among the areas covered.

G. Technology Development Board (TDB)

TDB was established in 1996 by DST to provide financial assistance in the form of equity, soft loan or grants. Two investors – the Venture Capital Fund of Andhra Pradesh Industrial Development Corporation and Ascent India Fund of Unit Trust of India – are involved with a corpus of Rs 300 million and Rs 750 million, respectively. A total of 141

agreements has been signed at a total project cost of Rs 20.44 billion, where TDB's share is Rs 6.63 billion. Areas covered are healthcare and medicine, engineering, road transport, energy and waste utilization, chemicals, telecommunications, etc.

H. New Millennium India Leadership Initiative (NMITLI)

In 2000, the Council of Scientific and Industrial Research (CSIR) launched a novel programme to enable Indian industry to attain a global leadership position in a few niche areas by leveraging innovation-centric scientific and technological developments in different disciplines. The programme covers areas of high market and technology uncertainty, and the funding is in the mode of soft loan or grant-in-aid.

In a very short span of eight years NMITLI has established 57 path-setting technologies involving 80 industry partners, 270 R&D groups and 1,700 researchers. Rs 5 billion has been disbursed thus far. NMITLI has developed technology in the areas of nano-material catalyst, industrial chemicals, gene-based new targets for advanced drug delivery systems, biotechnology, bioinformatics, low-cost effective computers, energy, ICT, improved liquid crystal devices, etc. Through this scheme, 100 international patents and 150 publications could be achieved by CSIR.

I. Initiatives of Department of Biotechnology

The Department of Biotechnology (DBT) has launched few programmes in the areas of innovation promotion pertaining to biotechnology. Five biotechnology parks and incubation centres have been created for promoting start-up companies and public-private partnerships. Such parks encourage entrepreneurs who may not necessarily be Indian. Small Business Innovative Research Initiatives (SBIRI), another programme launched by DBT, aims to promote small business start-ups in biotechnology. Funds are released in the mode of grants and loans.

So far, 71 beneficiaries could be funded under the scheme. In the areas of bio-energy and biofuel, DBT has initiated an end-to-end mission programme that aims at perfecting technologies for establishing: bio-energy plantations for different agro-climatic zones with the involvement of local people; economically viable production of ethanol using different raw materials and efficient high-yielding strains of micro-organisms; biodiesel production for oil(s) and hydrocarbon using alternate feedstock, especially lignocellulosic wastes, and improved transesterification process; and production of hydrogen from algae and bacteria. Other programmes include biotechnology information system and implementation of a bio-grid of India, and creation of centres of excellence in select areas of biotechnology.

J. Non-Government Organizations

Besides governmental agencies, there are non-governmental organizations (NGOs) involved in nurturing innovations. Some of these are:

- Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI);

- Grassroots Innovation and Augmentation Network (GIAN);
- Sustainable Agriculture and Environmental Voluntary Action (SEVA); and
- Rural Innovation Network (RIN).

III CHALLENGES AND BARRIERS

Each phase of innovation faces different, specific challenges as follows:

- Idea or birth phase – lack of screening and evaluation, support mechanisms;
- Survival phase – lack of awareness, less user friendliness; and
- Growth phase – intellectual property right (IPR), lack of market information.

The general issues faced are:

- Lack of synergy between department and agencies;
- Non-availability of technical expertise, testing and trial facilities;
- Skills shortage;
- Lack of organized system for converting prototypes to commercial products;
- Less organizational focus on innovation and knowledge management; and
- Less customer (user) need-based innovation.

IV PRESENT SCENARIO

The Government of India has taken several initiatives over the years to promote innovation. Action has been initiated in creating database for innovation and subject-wise panel of experts. Evaluation formats have been devised for the objective evaluation of proposals. Innovation awareness camps are being organized by outreach centres in the country. Funding mechanisms are being modified to make them more user-friendly. IPR awareness-cum-training programmes are being organized by reputed institutes like Indian Institute of Technology (Delhi). An institute of national importance, the National Institute of Intellectual Property Management, is being set up in Nagpur to educate and guide on IPR-related issues. Over and above the existing patent offices and their extension centres, an IP Appellate Board has been set up for trademark and patents.

A National Innovation Act is currently being drafted by DST, wherein an integrated S&T plan seeks to establish synergies between academia, R&D institutions and the industry. More incentives are proposed in the form of financial incentives to industries and angel investors, and creation of innovation parks and special innovation zones are proposed. Several studies have been conducted to promote a breakthrough in innovation and accordingly, reforms will take place from school education to higher technical education, including vocational education and training, which is expected to take care of skill shortage.

The present decade (2010-2020) has been declared as “Innovation Decade” and as an immediate step, a National Innovation Council (NIC) has been set up to make a roadmap for the decade. NIC is expected to create sustainable and cost-effective solutions for people at the bottom of the pyramid. US\$1 billion has been earmarked to promote new ideas for inclusive development and innovation in the country. About 22 government departments and their subsidiaries are promoting various innovation-related programmes.

So far, DSIR has recognized 1,300 R&D houses (number of units may be more) and 900 non-commercial scientific and industrial research organizations and public-funded research organizations. In the 2011-2012 national budget, the Finance Minister has increased the quantum of existing fiscal incentives. The 34 technological institutes of national level (14 Indian Institute of Technologies and 20 National Institute of Technologies), 7 Indian Institutes of Management and about 200 universities offer strength to the innovation drive. Recently, as a further boost for innovation, CSIR has promoted an Academy of Scientific and Innovative Research (AcSIR) to conduct research in the domain of inter-disciplinary and trans-disciplinary areas of science and technology.

V SUCCESS STORIES

Pure Tech India is an S&T company that Mr. Arvind A. Narayan formed in 2006. The venture is an R&D and manufacturing initiative on speciality engineering equipment for liquid pollution control. The company has grown six times over a period of just four years (turnover reached Rs 10 million in 2010 from Rs 1.6 million in 2006). The venture is successful in the areas of oil-water separator for Indian Oil Corporation (IOCL), pickling acid recovery using diffusion dialysis, liquid coolant recovery, etc.

IOCL, one of the public sector 'Navaratna' (nine gems) companies, is engaged in the business of lubricants and grease formulations. It is one of the six worldwide holders of marine oil technology. During 2009-2010, IOCL developed 181 lubricants out of which 135 have been commercialized. It owns 215 patents.

CSIR is an autonomous body under MOST with a network of 37 research laboratories (subject-specific) spread over the entire country. It owns a total of 3,016 patents out of which 1,770 are international and 1,246 are Indian. The focus of CSIR is global participation with local elements. The organization has started partnering with large national and international companies in the development of core technologies that could help people at the grassroots. The open duct delivery system developed by CSIR is an example. The CSIR lab in Jammu has partnered with Cadila to develop an anti-tuberculosis drug. In major engineering, it developed a carbon fibre technology in partnership with the industry. The National Chemicals Laboratory of CSIR has co-developed with Procter & Gamble a highly absorbent material that could be used for sanitary napkins and diapers. CSIR is also working along with the private sector on fuel cell, biofuel and solar energy technologies. The Council has joined hands with the Ministry of New and Renewable Energy to launch a programme, Jawaharlal Nehru Solar Mission, to encourage R&D on solar photovoltaic systems, solar thermal systems, efficient energy storage materials, etc.

Bhabha Atomic Research Centre (BARC), engaged in atomic research, has developed 149 technologies out of which 93 have been commercialized.

VI CONCLUSION

Innovation requires synergistic use of cumulative efforts of industry, government, educational system, R&D environment and customers. The Indian innovation system has adopted selected features of other countries to improve the effectiveness of its NIS. The government has been increasing the S&T outlay every year and allocating

higher funds for cutting-edge technological development. Suitable policies are being formulated as needed by the government to suit innovation. For unleashing the huge innovation potential, India needs to develop a strategy that focuses on increasing competition as a part of improving investment climate, supported by stronger skills, better information infrastructure and more finance from public and private sectors. It also needs to strengthen its efforts to create and commercialize knowledge, as well as better diffuse existing global and local knowledge, and increase the capacity of smaller enterprises to absorb it.

REFERENCE

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