

# 20

## Innovation

**20.1** India needs innovation to accelerate its growth and it needs innovation to make growth more inclusive as well as environmentally sustainable. Innovation is the process of creating something desirable that prevalent expertise says is not possible. An innovation can be a product like the Nano—a modern car that costs less than Rs 1 lakh. An innovation can also be a way of doing things differently to produce results that are very desirable but cannot be obtained by 'business as usual'. Conducting eye surgeries to the same standards as the best in the world but at a very small percentage of the cost is one example. Providing access to mobile phone services to hundreds of millions of people in the country at a fraction of the cost at which they are provided in rich countries is another. The Nano, low cost eye surgeries, and low cost mobile phone services are only a few examples of the many innovations brought about in India.

**20.2** Innovations are not just about the products or processes that produce them. They are also important in designing government programmes. The country has a huge backlog of unmet needs in education, health, water, urbanization, and in the provision of other public services. The sum of money required to meet these needs through conventional approaches is enormous and there is doubt about the ability of the existing programmes to deliver. Therefore, innovations are necessary in the approaches to these issues and in delivery mechanisms, along with innovations in products and services.

**20.3** Many innovations arise from scientific advances and technological developments through formal R&D. But many others, such as innovations in low cost surgeries and low cost mobile services mentioned earlier, arise outside scientific and industrial laboratories. They arise from new ways of doing things. Indeed, new ways of approaching work that will engage more people in productive economic activity are the sort of innovations required for inclusive growth. For example, rural BPOs, which are providing jobs in villages and small towns and also enabling BPO service providers to access a larger pool of human resources, thus managing their own costs better.

**20.4** International comparisons of innovativeness in nations rank India very low. Since India spends much less on R&D, has fewer scientists per million of the population, and produces fewer patents in relation to the size of its economy as compared to other countries, the conclusion is that India cannot have the same capabilities for innovation as those that spend more on R&D, have more scientists, and produce more patents. These conclusions arise from the paradigm of innovation equals science and technology. This is a misleading view of what innovation is and what the sources of innovation are. It also gives a misleading view of India's innovation potential. Because, as mentioned earlier, many useful innovations, which transform the lives of people arise outside scientific and industrial establishments where expenditure on R&D is measurable.

**20.5** According to a recent global comparison within this framework of competitiveness of countries presented by the World Economic Forum, India scores poorly, even though it ranks high on innovation, because the authors discount India's innovation scores on the grounds that it is not appropriate for India to be focused on innovation at its present stage of development. The more correct view would be that India must use the power of innovation to improve its factors of competitiveness—its large pool of potentially employable people being one of them—and it must also innovate ways to improve efficiencies. In other words, innovation will help India progress faster through stages of development.

**20.6** For these reasons, it is necessary to pay special attention to the importance of and scope for innovation viewed as a multidimensional concept. Indeed, there is a need for innovation in the concept of innovation itself.

#### INCLUSIVE AND FRUGAL INNOVATION

**20.7** India needs more 'frugal innovation', which produces more 'frugal cost' products and services that are affordable by people with low levels of incomes without compromising the safety, efficiency, and utility of the products. The country also needs processes of innovation that are frugal in the resources required to produce the innovations. The products and processes must also have a 'frugal impact' on the earth's resources. A paradigm which bases its assessment of innovativeness on the quantum of expensive inputs deployed—the numbers of scientists, and expenditures on R&D etc.—cannot by definition be frugal. In fact, innovation with expensive resources will tend to produce expensive innovations because the cost of innovation must be recovered in the prices of the products it produces. This is the dilemma of 'innovative' companies in the pharmaceutical industry, for example. They find it economically difficult to justify development of low cost solutions for ailments

that affect poor people. Frugality is the production of desired outputs with fewer and less costly inputs. Therefore, inclusive and frugal innovation requires, as mentioned earlier, innovation in the concept of innovation itself.

**20.8** India is rich in frugal innovation, which is perhaps an inevitable consequence of resource scarcity. When resources are limited, people are compelled to find innovative ways to fulfill their needs within their limited resources. Low cost eye and heart surgeries, low cost phone services, and the Nano, are examples of high quality products and services that are frugal in costs and hence affordable (Box 20.1). The 'Honeybee Network'<sup>1</sup> has documented over 1,00,000 innovations from grassroots inventors in India. Many of these inventors do not have formal education and many are from rural areas. They exemplify innovations that springs from frugal resources.

**20.9** Innovations in the delivery of government services, sometimes without any new technology or product, can improve citizen satisfaction and reduce the government's expenditures as well. There are examples of these from many parts of the country (Box 20.2). Such ideas need to be spread around and more widely applied, albeit after being customized to local needs.

#### STIMULATING THE INNOVATION ECO-SYSTEM

**20.10** India needs to stimulate its entire innovation eco-system—the formal scientific-industrial system, as well as its large informal eco-system—to develop solutions for the country's agenda of inclusive and sustainable growth.

**20.11** Eco-systems require accelerators that create conditions for good seeds to sprout and provide timely nutrients for plants as they grow. A survey of the experiences of other countries, research into the conditions for innovation and the process of innovation, as well

<sup>1</sup> The Honeybee Network is a network of organizations devoted to promoting and spreading the benefits of grassroots innovation. Its purpose is to gather and disseminate information about grassroots' inventors and entrepreneurs and their ideas. Its members include the National Innovation Foundation (promoted by the Department of Science and Technology), SRISTI (Society for Research and Initiatives for Sustainable Technologies), and GIAN (Grassroots Innovation and Augmentation Network).

### Box 20.1 Frugal Innovation

An example of a 'barefoot innovator' is Raghav Mahto from Vaishali district in Bihar. Only a second grade pass, Mahto was inspired by a cordless microphone to create an FM radio transmitter with which he transmitted for five years from his electronics repair shop, pioneering the concept of community radio with cheap broadcast equipment, empowering the rural masses. Mahato's station was shut down by the authorities when they realized that he did not have a licence.

The Digital Empowerment Foundation brought Mahato to Delhi, put him through an ICT and computer training programme, and provided him with equipment to run a community information centre. Meanwhile, the concept of community radio was picking up and the Barefoot College (BFC) in Tilonia village in Ajmer district commissioned Mahato to set up a low cost studio, making cheap FM radios, and putting together the digital infrastructure to run a station. Mahato has digitized BFC's records of folk music, art, and culture. Along with these, he has recorded programmes of local relevance, the Right to Information Act, and the National Rural Employment Scheme.

BFC has a community radio licence now. Barefoot Radio Tilonia was formally launched on 9 November 2009. Mahato's question to everyone was: 'When will I get legal permission to manufacture FM transmitters costing Rs 50? So that every 10–20 km there can be community radio stations helping us grow into a true information society?'

*Source:* Osama Manzar, 'Tech Tools', *Mint*, 13 November 2009.

as the experience in India, points to six igniters and accelerators of innovation in an economy that India should develop and use. These are as follows:

#### 1. Challenge the System

**20.12** Studies of innovations in many fields and in many countries reveal that innovativeness cannot be injected into a system. It is drawn out of a system as a response to aspirational challenges. John F. Kennedy's goal to send a man to the moon and back within a few years, which seemed far-fetched then, spurred the US innovation eco-system of organizations in the private and public sectors to respond, and it delivered. The goal to produce a modern car which would cost only Rs 1 lakh spurred many organizations in the Tata Motors' eco-system to produce innovations that enabled a seemingly impossible goal. The capabilities of US organizations developed in their pursuit of the national goal of a man on the moon and the capabilities of Tata Motors' suppliers developed to produce a Rs 1 lakh car have created many other markets for them too.

**20.13** India's innovation eco-system must be challenged and inspired to respond to aspirational goals that will enable the country to meet its inclusive and ecologically sustainable growth agenda. The innovations that innovators and innovative organizations will produce to achieve such goals can open huge markets for them.

### Box 20.2 Innovation in Government

In Nagaland, through a process of 'public–people' partnership, government-funded education, health, and electricity services have been improved significantly and the costs reduced too. The process, described as 'communitization', is based on a 'triple T' philosophy—Trust the community, Train the community, and Transfer power and resources for day-to-day management to the community. Incentives are provided to the community for improvement of performance of these government managed systems. For example, in power, the community undertakes responsibility for reducing unmetred power consumption and improving collection of charges. A percentage of the improvements obtained is given back to the community to invest in improvements of their choice. Similar approaches have been applied in education and health services. Notable improvements in all these areas have been independently verified by international agencies.

The e-Sewa project in Hyderabad has improved efficiency, as well as citizens' convenience, by online delivery of a host of government services, including payment of property taxes, electricity bills, vehicle taxes, and reservation of bus tickets. It has been implemented through Public–Private Partnerships. The Akshay Patra Mid-Day Meal programme is a partnership between the Akshay Patra Foundation and the governments of seven states across which it has now spread. It has adopted technology-driven processes to provide high quality cooked meals at a low cost to over a million children.

**20.14** The infrastructure of Indian cities is unable to satisfy the needs for water, sanitation, housing, roads, and public transportation of their inhabitants. In the next 25 years another 300 million people are expected to be living in Indian cities. Therefore, the country must expect to make huge investments to improve urban infrastructure. Experts estimate that Rs 75 lakh crore may be required for India's urban infrastructure in the next 25 years, excluding the cost of housing (half of this will be required for capex, and the rest for O&M). It seems very difficult to raise so much money, especially when there are so many other competing demands in the country—for education, healthcare, rural infrastructure, etc. Nevertheless, the needs of urban development must be met because they are equally important for the goals of inclusive growth in the country, especially when over half the country's population will be living in towns and cities as projected over the next 25 years.

**20.15** In all such areas, where the needs are on an immense scale, and the requirement for funds and resources to deliver against the agenda for inclusive growth may appear impossibly large, a national mission for inclusive innovation can focus the innovation eco-system towards high impact points where opportunities for innovative solutions may lie within these areas. For these ideas, innovations can be invited and rewards offered. Of course many entrepreneurs and commercial organizations may seize the opportunities they are pointed to and not worry about the recognitions and rewards offered. Nevertheless, this will serve the purpose of stimulating innovative solutions where they are required. However, for some smaller entrepreneurs, the process of recognition will bring them into the 'market' for innovations, where investors and potential partners will notice them and help them grow their innovations.

## 2. A Knowledge-Learning Portal and Practice

**20.16** Greater Knowledge of innovations can stimulate their adoption. It can also stimulate adaptations and further innovations. Towards this end, a lively and accessible database of innovations can be a powerful accelerator.

**20.17** Many organizations are gathering examples of innovations that have proved successful. They include various ministries in the Government of India. For example, innovations by government officers, which have contributed to inclusive growth and community welfare are being gathered by the Department of Administrative Reforms and Public Grievances and examples of innovations in urban improvements have recently been gathered and disseminated by an agency supported by the Ministry of Urban Development (MoUD).

**20.18** Innovations in public policy and innovations in delivery of public services are especially essential for accelerating inclusive growth. Such innovations lie outside the conventional, industrial concept of innovation with its emphasis on R&D labs, scientists, and patents. Such innovations may include ways in which local communities are engaged in the governance of their affairs. They may include models of 'People–Public–Private' partnerships in which the people who are the beneficiaries, whether farmers in rural areas, or poor urban residents, are integral to the design and management of schemes for their benefit.

**20.19** An electronic repository may be created in which good examples of innovations in many domains are available. The repository may be accessed through a website, which may also provide access to other websites and resources with examples. The website should give names and contact details of persons and organizations associated with the innovations so that they can be contacted by those interested to learn from them or to establish business relationships. The website should publish a calendar of up-coming events and meetings about innovations. The repository and website should be professionally managed to ensure their utility and to keep them up to date.

**20.20** In short, a resource is required to support a voluntary and lively 'innovation practice', whose members will be practitioners of innovation, and policymakers, investors, academics, and others interested in stimulating more innovation. The National Knowledge Network (NKN), mooted by the National Knowledge Commission, is being implemented. It

provides a platform for collaborative research in applications for health, education, agriculture, and e-governance. It is an important component of the larger platform and practice to be built.

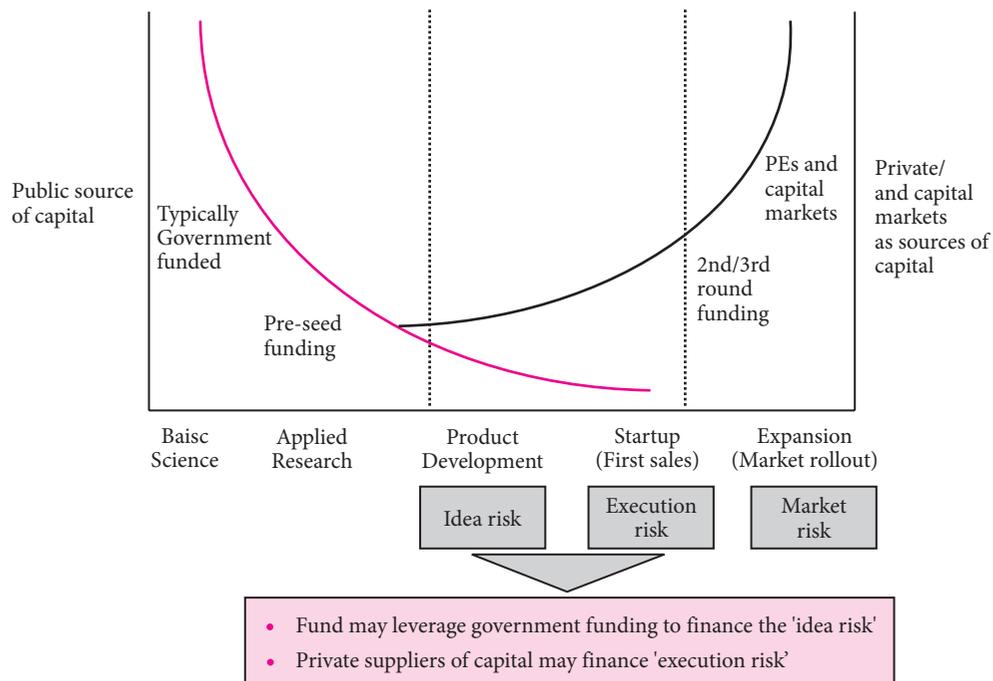
### 3. Early Stage (Angel) Funding

**20.21** Innovation requires a financial system, which is supportive and inclusive. Broadly, three kinds of risks need to be taken in order to convert an idea into a thriving business (Figure 20.1). First is the ‘idea risk’, which is about the quality of the idea that can be determined by its market potential, the underlying technology selection, and difficulty of replication. This risk exists at the ‘product development’ stage. Second is the ‘execution risk’, which deals with whether the idea is brought to the market in a manner which adheres to time lines and budgetary constraints. This risk is taken at the ‘start-up /first sales’ stage. Finally, there exists ‘market risk’, which deals with whether the customer will accept the product or service and also depends on competitive actions. This risk exists at the ‘expansion/market rollout’ stage.

**20.22** Venture capital for technology innovation is a special type of financing arrangement. It is different from other financing models because its provision is customized to the needs of the receiver and the skills of the provider. It is not a lender-borrower transaction with standardized contracts and requires close, ongoing, face-to-face interaction.

**20.23** Venture Capital (VC) funding necessarily involves sharing in the risks of the enterprise and has to have the character of equity even if it may not always look like it. In fact, since early stage technology ventures may well be floated by technology specialist but entrepreneurial novices, the mentoring and guidance provided by VC investors who have domain knowledge and useful business contacts may be crucial to the success of the enterprise. That is why venture funding also involves a substantially greater engagement of the lenders in management, especially in start-up firms.

**20.24** The effectiveness of a venture funding ecosystem depends on the entire range of options for



Source: NASSCOM BCG Innovation Report (2007).

FIGURE 20.1: Risks in Converting an Idea into Business

risk capital finance. But it is important to note that without an adequate system of funding at the very early seed stage the deal flow for the later stage venture capital may not be adequate. At the same time the availability of early stage venture funding will depend on the exit options made possible by strong private equity funds and a healthy stock market. One can distinguish the following funding requirements in most cases:

- *Seed financing* to the technologist/entrepreneur to prove a concept
- *Start-up financing* for product development and initial marketing to a few customers
- *First stage financing* to initiate commercial production and marketing
- *Second stage financing* for expansion to scale
- *Later stage financing* for expansion of an enterprise that is already profitable
- *Bridge/mezzanine financing* as preparation for going public or for buyout/takeover

**20.25** Seed and start-up financing is seldom provided by venture funds and often comes from angel investors, a category that can, in-principle include government agencies that provide low cost seed capital.

#### THE INDIAN VENTURE CAPITAL CONTEXT

**20.26** With its growing economy and large potential, India is attracting many investors. It is amongst the top recipients for venture funds and private equity funds in Asia. Investment through this route is estimated to have increased from US\$ 500 million in 1998 to over US\$ 19 billion in 2008. However, so far, most of this investment is going into relatively large and 'safer' investments, and perhaps less than 5 per cent is going into small, early stage start-ups. The US economy is not only large, but is known to be innovative too. In the US, the number of deals for start-ups is estimated to be around 3,900, with an average size of the deal of about US\$ 6.7 million. Whereas in India the number is less than 100 and the average size is around US\$ 17 million. If PPP is factored in, the comparable size for India should be US\$ 2.2 million. Therefore, there is a big gap. It is estimated that there are over 1 million 'angel' investors in the US investing in and supporting

small start-ups. In India, there may be fewer than 300 active angel investors at this time. Clearly there is a weakness in the eco-system for innovation in India: small start-ups in India are not getting adequate investment support.

**20.27** Some key trends of the Indian VC eco-system are as follows:

- A vast majority of the funding in India is still of the PE or Private Investment in Public Equity (PIPE) variety rather than pure-play risk-capital funding.
- There is almost a complete lack of seed stage venture funding for the technology sector in India. In most regions with strong VC eco-systems, for example, the US and Israel, a combination of angel investors and VC firms provide zero stage/idea stage funding.
- There are hardly any technology sector dedicated early funds and most of the funds invest across industries. Given the varied risk profile of industries, high risk investments like early stage technology firms, tend to lose out to 'safer' investments.
- There is a lack of India-denominated funds with most of the PE funds being FII denominated, which often leads to a conservative investment profile.
- Early stage funding in India through government institutions (Technology Development Board, SIDBI, DBT, and CSIR) is loan or grant-oriented. There is no special focus on the specific technologies and disbursement procedures tend to be complex and financially conservative. Additionally, government grants to start-ups are not accompanied by any mentoring which is critical to the success of start-up ventures.

**20.28** However, in spite of the growth in the VC industry in India and the complementary increase in government schemes, the seed funding stage continues to be severely capital starved. The situation in India is reminiscent of that in Israel in the 1980s and the US in the 1970s. The Yozma scheme in Israel and the Small Business Investment Company (SBIC) scheme in US were the catalysts for creating the VC industry in these countries. While both Yozma and SBIC were

government sponsored, there was strong private sector participation.

**20.29** Similarly, the Indian innovation eco-system needs early stage funds acting as angel investors created through PPPs. The advantage of such a model will be patient capital investments coupled with professional mentoring and management.

**20.30** To summarize, the crucial need in India now is to strengthen the research-finance-entrepreneurship linkages, to raise the supply of risk capital for early stage activities, and to ensure an enabling fiscal and regulatory system which encourages risk taking by financiers.

#### A FUND TO SUPPORT SOCIAL ENTERPRISE INITIATIVES

**20.31** Since angel funds and venture funds are sprouting in the private sector, some leveraged with government resources, the role of a Central Government fund for innovation should be to supplement these initiatives and provide assistance when these funds may not. One area could be social enterprise initiatives—innovations that will produce socially useful outcomes for poorer people. The financial returns from these initiatives will be more difficult to calculate and to capture and therefore, a government fund could provide seed money and early stage assistance to such initiatives till they can prove their value.

#### 4. Collaborative Enterprises and Clusters

**20.32** Innovation is fostered by collaborative enterprises that bring together the capabilities of many

people and organizations. The organizations may even be competitors who can benefit by working together to build capabilities that are valuable to all of them but which they could not build alone, or they may discover solutions that they would find difficult on their own by sharing their knowledge.

**20.33** Such collaborative enterprises can take various forms. Some may be physical clusters, many others may be virtual clusters of many organizations and individuals which work together, pooling knowledge and resources for shared objectives. The open innovation model being developed by CSIR aims at developing a new tuberculosis drug in a global collaborative effort using an ‘open source’ approach. By combining the resources of many organizations it expects to develop affordable drugs for the world’s poor for diseases that the ‘innovative’ pharma companies are not interested in because they cannot recover their innovation costs.

**20.34** An Enterprise Solutions for Poverty (ESP) innovation group has brought together several large Indian companies in a major fruit and vegetable initiative to engage large numbers of farmers directly, increasing productivity, quality, and earnings. These companies include ITC, Tata Chemicals, Mahindra, Reliance, and Bharti. Each of these companies is working to engage small farmers in India in their businesses. Through the ESP innovation group in agri-business, the CEOs of these companies have built the trust to share challenges, key success factors, and strategic choices.

**20.35** Collaborative Automotive Research (CAR) has been created to establish a globally competitive transportation industry in India. Four panels help the CAR programme committees in identifying and evaluating suitable technology projects and preparing position papers. Participants in the projects are from academia (national labs, IITs, universities), automotive companies (vehicle and component manufacturers), software companies, and high-tech start-up companies.

**20.36** Many other clusters and collaborative initiatives to foster innovation have started operating in

#### Box 20.3 Innovation Fund

An example of a fund drawing in private capital leveraged with government money

- Early stage fund promoted by NASSCOMM and IKP Knowledge Park to promote emerging technology driven innovations in India.
- Overall corpus of Rs 100 crore through a PPP model.
- Anchor investors include the government, TCS, Airtel, and the IKP Knowledge Trust.
- SEBI registered and professionally managed.

the country. These include SIEN, the Science and Entrepreneurship initiative hosted in IIT Powai; an automotive cluster in Pune; and an initiative at CMTI with involvement of ISRO to develop technologies for flexible manufacturing, and many others.

**20.37** While several initiatives have government support in different forms, some, like the ESP innovation group have no direct government involvement. The good news is that collaborations to promote innovation are multiplying. Some will do better than the others and there will be lessons to be learned. The proposed Knowledge-Learning Portal and Practice can facilitate the sharing of best practices amongst these initiatives for making such collaborative groups successful.

### 5. Entrepreneurship Training

**20.38** Innovation, as defined by the Royal Society of Engineers, is the successful exploitation of new ideas. Therefore, innovation and entrepreneurship can never be too far apart.

**20.39** Many schemes are operating in the country for developing entrepreneurial skills. Some are directed at unemployed youth, others at students, and some others at small enterprise owners. Some of these schemes are supported and managed by government agencies and some by academic institutions. Others are managed by industry associations and several by NGOs. Some of these schemes also receive support from international organizations.

**20.40** CII has been running a successful programme, supported by the National Manufacturing Competitiveness Council, to inject innovativeness into running manufacturing enterprises, even large ones. CII's Visionary Leaders for Manufacturing (VLFM) programme, is a unique programme, which brings together senior leaders from the manufacturing sector and urges them to look beyond the obvious, to see the invisible, and to unearth the latent needs of customers.

### 6. Making a Market

**20.41** The government can stimulate innovations through its purchases whether in urban infrastructure,

education, health, or renewable energy. In almost all the fields associated with inclusive growth and sustainability, the government is likely to be a principal buyer.

**20.42** Therefore, the government can prescribe the standards it wants to achieve and the cost at which it will buy. The size of government demand provides innovators with an assurance of a market if they can meet the standards.

**20.43** The government can also initially provide a subsidy to cover the gap between the commercially realizable price and the costs of production with new technology. For example, solar-based power producers may be given a subsidy for a few years to bridge the gap between grid prices and the cost of generating solar power with the present best practice solar technology. Thus there is an incentive for innovators to enter the market, improve their technologies, and expand their market. Similar principles can be selectively applied in other areas where the technologies are not yet fully evolved but must be encouraged.

### INNOVATION MISSIONS

**20.44** Since innovation is so important for the country to achieve its goals of inclusive and sustainable growth, and since the innovation eco-system must be stimulated widely, it is tempting to conclude that the country needs a central agency to make it happen. However, one must be cautious. Central agencies may even dampen the spirit of innovation within the eco-system.

**20.45** Innovation, by its nature, requires freedom. Innovation happens in many places and in many organizations. Hierarchical control can stifle it. Therefore, any agency that seeks to stimulate innovation in the eco-system must be clear about its role—which is to facilitate and not to manage innovation. Persons in this agency must have the skills and the style to give room to others and not to prescribe. They must lead through their ability to influence and induce change and not by their positional authority.

**20.46** Innovation can be induced in many sectors by 'missionaries' for innovation in those sectors: in

industry, education, health, and governance. The role of such missionaries and missions must be to stimulate the innovation eco-system, to ignite innovation, and to induce improvements in the accelerators of innovation in their sectors.

**20.47** Because innovation is so critical to the country's needs of more rapid, more inclusive, and more sustain-

able growth and since innovation is required in all sectors of the economy in private and public sectors and also in industrial and social sectors, the Planning Commission will have a major role to play in the stimulation of the innovation eco-system across all sectors.