Chapter 1
Global Narratives of Knowledge and Innovation-Based Development

Vibhore Bakshi and Arindam Biswas

Abstract The composite of knowledge and innovation play a vital role in the economic and spatial restructuring of the city. The chapter examines the research that includes need identification with emerging global discourses of knowledge and spatial development. The assessment of the critical parameters for knowledge and innovation from a global and Indian perspective. The evaluation of knowledge-based indicators for Karnataka along with sustainable development goals. This chapter has four sections. The first section discusses the global cases for knowledge-based development and growth. The examination of expenditure on research and development as gross domestic product percentage for India is only 0.64 in juxtaposition to Israel and South Korea which has a higher proportion of 4.95 and 4.80% dedicated to innovation and research. The second section discusses India's existing condition and proposed approaches to embark upon knowledge-based growth and development. This assessment includes the 'global innovation indices' and NITI Aayog's knowledge-based development parameters. The third section addresses the SDGs and innovation policies from notable Indian states. The chapter particularly focuses on Karnataka Vision 2030 since it has obtained the best score in NITI Aayog's ranking for innovation 2020. Lastly, some recommendations for knowledge-based development, demystifying the approaches from international and national cases, are included at the end of chapter.

Keywords Knowledge and innovation · Knowledge-based development and growth · Global innovation indices · NITI Aayog's · Knowledge indices · Innovative policies · Karnataka Vision 2030

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Introduction

The broader understanding of history and emergence of Knowledge-based clusters can be identified from paradigms of 'Theory of Creative Destruction' in 1940s by Joseph Schumpeter, Core Peripheral model by John Friedman in 1966, Michael porter's 1988 concept of cluster development, Manuel Castells and Peter Hall's principles of development of Knowledge clusters in 1994, Saxenian's networked approach for a region, network of global cities by Sasskia Sassen in 2001 and Richard Florida's philosophy of creative class in 2005. The advent of industries in 1950s around US and many europeon cities, causal implications on the cities was evident, migration to industries extensive region promoted spread effect; on contrary to the areas which lacked the prospects of development from where migration happened led to backwash effect (Mydral, 1957). The emergence of the approach of knowledge diversification can be witnessed from the model of Silicon Valley and Ottawa in the early 1950s, to knowledge specialisation around 1990s for Helinski and Cambridge. The attributes for Knowledge firm and environment sought to include factor inputs like public policies, market dynamics and supporting industries (Huggins 2008). The knowledge-based urban development framework depicts socio-cultural development, enviro-urban development, institutional development and economic development (Yigitcanlar 2011). The knowledge cluster proposition represents two approaches for knowledge-based development, i.e. regional approach and cluster development approach (Isaksen 2004). The knowledge development includes vibrant business climate, quality of life and economic prosperity. The cluster development approach depicts the role of organisation, governance and financing (Asheim et al. 2005). The knowledge proposition inculcates talent pool, education, technology, market, business network, capital, connectivity and incubation centres. Many cities, as emerge from the literature reflects on the essential role of knowledge in nation building, however few cities of Italy ponders us to think, how knowledge plays a vital role, when pandemic situation arises (Salvatore et al. 1950). The Knowledge theories have evolved over a period of time; the changing paradigms of knowledge is witnessed by the different countries across the globe.

The process of knowledge creation and entrepreneurship requires innovation that can contribute in making an effective regional innovation policy (Asheim et al. 2005). The five key elements are industrial knowledge bases, different territorial competence bases, the distributed knowledge base, the importance of creative knowledge environments and different institutional frameworks. In Neo liberal era, spatial restructuring process is predetermined by the industrial location and mobility linkages from residential clusters of the workers to industrial estates, this leads to emergence of gentrification (Easton et al. 2020). The economic recession around the 2000s has disrupted the growth of knowledge-based and technological industries (Anne 2021). The case of Silicon Valley, Cambridge, Ottawa and Helinski ought to emerge globally through new networks fostering economic policy and firm networking (Huggins 2008). The local development strategy for innovation districts focuses on policy realms

for urban and spatial aspects of the knowledge economy. As emerges from literature, Barcelona, Boston, Chattanooga, Detroit, Medellin, Montreal, Philadelphia, Rotterdam and Sydney are few visionary cities that tend to follow footsteps towards innovation district. The conceptualisation of the innovation district induces regenerative measures for underperforming settlements into major knowledge centres (Yigitcanlar and Velibeyoglu 2008). The knowledge theories address the sectoral facets associated with spatial cluster development (Porter 1996).

The emerging theories (Table 1.1) of knowledge development showcase the principles of creative destruction, spatial dynamics of core and periphery, cluster development, regional advantage, technology, digital and network cities, creativity, knowledge networking and framework for knowledge-based urban development.

Global Cities: Prospects of Knowledge-Based Development

The regionalisation process in Cologne adopts the regional clustering techniques with a framework of successful policy implementation. Singapore's approach for a knowledge-based economy describes ICT, innovation, entrepreneurship, business reorganisation, process of globalisation, government–industry partnership and effective implementation of policies. The applicability of the various knowledge paradigms is relatable to the case of London. The city of London has witnessed major spatial expansion in Knowledge-based industries in the peripheral boroughs around 1970s and 1980s, availability of peripheral land at cheaper price has fostered the Knowledge-based industries growth in juxtaposition to the slower pace growth of retail and leisure industries (Cottineau and Arcaute 2020). Cyberaja has emerged as a knowledge city by strengthening the knowledge networks through urban planning interventions by the administration in Peninsular Malaysia. The process of knowledge development in Cyberaja township started in 1997. The intent of developing Cyberaja as information and communication technology (ICT) hub focuses on the principle of Tacit knowledge. Cyberaja depicts an ideal case of influential spatial planning and knowledge-based cluster development. Furthermore, the proximity of ICT clusters has extensively contributed in restructuring process (Ramli 2012). The pillars of Knowledge creation, innovation and entrepreneurship are evident from Sweden. The strategies adopted in Sweden's case highlight the role and responsibilities of different institutions for nourishment of knowledge networks (Asheim et al. 2005). The innovation in Sweden can be assessed through the framework of the Triple Helix model, i.e. private, government and institution. The four-stage process can be envisaged in the development process of Sweden for promoting knowledge-based urban development—inception, implementation, consolidation and renewal. Triple Helix approach adopts innovation for business, government and academic factors. The extent of harnessing entrepreneurship skill sets in the universities with the process of creating incubation centres are the baby steps for promoting innovation. The emergence of revolution in automobile industries in 1940s and 1950s can be witnessed from the the developments by Henry Ford, where innovation took over

Table 1.1 Knowledge theories and propagators

Serial No	Knowledge theories	Year	Propagators	Concept
1	Theory of creative destruction	1942	Joseph Schumpeter	Capitalism replaced by innovation, regional innovation contributes to economic growth, more productivity and increasing wealth
2	Core peripheral model	1962	John Freidman	Spatial focus on the equal distribution of resources, includes economic, political and cultural sectors
3	Concept of cluster development	1966	Michael Porter	Economic activities are agglomerated in clusters, bind by social groups, industrial knowledge clusters depend up on education, information, research and technical support to a regional economy
4	Concept of technopolis, space of flows	1994	Manuel Castells and Peter Halls	Knowledge is technology driven. It depends up on proximity to research centres. Innovation and economic prosperity are major determinants of Knowledge
5	Regional advantage	1995	Anna Lee Saxenian	The importance of regional advantage, examples of Silicon Valley, emerging knowledge clusters reshaped the regional clusters in USA
6	Network cities and globalisation	2001	Sasskia Sassen	The global economic network, information flow and technological advancements can foster the regional development, sought to be seen in Tokyo, London and New York

(continued)

Table 1.1 (continued)

Serial No	Knowledge theories	Year	Propagators	Concept
7	Creative class	2005	Richard Florida	Regional policy depends up on creative professionals, creative industries, the multiple occupations in creative industry generates more wealth, the approach describes Chicago's creative class
8	Knowledge framework of urban development	2013	Yigicanlar	Sectoral facets of society, economy, institutions contribute to knowledge
9	BCI global	2020	Business Continuity Institute	Includes talent pool, education, technology, market business network, capital, connectivity and incubation centres

the capitalism, and the replacement of goods by better cost effective technology was evident (Schumpeter 1939, 1954). The approach to examine knowledge-based urban development from the domains of economy, society, management and technology is clearly evident in Austin, Barcelona, Helsinki, Melbourne, and Singapore. The capital city of Norway, Oslo, depicts very close interaction between consulting companies and important customers. The activities of clients and consultants are project-based and involve lots of coalition-building and face-to-face contact which is facilitated by knowledge sharing when players colocate. The industrial district model of Oslo highlights the interaction between the local software firms and suppliers (Isaksen 2004). The boost in economic prosperity of Brisbane can be attributed to shifting production from industrial and mass manufacturing to knowledge-intensive goods and services production through competitiveness, sustainability and urban development. It incorporates creative environment, administrative environment, business environment, natural and built environments (Yigitcanlar and Velibeyoglu 2008). The strategy for smart, sustainable and knowledge-based development in Brazil ascertains qualitative analysis through surveys and interviews with key experts and stakeholders' socio-cultural development, economic development, spatial development and institutional development (Sabatini et al. 2020). The urban and rural redevelopment process in France, UK and USA depicts the phenomenon of gentrification caused by increasing migration; the facilitation for housing migrants around knowledge-based industries is reflected in the industrial policies of EU and USA. The process of gentrification is evident in Chittagong, Bangladesh, induced by better employment opportunities and migration through urban development principles of social development, economic development and lesser real-estate prices (Morrison and Bevilacqua 2019). However, there are few issues observed in Chinese cities like inequality of income wage slabs,

income polarisation, lack of skilled-based technological change and fading network connections with premier institutions in the development of knowledge clusters that act as major hurdles towards inclusive urban development. In the past few years, knowledge-based economic development has further contributed to crony capitalism, and the rapid increase in urbanisation has contributed to widening income inequality. The ladder toward urban development has given rise to the creative disciplines and policy restructuring process for enabling knowledge-based urban development. The growth of tertiary sectors results in the widening gap between the wages of skilled labour in China (Liu et al. 2019). The efforts for making Melbourne a knowledge city focus on robust economic performance in knowledge-intensive sector, innovation and entrepreneurialism, availability of skilled labour, enabling infrastructure for knowledge dissemination, global ties, emergence of disruptive technology and high degree of livability. In Los Angeles, the process of innovation, entrepreneurship, academic institutions, business firms and potential investors converge to enable efficient vibrant and conducive entrepreneurial network (Graf, 2016). In Japanese cities, the role of global supply chain in Research and Development sector is identified as potential contributor in promoting knowledge and innovation (Huang et al. 2021).

Research Framework

In the previous section of the chapter, many approaches are demystified that collates a broader understanding of knowledge enabling mechanism from a global perspective. However, to understand the current situation of India in knowledge and Innovation, there are few questions to embark on the research chapter as mentioned below in Table 1.2. The emerging research need for knowledge and innovation can be identified for Indian cities from the attributes like global percentage share estimates by NITI Aayog in research and development sector for India which is just 0.68 percentage of overall country's GDP. UNDP, global innovation report card 2021, reveals that India is a moderate performer since it lags in the attributes of preliminary education, higher education, ICT, economy, enabling environment in comparison to the overall average.

The outcome of the research chapter focuses on the global and Indian perspectives of enabling knowledge and innovation-based framework perhaps it highlights Karnataka as a state model that can be adopted for other states in India.

Estimates for Global Research and Development

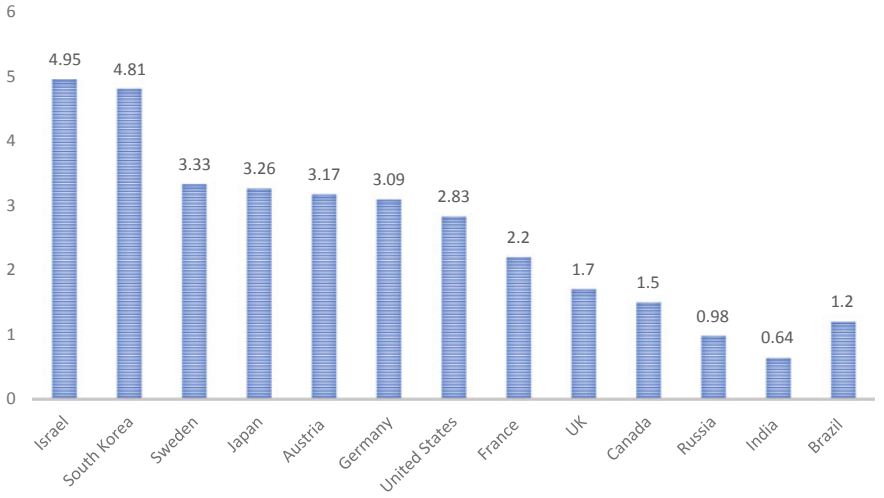
Research and development relentlessly drives the innovation and act as an engine to the IT sectors. This section of chapter tries to adopt a method of examining the reasons for, why few nations have invested more in the research and development industries, learnings and takeaways from the nations. Furthermore, understanding

Table 1.2 Research questions and objectives

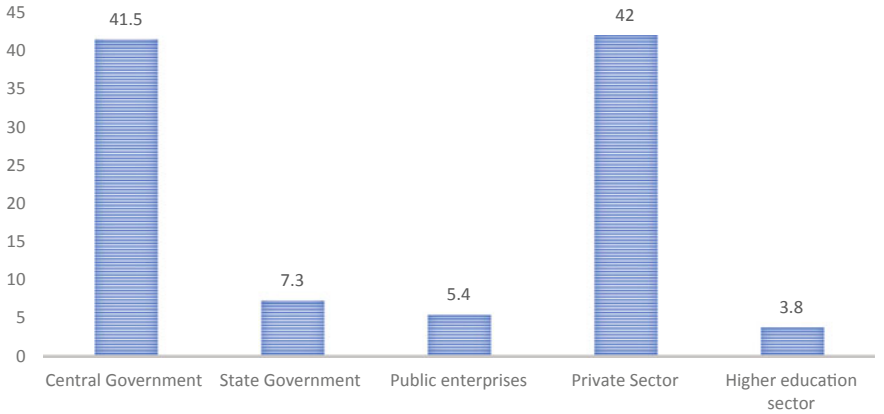
Serial No	Research questions	Objectives of the research	Datasets
1	What approaches can be adopted for fostering innovation and knowledge in Indian cities ?	Identification of theories of knowledge and innovation (Table 1.2) Assessment of existing frameworks for knowledge development across the globe	Approaches adopted in Cologne, Singapore, London, Cyberaja, Sweden, Austria, Barcelona, Melbourne, USA, UK and Brazil through literature
2	What is the current situation of India in knowledge and innovation?	Assessment of India from GDP, R&D investment percentage, from the lens of global and Indian indices and overall assessment of knowledge and innovation parameters Graphs 1.1, 1.2, 1.3 and 1.4 and Table 1.3	Estimates of global R&D, innovation initiatives in India, approach for innovation, NITI Aayog Index 2021, UNDP Global Knowledge Framework 2021, Bloomberg Index 2020
3	What is the existing mechanism for knowledge and Innovation dissemination in Karnataka since it has obtained best rankings in NITI Aayog report 2021?	Assessment of Karnataka's initiatives for Knowledge output through policy measures and the overall comparison of state's SDG indicators Fig. 1.1 and Table 1.4, Graphs 1.5 and 1.6	Karnataka's Vision 2030, Economic Survey for Karnataka 2021, IBEF report 2018

the dynamics, policy regimes of different nations, the major research question in the whole process is 'How the investments in Research sectors have transformed the city from the agrarian society to the major wealth generators', Why such contributions are lesser in the developing economies, what changes can be thereof thought off to strengthen the knowledge and innovation sectors. In this section of the chapter, the assessment of different countries is done as shown in Graph 1.4.

The (OECD, 2021) estimates depict the marginal increase in R&D expenditure, as percentage of gross domestic product increased from 2.4% in 2018 to 2.5% in 2019. The year 2017 and 2018 were marked by higher spendings on R&D sectors since there was a stagnation between 2013 and 2016. Israel and Korea are the top performers among OECD countries. Regions tend to witness spatial growth propelled

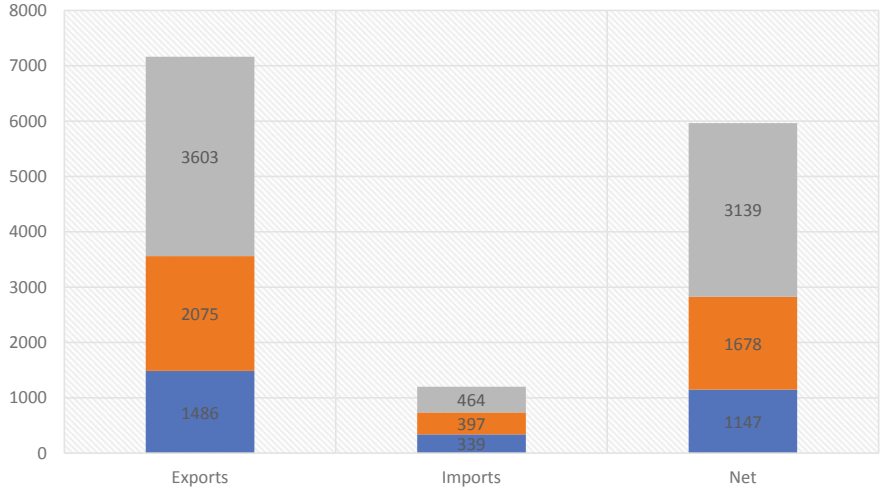


Graph 1.1 R&D expenditure (% of GDP). *Source* Niti Aayog Report (2020)

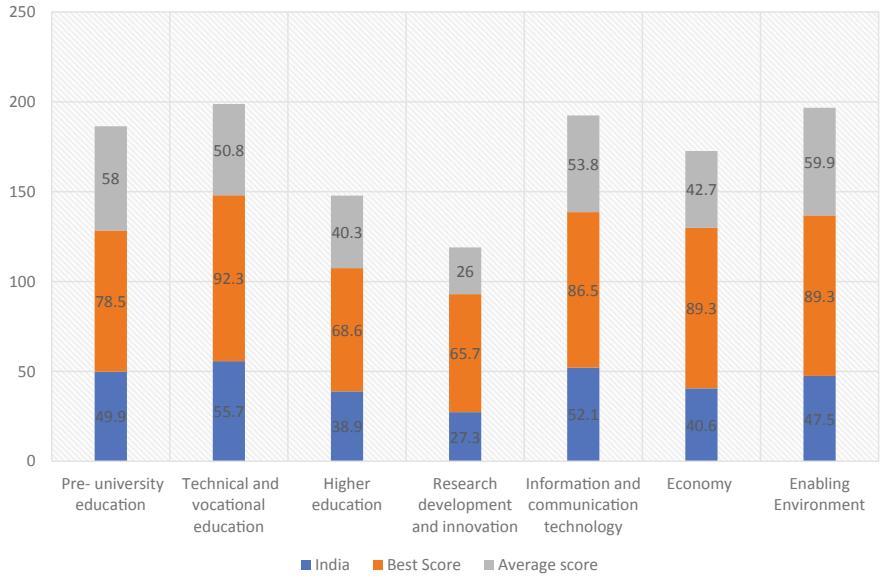


Graph 1.2 India's key players in R&D ecosystem. *Source* R&D ecosystem, India, 2019

by industrial locations, and population agglomerates around industries intensive regions, where the process starts with knowledge specialization followed by knowledge diversification in next subsequent stages (OECD, 2009). NITI Aayog, 2020 rankings for India reveal that R&D expenditure percentage in India leapfrogs around 0.64 in comparison to Israel and South Korea who are the top performers due to more contribution in R&D, varying from 4 to 5 percentage of overall, followed by the other nations.



Graph 1.3 Export, import and net trade in US dollars in R &D sector (2015, 2016 and 2017) 2015 2016 2017. *Source* RBI Datasets, India, 2019



Graph 1.4 Global knowledge scores. *Source* UNDP Report: Global Knowledge Index 2021

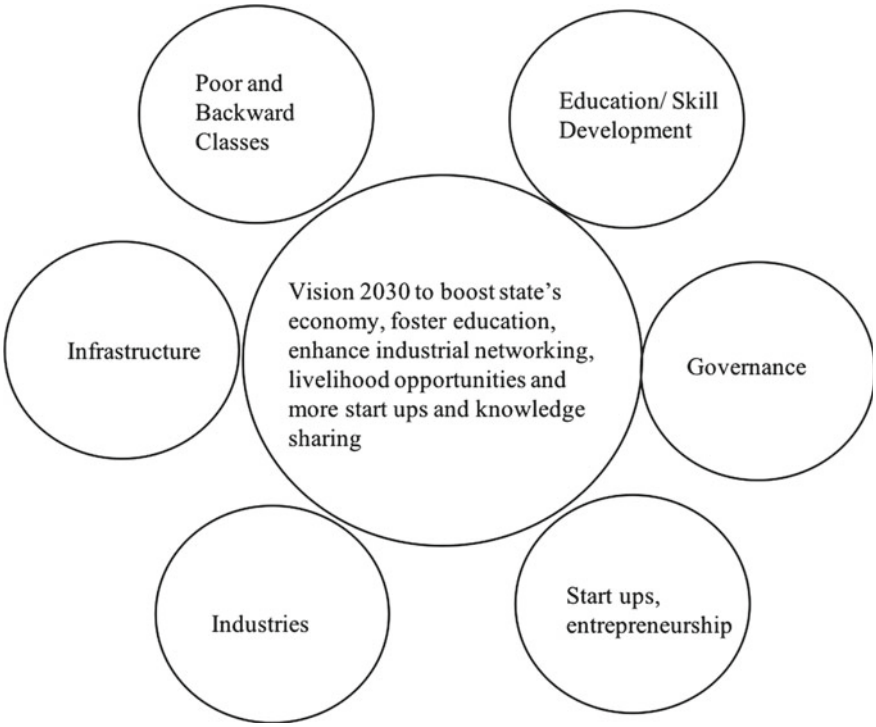
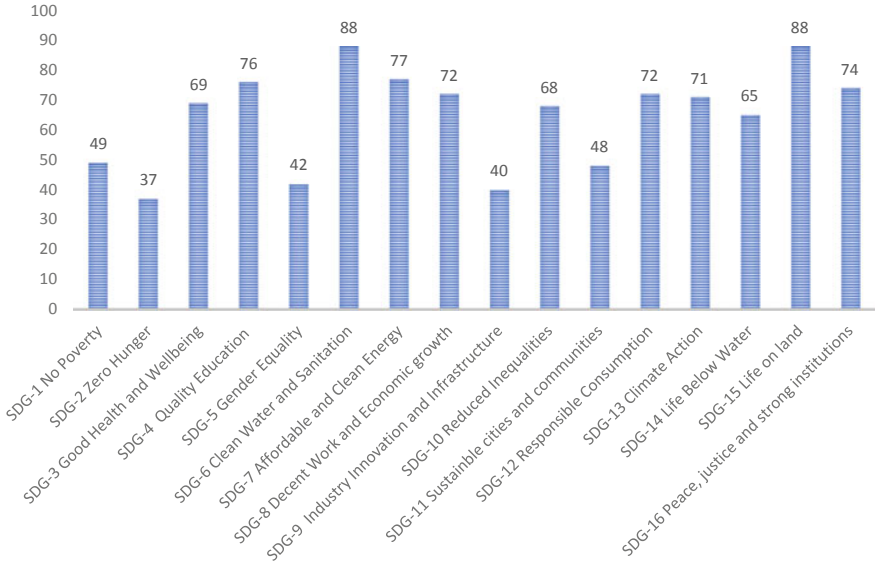


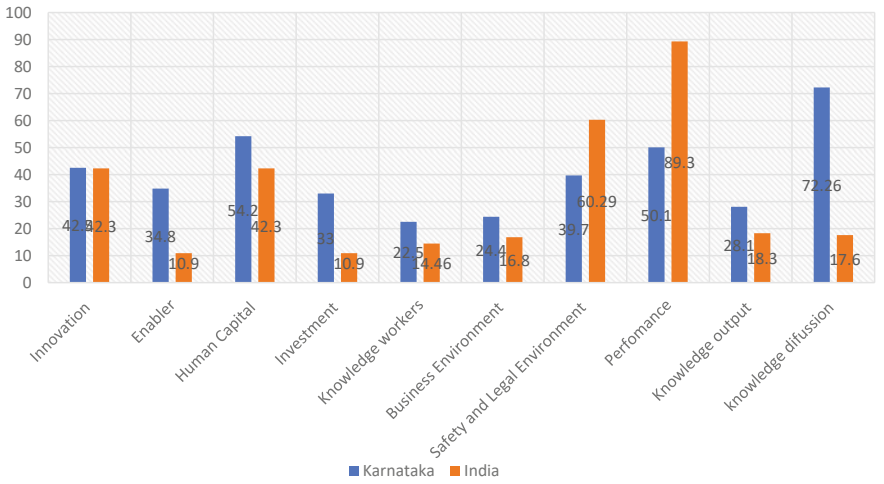
Fig. 1.1 Karnataka's Vision 2030: knowledge economy. *Source* Economic Survey of Karnataka, 2020

Innovation Initiatives in Developed Economies

Israel's high-tech sectors have contributed immensely in innovation, and the paradigm shift in technological sectors, with the government collaboration, has contributed to the emergence of Israel as one of the Silicon Valleys of the world (Trajtenberg 2001). The process of reevaluation and reassessment of the policies at periodic levels, the government initiatives for strengthening research and development sector dates back from 1968, the ministry of trade and commerce established office of the chief scientist (OCS) was set up in the initial years for subsidising the research and development projects undertaken by private firms. Moreover, Magnet Program was introduced by the government of Israel in 1990s to integrate the academic institutions and academic centres. To boost entrepreneurship, and welcome new ideas, the government introduced 'incubators program'. Later on, BIRD program, Israel-US Bi-national Industrial Research and Development Foundation (BIRD) came into formation in early 1980s to provide a support infrastructure for research and development activities. Israel leads in the intellectual property rights, i.e. the number of registered patents globally.



Graph 1.5 Karnataka sustainable development goals. *Source* Economic Survey 2021



Graph 1.6 Karnataka's innovation scores in comparison to India's average score. *Source* NITI Aayog 2021

The importance of intellectual property rights in dissemination of knowledge and innovation can be very well examined, from the Israel's model. The tremendous expenditure on research and development has resulted in the drastic transformation of Korea from agricultural economy in 1960s to technology driven land in later 2000s.

The interplay between government, academic institutions and the private companies has contributed immensely to the economic development. The large industrial conglomerates of family business led to the industrial advancements. The period of 1960s was also marked by the prestigious institutions, more knowledge exchange (Jung 2013). The Korean government established the Korean institute of Science and Technology in 1966 and made it operational in 1969. The institution played a significant role; it led to the technological advancements in the sectors of automobiles, machinery, electronics, metal steel and other industries. Few other initiatives were undertaken by the government of Korea around 1970s, like establishment of Korea institute of machinery and materials, Korean chemical research institutions and Korean institute of ship building. The government relied on the huge potential of human resource for research and development sector. The model of South Korea is sought to be highlighted from the economic growth paradigms of Romer (1990), Aghion (1992) and others, that focuses on the principles of more available resources like human resource in terms of engineers and scientists for research and development will contribute to the economic growth.

Within Europe, Sweden is the country, which has highest expenditures on R&D. The value of expenditure on R&D has doubled in last 25 years. The substantial expenditure of R&D in Sweden has boosted telecommunication sector, electronic sector and computing infrastructure. The Sweden has extensively invested in R&D sector as seen in Graph 1.4. It is intriguing to analyse the attributes of R&D sectors; automotive industry has contributed to more than 25 percentage of R&D expenditure in Sweden. Furthermore, information communication and technology also contributes to the major share in computer services. Sweden is described as one of the most prospering countries of European union since the process of R&D depicts the adoption of innovation measures in creating a niche in electronic market and attracting international investors. The regional innovation scorecard 2007–2019 released by European Commission highlights the emergence of Sweden as a leader especially in terms of increasing proportionate scores of research and development expenditure from 0.68 to 0.90 (R&D statistics 2019).

Innovation Initiatives in India

India is considered as one of the world's largest economies; therefore, there is a need to shift from net consumer of knowledge to net producer. The Vision 2022 for India needs to attract more investments in research and development. Investment in R&D sector is crucial for maintaining the global position of India as a knowledge economy. The gross expenditure on R&D has consistently increased in last few years. It has increased three folds from Rs. 24,117 crores in 2004 to almost Rs. 104,864 crores in 2016 (R&D Ecosystem report 2019). The share of India's R&D sector is illustrated in Graph 1.2.

Graph 1.2 showcases the major key player in research and development process is central government. Furthermore, the overall contribution of state government and

universities which act as the major key players for R&D have lower consolidated shares than central government and private player individually. There is a need for more investments in higher education sector to foster knowledge ties across the globe. From the previous section of the chapter, it is analysed that academic institutions play a vital role in knowledge dissemination and economic restructuring of the cities. Secondly, India's global share in R& D expenditure is 2.8% equivalent to USD 48.1 billion. Among BRICS countries, India's expenditure is lowest at 0.63% of GDP as evident in Graph 1.1. Although, the share of GDP expenditure on R&D leapfrogs around 0.63%, the expenditure on R&D has increased from Rs 57,908 crores in 2015–2016 to Rs. 73,720 crores in 2017–2018 (Ministry of Statistics 2017).

To reassert the importance of higher education sector in R&D sector, there is an urgent need to examine the revenue propelled by intellectual property. The intellectual property datasets relate to the copyrights, patents, publications and royalty. The RBI datasets depict that the R&D exports have drastically increased from USD 1486 million in 2015–2016 to USD 3603 million in 2017–2018, whereas imports have significantly increased from USD 339 million to USD 464 million in 2017–2018 as shown in Graph 1.3.

The datasets pertaining to intellectual property, i.e. royalties, copyright and licence fees, highlight the immediate need to increase the revenue share from the exports of the intellectual assets which still stands at 732 million USD in year 2017–2018, followed by 568 million USD and 489 million USD in year 2015–16 and 2016–17, respectively. Moreover, the intellectual property expenditure for imports stands at a much higher proportions in comparison to imports. The expenditure from intellectual assets has increased from 4891 million USD to 5720 million USD and further to 6877 5720 million USD in year 2016–17 and 2017–2018 (DIPP datasets 2018).

Approach for Innovation

The approach for innovation enables policymakers and other stakeholders to assess the footsteps of development through knowledge-based principles. There are various assessment tools designed for evaluation of a country's innovation. These innovation indices sought to consider attributes for identification of the certain areas where the countries are lacking and where the countries are progressing. To assess the parameters of innovation, few indicators of innovation are taken into consideration.

1. UNDP, Global Knowledge Index 2021
2. NITI Aayog, Innovation Report 2020
3. Bloomberg Innovation Index 2021.

UNDP, Global Knowledge Index 2021

The global knowledge index, which was developed in 1917 by UNDP and released every year, identifies seven parameters for assessment of the knowledge framework for the countries. These seven parameters are pre-university education, technical and vocational education and training, higher education, research, development and innovation, information and communications technology, economy and the general enabling environment. The index undertakes the multi-disciplinary approach of knowledge development. The concept depicts the interlinkage with knowledge societies and knowledge economies limiting itself to education and technology (UNDP 2021). Global Knowledge Index is constituted by multi-dimensional knowledge attributes pertaining to economic and social development. The approach adopted for knowledge-based innovation deciphers the diagnostic approach with a multi-facet principle of human development and knowledge sharing linking it with sustainable development goals Agenda 2030. The application of global knowledge index covers 138 countries and overall 199 comprehensive indicators, serving as important tool sets for urban planners, policymakers for inducing better knowledge centres. The Global Knowledge Index Report 2020 elaborates parameters highlighting pre-university education, technical and vocational education and training, higher education, research development and innovation, information and communication technology, economy and general enabling environment. attributes. While Norway sought to secure first position in the general enabling environment. Out of 138 countries, India ranks at 75 in the global knowledge index.

The global knowledge index depicts India as a moderate performer overall, and it ranks second in 24 countries with medium human development.

The examining of the sectoral indices for India identifies the attributes globally ranked universities, export of creative goods, i.e. trade scenario, the tertiary composition from science and technology, engineering and mathematics, protection of minority investors, best scientific journals; however, improvement is required in enrolment in vocational training programs, labour degree of freedom, labour participation from female to male, enrolment in globally ranked universities. The assessment of the parameters for the knowledge index indicates that Switzerland secures the first position with a score of 73.6. The examination of sectoral indices for knowledge reveals that Finland secures the first position in the parameter of pre-university education followed by Hongkong. For the aspect of technological and vocational training and information communication and technology, it is seen that the USA secures the first position with a score of 92.3. Switzerland obtains highest marks of 68.6 and 65.7 in research development and innovation and thus securing first position in the domain of higher education. Singapore obtains the highest score of 76.6, securing first position for economic attributes. It is sought to examine that scores for India for attributes like pre-university education, higher education, information and communication technology are lesser than the global average. The master planning approach and the innovation district planning approach with an efficient policy framework together can lead to better prospects for the future. With rise in urbanisation,

and demographic dividend comprising a young population, India has a huge potential to contribute to the knowledge sector, thus increasing the scores in knowledge indicators and securing a better position globally.

Bloomberg Innovation Index 2021

The Bloomberg Innovation Index 2021, released in Feb 2021, focuses on seven equally weighted metrics. The indicators for Bloomberg innovation inculcates indicators of research and development, more production and the knowledge agglomerations for high-tech companies. Seven European countries have ranked in the top ten rankings. South Korea has ranked first. The disruption in the health sector amidst coronavirus sought to promote innovation worldwide. Many countries have adopted digital innovation mechanisms to fight the virus. South Korea's first position depicts the innovation and efficient conducive working environment, major economic contribution in research and development sector and more budgetary fund allocation for business transition to digital economy. Prospering manufacturing units with digital technology sought to be analysed from Singapore's economic growth; furthermore, the eminent educational institutions have transformed the fabric of Singapore in emerging innovative and knowledge centre. While few cities like Germany lack of skilled labour and adequate strategies have disrupted the innovation process. Intellectual property rights have been a major hurdle in the growth process of the USA and China in the path of innovation. The developing Asian countries like India have ranked extensively in the top 50, for the first time in the last seven years. The indicators for Bloomberg innovation index highlight research and development, spendings of government thus contribution to GDP, manufacturing value contribution per capita, post-secondary education enrolments, Ph.D. enrolment and patents per million population.

NITI Aayog, Innovation Report 2020

The innovation report released by NITI Aayog in 2020 amidst COVID highlights the key principles of social and economic development. NITI Aayog innovation index ranks Karnataka in top position among the major states in India, while Maharashtra occupies the second place followed by Tamil Nadu. The vision of India sought to be called a 5 US dollar trillion economy is linked with the innovation led approach. (NITI Aayog 2020) It is evident that amidst the pandemic, economic growth has been disrupted in different lockdown phases across not only in India but also across the globe. The innovation strategies inducing knowledge-based development is the need of the hour. India should capitalise on the young manpower and knowledge-based facets of urban and regional planning. The advent of programs by the ministry like 'Make in India' and 'Atmanirbhar Bharat' sought to envisi on the economic

development process in India. India's innovation report describes the comprehensive assessment of innovation capabilities of 28 Indian states and 9 union territories. The Indian innovation index focuses on two aspects of enablers and performance. It depicts seven key indicators for assessment of innovation capabilities in terms of underperforming and over performing for different states in India. Innovation scores are calculated by taking the average of five indicators of enablers and two indicators of performance. The five indicators undertaken for enablers are human capital, investment, knowledge workers, business environment, safety and legal environment; furthermore, performance indicators are knowledge output and knowledge diffusion.

Human capital relates to the education attainment and the research capabilities of individuals, research and development potential of the states, enrolment in Ph.D., enrolment in engineering and technology, pupil teacher ratio, schools with ICT infrastructure. The pillar of human capital questions the role of education in innovation capabilities. Investment in innovation depicts the expenditure on research and development, expenditure on science and technology, FDI flows and venture capitals. The attribute of knowledge workers depicts employment of individuals in highly skilled professions which can contribute to innovation. The next enabler indicator is business environment which considers ease of doing business rankings and technological advancements. The indicator relates to the conducive environment for innovation and work. Safety and legal environment sought to regulate and enforce the open procedures for promoting knowledge and innovation. The performance indicators embarks on knowledge output and further entails on the extensive contribution of research and development in transforming Indian cities in to knowledge capitals. The knowledge output comprises of intellectual assets (number of patents, copyrights, trademark and research articles published), whereas knowledge diffusion includes outreach of knowledge at various levels. This involves the interdependencies between academic institution, industries and the government (Yigitcanlar and Velibeyoglu 2008).

The average score of innovation indicators for Indian states is 23.4, on the range of scale where 0 depicts the worst scenario and 100 best scenario. The enabler scores for Indian states is 29, and performance score is sought to be 17.9. The detailed assessment depicts that the major contributors for innovation are safety and legal environment (60) and human capital (42.3), whereas the investment score (10.9) highlights the immediate need for improvement. The robust cybersecurity system and India's ranking (23) in UN's global cybersecurity index in 2017 highlight the immense contribution of ICT sector in economy, the increase in the manpower and job opportunities post-neoliberalisation, rapid expansion of IT sectors, software parks, rise in premier engineering institutions sought to provide a good score, whereas the low employability in knowledge sector in developed countries like India becomes a huge hurdle in knowledge diffusion and knowledge output which reflects the human capital is not contributing much in research and development, sought to be examined from lower investments on venture capital and research sector.

The NITI Aayog report on Indian innovation depicts that there is a positive correlation between the gross state domestic product and innovation, while it has few exceptions like Goa has less innovation score with more economic contribution because of the flourishing tourism sector. The Karnataka innovation score for

the attributes depicts a GSDP contribution of 1.53 lakh per capita with efficiency ratio of 1.44; however, the state ranks first in innovation with overall score of 42.5, average score of the enabler and performance indicators. The enabler indicator is contributed by human capital (54.27), investment (33.01), business environment (24.43), safety and legal environment (39.75). The performance indicator includes parameters like knowledge diffusion (72.26) and knowledge output (28.13). The assessment of performance scores describes a fragmented picture for knowledge diffusion and Knowledge output in India in comparision to South Korea, Japan and Sweden, which have outshined in these indicators. There is a need to have more Ph.D. enrollments in India, the registration of higher institutions to professional bodies is a challenge, with a facilitation of ICT infrastructure. There is a need to invest more on higher education, since it will trigger knowledge-intensive employment. The participation of NGOs involved in knowledge sector is declining in India, therefore what attractive mechanisms can attract NGOs in Knowledge intensive sectors needs to be relooked through policy regimes, capacity building and community mobilisation. Business environment needs to be fostered by improving Ease of doing business ranking (42.86) and facilitation of more incubation centres for better knowledge needs. The chapter identifies Karnataka's State model as best case for examination for convergence of policies to boost knowledge and innovation, which are discussed in the later stage of chapter. Karnataka is performing well in terms of Knowledge diffusion (50.19) that relates to ICT export (100) which have increased sharply with advent of IT and software policies, around the period of economic liberalisation post-1990s. Another bigger challenge in knowledge diffusion through high and medium industries (9.12). Knowledge output (28.13) highlights the scope to further improve on grassroot innovations, patents, start-ups, innovation industries.

The (Table 1.3) knowledge and innovation parameters are extracted from global and Indian indices. The matrix identifies the areas of interventions for improving the overall process of knowledge-based urban development furthermore, it depicts the best case studies from sectoral point of views as discussed in UNDP, Global Knowledge Index 2021, NITI Aayog, Innovation Report 2020 and Bloomberg Innovation Index 2021.

Vision 2030: Government of Karnataka and SDGs

The strategies and action plans for achieving sustainable development goals 2030, a document prepared by the state department of Karnataka, highlight the visionary points in line with the state's vision for SDGs 2030. The indicators include sectoral aspects, social, economical and environmental dimensions of development. However, the report on vision 2030 assesses the 17 SDGs in detail. This research takes into consideration the critical parameters from the knowledge innovation indices at the country level and state level. The assessment of knowledge innovation indicators takes into consideration SDG 4 (quality education), SDG 8 (decent work and economic growth) and SDG 9 (industry, innovation and infrastructure). Vision 2030

Table 1.3 Knowledge and innovation parameters

Serial No	Parameters	Indicator	Need to focus	Best case models
1	Pre-university education, technical and vocational education, research development and innovation, ICT and economic environment	UNDP, Global Knowledge Index (2021) India ranks 74 out of 138 countries	Pre-university education, higher education remains a bigger challenge since dropouts are more in rural areas Research development infrastructure investments ICT enabling framework Need for enabling environment, since ease of doing rankings is a challenge	Switzerland scores the best in overall position, highest for research and development Norway secured first position for general enabling environment Finland efforts for facilitation of social infrastructure are best for pre-university education Digitalisation through policy, accessibility to big data in USA has resulted in improved rankings for ICT Singapore economic environment and policies are role model for other countries since it has secured the best position
2	Research and development, high-tech companies, conducive work environment, secondary education enrolments, economic contribution in education, Ph.D. enrolments and patents	Bloomberg Innovation Index (2021) India ranks 74 out of 138 countries	More research and incubation centres are required in India Digital technology adoption is a big challenge Rising number of Education dropouts	South Korea's first position depicts the innovation and efficient conducive working environment, major economic contribution in research and development Singapore has efficiently transformed due to eminent institutions and knowledge industries

(continued)

Table 1.3 (continued)

Serial No	Parameters	Indicator	Need to focus	Best case models
3	Enabler indicators: human capital, investment, knowledge workers, business environment, safety and legal environment	NITI Aayog Innovation Report 2020 for Indian States Karnataka ranks first in innovation	Enrolment numbers in Ph.D. Number of education institutions with NAAC accreditation. Schools with ICT infrastructure Higher education expenditure Knowledge-intensive employment in NGOs needs to be improvised Business environment rankings needs to be at a better position More incubation centres are required Knowledge diffusion through high and medium industries Improvisation in rankings of innovation, patents and start-ups	Economic activities are agglomerated in clusters, bind by social groups, industrial knowledge clusters depend up on education, information, research and technical support to a regional economy

Source Niti Aayog, 2020, Bloomberg, 2021, UNDP, 2021

specifically for SDG 4 focuses on reducing the dropout to zero from 26.18% in 2019 by creating awareness.

However, Karnataka's efforts for achieving the innovation rank-1 are witnessed from the relative comparison of sustainable development goals, (Graph 1.5), the gender equality, industry innovation and infrastructure, sustainable cities and communities which still remain a big challenge, despite of software and hardware statutory provisions which Karnataka underwent in 1980s and majorly triggered in 1990s (NASSCOM).

The vision 2030 Fig. 1.1 highlights the attributes pertaining to economic generation. Governance depicts the democratic participation of community, encourages transparency and more accountability. Furthermore, it focus on enriching the role of Bangalore's leadership in science and technology through knowledge-based industries. For poor and backward class, it focuses on increasing the incomes for rural areas through knowledge-intensive allied activities. This process is sought to reduce the social fragmentation between different classes of society. From very early phases of development, Karnataka has focused on Education and skill development as important pillars of knowledge and wealth generation, and have pioneered many schemes for reducing the school dropouts and engaging more number of students in the education impartment. State depicts the model case of proliferation of quality and accessible education to all. In rural areas of Karnataka, the school dropouts have significantly dropped to zero, and these records are maintained by the village education

register under Right to Education. Amidst pandemic, Technology Assisted Learning Program (TALP) is sought to ensure 100% participation of children in imparting education on the principles of quality education to all socio-economic segments of society.

There is a need to facilitate more computer literacy initiatives to strengthen the digital gap and further expansion of digital education initiatives from pre-primary education to post-graduate educational programs. Karnataka still holds the legacy of prestigious institutions which is discussed in the later part of the paper. Karnataka as a state may emerge as one of the global knowledge, education and research hubs by 2025. The vision 2030 envisages to develop model schools in each Gram Panchayat, since it has already attained zero dropout. However, there is a need to facilitate a coherent role of NGOs, social help groups and private organisations to foster education at a state level. To embark on SDG 8, decent work and economic growth, there is a need to foster occupations that generate better wages and enhance the livability of citizens with prospering, economic growth. SDG 8 envisions on need to promote social infrastructure in health education and skills through public private partnership by attracting humongous investments. There is a need for conducive work environments for knowledge workers and MSME industries, to diffuse polarisation of wages, promoting equitable distribution of wages, from the perspective of Knowledge diversification. Karnataka ranks in topmost states of India in terms of employment; however, the vision 2030 on the aegis of Atma Nirbhar scheme focuses on reducing the unemployment rate less than 1% by 2030. Eradication of labour inequalities, child labour and encouragement of conducive work environment constitute as the primary ingredients for the vision of the SDGs by UN Habitat and the State Government of Karnataka, furthermore, fostering entrepreneurship, accounting the informal employment and boosting MSME's in knowledge production. To foster knowledge networks across the country, there are central government initiatives like start-up India, Skill India, Prime Minister's employment generation program, Pradhan Mantri Kaushal Vikas Yojana. Karnataka state-level policy initiative under the aegis of Chief Minister's Koushalya Karnataka Yojana, Chief Minister's Karnataka livelihood scheme, Rajiv Gandhi Yojana have transformed the livelihood opportunities of locals, state has witnessed occupational shifts from traditional occupations to creative profession in search of earning better. Start-up policy has propelled the start-ups and entrepreneurs to innovate and contribute to the economy of the state. Bangalore has emerged as the hub for start-up culture (UNH Report 2020). There is a need to necessitate huge investments in the services sector for increasing the gross state share per capita share of Rs. 210,877 (MOSPI 2020) as it ranks seventh in the country among different states, developing more innovative and knowledge-based industries and organising more investors to meet up. NITI Aayog 2018 datasets highlight accessibility of rural area inhabitants through roads under the aegis of Pradhan Mantri Gram Sadak Yojana; moreover, the mobile connections per 100 individuals in rural areas and urban areas appear to be one of the best for the state of Karnataka. The number of Internet users (44.32) is also more than the Indian average of 33.47, which sought to promote industrial innovation viz digitalisation. In regard to Global Start-up Ecosystem Ranking Report 2015, Bengaluru is the only Indian city to be

ranked within the best twenty start-up cities across the world. To accomplish SDG 9, the government of Karnataka envisages to possess a leadership position in software and information technology-enabled services, biotechnology, nanotechnology and light engineering industry by 2025, paving the way for the state to achieve SDG 9 by 2030.

Graph 1.6 depicts the position of Karnataka in 'Knowledge dissemination process' through various attributes. The vision of Karnataka government is to foster the innovative capabilities. The huge investments in software and hardware, IT industries have extensively contributed to human capital and investments, which other states in India are still spearheading towards. The Karnataka represents the ideal case to examine the attributes in much details, the strategies, policies and attributes related to better scores can be a model for other Indian states; however, there is a need to focus on safety and legal environment for business.

Karnataka's Economic Initiatives to Foster Knowledge Ties

In the previous sections of the chapter, we have discussed the reasons for Karnataka's best innovation rankings. The state has emerged as one of the best investment destinations for investors. To improve the scorings for industry, innovation and infrastructure (Graph 1.3), New Industrial Policy 2020–2025 emphasises on the innovation parameters that will thrive the state's growth. Karnataka is pioneer in aerospace exports, software and hardware production. The statutes, the policies, statutes and location for Karnataka favour more foreign direct investment, availability of cheap labour, excellent accessibility and connectivity for the investors. The state contributes to 8% of overall foreign direct investment for India. The state has emerged home for tremendous population of 12 lakh software professionals, furthermore contributing to 31 lakh more jobs (Economic Statistics 2021). The Karnataka start-up policy 2015–2020 has registered 10,000 people thus contributing to USD 48 million. Karnataka start-up cell is sought to approve the licences for start-ups, incubators, investors, etc. Karnataka alone accounts for one third of electronics and computer software exports.

The advantages for Karnataka for promoting efficient business and improving knowledge ties include firstly good law and order situation prevailing in Karnataka which is conducive to foreign direct investments. Secondly, abundant availability of highly skilled manpower. Thirdly, Karnataka ranks among the top five industrially developed states in India. Furthermore, the state provides excellent logistic support and connectivity to the investors. All these points have extensively resulted in emergence of state as one of the biggest and fast expanding markets in the country since Karnataka has attracted FDI of USD 38,410 million from 2007–08 to 2020–21 (up to Nov 2020) constituting 8% of all India FDI.

The policies and initiatives to foster knowledge ties are evident from Table 1.4. The Karnataka Start-up Policy 2015 has extensively propelled the start-up culture in Karnataka and has boosted the innovation process, whereas the industrial policy 2014 has attracted huge investments across the globe, which has eventually resulted in the

Table 1.4 Karnataka's Policy Initiatives for Innovation and economic growth

Serial No	Policies for innovation	Intent for innovation
1.	Karnataka Start Up Policy-2015	Encouragement of start-ups in the State, Establishment of 25 innovative Technology Solutions in the State, Envisages to create 0.6 million direct as well as 1.2 million indirect jobs in Technology sector
2.	Industrial Policy 2014	To make Karnataka, the most preferred investment destination through inclusive, sustainable and balanced growth
3.	ESDM- Electronics systems Design and Manufacturing Policy, 2014	Generation of 240,000 new jobs, one fourth of India's Phd and more patent fillings in Karnataka, Investments in sector like Telecommunications, Defence, Medical, Industrial, Automotive, Consumer Products, applications and components. To Foster economic growth of ESDM to US $ 400 billion by the year 2020 and job generation over 28 million
4.	ICT Policy, 2011	Karnataka's pioneer role in outsourcing service for ICT. To retain the Karnataka's position in terms of largest skilled workforce in India for IT services. Products and R&D. To enable Karnataka to be the most preferred destination for MSMEs (Micro small and medium enterprises)
5.	SEZ Policy, 2009	Facilitation and establishment of SEZs at the same time safeguarding the environment and the interest of land owners

Source Economic Survey, 2021, IBEF report 2018

Karnataka's emergence as the top ranker in knowledge and innovation rankings by Ministry of Urban Development. Although it is discussed that the software policies have extensively contributed in restructuring process of urban planning, the ESDM 2014 is visionary in terms of job employment.

Role of Software Policies in Reshaping the State's Economy

The role of IT industries and software parks for Karnataka in global investments have been ground-breaking amidst 1990s liberalisation process in comparison to other

states of India. Furthermore, it is intriguing to explore the spatial temporal dimensions of growth and innovation since the emergence of academic institutions and electronic cities have contributed immensely to the knowledge-based spatial growth. The research chapter also explores the possibilities of spatial expansion enlisted in the Master Plan of Bangalore and the way forward in development fostering innovation.

The software industries started flourishing in the mid-1980s with the advent of computer policy 1984. The rise in export of computer softwares and later technologies to abroad was evident in the early 1990s. The growth of software technology parks scheme facilitated a sharp increase in offsite services from on-site services. The global recognition share of offshore services has increased sharply post-IT reforms and policy amendments. Computer policy in 1984 initiated restructuring for software industries in a better way for increasing software exports globally with a vision to enhance global competitiveness. Although, on the contrary to this, the Department of Electronics (DOE) felt that provisions under the software policy were too rigid and cumbersome, the idea of self-dependent and global recognition was falling apart (Sridharan 2011). The digital revolution ought to be envisaged from the railway system computerisation administered by Rajiv Gandhi furthermore marked by the creation of Centre of the Development of Telematics (C-DoT), digital technology. The 1984 and 1986 software reforms for fostering economic growth for the country deciphers mere increase in gross domestic product (Sen 1994). The hike in software exports and global recognition were experienced in the 1990s around the neoliberalisation process. The introduction of Texas instruments in 1986 led to a flexible approach in the software development process and questioned the statute. For further expansion of software markets, the software technology park scheme was introduced by the Department of Electronics in the 1990s. Later on, 1991 the Software Technology Parks demanded for an autonomous power to avoid the government hindrance in the process of expansion of the software market all across the globe. The money devaluation post-economic liberalisation in 1991 attracted foreign investors. The removal of barriers in import of IT equipment and peripherals further led to the emergence of an export-oriented market for softwares in India. The Department of Electronics significantly contributed in reforming software statutes further followed by the efforts of National Association of Software and Service Companies (NASSCOM).

With the advent of 1984 policy changes in software, the global market allowed the local workforce in lesser wages in comparison to the prevalent wages in the USA. The availability of unemployed engineer youth was massive. The situation was marked as an opportunity for the English-speaking engineer in the country around the early 1990s. In this way, Bangalore has emerged as one of the unicorns for knowledge developments in India. In the next stages of research, the attempt to study the impact of Bangalore urban expansion in regard to the advent of IT and software parks will be analysed in detail since it has contributed extensively in the economic growth of Karnataka as a state, in terms of attracting huge investments and fostering knowledge networks.

Conclusion

The roadmap of India's innovation and knowledge development needs to identify the existing lacunas in the current innovation frameworks for efficient and effective knowledge dissemination. The convergence of approaches from the model of Cologne, Singapore, London, Cyberaja, Sweden, Austria, Barcelona, Melbourne, USA, UK and Brazil is lesson for India's economic growth. The integration of academic institutions with research and industry and network ties needs to be relooked. The current education system for higher studies needs to be fostered as India since the global rankings is not satisfactory in its representation for UNDP Global Knowledge Index, 2021. More school dropouts in rural areas, lack of investments and business enabling environment are the major concerns, more investment in R&D sector is required as can be learned from the models of South Korea and Singapore. The involvement of NGOs in imparting knowledge and promoting innovation is lacking in India as stated in NITI Aayog report, 2021. The ladder towards boosting knowledge economy for Indian states is challenging but not impossible, perhaps the contribution of policies and state's vision for boosting innovation and knowledge economy in Karnataka is an eye opener for other states of India. The research chapter has made an attempt to demystify Karnataka's model to be replicated for Indian cities in addition to the cross-learnings from global cases as discussed. The vision 2030 for Karnataka focuses on industries, facilitation of start-up culture, education and skill development as thrust sectors. The efficient policy implementation framework not only depicts the state's vision but also tries to analyse the knowledge attributes from the lens of global agenda of sustainable development goals. Amidst, neoliberal era the advent of software and hardware industries has emerged as knowledge industries in Karnataka where Bangalore has an immense contribution. The economic state policies for India must reflect on mechanisms to attract huge investments, enhancing human capital, more knowledge occupation and conducive business environment; however, India is emerging as one of the blooming economies; on this 75th Independence Day address, India has surpassed UK's economy and has become fifth largest economy of the world. The enhancement of above indicators through policy measures and effective implementation framework will leapfrog India's position to a better place in knowledge and economic rankings from global perspective.

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