
# REPORT OF THE SEMINAR ON

# KNOWLEDGE ECONOMY: THE PATH TO SPEEDY AND HIGH-QUALITY GROWTH

**PREPARED BY**

**NUST INSTITUTE OF POLICY STUDIES**

**NATIONAL UNIVERSITY OF SCIENCES AND TECHNOLOGY**

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## LIST OF SPEAKERS & PARTICIPANTS

**Speakers** (in order of speaking)

| | |
|---|---|
| • Lieutenant General Naweed Zaman (Retd) | Rector National University of Sciences & Technology (NUST) |
| • Mr. Asad Umar | Federal Minister, Ministry of Planning Development & Special Initiatives |
| • Dr. Atta ur Rahman | Chairman Prime Minister's Task Force on S&T, Vice Chairman Prime Minister Task Force on Technology Driven Knowledge Economy. |
| • Ms Tania Aidrus | Special Assistant to the Prime Minister on Digital Pakistan |
| • Dr. Tariq Banuri | Chairman Higher Education Commission (HEC) |
| • Mr. Tariq Sayeed Saigol | Chairman Kohinoor-Maple Leaf Group |
| • Mr. Ameer Hassan | Chief Executive Officer APIMatic |

**Participants**

- Vice Chancellors
- Academics, experts & students
- Senior serving and retired government officials
- Industrialists and members of business community
- Representatives of Chambers of Commerce and Industry
- Members of think tanks
- Media representatives

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## *Executive Summary*

Making fast and lasting gains in knowledge economy is a fundamental requirement for Pakistan's long-term growth and development. These gains have to be centered on the comprehensive development of the four key pillars of knowledge, namely, **a favorable economic and institutional regime**, **high-quality human resource development**, **a dynamic national system of innovation**, and **advanced information and communications technologies (ICTs)**.

In order therefore, to identify multidimensional measures required for the development of the Pakistan's knowledge economy, NUST Institute of Policy Studies (NIPS) organized the national seminar on "Knowledge Economy: The Path to Speedy and High-Quality Growth" on March 3, 2020. The seminar brought together the leading stakeholders of Pakistan's knowledge economy. The distinguished speakers of the seminar included Asad Umar (Federal Minister for Planning, Development and Special Initiatives), Dr Tariq Banuri (Chairman Higher Education Commission), Tania Aidrus (Special Assistant to the Prime Minister on Digital Pakistan), Dr Attaur Rahman Chairman, (Prime Minister's Task Force on S&T, Vice-Chair, Prime Minister's Task Force on Technology-Driven Knowledge Economy and Co-Chair, Task Force on IT), Lieutenant General Naweed Zaman (Retd) (Rector NUST and Patron NIPS), Tariq Saeed Saigol (Chairman Kohinoor-Maple Leaf Group), and Ameer Hassan (CEO APIMatic). The seminar was moderated by Dr Ashfaque Hasan Khan (Principal and Dean, NUST School of Social Sciences and Humanities, Director General NIPS, and Member, Economic Advisory Council, Government of Pakistan), and was attended by senior government officials, university leaders, business executives, public and private innovation and entrepreneurship managers, academic experts, scholars, and students.

Following the seminar, two dedicated focus group sessions were arranged on March 12 and 16, 2020, with innovation managers, entrepreneurs, and policy researchers to discuss the steps that needed to be taken for developing the four pillars of the knowledge economy in Pakistan on a fast-track basis.

Investments in knowledge are the solid guarantee for sustained growth and development of countries. Knowledge economy commands top priority in the policy agenda of major economies of the world. This is evidenced by the public spending on education and R&D of major advanced nations, newly industrialized nations, and emerging economies. China spends more than 8% of GDP on education and more than 2% of GDP on R&D. Norway is spending 8%. Finland, South Korea, and the United Kingdom spend more than 6% of GDP on education. South Korea spends more than 4% of GDP on R&D, whereas the U.K.'s R&D spending is almost 2% of GDP. The United States spends 5% of GDP on education and almost 3% on GDP. Malaysia spends more than 4% of GDP on education and more than 1% of GDP on R&D. In contrast, Pakistan is spending around 3% of GDP on education, whereas R&D spending is less than 0.3% of GDP.

Following are some of the key recommendations that emerged from expert deliberations during the seminar.

1. Increase public spending on education to at least 5% of GDP by 2025, and increase public R&D spending to at least 1% of GDP on urgent basis.

2. Ensuring the quality, move toward the massificaiton of higher education, with tertiary enrolment reaching at least 3-4 million in the next 10 years, and increase R&D personnel to 2500-3000 per million inhabitants by 2030.

3. In view of the central position of universities in knowledge economy, select and support at least 3 top Pakistani universities with generous funding and other resources to rank among the top 100 universities of the world by 2030.

4. Promote science-based regional and urban development based on the comprehensive development of dynamic hybrid spaces like business and technology incubators and accelerators, research parks, science and technology parks, special economic and technology zones and innovation areas which can act as a critical tool for economic growth, wealth creation, and poverty alleviation.

5. Enhance the potential of science-based regional development through a policy mix approach that aims to build complementarities between several policies like education policy, S&T policy, social policy, labor policy, legal policy, monetary policy, and fiscal policy.

6. In order to build a successful knowledge economy, aim to transform the economic structure of Pakistan in a manner that industry and high-end services come to comprise, at least, 40% each of GDP.

7. Enhance the capacity of the elaborate national system of S&T execution and facilitation under the umbrella of the Ministry of Science and Technology (MoST). Leverage China-Pakistan cooperation, especially the mechanisms made available through the Belt and Road Science, Technology, and Innovation Cooperation Action Plan, for developing the national S&T infrastructure so that the innovative capacity and absorptive capacity of Pakistan's innovation system can be increased.

8. Link the approval of all foreign assistance and FDI projects to mandatory knowledge transfer, so that at least 5% of the cost of such projects is set aside for training and indigenous capacity building, can also help prove helpful.

9. Regular foresight exercises for the promotion of knowledge economy, duly aligned with the national achievement of Sustainable Development Goals can help in the formulation of the national knowledge economy roadmap.

10. Build the digital economy with 1 million jobs under the Digital Pakistan Vision duly backed up by comprehensive human resource development and the promotion of new technology-based startups as well as technology-based small and medium firms so that the digital economy does not end up getting stuck in the low middle income trough.

## Knowledge Economy: The Path to Speedy and High-Quality Growth

### 1. Introduction

The record of global growth in the 20th century, especially following the end of the Second World War, amply demonstrates that nations that did not prioritize knowledge and innovation in their development strategies failed to experience sustained growth. The 21st century will likewise belong to those countries that succeed in institutionalizing the transformation of knowledge into economic value and wealth creation. Countries like China, South Korea, Singapore, and India have witnessed rapid economic growth in the last two decades through increasing the share of knowledge economy in growth and development.

Indeed, one of the most significant events in development policymaking in the last 50 years has been the transposition of the critical role of knowledge, technology, and technical skills from the microeconomic level of firms to macroeconomic level of national development. If Pakistan in not to be left behind in the global race for competitiveness, urgent steps need to be undertaken so that knowledge can transformed into the motive force for growth and development. The attention of the nation and the state should be equally concentrated on the challenges of building knowledge economy. This attention should be based on bold and fearless exploration of these challenges followed by viable and decisive response.

Following is the critical report based on consolidated views of the speakers and participants of the seminar and the subsequent focus group sessions in each of the four key pillars of knowledge economy.

### 2. Development of Four Key Pillars of Knowledge in Pakistan

#### *2.1. Economic and Institutional Regime*

The economic performance of a country in the medium and long terms depends upon the technological advancement of industrial production, the quantum of capital being used in production of aggregate output and the size and skills of the labor force. This is directly related to quality of education system of the country, its national saving rate, and the role and quality of the system of governance expressed through the seriousness, commitment, and competence of the government in promoting a favorable economic and institutional regime that can fuel the growth of societal, institutional, economic, and industrial processes for the development of functional knowledge economy.

First, at the most fundamental level, it means the ease of doing business and incentives for economic agents that play a leading role in the knowledge-based economic and industrial production like researchers, innovators, and entrepreneurs. This presupposes functioning market economy with a healthy relationship with the government that can provide the economic safety net to deal with market failure as and when it occurs. This means not an interventionist government but a supportive system of governance.

Second, knowledge economy does not develop in national environment characterized by the lack of clear property rights, especially intellectual property rights. This requires a proper juridical recognition and legal enforcement of intellectual property rights in the system of patents, trademarks, and copyrights that protects owners in general and the owners and creators of ideas, knowledge, and research in particular.

Third, the institutional conditions of developing economies like Pakistan are sometimes characterized by a rent-seeking mentality that promotes lack of transparency and arbitrary practices that discourage entrepreneurship and enterprise. Sometimes, this rent-seeking behavior is an outgrowth of a mind-set dominated by turf protection in which economic agents and players are seen as outsiders out to short-change the government and state. This suspicious mindset is indicative of low trust and social capital which may prevail in economies with a history of sub-optimal performance and skewed distributive and redistributive mechanisms. Unless the understanding prevails across the board that entrepreneurship is the motive force of knowledge economy which can redress economic and societal imbalances in the medium and long run, such trust deficit can stunt the growth of a pro-innovation institutional regime.

Fourth, a country's investment rate, the ratio of investment to output, is a good indicator of the competitiveness of its economy. Of the four major South Asian economies, Pakistan's investment was at 15.4% of the GDP in 2019. In the same year, investment accounted for 31.6% of the GDP of Bangladesh, 28.8% of the GDP of India, and 20% of the GDP of Sri Lanka. This indicated sluggish growth conditions which generally tend to be non-conducive for the innovation performance and entrepreneurship promotion. Similarly, the saving rate in Pakistan was considerably low at 5.2%.

Fifth, regional development in Pakistan should be considered a major dimension of national economic development. Urban development, as the key form of regional development, should focus on making a particular sub-national region understood as a single city or town or a number of cities or town, attractive for business and industrial activity, leading to better economic and life outcomes for people and firms alike. In this regard, urbanization should be viewed as a critical tool for economic growth, wealth creation and poverty alleviation.

Sixth, contemporary regional urban development has increasingly come to be seen in the context of science-based regional development. This brings into focus the immensely important role of new industrial clusters like business and technology incubators and accelerators, research parks, science and technology parks, special economic and technology zones and innovation areas should be enhanced in the regional urban development strategies in Pakistan.

Seventh, in terms of science-based regional development as the contemporary form of urban development, the role of triple helix of collaboration between government, industry, and academic should be maximized as the potent engine of promoting new industrial clusters. In this regard, universities with their advanced knowledge production functions should be considered dynamic nodes of new industrial cluster promotion. They should be understood as providing both critical input for and output of innovation function which can be defined as the relationship between aggregate innovation and gross knowledge endowments, the latter

denoted by the quantity and quality of R&D spending in a national economy. Universities should be understood as especial entities which both provide the supply and absorb the demand for knowledge.

Eighth, as an important component of science-based regional and urban development strategy, the proportion of the technology-based small and medium enterprises to aggregate output needs to be increased. While Pakistan's technology-based startups have been integrated more or less in the global production networks of global multinationals, their integration into the domestic production networks of big domestic firms and corporations has remained sub-optimal. This points to unfavorable connection and integration between domestic big business and local technology-based startups. The integration of domestic technology startups in the supply chains of big domestic industries and firms is badly needed for the speedy development of knowledge economy. This has become critical as the coronavirus pandemic has disrupted globally dispersed chains and as global multinationals will scramble to effect economic decoupling and focus on restoring their supply and production networks closer to home. This means that Pakistan should brace for the impact as it cannot remain immune from the global meltdown generated by the pandemic. A key coping strategy is for big business in Pakistan is to encourage and prioritize the technological inputs provided by local technology-based startups.

Ninth, knowledge economy cannot be developed in conditions of low domestic social and scientific mobility. The levels of both need to be ratcheted up in Pakistan. This means that the career and knowledge incentives of public and private universities, laboratories, research centers, policy institutes, and other knowledge- and science-based organizations should be increased sizably.

Tenth, based on the experience of advanced economies, newly industrialized nations, and emerging economies a policy mix approach has proven to be the best policy tool for taken for the development and advancement of knowledge economy. Several policies, such as education policy, S&T policy, social policy, labor policy, legal policy, monetary policy, and fiscal policy, have to be designed in such a manner that they collectively tend to encourage and incentivize the knowledge-based activities in the government, society, and the market.

Eleventh, the development of knowledge economy also demands a major change in the economic structure of Pakistan. At present the agriculture contributes about 18.5%, industry comprises 20.3%, and service make up 61.2% of the GDP. Most of these services are low-end with low technology input. The share of industry should be around 40% in order for Pakistan to successfully cross over from the current factor-driven stage of growth to industrialization. Once industrialization has successfully been completed, then the share of industry may come down with a proportional increase in high-end services with high technology quotient. Such a structural change would be conducive for the development of knowledge economy in Pakistan.

Finally, there is a need to understand that innovation and entrepreneurship are determined and influenced by the overall health of the economy. They are not hermetically sealed from general economic conditions of a society. They fail to prosper in conditions characterized by low competitiveness. This means that policymakers should not think of these features in isolation

from the general macroeconomic conditions of the country. Innovation and entrepreneurship growth, therefore, presupposes macroeconomic stability. A healthy and rather fast output growth combined with low unemployment rate and reasonably low inflation rate is required for innovation and entrepreneurship become economically significant forces.

### *2.2. Human Resource Development*

In the context of knowledge economy, high-quality human resource development translated into the availability of a skilled workforce that can perform the basic, medium, and advanced technical and analytical functions associated with industry and services. Of these, the most crucial functions are those related to an environment of high R&D intensity, especially in industrial production. This requires a skilled workforce with a high-technology quotient. The fundamental function of this high-technology quotient workforce is to enable the creation or addition of new value in different economic sectors combined with the efficient transfer of existing value within sectors and between sectors.

This in turn requires a mature and developed system of higher education and vocational education and technical training which is supported by quality systems of primary and secondary education. Pakistan faces serious challenges in the systems of primary education, secondary education, vocational education and technical training, and tertiary or higher education.

According to UNESCO, between 2000 and 2017, Pakistan's highest spending on education was 3% of GDP in 2016. In the same year, China spent 8.30%, Norway spent 8%, South Korea spent 6.20%, and Malaysia spent 4.70% of their GDP on education. This historically low spending on education in Pakistan is matched by low spending on R&D. Between 2000 and 2018, Pakistan's highest spending on R&D was 0.63% of GDP in 2007, whereas in 2017, it spent only 0.24% of GDP in 2017. In 2017, South Korea spent 4.5%, China 2.15%, Turkey 0.96%, and Iran 0.83% of GDP on R&D.

Low resource mobilization in Pakistan is also indicated by low levels of availability of R&D workers such as scientists, engineers, researchers, etc. According to UNSECO, in 2017 Pakistan had only 911.7 total R&D personnel per million inhabitants whereas in the same year, China had 14,370.3, South Korea had 12,725.8, Japan had 9405.6, Turkey had 3285.1, and Vietnam had 1825.4 total R&D personnel per million inhabitants.

While tremendous gains in higher education system `have been made since the founding of the Higher Education Commission of Pakistan in 2002, historically tertiary or higher education enrolment has remained low in Pakistan. According to UNESCO, in 2017 Pakistan total tertiary enrolment stood at approximately 1.94 million trailing significantly behind China's 44 million, India's 33 million, Indonesia's 8 million, Turkey's 7.2 million, Iran's 4.1 million, South Korea's 3.14 million, and Bangladesh's 2.8 population in the same year. This should cause concern when it is remembered that with the exception of China, India, and Indonesia, the populations of Bangladesh, Iran, Turkey, and South Korea are significantly less than Pakistan's.

The significance of universities in the knowledge economy cannot be emphasized enough. Under the triple helix model of innovation, universities have assumed a central mechanism for above-proposed innovation function dependent upon the exponential increase in knowledge production. The global trajectory of knowledge economy advancement, based upon the historical record of development in North America, Europe, and Asia Pacific, shows that universities serve as critical nodes of new growth owing to their unmatched ability to introduced new ideas, skills, technology, talent, and value to the world on a sustained basis. Their direct role in large-scale human capital formation determines their centrality in the triple helix. They can become the connecting tissue between government and industry by drawing upon their convening capabilities enabling people from different occupational and professional domains to interact with each other through knowledge exchange and collaborative inquiry.

Through their inherent diversity, dynamism, and flexibility, universities reinforce governance and production functions of government and industry respectively. They perform policy research and advisory roles at the same time that they promote technological evolution of the production function of industry through scientific research combined with the direct and indirect facilitation of new industrial clusters like business and technology incubators, science and technology parks, high technology zones, and innovation areas.

Pakistan has witnessed rapid increase in the number of universities since the establishment of HEC. This is a positive trend and should be consolidated. The current challenge is to improve the quality of these higher education institutions and make them globally competitive. While in the last ten years, not more than one or two universities have figured in the leading global rankings of universities, the fact needs to be appreciated that the graduates prepared by these universities have gone on to receive education in some of the best universities around the world. This shows that the basic direction of higher education development is correct in the country. It, however, needs to be strategically prioritized like, say, national defense or the construction of CPEC and then sufficiently resourced.

The financial straits faced by higher education are indicated by the federal higher education financing. Against the projected requirement by HEC of Rs 103.5 billion for the fiscal year 2019-2020, the commission was allocated Rs 58.50 billion under recurring grant, around 8 billion less than what it had received in the fiscal year 2018-2019. HEC received Rs 29 billion under Public Sector Development Programme (PSDP) for fiscal year 20192-2020 against the development budget demand of Rs 55 billion. Under-resourcing the HEC will predictably impact the development of national higher education system. While the government cannot be faulted entirely in view of the magnitude of its overall financial burden, yet more needed to be diverted to higher education if only to meet HEC's projected financing needs for fiscal year 2019-2020. Adequate funding will allow the HEC to resume its foreign scholarship scheme which has yielded significant brain circulation benefits for Pakistan and made available highly-qualified personnel for universities and private sector alike. It needs to be remembered that increase in the number of universities without the availability of high-quality staff, including faculty and technical personnel, can lower the standard of higher education.

HEC is making serious efforts to bring about changes to the structure of the PhD program so that it shall be focused on mentoring and creating skills that are central to knowledge economy. Low-quality PhD degree providers would be suspended till standards are met by them. It is expected that this will improve quality. HEC is liberally funding research projects that are logical and about problem solving. FBR may be requested for the reduction of taxes on privately funded research projects. HEC is working on building the capacity of academic journals. In terms of the standardization of admission criteria, an indigenous testing system called the Education Testing Council (ETC) is already functional since late 2017. ETC is mandated to hold standardized entry tests for public and private universities of Pakistan, and aims to arrange "uniform, accessible, and competitive assessment base" for university admissions.

The role of universities as an economic and societal actor is the key fourth-generation function of universities. Universities that increasingly play an active role in sustainable regional (sub-national and supra-national) socioeconomic development will become not only national and global higher educational leaders but also lead the way in knowledge and science diplomacy for promoting peaceful relations among nations. This function will be powered by increased circulation of ideas and knowledge-based mobility combined with sustained knowledge transfer to economy and society using multiple formal and informal channels. Such universities will produce not only leading professional, scientists, entrepreneurs but highly developed citizens deeply involved in regional prosperity and societal welfare.

In the context of Pakistan, NUST can serve as a successful case study of a developing country university prioritizing and achieving excellence in high quality human capital formation, especially S&T human resource development, research and knowledge advancement, and innovation and entrepreneurship promotion. The potential and scale of the contribution of the university's contribution to national development can be gauged by the development by NUST of a less expensive screening kit for coronavirus expected to cost one-fourth the current prince for the foreign kits currently being used for detecting COVID-19.

In view of the central position of universities in fostering sustainable knowledge-based growth, development, and modernization, the government should set the target that, within the next 10 years, top three universities of Pakistan should rank amongst the top 100 universities of the world. For this, government should provide each of these three selected universities with sizeable annual public funding during this period to upgrade their comprehensive S&T-based research and knowledge production capabilities. It is a foregone conclusion that public funding is the major source in bankrolling this journey towards knowledge economy.

Although, the seminar focused on higher education and mobilization of R&D resources, it must be mentioned in passing that serious challenges remain at the level of primary and secondary education in terms of enrolment, school life expectancy, progression, and completion. These problems manifested in the bad school management, ghost schools, poor pedagogical techniques, dearth of skilled teachers, poor learning outcomes, absence of independent

assessment, poor student performance in science subjects and mathematics, and resource paucity.

### *2.3. Dynamic National System of Innovation*

The triple helix model, consisting of sustained collaborative interaction between government, industry, and universities, represents the fundamental nodes and linkages of the national system of innovation. Over the years, society has been added as a key nodal actor to the classic triple helix model making the triple helix "quad helix." While the nodes of the national system of innovation may be present at different levels of maturity and evolution in any specific country, what matters is the degree of the maturity, breadth and depth of the linkages that exist between the nodes.

In Pakistan, the major nodes of the national system of innovation are fairly well-developed and exist at a certain level of historical maturity in themselves. This is the positive factor for the development of the national system of innovation. However, the linkages between these nodes are fairly elementary lacking both breadth and depth. This is the challenge faced by the development of the national system of innovation. The innovation function, defined here as the relationship between aggregate innovation and gross knowledge endowments or innovation input, the latter denoted by the quantity and quality of R&D spending and R&D personnel in national economy, is not sufficiently advanced. This means that the increase in the quantity of R&D spending will increase the innovative capacity in the national economy. As mentioned earlier, the R&D spending in Pakistan has historically remained less than 1% of GDP. This has contributed to the low innovative capacity of the national economy marked by underdeveloped innovation function. Lack of macroeconomic stability has also contributed to the difficulty of diverting great funding into R&D as basic existential economic challenges of low growth still remain to be overcome.

Low innovation input, especially R&D spending more so than R&D workers, has naturally resulted in low innovation output that can be measured by scientific or research output measured by the publication of S&T-based research articles on the one hand and technological output that can be measured by patents, number of total new technology-based startups or firms, and the high-technology exports. Pakistan scores low both in terms of innovative input and output. According to World Bank, Pakistan's high-technology exports as a percentage of manufactured exports were only 1.91% which compared unfavorably with Singapore's 48.85%, Malaysia/s 42.97%, South Korea's 26.58%, China's 25.24% and even Indonesia's 5.79%. Incidentally Indonesia, also happens to be the only Muslim state to have a nominal GDP of more than 1 trillion US dollars (US$1.2 trillion in 2019, to be precise). Pakistan's low rank of 105 out of 129 countries ranked in the Global Innovation Index (GII) 2019 summarizes the scale of challenge of the development of the national system of innovation.

Low innovative capacity tends to be directly proportional to low absorptive capacity of the national system of innovation characterized by suboptimal development of S&T infrastructure, low levels of technology transfer, low levels of foreign direct investment, and scientific mobility.

On the bright side, it needs to be stressed that while the number of R&D workers in Pakistan is low as mentioned above, the quality is fairly good, especially in leading public and private higher education and other R&D institutions in the country. However, innovative scale and the quality of innovative can only be built with sufficient long-term public investment in R&D.

In so far as the fast-track development of S&T infrastructure is concerned, China-Pakistan strategic cooperation should be leveraged to build and upgrade the S&T-based innovation infrastructure of Pakistan. In this regard, the Belt and Road Science, Technology, and Innovation Cooperation Action Plan launched during keynote speech of President Xi Jinping at the First Belt and Road Forum (BRF) for International Cooperation in May 2017 should be understood and utilized properly. The key provision of the said plan include Science and Technology People-to-People Exchange Initiative, the Joint Laboratory Initiative, the Science Park Cooperation Initiative and the Technology Transfer Initiative. Further, as a part of the plan, China has pledged to offer at least 2500 short-term research visits to China for promising young scientists, arrange the training of 5000 foreign scientist, engineers, and managers, and establish 50 joint laboratories.

Pakistan should endeavor to reap the maximum benefit from the menu of S&T cooperation offered by the plan as it can directly lead to major improvement in its S&T-based infrastructure. Doing so can provide direct linkage between infrastructure-led development and innovation-led development. Similarly, this national ecosystem of innovation should be supported by the development of special economic zones, science and technology parks, and innovation areas. These can pave the way for smart urbanization on the one hand and the enhancement of Pakistan's trade competitiveness by increasing the value addition of manufactured exports and increasing the proportion of high-technology exports. The challenge is to integrate regional development, urban development, and S&T development in ways that countries like China, Japan, and South Korea, and Singapore have done.

Further, government should link the approval of all foreign assistance and FDI projects to mandatory knowledge transfer, so that at least 5% of the cost of such projects is set aside for training and indigenous capability development, leading to national self-reliance. Instead of importing technology we need to empower our own industry. And government contracts should go to Pakistani companies, if they are short of technology only then they should allow to partner with foreign companies. This single policy can bring huge development in IT industry.

It is encouraging to note that policymakers in Pakistan have been cognizant of the importance of national system of innovation for almost two decades. The establishment of the HEC has been the greatest token of public commitment to the promotion of knowledge economy in the recent history of Pakistan. Similarly, the establishment of entities like the National Incubation Center (NIC) and the Ignite National Technology Fund are proofs of the government's commitment to foster innovation and entrepreneurship in the country. Similarly, the elaborate system of S&T execution and facilitation in the form of various S&T organizations and entities working under the umbrella of MoST should be enhanced. The fundamental step to take is to

remove their resource and funding constraints. This can be done through increasing the public spending on R&D to at least 1% of GDP in the next 5 years.

The Task Force on Technology-Driven Knowledge Economy has identified the following key areas: education, technical training, innovation and entrepreneurship initiatives; high-value agriculture using modern technology; IT-related technologies; mineral processing and natural resources; and emerging technologies, industrial biotechnology, nanotechnology, 3D printing, energy storage systems. Different programs have been launched under these broad priorities.

These priority areas should focus the concerted efforts of government, academia, and industry to develop dynamic national system of innovation. For instance, low value addition in agriculture is a big challenge as 60% of our textiles are low value-added. Knowledge-based interventions can help increase revenue collections. In this regard, Knowledge Economy Task Force undertook a project aimed at linking FBR and NADRA that was based on the development of some algorithms for identifying non-filers. This led to the identification of undeclared asserts of about 1.3 trillion rupees as well as an additional tax collection of 63 billion. Challenges like this need to be tackled on priority basis through triple-helix collaboration. In order to help accelerate the process of the development of the national knowledge-based economy together with a dynamic functional innovation system, the Ministry of Planning, Development and Special Initiatives, in consultation with all public-private stakeholders, should conduct regular foresight exercise that is aligned to the Sustainable Development Goals (SDGs) and integrated across all line ministries.

### *2.4.* Information & Communications Technologies (ICTs)

The development of ICTs in Pakistan has been particularly encouraging in recent years. In view of their backbone status for the development of knowledge economy, ICTs rightly form a focus area for policymakers. Pakistan has a growing digital ecosystem. According to Pakistan Telecommunication Authority (PTA), as of December 2019, there were 165 million cellular subscribers with the tele-density of 78.16%, 76 million 3G/4G subscribers with 35.90% penetration, and 78 million broadband subscribers with 36.86% penetration. Moreover telecom revenues had experienced a growth of 12.9% in from 2017-18 to 2018-19. At 0.6%, Pakistan had the second lowest data cost to gross national income (GNI) per capita. According to Pakistan Software Houses Association for IT & ITES (P@SHA), the sector employed more than 300,000 personnel nationally. The ICT sector was growing fast with more than 10000 application developers and freelancers enter IT workforce each year.

Moreover, the exports of IT and IT-related services had registered a surge of 2.44% in financial year 2018-19, having registered exports of US$1.09 billion compared to US$ 1.065 billion. According to Pakistan Software Export Board (PSEB), Pakistan's total ICT revenues hit USD4.1 billion in 2019 as the export sector included animation, software development, gaming, systems integration billing, and telemarketing services. The number of IT and IT-enabled services (ITes) companies grew to 2163 in 2019 from 1873 in 2018. There were estimates of more than 5000 companies providing services in about 100 countries. The software sector was slated to grow by more than 3% during the next four years. Export remittances of

IT and ITes increased to US$439.963 million in first five months (July-November) of the financial year 2019-2020 compared to US$356.687 million during July-November of the financial year 2018-19. This was a phenomenal growth of 23.35% Moreover, the government's decision in February 2020 to increase IT exports to US$10 billion was encouraging likely to increase investment in the sector. It was hoped that the decision to build a 40-acre software city in Islamabad will further lead to IT agglomeration in the Islamabad Capital Territory. The relief package announced for small software exporters together with the abolition of double tax levied on exporter by federal and provincial governments would boost IT exports. According to Global Findex Database 2017, World Bank's data resource for measuring financial inclusion and the Fintech growth, mobile money account ownership had consistently grown in Pakistan from less than 10% to more than 20% between 2011 and 2017.

The fact that 64% population of the country is under 30 years is good news for the growth of digital ecosystem. The launch of the Digital Pakistan Vision in December 2019 was aimed at capturing the growth potential of this young digital-ready population. It indicated the correct prioritization of the government. The initiative was designed to act as the masterplan for the development of national digital economy, leveraging the booming growth of ICTs for the purpose of business and job creation in the country. The four pillars of the vision, namely, digital access and connectivity, digital infrastructure, digital skill acquisition and digital literacy, and innovation and entrepreneurship promotion, would consolidate the development of national knowledge economy.

The big idea driving the vision is to leverage digital technologies to enable every Pakistani to live a dignified financially independent life. The initial goal under the vision is to build the national digital economy leading to the creation of 1 million jobs. This means creating and providing employment opportunities for all strata society and segments of population on the one hand and ensuring local, national, and global connectivity on the other. The first requires that every Pakistani of working age had a job. The second demands that every Pakistani owned a smartphone. This goal of creating 1 million digital economy jobs is a worthy one. This goal should be achieved in tandem with the continuous improvement and development of the primary, secondary, vocational and tertiary education in Pakistan.

In order to be sustainable and transformational at the same time, digital economy job creation should be linked with the growth in the number and output of technology-based, especially new technology-based, small and medium enterprises linked to global production networks of foreign multinational corporations and the domestic production networks of major domestic corporations. At the same time, the structural transformation of the economy from factor-driven to industrialization should be effected. The creation of 1 million digital-enabled jobs in the absence of these changes will run the risk of creating the low middle-income band if innovative input and output do not increase at the same time. However, predictably like other emerging market economies Pakistan is experiencing economic, social, political and regulatory problems bur these problems could be resolved through proper policy planning and implementation.

## 3. Recommendations

Based on the foregoing analysis, following recommendations are proposed:

### *3.1. Favorable Economic and Institutional Regime*

***3.1.1.*** Create ease of doing business and improve incentives for economic agents playing a leading role in knowledge-based economic activity like innovators, entrepreneurs, researchers, etc.

***3.1.2.*** Promote supportive government action to prevent market failure, especially in terms of cushioning technology-based startups and firms from economic shocks and market crashes.

***3.1.3.*** Establish a clear legal system of intellectual property rights based that takes cognizance of the global regime of trade-related intellectual property rights.

***3.1.4.*** Discourage rent-seeking behavior, increase institutional transparency, and promote greater trust between government and innovation agents and actors.

***3.1.5.*** Enhance the competitiveness of the economy and focus on increasing the investment rate of 20%-25% and saving rate to at least 10%-15%.

***3.1.6.*** Promote concerted science-based regional urban development based on the comprehensive development of new industrial clusters like business and technology incubators and accelerators, research parks, science and technology parks, special economic and technology zones and innovation areas.

***3.1.7.*** Increase the intensity of the innovation function in the economy defined as the relationship between aggregate innovation and gross knowledge endowments denoted by the quantity of R&D spending and the number and quality of R&D personnel.

***3.1.8.*** Promote and protect the new technology-based startups as well as technology-based small and medium enterprises integrated with the domestic production networks of major domestic public and private corporations as global supply chains come to be disrupted and economic decoupling hits local enterprises in the wake of coronavirus outbreak.

***3.1.9.*** Promote and increase the levels of domestic scientific mobility and science-based social mobility with prosperous life outcomes for the agents of knowledge economy.

***3.1.10.*** Just as the dominant principle of the agricultural age was extraction and envy and that of the industrial age was competition and conflict, so the dominant principle of the post-industrial knowledge-based age is cooperation and collaboration. In Pakistan however, the envy characteristic of the agricultural age and conflict characteristic of the industrial age thwart the development of collaboration characteristic of the knowledge economy. Triple helix collaboration should be promoted in letter and spirit to outgrow the stage of envy and competition if the transition to knowledge economy is to take place.

***3.1.11.*** In order to promote knowledge economy in, a policy mix approach should be adopted for that is based upon building complementarities upon various policies like the education policy, S&T policy, social policy, labor policy, legal policy, monetary policy, and fiscal policy.

***3.1.12.*** Economic structure of Pakistan needs to be transformed to increase the share of industry and high-end services with high technology quotient each to at least 40% of GDP.

***3.1.13.*** Overall macroeconomic stability characterized by medium to high output growth, low unemployment rate, and reasonably low inflation rate should be achieved since innovation and entrepreneurship are influenced by the overall health of the economy.

### *3.2. High-Quality Human Resource Development*

***3.2.1.*** Move toward the massification in higher education system in the next 10 years with tertiary enrolment approximating at the least the levels of South Korea or Turkey, i.e., 3-4 million.

***3.2.2.*** Increase the public spending on education to at least 5% of GDP by 2025 and 7%-8% by 2030.

***3.2.3.*** Increase the public spending on R&D to at least 1% of GDP by 2025 and at least 2.5-3% by 2030.

***3.2.4.*** Increase by 2030 the number and quality of total R&D personnel per million inhabitants comparable to Turkey, i.e., between 2500 and 3000 R&D personnel per million inhabitants.

***3.2.5.*** Increase by June 2020 both the recurring grant and development budget of HEC to come closer to the projected requirements of HEC.

***3.2.6.*** Help promote the fourth-generation function of universities of sustainable regional (sub-national and supra-national) socioeconomic development as well as the knowledge and science diplomacy potential for peace among nations of the leading universities of Pakistan characterized by internationalization of higher education and global scientific mobility.

***3.2.7.*** Select, support, and fund 3 top universities of Pakistan with the objective of their ranking amongst the top 100 universities of the world within the next 10 years.

### *3.3. Building Dynamic National System of Innovation*

***3.3.1.*** Increase and intensify between government, universities, and industry based on mutual trust and common problem identification.

***3.3.2.*** Intensify the R&D intensity of industrial production together with increased public and private spending on R&D for increased scientific and technological output. Increase the high-technology exports to form at least 15% of manufactured exports by 2030.

***3.3.3.*** Increase the absorptive capacity of the national system of innovation through the rapid development of S&T infrastructure in Pakistan leveraging the China-Pakistan strategic cooperation including the utilization of the key provisions of the Belt and Road Science, Technology, and Innovation Cooperation Action Plan announced by President Xi Jinping during the First Belt and Road Forum (BRF) for International Cooperation in May 2017.

***3.3.4.*** Link the approval of all foreign assistance and FDI projects to mandatory knowledge transfer, so that at least 5% of the cost of such projects is set aside for training and indigenous capability development, leading to national self-reliance.

***3.3.5.*** The elaborate system of S&T execution and facilitation under the umbrella of MoST should be provided adequate resources and funding.

***3.3.6.*** The priority areas of the Task-Force on Technology-Driven Knowledge Economy should be adopted as the public and private national R&D agenda.

***3.3.7.*** Regular foresight exercises be conducted focusing on the objective of enabling the transition to knowledge economy should be conducted by the Ministry of Planning, Development and Special Initiatives. These exercises should be duly indexed to the SDGs.

***3.3.8.*** The key prerequisite for developing knowledge economy in Pakistan is the establishment of an overarching strategic outfit – an authority or a think tank. It will provide an anchor for the ongoing useful but scattered attempts of strengthening the KE landscape in Pakistan. Select experts may steer through production of workable concepts and implementable strategies.

### *3.4. Advancement of ICTs*

***3.4.1.*** Software exports should be increased to US$10 billion by 2030.

***3.4.2.*** The construction of the 40-acre software city in Islamabad should be promoted as an integrated national plan for developing new industrial clusters.

***3.4.3.*** Digital Pakistan Vision should be realized on priority basis. The strategic objective of building the national digital economy with 1 million jobs should be achieved in a smart manner concomitantly with improvement and upgradation of the secondary, vocational, and higher education in the country. This job creation should also co-occur with the increase in the number of new technology-based startups and technology-based small and medium enterprises if the economy were not to run the risk of getting stuck in the low middle income band.

## 4. Conclusion

The development of the general features of Pakistan's knowledge economy should be completed by 2030, if Pakistan is to become a trillion-dollar economy in nominal terms by 2040. Pakistan will have to race against time to make up for lost time as it is already lagging behind in the regional competition for growth and development. This requires a high sense of urgency, an extraordinary degree of self-less cooperation on the part of all stakeholders of the national knowledge economy, and well-coordinated actions for ensuring the consolidated growth in the four key domains of knowledge economy. Patient and long-term investment of resources, not held captive by the urge to see quick results achieved in an ad hoc manner, will guarantee success if willing full-spectrum cooperation is in place.