

# Science, Technology, and Innovation (STI) Gap Analysis of Afghanistan

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## List of Acronyms

ATRA	Afghanistan Telecom Regulatory Authority
AWCC	Afghan Wireless Communication Company
CASA	Central Asia South Asia
DFS4A	Digital Foundation Strategy for Afghanistan
FDI	Foreign Direct Investment
ICT	Information and Communication Technology
MAIL	Ministry of Agriculture, Irrigation and Livestock
MCIT	Ministry of Communication and Information Technology
MIS	Management Information System
MoHE	Ministry of Higher Education
NIXA	National Internet Exchange of Afghanistan
NSIA	National Statistics and Information Authority
OFC	Optical Fiber Cable
PPP	Public-Private Partnership
SME	Small or Medium-Sized Enterprise
TDF	Telecommunication Development Fund

# PART A. OVERVIEW OF SOME MAIN ASPECTS OF NATIONAL STI GOVERNANCE

## INTRODUCTION

The nations which are competent at guiding and steering science, technology and innovation activities towards knowledge-based economies experience rapid economic growth and success compared to those which are not (Hornidge, 2011; Bechmann, Gorokhov, Stehr, & Nico, 2009). Furthermore, such innovation also supports and contributes to other areas of development with social and ecological benefits by finding solutions for certain challenges and advancing the knowledge base for development (Sumner, Nick, & Johanna, 2009).

Afghanistan has been embroiled in conflict for several years, nevertheless, opportunity still exists for decision-makers at the national level in the Islamic Republic of Afghanistan. The decisions and policies they apply at the local and national level will arguably determine the path and commitment of the Afghan Government towards introducing new technologies and innovations in various areas. In recent years, a huge amount of foreign aid has been infused into the Afghan economy through international institutions and countries, especially the United States of America. Additionally, Afghanistan is a rich country in terms of having large and varied reserves of untapped natural resources which can help the Government to more effectively overcome the existing challenges and implement technology and innovation endeavors. Technology and innovation are considered to be key drivers in economic development and means that the Government needs to continue current efforts to shift the nation's primary economic focus to be more science, technology and innovation-based. This will, in turn, help the country to move smoothly towards the long-term goal of industrialization. In recent years, the Government has put considerable effort into enhancing the use of technology and innovation in Afghanistan regarding, for example, electronic identity cards, presidential elections and revenue collection.

Afghanistan is well behind other countries in the region from a technology and innovation perspective and therefore it is necessary to have a continued strong focus on developing and implementing science, technology and innovation capabilities throughout the country. This will result in improved and strengthened resolve in both the public and private sectors to invest in upgrading technology and implement innovation which will help the country to achieve a more competitive position at the global level.

The Afghan Government is currently working on several projects to bring about a greater degree of innovation and digitalization in both the public and private sectors of the economy. However, there are several challenges besides corruption and security issues that impede these endeavors.

## NATIONAL STI PRIORITIES

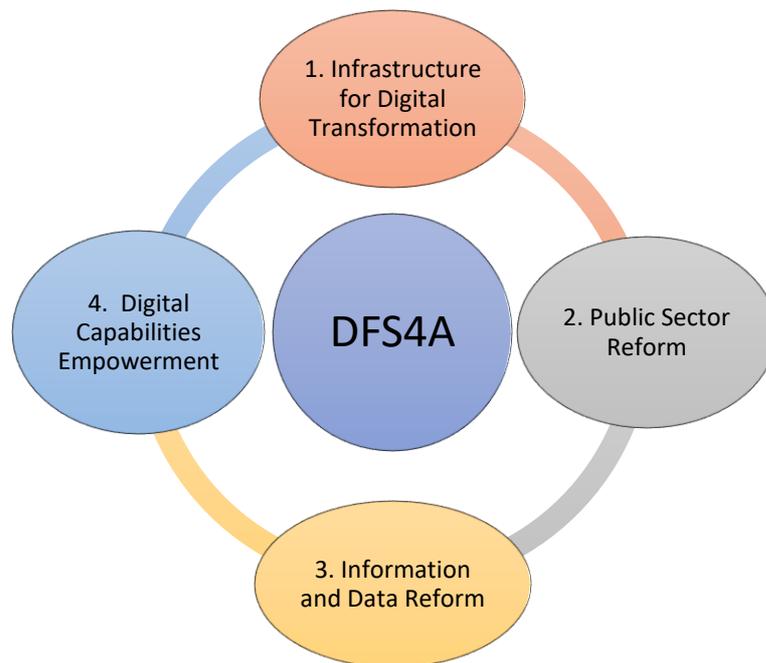
The National Statistics and Information Authority (NSIA) has undertaken some initiatives to introduce technology and innovation in Afghanistan through the digitalization of systems in various economic sectors which helps to transform innovation processes, reduce production

costs, stimulate collaboration and increase the speed of innovation cycles. In order to effectively encourage innovation in business and improve business decisions, policymakers need access to pertinent data meaning that such data is one of the key inputs for innovative endeavors.

As much of the world is already and, indeed, ever-increasingly digitalized, technology has become an indispensable driver of economic development which empowers and enables economies and societies both directly and indirectly. Afghanistan also recognizes this and is eager to use the opportunities that have been created by the digital revolution and enhancement of information and communication technology to speed up its economic development, connect communities and geography. Additionally, these opportunities aid in the establishment of a modern and transparent system to provide services based on the need of citizens and the Afghan Government is determined to establish a digital foundation which will ensure such a digital transformation in coming years. Given the foregoing, a customized strategy has been developed by NSIA in 2019 for the Afghan context entitled Digital Foundation Strategy for Afghanistan (DFS4A) (NSIA, 2019).

This strategy has four main building blocks which comprise the broad goals. Every goal in its turn has certain objectives.

Figure 1. Main Pillars of DFS4A



### Strategic objectives of the 1st Pillar

- Establish secure infrastructure for e-government, higher education, digitalization of the economy and development of the public sector.
- Make the internet accessible and ensure its affordability.
- Accelerate digital transformation processes.

### Strategic objectives of the 2nd Pillar

- Adopt technological solutions and re-engineering of government processes.
- Develop a digital system at the national level.
- Create a systematic mechanism for digital asset management.
- Develop and promote smart digital investment in the public sector.

### Strategic objectives of the 3rd Pillar

- Transformation of data and information management in the government sector.
- Accessibility to government data.
- To encourage evidence-based decision making.

### Strategic objectives of the 4th Pillar

- Develop education based on need assessment.
- Develop greater technological capabilities in government employees.
- Create e-learning opportunities.
- Conduct research and development into technological innovation

## KEY STI POLICY DOCUMENTS

In this section, various laws and policies are analytically discussed and serves to clarify the potential for technology and innovation advances in areas where such development is needed.

### ICT Policy for Afghanistan

In the last two decades, the country has experienced dramatic enhancements and progress with respect to information and communication technology (ICT). By way of example, in 2002 there were only 50000 active telephone subscriptions, which represents a very small part of the population, by 2018 this number had increased to almost 23.65 million. The Government of Afghanistan continues to strive to optimize and expand ICT activities in the country to strengthen and improve the performance of the public sector, an endeavour that aids the acceleration of economic development and social change.

*Table 1. Telecom Statistics (4th Quarter 2019)*

No.	Telecom Services	Population
1	GSM Subscribers	34,671,206
2	Active Subscribers (90 days)	22,580,071
3	4G Services Subscribers	633,050
4	3G Service Subscribers	6,676,747
5	Landlines	134,636
6	Investment (Local Currency)	182 Billion
7	Total Telecom Base Stations	7,179
8	Population Coverage	90%

Source: MCIT, 2019

### *ICT Policy Goals*

1. The Ministry of Communication and Information Technology (MCIT) strives to adopt an approach which will result in maximizing penetration and diffusion of ICT in the country. This approach will aid both the government sector specifically and Afghan society in general.
2. To optimize ICT's use to further the efficiency and productivity of economic and social activities.
3. To use ICT services to add transparency and productivity to government operations.

### *Strategic Focus Areas*

Given that ICT is such a powerful tool it can influence every aspect of life, including both the economic and social spheres. The key focus areas in this respect are connectivity, ICT policies, data infrastructure and security, enterprise services, internal government data/service sharing, and public services (e-service).

### *Information Technology Industry Development Policy*

An open consultation process with various stakeholders and the broader community has taken place through which the IT industry's Development Policy is formed. The feedback from stakeholders highlights a number of IT sectors with potential to develop if provided with robust support from the formation of an IT industry. The effect of establishing this fresh sector would be wealth generation, creation of employment, increased domestic demand, sustainable export potential, better and improved efficiency, productivity, and innovation in both private and public sectors.

### *Policy goals:*

The main aims of the Afghanistan National IT Industry Development Policy are to ensure the following transformations:

1. Identification of the IT industry as a remarkable economic growth sector in Afghanistan.
2. To provide economic and physical infrastructure to strengthen IT development.
3. To enhance the IT market at the national level.
4. To encourage and promote gross domestic product and strengthen domestic institutions to operate with the WTO framework.
5. To encourage and support Public Private Partnerships (PPP).

### *Policy Strategy*

1. To declare the IT industry as a fundamentally important economic growth sector and provide it with the significant investment support and tax relief considerations it needs from the Afghan Government through the pertinent ministries.
2. Coordinate with the international donor community to direct funds and investments towards the Afghanistan IT industry, especially regarding physical infrastructure development. Additionally, the policy strategy involves creating a highly skilled

workforce, investment enhancements, access to global markets and beneficial regulatory mechanisms.

### The Law of The Academy of Science

This law was developed based on the 47th article of the constitution of Afghanistan. The Academy of Science is the peak domestic institution for scientific research and has an independent organizational structure and budget to bring together scientists and scholars from various scientific areas. Additionally, it conducts scientific research in Islamic sciences, humanities, natural-technical sciences as well as coordinates scientific research in designated areas, conducted through higher education institutes, undertaken to improve social conditions, provide cultural enrichment and stimulate economic growth. Furthermore, the academy identifies and implements new findings and achievements in science and technology to enhance national economic growth.

The goals of this law are as follows:

1. To provide the opportunity to conduct advanced and goal oriented scientific research in various scientific disciplines.
2. To provide the opportunity for the qualitative and quantitative growth of knowledge and education while improving the educational level in various fields throughout the country.
3. To strengthen religious and Islamic culture.

### *General Assembly of the Academy of Science*

The general assembly of the Academy of Science is the institution's supreme decision-making body which is formed of academicians, candidate academicians, and members of the scientific council of the academy. The main task of the assembly is the analysis of issues pertinent to the growth and development of sciences in various fields.

### The Law of Higher Education

This law resulted from the 79th article of the constitution of Afghanistan.

### *Goals*

1. Promote growth and quality enhancements in higher education with the intent to improve the nation's human capital.
2. Secure the rights and privileges of members of the scientific cadre to train and educate students.
3. Determine the duties and responsibilities of members of the scientific cadre when training and educating students.
4. Train members of the scientific cadre in various disciplines of science, art, and technology.
5. Implement scientific research and service training activities.
6. Strengthen the spirit of national unity and attachment to the country among the youth.

### *Academic Council of Higher Education*

The minister of higher education chairs the meetings of this body while the deputy ministers of higher education, finance, education, and economics are members. Among the prime responsibilities of the council are the confirmation of the strategic plan and its recommendations for the further progress, approval of strategic plans and policies of various higher education institutes, taking measures to enhance both the quality and availability of higher education and so forth.

### *The Law of Access to Information*

This law resulted from the 50th article of the constitution of Afghanistan.

### *Goals*

1. Secure the right of access to information from public institutions for the residents of the country.
2. Consider international conventions regarding political and civil law based on the constitution of the country.
3. Ensure the accountability and transparency of performance in the public sector.
4. Arrange systems of inquiry and information delivery.

### *Monitoring Commission of Access to Information*

Authorized representatives of the Ministry of Information and Culture, the Ministry of Communication and Information Technology, the Directorate of National Security, the Afghanistan Independent Commission of Human Rights, various political parties and others are members of this commission. This body's responsibilities include monitoring the processes of inquiring for information and its delivery as well as analysis of complaints about inquirers, inquiry of documents when needed, the provision of advice for inquiries, and strengthening the awareness culture in the country by conducting training programs.

## **STI GOVERNANCE STRUCTURE**

There are several government bodies which have the responsibility of innovation governance in Afghanistan. These bodies include but are not limited to, the Ministry of Communication and Information Technology (MICT), the National Statistics and Information Authority, and the Afghanistan Telecom Regulatory Authority (ATRA). The directorate of the chief information officer, directorate of innovation and science, and ATRA all work under the guidance of the MICT and were established in accord with the Telecommunication Law of 2006. ATRA is an independent, open, objective, transparent, and non-discriminatory body operating within the legal framework in the country that is responsible for the regulation of affairs related to the telecommunications sector.

1. The Directorate of the Chief Information Officer

The MCIT is one of the vital national ministries which aids the Afghan Government to coordinate, plan, and promote ICT endeavours designed to stimulate the economic development of the nation. The main goal of the General Directorate of IT is to facilitate the

required competencies and infrastructure under current conditions. Additionally, this directorate promotes the digitalization of government, the development of both IT hardware and software industries while simultaneously striving to create the necessary pool of skilled human capital to support these endeavors.

## 2. The Directorate of Innovation and Science

The prime objective of this government body is to standardize IT penetration, especially in government organs. This involves challenging the current administration and government service operations by promoting innovative technology solutions to transform various public sector processes and bringing about effective solutions to problematic situations. Furthermore, this directorate ensures sufficient research and development activities are undertaken before any enhancement of technological and innovative projects is initiated. This, in its turn, better ensures the successful implementation of new projects by government agencies. Moreover, the executive personnel of the directorate coordinate with various academic institutions to establish research bodies and develop mechanisms to train the required skilled human resources necessary for today's highly competitive and complicated economic environment.

Recently, The MCIT introduced some changes to its organizational structure and developed certain policies to support its innovation activities. These policies have been approved by the president of Afghanistan but not yet finalized and implemented. They will help and support the information technology industrial parks and establish both hardware and software centers. Interestingly, prior to the implementation of these policies, there were no such programs for business incubators and technology transfer offices in Afghanistan.

## STI POLICY FORMULATION

The legislative documents have a firm and structured system of processing and implementing changes based on the law. There are five or six stages for a law or similar document to pass through prior to final approval. The vast majority of the procedures are substantially similar to the following:

1. **First Draft:** The first draft of the document is prepared by the relevant government body based on their need and in accord with the plan of the Ministry of Justice for such documents. There are some international organs and members involved in the drafting and processing of the policy document both within and externally to the ministries, independent government organs or other government bodies such as the Ministry of Communication and Information Technology, the Academy of Science, and the Ministry of Higher Education.
2. **Scrutinization and Evaluation by the Ministry of Justice:** After the document is finalized by the pertinent government organ, it is forwarded to the Ministry of Justice for further scrutiny and evaluation. This ministry has several specialized departments to deal with various documents based on their particular focus. The forwarded document is primarily scrutinized in two areas, namely its content and formation.
3. **Ministers' Counsel:** At the third stage the document is forwarded to the ministers' counsel for confirmation where it is either sent to the parliament to advance the process or rejected and sent back for further refinement.
4. **The House of the People of Afghanistan:** The document then is processed by the State Ministry for Parliamentary Affairs and is forwarded to the House of the People of Afghanistan. If the document is approved by the parliament, it will go to the Upper House of Elders. If the second house also approves it, the document will be finalized

and forwarded to the president of Afghanistan to be signed. If a case should arise where the upper house does not approve the document, then a delegation or commission is formed by a number of members drawn from the two houses of parliament introduced to decide on a course of action. If subsequently approved by such a delegation the law will be forwarded to the president's office. If the delegation does not approve the document then parliament needs to vote on it with a two-thirds majority of all members for the law to then be approved and sent directly to the president's office.

5. **Presidential Office:** The president has the option to sign any forwarded document or not. If the document is signed, then it will be returned to the Ministry of Justice to be published in the Official Gazette of Afghanistan. If not signed and kept for more than 15 days, it is automatically considered as valid and can be published. On occasion, the president may send a document back to the upper house with some concerns and comments. If the parliament voted with a two-thirds majority for the document, there is no need for the president's signature and it is directly published.

## STI POLICY INSTRUMENTS, POLICY IMPLEMENTATION AND COORDINATION

### Science, Innovation, and Technology Projects

The main implementing body of science technology and innovation in Afghanistan is the Ministry of Communication and Information Technology where the relevant legal and policy documents are also developed according to a structured and planned procedure. Innovation and technology initiatives are funded by the Government of Afghanistan and a number of international donors.

Currently, several projects are running in the country, some of which are briefly mentioned here. Afghanistan's information technology development, or E-governance, is one of the key projects currently running. This endeavour is supported by the Telecommunication Development Fund (TDF) and the necessary human resources are being employed and trained in order to implement the project.

There is also a project involving the creation of an app (Hot Standby) for data center and for the supply of Microsoft equipment needed to establish an internet exchange center. The development of the Hot Standby app is also being aided by TDF. The infrastructure, including the construction of an administration complex, has been initiated while the contract for the equipment needed for the project as well as that required by the information management system has already been concluded.

The Government of Afghanistan, through the MCIT, is implementing the National Internet Exchange of Afghanistan (NIXA) project which is an internet exchange center. The procurement document for purchasing the equipment and necessary materials for NIXA was drawn up, the procurement process has been completed, and the contracting company has been determined. Additionally, the optical fiber cable (OFC) has also been connected and activated at the internet exchange center.

The World Bank implemented and funded the Digital CASA (Central Asia South Asia) Afghanistan project, a regional program having projects in Afghanistan and other Central Asian countries. The prime objective of this program is to connect Central Asia to South Asia via Afghanistan using OFC.

Furthermore, the World Bank is aiding numerous programs and projects for advancing the ICT sector in Afghanistan. Such projects aim to support the MICT and ATRA to transform the country to a more information-based society and a regional ICT partner.

#### Innovation Support Program (World Bank Project)

This program was initiated to promote the culture of innovation and to promote the adoption of ICT in the country. The name of the program is DEWAE, which can be translated as “Innovation beacon”. DEWAE was awarded to Afghanistan Information Management Services (AIMS) which is based in Kabul while the Technology and Innovation Directorate at the MCIT has the responsibility of supervising and overseeing the program’s activities. The award was up to \$80,000 in four classes, namely, mobile government, mobile technology, IT champions and student awards.

#### COVID-19 AND INNOVATION ACTIVITY

The Afghan minister of public health shared an estimation about the infection of COVID-19 in the country in March 2020 and, according to his estimations, up to 25 million people may ultimately be infected by the novel corona virus from a total population of some 36 million. The Government took several measures to combat this new threat to its citizens by mirroring global practices of physical distancing. Due to weak healthcare infrastructure, more than half of the population living in poverty and decades of conflict, the Government was faced with several severe challenges to manage the outbreak (Watkins, 2020).

Afghanistan, as a developing country, is impacted by COVID-19 to a large extent in a number of ways. The main impact was on the country was the food industry and supply chains as Afghanistan is a landlocked country that suffers from food insecurity. Other major sectors notably affected were secondary and higher education with the spring semester of 2020 not able to start with physical classes and only a very few private schools and private universities starting online class during the pandemic.

The pandemic has had numerous negative impacts on various sectors in Afghanistan but also surprisingly produced a few beneficial outcomes. As mentioned before, the Government applied a wide-ranging lockdown in the country which resulted in the complete closure of all schools and universities. In response to this, the Ministry of Higher Education (MoHE) and the Ministry of Education took some initiatives to confront the challenge and this resulted in the MoHE launching the Higher Education Learning Management System (HELMS). The purpose of this system is to conduct online class through an application named Big Blue Button (BBB) which also allows lecturers to share lecture materials, useful links, files, and books. In addition to this, the Ministry of Education started teaching through national and private televisions for school students. Unfortunately, due to the lack of technological infrastructure, the unaffordability of the internet for many, low internet speed, persistent electricity shortages and

power cuts, and the lack of technical know-how among both students and educators all contributed to the program frequently being unsuccessful. The country's public services also suffered from the pandemic as recommendations from the Ministry of Public Health and with approval by the cabinet of ministers, the working time of government offices was restricted to between 8 AM and 1 PM.

Unsurprisingly, the STI sector did not remain untouched by COVID-19. Reports show that various government authorities, especially the designated committee charged with combatting the pandemic, recommended modifications to the national budget of 2019-2020. This has resulted in several development projects, including innovation and technology, suffering budgetary shortages. The World Bank's Board of Executive Directors approved a grant to Afghanistan of US\$100.4 million in response to the COVID-19 pandemic to allow the country to take effective action in response to the challenges and threats imposed by the pandemic and to strengthen the public health sector in the country.

The majority of the Afghan population live below the poverty line and during the pandemic there was widespread and deep seated fear of starvation among those sections of society who relied on their daily income for survival. Besides tackling the pandemic, the Government's priority was also to avoid starvation among those individuals and their families who previously worked on the streets and lost their entire income. According to the plan addressing this problem, needy families were identified across Afghanistan and the Government distributed bread to them through local bakeries.

Furthermore, the Government of Afghanistan requested a loan from the IMF, after receiving parliamentary approval, to minimize the negative impacts on the various sectors.

Nevertheless, for the next couple of years at least, STI activities will inevitably suffer some negative impacts or even regress. This result is a very obvious outcome for a nation already in difficult times that must now face a new and very tough situation. Hence, the Government's priority during and after pandemic will be to avoid starvation, to reduce the percentage of the population living in poverty and strengthen the public health sector. All of this is of course only complicated by the relatively high levels of corruption that can change the direction public resource utilization, including that for STI activities. On the other hand, there are a number of technology and innovation projects running to support innovation in the public sector, such as e-governance, as well as in the private sector and these are pre-planned endeavours with financial sources secured for the life of the projects. The good news here is that the donors will continue to support these innovation activities and remain committed to their promises.

## PART B. KEY CHALLENGES AND PROBLEMS IN FOSTERING INNOVATIVE DEVELOPMENT

### SECTORS WITH POTENTIAL TO UPGRADE TECHNOLOGY AND IMPLEMENT INNOVATION DEVELOPMENT IN AFGHANISTAN

In this section the recommended questionnaire was used and where some of the stakeholders were interviewed to get further insight about various topics. The respondents included the Director of Policy in the National Procurement Authority, the Director of Technology and Innovation, numerous university professors, a representative from the National Statistics and Information Authority, various experts in technology and innovation, a civil activist representative, government officials, and representatives from the private sector. The questionnaire was distributed to 17 respondents, and 13 of them were answered completely. Therefore, the total number of questionnaires on which section B is based is only the 13 completed questionnaires.

According to the following table generated from the respondents' answers, 21 economics sectors/industries were identified with high potential to have their technology upgraded and be targeted for innovation development. Some of these sectors are more significant than others and are discussed below.

1. **Agricultural Sector:** Afghan society is still fundamentally based on agriculture with estimations of the NSIA suggesting that 80 % of the population is directly or indirectly engaged in agricultural activities. The above statistic highlights the significant potential that any improvement in the agriculture sector would have on the country's population as a whole. This sector can generate huge incomes, by Afghan standards, for many of the residents of this country. In the recent year, the Government has undertaken some initiatives to mechanize the agriculture sector but there is still a long way to go to adequately develop this industry for both domestic purposes and modern markets. The Ministry of Agriculture, Irrigation and Life Stock is responsible for the implementation of government projects and those of donors (MAIL, 2016). The results show that 54% of respondents have the opinion that the agricultural sector is a prime target for development.
2. **Governance:** For several years, Afghanistan has ranked among the countries in the world in terms of corruption. While the UNDP is helping the Afghan Government and its institutions to become more effective and accountable to the residents of this country (UNDP, 2020), technology and innovation improvements can further help the Government to overcome several problems including corruption. Based on the interviews, numerous irregularities exist in areas such as procurement processes, government employee recruitment as well as accountability and transparency in public sector projects and, as such, good governance was considered important among 46% of the respondents who supported the notion of innovation in governance. The Government of Afghanistan is committed to the digitalization of the public sector and the NISA is responsible for implementing and overseeing the digitalization and e-governance project. With the implementation of e-governance, several transparency problems will be solved. Recently, an online platform was created for access to information and it revealed several instances of recruitment irregularities involving the

military, education, national police and other sectors of government. In these revealed cases, the authorities involved received the salaries because people were not actually recruited to the advertised positions. Through the process of digitalization and biometrics, this sort of problem can be addressed to some extent.

3. **Finance and Banking Sector:** With the new Government that formed after the Taliban, the finance and banking sector received a fresh breath of life as several changes occurred both in terms of the quality and quantity of banking in Afghanistan. However, 46 % of the respondents believe this sector has tremendous potential for technology implementation and innovation with the areas highlighted by stakeholders being electronic money and ease of access to finance for small and medium-sized enterprises. Taxation is another aspect of finance classified by respondents as having innovation potential. Due to the lack of technology, a considerable percentage of telecommunication tax is wasted, a situation exasperated by the Government's failure to formulate an appropriate plan to oversee this income and the lack of accountability in this area.
4. **Education:** Education is another area singled out by the respondents as having potential. Three respondents, which represent 23% of the total, said education would benefit significantly by having its associated technology upgraded. According to World Bank data, only 43% of the young population of Afghanistan is literate (The World Bank, 2018) while most of the students in higher education complain about the quality and relevance of the teaching materials in universities. In a recent interview, Afghan president Mohammad Ashraf Ghani named several disciplines taught in Afghanistan universities that are thought to be irrelevant to the current job market. However, the Directorate of Academic Programs at the MoHE conducted several curriculum surveys in recent months. Most of the faculties' curriculum reviews and renewals have been finalized with only a few still waiting to be finished. Currently, there are 39 public universities, including a new university to be established in Nooristan province, and 128 private universities and institutions of higher education all over Afghanistan (MoHE, 2020). There are 9.69 million enrolled students in governmental and private general education institutions in Afghanistan with an additional 424,621 students enrolled in both public and private universities (NISA, 2020). According to (UNICEF, 2016) , around 3.7 million children are deprived of going to school in Afghanistan and the majority of these, that is some 60%, are female. Nevertheless, most of the schools and universities lack both a reliable, quality internet connection and technological equipment while only a handful of universities have Management Information Systems (MIS) or a similar platform. In the rest of the universities, all academic and administrative activities are carried out manually.
5. **Telecommunication:** Afghanistan previously had a wired telephone network, however, it deteriorated with successive conflicts until being finally destroyed in 2001, from which point onwards Afghanistan literally did not have any kind of active telecommunication infrastructure. People who wanted to connect to their families either domestically or internationally needed to record a cassette or travel to neighboring countries such as Pakistan or Iran to make a phone call. The Afghan Wireless Communication Company (AWCC) was the first and only private telecom company authorized to provide mobile (GSM) services and after 2002, due to the rapid growth in various economic sectors, this telecom company was one of the largest revenue generators in the country and created a significant number of employment opportunities for job seekers. This rapid economic growth was because of foreign aid, the development of infrastructure, services, and a regulatory framework. Currently, 4 major private telecom companies operate in Afghanistan, namely AWCC, Roshan, Etisalat,

MTN and a national company Salam under Afghan Telecom with a further 63 other companies providing internet services across the country (MCIT, 2020). Despite the rapid growth in the telecommunications sector in Afghanistan, the prices and quality of internet in the country are not satisfactory for users. Indeed, when comparing Afghanistan with other countries in the region, Afghanistan lags far behind for both internet and telephone calls in terms of quality and price with the lack of security being the main reason for this. Unsurprisingly in conflicts, the infrastructure of telecommunication companies is frequently targeted and the companies incur considerable expense replacing their structures and equipment, a cost that is passed on to customers.

6. **Power and Energy:** The supply of power is one of the necessary drivers of economic growth in Afghanistan as it is elsewhere in the world. After two decades of rapid and remarkable growth in various economic sectors, the Government could not supply sufficient power to meet the needs of households and industry. Even in the capital, Kabul, electricity cannot be reliably supplied around the clock. However, the country has abundant sources and potential for power generation through natural resources such as water and wind but also because of the huge amount of investment pouring in. More than US\$100 billion has been infused into the Afghan economy but still, the cities do not have sufficient power to even meet just domestic household needs. Several provinces such as Helmand, Kabul, Konar, Paktia, Wardag and others have tremendous potential as locations for dams but doing so requires US\$800-900 million. However, investors are not willing to support dam building given the controversial nature of the rivers on which the dam would need to be built. Pakistan is to the east of Afghanistan and Iran to the west and building dams that will reduce the water flow on cross border rivers would only serve to create tension in an already volatile region. In this research, 23% of respondents are of the opinion that the power generation and supply industry has the potential to apply innovation and improved technology.
7. **Transportation and Aviation:** Transportation infrastructure is necessary for any economy and significantly improves the quality of life for those able to access it. After 2002, the Government of Afghanistan started work on building and reconstructing roads all over Afghanistan. This undertaking was successful to some extent in several provinces and with regard to roads connecting the provinces. However, over the last two decades, Afghanistan has been subjected to continuous conflict and this has led to the destruction of many roads. The Kabul to Kandahar and Kabul to Khost highways typify the types of transportation infrastructure that was seen as crucial as these roads connected several provinces in the south and southeast. As of mid-2020, both these roads are heavily damaged, especially in areas where the roads cross small bridges as these were destroyed when local government and foreign military personnel were targeted by armed militias.
8. **Private Sector:** In the last four to five decades, Afghanistan has experienced a variety of economy types ranging from an Islamic economic system to a socialistic one and currently employs a market economy based on the constitution of Afghanistan. In the market economy, freedom is given to individuals and firms to decide what to produce and how to produce it within the legal framework provided for businesses in Afghanistan. Thus, there is no obligation that enterprises should be owned by the State as was the case under the socialist model and since the end of the Taliban era, the private sector has been renewed and started functioning again in sectors such as telecommunication, higher education, manufacturing, healthcare services, transportation and others. However, this re-emergence of a private sector being forced to operate with corruption and a hierarchical bureaucracy has created several

challenges. Therefore, the Government has embraced innovations such as digitalizing the business registration processes and tax exemptions to help private-sector development. While developmentally it still has a long way to go, Afghanistan today is self-sufficient in the production of 25-30 items such as poultry products, plastic pipes for construction, dairy products and so on. Three out of the thirteen questionnaire respondents, which is 23%, suggest that the private sector has innovation potential. Additionally, a few respondents insist that technology implementation and science-based workplaces can further enhance the activities of private sector operators which in turn will benefit not only the entrepreneurs but also households, government, and the nation as a whole.

9. **Mining:** Afghanistan is a mineral-rich country with reserves of several high-worth metals such as iron, gold, copper. Additionally, some provinces such as Panjshir, Nooristan, Badakhshan are sources for precious gems. The copper mine in Logar province is one of the largest in the world and produces a number of other valuable materials. Furthermore, lithium is another rare resource that exists in Afghanistan in large quantities. Lithium is used for making batteries for electronic devices. This is a promising item for the economic growth of the country and as a source of public revenue given its application in several high-tech products such as batteries for electrical cars and communication devices. According to one estimation, Afghanistan has the potential to earn some US\$3 trillion from mining (Najafizada, 2011), which would give it a comparable economics status to that of Saudi Arabia. The prime challenge with resource extraction is the lack of sufficient technical know-how, required machinery and technology, and a well-structured plan. In addition to this, the existence of large organized crime gangs is another challenge as they extract from these mines illegally and smuggle the resources to neighboring and western countries. About 15 % of the respondents see innovation potential in the mining sector.
10. **Livestock:** As mentioned in connection with the agricultural sector, the majority of Afghanistan's population is engaged in agricultural activities and livestock rearing is closely connected to agricultural activities. However, despite Afghans being culturally tied to both agriculture and livestock, meat and animals are still imported from other countries such as India and Pakistan. The Government has engaged in some initiatives designed to raise awareness, build appropriate and healthy locations for animal care and to generally support the livestock sector. Nevertheless, this sector continues to operate employing its traditional approaches and is impeded by insufficient professionals and veterinarians. One unique example of a group which would particularly benefit from improvements in this sector is the Kochi tribe who travel to different seasonal locations. Livestock is their main, and sometimes only, source of income and livelihood yet animals are unnecessarily lost each year to either disease or the lack of appropriate facilities.
11. **Other industries/sectors:** There are a number of other economic sectors identified by one or two respondents that would greatly benefit from innovation and technology as briefly mentioned below:
  - **Healthcare:** Both the private and public healthcare sector suffers from a lack of technological and innovative investment which compels numerous patients to travel to India, Pakistan, or Turkey to receive treatment. In some locations in Afghanistan, even a basic diagnosis of a problem is not possible and patients need to travel to neighboring countries as a first step when seeking a remedy.
  - **Services:** The service sector has advanced tremendously in recent years, especially higher education, healthcare, and telecommunication being among the most rapidly

growing industries. Nevertheless, there is a long way to go as no service sector industries are equipped with cutting edge technology.

- **Food Processing:** The food sector is one of the sectors which has been ignored to a large extent. Despite having huge potential for food production, the country is still not self-sufficient in this regard. A large number of food items are imported from other countries which means an already impoverished population has to pay high prices for products.
- **Taxation:** Recently, the president of Afghanistan issued an order to exempt new businesses from taxes for at least five years to assist them to get established and compete in the marketplace. A major challenge for new business incubators in Afghanistan is the business practices and economics of other countries which sees various industries use dumping strategies, making it difficult at best for domestic firms to compete with foreign rivals.
- **Textiles:** There were a couple of textile factories in Afghanistan in the past but currently they are inactive after all years of conflict. The Government has requested input from knowledgeable industrialists to develop a plan for reviving this industry. This is seen as a potential growth industry because Afghanistan is very well suited to cotton production and the current figures of MAIL indicate that only 73,119 tons of cotton are produced annually, well below its feasible maximum.
- **Steel:** Throughout the reconstruction of Afghanistan steel has been one of the most in-demand items. A number of steel production companies, such as Khan Steel and Maihan Steel, commenced domestic operations but the market potential in this sector is significant.
- **Automobiles:** Afghanistan is a largely agricultural country and suffers from a poor economic status. As with virtually all heavy industry, the automobile industry does not operate in Afghanistan. The prime reasons for this are the non-existence of required infrastructure and technological investments and almost all the cars in the country are imported from overseas.
- **E-Commerce:** With the recommencement of the telecommunication sector, citizens now also have internet access. However, e-commerce still functions poorly as there is inadequate demand, weak infrastructure and awareness are low too to make it viable.
- **Medicine:** One of the reasons for poor treatment options and the generally sub-standard health sector in Afghanistan is the low quality of medicines available. This problem equally exists for both domestically produced medicine and those which are imported as Afghan traders enter into deals with foreign companies to get lower-priced medicines. Such deals are only made possible through the use of poor quality medicines which, when used by patients, have little or no effect on the treatment of ailments.
- **Carpentry:** Some of the respondents pointed to the carpentry industry as having the potential for innovation and technology. This fact has also not escaped the Government which has implemented a number of training programs through which citizens could learn the occupation and establish a source of income for themselves and their families.
- **Dried and fresh fruit:** As discussed in the section detailing the agricultural sector, most of the country's citizens are engaged in agricultural activities of some sort. The quality of Afghanistan's dried and fresh fruit is outstanding and these two foodstuffs are the shining light in the nation's exports which generate a meaningful amount of foreign revenue.

- **Electronic money:** Among the host of other problems, the lack of security heavily weighs on individuals and business people at the moment. However, the practice of using electronic money transactions in Afghanistan is virtually non-existent. Investment and innovation in electronic money would substantially reduce the security risks associated with using cash.

*Table 2. Opinion about economic sectors/industries with potential to upgrade technology and implement innovative development*

No.	Economic sector/industry	Percentage of respondents who indicate the sector
1	Agriculture	54
2	Governance	46
3	Financial Industry	46
4	Education	23
5	Telecommunication	23
6	Power and Energy	23
7	Transportation and Aviation	23
8	Private Sector	23
9	Mining	15
10	Livestock	15
11	Healthcare	8
12	Service	8
13	Food Processing	8
14	Taxation	8
15	Textile	8
16	Steel	8
17	Car	8
18	E-Commerce	8
19	Medicine	8
20	Carpentry	8
21	Dried and Fresh Fruit	8
22	Electronic Money	8

## EFFECTIVENESS OF STI POLICIES AND POLICIINSTRUMENTS IN AFGHANISTAN

In table 3 below, respondents were asked about their opinion concerning the effectiveness of STI policy and the policy instruments supporting STI's development in Afghanistan. In this section, 8 statements are shown and the participants of the research selected an option from 1-5. Rank 1 means the respondent fully agreed or felt the situation was adequate whereas 5 meant that they completely disagreed or felt the situation was unsatisfactory. the numeric results displayed on the right of the table were obtained by calculating the arithmetic average of all the responses.

*Table 3. Opinion about the effectiveness of science, technology and innovation (STI) policy and the policy instruments supporting STI development in the country*

No.	Policy aspects	Average rank
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1	The national authorities assign high importance to the development of science, technology and innovation (STI)	3.2
2	The national STI priorities and strategic directions of STI development are well formulated and widely publicised	3.7
3	The officially proclaimed national STI priorities correspond to sectors and businesses with high innovation potential	3.7
4	There is a clear division of responsibilities between the public bodies tasked with STI governance	3.6
5	There is good coordination in the functioning of the different public bodies tasked with STI governance	3.8
6	The functioning of the main R&D institutions in the country is well guided and managed	4.3
7	The authorities allocate sufficient public funds to the support of STI activities	3.9
8	The policy instruments used to support STI activity are efficient and well managed	3.8

The average opinion for the first statement returned a result of 3.2. This clearly, indicates that national authorities to a large extent do not assign sufficiently high importance to the development of STI. However, for the second statement, the average value is 3.7 which shows some disagreement among the interviewees. Most of the respondents believe that national STI priorities and strategic directions are not appropriately formulated. For the third part, the average score was also 3.7. This means the national STI priorities are not seen as well coordinated with industries for which there is high innovation potential. The fourth question has a value of 3.6 as some stakeholders disagreed that there is a suitable division of responsibilities among various government bodies responsible for STI activities. The fifth point in the table ranked at 3.8 and based on results it indicates that the respondents felt there was a lack of coordination among the various government organs responsible for STI tasks. More than one public body is responsible for following the STI priorities, but all are not coordinated.

#### FRAMEWORK CONDITIONS AND BUSINESS ENVIRONMENT IN AFGHANISTAN

Table 4 displays the respondents' average opinions about the framework conditions and business environment in Afghanistan and to what extent these are conducive to innovative development. Once again, the respondents had the option to select from 1-5 and the ranking and calculation method was identical to that used in table 3.

*Table 4. Opinion about the framework conditions and business environment in the country: to what extent they are conducive to innovative development*

No.	Aspects of the environment	Average rank
1	The authorities make efforts to reduce the administrative hurdles of doing business	3.2

2	The authorities assign a high priority to small and medium-sized enterprise (SME) development and SMEs have access to different forms of public support	3.5
3	Entrepreneurship is encouraged and the development of entrepreneurial culture is supported by the authorities	3.4
4	It is relatively easy for entrepreneurs to start and develop a new business	3.4
5	Businesses cooperate with R&D and academic institutions for the commercialization of their R&D results	3.7
6	Universities encourage the establishment of startups and spin-offs for the commercialization of innovative ideas	3.5
7	The intellectual property rights of innovative entrepreneurs are well protected by law and regulations	3.4
8	Innovative entrepreneurs and SMEs have access to public funds to support the initial stages of commercializing their ideas	4.0
9	There exist adequate private funding sources to support innovative entrepreneurs and SMEs in the initial business stages	3.9
10	SMEs have relatively easy access to bank credit and other commercial funding for the development of their business	3.3

The value for the first statement is 3.2 because some of the respondents disagreed that government authorities are putting in sufficient effort to minimize the challenges that exist to start doing business. However, for the second statement the value is 3.5, showing that the Government is not seen as assigning a high priority to SME development and the SMEs do not have sufficient access to public support. The third statement in the table returned a value of 3.4 which illustrates that the authorities do not fully support and encourage entrepreneurial endeavors. The fourth statement also received a value of 3.4 denoting that starting a new business is not as easy as it could be. However, the fifth statement garnered an average response of 3.7 a higher disagreement regarding businesses cooperation with R&D and academic institutions for commercialization of their R&D findings. The respondents perceive that universities do not adequately encourage the organization of startups for the commercialization of innovative ideas based on the average response to statement 6. Additionally, respondents are of the opinion that the intellectual property is not fairly protected by law and regulation this point obtained a 3.4 ranking as the seventh item in the table. The public fund and support are insufficient for innovative entrepreneurs and SMEs to commercialize their ideas as this point receives the ranking of 4.0. For a business in its initial stages, there are insufficient private funding sources available as in seen with the result for 9 statement in the table which obtained a rank of 3.9. Finally, the last opinion displays that SMEs have trouble gaining access to bank credit and other commercial funding options for their development. This is illustrated in the last statement which has an average value of 3.3.

## PROBLEMS AND CHALLENGES FOR INNOVATION DEVELOPMENT IN AFGHANISTAN

- **Corruption:** For several years Afghanistan has sat atop of the list of corrupt countries. Every economic sector suffers from corruption and attempts to introduce innovation and technology are equally influenced by this phenomenon. Clearly, business is negatively affected by corruption and this creates problems competing with other firms. For example, if one company pays less tax compared to a similar company because it enriches a corrupt official and thus reduces its overall costs and giving it a competitive advantage.
- **Uncertainty:** Uncertainty increases the risks associated with business predictions and decision making. Demand uncertainty, lack of security and political unrest are major factors hampering businesses, especially in innovation development areas. Due to the dire security situation in Afghanistan, almost 30% of business costs are incurred for security reasons. This obviously, increases the burden sharply on small and medium enterprises meaning that they cannot operate cost-efficiently.
- **Poor Education System:** The education system in Afghanistan is characterized by an inadequate use of technology in educational institutions and classrooms. Some of the educational disciplines still taught in Afghanistan are irrelevant to the current job market and the curriculums of most universities are out of date and not based on market needs. Therefore, educational graduates are not well equipped with the technical and soft skills that allow them to shoulder the responsibilities assigned to them in the workforce. This means companies cannot find skilled employees, both businesses and markets are impeded while every year university graduates remain unemployed. Banking and other sectors often employ skilled foreign nationals in their top posts and hence the country loses large amounts of money to other nations.
- **Lack of Government Support for Innovation Development:** The results of the research indicate that there is no adequate governmental program which sufficiently supports innovation practices. As the implementation of innovation and technology is inherently risky, any company seeking to do so are discouraged because there are no public financial resources which can be used to help manage the risks involved.
- **Limited Access to Finance for Startups:** According to the findings, start-up companies have insufficient access to finance and companies which recently commenced operation face several challenges and need reliable sources of finance.
- **Poor ICT Capability in the Country:** Despite rapid ICT sector growth over the last two decades in Afghanistan, it still does not offer services of adequate quality and price and remains costlier compared to other countries in the region. To successfully implement new technology and innovation projects firms need a variety of ICT services, which the country still lacks.
- **Unsophisticated Domestic Market:** The domestic market of Afghanistan is flooded with varieties of products from numerous competing firms of other countries. Domestic firms in Afghanistan have less experience in terms of innovation and technology than the international players they compete against. Furthermore, the Government does not have a well-structured mechanism through which domestic firms can gain surety and

support. Foreign products are used in governmental projects even though domestic firms may offer the same product with better quality and lower prices. A suitable example in this regard would be plastic pipes commonly used in construction.

- **Deficiency of STI Policy:** The country lacks an accountable and well-designed policy for STI activities. Most of the companies do not use science-based approaches in their production process and as a result, the quality of their product is poor and cannot compete with other international well-established firms.
- **Lack of Legal Framework Compliant with Cutting Edge Technology:** Technology is changing rapidly. However, the Government and legislative authorities do not have the capability to keep up with these technological changes. For example, it is relatively easy for a business to imitate the innovations of another business yet the authorities are unable to guarantee the legal rights of the original innovator.
- **Competition from Neighboring Countries:** Some of the neighboring countries use dumping strategies in Afghan markets. They charge such low prices for their products that domestic companies simply cannot compete with them as the domestic costs are too high. Furthermore, the borders are not controlled and as a result illegal imports readily flood into the country. This is a problem caused partially by corruption and partially by the inability of the central Government to control all areas along the border.
- **Inadequate Infrastructure:** For a business to run its operation smoothly, it needs all the required infrastructure ranging from roads, electricity, IT services and so on. However, the infrastructure in Afghanistan is very poor at best, as typified by the fact there is no adequate electricity supply in any part of the country, including the industrial parks. Hence, running a business with electricity generators is very expensive and almost all factories need to use such additional sources of energy, especially in peak hours of energy consumption even though a large percentage of electricity is imported from neighboring countries. With respect to transportation problems, some initiatives have been taken and some roads have been built while some are still to be built. Nevertheless, due to the low quality of these roads it often only takes a few months to a few years for them to suffer either significant degradation or partial destruction.
- **Complex Legal Framework:** The Afghan economy, as with any emerging economy, struggles with several challenges and one notable issue was the legal framework which presented a major obstacle for the commencement of business. While the entity registration process was very complex and time-consuming in previous years, today the problem has been addressed to some degree but loopholes still exist. Several interviewees believe that investors and business owners do not trust the Government to solve their legal issues. In certain cases, companies refrain from contacting government authorities to solve the company's problem with an individual or other companies because of the exasperating administrative barriers and corruption.

## CHANGES NEEDED TO INVIGORATE INNOVATIVE DEVELOPMENT

- **Legislative Support for Innovative Development:** The Government needs to develop a mechanism through which innovative businesses receive support based on the law

created by the relevant government body. Additionally, there is a need to raise awareness among business people regarding the public aid and support available to them. Doing so will help businesses to take the initiative with respects to the application of technology, innovation and science-based workplaces, especially if firms are assured of governmental support in terms of monetary or nonmonetary backing and assistance.

- **Incentives for Innovation Development:** Since innovative endeavours are inherently risky some firms simply prefer not to implement them. Therefore, it is the responsibility of the State to assist the companies to confront the risks involved in innovation. Incentives could take the form of monetary payments, providing technological equipment, technical know-how, tax exemptions or any other approach perceived appropriate by the Government of Afghanistan.
- **Accelerate Digital Transformation:** The Government of Afghanistan has undertaken a number of initiatives in order to implement a digital transformation and move towards e-governance. NISA has the responsibility of implementing e-governance in Afghanistan, however, its efforts are insufficient and slow. The manual procedures and paperwork create numerous hurdles and inconveniences for business startups in Afghanistan. These challenges range from simply wasting time to corruption. The planned digital transformation will help would-be businesses in the country to register as companies easily and deal with government requirements in a timely fashion. Corruption and administrative barriers would not readily find a place in such communications.
- **Support Entrepreneurs with Technical Input:** The business environment in Afghanistan is not favorable for heavy industry operations due to high levels of uncertainty and the lack of security. Therefore, technical input needs to be imported from other countries. This puts a heavy burden on private businesses as they have to pay for all the transportation costs and customs duties associated with the machines. When any such technical input is received in the country the cost is exorbitant. The Government of Afghanistan, through the Ministry of Foreign Affairs and embassies in other countries, can obtain the support of exporting countries to help Afghan entrepreneurs receive better terms in the purchase of such technical input. The Government should create a mechanism to attract such assistance from overseas. The Ministry of Commerce and Industry, Ministry of Foreign Affairs, Ministry of Communication and Information Technology, and Ministry of Economics should develop sufficient cooperation with respect to implementing this change.
- **Access to Finance:** Starting a new business in Afghanistan is perceived as a risky venture as it is uncertain whether it will succeed or not, hence, banks and other financial institutions are reluctant to finance such activities. The Government of Afghanistan should create a legal framework through which these firms obtain some assurance for the risks they take.
- **Sustainability and Environmental Protection:** Sustainability and environmental protection are among the significant issues in Afghanistan which urgently need addressing. There are certain rules and regulations in this regard that have not been implemented thoroughly. Kabul, the capital city of Afghanistan is among the most

highly polluted cities in the world. The situation gets even worse in the winter season as poor households burn materials such as tires and plastics to remain warm in the cold weather. Additionally, the factories, bakeries and bathhouses also burn prohibited items which intensify the pollution in the cities. Crime organizations are active in several areas of Afghanistan which cut the green trees and forests illegally and unprofessionally to smuggle the resources thus gained to neighboring countries, particularly to Pakistan.

- **Streamline Procedures:** Various business procedures need to be streamlined as these are often vague for investors and leave them confused as to how to start and process documents for even a small business. It is perceived as vital to raise awareness in this regard for potential investors and establish several focal points across Afghanistan so everyone who needs information can readily access an information center.
- **Control of International Trade:** Afghanistan runs a huge trade balance deficit each year. Based on the NISA and MoCI annual figures, Afghan exports are approximately US\$1 billion while imports total more than US\$6 billion creating a significant cash outflow. There are several items which are produced in Afghanistan with better quality and prices than the international equivalents but the latter are still imported. The Government cannot even control the illegal import of such items as it does not have full control of all the border areas of the country. The problem extends beyond the illicit traders who smuggle and illegally import materials from other countries as high levels of corruption in customs also facilitates the import of such items. The imported items are taxed less compared to how much actually they should be taxed based on the guidelines provided to them by the Government. For example, a vehicle arrives carrying cooking oil but when it passes through customs it is registered as carrying mineral water. Obviously, the tariffs are reduced and when the product comes to the market domestic firms' products cannot compete with the illegal imports.
- **Attracting Foreign Direct Investment:** Foreign direct investment is one of the significant drivers for economic growth in developing countries. Afghanistan has a raft of opportunities for FDI but due to the security situation and insufficient infrastructure foreign investors are unwilling to invest. The Government of Afghanistan has to create a safe environment for such investors and ensure their security in the country.
- **Political Will for Law Enforcement and Innovation Development:** All too often the Government simply does not seem to enforce the law. This is in certain circumstances due to inability or the lack of political will. The business environment in Afghanistan in certain places and sectors is dominated by organized crime and law enforcement remains a factor in theory only. Therefore, the Government must gradually deal with this issue and create a reliable environment for business that establishes a level playing field for all.
- **Simplification of Registration Process:** The simplification of the registration processes is a vital element to attract new investors and entrepreneurs to commence new businesses. These simplified processes must ease licensing procedures and encourage investors to invest which will, in turn, create employment opportunities in Afghanistan as small and medium enterprises are the best source of employment given the profound issues surrounding establishing heavy industry.

- **Collaboration:** Establishing a mutual and collaborative relationship between different stakeholders such as the private sector, the Government and universities to work jointly on research and innovative ideas so as to implement them.

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