

Science, Technology, and Innovation: Finding a Bhutanese Path

Ujjwal Deep Dahal

A Case in Point for Developing Economies

Amid changes and challenges lie opportunities. In the last 300 years, when human civilisation has undergone three industrial revolutions, unprecedented innovation has taken place at fundamental and applied levels. As our civilisation adopts and adapts to the 4th Industrial Revolution, largely leveraging the theories and systems of the past, there lies opportunities not only to be consumers of technology but to influence the fundamentals in creating the technologies of the future. While it is often thought that “most of the fundamental theories, systems and technologies predicted to rule the future has already been established” or that “we do not have the fundamentals or the human resource capacities and basic priorities of development await” how can we aspire to leapfrog and contribute to cutting-edge technologies?

Nothing could be further from the truth. Even with the latest technologies like remote sensing, Big Data, and AI, we are still not able to answer the basic questions in predicting or effectively containing a virus pandemic. But this is possibly the only time in human history when individuals are empowered to solve problems of the world almost independently; it has been largely possible because of the evolution of available and affordable computing power and sharing and access to knowledge.

Technology revolutions have transformed societies and economies throughout human history. The advent of steam engine mechanised systems, the oil and electricity era brought in the mass production industrialisation age and the semiconductors and the Internet gave us the digital revolution. The next big revolution in technology - the era of Artificial Intelligence (AI) - has the potential to largely merge our digital, physical, and biological worlds. AI and other related disruptive technologies are breaking grounds (viz machine learning, big data, blockchain, quantum computing, IoT, virtual and augmented reality, 3D printing etc.) and their impact on societies and economies - even on moderate forecast scenarios - could

bring unprecedented changes in the way we live and inspire fundamental changes to the very systems we have built over the centuries as societies.

In organising ourselves, not only to prepare for change, but also be a part of the change, we need to look at the building blocks of innovation and creativity including inculcating a flare for technology and economic mindset in our society. Also, there is a need for 21st century business models to bring together technology and creativity to create value proposition for societies, largely for socio-economic development. Many a time, technology and creativity are not perceived in the same wavelength in discussions. Existing systems and businesses for the future need to understand and incorporate the changing technology landscape and markets in both services and products of the next generation.

Bhutan and Technology

As disruptive technologies become mainstream industries, we need to position ourselves to leverage the opportunity to be a part of the development as it matures and takes control of our economy, development, and largely our lives. Developing economies should articulate a vision for Industry 4.0 and Bhutan already has. So how do we now position our innovation policy and provide a national platform of innovation ecosystem to leverage the technology and create an alternate economic model?

Innovation, as we have seen, is required to leverage knowledge of technology to build economic value. Policy and practice have to evolve and develop sustainably and ensure the positive impact of technology on society. Generally, policy is always steps behind technological development often beneficially providing the space for free innovation to evolve and develop without being stifled. But how do we ensure the balance and how can Bhutan adopt technology for the right purposes?

Today, Bhutan stands at a juncture where we could strategically institutionalise the building of skills required for the development of technologies of the future. The initiation of the establishment of a Super FabLab, the existing FabLab, and an operational startup ecosystem to engage the youth are inspiring innovative projects in areas of e-commerce, agriculture and information technology. The next logical step is to ensure

that these institutions are strengthened, supported for scaling up with funding by establishing venture capital funds, and not work in silos but as an ecosystem to build a vibrant technology society in Bhutan.

Bhutan's Initiatives

For a country there are always major technology milestones not only providing opportunity for current times but more significantly creating opportunities and pathways for the future. As we look through Bhutan's development chapters, the establishment of a radio station and wireless and telegraphic services in the 1970s, the introduction of Druk Air and the opening to the hydro power investments in the 1980s are felt to be the major milestones which has provided the direction for technological and economic development. The impetus provided for industry 4.0 in this decade, and how it is leveraged for development and innovation, would largely define the Bhutanese technological pathway into the future.

Education and Jobs

Bhutan being a small economy provides that perfect platform to leapfrog in adopting, adapting, and developing systems and technology. Being small and landlocked are no more barriers at present for innovation, research and markets for products and services unlike in the past. While it may have taken decades for new technologies in the 1970s to be available around the globe - taking example of television as a technology - mobile telephony took less than a decade and the Internet and its related applications was much faster. The innovation ecosystem today has also largely levelled and is not concentrated to a particular country or a region. This has been possible with cheap computing power, education, and availability of development platforms and tools largely through the use of Internet. The present initiatives in Bhutan in the training and education space, with a major focus on developing the 21st century technology skills, the revamping of the Technical Vocational Educational Training (TVET) to meet the international standards, and the sandboxing and discussions to institutionalise the education system required for the jobs of the future, clearly provides hope for Bhutanese technological path to take the right direction.

Super FabLab

A few years ago, finding an electronic breadboard or a simple electronic component for a technology enthusiast or a researcher in Bhutan was impossible. Today, Bhutan not only hosts a FabLab but is also establishing a Super FabLab (SFL), in collaboration with Massachusetts Institute of Technology (MIT), Cambridge, USA. The SFL is expected to be established by the end of the year 2020 and is expected to have machinery, software, and platforms to prototype almost any idea that we could possibly imagine and only draw on a piece of paper today. The SFL will be the “go to” place for designing and prototyping almost anything. This provides the platform for individuals, established corporations, and business sectors to simulate the ideas and build prototypes and start on a journey of lean and agile startup in building technology, creating innovation, and solving the problems that matter to the world.

Digital Drukyul

How will digital Bhutan provide the needed impetus to progress, rooted in GNH values and meeting the aspirations of the 21st century integrated society? The Digital Drukyul Flagship programme is expected to provide the platform for digital Bhutan, powered by the technologies of today and providing the platform for tomorrow is based on the objectives - viz scalability, security, interoperability and sustainability - in its design, implementation, and development. The Digital Drukyul programme is also expected to provide the fundamental building blocks for the national digital economy on which organisations and, importantly, individuals can leverage, develop, and evolve. It should provide a vision, direction, and a platform which can be leveraged to develop our digital future.

A Way Forward?

Technology Leadership

“The question I have is how are we able to leverage technology for education; job creation; good governance; effective, timely and efficient delivery of services to our people; private sector development and growth; for accountability and transparency?” His Majesty The King at the 14th Convocation of the Royal University of Bhutan on 24 May 2019.

In preparing to leverage technology for nation-building “technology leadership” development is at its core apart from technology workforce itself. Technology leaders have to be cognizant and prepare to lead generation Z and generation Alpha who would be the frontline work-force over the years. So, the opportunity that we need to seize today is to strategise our organisations and the systems to empower employees and individuals in developing technology leadership skills for a multi-generational and diverse workforce in building a technology led ethical business environment.

Science and Technology R&D

Government support is imperative, especially during the inception stage, for science and technology R&D with the goal of producing innovations that will enhance the health, security, economic and general well-being of all Bhutanese. After World War II, American investment in science and technology R&D has given the leverage in attracting talent, developing national patents, intellectual property and technology that today are some of the biggest businesses in the world. The ratio of Government and industry financing for science and technology R&D is an important matrix for development. While in developed economies the industry financing generally increases over the years, Bhutan will have to very critically study the core areas and design progressive budget for science and technology R&D financing. This would be imperative to provide the platform to nurture talent and ultimately build technology, increase academic publications and patents, and also provide the avenue for industry to take the lead in R&D over the years.

The interaction amongst Government, Industry and Universities to foster innovation and socio-economic development also theorised in the triple helix model of innovation would be important for Bhutan. This could look into optimally designing systems of R&D and innovation, building organisations towards a knowledge-based society and an economy.

Creating a Data Economy and Breaking the Data Silos

Bhutan, in the past few decades, has attempted to embrace technology in governance and in delivering public services.

Enormous digitised data volume are available, ranging from health, education, power and energy, cities, and largely from all domains though

these need to be collated. These data do have an intrinsic value if centralised, correlated, and channeled towards a purpose though Governments and agencies need to ensure that data is not an afterthought. Towards this, applications predicting the next power outage in a city or a locality could be designed with machine learning algorithms provided with historical structured or unstructured data. Where human analytics cannot manage correlation of data beyond certain number of dimensions, the machine learning algorithms are built to find the correlation/patterns and importantly also learn from multi-dimensional databases and provide insights. These predictive algorithms, leveraging the data, can provide alternative planning possibility in any sector or business and also help prepare for eventualities.

Another classical application of data in governance would be to develop automated and proactive public service with applications such as targeted subsidies during times of crises and scientific evaluation of events such as rural-urban migration, impact of stimulus plans and importantly predict impacts of policies and regulations which can then be reiterated and engineered before implementation.

Opportunities are also available to collect and provide data sets that would be unique to the latitude and longitude of Bhutan and perhaps have unique value to the learning algorithms and in creating Big Data analytics for social and commercial purposes. Where a self-driving car algorithm learns with simulated data, these could be fed with real situation data of our transportation environment towards making the learning algorithms more robust and generic apart from possibilities of building the research ecosystem locally with data as our equity in research collaborations. These possibilities can also be extrapolated to other domains such as health, energy, and telecommunication.

The experiences of other nations and institutions in leveraging Big Data should provide a possible pathway for Bhutan to position itself towards a data economy and find our own technology pathways. Consolidating platform and data democratisation is required for evidence-based decision-making, efficient public services, leveraging data for monetisation and more importantly inculcating innovation and creativity at grassroots level. Business's long-term success and failure depends on adapting to the changing market, technology and customer expectations. The stories of

Kodak and Instagram are testimony to this fact. How effectively a business can strategically adapt its services and create alternate revenue stream defines its continuity and this can be seen in how telecom industry has evolved with revenue from “voice service” to “data supply service”. It is felt that for most industry to evolve and adapt in the 21st century economy would require to look into “service with data” as the way forward. This is where creativity and grassroots innovation can evolve, data monetisation could happen apart from data being used for decision-making and efficiently planning and operating public services.

With data democratisation, it is also important that the public policies for data security, privacy, and cyber security evolve apart from public policies, acts, and regulations around data and usage. A good point to start would be to look at institutionalising an efficient “National Data Repository”, considering multi-organisation/agency collaboration with a “National Chief Data Officer”. These would be important initial steps towards creating the national platform for a data economy and in breaking the data silos.

Ethics in the Industry 4.0

We need to explore how our GNH philosophy for governance could possibly bring value to the industry 4.0 which is expected to be governed largely by technologies such as AI, Blockchain, and Big Data. As we build a body of knowledge, new algorithms and systems that govern the human race more digitally and autonomously, the question that arises is how these systems are being built. Research laboratories and facilities around the world are creating autonomous digital AI driven physical and biological systems; there are largely no internationally agreed policies on ethics around what can and cannot be done and eventually these technologies become the next unicorns and corporations. While innovation should not be constrained with policies even before germination of ideas, it is also important that an ethical framework discussion on the building and use of technologies happen. We often wonder if companies like Google or Facebook could have leveraged the potential of technologies if there were early institutionalising of data privacy and security laws and also provokes thoughts on the pros and cons of Non-Proliferation Treaty discussions before or during the Manhattan project.

Can GNH contribute in this space of AI era? These discussions and building a body of knowledge around ethics and AI would form an important part of our own technology pathway as we look to diversification of our economy.

Moving Ahead

The Druk Holding and Investments (DHI) as the commercial arm of the Royal Government of Bhutan is positioning itself to champion science and technology as a measure to provide the platform for the larger vision of economic diversification and in building the next generation technology, industries, jobs and human talent. In pursuit, DHI is establishing a science, technology and innovation “Think Tank” and an “Technology R&D center”- “DHI Research and Innovation Venture Excellence” (DRIVE) which would be operating programmes at applied level to begin with and fundamental research over the years in multifaceted thematic areas relating to science and technology. DHI and its DRIVE centre aspires to collaborate with universities/colleges, research labs/centers, tech startups, scientists and thinkers both nationally and internationally including leveraging the Super FabLab being established for designing, modelling and fabrications of ideas to prototypes and in pursuit of developing national intellectual property.

As we move into the next decade with the disruptive technologies from the labs and startups becoming mainstream industries, what and how as a nation should we strategise to position ourselves as a force in the next technology revolution? As we grapple with the challenges of providing the basic services to our population, we cannot lose sight and the opportunities on the possibilities of core strength development and leveraging the next technology revolution largely powered by Artificial Intelligence. We have to consolidate our past experiences, develop the present systems, and invent the future technologies in finding our own unique Science, Technology and Innovation pathway.