**Planning for the future**

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In order to transition to a strong technology-driven knowledge economy, Pakistan must focus on the manufacture and export of high-tech (high value-added) products for export.

This requires us to acquire the highest level of expertise in new and emerging technologies to be able to leapfrog into the future. We must also establish a clear roadmap for our development after carrying out a proper well-designed ‘foresight’ exercise, as per international norms.

This process must be repeated, and our strategies adjusted at regular intervals, so that we keep abreast of the changing dynamics and new challenges.

Economic prosperity now depends almost entirely on high-quality education, science, technology, innovation, and entrepreneurship. The world of discovery is a vast and ever-expanding domain encompassing various sectors, each contributing to the advancement of human knowledge and technology.

From new materials to space engineering – from biotechnology to autonomous vehicles – recent developments across these emerging sectors have been nothing short of astounding.

In the case of materials science, let us consider the example of graphene, a single layer of carbon atoms arranged in a hexagonal lattice. Graphene exhibits extraordinary strength, flexibility, and conductivity, making it ideal for applications in electronics, energy storage and medical devices.

Nanotechnology, the manipulation of matter at the nanoscale, has revolutionized various industries with its ability to engineer materials and devices at the atomic and molecular levels. Recent advancements in nanotechnology include the development of targeted drug delivery systems for cancer treatment, ultra-sensitive sensors for detecting environmental pollutants, and high-efficiency solar cells for renewable energy generation.

Nanomaterials such as quantum dots and carbon nanotubes hold promise for applications in electronics, photonics and biomedicine, driving innovation across multiple sectors.

Pakistan’s first full-fledged research institution has been established by us as part of the International Centre for Chemical and Biological Sciences (ICCBS) in Karachi University through a magnificent donation from Mr Aziz Latif Jamal funded generously by the Husein Ebrahim Jamal Foundation.

Artificial intelligence is already finding a myriad of applications and its economic impact has been predicted to exceed $15 trillion by 2025. The first new class of antibiotics was recently discovered using artificial intelligence after 60 years, which is active against drug-resistant bacteria that kill thousands of people each year.

Artificial intelligence is now being applied in almost every sphere of human activities and may well change the y face of civilization. Several centres of excellence in the field of artificial intelligence are presently being established in Pakistan under my stewardship including those in the Pakistan Austrian University of Applied Science and Engineering (Fachhochschule) in Haripur Hazara and at the ICCBS in Karachi University.

Another fast-evolving field is that of quantum computers. These are hundreds of millions of times faster than the fastest supercomputers. When artificial intelligence (software) begins to work with quantum computers (hardware), a huge revolution in civilization will occur, and it is just around the corner.

The world speed record for the fastest computers was recently broken by the light-based Chinese computer Jiuzhang 3.0. It can calculate the most complex problems in one microsecond while the world’s fastest supercomputer ‘Frontier’ would need more than 20 billion years to complete the task.

There are three types of quantum computers under development: electron-based (superconducting), atom-based (cold atom or trapped ion) and photon or light-based.

Recent achievements in biotechnology include the development of gene editing techniques such as CRISPR-Cas9, which enables precise modification of DNA for therapeutic purposes. This technology holds promise for treating genetic disorders, combating infectious diseases, and engineering crops with enhanced nutritional value and resilience to environmental stress.

Genomic medicine, enabled by rapid DNA sequencing technologies, now allows clinicians to tailor treatment strategies based on an individual’s genetic makeup, improving efficacy and reducing adverse effects. Immunotherapy, which harnesses the body’s immune system to fight cancer, has emerged as a promising approach for treating various malignancies, offering new hope to patients with advanced or refractory disease.

In the present era, which is marked by rapid technological advancement, global interconnectedness, and complex societal challenges, nations around the world are increasingly recognizing the importance of preparing a proper and well-thought-out developmental roadmap for their short-, medium- and long-term development plans.

This is done by carrying out a comprehensive strategic foresight exercise in order to shape their future development trajectories. This involves identifying the overarching objectives, thematic areas, and time horizons of the road map under the supervision of a steering committee comprising experts from government agencies, research institutions, industry associations, and civil society organizations to provide strategic guidance and oversight.

It also involves conducting a preliminary assessment of the country’s strengths, weaknesses, opportunities, and threats (SWOT analysis) to identify priority areas for future exploration.

An important aspect of a foresight exercise is that of horizon scanning. The process involves imagining the desired future state of the country, encompassing social, economic, environmental, and governance dimensions.

This requires engaging citizens, experts and stakeholders through surveys, focus groups and public consultations to solicit input and feedback on the proposed vision and goals. Indicators and benchmarks are then established to measure progress towards strategic goals.

A number of methods and tools are available to support the conduct of a foresight exercise. For instance, the Delphi method is employed as a structured approach to forecasting that involves soliciting input from a panel of experts through a series of iterative surveys or questionnaires.

Experts provide their judgments and insights on future trends, uncertainties and potential developments, which are then aggregated and analyzed to identify areas of consensus and divergence. Road mapping is then needed to determine the specific steps, milestones, and dependencies involved in achieving a specific goal or objective over time.

A Delphi-type foresight exercise was conducted under my supervision in 2005/2006. The resulting 300-page document contained sector-wise visions, strategies, and action plans. These were approved by the cabinet in August 2007. Unfortunately, no such exercise has been conducted subsequently with the result that Pakistan presents an example of a fragmented vision and strategy with each political party singing a different tune for socio-economic development.

It is high time that a united strategy, vision, and action plan were prepared by the government and opposition parties together to ensure its sustainable implementation. This will involve updating the first document prepared by us and approved by the cabinet after extensive consultations with all stakeholders so that we can embark on the road to sustainable and equitable socio-economic development by transitioning to a strong technology-driven knowledge economy.

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founding chairman of the HEC. He can be reached at: ibne\_sina@hotmail.com