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Special Issue

Forecasting Transformations in Science and Technology: The Arab Door to the Future

In today's world science and technology feature prominently in daily economic, social and cultural life, in contexts ranging from schools to communications to medical treatment, work, production and consumption. Their greatest impact lies in their ability to shape tomorrow's world. Faced with the 21st century challenges of energy transition, climate change, the digital revolution, and the preservation of biodiversity, science and technology offer enormous potential. Conversely, they also involve major risks, as became apparent with the Covid-19 pandemic, and give rise to new ethical questions, especially with the emergence of artificial intelligence and genetic engineering.

Science and technology have rapidly developed throughout modernity, with the promise of human transcendence of all former restraints, be they in space exploration, human intelligence, or even human mortality. Yet a series of international crises, most recently the Covid-19 pandemic, have

revealed the fragility of this promises and the failure of science in its most important role: to keep us alive and healthy.[1]

In the era of artificial intelligence, genomics, and self-driving vehicles, humanity has not found a more effective solution to the pandemic than mass quarantine, a preventative public health measure current in the Middle Ages. Science and technology not only failed to ensure the reliability of tests and to devise a treatment or a vaccine, but also to provide political actors with the expertise and scientific advice to counter their uncertainty and help them do more than just improvise. Major weaknesses, shortfalls and vulnerabilities have been exposed in the scientifically and technologically advanced health systems of developed countries.

It is thus important to go beyond appreciating the impact of science and technology in today's world, to look forward to what can be achieved over the next ten, twenty or thirty years, and how to prepare for this. How will these massive changes affect the way we all live? This is especially relevant in our Arab countries, which are still plagued by a lack of development, manifested in the status of science and technology.

Will science and technology lead – as promised – to the emergence of a disease-free humanity, the production of super-energy foods, super-intelligent, self-learning robots, or even superhumans? Will their effects in our Arab countries engender profound political, economic, social and cultural transformation? How should the Arab world anticipate, prepare for and understand these transformations?

[1] As of 30 September 2020, the number of people infected with the virus exceeded 34 million, and the number of Covid related deaths exceeded one million: Cf. The Johns Hopkins Coronavirus Resource Center, at: https://coronavirus.jhu.edu/map.html

It is certain that scientific and technological developments with strong impact have pronounced effects in the future in various fields, one of the most prominent today being computing and digitization.[2] In general, the impacts of science and technology will be concentrated over the next decade in:

I. **Genomics**: a branch of genetics related to the study of genetic material within various organisms, which underwent a real revolution in 2003, when the human genome was sequenced, significantly reshaping our approach to medical care, medication and living to a healthy old age. With the enormous risk involved in frenzied and uncontrolled progress, virus mutations (normal or modified in BSL-3 and BSL-4) are just one of many dangers that may arise in this field.

II. **Nanotechnology**: is a field privy to greater degrees of specialization and wider uses, especially in the field of medicine where it will be possible to inject "nanorobots" into the blood and transport them through the circulatory system. Other potential applications will also increase, especially in the military.[3]

III. **Energy storage:** technologies of renewable energies will develop, and future battery technologies will be made of materials capable of storing energy in large quantities and recharging in record time, causing

[2] For example, on 23 October 2019, Google announced that, in partnership with NASA and ORNL, it had reached the "quantum supremacy threshold" whereby they developed a new 54-qubit processor, named "Sycamore", comprised of fast, high-fidelity quantum logic gates, in order to perform the benchmark testing. The machine performed the target computation in 200 seconds, a feat that would take the world's fastest supercomputer 10,000 years to produce a similar output.

[3] Yassine Yahyaoui, "Has the Future War Started?" Review of Christopher Coker's *Future War*, *Istishraf*, Second Yearbook 2017, pp. 328-334. (in Arabic)

breakthroughs in transportation fuelled by electricity and other alternatives to fossil fuels.[4]

IV. **Robotics:** daily uses have become widespread in some countries, as in Japan, and this is a trend that will spread globally in the future.

V. **Internet of Things** (IoT): In the future, coherence between interconnected devices (via sensors, software and various artificial intelligence tools) will increase. This will contribute to increasing human freedom from space, for example in connected "connected and intuitive homes"[5] in which there will be an enhanced synchronization of connected household items with smartphones, computers and televisions; , in "smart cities" using digital technologies to improve the economic, social and political conditions of their inhabitants;[6] and in the energy economy.[7]

Applied to living organisms, these new sciences and technologies offer endless possibilities for developing species more resistant to external threats, as well as for meeting the requirements of systems of production and consumption. They can also reduce the spread of some genetic diseases

[4] For example Tesla, the leading American company in the field of electric and self-driving cars, became the most valuable car company on the stock exchange in the world on 1 July 2020, with a market value of more than $208 billion: Sergei Klebnikov, "Tesla is now the World's Most Valuable Car Company with a $208 Billion Valuation," *Forbes* (July 1, 2020), at: https://bit.ly/2Gufueo

[5] Cf. Amin Hosseinian-Far, Muthu Ramachandran & Charlotte Lilly Slack, "Emerging Trends in Cloud Computing, Big Data, Fog Computing, IoT and Smart Living," in: Dastbaz, Mohammad, Arabnia, Hamid & Akhgar, Babak (eds.), *Technology for Smart Futures* (London: Springer, 2017), pp. 29-40.

[6] Cf. Eunil Park, Angel del Pobil & Sang Jib Kwon, "The Role of Internet of Things (IoT) in Smart Cities: Technology Roadmap-oriented Approaches," *Sustainability*, vol. 10, no. 5 (2018), pp. 1-13.

[7] Cf. El Sayed Yousef, "'Internet of Things, IoT' and the Future of Energy", *Istishraf*, Third Yearbook 2018, pp. 199-215. (in Arabic)

when applied to human embryos. Added to this is the ability to develop powerful new tools to explore remote distances in space, descend into the deepest oceans, and better understand our place in the universe.

Nonetheless, nanotechnology, gene editing and other modern technologies carry many risks.[8] There is a concern that they could also fuel major conflicts at the international level. This is highlighted today, for example, by the contention surrounding fifth generation (5G) and even the sixth generation (6G) wireless systems, which are largely dominated by China,[9] and have become major economic and geopolitical stakes in today's world, with their importance set to increase in the future.[10]

Within this framework, it is not only our scientific and technological knowledge that will change dramatically in the future, and increase at a pace unprecedented in human history, but also the way in which science and technology operate. New environments for science and technology will crystallize, moving from isolated and closed structures of academic, industrial and military research to open models based on social communication and open and more democratic technologies (Open Science), which will intersect with the "Technoscience Paradigm" that marked the development of Western modernity but is today deadlocked,[11]

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[8] Cf. Claire Craig & Paul Chamberlain, "Designing Health Technology: The Ethical Dimension," in: Dastbaz, Mohammad, Arabnia, Hamid and Akhgar, Babak (eds.) *Technology for Smart Futures* (London: Springer, 2017), pp. 289-301.

[9] Cf. Scott Malcomson, "The Real Fight for the Future of 5G: Who Will Patrol the Borders of a New Network?," *Foreign Affairs* (November 14, 2019); Nicol Turner Lee, "Navigating the US-China 5G competition," *Brookings* (April 2020), at: https://brook.gs/3jiFfND

[10] Cf. Asa Fitch & Stu Woo, "The U.S. vs. China: Who Is Winning the Key Technology Battles?," *The Wall Street Journal* (April 12, 2020), at: https://on.wsj.com/36kFKCW

[11] Cf. Karen Kastenhofer & Doris Allhutter, "Technoscience and Technology Assessment," *Poiesis & Praxis*, vol. 7, no. 1 (June 2010), pp. 1-4; Nasser Mansour, "Science-Technology-Society (STS): A

especially when it comes to the issue of climate change and environmental sustainability. This would also allow the social sciences and humanities greater scope to explore these issues, as they are inseparable from their social and cultural surroundings.

In the Arab region, science and technology has been neglected but they can provide unprecedented opportunities in the future. All aspects of Arab economic and social life stand to be improved by encouraging and developing science and technology. Even political structures can be severely affected, as was evident, for example, with the major transformations that took place during the first wave of the Arab Spring, with the internet and social networks playing a major role.

Arab countries can anticipate achieving great breakthroughs in the future provided that the initial conditions for this are fulfilled, as evidenced by the experiences of Asia and the BRICS countries, which have achieved wide-ranging breakthroughs in scientific and technological fields in recent years, becoming principal actors in many of them.

However, the fallout from the Covid-19 pandemic and a climate of growing uncertainty has exposed the apparent inability of science and technology to anticipate crises that may arise in the future. There is now an urgent need to confront changes in the ecosystem and strengthen capacities to adapt, by taking a forward-looking perspective on the future transformations and opportunities of science and technology in the Arab countries. This entails studying their multi-faceted impacts on the future of these countries, especially through the following main themes:

New Paradigm in Science Education," *Bulletin of Science Technology & Society*, vol. 29, no. 4 (July 2009), pp. 287-297.

- The current state and future of Arab scientific research systems.
- Challenges of building and empowering Arab knowledge capital.
- Science, technology, and Arab social, economic and political challenges.
- The stakes and risks in the future of medicine, genetics and genomics.
- The future of genetic and organic farming and its impact on food security
- Renewable energies, climate change, and sustainable development.
- Emerging trends and future implications in cloud computing, big data, and fog computing.
- New technologies: nanotechnology, quantum computing, artificial intelligence, and neural networks, and their effects in the Arab countries and the Global South.
- Artificial Intelligence and high-frequency trading (HFT)
- The Internet of Things (IoT) and the potential for "smart living" and its impact on the global economy.
- New environments for science and technology and the challenges and opportunities of research and development in the Arab world.
- The future of information and cybersecurity.
- Future wars and their stakes in the Arab world.
- Communication technology (5G & 6G) and its impact on the basic units of the international system.

- Science, technology, and new models of production and consumption.

Istishraf for Future Studies hopes that this issue will represent an opportunity to study and analyse various dimensions of the future of science and technology, and to stimulate discussion in the Arab context. The journal calls for researchers from different backgrounds to contribute according to the guidelines below.

Submission guidelines

- *Istishraf* welcomes research proposals on "Forecasting Transformations in Science and Technology: The Arab Door to the Future", which offer new themes or add research value or novel conclusions, according to the ACRPS's specifications for research proposals.
- Papers will be subject to peer review via a specialized academic committee.
- Research papers should be anywhere between 6,000 to 8,000 words.
- Papers should be sent in Arabic or in English, in which case they will be translated once approved.
- Proposals should be submitted by **May 31, 2021** at the latest.
- Proposals should be sent to istishraf@dohainstitute.org.

N.B. *Istishraf* also accepts Critical Book Reviews of recently published books and reports relevant to the topic. Book reviews should be between 2500 and 4000 words.