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GLOBAL TECHNOLOGY TRENDS: 2020

16 applications that could change the world

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THE world is in the midst of a global technology revolution. For the past 30 years, advances in biotechnology, nanotechnology, materials technology, and information technology have been occurring at an accelerating pace, with the potential to bring about radical changes in all dimensions of life. The pace of these developments shows no sign of abating over the next 15 years, and it appears that their effects will be ever more remarkable. The technology of 2020 will integrate developments from multiple scientific disciplines in ways that could transform the quality of human life, extend the human lifespan, change the face of work and industry, and establish new economic and political powers on the global scene.

While people often do not understand a technology itself, they can often understand what that technology, when applied, might do for them and the societies in which they live when an application concept is presented to them. Actual adoption, however, is not necessarily automatic because of the confluence of economic, social, political, and other mitigating factors. Such technology applications, designed to accomplish specific functions, and their mitigating factors are the focus of a study done for the National Intelligence Council (NIC) in the United States.

16 technology applications that could change the world

The study identified 56 applications that were possible by 2020, and of these, 16 appear to have the greatest combined likelihood of being widely available commercially, enjoying a significant market demand, and affecting multiple sectors, for example, the water, food, land, population, governance, social structure, energy, health economic development, education, defence and conflict, and environment and pollution sectors.

The 16 technology applications, in order of likelihood of implementation, include the following:

- *Hybrid vehicles*: Automobiles available to the mass market with power systems that combine internal combustion and other power sources while recovering energy during braking.

- *Rapid Bioassays*: Tests that can be performed quickly, and sometimes simultaneously, to verify the presence or absence of specific biological substances.

- *Rural wireless communications*: Widely available telephone and internet connectivity without a wired network infrastructure.

- *Targeted drug delivery*: Drug therapies that preferentially attack specific tumours or pathogens without harming healthy tissues and cells.

- *Communication devices for ubiquitous information access*: Communication and storage devices, both wired and wireless, that provide agile access to information sources anywhere, anytime. Operating seamlessly across communication and data storage protocols, these devices will have growing capabilities to store not only text but also meta-text with layered contextual information, images, voice, music, video, and movies.

- *Ubiquitous radio frequency identification (RFID) tagging of commercial products and individuals*: Widespread use of RFID tags to track retail products from manufacture through sale and beyond, as well as individuals and their movements.

- *Improved diagnostic and surgical methods*: Technologies that improve the precision of diagnoses and greatly increase the accuracy and efficacy of surgical procedures, while reducing invasiveness and recovery time.

- *Quantum cryptography*: Quantum mechanical methods that encode information for secure transfer.

- *Cheap solar energy*: Solar energy systems inexpensive enough to be widely available to developing and undeveloped countries, as well as economically disadvantaged populations.

- *Filters and catalysts*: Techniques and devices to effectively and reliably filter, purify, and decontaminate water locally using unskilled labour.

- *Green manufacturing*: Redesigned manufacturing processes that either eliminate or greatly reduce the waste streams and the need to use toxic materials.

- *Tissue engineering*: The design and engineering of living tissue for implantation and replacement.

- *Genetically Modified (GM) crops*: Genetically engineered foods with improved nutritional value (for example through added vitamins and micronutrients), increased production (for example by tailoring crops to local conditions), and reduced pesticide use (for example by increasing resistance to pests).

- *Pervasive sensors*: Presence of sensors in most public areas and networks of sensor data to accomplish real-time surveillance.

- *Wearable computers*: Computational devices embedded in clothing or in other wearable items such as handbags, purses, or jewellery.

- *Cheap autonomous housing*: Self-sufficient and affordable housing that provides shelter adaptable to local conditions, as well as energy for heating, cooling, and cooking.

Impact of Change

The initial 56 technology applications identified vary significantly in technical and implementation feasibility by 2020. Technical feasibility is defined as the likelihood that the application will be possible on a commercial basis by 2020. Implementation feasibility is the net of all non-technical barriers and enablers, such as market demand, cost, infrastructure, policies and regulations. An assessment of implementation feasibility was made based on rough qualitative estimates of the size of the market for the application in 2020 and whether or not it raises significant public policy issues. The 16 identified technology applications had both a high technical feasibility as well as high implementation feasibility.

What can be observed is that increasingly, the technology applications that will be introduced in the future entail the integration of multiple technologies. New approaches to harnessing solar energy, for instance, are using plastics, biological materials, and nanoparticles. The latest water purification systems use nanoscale membranes together with biologically activated and catalytic materials. Technology applications such as these may help to address some of the most significant problems that different nations face, that is, those problems involving water, food, health, economic development, the environment, and many other critical sectors.

While extensive, this technology revolution will play out differently around the globe. Although a technology application may be technically possible by 2020, not all countries will necessarily be able to acquire it, much less put it widely to use, within that time frame. An adequate level of science and technology (S&T) capacity is the first requirement for many sophisticated applications. A country might obtain a technology application through its domestic research and development (R&D) efforts, a technology transfer, or an international R&D collaboration, all of which are indicators of a country's science and technology capacity. A country could also simply purchase off-the-shelf systems from abroad. However, many countries will not have achieved the necessary infrastructure or resources in 15 years to do such things across the breadth of the technology revolution.

The key role of R&D

What is more, the ability to acquire a technology application does not equal the ability to implement it. Doing research or importing know-how is a necessary first step. But successful implementation also depends on the drivers within a country that encourage technological innovation and the barriers that stand in its way. Such drivers and barriers reflect a country's institutional, human and physical capacity; its financial resources; and its social, political, and cultural environment. Each of these factors plays a part in determining a nation's ability to put a new technology application into the hands of users, cause them to embrace it, and support its widespread use over time.

For these reasons, different countries will vary considerably in their ability to utilize technology applications to solve the problems they confront. To be sure, not all technology applications will require the same level of capacity to acquire and use. But even so, some countries will not be prepared in 15 years to exploit even the least demanding of these applications, even if they can acquire them, whereas other nations will be fully equipped to both obtain and implement the most demanding of the applications.

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