RSIS S. RAJARATNAM SCHOOL OF INTERNATIONAL STUDIES
Nanyang Technological University

RSIS COMMENTARY

www.rsis.edu.sg No. 279 – 24 December 2015

Future Landscape of Global Technology

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Synopsis

The technology landscape is not about making predictions regarding certain uses or the degree to which they affect outcomes. It serves as a starting point for leaders to consider assessing the consequences and make intelligent decisions.

Commentary

TECHNOLOGY IS moving so quickly, and transforms the way we live and work. In order to maintain the current economic and social status quo, leaders and policy makers must be able to recognise and consider the potential disruptive power of certain technologies. They need to think ahead to answer the "WHO, WHAT, WHY, WHEN, WHERE and HOW" questions.

In this commentary, I hope to integrate a host of recent science and technology (S&T) forecasts that were published by industry (Cisco), media (CNN), think tanks (RAND, McKinsey) and government (UK MOD, NIC), to provide a consolidated look at S&T domains that are most likely to generate revolutionary change in the future.

Science and technology forecasts

• *Basic human needs*

Food. Roughly 25% of current farmland is already degraded by over-farming, drought, and air/water pollution. In the future, genetic modified (GM) crop technology will expand to allow desired traits to be transferred to more crops. Automation of equipment for precision agricultures will be used to give higher yields per area.

Water. Micro-irrigation techniques have been able to deliver water to roots with 90%

efficiency. In the future, cheaper subsurface drip-irrigation together with precision agriculture is likely. Many water technologies will be developed to purify, recycle, treatment, etc. New type of membrane will be developed to remove salt from sea water or brackish water.

Energy. The discovery of new methods for extracting fossil fuels, such as fracking to recover natural gas from shale, means that carbon-based fuels will remain part of the global energy equation for the next several decades. Solar, wind, and hydro-electric are all renewable energy sources that have the potential to provide unlimited power without draining resources or effecting climate change.

Health. Over the next 30 years, medicine will be completely transformed. Genomics will enable doctors to tailor treatments for diseases such as cancer to an individual's genetic makeup. Artificial organs will be grown for transplantation using a patient's own DNA. People will live longer and stay healthy and active well into what today we consider "old age".

• *Materials, manufacturing and systems*

Materials. Materials science is an important cross-cutting trend for many future technologies. Nanomaterials can lead to new medicines, multi-functional coatings, and more durable composites, among other things. Graphene and carbon nanotubes have the potential to serve as building blocks in novel display types, solar cells and even super-efficient batteries. Nanoparticles could be used for targeted drug treatments for cancer.

Additive manufacturing. 3D printing or prototype printing or additive printing is a method of building physical objects one layer at a time. A 3D structure can be built by superimposing a 2D layer on top of other 2D layers, hence the term additive printing. This method allows a complex structure to be built otherwise impossible by conventional methods. Since the object or product is built precisely layer-by-layer, there is no waste materials and an idea can go directly from a designed file to final product essentially bypassing many traditional manufacturing steps.

Autonomous systems. Autonomous systems will likely be a ubiquitous part of everyday life. Self-driving road vehicles could revolutionize ground transportation, and inexpensive commercial drones and submersibles could have the potential for use in various tasks. Intelligent software agents will automate critical infrastructure such as power plants and perform knowledge work, including routine administrative and research tasks.

Robotics. Thanks to advancements in several areas including artificial intelligence, sensors, and machine communication, more complex robots are being created with improved intelligence, senses, and dexterity. These advances could result in it being more cost-effective, possibly even more efficient overall, to replace human labor with robots in manufacturing or service settings.

• *Biotechnology and Human augmentation*

Synthetic biology. It has become possible to engineer custom organisms by building

new sequences of DNA from scratch, essentially programming life itself. Scientists can now methodically examine how variations in the genetic code generate and affect specific traits and diseases by using computers and rapid sequencing rather than having to resort to trial and error. Relatively cheap sequencing devices could play a potential role in routine tests, and in doing so improve treatments by matching proper ones to patients.

Human augmentation. Wearable devices could provide context-sensitive information to enhance memory and physical performance. Exoskeletons will provide superhuman strength and endurance. As power of computer keeps increasing and cost decreasing, we could see in the future hospitals can augment patient care with virtual machines.

• *Computing and information technology*

Computing. The cloud is allowing for rapid expansion of Internet-based services,- including media searching, streaming, and offline storing - as well as improvement in Internet-capable mobile devices' background processing abilities that make things like responding to verbal directives and even getting directions possible. In the future, smartphones could monitor vital signs and communicate directly with diagnostic applications.

Big data. Over the next 30 years, our ability to make sense out of massive, dynamic data sets will improve. This will affect almost every sector of the economy, create new industries, and transform our capability to understand and influence the world.

Social networking. With always-on connectivity, social networking has the power to change cultures as dissemination and consumption of events are moving at almost real-time. More and more people are being connected through social networks and this trend continues to grow as people will find innovative ways to connect together.

Cyber – Internet of Things. Everyday objects such as home appliances, cars, and infrastructure will be embedded with sensors and connected to the Internet. Social and economic impacts will be felt through more efficient production, optimized logistics, flexible smart grids for utilities and transportation, and countless other applications. Sensors embedded in biological tissues and medical implants will open new opportunities for everything from medical monitoring to tracking biological threats.

Implications and possibilities

Science and technology present both challenges and opportunities. While it is impossible to accurately predict the future, the intent behind this analysis is to inform policy and decision makers about where the future might be heading and raise questions about how we might best prepare for a dynamic and uncertain future.

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