ISN
ETH Zurich

19 November 2013

Printing the Future?

Is 3D printing eventually going to exceed the Internet in its economic impact? Nayef Al-Rodhan thinks so, and in doing so it's also going to transform our societies, our freedoms and our sense of security.

By Nayef Al-Rodhan for ISN

Most technologies featured in the genre of science fiction are far from materialization but, to some extent, we already live in the future it anticipated. Some objects that were incredible, futuristic or fictitious just a decade ago are now accessible in local stores or exist as works-in-progress in laboratories. Laser guns, touch screens, the roomba robot, and genetic engineering are just a few of the objects and techniques that can be duly credited to the 'Sci-Fi' imagination (a full glossary is available here). The functionality of these technologies is extremely broad and their use ranges from entertainment to national defense (such as the Laser weapons systems, or LaWS, currently being tested by the US Navy). While the invisibility cloak is still under development, Three Dimensional (3D) Printing, long regarded with skepticism, is already at the beginning of a triumphant rise which promises to bring about revolutionary changes in manufacturing. The Economist rightly called 3D printing "the third industrial revolution" and its increasing use will likely be as transformative as the Internet has been in the past decade.

Democratizing manufacturing

Experiments with 3D printing began in the late 1960s but it was only in the mid-1980s that 3D printing was developed on the basis of a process known as additive manufacturing which created solid objects layer by layer from data delivered to a 3D printer. The material used for 3D printing has traditionally been plastic, although a growing number of materials are now also used, including ceramics, glass, wax and even human tissue.

In the beginning, 3D printing was designed for making one-off prototypes but the improvement in 3D technologies has led to more things being printed as finished goods. For now, prototyping is still the main application of 3D printing, but, as the technology expands and prices drop, more goods are expected to be manufactured close to or at the point of consumption or purchase, thus blurring the line between manufacturer and customer. In the future, production at the household level or at work is a distinct possibility. The "democratization of manufacturing" that this implies will pose new challenges to businesses, firms, copyright law and society as a whole. To some, the prospect of unrestricted availability of 3D printers raises concerns that traditional manufacturing will be destroyed in the process.

This extreme case remains unlikely. Nevertheless, 3D printing is likely to have a disruptive effect on

existing businesses because it allows 1) endless customization (which means that alterations and repairs will only require changing software instructions rather than wholesale retooling), 2) the production of things that were previously considered too complex and 3) weight savings. A report in the Economist cites a study by the European aerospace consortium which suggests that titanium powder could be used to make satellite parts that are as strong as machined parts but only use 10% of the raw material. Innovative applications of 3D printing technologies such as these are being taken seriously. The European Space Agency, for instance, has already initiated a project to 3D-print parts for jets, thus taking 3D-printing into the "metal age".

While the uses of 3D printing to date have been either limited to certain sectors or experimental – for objects such as printed bikes or artificial insects – the technology holds immense potential, particularly for heavy industry and healthcare. As shown, the aerospace sector is keen to leverage 3D printing for the production of aircraft components and military industries are becoming increasingly interested. Even more impressive is the potential impact of 3D printing in healthcare where advanced research is attempting to print new tissues, organs and bones – with the ultimate aim of solving the shortage of organs for transplant. Such advances, however, will come at huge costs.

Risky spillovers

The rapid advance of 3D printing technologies can be seen as an example of 21st century scientific progress where innovation continuously eclipses innovation. Aside from the breeding ground this provides to enthusiastic scientists, it also brings to the fore complex and open-ended issues. Like in the past, these technological developments have the potential to exacerbate inequalities and will create new types of risks, power asymmetries and competition.

The cost of 3D printers makes their mass availability limited for now. The price for industrial-scale 3D printing systems starts at about $15,000 dollars and can reach $1 million. However, once acquired, 3D printing technologies entail lower costs because their software can be tweaked endlessly. This can be potentially devastating for economies of scale and labor relations. Some analysts even claim that the era of 3D printing announces a restructuring of the world economy and the end of China`s status as the mass-manufacturing powerhouse of the world.

The question of costs is, nevertheless, more complex and daunting. Not only is an entire market opening to offer smaller, cheaper and readily affordable desktop machines but the appeal of additive manufacturing is growing among "do-it-yourself enthusiasts," inventors and entrepreneurs. The dangerous side of this is that criminals, extremists and other non-state actors can gain access to such devices in order to produce weaponry. Printed guns already exist – though, in their current form, they can only fire six shots before disintegrating. Another cause for concern is that 3D printing could allow criminals and extremists to adapt more quickly and effectively to law enforcement measures. This has been witnessed, for example, in recent cases where 3D printed 'skimming' devices were developed for ATM machines. In these cases, 3D printing allowed criminals to rapidly implement new designs once the fraud was detected.

In addition to its many benefits, science and technology have always also been used to the detriment of peace and security, and 3D printing could be no exception if left unregulated. 3D printing could provide the next milieu for arms production or other tools of hazard and insecurity. Even if we do not envisage a day when nuclear arsenals can be 3D printed, other small-scale uses of three dimensional printing can be disruptive enough. For instance, MIT students have recently revealed 3D printed versions of Primus high security keys – using the company`s algorithms taken from the manufacturer manuals. Such schemes could be used for various crimes but they could also be the weapon of choice for security breaches in particular, such as the prison escapes of senior Al-Qaeda members earlier this year.

Making use of technology

Exactly three decades ago, in 1983, Ithiel de Sola Pool referred to late 20th century technologies as "technologies of freedom". His assumption was not that technology promoted freedom *per se* but rather that communication technologies were enablers of positive political developments. Arguably, technology has also been a force for oppression, alienation and insecurity. Recent developments in biotechnology, genetics and neuro-pharmacology have equally evoked fears of the potentially immoral and self-destructive effects of such techniques on mankind.

In between these contrasting perspectives stands the sensible view expressed by Leon Kass who described technology as essentially *instrumental* . "Technology is itself morally neutral," he wrote, "usable for both good and ill. There are, of course, dangers of abuse and misuse of technology but these appear to be problems not of technology but of its human users, to be addressed by morality in general".

In this sense, the impact of 3D printing will depend on how well it is managed and regulated. Three dimensional printers are already raising challenges for international copyright law but the technology will have implications and repercussions far beyond that. Environmental concerns are no less relevant in this case, particularly as a substantial part of 3D printing is now achieved with plastic. As source materials continue to diversify, the environmental concerns will increase as well.

Despite such considerations, it should not be implied that scientific progress and technological development should be halted. Rather, the first task ahead is to understand and anticipate the rise of 3D printing technologies and then strive to establish consistent and clear frameworks for their use. Indeed, the next big global challenge might just be to balance the human pursuit of innovation and scientific progress with the need for sustainability and security.

Like any emerging strategic technology, 3D Printing pushes the boundaries of the current status quo and raises ethical, moral and even cultural issues. While 3D Printing know-how and technologies should be made widely available, it is imperative to guard against potential misuse. As with other emerging technologies, maintaining the balance between security and innovation is critical in order to ensure a safe and equitable world.

Nayef Al-Rodhan is a Philosopher, Neuroscientist and Geostrategist. He is a Senior Member of St. Antony's College, University of Oxford, UK, and Senior Fellow and Director of the Centre for the Geopolitics of Globalisation and Transnational Security at the Geneva Centre for Security Policy, Geneva, Switzerland. Author of The Politics of Emerging Strategic Technologies. Implications for Geopolitics, Human Enhancement and Human Destiny (New York: Palgrave Macmillan, 2011).

Publisher

International Relations and Security Network (ISN)
