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Manufacturing Goes Digital with 3D Printing

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The face of manufacturing is changing. The “**re-shoring**” of some previously “off-shored” manufacturing back to the West, caused by increased higher wages in emerging economies, higher transportation costs, and increasing commodity prices globally, are all contributing to this change. At the same time, while traditional manufacturing factories in Canada and other OECD countries have closed and jobs have been lost, new technologies such as three-dimensional (3D) printing point to opportunities for revival in this sector, suggesting that manufacturing in 10-15 years may not be limited to mass production in centralized industrial plants. All you may need is a computer and a ‘3D printer’.

3D printing (sometimes referred to as “additive manufacturing”) is a manufacturing process that involves using computer-aided design (CAD) software to design a product, and then sequentially depositing layer-upon-layer of material in order to build **products, structures, moving components, parts within parts**, and even **human bones**, with varying size, complexity and fragility. For example, **bioprinting** is allowing doctors, engineers and computer scientists to manipulate living human tissue at the molecular level. The technology has been around for several years, but is getting cheaper (e.g., printers ranging between \$1500 and \$5000), with increasingly different **materials** available (e.g., stainless steel, glass, ceramics, or certain combinations thereof), along with better and more user-friendly **software**, enabling designers to find more practical applications. In 10 to 15 years, we could see **nanomaterials** being used, such as carbon nanotubes and nanoparticles, which generally decreases sintering temperatures, improves part density, and decreases shrinkage and distortion of printer parts.

Metal nanoparticles embedded into polymer materials can also provide improved electrical conductivity in printed objects (i.e., circuitry).

The increasing usage and popularity of 3D printing has significant implications. These emerging technologies point to the potential personalization of products and opportunities for local, niche or customized manufacturing that are more dispersed and that take place closer to markets and to the consumers themselves. As a result, value chains could be significantly impacted as these new manufacturers remain closer to their target consumers. 3D printing could also mean a reduced carbon footprint; instead of shipping products, the focus is on shipping data. Some **products** are already being developed to allow customers to recycle home plastics as inputs into their 3D printers, which could pose some significant changes for traditional natural resource sectors. Why purchase metals to make a chair when you can print one using plastics at home? In this sense, manufacturing could be distributed across all economies, developed and emerging alike. Over the next 10 to 15 years, it is expected that the underlying technologies of 3D printing will increase in capability and decrease in costs. Today, manufacturing is increasingly using 3D capacities on the shop floor; the question remains: where will it go from here?

Some significant policy questions emerge with this new trend:

- What is Canada's competitive advantage in a world where many countries are harnessing advancing technology in the design, production and delivery of goods and services?
- Could 3D printing result in a revival of manufacturing capacities in OECD countries? In which 3D printing niches could Canada become competitive?
- What kinds of **strategies** will firms, large and small, use to extract profit in this revolutionary new manufacturing world?
- How will natural resource sectors respond to customers making their own products from their 3D printers?
- What skills and technologies will Canadians need to be successful in a digital manufacturing world?

We explore the future of 3D printing and other manufacturing shifts in our report on "**The Next Economy**".

For more information on 3D printing, please see the following links:

- **Ted Talks. Lisa Harouni: A Primer on 3D printing**
- **The Economist. 3D Printing: The Shape of Things to Come**
- **The Economist. Layer by Layer: How 3D printers Work**
- **3D Printers, Shapeways, and the Future of Personal Products**

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