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Additive Manufacturing and Supply Chains

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Much has already been written about the effect of additive manufacturing, also known as 3D printing, on the future ability of consumers to manufacture their own devices at home. Most of the "home machines" spray thin layers of plastic resin one after another, until the layers add up to an object (hence the name "additive manufacturing"). The method, however, is also likely to replace significant portions of traditional industrial manufacturing. The technology involves a bed of material – which can be a mixture of alloys – and a computer-controlled laser which shoots a beam into the bed to melt the material according to a computerized blueprint, building ultra-thin layers of material one by one. The technology has several significant advantages over the traditional methods of casting, machining and welding.

Benefits and challenges for logistics

With 3D printing, manufacturing complexity is no longer a constraint for hardware designers. The technique can be used to manufacture any shape, including complex hollow structures which are difficult to forge otherwise. Similarly, variety can be enhanced since the parameters of the computerized blueprint can be changed from item to item. This is likely to lead to a huge increase in consumers' desire for customization.

The resulting explosive increase in stock-keeping unit (SKU) count is likely to lead to significant challenges for logistics and distribution. However, other characteristics of the technology are likely to mitigate this effect. The first is that the machinery is smaller and more compact than that needed for traditional manufacturing. Add to this the fact that fewer and less-skilled operators will be needed and the result is that manufacturing sites can be located closer to consumer locations. Furthermore, the technology allows for shorter lead time for manufacturing (once the computer blueprint is given), and the result is shorter supply chains and less need for large inventories. As the lead time between retail consumption and manufacturing shrinks, manufacturers and retailers can tighten delivery schedules and adopt just-in-time procedures while increasing service levels.

Another impact both on sustainability and transportation is the reduction in waste – of both material and packaging. During the manufacturing process, the technology uses the exact amount of material needed and creates zero waste. Furthermore, as items are made more and more "to order," the packaging can be designed to fit the item exactly. In fact, companies like Staples have already invested in machinery to create exactly-fitting packages for items ordered from Staples.com, resulting in not only less packaging waste but very positive customer response.

The full vision of additive manufacturing is not yet technologically feasible but scientific breakthroughs in this field are occurring rapidly. Significant uses to date include: (i) rapid prototyping, where the ability to manufacture "one-offs" quickly accelerates product development processes; (ii) the manufacture of spare parts which obviates the need for end-of-life production runs with the resulting inventory implications; (iii) making prostheses where the ability to fit exactly is of paramount importance. As mentioned above, resin-based products can already be made almost anywhere.

Interestingly, leading manufacturers are starting to use the technology even for volume production due to the ability to create complex parts. CFM International, GE's joint venture with Snecma, the French aviation giant, is developing a new jet engine, LEAP, using 3D printing. GE is committed to start delivering 25,000 such jet engine nozzles a year starting in early 2016. The raw material for the new nozzles is cobalt-chromium powder.

In addition to the manufacturing benefits of using less material resulting in lower costs, the new parts are expected to be lighter than parts based on traditional manufacturing methods, leading to fuel savings for the airlines using the new engines. According to a recent article in MIT Technology Review magazine,[5] many other manufacturers are watching GE. It is the first big test of whether the technology can revolutionize the way complex high-performance products are made at scale. The implications for supply chain operations, however, are likely to be more important when the technology is used for shortening supply chain lead times; for using small-scale manufacturing locations close to markets; for spare parts manufactured on an "as needed" basis; and for customization of products. Hundreds of companies large and small are developing and perfecting this technology, which is likely to mature very quickly.