APPENDIX I-23: TREND ANALYSIS – 3D PRINTING AND PRODUCTION

Trend Statement

Three-dimensional (3D) printing, or additive manufacturing, encompasses various processes for producing an original or exact replica of an item using computer-aided design (CAD) or a laser scan. Continued refining and honing of these processes could eventually result in many consumer products being "manufactured" locally or at home on 3D printing devices. This trend could have a dramatic impact on freight by reducing or eliminating the need to transport components and finished products (domestically or internationally), resulting in shorter, simpler supply chains.

Background

3D printing, also known as additive manufacturing, creates an original or exact replica of an object from the bottom up by literally building up (adding) layers of material using designs from computerized digital files. CAD or laser scanned images of an object are digitally "sliced" into thin layers that the printer transforms into three-dimensional products using raw materials loaded into the device. Because digital files are used, these products can be more complex, precise, intricate, customized, and stronger than previous methods. Traditional "reductive" machining methods (where materials are removed to form a product) can take longer, be more costly, and create more waste.

Originally producing only solid objects in the 1980's, some 3D machines are now creating fully-assembled products with multiple materials, different colors, embedded electronics, and moving parts from materials such as metal, plastics, ceramics, metal alloys, sand, and food. Applications for 3D printing include manufacture of nearly every conceivable commonly-shipped consumer product – from water bottles to cars, and everything in between. Perfect for rapid prototyping and producing unique customizable products, 3D technology is already entrenched in the dental, medical/orthopedic, automotive, and aerospace sectors. 3D machines can also create clothing, food, and human tissue. Over the years these devices have become smaller, faster, and cheaper – to the point where consumers can fabricate some items from home with printer design files that are already being stored, shared, and sold.

Prior to 3D printing, most manufacturing models used mass production and distant low-wage countries to create economies of scale (cost advantages per unit through quantity production) in addition to maximizing efficiency of transportation costs to improve profits. With 3D technology, businesses can dramatically reduce their profit break-point by reducing labor costs, foreign and domestic freight costs, and import duties; saving time (no need to wait for prototypes, spare parts); eliminating capital investments (such as molds, casts and machine tools); reducing inventory, stocking levels, and warehousing requirements; reducing lead times; removing handling and distribution costs on component part transportation; and reducing scrap, waste, and cost of their disposal.

Global Industry Analysts estimated that by 2018, the global 3D printing market will reach around $3 billion and that personal manufacturing technologies will profoundly impact the design, production, transportation, and consumption of physical products, which will in turn impact the supply chain. By 2020, it is expected that up to 80% of finished products will involve some kind of 3D printing. According

to a Supply Chain Management poll, responders predict that 3D printing will play a key role in the supply chain in the next three to five years and in less than ten years will play a much more prominent and widely implemented role. Complete transformation will take decades, partially due to limitations such as materials, speed, and lack of operator working knowledge.

Freight System Implications

Continued refining and honing of 3D processes could eventually result in many consumer products being "manufactured" locally or at home on 3D printing devices. This trend could have a dramatic impact on freight by reducing or eliminating the need to transport components and finished products (domestically or internationally), resulting in shorter, simpler supply chains.

In their simplest form, supply chains are typically about warehousing and shifting products outward from the point of manufacture. With localized production, 3D printing allows for on-demand manufacturing and leaner inventories. Zero-inventory business models could potentially eliminate the need for transportation of some freight. 3D technology has the potential to dramatically alter the supply chain industry, lower carbon footprints, and revolutionize the way international trade moves. The extent of impact 3D technology will have on goods transportation is still unknown and will depend upon how widespread and affordable it becomes.

By shaving weeks off manufacturing times and at-home production, this technology may reverse the trend of low-cost global manufacturing outsourcing, distribution (parts warehouses and forward stock locations will become unnecessary), production, and retailing – posing a significant change to the global transportation industry. Although many supply networks will likely be altered, it is predicted that some supply chains and distribution networks would remain intact, due to the rapid growth in business and home need for raw materials to feed the 3D printers. Birth of a new logistics sector for storage and movement of these powders and supplies, recycling, and waste disposal is also anticipated.

With growth in 3D printing, it is predicted that:

- Some retail sectors will either cease to exist or become "shop windows" for manufacturers (not keeping stocks);
- Some third-party logistics providers will be hard hit (businesses will print what they need);
- Small and midsize companies will form around specialized 3D printing shops (contract manufacturers);
- The service parts industry will be replaced by portable 3D machine operators;
- More software-based supply/management corporations specializing in digital rights management, insurance services, software development, delivery services, contract management, market monitoring, energy supplies and other utilities, recycling and disposal, and materials/resources procurement will rise; and
- Safety and standardization with regulation by government will be needed.

Planning Considerations

3D printing could reduce infrastructure requirements should some of the items currently manufactured overseas shift to domestic production facilities. Mass production of items may no longer be required in certain industries which could in turn reduce shipment volumes from countries to which they were globally outsourced, as supply chains become leaner, simpler, flexible and more localized. This might also reduce wear and tear on the transportation infrastructure in general; but, there could also be an increase in local deliveries with smaller commercial vehicles.

It is estimated that by 2020 3D printing and production will comprise up to 20% of the supply chain. A recent International Business Machines (IBM) study stated that for government policy makers there could be implications for labor (employment), infrastructure, workforce development, taxation and intellectual property in this new marketplace.

Resources

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