Hype or new business model?

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Additive manufacturing, better known as 3D printing, has been around for a while, at least conceptually. Invented in 1980 by Chuck Hull, it is a manufacturing process whereby precisely dosed materials (plastics, concrete, synthetic resins, metal, etc.) are built up, layer-by-layer, using a computer to drive the machinery. In comparison to how things were traditionally produced, additive manufacturing is faster, cheaper, and generates less waste. With recent leaps in Artificial Intelligence (AI) and machine learning, how we design concepts for printing is also resulting in products that are lighter, stronger, and more efficient. Finally, and probably the most potential to impact the maritime industry, 3D printing allows for individual, on-demand production of highly unique goods.

Pair the benefits with the considerable hype that exists around 3D printing, and it begs the question – is it all media puffery or maybe indeed a new business model for maritime? As a matter of fact, we at INFORM believe 3D printing is the latter for ports and terminals to consider, along with other developments such as software as a service or big data-based decision-making, to name a few.

To answer whether 3D printing is something more than just a hype, we started with the trusted Gartner "hype curve." The first thing to note is that 3D printing, as a technological concept, is no longer on their general hype curve; in fact, the last time it appeared there was in 2015. The most recent curve from 2018 shows many of the supporting technologies (software, scanners, printers, etc.) have nicely progressed up the "slope of enlightenment." This helps to explain why many 3D applications have gone from hype to workable across the healthcare, aerospace, defence, manufacturing, and supply chain industries, with the same destined to take place within retail. It is our belief that the last two will have the most significant impact on the maritime industry.

From spare parts to entire vessels

Digging into the uses of 3D printing in the maritime supply chain, we've found that almost all the cases are focused on the production of spare parts, with some smaller exceptions around rapid prototyping of equipment and some manufacturing-side 3D printing. In short, while 3D printing in the supply chain area is further along than retail, the applications within maritime specifically are still quite limited.

That said, we had the opportunity to tour the Port of Rotterdam's Innovation Quarter in November 2019, as part of the Smart Digital Ports of the Future Conference, and what struck us the most was the sheer quantity of 3D printing start-ups. One, in particular, was RAMLAB, who had successfully printed the first marine propeller using a robotic welding arm "printing" in metal. This has allowed the start-up to move into the refinement and scale-up phases. While there's still some work to do, they've shown that they can reduce the time it takes to produce nearly any metal spare part, on premises, from a matter of weeks to a matter of days; traditional manufacturing can take up to eight weeks to produce a propeller, whereas RAMLAB estimates they can complete the printing as quickly as nine days.

Rotterdam isn't the only place that 3D printing innovation is happening. The Maritime and Port Authority of Singapore, among others, is innovating in this space. DNV GL has already engaged in research for MPA Singapore as regards the printing of metal equipment for shippers. Further still, Singapore has succeeded in building a 3D printing plant alongside PSA at their Pasir Panjang Terminal.

Many arguments abound regarding the impact such developments will have on the broader spare parts industry and the flow-on impacts to ports. Many argue that 3D printing will result in a paradigm shift whereby current spare part manufacturers and patent holders licence CAD designs to ports/shippers who can then have them printed where – and when – they are needed, including offshore. The US Navy is trialling the use of 3D printers on-board their vessels at sea. While the applications are still very limited (again, think spare parts), they are making early progress, and the ball is rolling, so to speak.

Like shoes in 3D printing for retail, ship designers are able to use 3D printing in prototyping to speed up the design process. This, combined with the slow emergence of 3D metal printing techniques, will speed up the manufacturing process. It is still early days, but the US-based 3D Systems, which has partnered with a local shipyard, is aiming to revolutionize shipbuilding at a level on par with the invention of nuclear-powered vessels.

Finally, the last example is the printing of a complete boat by the world's largest 3D printer completed by the University of Maine. The 3D printer uses a special polymer and is capable of printing objects as long as 33 m (100 ft). It took just 72 hours for them to print a 7.5 m-long (25 ft) patrol boat.

Clever!

Punch into Google "3D printing in retail," and you get some 58.6m results… Not bad at all! While still at peak hype, 3D printing in retail has shown real signs of progress over the past five years with major brands like IKEA, Nike, and Lowe's investing in initiatives for 3D printing-based manufacturing and print-in-shop. With innovative start-ups – e.g., the Ministry of Supply and Bits and Parts – making 3D printing available direct to consumers in-shop and at home, the future of 3D printing in retail is likely to progress quickly, provided the cost of the technology continues to go down, allowing the advantages to be realized by many more year-on-year.

There are two exciting developments in the realm of 3D printed clothes. The first is the advent of brands like Danit Peleg, that offer fully customized and printed garments for sale online. While their production capacity is limited, this seems to be as much a branding choice as it is a manufacturing one. Despite their limited quantity (and relatively expensive unit cost), they are garments that are in demand. The second advent is the application of 3D printing technologies into knitting more traditional clothing items like jackets. By way of example, the Ministry of Supply has implemented a Japanese-built machine for 3D printing knitted clothing. Customers visit the shop and configure their custom jacket, which is then printed before their eyes over the course of about 90 minutes.

Major brands like Adidas, Nike, and New Balance have all begun manufacturing components of their shoes using 3D printing techniques. These include midsoles, uppers, and soles respectfully. In essence, spread across these three brands are all the makings for a fully printed shoe. It isn't so far-fetched to envisage a shopping experience where your foot is scanned, and a custom shoe is printed in-shop for you. While the goal of a fully printed shoe is still some time off, there are many advancements with several companies making progress. Having said that, the primary use of 3D printing in the shoe industry today is still in the widespread application of rapid prototyping.

Unlike clothing and shoes, whose materials make it challenging to print these items at home, furniture and homewares are making steady progress. The aforementioned Bits and Parts is an organization that aims to make furniture available to all by utilizing downloadable 3D printing designs. Currently, you can download CAD files for three "puzzle" chairs that you can print and assemble yourself. Olivier van Herpt is revolutionizing the concept of ceramics with high-end 3D printed ceramic wear. As with Danit Peleg, their target is clearly the premium end of the market, but it isn't long-sighted to see the print-at-shop and print-at-home business models taking hold here. As a case in point, IKEA has been prototyping customized chairs using 3D printing according to the print-in-shop model. It is also worth taking note of IKEA's ThisAbles project, which utilizes 3D printed, highly customized product solutions to increase the quality of life of disabled users. "By bridging the gap between existing IKEA products and the special needs of people belonging to the [special use] populations," the Swedish giants says, they aim to improve the usability of off-the-shelf products.

Another great example of customized product solutions using a print-in-shop business model is Lowe's, trialled on the US market, thanks to which you can print customized products and outdated replacement parts as needed. While it appears that the demand for this service is still low, the service nevertheless seems to be on the offer five years after its launch showing that there is some demand.

The final example is one of clever marketing. In 2014, Nescafé put together an innovative campaign using 3D printed lids for their standard product jars that doubled as alarm clocks. Users had to open the coffee jar, releasing the aroma of coffee to turn off the alarm clock. "Clever" is perhaps an understatement for the campaign; 3D printing was central in allowing the company to produce a limited, custom-made run of the lids.

Containerisation decimated?

Most of the retail examples we brought forward revolve around a dramatic shift in what is shipped and where. When the final retail shop or end consumer is the destination of unrefined manufacturing inputs and not the finished goods, one can easily envisage a dramatic overhaul of the entire supply chain. It isn't far-fetched to see container loads of raw, 3D printing materials (thread, plastics, metals, rubbers, and other synthetic materials, or simply plug-in cartridges with the suitable mixture) being imported to countries that would have typically been importing finished goods, to facilitate the 3D printing retail boom.

Furthermore, it is worth thinking about the source location and the size of supply chains in the future. Is it safe to assume it'll be necessary for raw commodities to travel as far as across the whole supply chain? Will China remain the steamroller if all you need to produce finished goods is raw plastic, metal, or other inputs, say wood-made shirts (wijld.com), sourcing certified materials from nearby forest industry powerhouses Finland and Sweden?

Finally, the impact on inland and last-mile delivery is probably going to change, too. Instead of large-format trucks shipping bulky finished end products, it's likely that we'll see smaller vehicles performing a higher number of bespoke runs – much like what we see in the last mile of parcel shipping today, which will, of course, have its impact on the grander cargo flow scheme.

As 3D printing becomes an ever more-viable reality for businesses, ports and terminals can use this technology to re-imagine their business models wholesale. After all, if cargo can be printed on the spot, this will significantly reduce the need for the plethora of long and environmentally damaging voyages container ships take on a daily basis. There are voices out there, saying in this context, "I think 3D printing is one of those disruptive technologies that is going to decimate containerisation in 20 years," like in 2018 did Diane Edwards, WISTA International Secretary and the Port of Auckland's General Manager People, Foresight and Innovation. ■

INFORM INFORM specializes in AI to improve operational decision making in container terminals. Based in Aachen, Germany, the company has been in the optimization business for 50 years and serves a wide span of logistics industries including maritime and intermodal terminals. For more information please head to www.inform-software.com