GE Healthcare Additive Messaging

Additive: Gamechanger for clinical care, healthcare industry

Additive Manufacturing, also known as 3D printing, has been hailed as the fourth industrial revolution because of its potential to improve overall product design, cost, and manufacturing[1]. Additive is transforming many facets of the healthcare industry, including patient care, research, and device manufacturing, and is positioned to drive cost efficiencies in clinical and industrial applications.

How GE Healthcare is adopting additive

- **Clinical**: There is growing clinical interest in 3D printing in the healthcare industry. GE Healthcare is partnering with clinicians to optimize 3D printing technologies to enhance surgical planning, patient education and physician training.
- **Software**: In 2016, GE Healthcare introduced a software that efficiently converts images from GE imaging systems into 3D printable files, accelerating connectivity for clinicians.
- **Engineering and manufacturing:** Additive is enabling GE Healthcare to pursue new designs not possible with traditional manufacturing methods, and develop parts and products more efficiently and effectively. In our Life Sciences business, we're working with customers on customized additive applications for bioprocessing.

In the next 10 years, GE Healthcare estimates that 70 percent of its imaging systems have additive manufacturing opportunities. Within 50 currently active additive projects across CT, X-ray, MR and Ultrasound, GE Healthcare is anticipating reductions in sub-system component parts of more than 80%, decreased production costs of 30%, and improved image quality made possible by additive techniques.

Clinical:

Surgical planning and education: GE Healthcare's Voluson E10 is the first ultrasound system in the OB/GYN field to have a print capability directly built into the system. With this, doctors can help parents better understand defects such as cleft lip, abnormal extremities, or abdominal wall defects. In some cases, 3D printing can enhance discussions around surgical planning and for education purposes.

3D printed device components: GE Healthcare introduced a new head coil for two MR systems designed and developed using 3D printing innovation. The head coil, which is placed on top of a patient's head and neck during an MRI, can help deliver improved clinical performance for patients via a fit-adaptable design that fits 99.99% of the patient population. Fit can be an issue in MR imaging, where coils need to be adjusted to fit patients ranging in size from children to football players. The 3D innovation used in the head coil design saved development time and costs, and supports a design that couldn't be produced using traditional manufacturing technologies.

Custom bioprocessing solutions: GE Healthcare's Life Sciences team is working with the biotechnology company Amgen to test the performance of a chromatography column, which is used in the complex biopharmaceuticals development process to identify a range of drugs used to treat diseases including cancer and immune diseases. The 3D printed column has been custom-designed and is now being tested to see if it can be used in Amgen's research to help develop improved processes for the purification stage of biopharmaceutical production.

Software:

- After a patient is scanned, Clinicians use GE Healthcare's AW advanced visualization software to review the images, segment organs or regions of the body, and use The Volume Viewer application to create 3D renderings of the affected area. AW's advanced visualization application accelerates the workflow necessary to create these models – and are 20% faster than previous AW products.

- High-quality 3D printing requires high-quality images that can be segmented. GE Healthcare's AW software provides detailed visualization, segmentation and quantification of specific organs and systems.

- Until recently, if clinicians wanted a 3D print of the rendering, they would rely on third parties to export the renderings to a 3D printer-friendly file. According to some clinicians, this could take days depending on the complexity of the models. In 2016, GE Healthcare introduced a software that converts a 3D segmented image to an STL file readable by 3D printers, right from any VolumeShare 7 platform, which can cut down the processing time significantly.

- Unlike other file converters, this software was designed specifically for healthcare clinicians to print 3D medical models.

- Clinicians use 3D organ models for a variety of reasons, including patient education and surgical planning or simulation.

Engineering & Manufacturing:

- Additive manufacturing will help drive new levels of productivity for GE and its customers. It combines cutting-edge technology and new manufacturing processes to lower cost and accelerate the innovation, speed and performance of industrial products.

- Additive manufacturing enables GE Healthcare to develop parts and products more efficiently, precisely, and cost-effectively, accelerating the speed at which we can test prototypes and bring products to market. Instead of waiting days or weeks for a component part to be produced and delivered by a 3rd-party supplier, we can fabricate and test it onsite.

- GE Healthcare is deploying 3D printing capability in its product design and engineering for component parts. By 2025, GE Healthcare estimates that more than 70% of the major components of its imaging tech will be touched by additive advancements and 3D printing (detectors, tables, etc.).

- We recently opened our first European 3D printing lab, called the Innovative Design and Advanced Manufacturing Technology Center, in Uppsala, Sweden, adjacent to our Life Sciences business there. The center will use technologies including 3D printing and robotics to help speed up the launch of new innovative products for the healthcare industry. Teams will design, test and produce 3D-printed parts for GE Healthcare products and prepare for final transfer to manufacturing. GE Healthcare's other Advanced Manufacturing Engineering Center is in Milwaukee, WI.

Other Advanced Manufacturing

- In addition to 3D printing, GE Healthcare is pursuing other advanced manufacturing capabilities such as augmented reality and collaborative robots in its production facilities.

- Further part consolidation and material optimization are being explored as part of our manufacturing strategy, along with 3D printing applications for electronics and sensors.

Growing our Capability for Customers

- Customer interest in 3D printing spans various disciplines including radiology, surgery, orthopedics, general practice and medical education and research. Recognizing the potential of 3D printing, many hospitals are exploring development of 3D printing capabilities onsite and we are working with them to explore these opportunities.

About GE Additive: Through GE Additive, a business unit focusing on industry-changing software-defined machines, GE is developing 3D printers for the healthcare space. GE Additive includes controlling ownership of additive machine providers Concept Laser and Arcam EBM. Metal additive machines from both companies are used in the medical industry today, including surgical, implant and medical instrument segments.

[1] Maynard, Andrew D. "Navigating the fourth industrial revolution." Nature nanotechnology 10.12 (2015): 1005.