World Knowledge Forum 2013

Technology Frontier – 3D and 4D Printing

Imagine a printer that is capable of printing its own parts. This is the reality that 3D printing is presenting us with. The current state, applications, and future of 3D and 4D printing were discussed by both business and academic perspectives on the final day of the 2013 World Knowledge Forum. Skylar Tibbits, Director of the MIT Self-Assembly Lab, and Jonathan Jaglom, the General Manager of Stratasys for Asia-Pacific and Japan joined moderator Eric Kim, the Managing Director of Maverick Capital, to explain the future of printing.

Mr. Jaglom began from a business and manufacturing perspective. "We are helping designers to perfect their ideas, helping manufacturers to evolve the way they make things, and transforming the way individuals, teams, and organizations work," he said. To accomplish these goals, Mr. Jaglom identified three major areas that Stratasys works in: rapid prototyping, digital direct manufacturing, and the consumer space.

"People don't want to buy a quarter-inch drill; they want to buy a quarter-inch hole," Mr. Jaglom stated. The 3D printer allows the user to rapidly create prototypes. "These printers are the enabler. The actual product at the end of the day is the model at hand. What you can do with that product is key," he added.

Currently, 3D printers are able to utilize both thermoplastics and photopolymers to create different materials with their own distinct properties. These highly versatile materials find applications in the dental, automotive, defense, and aerospace industries. Mr. Jaglom was particularly enthusiastic about the aerospace application. "We can print parts that are lighter than conventional parts, so fuel efficiency is advanced," he said.

In the private sector, 3D printing opens the door to customization and personalization of consumer goods. "The world is becoming more and more customized," said Mr. Jaglom, adding, "One thing we have to realize is the importance of you." Using software, customers are now able to manipulate

CAD design files, create their own custom version of a product, and print it themselves. "With 3D printing we are given the ability to express how we are different," he said.

From the academic perspective, Mr. Tibbits imagines a future where "we don't just 3D print things that we already have, but make things that could not have been made before." To this end, Mr. Tibbits has been working on self-assembling materials. He said, "The parts themselves have the information; the parts know how to build the product."

3D objects, which are able to alter their shape over time and varying conditions, have been dubbed 4D. "The fourth dimension is time, we wanted to add time," defined Mr. Tibbits. To foster this change in shape, there must be a certain amount of energy added to the system, but the source of the energy is unimportant. "Random, super noisy, cheap energy can be used to build a precise structure," he clarified.

One of the goals of 4D printing was explained by Mr Tibbits. "We need materials that can be programmed, that can be printed easily, and have that intelligence, that they can transform; parts that are smart enough to assemble themselves," he stated.

Mr. Tibbits also spoke of potential applications of his research in areas as diverse as the up-close study of protein folding, the disassembly of consumer electronics into recyclable forms, and environmentally adaptable sportswear. "You can imagine equipment, clothes, and shoes that respond to the environment and perform better," he explained, highlighting the possibility of sport shoes being capable of growing cleats when in contact with grass.

There are, however, certain limitations to 3D printing technology. Mr. Tibbits mentioned that print speeds are too slow, and the difficulty in printing objects larger than the printers themselves are issues which must be overcome. He was not without ideas for potential solutions to the latter, suggesting that with the use of his 4D research, it could be possible to "fold up the design into a super dense and small shape, print that, and unfold it after printing."

While Mr. Tibbits focused on technical issues with the printers, Mr. Jaglom brought up different issues altogether. "Communicating the value of 3D printing and creating awareness of the product remains our biggest challenge," he said. Despite the challenges, Mr. Jaglom is eager to champion the technology, and echoed the sentiments of both speakers when he said, "We are passionate believers in the value and power of 3D printing, and the change it can bring to the world."