4D Printing

Self-Assemble, Self-Shape, Self-Repair

4D printing, which builds objects using smart materials, could change everything.

This next-generation technology will enable companies to manufacture products that can self-assemble, reshape themselves, or otherwise react to changing conditions, revolutionizing how we design, manufacture, and interact with objects of all kinds.

Programmable Materials

There is no such thing as a 4D printer; 4D printing is actually a new use for 3D printers. The real stars of the show are smart materials that enable the printed object to alter itself long after it is made. These materials – such as hydrogels, or shape-memory polymers – are programmed to stimulate the object to change its shape, function, or color, such as when it encounters water, light, heat, or electric current.

The output? Self-flattening boxes for warehouses and logistics. Plumbing pipes that expand or contract in response to water flow. Medical implants that adjust to our bodies. Self-assembling shelters that spring into place after natural disaster. Bridges and roads that can self-heal.

The First Shape Shifters

While 4D printing is largely used for prototyping, a number of real use cases have emerged:

- NASA's flexible metal "space chain mail," which could be used to shield a spacecraft from meteorites, for astronaut spacesuits, or for capturing objects on the surface of other planets
- A self-assembling shoe that could eliminate a complex production process involving significant labor
- A 4D-printed airway splint that grows with the child for infants suffering from a condition that causes their windpipes to collapse
- Airbus's air inlet component, which is made of programmable carbon fiber that adjusts itself automatically to control airflow used to cool the engine, removing the need for heavy mechanical control systems

A Living Product

Smart materials and 4D printing have the potential to expand the types of products we design and manufacture, as well as change how we use them.

Companies will be able to make products that change and grow throughout their lifecycle. When combined with other advancing digital capabilities, including Internet of Things, AI, and robotics, the potential disruption to manufacturing could be even more profound.

Read More in *How 4D Printing Will Shift the Shape of Manufacturing*