"4D" printing means producing a 3D multi-material printed part that reacts to external stimuli, such as heat, moisture or sound. In 4D printing, material is pre-programmed to have sensing and actuating abilities that allow the material to self-transform over time. When exposed to energy from heat, light or moisture, the printed component can morph into the chosen 3D shape. The part can also be returned to its original shape by applying the relevant stimuli.

3D printing offers an alternative way of producing the same product that might have been created using CNC machine or injection moulding before, 4D printing allows creation of parts that traditional manufacturing methods cannot fabricate. 4D printing will open access a whole range of functions that weren't feasible in the past. It is possible to print non-static, highly intelligent, active parts that can sense and self-transform, without the need for heavy and expensive sensors or motors. This ability will allow 4D printed products to thrive in the quest to form smarter and lighter products.

Smart materials are typically a niche area, and their fixed properties can make them difficult to implement, but using printing processes for rapid design and manufacturing opens a whole new world of highly customisable complex parts. The 4D printing market is still in an early R&D phase, and there is not yet a standard process or software package for 4D printing. Given these challenges, commercialisation is at least 10 years away.

There are potential automotive applications in these new materials technologies, especially in future autonomous vehicles. The BMW Design Department, working with MIT's Self-Assembly Laboratory, have successfully developed printed inflatable material technologies that self-transform, adapt, and morph from one state to another. The MIT lab created a "Liquid Printed Pneumatic" process, which uses air chambers that inflate or deflate in a stretchy material. The designs would be 3D-printed and programmed to respond to getting or losing air whenever needed; the breakthrough came when they managed to print air- and watertight inflatable geometries, like customised printable balloons. With this technology they can produce complex channels and pockets that self-transform.