

# Chapter 1

## Digital Technologies and 4D Customized Design: Challenging Conventions With Responsive Design

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### ABSTRACT

*Digital design tools are rapidly changing and blurring the boundaries between design disciplines. By extension, the relationship between humans and products is also changing, to the point where opportunities are emerging for products that can co-evolve with their human users over time. This chapter highlights how these ‘4D products’ respond to the vision laid out three decades ago for ubiquitous computing, and have the potential to enhance human experiences by creating more seamless human-centered relationships with technology. These developments are examined in context with broader shifts in sociocultural and environmental concerns, as well as similar developments being researched in Responsive Architecture, 4D printing and systems designed to empower individuals during the design process through interactive, parametric model platforms. Technology is fundamentally changing the way designers create physical products, and new understandings are needed to positively guide these changes.*

### INTRODUCTION

Human-centered product design, where the end users of a product remain at the forefront of all design decisions, is evolving rapidly as the opportunities of the digital age become better understood. The boundaries between design disciplines are blurring as digital technologies break down traditional practices, creating products that challenge design conventions. This chapter discusses the significance of changes to product design and design systems enabled by digital technologies in relation to human

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development. In particular it considers how the relationship between people and products could change with a shift in thinking from static, resolved outcomes to digitally enabled products, in particular ones that are capable of changing over time—4D products—and the implications of that change. This affects the designer-product relationship, and the customer-product relationship as well as the systems within which they operate.

Examples of practice-led design research in the latter part of this chapter introduce different approaches to the development of 4D products. These provide starting points for a practical and theoretical framework for design research and education in the changing digital design environment from user experience, through interaction, to a digitally enabled product service system. Designs based on ubiquitous computing allow for the development of products that change the relationships and experiences in human-centered product design. Based on additive manufacturing processes, 4D printing allows for products that morph under certain conditions, as do examples from the field of responsive architecture (Meagher, 2014). These approaches challenge designers to think less about static, final outcomes, and more about the opportunities for objects to evolve into different states through their lifespan. As such, designers are called on to develop systems and parameters for product permutations, rather than fixed product outcomes, and rethink their role and relationship to products and users, and the impact of their designs in a digitally connected world. This aligns with current theory on the relationship between human evolution and digital technologies.

## **HUMAN EVOLUTION IN A DIGITAL ERA**

There is an argument that the biological mechanisms that have governed human evolution for 3.5 million years have been disrupted by the development of human cognition and cultural behaviors, overwhelming natural systems, and resulting in what is termed “Human Evolutionary Stasis” (Powell, 2012). The suggestion is that humans have the ability to collectively circumvent the challenges they may otherwise face as individuals, and that this is impacting the biological evolution of the species as a whole.

*The human organism is a paradigmatic case of ontogenetic adaptation: thanks to an enormously flexible cognitive and behavioral repertoire, including the ability to acquire and transmit cumulative (intergenerational) cultural adaptations, humans can survive and reproduce across a wide range of otherwise hostile developmental conditions. (Powell, 2012, p. 150)*

Yet the impact of technological development on early learning and ontogenetic adaptation could be argued to be challenging the idea of a stalled evolution of the species. If human evolution is seen as referring to its adaptation to the complex systems in which humans operate, then human development in a technological age is evidenced by the ability of each successive generation to adapt more quickly to evolving digital systems:

*Gen Y have grown up in a world of rapid technological advances affecting the way they learn, their approach to knowledge acquisition and the forms of interaction between themselves... as a result of their techno-dependency and the fact they are accustomed to using computers and Internet to perform any given task, Gen Y has formed unique characteristics and competences... (Petrova, 2014, p. 525)*

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