

## **Consumer Product Innovation and Sustainable Design**

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This paper summarises some of the content and conclusions of a new book titled *Consumer product innovation and sustainable design* published by Routledge in 2015. The book is based on the author's previous research [1,2,3,4] and inspired by his archive collection of *Which?* magazine. This (UK) Consumers' Association publication provides a unique written and pictorial record of the technological and design evolution of consumer products marketed in Britain from 1957 to the present. The core of the book comprises case studies of six classes of consumer durable product– bicycles, washing machines, electric lamps, television equipment, vacuum cleaners and mobile (cell) phones. The case studies draw upon the reports in *Which?* plus numerous other sources to track the technological innovation and design evolution of these products from their initial invention to the present day. The case studies also examine when, why and how environmental criteria such as improved energy efficiency became part of the design specification of these product classes; the influence of socio-economic and cultural factors on their innovation and design; and the impacts of consumer adoption of these products on society and the environment.

The paper draws on empirical evidence from the product case studies to provide general conclusions about patterns of technological innovation and design evolution and to compare these patterns with existing innovation theories. The paper will also make use of the evidence of the case studies to provide guidelines and lessons for product designers, engineers, developers, managers and marketers; for example, on what makes some models and brands of consumer product successful and others market failures; how to design for reduced ecological impacts; and any general trends that might be useful when planning future consumer products.

The first conclusion from the cases is that the different products follow similar patterns of innovation, design and evolution; going through one or more divergent, convergent and divergent phases. For all the products, one or more key inventions were created that started an initial divergent phase of design experimentation and technical development. Following this early divergent experimental phase, one or dominant designs typically emerge – as originally proposed by Utterback and Abernathy [5]. The dominant design phase is typically followed by another period of technological divergence and design variety. This phase can be explained by innovation S-Curve theory [6] and the concepts of *sustaining* versus *disruptive* technologies [7].

Another conclusion from the case studies is that the products could not have been developed without prior scientific and technical knowledge and enabling technologies. The extent of this dependence varies for different products, with mechanical and electro-mechanical products such as vacuum cleaners being based, at least initially, on craft knowledge and practical skills, while the electronic innovations of television and mobile phones could not have been invented without scientific, theoretical and technological foundations.

A third conclusion is that information and communications technology (ICT) is being applied in many more consumer products. For example, washing machines connected to smart meters or the Internet will enable the machine to be turned on remotely by an energy supplier when the grid is lightly loaded or when a domestic solar energy system is generating electricity. This is part of a general trend towards the interconnection of different products and systems [8].

Designing for the environment and sustainability is becoming increasingly important. Designing for the environment is evolving from narrow 'green' design approaches to designing more sustainable product-service mixes and systems innovations [9]. The shift to sustainable design and innovation is of growing urgency as demand for and ownership of consumer products spreads from already wealthy countries, first to rapidly developing countries such as China, India and Brazil and then, with increased electrification, to low income countries.