
New Product Development of Wearable Technologies: A Framework of Wearable Epiphanies

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Abstract

This paper tackles the issue of wearable technologies' marketability, analyzing alternative paths of new product development (NPD). Currently, wearable technologies NPD mainly remains within the borders of computer science which develops oddly looking wearable computers and radical fashion design which emphasizes the beautification of technologies as experiments to interaction design. Users are generally considered as passive adopters of technologies with little engagement at design and post-design stages. In contrast, a proposed framework of wearable epiphanies places users on the intersection of technology push innovations and radical fashion stressing current HCI implications, while investigating future possibilities.

Author Keywords

Wearable technologies; technology epiphanies; radical fashion design; new product development

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous. See:

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Introduction

Wearable technologies refer to interactive clothing and accessories that couple radical fashion design with breakthrough technologies. While technological innovations in wearable technologies may refer to nanotechnology, sensor technology or intelligent systems, radical fashion design combines the aesthetics of fashion with an interactive experience [1,10,11].

Although interactive qualities of wearables technologies are largely acknowledged and systematically explored, their commercial appeal shrinks to market niches, and their future diffusion to broader audience is still ambiguous [5,6]. Different communities and firms also engage with wearable technologies' research and development without any of them defining a clear path of commercial exploitation yet.

By coupling human-computer interaction (HCI) and innovation management literature, we aim to illuminate the problem of wearable technologies' popularization: how wearable technologies are going to be the fashion product of the future? This question underpins not only technological innovations that radically or incrementally improve wearable technologies, but also the cultural, organizational and market factors that determine their future diffusion to larger audience.

Especially in NPD literature, the increasing interest about radical design makes wearable technologies an ideal, but currently unexplored case to discuss. NPD theory supports that when radical design is combined with technology push innovations, new products emerge on 'technology epiphanies' [14] (Fig.1). While technology push innovations radically improve functionality of products, radical design imposes new

meanings and aesthetics. However, this framework considers users as passive adopters of these products, without being able to reassign meaning in wearable technologies. In contrast to fashion apparels adoption based on creating style as bricolage, wearable technologies are technological products designed to perform specific and in most of the times single tasks.

Currently, NPD of wearable technologies mainly exploits market niches, such as health, sports, military and workwear interactive clothing and accessories [10,11], creating products as technology epiphanies that users adapt and use without being able to reassign their functionality, aesthetics and meaning.

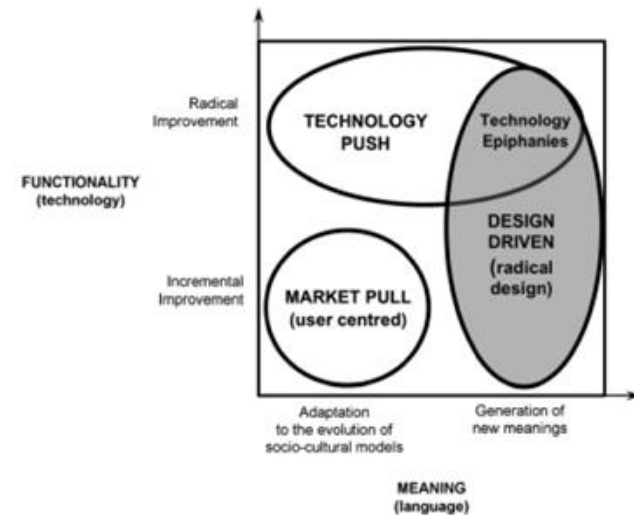


Fig. 1. Innovation strategies and the positioning of radical design and technology epiphanies (Source: Verganti, 2011).

Although technology epiphanies' framework describes wearable technologies' design as an interdisciplinary

field that couples digital technologies and aesthetics of fashion [10], the cultural acceptance of wearable technologies from consumers is relevantly neglected and restricted to adopting certain products.

In contrast, a proposed extension of this framework which we call 'wearable epiphanies' (figure 2), provides fruitful implications to HCI and NPD repositioning the user in the development process of wearable technologies. Innovation management also needs to reconsider the role of users in the development and use

experience [9]. Based on our wearable epiphanies framework, we finally aim to address HCI implications that give a clearer direction to future development of wearable technologies, while revealing the main barriers of their marketability and popularization.

A framework of wearable epiphanies

The past two decades have ushered in a growth of interest on the integration of wearables with digital technologies, such as mobile communications, social networks or ambient intelligence networks [2]. Smart

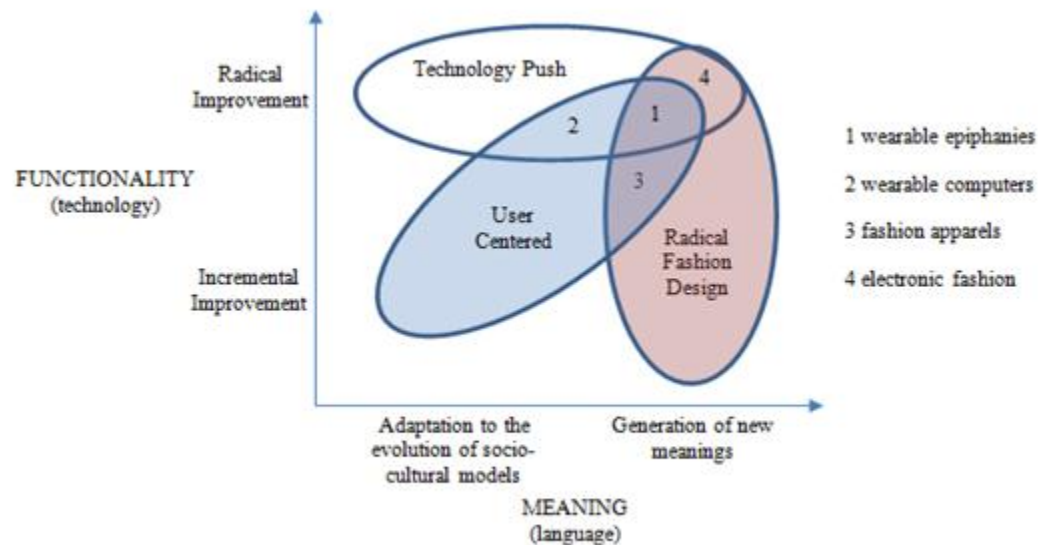


Figure 2. A framework of wearable epiphanies (Source: the authors).

of wearable technologies, addressing organizational and market requirement. Our main contribution focuses on identifying promising research areas in the unexplored space between wearable computing, radical wearable technologies' design and NPD that emphasize users'

garments as key component embedded on wearables monitor our embodied conditions and emotions, while actuating them on the wearable interface and/or mobilise action on spatial environment [2,11]. As interactive interfaces, wearable technologies respond to

light, sound, environmental stimuli and gesture, while as emotive interfaces they are able to detect and broadcast wearers emotions, such as joy, anger or fear [10,11].

In particular, wearable computers (2) incorporate technology push innovations in materials and require systematic efforts in order to meet functional applications. On the other hand, computer scientists constantly push the boundaries of what wearable computers are able to do; nevertheless their designs are often experimental prototypes and rarely exploit the aesthetics of wearable technologies. In addition, this area includes a wide range of wearable technologies, which are designed to perform particular tasks. For instance, wearIT@work included a variety of wearable application in working conditions, however this project did not provide “an overall system that can be used for all wearable applications” [8:3688].

In addition, fashion apparels design (3) is a second marginal area to wearable epiphanies. Although this area is non-technological, it often includes technological innovations in materials. However, stylistic innovation which revitalizes market and tastes results as an outcome of fashion design and bricolage based on social signalling mechanisms [3]. NPD of wearable technologies requires a good understanding of how style is created and diffused, because positioning of wearable technologies is still unclear: are they going to enhance or replace fashion apparels in the future?

Furthermore, electronic fashion (4) is an additional marginal area that celebrates wearable technologies. Designers, such as Hussein Chalayan have provided beautiful visions of *haute* technologies which integrate

aesthetics with computing; however their aim is often to create experiments of interactive design which ultimately end up in museum collections and not in the market.

A closer view to the relationship between fashion and technology reveals a significant role for users which is relatively dismissed in technology epiphanies framework. Thus, we propose an extended version that we call ‘wearable epiphanies’ (1) in order to analyse wearable technologies on the intersection of radical fashion design and technology push innovations, while addressing the ways in which the three marginal areas can contribute to their development. In contrast to a model of wearable technologies’ NDP according to which users as passive adopters, wearable epiphanies repositions the role of users into an active mode, as they create new meanings through the wearable interface: “the profound psychological and cultural reasons people use a product” [12].

Design Implications for Wearable Space

Designing for the wearable interface

Wearable epiphanies underpin wearable technologies as a medium, a wearable interface that performs interactive qualities, instead of a technological product designed for a particular function. Wearable epiphanies emerge as radical products that shift the context of innovation from social signalling mechanisms of fashion apparels [3] into the creation of an interactive wearing experience, which forms the basis for NPD, future marketability and further commercial exploitation. In contrast, wearable epiphanies introduce new qualities to wearable technologies NPD, highlighting novel HCI requirements.

In particular, wearable interface can be manipulated by users, performing multiple tasks instead of a single task approach. For instance, Google's 'Google Glass Project' is an augmented reality wearable device in the form of a glasses' frame, which brings applications of smart phones to a wearable device using novel software. Similarly, the WUW project is developed on wearable epiphanies, as users can reconfigure settings and use it in different situations [9]. Consequently, these versions of wearable epiphanies conceptualize wearable interface as an information space, which can be reconfigured according to users' needs.

Building services on the wearable interface

These new meanings form a novel 'core product' that includes the physical aspect of apparels and accessories enriched by digital media, such as software and hardware, as well as an 'actual product' based on an interactive experience. In addition, wearable technologies offer an unprecedented opportunity to shape a radical 'augmented product' building services and applications at post-design stage [6]. Therefore, wearable epiphanies invite a new type of bricolage which re-assigns meaning which exceeds the social signalling of the clothing and includes digital qualities. Wearable epiphanies invite 'digital bricolage' of wearable technologies as a process of open innovation and participation in the design process that enables personalisation and self-exploration of the wearing experience. Fashionability refers not only to the surface, but also to the digital qualities of wearables.

Provide platforms for interdisciplinary collaboration, this is organizing problem and an end in which innovation management should develop in order to integrate HCI attributes. Since collaboration is taking unique forms,

there is no 'best practice' of how to develop wearable technologies, similar to mass market fashion apparel firms. Organizational practices are currently fragmented and reflect the heterogeneous nature of this interdisciplinary field, revealing an organizational role for innovation management, and an additional dimension to HCI research: how to couple diverse communities into single projects, as well as how to accumulate knowledge over time.

Including users in the development process

A final dimension of wearable epiphanies which to the best of our knowledge not explored within HCI research concerns the extent to which users can participate to wearable technologies' design. Processes of mass customization and open innovation may contribute to explore this dimension, which currently is explored in artistic projects, such as wearable performance. These projects can be a rich source of user experimentation, placing performers in the role of users.

Discussion, Conclusion and Future Research

Wearable technologies shift the creative and technological exploration from fashion object itself to an interactive experience that occurs through a fashion object. On one hand, radical product development and discontinuity might lead to constant emergence of new technologies; however this approach places the creation of the interactive experience within a purely technological context. As such the exploitation of technology epiphanies from technology push innovations to radical design is essentially based on disciplinary forces that develop technologies based on transparent remediation.

In contrast, when wearable technologies emerge within a design-driven context, interactive qualities place the context of creative and technological exploration on the wearable interface, challenging previous structures and roles. Interdisciplinarity does not only emerge as horizontal collaboration within and between organisations, but essentially as a new paradigm in radical design, according to which wearable epiphanies fuel technological innovation and the evolution of new media. Nonetheless, wearable technologies as augmented products provide unprecedented opportunities for novel applications, building services on interactive qualities of wearables and by further exploiting the wearing experience.

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This paper aims to set the theoretical ground for further empirical research in the field of wearable technologies. In particular, future research aims to include data from cases that engage alternative paths of NPD in order to verify key theoretical positions of this paper. As many projects have been initiated within interdisciplinary collaborations; there is still an urgency to fully explore this direction, especially considering the role of users at design and post-design stages. Finally, future research can emphasize organizational innovation in the development of wearable technologies as policy-making and entrepreneurial practices shape a fertile context of innovation that includes producers and consumers.

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