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Moving towards the incomplete: A research agenda for the development of future products in the digital economy

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Abstract

Pervasive digital technologies are advancing at an exponential rate, changing the nature of products and services as we know them. Firms could now serve context through the delivery of digitally enabled offerings. Serving context requires the product to be designed as incomplete, allowing the consumers to complete the offering in context through the application of their own resources. An offering may be digitised in such a way that functionality can be added (reprogrammed) even after the product has been transferred to the customer. In that respect, the product will remain "incomplete" through life [1]. An incomplete product can be tailored to the customers' context to obtain a better "fit" with its environment and what the customer wants to achieve. Value co-creation occurs in context; empowering the consumer with the ability to dynamically reconfigure the offering the benefit is potentially increased. Incomplete products skew the trade-off between standardisation and personalisation. In the case of the iPhone®, the boundary of standardisation is drawn at the hardware level where as the boundary for personalisation is drawn at the digital app layer, allowing firms to derive scale economies whilst the customer achieves high levels of personalisation. This paper proposes three areas need a completely need study. First, it explores product and service architectures and the role of modularity within incomplete products. Second, it aims to conceptualize a meaning for indefinite postponement, a new concept enabled by incomplete products and digital technologies. The final area for discussion is transaction boundaries. Roll Royce have shown through their Power by the Hour © that transaction boundaries can be redrawn so that the focus is on outcomes rather than exchange. The concept of incomplete product will have a significant impact on transaction boundaries in the digital economy. As the offering is reconfigured in context, understanding the human resource and how they integrate their own resource into the offering will be key. A number of challenges for service research are proposed that will have significant implications on the development of incomplete products in the connected digital economy.

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1. Introduction

The digital economy is providing firms with new opportunities. One of these is that firms could potentially serve context (value-in-use). Huge strides have been taken to understand how to achieve value-in-use, especially within fields like marketing. Research has shown that consumers evaluate value of the offering against their use and experience of it [2]. This suggests value to the consumer is different to that of a firm. The consumer evaluates value based on use and experiences, yet the firm views value as worth (money) [3]. With this in mind, the consumer will more often than not buy the offering out of the context of use.

Firms have the chance to serve context by developing dynamically reconfigurable offerings. The concept of dynamic reconfigurability has been developed considerably in systems design but as of yet, hasn't been appropriately transferred to the product design and engineering community. Within system design, it has been described as *"the capability to modify their functionalities, adding or removing components and modify interconnections among them"* [4, p.1]. By incorporating this concept into future offerings functionality can be added (reprogrammed) even after the product has been transferred to the customer. In that respect, these products remain 'incomplete' through life [1]. The 'incompleteness' means future offerings will exhibit flexible boundaries (as opposed to 'fixed' boundaries that limit the offerings functionality) allowing them to materialize new affordances based on the context of use [5]. We define incomplete product to be 'a physical product, design with a modular architecture, capable of dynamic reconfigurability allowing for the offering to obtain an optimal fit within the actors dynamic and ever changing context of use where the transaction boundaries are aligned with the context of use. It is suggested an incomplete product exhibits the following characteristics: it can be actuated (controlled); capable of dynamic reconfigurability (through its modular architecture); it is visible; integrates personal data and is part of a system (can be coordinated) [3]. The classic example is the smart phone. When transferred to the customer it only has a few functionalities but through the app store, customers are able to configure the phone to materialize new affordances such as a dictionary or a games platform. The platform is therefore standardized at the point of exchange (economies of scale benefitting the firm) yet highly customizable in context. Empowering the consumer with the configurability means that transaction boundaries must be engineered to context and postponement now becomes indefinite [6] while the offering begins to exhibit characteristics of a service. These are made possible through the products architecture, where modules are capable of dynamic reconfigurability within the consumption space. It is these concepts - postponement, transaction boundaries and product and service architectures - that are seen as key features for the development of incomplete products in the connected digital economy. However, theories and methods in these areas have been developed in a material world where the focus was on standardization and value-in-exchange. The digital economy provides new challenges, which require an extension of these theories to cope in a digital world. The subsequent section proposes that these areas need a completely new study for the development of incomplete products in the connected digital economy where the focus is on value-in-use and outcomes.

2. Literature review

2.1. Product architecture, service architecture and modularity

Product architecture is predominately known as *"the scheme by which the function of a product is allocated to physical components"* [7, p419]. Following the inception of Henderson and Clarks [8] paper on architectural innovations, product architecture research gained momentum. The research community focused heavily on product and process architectures with two main concepts at its core; modularity and integrality.

Recently, a new set of architectural literature in the service community has been growing. An important characterization of services in comparison to products is that they are usually produced and consumed at the same time [9]. IfM and IBM [10] have stated that service architectures are one of the most important challenges for the service community, calling for a greater emphasis on understanding and developing them. It is said that the decomposition of service system functions into individual elements is what delivers the overall services of the service system [9]. It is easy to see the similarities between service and product architecture from this definition whilst the concept of interfaces is also similar. Service interfaces include people and information [11], as opposed to physical product interfaces. It can be said that both product and service modules deliver information, albeit through

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