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Product-Service Systems across Life Cycle

User-Interface Design for Individualization Services to Enhance Sustainable Consumption and Production

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Abstract

Mass Customization (MC) inherently offers the service of individualization of goods and services to customers aiming at better meeting customers' personal needs. The potential to increase the sustainable performance of businesses by applying MC has been examined in various consumer goods related EU projects so far. Especially, when offering MC as a sustainable Product Service System it is capable of improving the management of the whole product lifecycle. Evidence of this approach has already been presented for some sectors, such as in food and apparel. In other sectors, the interaction between MC and sustainability has not been significantly explored yet. In this paper, we both, theoretically and empirically assess the integration of sustainability in the individualization service offered through user-interfaces, such as in particular configurators. We provide insights from reviewing more than 900 web-based configurators within 16 different industries. Our analysis reveals that only about five percent of all user-interfaces address sustainability issues in their individualization services. By linking our results with the insights gained in our literature review, we make recommendations for the integration of sustainability in the user-interface design. Furthermore, we identify opportunities for future research.

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Keywords: Mass Customization, Sustainable Product-Service Systems, User-Interface Design; Sustainable Configuration

1. Introduction

The European research project *SMC-Excel* aims at enhancing the sustainability in the consumer electronics industry through the integration of new business models based on the ideas and concepts of Mass Customization (MC). This, on the one hand, requires the development of new services for an effective management of the entire product lifecycle and an empowerment of the product manufacturers and distributors, which can both take the lead of the systemic innovation required for the implementation of sustainable mass-customized consumer electronics goods. On the other hand, a modification of consumers' behavior is required. This paper mainly addresses the latter objective. Through the development of user-interfaces that enable the configuration of products according to individual needs, purchase decisions could be stimulated towards more sustainable choices. User-interfaces, which systematically provide information on the sustainability impact of the combination of various product attributes, could lead to the production of more sustainable products, and they might encourage a sustainable management of the products' middle and end of life span. The verification of these assumptions is an integral aim of the *SMC Excel* research project.

The general potential to increase the sustainable performance of businesses by applying MC has already been examined in several consumer goods related research projects (e.g. CoRNet "Customer-Oriented and Eco-friendly Networks for Healthy Fashionable Goods, Enviro-Tex-Design, Micro-dress", SMCS "Sustainable Mass Customization - Mass Customization for Sustainability", My Wear "Customised Green, Safe, Healthy and Smart Work and Sports Wear").

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These projects provide evidence of the application of sustainable MC in practice in some specific sectors, such as in food, apparel and furniture.

In this research paper, we assess the current state of sustainability integration in web-based user-interfaces in theory and practice. The provision of a user-interface and its respective usage constitute a service of individualization that could be capable to enhance sustainable consumption and production. We design a framework of analysis to assess the inclusion of sustainability aspects in user-interfaces using the cyledge configurator database (configurator-database.com). We analyze 903 configurators from 16 branches. With our review, we provide a state-of-the-art overview on the present degree of sustainability integration into the product service system (PSS) of MC. Furthermore, we aim at understanding how sustainability information is currently presented and used in user-interfaces. Finally, based on the insights from both theory and practice, we define generic recommendations for the integration of sustainability in user-interfaces. These generic ideas constitute the basis for testing the integration of sustainability information in user-interfaces in future research.

Hence, with our paper, we seek to improve the understanding of how individualization services can be used to positively influence consumer behavior towards sustainable consumption. By this means, we also contribute to the understanding of how companies can promote sustainable production by integrating sustainability information consequently into their individualization service.

In the following, we give a short introduction to the concept of MC and its relation with sustainability. Thereupon, we turn to the particular topic of user-interface design for individualization services in theory. In a next step, we outline the methodology of our empirical analysis of sustainability integration into user-interfaces in practice. In section 3.2, we describe the results of our investigation. This is followed by a discussion, comprising a joint reflection of our insights obtained in the theoretical and practical analysis. We conclude our paper by summarizing our key findings and indicating opportunities for future research.

2. Sustainable User-Interface Design in Theory

2.1. Mass Customization and Sustainability

The term MC was popularized by Joseph Pine in 1993 who described it as “developing, producing, marketing and delivering affordable goods and services with enough variety and customization that nearly everyone finds exactly what they want”[1]. The intention of MC is the production of goods and services that coincide with the idiosyncratic needs of customers while maintaining mass production efficiency[2]. For the customer, the decision to purchase a customized good is the result of a simple economic equation: the higher the expected returns from the product exceed the costs, the more likely customers are to consider a customized product in their purchase decision[3]. The returns of an individualized product are twofold: First, the customer’s conceived value of a mass customized product is greater than the value of a mass produced product due to increased utility[4,5]. Second, the customer gets rewards from the designing process, such as the satisfaction of fulfilling a co-design task[6,7].

The higher value that customers perceive when purchasing a product tailored to their individual requirements results in an increased willingness to pay. For customized products and services, customers have been found willing to pay a slightly higher price than for standard products[8]. Based on the additional value and the increased willingness to pay, Wijekoon and Badurdeen (2011) claim that MC is a suitable model for integrating sustainability: higher costs for sustainable products can be shared between the manufacturer and the customer[9].

An increased willingness to pay for customized products as an enabler for selling sustainable products is not the only link between MC and sustainability that has been discussed in research. In the light of the debate on sustainability, the analysis of social and environmental aspects of MC has gained importance in recent years. For instance, Chin and Smithwick (2009) and Petersen et al. (2009) provide a comparison of the sustainability of MC versus mass production based on the different stages of the product life cycle[10,11]. Hankammer and Steiner (2014) and Pourabdollahian et al. (2014a) examine the relation of MC and sustainability from a business model perspective[12,13]. Kohtala (2015) gives a thorough overview on further studies on this topic[14]. Finally, Pourabdollahian et al. (2014b) develop a research agenda for assessing MC from a sustainability point of view[15]. Tukker & Tischer (2006) described the potential to improve sustainability through PSS. They identified that although PSS can serve to increase sustainable performance through system innovation, it does not guarantee subsequent sustainable benefits when not taking care of specific guidelines and rules [16]. The same can be attributed to MC: We consider the individual configuration of a product as a PSS as for instance stated by Van Halen et al. (2005) [17]|. However, it has to be stated that the majority of studies still remain mainly conceptual.

2.2. Sustainable Configuration

One of the key factors of MC is the interaction between manufacturer and customer[17]. Mass customizers have to support customers in expressing their individual requirements and creating their own solutions while minimizing the complexity and the burden of choice[18]. When customers are exposed to too many choices the increased utility from having more options to choose from is less important than the additional cognitive cost of evaluating all the available product variants[19]. These drawbacks are described by Huffman and Kahn (1998) as “mass confusion”[20]. Customers are not always entirely sure about their actual preferences. To uncover these preferences, software that incorporates trial-and-error or fast cycle learning is helpful[18]. Hence, an effective customer interaction system requires tools to ease the search for the desired solution of a customer. The technological progress and information technology have made it much easier and more cost efficient for companies to interact with their customers[21].

An increasing number of studies have dealt with web-based user-interfaces, also referred to in literature using the terms configurators, user toolkits, online customization support systems or customization interfaces[3,22–24]. According to