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Towards a Reference Model for Agile New Service Development using the Example of E-Mobility Service Systems

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Abstract

Electric mobility (e-mobility) is currently an intensively discussed topic in research and business practice. While there are both clearly defined physical products, such as electric vehicles, batteries, and charging components, and clearly defined services, we often also see a combination of both in service systems, charging services being one example. This means the relatively young e-mobility market offers excellent potential to develop and implement integrated solutions with a focus on delivering mobility as a key value proposition to users. From the point of view of new service development (NSD), creating service systems in an integrated way represents a major challenge: complexity emerges as a key characteristic from the ecosystem setup, mainly caused by the need for cross-company collaboration and the development of combined solutions (physical products, software, services). This article is based upon the hypothesis that existing NSD models and practices are not sufficiently applicable to this kind of innovation environments and thus need to be adapted and modified. The aim is to make the initial steps towards an agile reference model for NSD.

Keywords: Agile development; electric mobility; new service development; project management; service systems

1. Introduction

Electric mobility (e-mobility) is currently an intensively discussed topic in research and business practice, especially when it comes to the spread of electric vehicles (EVs). Three main drivers for the spread of EVs are mentioned in current studies: Consumer demand (e.g. key motives for early EV adoption), industry developments (e.g. major OEMs releasing or announcing EV models), and government stimulus (e.g. subsidies) [1]. These drivers are flanked by the often-stated advantages and disadvantages of EVs and the system facilitating e-mobility. For EVs, the stated benefits include technical advantages such as high efficiency of the powertrain, rechargeability of the battery system, outstanding acceleration and power transfer compared to combustion-engine technology, advantages concerning new vehicle concepts, decreasing lifecycle costs, local zero emissions from electric drives, and smart energy solutions emerging on the market. The drawbacks of EVs include the heavy weight of many electric propulsion systems, limited cycle time and complex cell technology in batteries, limited electric range, high effort regarding new vehicle design concepts, the high cost of components, today's overall carbon footprint, and today's infrastructure [2].

To make effective use of EVs, a systemic view is clearly needed. First, it must take into account components such as the users' perspective (e.g. price, range, and charging infrastructure), vehicle technology (e.g. powertrain technologies and vehicle integration, battery technology, and lightweight design), charging infrastructure, regulation and standardization, information and communication technology (ICT), energy and the environment, urban planning and intermodality, as well as education and training [3]. Second, while the focus of the discussions concerning e-mobility is often on plug-in hybrid vehicles (PHEV), range-extended electric vehicles (REEV), and battery electric vehicles (BEV), as shown for

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instance in [4], and on technical components regarding batteries and charging points, in fact e-mobility can be defined far more broadly if we assume a broader view of related concepts such as sharing, housing, public transport, and the smart grid. The term "ecosystem" is often used to describe the complexity inherent in setting up and maintaining successful e-mobility businesses, for instance collaboration between different organizations or integrated ICT platforms [5,6]. While there are clearly both defined physical products, such as EVs, batteries, and charging components, and clearly defined services of different types, we often also see a combination of both in service systems, charging services being one example. This means the relatively young e-mobility market offers excellent potential to develop and implement integrated solutions with a focus on delivering mobility as a key value proposition to users. From the point of view of new service development (NSD), creating service systems in an integrated way represents a major challenge: complexity emerges as a key characteristic from the ecosystem setup, mainly caused by the need for cross-company collaboration and the development of combined solutions (physical products, software, services). This article is based upon the hypothesis that existing NSD models and practices are not sufficiently applicable to this kind of innovation environments and thus need to be adapted and modified.

Thus, the aim of this paper is to make the initial steps towards new flexible NSD models and to introduce an agile reference model for NSD, to extend traditional approaches by rather modern practices.

2. Research background

2.1. Organization of NSD processes

It is thoroughly explored and well-known that "successful new services rarely emerge by mere happenstance. Rather, they tend to be the outgrowth of an appropriately designed structure and a carefully orchestrated process" [7]. Success factors related to organization and formalization have already been highlighted in earlier NSD research, including aspects such as a high level of coordination, qualification and motivation of project team members [8,9], and formal development processes [10,11,12]. In terms of performance, process formalization has been found to directly and positively contribute to NSD speed, whereas using cross-functional (multidisciplinary) teams promotes creativity in NSD [13]. Key activities in organizing NSD can be seen concerning both structure and people, not only in terms of operational management, but also with regard to creating an innovative climate; a combination of creativity techniques and formal systems is seen as beneficial for successful NSD [14,15]. In this sense, NSD is not limited to an effectively and efficiently executed development process, but is completed with the introduction of new services into the market [10], which is closely related to the definition of an "innovation" [16]. With regard to formalization, manufacturing companies that exhibit optimized processes for developing their product-service systems strive to install formal roles or functions, project-based teams, roles explicitly dedicated to methodological aspects, advanced project management, and specified tools and methods. These companies involve selected customers as co-producers or co-designers, and they incorporate regular feedback for continuous improvement [17]. Finally, formalization of NSD processes should also enable learning from internal and external stakeholders as well as the integration of different skills and customer knowledge [18].

While the existence of a structured NSD process is one of several key elements for successful development, there are still issues to be dealt with. NSD processes seem to be less formalized in practice. Especially in fast-paced innovation areas (e.g. web-based services), companies seem to have a hard time applying them, showing a need for rapid development approaches. In addition, services tend to be rather intangible, and there are practical difficulties in creating a common understanding among development teams of what they are actually developing, which calls for adequate visualization methods [19].

As a conclusion, success in NSD can be defined as an effectively and efficiently conducted development process from idea management to market launch that promotes an innovative culture in a sustainable way by systematically managing not only the organizational structures and people within a company but also external stakeholders (e.g. customers and partners). Efficiency in more dynamic environments can be supported by rapid development techniques and visualization methods facilitating agile and flexible collaboration. The ideal approach thus seems to be both formal and flexible.

2.2. Applicability of existing NSD processes for developing service systems

As defined in the Capability Maturity Model Integrated for Development (CMMI-DEV), a "service system encompasses everything required for service delivery, including work products, processes, facilities, tools, consumables, and human resources," and a "complex service system may be divisible into multiple distinct delivery and support systems or subsystems […]" [20], which matches the understanding of an ecosystem. These delivery and support systems or subsystems can be observed in some types of e-mobility services, e.g. charging, car sharing, mobile navigation. Regarding the large number of NSD processes that have been elaborated over recent decades, a critical question to consider is to what degree the models and techniques are applicable in today's dynamic markets, while remembering that stage gate models might be outdated due to the need for more informal processes, faster NSD cycle times, less bureaucracy and norms of NSD [15,21]. What is true for single industries or international markets can also be applied to the field of e-mobility, which is, due to its ecosystem nature, characterized by dynamic and interdependent structures.

An analysis and comparison of process models for NSD has led to the conclusion that they typically consist of a stage gate process (see fig. 1) that prescribes phases and activities without distinguishing between different types of services; however, it could be shown based on a service typology that