Characterising product-service systems in the healthcare industry

Man Hang Yip*, Robert Phaal, David R. Probert

Centre for Technology Management, Department of Engineering, University of Cambridge, CB3 0FS, UK

ABSTRACT

Since the 1970s, marketing and innovation management communities have been investigating how to incorporate customer-desired functions into new product and service designs. These wide-ranging enquiries have shed light on the impact of lead-user engagement in new product development, demonstrated ways to examine service production and delivery, such as the use of 'line of visibility' in service blueprints and the modelling of 'service encounters', and have created new terms such as 'value co-creation'. Despite these efforts, recent reviews have identified the lack of an holistic approach to new product-service system (PSS) development. This deficiency needs to be rectified, especially for complex PSS developments in regulated industries such as healthcare, as often there are multiple stakeholders posing conflicting priorities to the development team.

This paper describes a novel PSS characterisation approach that supports the early-stage new PSS development process. The approach is originated from eleven healthcare case studies, involving twenty-five new products, services and PSSs. Following the methodology of action research, further cases are selected for the application of the approach to a new product, service or PSS concept in facilitated workshops. Initial implications of employing this approach in three cases are discussed in this paper.

© 2015 Elsevier Ltd. All rights reserved.

1. Introduction

The ageing population is an unprecedented, enduring, and pervasive global phenomenon, affecting economic, social, and political aspects of life [1]. On the one hand, the healthcare industry is facing a growing demand for new medical technologies from healthcare service providers. On the other hand, there is a trend that governments are reducing their health spend [2]. There have also been studies and debates about preventive care as a potential remedy, and how preventive care can be implemented at a national level through policy and technology [e.g. Refs. [3—5]]. Healthcare equipment manufacturers and service providers may be able to help by developing and delivering suitable products and services that are valued by customers. In this paper, 'healthcare' industry refers to the healthcare equipment, device and software, healthcare professional services, and physical and mental fitness services, while 'companies' refers to both manufacturers and service providers.

The healthcare industry involves multiple stakeholders who regularly have conflicting interests. Companies often have to innovate in a constrained environment: governed by multiple regulations, laws, and quality standards, and impacted or confined by existing infrastructure and established work procedures of the customer or end-user environment. Given the increased interest in healthcare service effectiveness, how healthcare companies develop new products and services is an important area for investigation, especially at the early stage of the development process where a large proportion of the product-service system (PSS) life-cycle cost is not yet committed [6].

Set against this context, this research is being undertaken to explore how healthcare PSSs can be characterised with the contextual factors in mind, for the early stage of the new PSS development (NPSSD) process. Furthermore, the impact of this characterisation on the definition of the new PSS is explored.

This paper describes the PSS characterisation approach that is a new tool developed with industry practitioners to support the early-stage new PSS development process. Its application to three healthcare PSSs, and the implications on the NPSSD and PSS definitions, are also discussed. A brief overview of the methodology is presented in Section 2, which is then followed by a literature review in Section 3. Section 4 describes the PSS characterisation approach, and Section 5 gives a description of the setting of the workshops for applying the PSS characterisation approach. Section

* Corresponding author.
  E-mail address: mhy29@cam.ac.uk (M.H. Yip).

6 discusses the findings, Section 7 concludes the paper, and Section 8 discusses the limitations of the findings.

2. Research methodology

This research intends to contribute novel theories in PSS characterisation for the early stage of the NPSSD process. There are two phases in this research: the first explores how to characterise PSS in a way that is useful for the early stage of the NPSSD process; the second builds a repeatable process to characterise PSS and explore the implications of the method on the PSS definition.

In the first phase, a case study research methodology has been selected. The unit of analysis is a new product, service, or PSS under development. The reasons for selecting a multiple-case/single unit of analysis design [7] are: (1) building theory from cases is more likely to generate a testable and empirically valid novel theory [8]; (2) the boundary of the phenomenon of interest, the internal and contextual factors of a PSS when it is in-use and how these factors impact a new PSS definition, is unclear [7].

A conceptual framework with potential variables developed from literature review has been revised after pilot interviews involving 14 stakeholder groups. The use of *potential* variables minimises bias and limitations from prior theoretical perspectives [8]. Data collection and analysis are designed to be overlapping to allow changes of data collection instrument if found to be necessary upon reflection [8]. The degrees of data and process connectivity have emerged as the case selection criteria upon preliminary data analysis. Eleven cases involving 25 commercial offerings have been completed. Four variables have been identified to be useful to characterise PSS for NPSSD, forming the novel PSS characterisation scheme. From the data analysis of the first phase, a systematic approach to apply this novel PSS characterisation scheme has been developed.

In the second phase, action research [9] has been selected as the method to build, test and refine the PSS characterisation approach to support the early stage of the NPSSD process. Action research was selected because it develops knowledge through application, collaborating with practitioners (company employees) who have a personal interest in the result [10]. New PSS ideas or concepts are the subject of analysis for the PSS characterisation approach, using a facilitated workshop approach with selected new PSS development team members from the participating companies. Both healthcare and non-healthcare new PSS ideas have been targeted to investigate how the approach works in different contexts. The workshops have been facilitated by the same researcher for consistency [11], until the PSS characterisation approach has reached a stabilised form. The number of workshops was not fixed in advance, as the objective was to reach procedural stability [12]. To ensure validity of the findings from the workshops, the research process of preparing and conducting the workshops, the setting of the workshops, the context of the participating companies and individuals, and the assumptions about the participants and the facilitator were documented [11,13].

Three assessment criteria on the PSS characterisation approach have been adapted from the evaluation of manufacturing strategy formation process proposed by Platts [9]: feasibility, usability and utility. Feasibility concerns the degree to which the process laid out for the workshop participants can be followed. Usability relates to the ease of following the approach. Utility focuses on whether the approach achieved its intended benefits for the participants. The implications of the PSS characterisation approach on the PSS definition result directly from the reflection on the discussions regarding utility.

To minimise the possible adverse impact of the newly developed PSS characterisation approach on a NPSSD project, the first workshop analysed an existing PSS that has been launched within the last two years, instead of a new to-be-developed PSS. Three cases in the healthcare industry, including the initial post-launch case, are discussed in this paper.

3. Literature review

This section is divided into three sub-sections. The first summarises a review of the existing literature on the definitions and classifications for product, service, and PSS, which has led to a realisation that existing PSS classifications are not complete or useful for new PSS development. The second sub-section summarises a review of engineering design theories that provides the theoretical foundation for new product development (NPD), new service development (NSD) and new PSS development (NPSSD) process models. This sub-section shows the need of an holistic approach to new PSS development. To explore the contextual factors that are potentially significant for NPSSD, a literature review covering actor-network theory and value-in-use is summarised in the third sub-section.

3.1. Product, service, and product-service system

The economics and marketing communities have provided a number of definitions and classifications for products and services. In fact, some commonly quoted characteristics of products and services have their origins in concepts proposed by Adam Smith and Jean-Baptiste Say in the 18th century, Nassau Senior in the 19th century and Joan Robinson in the 20th century [14–16]. Since the 1960s, a common perspective adopted by scholars is that products are tangible, and services are intangible, heterogeneous, inseparable, and perishable [17]. Another perspective to separate services from products is that a product is a tradable object [18], while a service is an act performed [19–21] to change the state of objects and/or people [21–24].

Tangibility has been a useful characteristic for the marketing community, as it allows product classifications such as: durable/nondurable, industrialised/customised, and differentiated/commoditised to be developed and applied [25,26]. More than 30 service classifications have been proposed since the 1960s [27]. Some examples are: whether the service provision involves a product and who owns the product [20,28]; whether the service impacts people or objects [18,23]; and whether the impact created by the service is temporary/permanent, reversible/irreversible [22], or tangible/intangible [23]. With the advancement of digital technology, the use of tangibility as a demarcation of products and services has created confusion. For example, is a digital sound track that one can buy online, which is intangible, a product or service? More recently, Vargo and Lusch have defined a service as "the application of specialised competences (knowledge and skills) through deeds, processes, and performances for the benefit of another entity or the entity itself" [29]. This broad concept is not dissimilar to Levitt's viewpoint that a product is "a tool to solve [customers'] problems" [30].

As a result, the definition proposed by Hill [18] is considered to be more suitable and is adopted for this research. Hill's proposal is that a product "exists independently of its owner and preserves its identity through time" [18]; and a service cannot be stocked without losing its identity and requires both producer and consumer, and hence is constrained by time and location [18].

PSS is a more recently defined terminology. Baines et al. [19] suggest that PSS was first formally defined in 1999 by Goedkoop, van Halen, te Riele and Rommens [31] as "a marketable set of products and services capable of jointly fulfilling a user's need". However, the idea of customers buying bundles of products and