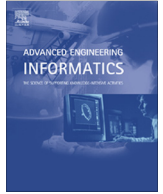




Contents lists available at ScienceDirect

Advanced Engineering Informatics

journal homepage: www.elsevier.com/locate/aei

Modularized design-oriented systematic inventive thinking approach supporting collaborative service innovations

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ARTICLE INFO

Article history:

Received 31 May 2016

Received in revised form 27 October 2016

Accepted 28 November 2016

Available online xxx

Keywords:

Collaborative service design

Service engineering

TRIZ (Theory of Inventive Problem Solving)

Systematic inventive thinking

Collective intelligence

ABSTRACT

The rapid evolution of new service systems raises crucial challenges for service design and requires effective methods. This study depicts a conceptual service design framework, called design-oriented systematic inventive thinking (DSIT) approach, which can be applied in different problem contexts. DSIT is presented as a new systematic and collaborative intelligence approach for creating and evaluating complex service systems using multi-criteria data analytics. DSIT synthesizes the current field of TRIZ service-design knowledge system and the emerging area of non-TRIZ service-design knowledge system. DSIT enables integrated development of service offerings at four dimensions and provides the matching integrated service design approach for each dimension. Four types of service design approaches are conceptualized as “human-independent service engineering,” “problem-clarified service engineering,” “solution-converged service engineering,” and “designing for service.” A new service computer-aided design system (service CAD) named DSIT explorer is developed consisting of customization, compatibility, and extensiveness of DSIT modules. A pervasive and smart collaborative service system (i.e., the smart MOS burger service solution) designed using DSIT explorer is illustrated. DSIT is a holistic, interdisciplinary, and collaborative service design concept, which is incorporated into a collaborative and intelligent service CAD framework to enable systematic inventive thinking throughout phases of service design lifecycle from problem definition, problem resolution, to solution evaluation.

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1. Introduction

ICT technology (ICT, which refers to information, communication, mobile, and networking technologies) plays a critical role in the service economy [1]. More and more companies have embraced ICT-related service as a way to carry out innovation and obtain sustainable competitive advantages [2,3]. However, the fast proliferation of complex service systems raises new changes for service design [4]. Challenges for service design contains (a) how to come up with a large amount of creativity; (b) how to select the suitable, useful, attractive and impressive ideas from the pool of the above creativity and then take the use of appropriate technology; (c) how to design innovative services that are able to meet customer needs and to provide enterprises obtaining benefits and competitiveness; (d) what is the better design process that can carry out new services more quickly, efficiently save

time costs [5,36]. To satisfy the above service-design issues, system thinking approaches or models can synthesize the understanding of customers' needs and possible solutions in ways that help different stakeholders find new ideas [4].

Furthermore, some areas need particular attention, such as the growing complexity of service systems, the emergence of multi-interface services, customer cocreation of service experiences. These trends have led to the emergence of service design as a new field [7,4] that takes a more holistic view of the service system. That is to say, when designing complex service systems, a holistic systems thinking approach is required [51,8,4]. Which service innovation and service design schema can operate in the individual service enterprise for a service designer? Can the schema be developed as a computer-aided tool that can be easily used when doing service design? The questions are important because by answering some designing inquiries in a simple and clear guidance, a service designer can obtain more knowledge of service design methods efficiently and effectively on an under-researched designing field [5,36,4].

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<http://dx.doi.org/10.1016/j.aei.2016.11.006>

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In order to design a new service with an effective and efficient way, a different systematic design approach and even a computer-aided system is required. However, few researchers have dealt with this topic with an integrated way of both service-design approach and computer-aided design [8]. To tackle the above questions, a novel service-design approach called DSIT (design-oriented systematic inventive thinking) model has been proposed. The Theory of Inventive Problem Solving (TRIZ) approach which can help designers perform innovative design tasks under constraints [28] is adopted to develop dimensions of service-design framework, and the different attributes of the dimensions. Furthermore, a computerized system, named DSIT explorer, for supporting conceptual service design is described as an application of DSIT model. It is also a concept of the new service computer-aided design system (service CAD).

The remainder of the paper consists of the following sections. Section 2 begins with an explanation of how different the concerned design is compared to traditional service design, and then describes the nature of the service CAD system. Section 3 proposes the stage-analyzed and adaptive service design framework-DSIT (design-oriented systematic inventive thinking) model, moreover, TRIZ-based methods and non-TRIZ methods are analyzed and integrated into the whole DSIT model. Then, Section 4 proposes a service CAD system, named DSIT explorer, and the framework of the software and the example for this pervasive and smart collaborative service system is illustrated. Finally, following some discussion of contribution, Section 5 concludes the paper.

2. Literature review

2.1. Service design and service computer-aided design system

Service innovation is a multidimensional phenomenon [60]. That implies that service innovations can take various forms and can be linked to different parts of the value creation process of a service firm. Den Hertog [62] first proposed 4D model to deconstruct service innovation, which comprises new service concept, new client interface, new service delivery system, technological options. Service innovation dimensions can be revisited by the 6D-service innovation model [60]. The 6 dimensions comprises new service concept, new customer interaction, new value system or new business partners, new revenue models, new service delivery system (organizational component) and new service delivery system (technological component).

Service innovation comprises significantly improved service concepts and offerings in the service process, service infrastructure, customer processing, business models, commercialization, and service productivity [53,57,56]. The transformative power of service innovation is understood as the process when services “disrupt traditional channels to market, business processes and models, to enhance significantly customer experience in a way which impacts upon the value chain as a whole” [55,58]. In this way, service innovation is shaping emerging sectors, industries and markets, and is contributing to structural change and industrial modernization [54,59].

Service design is an emerging field [7] whose methods are still being developed and are often integrated from related areas. Service design has been traditionally viewed as a specific stage of the new service development process [10,11]. Moreover, the tendency of service design field has adopted a broader approach, involving understanding users and their context, understanding service providers and social practices, and translating this understanding into the development of evidence and service systems interaction [4].

Service design activities appear throughout a service development process to develop new service and make service improvement or service innovation happen [9]. In these processes service design contributes with a set of modeling techniques for service experiences to gain service innovation. Among these modeling techniques, service-scape, customer journeys, service interface etc. are often mentioned [7].

Compared to general and traditional product design, service design is a macro-design activity and a planning progress [12]. Briefly speaking, service is the interaction and experience delivered to customers. Service design is an approach to design the way to deliver a series of unique experiences that customers view with favor and with a positive perception of their value [13]. Therefore, the objective of service design is to generate links with people through various contact points in the experience journey. Service design not only pays attention to the links of customer emotions and services, but also to customers' participation in the servicescape. Integrating with service innovation including the creation of new and/or improved service offerings, service processes, and service business models can enhance customer satisfaction, and to verify the effectiveness new service system after service designing [14].

In the literature of service design and development in the tertiary industry, two main ways of concerning the design of product service systems are identified. The first way is from a lifecycle point of view. Different design methods of phase-oriented points of view are proposed to design and manage services effectively in the service industry [10,11]. The second way is from a nature-conceptualizing point of view. Based on the nature of service design concerns, conceptualizing model are proposed for service designers to think and take proper actions when designing services [15,4,21]. When designing complex systems, thinking with models helps fill the gap between problem and solution [15]. Models synthesize the understanding of customers' needs and possible solutions in ways that help different stakeholders find new ideas [4].

In the first way, some important research papers are briefly introduced as follows. Dubberly et al. [15] proposed the analysis-synthesis bridge model (ASB) model. According to ASB model, the design process starts with observation and investigation of the current situation. Then, modeling forms a bridge between problem and solution, by helping interpret and systematize the understanding of the extant situation and explore new potential solutions. Finally, idealized solutions are put into prototypes and finished forms. Pezzotta et al. [50] proposed a service engineering methodology (SEEM) for service-designers to design and assess an integrated product-service so as to balance product-service provider's performance and customer's value. In addition, Chai et al. [5] proposed three phases when doing service design, which are the problem definition phase (PD), the problem resolution phase (PR) and the solution evaluation phase (SE).

In the second way, several research papers are briefly introduced as follows. Kimbell [21] proposed four different ways of approaching service design which is related to service engineering concept. When doing service design, it must involve thinking of the service and thinking of the design (as shown in Fig. 1). Among the four quadrants, from the service thinking perspective, service engineering is involving in “service is the basic unit of economic exchange” and “design as problem-solving”. Thereby, service engineering is related to both the concept of product-service system (PSS) and pure service system [20,22]. The top right quadrant sees design as problem-solving, but views service as a fundamental process of exchange influenced by the service-dominant logic [23]. This quadrant is labeled “service engineering” since the emphasis is on service, but the underlying design tradition is engineering. Besides, the bottom right quadrant is labeled “Designing for

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