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Service conflict identification and resolution for design of product–service offerings

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ABSTRACT

Many manufacturers today are striving to provide high value-added product–service offerings (PSO) to their customers. PSO has heterogonous structure and various requirements, which may lead to technical attributes' conflicts during the design process. The conflicts will lead to the difficulty of concept generation, increase of service delivery failure, and eventually the decrease of customer satisfaction. However, the conflicts in PSO design areas are more intangible and harder to formulate. Moreover, those conflicts are often resolved with trial and error methods in ad hoc processes, which largely depend on the designer's intuition. Thus, in this paper, the authors propose a systematic method to identify PSO design conflicts and resolve them. The proposed method is based on the approach of service function and attributes analysis, group decision making with unbalanced linguistic label set and TRIZ methodology. In addition, a case study of design conflict identification and resolution for elevator service reveals the feasibility and potentials of the proposed method.

1. Introduction

Most manufacturers today are implementing servitization strategy due to increasing competition and environmental concerns (Baines, Lightfoot, Benedettini, & Kay, 2009; Geng, Chu, Xue, & Zhang, 2010; Yang, Moore, Pu, & Wong, 2009). They provide customers with high value-added product–service offerings (PSO) (Lee, Han, & Park, 2015; Sakao & Shimomura, 2007; Song & Chan, 2015; Song, Ming, Han, Xu, & Wu, 2015). The PSO solutions mainly contain industrial services based on the product, such as product support, repair, maintenance, and upgrading and recycling. PSO design is one of the most important elements to the success of PSO solutions (Aurich, Fuchs, & Wagenknecht, 2006). However, in PSO design process, improvement or enhancement of one service attribute may cause the deterioration of another. Then, it can be considered that conflict exists between the two service attributes. For example, self-service attribute can enhance customer convenience, but it reduces the direct interactions between service provider and its customers, and therefore, it may undermine customer perception and experience. Another example is that enhancement of response speed often needs to increase investment in service infrastructure and personnel. Technical conflicts are conflicts between two or more functional attributes of a PSO. The PSO design conflict will lead to the difficulty of the design task, failure rate increase in the delivery phase, and eventually the decrease of customer satisfaction. Especially, in designing service attributes in industry, design is often carried out in an unsystematic manner. Conflict will be among the most troublesome problems obstructing the road for new PSO concept generation. In this respect, design conflict identification and resolution is critical to the success of PSO.

However, the current research largely depends on heuristic methods in identifying conflicts. In industry, designers often use tentative rules (e.g., design reviews, change memos, and mock-ups (Klein, 2000)) to resolve design conflicts. Furthermore, different with physical products, PSO has the features of stakeholder interaction, heterogeneity, and service intangibility, etc. (Song, Wu, Li, & Xu, 2015; Váncza et al., 2011). The conflict between service attributes of PSO is more difficult to be identified. The service attributes conflicts in PSO design areas are more intangible and harder to formulate. These contradictions are often uncertain conflicts between two design parameters. Even though some conflicts are identified by designers, they are often resolved with trial and error methods in ad hoc processes. The service attributes conflicts resolution in PSO largely depends on the designer's experience and intuition. This will heavily influence the quality and efficiency of PSO design.

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Therefore, in this paper, the authors propose a systematic method for service attribute conflict identification and resolution for PSO design. The proposed method consists of three successive phases, i.e. (1) service function and attribute analysis, (2) service attribute conflict identification in PSO, and (3) service attribute conflict resolution for PSO design. Using a method to identify and resolve product design conflict is not necessarily novel, but providing a systematic method for PSO design conflict identification and resolution is rarely to be seen in previously academic works. The proposed method is expected to enhance the quality and efficiency of PSO design.

The rest of this paper is organized as follows: Section 2 reviews literature on design conflict identification and resolution; Section 3 provides the new systematic method for PSO design conflict identification and resolution. In Section 4, an industrial case of design conflict identification and resolution for elevator service is presented to illustrate the feasibility and potentials of the proposed method. A discussion of the proposed method is made in Section 5. Conclusions and future research suggestions are presented in Section 6.

2. Literature review

2.1. Design conflict identification

Due to multi-actors interaction, conflicts can emerge from disagreements between designers about proposed designs (Ouertani, 2008). Blackhurst, Wu, and Craighead (2008) believe that the conflict can degrade the performance of the system as a whole if not handled effectively. Besides, conflict is a simple and effective mode of problem expression, revealing unsolved inventive challenges (Cavallucci, Rousselot, & Zanni, 2009). Thus, the ability to discover conflicts would be a valuable asset, particularly if the discovery occurred proactively. Some researchers have explored the design conflict identification approaches.

Kim et al. (2013) propose a method to detect conflicts, which may occur during the execution time of composite web services, based on model checking. Yan and Zeng (2011) propose a formal structure which represents conflicts based on the axiomatic theory of design modeling and the recursive object model. These methods do not provide a systematic conflict resolving mechanism. They lack tools considering the features of PSO, e.g. the conflict identification method in Kim et al. (2013) is only designed for composite web services. Yan (2013) proposes methods for detecting conflicts and presents a set of general resolution principles, which include modifying resource object, separating conflict relations in time or in space, changing the two competing objects, using optimization methods, and replacing the whole conflict. In addition, Sakao (2007) proposes a method to detect conflict between product requirements by extending Quality Function Deployment as well as to resolve the identified conflicts, which can be applied to environmentally conscious product design (Sakao & Fargnoli, 2010). However, these methods are not suitable to be used in the PSO design conflict resolution due to lack of considering features of PSO design. Chen and Nof (2010) study the performance of a newly developed decentralized conflict and error detection and prediction model over different networks. However, this model is not suitable for PSO design conflict resolving for the lack of systematic process support. Ceroni and Velásquez (2003) describe a particular approach to conflict identification and resolution in collaborative design (Vera, Kvan, West, & Lai, 1998) processes. The developed conflict identification and management system allows testing for conflict identification and resolution by providing a collaboration interface for the distributed designers (Krause, Kiesewetter, & Kramer, 1994; Lara & Nof, 2003).This method lacks systematic analysis of design functions and attributes, which may influence the accuracy of conflict identification. Based on an analysis of conflict nature and conflict-related human behavior in the concurrent engineering design, Jiang and Nevill (2002) develop a computational model for autonomously identifying the conflict cause in the web-based concurrent engineering design environment. This method also lacks systematic process to aid conflict resolving. Lara and Nof (2003) developed a method which provides fast identification of the conflict situation, diagnostics of conflict parameters, access to the conflict information by all conflicting parties and mechanisms for conflict resolution. However, the method is based on social science theories used to solve conflicts of dispersed designers. Beside conflicts of dispersed designers in PSO design, there are also other types of conflicts, such as product element conflict, service element conflict (e.g. conflict between service cost and service response speed), and even conflict between product elements and service elements. In this respect, PSO design conflict is more complex than the dispersed designers' conflict. Therefore, these different types of conflicts make the method in Lara and Nof (2003) difficult to be directly applied into PSO design domain.

2.2. Design conflict resolution

To resolve the design conflicts, some methods have been proposed in the past researches. A graph model for conflict resolution is used in Velasquez, Lara, and Nof (2008) to facilitate conflict modeling and analysis. Hisarciklilar, Rahmani, and Thomson (2010) describe a conflict management approach that lead to the computer-aided management of the product specification conflicts that happen due to the integration of subsystems. Li et al. (2002) put forward an integration-based conflict resolution system to manage and resolve conflict in a life cycle way. A hierarchical constraint network is used to detect conflict, and the knowledge-based method is used for knowledge conflicts and schema conflicts, while constraint relaxation is used for data conflicts. Lee and Lee (2005) propose a conflict resolution method based on case-based reasoning (CBR) approach which helps to resolve some conflicts easily based on the previous resolved similar cases. A major advantage of these methods is the high efficiency of detection if a conflict similar to the problem under consideration is already defined. However, if a new type of conflicts emerges that are different from the predefined conflict types, those methods may fail to identify them. To quickly coordinate conflicts in product performance design, Zhao et al. (2013) propose a transformation bridge method. However, the method requires the designer to have some knowledge of Extension Theory. The designer has to grasp knowledge of extension model, affair-element analysis and extension transformation, which will increase the burden on the designer. Therefore, it is difficult for the designer to use to resolve conflicts in real practice in industry. Considering that consensus can be used for working out an agreement during design conflict resolution, Ostrosi, Haxhiaj, and Fukuda (2012) introduce an approach for consensus modeling in collaborative design (Vera et al., 1998) and distributed design (Krause et al., 1994). Shimomura and Hara (2010) provide a methodology to enable designers to determine the existing conflicts in design solutions and obtain the basic strategies to solve them. Lexical expressions of functions and the ranges of design parameters are used to detect conflicts and TRIZ methodology are used to solve conflict problems. Although the use of TRIZ methodologies makes it possible to solve the design conflicts without unsystematic trial and error, this research does not consider much about the designers' knowledge and experience in the process of conflict identification.

In fact, TRIZ is a well-known methodology for the detection and resolution of conflicts in the product design field. It is created on the basis of the analysis of millions of patents. Contradiction