Available online at www.sciencedirect.com

SCIENCE DIRECT®

Decision Support Systems 41 (2005) 262–278

Decision Support Systems

www.elsevier.com/locate/dsw

An effective customization procedure with configurable standard models

Hyun Jung Lee*, Jae Kyu Lee

Graduate School of Management, Korea Advanced Institute of Science and Technology, 207-43, Cheongryang, Seoul 130-012, Korea

Received 12 June 2003; received in revised form 24 June 2004; accepted 24 June 2004
Available online 14 August 2004

Abstract

In electronic catalogs, commodities such as computers and electronic equipment are specified as standard models although a variety of possible alternative specifications can exist as a combination of selected options; therefore, customized configurations are essential to support various customers with individual needs. Thus, the problem here is the selection of a standard model and reconfiguration with this selected model. An issue is that requirements may be fulfilled by more than one standard model. To develop an algorithm that can find the near minimum price without causing unacceptable computation effort, we devised the Standard Model Selection and Modification (SMSM) Algorithm. To establish the SMSM Algorithm, we propose the Concurrent Local Propagation procedure complemented with pruning capability owing to the nature of standard models. The effective strategies for selection of seed variables and stopping rules are devised through comparative experiments.

For the experiment, we use Dell's personal computer (PC) products consisting of 42 standard models with 25 specification variables. The SMSM Algorithm is tested with 75 experimental cases, and we found that the most similar standard models could discover the minimum price only in 24 out of 75 cases and that the SMSM procedure could reduce the price by 6.04% from the one offered by the most similar standard models.

Keywords: Configuration; Customization; Case-based reasoning; Comparison shopping; Constraint satisfaction problem

1. Introduction

There is an abundance of products in online shopping malls and comparison sites on the Internet. Products such as books and CDs on the Internet have fixed features without optional changes. However, many products such as computers, electronic equipment, and automobiles are customizable by customers

* Corresponding author. Tel.: +82 2 958 3612; fax: +82 2 960 2102.

E-mail addresses: leehj@kgsm.kaist.ac.kr (H.J. Lee), jklee@kgsm.kaist.ac.kr (J.K. Lee).

0167-9236/$ - see front matter © 2004 Elsevier B.V. All rights reserved.
doi:10.1016/j.dss.2004.06.010

to some extent. Hence, customer-driven customization is becoming more popular [8,42]. Since generative configuration is not easy for customers, manufacturers build a series of standard models to make the selection process simpler. With the standard models, customers select an appropriate one first and customize it by adding optional features. For instance, when a customer selects a notebook, s/he selects a favorite standard model first and probably enhances the CPU Speed. Under this circumstance, a concern is whether the same target specifications could have been achieved by another standard model possibly at a lower price.

Although the customer's ultimate concern is configured specifications, most sites, nevertheless, merely display the standard models and options without appropriate support for reconfiguration with the standard models. For the effective display of comparable models [11], similarity-based ordering that is used in Case-Based Reasoning (CBR) is widely adopted [21]. Tabular comparisons [32] of particularly interesting models are complementarily provided to support detail comparisons. Some systems support the selection of optional features; however, compatibility check among selected features is rarely supported in the real world, although there are many studies done for this purpose [6,28,37,45]. Without appropriate assistance in checking compatibility during the reconfiguration of a standard model, there is no guarantee that the customized specifications are feasible. Although more than one standard model may be able to satisfy the customer's requirements, customers do not know about it in advance, let alone which standard model provides the best price.

In this research, we develop an efficient algorithm to solve the Standard Model Selection and Modification (SMSM) problem. The SMSM Algorithm seeks the standard model and its modification, which can minimize its price while satisfying the customer's requirements. For the selection of the standard model, a similarity measure can be used. For modification, the Constraint Satisfaction Problem (CSP) can be adopted. To solve the CSP effectively while resolving the conflicting goals, the Concurrent Local Propagation approach is proposed in this research. The approach needs to set an effective strategy of selecting seed variables which partition the CSP into multiple sub-CSPs. The algorithm also needs to prune the unnecessary propagation whose compatibility is assured by the nature of the standard model. Along with these features, the SMSM Algorithm needs to establish an effective stopping rule for iterative comparisons of standard models. By putting these ideas into a procedure, we devised the SMSM Algorithm. The procedure is demonstrated with the Personal Computer (PC) selection and reconfiguration problem at the Dell web site, and the performance is evaluated to discover best policies in establishing the algorithm.

To fulfill this aim, this paper is organized as follows. Section 2 reviews related literature and systems on customization and configuration. Section 3 specifies the product structure and customer's requirements with the PC example. Section 4 describes the SMSM Algorithm formally, and Section 5 illustrates the algorithm with 42 standard models at the Dell site. Section 6 conducts a series of experiments to validate the performance of the SMSM Algorithm. Limitations and future research potentials are discussed in Section 7.

2. Review of customization and configuration

In this section, let us review the relevant literature on customization and configuration and identify the goal of this research more specifically.

2.1. Mass customization and configuration

In the late 1980s, the notion of mass customization was introduced to support customized products or services in high volumes at reasonably low costs [41]. Many business managers and researchers expected that *generation of standardization* would shift to *generation of customization* [24,40]. Typical strategies for customization are pure aggregation, personalization, and modification of standard models. To assist the modification with standard models, we need a configuration process, and this process is called *reconfiguration*. In finding the most preferred specifications and price, there are several approaches. First, if the functional requirements are given in advance, the aim of configuration is finding the specifications that meet the requirements at the lowest price. Second, the problem may be viewed from a different direction—find the model that maximizes the consumer surplus