Chapter 4
A Multi-Agent System for Recommending Customized Families of Products

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ABSTRACT
Electronic markets and web-based content have improved traditional product development processes by increasing the participation of customers and applying various recommender systems to satisfy individual customer needs. This chapter introduces a multi-agent system to support customized product family design by recommending customers’ preferences in dynamic electronic market environments. In the proposed system, a market-based learning mechanism is applied to determine the customers’ preferences for recommending appropriate products to customers in the product family. The authors demonstrate the implementation of the proposed recommender system using a multi-agent framework. Through experiments, they illustrate that the proposed recommender system can determine the preference values of products for customized recommendation and market segment design in various electronic market environments.

1. INTRODUCTION
Mass customization depends on a company’s ability to provide customized products based on economical and flexible development and production systems (Silveria et al., 2001). Electronic markets and web-based content have improved traditional product development processes by increasing the participation of customers and applying various recommender systems to satisfy individual customer needs. With the potential of reducing transaction costs between providers and customers, the applications of electronic markets are dramatically increasing in various industries (Bakos, 1997).
The growing number of electronic markets for product development has significantly increased information related to design and the complexity of transactions, making it difficult to control the electronic markets with human resources (Padovan et al., 2002). In recent years, agents and multi-agent systems have become a powerful and prevalent methodology to investigate and develop complex systems integrating human factors (Ezzedine et al., 2005; Monticino et al., 2007).

The division of a market into homogenous groups of consumers’ preference is known as market segment (Meyer and Lehnerd, 1997). Because market segment provides guidelines for determining and directing customer requirements, it can be used to identify the criteria for designing product family more accurately and non-hypothetically (Simpson et al., 2005). In an electronic market environment, customers’ preferences can be determined by information related to customers’ purchasing patterns and evaluations for products. Product family planning is a way to achieve cost-effective mass customization by allowing highly differentiated products to be developed from a common platform while targeting products to distinct market segments (Simpson et al., 2005).

The objective of this chapter is to introduce a multi-agent system to recommend customized families of products in dynamic electronic market environments. The architectures of agents in a multi-agent system (MAS) are described including specifying their roles and knowledge. The proposed recommender system uses a market-based learning mechanism to determine customers’ preference for recommending appropriate products to customers in a distributed and dynamic electronic market environment. In the proposed system, product preference values are identified from customers’ preferences and are used to provide customers with customized product recommendations. A market-based learning mechanism is applied to determine the customers’ preferences for recommending appropriate products to customers in the product family. We demonstrate the implementation of the proposed recommender system using a multi-agent framework.

2. BACKGROUND

A product family is a group of related products based on a product platform, facilitating mass customization by providing a variety of products for different market segments cost-effectively (Simpson et al. 2005). A product platform is the set of features, components or subsystems that remain constant from product to product, within a given product family. A successful product family depends on how well the trade-off between the economic benefits and performance losses incurred from having a shared platform are managed. There are two recognized approaches to product family design (Simpson et al., 2001): (1) a top-down (proactive platform) approach and (2) a bottom-up (reactive redesign) approach. In the top-down approach, a company’s strategy provides a guide line for developing a family of products based on a product platform and its derivatives. Meanwhile, the bottom-up approach is focused on redesigning and/or consolidating a group of distinct products to standardize components for sharing and reusing. In platform-based product development, two common types for product families are module-based product family and scale-based product family (Simpson et al., 2001). Products in a module-based product family are obtained by adding, substituting, and/or removing one or more modules from the platform. In a scale-based product family, products are created by scaling one or more variables related to the platform design to satisfy a variety of market niches.

A multi-agent system is an appropriate tool to design and implement a system for integrating information in a distributed environment because of its flexibility, scalability, and adaptability (Blecker et al., 2005; Lee et al., 2003; Montestori, et.al., 2006; Symenonidis et al., 2003). An