

## Chapter 6

# **A MULTI-AGENT SYSTEM FOR COPING WITH VARIETY INDUCED COMPLEXITY**

The complexity problems in mass customization are primarily due to the proliferation of product variety. Therefore, variety optimization is a necessary requirement for leading this business strategy to success. The main goal should be to offer an optimal product assortment that consists of product variations that fulfill the objective customer needs by simultaneously minimizing complexity in operations. However, it is not possible to define an absolute optimality level of the product solution space because customer needs and preferences continuously evolve in the course of time. These changing requirements have to be recognized in sufficient time to adequately adapt and update the product assortment.

The discussion of the interdependencies between mass customization and complexity in chapter three has shown two major complexity problems in mass customization that can be classified into internal and external complexity. We define the internal complexity as the complexity that is induced by variety in operations and manufacturing related tasks. In extensive variety environments, customers experience external complexity during the product selection process. In this context, the advisory system only enables one to cope with the external complexity, but does not deal with the internal complexity. Due to changing customer tastes and preferences, it is relevant to determine the product variants to be retained and/or eliminated from the production program. The product assortment optimization problem aims at eliminating the product variants that are not fulfilling the objective customer needs and only retaining those with high relevance for customers. In so doing, the internal complexity is automatically reduced without restraining the product variants that are required for the fulfillment of the objective customers' needs.

The internal complexity is addressed within the scope of *variety steering*, whereas the external complexity problem is solved within *variety formation*. Variety steering refers to which product variants should be retained or eliminated. It aims at solving the optimization problem that balances the customer's and company's perspectives. However, variety formation relates to decisions concerning the product variants that should be instantly formed and offered to a customer by responding in the best way to his or her specific needs and preferences. In this context, it can be stated that the advisory system supports the variety formation task. In the e-commerce-enabled mass customization, variety formation is of high relevance because customers do not want more choice; they just would like the choice that exactly meets their needs (Piller/Ihl 2002, pp. 16). By assuming the existence of a well-defined product assortment, the main objective of variety formation is not to determine what product variants are generally feasible, but to form the product variants with the best chances to fulfill particular customer needs. The suitable product variants are determined by taking into account both customer requirements and the solution space that consists of all of the theoretically possible product variants. As a result, the variety formation task assists customers during the online-buying process in order to lead them to an optimal decision.

Up to now, there is no concept that enables mass customizers to conjointly deal with variety formation and steering tasks. That is why in this chapter, we propose to develop a comprehensive information system that simultaneously addresses both tasks. In order to determine which technology is suitable for the development of such an information system, it is important to first identify the reasons why existing methods and tools for variety formation and steering are not adequate. In effect, it is common that during variety formation, no information is generated about the extent to which the product variants fulfill customer requirements. It is generally supposed that customers are perfectly aware of their requirements. Consequently, the task of forming respectively configuring a suitable product variant out of modules is left to customers. According to the objective and subjective customer needs' model, this strategy is not optimal because customers may be unaware of their real requirements. In addition, state-of-the-art variety steering methods are generally based on centralized approaches. In other words, there are human managers who decide about the retention or elimination of product variants by applying centralized methods such as ABC-analysis, contribution margin accounting, or activity based costing, etc. Centralized approaches have many disadvantages that are due to the following problems: