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Agent-based support of mass customization for corporate knowledge management

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Abstract

The paper describes an agent-based architecture developed as a part of the KSNNet-approach to the knowledge logistics. This approach is targeted to timely provide an appropriate personalized knowledge for an intelligent support of decision-makers. In the KSNNet-approach the problem of knowledge logistics is considered as a configuration of a network of end-users/customers, loosely coupled knowledge sources/resources, and set of tools and methods for information processing. Such network located in the information environment has been referred to as knowledge source network or “KSNNet”. The paper presents this approach from the perspective of application of the mass customization idea to corporate knowledge management as a major information kernel technology of intelligent enterprises. As an example of intelligent enterprise the paper considers virtual supply network. Main ideas of the KSNNet-approach are presented and the structure of the developed agents’ society is described in more detail. Main results are illustrated via a configuration case study and discussed in conclusions.

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1. Introduction

Nowadays, among the major trends of the knowledge-dominated economy the following two can be pointed out: (i) from “capital-intensive business environment” to “intelligence-intensive business environment”—an “e” mindset—and (ii) from “product push” strategies to a “consumer pull” management. These trends require global changes in business paradigms. While the traditional thinking about manufacturing involves people, processes, and technologies, e-manufacturing considers two more factors: infrastructure and strategy. One of the major restrictions in the widespread acceptance of e-manufacturing and e-business communities is the difficulty of collective bringing together many disparate industry competitors, non-industry players, and other participants/units, and ensuring a common level of knowledge, understanding, and commitment. These communities require cooperation and open information exchange among all participants. Therefore modern companies have to intensively colla-

borate and at the same time rapidly changing markets require the relationships to be loose what, in turn, have caused appearance of such technologies as e-business.

E-Business requires cooperation and open standard-based information/knowledge exchange between all its participants. Thereby, the corporate knowledge management in the field of e-business is currently one of the most advanced areas in regard to the quantity of information being interchanged and information technologies being used.

An efficient approach has been needed in order to provide mechanisms which allow for a decision maker to have required knowledge “at hand” in an appropriate form for making correct and timely decisions, what in turn will make possible for the intelligent enterprise to quickly react on changes in its environment and to be flexible enough. The approach has to provide for the knowledge management systems to be dynamic and flexible, to keep up-to-date resource value assessment data, to support rapid conducting of complex operations, and to deliver results to users/knowledge customers in a personalized way.

Along with a large number of distributed knowledge sources (KSs) representing knowledge in various

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formats this need has led to an appearance of a new direction in the knowledge management called knowledge logistics (KL). KL stands for acquisition of the right knowledge from distributed sources, its integration and transfer to the right person within the right context, at the right time, for the right business purpose. It is based on individual user requirements, available KSs, and current situation analysis.

Being currently developed approach called “Knowledge Source Network” or “KSNet” addresses KL. It is based on a synergistic use of knowledge from multiple sources, and provides a good basis for a personalized service of users—knowledge customers. This approach utilizes such technologies as ontology management, intelligent agents, constraint satisfaction, soft computing, and groupware (Smirnov et al., 2002). The distributed nature of the KL problem was the main reason of the application of intelligent agents to this approach. As a formal model for knowledge integration the ontology model with the knowledge representation formalism of object-oriented constraint networks was chosen. This formalism allows to simplify the formulation and interpretation of real-world problems usually presented as constraint satisfaction problems in the areas of engineering, manufacturing, management, etc. (Baumgärtel, 2000; Giachetti et al., 1997; Hirsch, 1995; Tsang, 1991).

The KSNet-approach tries to apply the mass customization (MC) idea to the KL system serving their users (decision makers) who can be considered as knowledge customers. The term of mass customization assumes individualization of mass-market goods and services to satisfy a very specific customer needs. It serves as a combination of “custom-made” and mass production.

The main principles of the MC idea used in the KSNet-approach are the following: (i) deliver personalized results to users/knowledge customers, (ii) modularization and customization around standardized products and services, and (iii) Just-in-Time (JIT) or even Just-before-Time (JBT) delivery. These principles were a basis for designing the architecture and selecting the framework for the system “KSNet”, which is being developed for validation of main and innovative ideas of the KSNet-approach. The paper describes main ideas of the KSNet-approach related to MC and concentrates on the agent-based architecture of the system “KSNet”.

The main goal of the presented case study is to test implementation of the described KSNet-approach to complex dynamic system—“product—process—business organization (business)” system with a list of different configuration types: (i) marketing/order configuration, (ii) product configuration, (iii) upgrade/add-on configuration, (iv) distributed process configuration, (v) business network unit configuration, and (vi) whole business network configuration.

2. Background

2.1. Intelligent enterprise and corporate knowledge management

As firms compete in global markets they assume complex organizational forms, such as supply chain, virtual supply network, web-based enterprise, production network, e-business, e-manufacturer, etc. Common traits of these organizations are: (i) willingness to cooperate, (ii) global distributed processes, and (iii) high level of coordination and communication. Fig. 1 represents this evolution from traditional forms of the conventional enterprise organization to the intelligent enterprise (Olin et al., 1999).

An intelligent enterprise is any enterprise envisions getting the right information, in the right context, to the right person, in the right time, for the right business purpose stated. Virtual supply network (VSN) is one of the generic concepts of the intelligent enterprise. VSN is a temporal flexible cooperation of independent units providing a service based on the shared products, technologies (or processes), and resources for changing market needs and built on a common business understanding.

Outsourcing is the core of VSN, when organisations rely on third parties in both goods production and process technology usage. Development of information technologies also allowed for many companies to outsource their information function (Caddy, 2000). In this case, information support can be seen as an extension of information system support including not only systems but the entire information environment. Hence, in the case of information function outsourcing by the third party companies, these companies can be considered as members of VSN with the information function becoming a part of the MC-macro processes (Fig. 2), which are a part of VCN model for MC also including information support related to sub-processes, changing roles of participants in the process, and a flexible and open coordination concept (Rautenstrauch

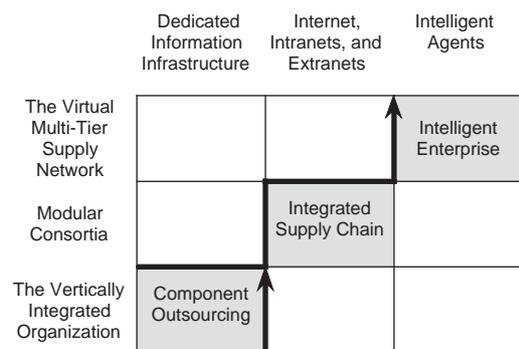


Fig. 1. Evolution of enterprise organizational forms (adapted from Olin et al., 1999).

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