A Web-based ERP system for business services and supply chain management: Application to real-world process scheduling

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Abstract

A Web-based ERP system developed for attacking business problems and managing real-world business processes ranging from simple office automation procedures to complicated supply chain planning is presented. The system's Web-aspect provides significant advantages, as the system is distributed through interoperable, cross-platform and highly pluggable Web-service components. The system involves a powerful workflow engine that manages the entire process event flow within the enterprise increasing efficiency and control at the same time. Business processes, when needed, are controlled by the enterprise quality management system and consequently the ISO directives are accurately followed. A real-world process scheduling system developed for the specific needs of Greek Construction Manufacturing Enterprises is illustrated as a detailed paradigm of the system's capabilities. The problem was formulated to assign project tasks in form of lots to enterprise resources in order that resources idle time and delays in project preparation time were minimized. The problem was solved by a simple and effective heuristic algorithm.
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1. Introduction

During the last decade, there has been acknowledged a tremendous change in enterprise-oriented business software where traditional accounting and commercial management products have gradually left their place to integrated solutions that would rigorously deal with every single business aspect of each individual enterprise. These systems, typically called enterprise resource planning (ERP) systems, are usually developed as individual stand-alone monolithic applications or modular separable tools assembled in a Suite structure for all individual business needs. Most systems in this category have a similar client-server or multi-tier architecture built around a central database server. Typically, in traditional multi-tier standalone ERP applications, critical application components (such as the Application server) are essential for any functionality,

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transaction or access to the database. On the other hand, a new generation of Web-based enterprise information systems is gradually gaining ground, where the system structure is entirely modular, pluggable and separable and no component or module is obligatory for the application's operation. The system presented in this article belongs to the second category, as it is developed on open-source Web-Development platforms and possesses modular and flexible structure.

Web-based techniques are less expensive, more efficient and lately have been the target of most development efforts. Additionally, web-access has been severely facilitated by recent advances in telecommunications and network technology that favor the creation of virtual private network (VPN) structures which unite different enterprise spatial entities (stores, warehouses, offices etc.). VPNs are networks constructed using external network infra-structure (usually the internet) to connect nodes. Web applications are cross-platform in terms of operation system and hardware requirements. Finally, web-based solutions are able to easily interoperate with the whole supply chain entity, consisting what is usually referred as Virtual Enterprise (the enterprise along with its main associates, customers and suppliers) [1].

Besides, ERP systems cover a wide range of functionalities ranging from accounting to commercial operations. In the proposed case, two major issues brought about new insight into business software solution functionalities. The first one is the adoption of quality management concepts in enterprise processes. In order to successfully implement quality management, organizations usually need to abide by the standards of quality management systems (such as ISO). Compliance with total quality standards is very important, since it guarantees that a specific company's products and services are meeting specific quality criteria. To adopt each particular quality standard, several business processes, mostly of bureaucratic nature, have to be carried out in order to coincide with the standard procedures that the enterprise actually follows. As a result, if one wants to control these processes digitally, one has to incorporate them in the main information system of the company, which most of the times is an ERP application. The second issue is the need for the systems to encompass more complex applications, which are vital to the enterprise efforts to exist in ample competitiveness between its market rivals. Critical modules in this direction are the ones that solve Supply Chain Management (SCM) and Logistics problems.

The information system presented in this manuscript possesses two basic parts. A workflow engine that manages the entire business process task flow across the enterprise, incorporating quality management rules and a resource management module, which utilizes a project scheduling management sub-system. The scheduling problem is solved by a suitable heuristic algorithm.

In Section 2, a short list of combined supply chain and workflow management related work is provided. Section 3 discusses the ERP and Web-services integration issue. In Section 4, a detailed description of the general solution framework is presented. Section 5 provides the analysis of the project scheduling algorithm. An illustrating example of one of the system's implementations is reported in Section 6. The conclusions of the text are finally presented in Section 7.

2. Literature review

2.1. Combined business process and supply chain management

Although ample Workflow Management Software systems (WfMSs) exist as stand-alone software applications or even as modules of several types of information systems, either on the commercial software area or in the academic field, the occasions where WfMSs are consolidated with SCM software solutions in the same system or even in many integrated systems, are not proportionately numerous. Nevertheless, there have been some cases in the literature where solutions have been developed combining WfMS and SCM features. For instance, Liu et al. [2] developed an inter-enterprise (Virtual Enterprise) Workflow Supply Chain Management information system, using a lightweight workflow engine and covering ordering, inventory and outsourcing operations of the virtual enterprise. Marquardt and Nagl [3] proposed some concepts on a consolidated platform called CRC IMPROVE, regarding integration of chemical process management software systems with flowsheet and other application tools. However, the problem of job time scheduling in a manufacturing environment and implementing workflow management system solutions at the same time on the same information system, remains in general unexplored.