

# Development of an e-Engineering Framework Based on Service-Oriented Architectures

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**Abstract.** This paper presents an ongoing project on the development of an e-Engineering framework proposed by KIMM (Korea Institute of Machinery and Materials). The framework is based on a number of advanced technologies, such as intelligent software agents, Web Services, and Service-Oriented Architecture. And it aims to provide an integrated design environment to support integrating personnel, design activities and engineering resources during product development process. Especially Service-Oriented Architecture technologies enable to utilize and integrate effectively various engineering resources on the heterogeneous geographically distributed computing environments.

## 1 Introduction

With the rapid growth of electronic computer, information technology, and related engineering technologies (CAD, CAE, CAM, etc.), e-Engineering is becoming an emerging technology, as a new engineering paradigm, to be able to increase rapidly the productivity of the industries and the quality of the products[1,2].

While with the globalization of manufacturing, there is a considerable need for collaborative design environments over the Web to utilize and integrate effectively various engineering resources on the heterogeneous computing environments and to enable collaboration among geographically distributed design teams[3,4].

Integration of the distributed various engineering resources and orchestration (coordination and cooperation) of engineering services provided by the resources have been recognized as crucial issues to construct such collaborative design environments successfully [3,4].

The combination of intelligent agents and a Web services based SOA (Service-Oriented Architecture) framework can be an excellent candidate for the successful implementation of collaborative design environments. Because Web services technology is very powerful in integrating world widely distributed resources, and intelligent agents support cooperation and coordination mechanisms for a range of distributed problem-solving engineering services.

KIMM has a plan to develop an e-Engineering framework from 2004 to 2009 under the Korean government financial support[11]. This paper reports KIMM's framework, which is being developed with a number of advanced technologies, such as SOA, intelligent software agents, Web Services, business process modeling, workflow, and optimization. And it includes PDM (Product Data Management) interface and various kinds of virtual prototyping technologies.

There are some engineering frameworks such as Phoenix Integration's Model-Center [5], Engineous Software's iSIGHT [6], and VR&D's VisualDOC [7] that integrate diverse engineering programs and provide optimization algorithms, approximation scheme, and function of reliability analysis. MSC Software has developed SimManager [8] which manages the CAE data and provides the web based engineering portal and the reporting tool.

However, traditional commercial engineering frameworks have limitations such that those just perform the pre-defined processes and activities. And Web-based technologies only provide basic infrastructures for collaborative design systems by standardizing communications between systems. Thus those have difficulties to change the design process dynamically, to perform the decentralized design, and to support the integration of multidisciplinary design environments.

On the one hand, a number of integrated development platforms such as IBM's WebSphere[9] and Microsoft's BizTalk[10] implement the widely accepted industrial application development frameworks for Web services. They support the SOA paradigm through the use of web services, BPEL, and Web services protocols such as UDDI, SOAP, and WSDL. They have achieved various successes at the application level, especially in e-Business applications.

However, the integrated platforms have no the specialized characteristics for engineering domain. Especially in case of BPEL there are many aspects to be improved when it is applied to modeling the engineering processes. The engineering processes may be changed and/or performed dynamically according to its execution history, its state, and so on [11]. But current versions of BPEL are too static to accommodate the dynamic features needed by engineering processes.

Under these circumstances, intelligent software agents and SOA technologies are all very useful in developing collaborative design engineering environments. The combination of these technologies has a greater potential to bring advantageous characteristics, such as autonomy, cooperative, flexibility, adaptability, interoperability, scalability, and loosely coupled architecture.

## 2 An e-Engineering Framework

### 2.1 System Architecture

Figure 1 shows the overall architecture that extends the previous multi-agent version [3] as an integrated design/analysis system by applying SOA concept. The architecture is separated to the three layers; the top is a presentation layer that provides several interfaces for various users, the middle is a business processing layer that performs several engineering jobs, and finally the bottom is an