

# Chapter 2.5

## Decision Support With BPEL and Web Services

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### ABSTRACT

A review of difficulties experienced with proprietary guidelines languages and in clinical decision support has led us to the development of a decision support system (DSS) based on a service oriented architecture (SOA) using Business Process Execution Language (BPEL) and Web services. BPEL allows simple branching conditions and tests to be set based on the information artifacts in the workflow. For more complex tests, we preferred to place decision support in an external DSS Web service. An advantage of this approach is that the DSS could evolve independently of the clinical workflow. We have implemented an exemplar of the above using the Java expert system shell (JESS). The domain objects are sent by the BPEL engine into the DSS which consults external rules, reasons on the domain objects and rules, and transmits recommendations back. The article will discuss issues involved in implementation using as an example drug-drug adverse reactions.

### INTRODUCTION

In an earlier article (Liaw, Deveny, Morris, Lewis, & Nugrahanto, 2004), we developed an approach to Clinical Decision Support (CDS) based on the BPEL and Web services. The process flow associated with the treatment (diagnosis, referrals, consolidation, and action), was expressed, following expert group analysis, in a series of blocked activities which could then be drilled down into specific actions. The expert analysis led to (i) a set of activities (tasks or services or actions) and decision points; (ii) a set of information requirements at each stage of the process flow, to be mapped onto information sources and sinks; and (iii) a “best-practice” sequence of activities and actions. The sources and sinks and activities could be resolved into local process variables, or a Clinical Information System (CIS) or a set of external service providers described through Web Service Description Language (WSDL) (W3C, 2001).

In a follow-up article (Morrison, Lewis, & Nugrahanto, 2006), we explored issues in interoperability between the workflow engine executing the decision support guideline and the endpoints supporting the external service providers (including manual intervention). We showed the pros and cons of using either SOAP-encoded RPC-style information transfer or document-style transfer and how these approaches were reflected in the design of Web services endpoints and the types of Information Models able to be used to transfer application data.

The examples we provided at that time performed decision support within the workflow engine, utilizing BPEL decision constructs. However, this approach is not suitable when the decision is complex or if flexibility is required in environment/language bindings as in rule-based approaches commonly used in clinical decision making.

In this article, we present and discuss implementation of an evolved architecture, focussing attention on the separation of concerns amongst clinical workflow, reasoning engines, and rules bases in drug-drug adverse reactions as an application scenario. We place complex decision support in an external DSS Web Service accessible to the workflow engine in the same way as the EHR and other service providers. Thus, the detail of the DSS implementation is abstracted from the workflow description and its mechanisms hidden behind an interface façade. Different reasoning engines can be made available depending on the application context and rules bases can be updated following expert review independent of the CDS processes. The rules bases could be maintained centrally and the most current version loaded on-demand.

## **SERVICE ORIENTED ARCHITECTURE AND CLINICAL DECISION SUPPORT**

### **Service Oriented Architecture**

The basic principles of SOA consist in modularizing functions and exposing them as services. This idea of a software application as a service was recognized in the past (Sun's RPC, Microsoft's COM/DCOM), but it can now be fully realized using the Web services for systems interoperability.

A Web service is a software application available on the Web whose capabilities are described in XML and is able to communicate through XML messages over an Internet transport protocol. Basic elements of Web services are the standards for interoperability: XML for information representation), SOAP (W3C, 2000) for invoking, WSDL (W3C, 2001) for describing, and UDDI (<http://www.uddi.org>) for discovering.

On top of this basic interoperability protocol stack, new languages and specifications for defining the composition of Web services to form business processes have emerged, such as Business Process Execution Language (BPEL) (IBM, 2002). Characteristics of BPEL include a service orientation model that emphasizes standards compliance and XML encoding. As well as a formal basis to the language, services are loose coupled and can support synchronous and asynchronous activation.

When compared to related standards (such as XPDL and WSCI), it appears that BPEL is relatively expressive (Wohed, van der Aalst, Dumas, & ter Hofstede, 2003) and currently BPEL is the only standard that comes with execution engines such as Oracle BPEL Manager (Oracle, 2006), IBM's BPWS4J (IBM, 2004a) and ActiveBPEL (ActiveBPEL, 2006)

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