Interactive and Iterative Service-Composition-Based Approach to Flexible Information System Development

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ABSTRACT
An emerging class of technologies defined as Service-Oriented Architecture (SOA) has been heralded as the answer for inflexible IT architecture and promises to reduce operational barriers of current IT infrastructures. In SOA, loosely coupled Web services are integrated to provide dynamic digital capabilities within and across enterprise boundaries. Little research exists on development processes of information systems using Web services and against certain development metrics. One way to perform such research is to propose a development approach, identify the metrics, and embed the metrics into the technique of service composition to allow system development with desired characteristics. This paper reports an approach to information system development based on Web services composition and the metrics designed for such approaches. This approach is based on semi-automatic, interactive, and iterative Web service composition -- a hybrid technique based on developing and searching an AND/OR graph for composite services discovery while taking into consideration human judgment for solution selection and validation by interactions in an iterative way. The composition process leverages historical Web service usage data and provides helpful suggestions to the users regarding available component services. The authors propose that the metrics can investigate the characteristics of such development approaches.

Keywords: AND/OR Graph Search, Flexible, Interactive, IS Development, Iterative, Metrics, Service-Based Development, Web Service Composition

1. INTRODUCTION
The rapid growth of the Internet and associated technologies has persuaded many firms to not only reevaluate their strategic options, but also to fundamentally rethink the role of information technology (IT) in shaping their business strategy. Notwithstanding the skepticism of IT’s role expressed in certain quarters (Carr, 2003), business executives and other technology visionaries contend that today IT matters...
more than ever before in shaping and enabling business growth (Brown & Hagel, 2003). Classical notions of IT’s value to the business has centered around the creation and deployment of strategic applications for manipulating the competitive forces shaping the industry (Ives & Learmonth, 1984). However, these views have been superseded by a more holistic perception of IT as a digital options generator or a platform of digitized business processes (Sambamurthy et al., 2003). Similar viewpoints have also been put forth by others who conceptualize a firm’s IT architecture as a platform for collaborative business processes wherein new products and services can be dynamically created through loosely coupled process modules that can span multiple enterprises and supply chains (Wheeler, 2002).

Despite these emerging ideas about IT’s role as a flexible platform for creating and delivering new business processes, practical realities have to be contended with before organizations can begin to realize this potential. IT inflexibility is endemic in organizations. Large enterprise wide applications with hard wired business logic tightly define the nature of activities and processes that firms can perform and severely limit their interoperability with other applications. Thus IT systems are often found to be lagging behind the pace of business change, thereby severely limiting business agility. An emerging class of technologies broadly defined as Web services has been heralded as the answer for inflexible IT systems and promises to go a long way in reducing some of the operational barriers to achieving scalability and interoperability.

The Web services programming paradigm is a radically different approach to developing and interconnecting IT applications. Rather than relying on customized software solutions (such as customized ERP modules), this approach relies on the use of loosely coupled IT resources – called Web services – that can be dynamically assembled to create composite business processes. Web services are essentially self-contained, self-described pieces of software code that performs a specific function and that are network accessible. Web services can dynamically be found and integrated with other services to form more complex services, or composite services, given the trust among IT firms is taken care of (Zhang & Zhang, 2005). Seamless service composition therefore has great potential in solving the integration problem both within and across enterprise boundaries.

However, in order to exploit the potential of Web services, businesses first need to evolve a new approach for IS development that eschews the current practice of custom-built applications from the ground up whenever new functionality is needed. In other words, we need solve the problem of IS development using Web services and against certain development metrics. One natural way to solve this problem is to propose a IS development approach, to identify the metrics for the development approach, and then to embed the metrics into the technique of service composition itself. In this paper, we lay the groundwork for a semi-automatic, interactive, and iterative approach to flexible software development based on the emerging Web services paradigm. We employ a hybrid technique based on developing and searching an AND/OR graph for services discovery while taking into consideration human judgment for solution selection and validation in an iterative way. Furthermore, the composition process is informed by historical Web service usage data and is able to provide helpful suggestions to the user regarding appropriate services and their availability.

The research described here proposes and tests a semi-automatic, interactive and iterative Web service composition-based (hereafter, referred to as SII) approach for developing IS systems. In Section 2, we first give an overview of our development approach. We then describe the development metrics for similar approaches to IT system development based on service composition in Section 3. The metrics of flexibility and of interactive and iterative are discussed further in detail in the same section. Using the system development metrics as a guideline, we present the process of our development approach in Section 4. We present
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