TOWARDS A SELF-FORMING BUSINESS NETWORKING ENVIRONMENT

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Abstract: The rapid evolution of the markets and the changing client's demands determined enterprises to adapt their business from traditional business practices to e-business, and new forms of collaboration (such as supply chain enterprises, extended enterprises or virtual enterprises) were created. Technologies such as Peer-to-Peer, Web services, intelligent agents, Workflow become core technologies supporting enterprise integration, streamlining transactions while supporting process coordination and consistency. The aim of this paper is to concisely present some relevant business integration reference models, frameworks, standards and technologies, and to propose an approach towards the development of a conceptual framework for a self-forming business networking environment based on Plug-and-Do Business paradigm.

1 INTRODUCTION

Nowadays, in the information age, agility and flexibility are key characteristics for enterprises' business success. Paradoxically, actual information and communication technology (ICT) solutions do not guarantee a true natural operational environment; they often separate and isolate particular departments, companies, supply chains, authorities, research institutions and each individual of their surroundings. In this context, technologies such as Peer-to-Peer (P2P), Web services, workflow system, intelligent agents emerge as core solutions for enterprise integration (EI). Therefore, it is required to develop new applications, frameworks, paradigms, information systems architectures in a speedy manner which than facilitate the achievement of flexible business ICT infrastructure support and can serve as basis for EI.

The current research project addresses the issues identified by the European Commission as research challenges for enabling technologies supporting e-activities (European Commission, 2004), and contributes to the realization of a full-flagged collaborative working environment that answers the needs of the current e-activities, supporting the development of new technologies and functionalities in ICT area.

The aim of this paper is to concisely present some business integration reference models, frameworks, standards and technologies, and to propose a new approach towards the elaboration of a business networking environment based on Plug-and-Do Business paradigm.

2 ENTERPRISE INTEGRATION

2.1 Needs for Enterprise Integration

The complex and sometimes hostile business environment, the new forms of collaboration and the heterogeneity of information systems adopted by enterprises require innovative solutions able to handle distributed business processes that cross the borders of various enterprises in a networked environment. EI aims at developing solutions and computer-based tools that facilitate the coordination of work and information flow across organizational boundaries. "EI is concerned with facilitating information, control and material flows across organizational boundaries by connecting all the necessary functions and heterogeneous functional entities (information systems, devices, applications, and people) in order to improve communication, cooperation, and coordination within this enterprise

so that the enterprise behaves as an integrated whole, therefore enhancing its overall productivity, flexibility, and capacity for management of change (or reactivity)" (Vernadat, 1996).

EI does not represent a new issue. Evolving from physical integration to application and later business integration, EI has been a challenge for both information technology (IT) and manufacturing industries for several decades. Despite the existence of a significant number of computer-based tools claiming to support EI and scientific results in the business networking area and on the so-called "collaborative work", it is generally accepted that more work needs to be done since available solutions are usually cumbersome and lack in flexibility to respond to the most recent technological outcomes, focusing on very specific aspects, and do not provide or tackle all aspects related to EI. The scientific community agrees that questions related to the formalization, conceptual development and semantic integration (namely concerning the formal description of the domain, ontology, behavior, etc.) are fundamental research topics waiting for a consistent development (Camarinha-Matos, 2003).

2.2 Enterprise Integration Reference Models, Frameworks, Standards and Technologies

Several reference models and architectures were developed aiming at organizing EI knowledge and serve as guide in EI programs. This section succinctly presents some integration reference models, frameworks, standards referring to business-to-business (B2B) domain, and relevant infrastructures and technologies supporting EI.

A. Reference Models and Frameworks

SCOR (Supply Chain Operations Reference Model) (www.supply-chain.org) is a process reference model developed as cross-industry standard for supply-chain management, used to describe, measure and evaluate supply-chain configurations. SCOR model is organized around five primary management processes (plan, source, make, deliver and return) that allow it to be used to describe, measure and evaluate very simple or very complex supply chains by using a common set of definitions.

GERAM (Generalized Enterprise Reference Architecture and Methodology) (GERAM IFAC/IFIP, 2000) refers to the methods, models and tools which are needed to build and maintain the integrated enterprise, a single enterprise or a network of enterprises. GERAM is not a reference architecture; it aims at organizing enterprises' existing integration knowledge.

Zackman's Framework for enterprise architecture (Zachman, 1987) describes a holistic model of an enterprise information infrastructure from different perspectives, ensuring that all aspects of an enterprise are well organized and exhibit clear relationships.

Workflow Reference Model (Workflow Management Coalition, 1999) provides the general architecture framework that defines interfaces and covers broadly various area of functionality between a Workflow Management System and its environment.

B. Business-to-Business Integration Standards

As defined by (Bussler, 2003), B2B integration is the enabling technology and the necessary infrastructure (referred as B2B integration technology) to make automated supply chain integration possible, to send XML-formatted messages over the Internet, to send messages in a P2P pattern to trading partners or to exchange messages with marketplaces.

According to (SWWS, 2003), B2B standards' scope can be roughly separated into: **catalogue systems** (*i.e.* BMEcat, eCX-Electronic Catalog XML, OCP-Open Catalog Protocol) and **classification standards** (*i.e.* Ecl@ss, UNSPSC-United Nations Standard Products and Services); **document exchange** (*i.e.* EDI-Electronic Data Interchange, EDIFACT -Electronic Data Interchange For Administration, Commerce and Transport, XML- eXtensible Markup Language, xCBL-XML Common Business Library, cXML-commerce eXtensible Markup Language, RNIF-RosettaNet Implementation Framework); **collaboration** (*i.e.* ebXML – Electronic Business XML Initiative, RosettaNet); and **business processes.**

C. Infrastructures and Technologies

Message-Oriented Middleware (MOM) is a client/server infrastructure that increases the interoperability and flexibility of an application by allowing it to be distributed over multiple heterogeneous platforms.

Agent technologies brought a promising contribution to the development of infrastructures and services supporting collaborative networked organizations (Camarinha-Matos, 2004). The conceptual approach behind solutions designed and developed for agent-based architectures strongly relies on the interaction of autonomous processes that dynamically coordinate their actions by communicating with each other.

Web services are self-contained, self-describing modular applications that can be published, located and invoked across the Web.

Semantic Web is an extension of the current Web in which information is given well-defined meaning, better enabling computers and people to work in cooperation.

P2P technology allows the development and secure deployment of business solutions supporting several communication capabilities, such as transparency, awareness, adaptability or mobility.

3 TOWARDS A PLUG-AND-DO BUSINESS ENVIRONMENT

3.1 Plug-and-Do-Business Paradigm

Plug-and-Do-Business paradigm refers to the natural integration of an enterprise in a networked environment. European Commission's Information Society Technologies R&D Program (Backet *et. al.,* 2002) hosted an expert group with a view to providing a framework for the development of a radically new basis for interoperability of Internet-enabled business (applications). The group is aiming at building a wide consensus on the strategy and approaches, which could be implemented through a research initiative supporting the vision of "Plug and Do Business". The technology-oriented themes identified were: modeling Internet-worked organizations; open architectures supporting inter-enterprise collaboration, and ontologies. The current research project tackles these areas of research.

Few approaches to Plug-and-Do Business paradigm have been made. IBM developed and promoted On Demand Business (ODB). ODB represents "an enterprise whose business processes-integrated end-to-end across the company and with key partners, suppliers and customers – can respond with speed to any customer demand, market opportunity or external threat" (IBM). It relays on three levels of integration: horizontal integration, vertical integration and integration across the value chain.

The solution of the current under development research project will assure just-in-time just-in-place business process execution, trust-based B2B integration, transparent inter-enterprise business processes access, seamless contract- and ontology-based access to a networked organization by focusing on semantic integration on top of B2B standards, and distributed workflow technology will be used for coordination activities.

3.2 Main Research Questions

The research project under development will provide an improved understanding of critical issues related to EI and networked organizations, which could eventually lead to answers to questions such as:

Question 1: Which are the differences and similarities of the current existing (or still under development) frameworks for business networking?

Question 2: Are the available technical solutions and conceptual frameworks competing or are they complementary?

Question 3: Which criteria must be used to compare the available integration frameworks and standards?

Question 4: Which is the most effective methodology allowing the integration, in a natural way, of one or more networked organizations?

Question 5: Which are the organizational, functional and technological requirements for the implementation of an integration paradigm suited for a Plug-and-Do-Business environment?

Question 6: Which are the requirements for the semantic integration among heterogeneous and autonomous business partners that are part of a network?

By answering all these questions, it will be possible to respond the main research question: *how is it possible to achieve self-forming collaborative networks?*

3.3 Methodology

The methodology developed has three main phases: **foundations** (research basis and business orientation), **development** (business model, infrastructure, and prototypes development) and **evaluation** (deployment and evaluation). Thus during the first phase of the project research results are intended to give input to the development phase, development tests can also inform what is feasible in terms of research and business goals. Similarly, the third phase of the research project intends to apply the output to the development process, which will lead to improved output to test. In this way, the research and development activities and outcomes are combined. The first phase (foundations) provides requirements, models and specifications to the second phase (development), while the second phase infers outcomes, which will focus research. Similar relationships hold between all three phases.

Phase 1 (Foundations) provides the research basis and business orientation for the research project. It contains the following sub-phases:

a) *Requirements capture and state of the art*, aiming at identifying, representing and structuring the requirements related to the research project

domain by using requirements engineering methodologies;

b) *Business collaboration logic* sub-phase aims at developing the business logic for self-forming networking organizations by the inter-operation of the business processes;

c) *Business collaboration infrastructure* sub-phase has as objective the elaboration of a roadmap for the implementation and usage of different technologies supporting collaborative environments.

Phase 2 (Development) aims at developing the business model, supporting infrastructure, and also the implementation of two prototypes that will validate the concepts developed. It contains two sub-phases:

a) *Building the collaborative operational environment* sub-phase aims at specifying the operational environment for the self-forming business network;

b) *Prototype deployment* sub-phase has as objective the design and implementation of two concept prototypes.

Phase 3 (Evaluation) aims at assessing project's results. There will be designed and developed several scenarios, and pilot instantiations will be made.

4 CONCLUSIONS AND FURTHER WORK

The need to support EI is increasing. Several conceptual frameworks, integration standards and technologies are being developed. Although there are available several tools claiming to support EI and numerous scientific results in the business networking area and on the so-called "collaborative work", it is generally accepted that more work needs to be done. The urgent need for new business ICT solutions is also shown in several research projects, such as VOSTER (http://voster.vtt.fi) or THINKcreative (http://www.thinkcreative.org).

The current research project proposes a new approach aiming at building a business collaborative environment based on Plug-and-Do business paradigm, allowing the natural integration of an enterprise in a networked environment, and exploring issues on semantic integration and technologies, such as P2P, Web services, Workflow and agents.

Further work will be developed towards the development of a self-forming business networking environment, in order to achieve the objectives proposed by the research project, while making methodology and concept tuning.

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