

COLLABORATIVE FRAMEWORK FOR VIRTUAL ORGANISATION

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Abstract: *In today's dynamic business environment the manufacturing companies face unprecedented changes in the business processes. The companies have shifted away from hierarchical one-dimensional corporation and are forming strategic partnerships with external entities.*

The review of inter-organizational processes enables enterprises to improve customer service thorough sharing expenses, resources, knowledge and information with strategic partners

This paper introduce the stages that should be completed before enterprise can join the collaborative network and presents the agent based framework for data exchange between partners based on SOAP messaging. The case study is based on the ROMEIcop project. The main aim of the project is to prepare subcontractor enterprise to join collaborative environment of main customer.

Key words: *collaborative enterprise, Virtual Organization, Enterprise audit, supplier relationships.*

1. INTRODUCTION

In global market the standalone companies are not able to stay competitive and provide the full spectrum of products and services to satisfy today's customer requirements. To face those challenges organizations should be flexible, adaptable, and prepared for the collaboration. The collaborative networks enable partners to concentrate on core professional skills and capabilities [1].

In order to improve the efficiency of collaborative process the companies are started the implementation of systems

and technologies for collaborative enterprises. The insufficient communication, lack of feedback between partners and missing data leads to uncertain demand forecasts and shorten orders lead times. The systems for collaborative networks help organizations to streamline and manage partners' quality and performance and at the same time, mitigate and manage partner risks for key procurement and manufacturing process [2].

In second section the business partner concept is introduced. In the third section is given the review of enterprise assessment process. The forth section is the review of technologies used today to support enterprise collaboration. And in the last section we introduce the Virtual Organization establishment case study.

2. BUSINESS PARTNER CONCEPT

The earlier research have assumed that partners for a new Virtual Organization (VO) could be easily identified and simply selected from the wide open universe of available enterprises / organizations, and merged into a collaborative network [3]. This assumption however overlooks a number of important obstacles:

- Potential partners search and integration of incompatible data sources.
- Acquisition of partner profile information without common standard.
- The fast establishment of collaborative infrastructures under the conditions of heterogeneity of enterprises and diversity of systems.

- Trust building among organizations and development of common rules for the information sharing and collaborative activities.
- The definition of partner's roles and responsibilities
- The sharing of tasks and the ownership on the produced results.

3. REVIEW OF THE BASE ASSESSMENT PROCESS

The enterprise assessment process is an evaluation process for each of new enterprises, which are going to joint to Virtual Organization (VO). The scheme of the assessment process includes four steps as presented in Figure 1.



Figure 1. The basic steps of preparation to cooperation

Stability and success of a strategic alliance among VO, such as the the Virtual Breeding Environment (VBE), require the trust among its members [3]. The breeding environment is the necessary context for the creation of dynamic virtual organizations [4].

The enterprise specification includes the description of partners roles and responsibilities and identify a set of Pareto-optimal configurations. The Decision-Maker model suggests several good alternatives in respect of different preferences over the selection criteria to decision maker [5].

The audit process is the survey of the current state of cooperation within VBE. During the interviews the information related to differences between the business partners interests and working process organisation is collected. The differences in organizational culture in the virtual context lead to differences in working styles, decision structures, authorities of the contact persons,

remuneration and influence of the workers' council. Those differences hold the danger of conflicts [6].

After the partners have signed the contract the partners are ready to use the benefits of collaboration. The VO partners are entitled to purchase goods and services from new partner based on the contract terms and conditions.

4. INTEGRATION OF ENTERPRISE SYSTEMS.

Today the Internet enables enterprises to search for the low cost high-quality suppliers globally. The big challenge for creation of virtual organization is the integration of business software and establishment of information flow between the partner enterprises.

The Enterprise Resource Planning (ERP) systems are mainly focused on transactions and insufficient for VO requirements. Also the ERP/SCM systems suffer from the lack of software interoperability. The E-manufacturing solutions are used to establish the collaboration. The ERP/ SCM and E-manufacturing software today fulfill different tasks as it could be seen from Figure 2. In PRODNET project it was proposed to use internal module and cooperation layer in order to achieve the software interoperability [3].

ERP/SCM	E-Manufacturing
Financial systems	Waste and downtime tracking
Procurement	Product tracking
Finished goods, raw materials	Production management
Customer service	Control systems integration
Customer orders	Process history
Capacity planning	Real-time quality management
Shipping and logistics	Shop floor metrics
Warehouse management	Decision support
Supply-chain planning	Shop floor user interface
Scheduling	

Figure 2. E-manufacturing and ERP/SCM environment collaboration.

The cooperation between industry, research institutions and software vendors is required to find the suitable solution to enable interoperability between ERP/SCM and E-manufacturing systems. The eXtensible Markup Language (XML) based models have great potential in efficient data transmission and communication, data visualization, VR, and computer rendering. The clients from different location were successful in sending and receiving XML files as given in Figure 3.

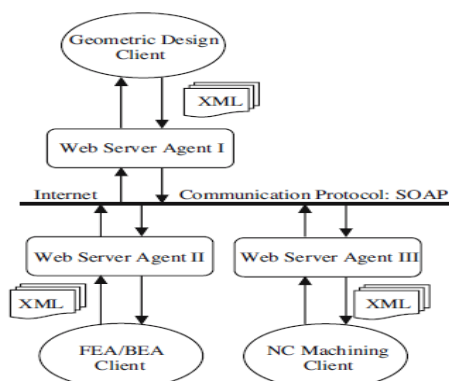


Figure 3. An information-integrated framework to support e-Manufacturing via XML and the Internet

The XML technology was successfully used for engineering applications, such as FemML [7]. The capability of the integrated system to interact with remote applications is often needed and XML files can be sent and received with the Simple Object Access Protocol (SOAP). SOAP allows clients to issue an RPC (Remote Procedure Call) to a server application and then receive a response. SOAP provides a standard way of exchanging XML data on the internet. The architecture in general is called Web Services. The specification of SOAP consists of two major parts: a simple and extensible message envelope defined as an XML document, and an encoding rule for representing application-specific data structure in XML [8]. The VO communication was achieved by Manufacturing Message Transfer

Protocol (MMTP) which is designed by deriving the required features from various existing protocols Hyper Text Transmission Protocol (HTTP), Transmission Control Protocol (TCP), User Datagram Protocol (UDP), and Manufacturing Messages Specification (MMS) [9]. The combination of XML and MMS is a language independent platform that improves the flexibility, re-configurability and interoperability of manufacturing systems [10]. The agent technologies are suitable for usage within a Virtual Organization where the participants are geographically distributed, use different software systems, and with dynamically changing environment in response to market needs and requirements. Agents are proactive, and learn from the environment, because it is not possible to predict the all possible situation in VO [11].

5. THE ESTABLISHMENT OF VIRTUAL ORGANISATION

VO is usually established for specific project needs from the VBE network enterprises and it is dissolved after project order is fulfilled. The enterprises selected into VO are the VBE partners who have the best qualification for the project. If a potential order task is identified the information could be downloaded from the Web page of VBE. In addition every partner is informed automatically by an e-mail or web service message that a new order is added and the partners are sending the offers for the tasks they are interested in. The project initiator enterprise manager selects the suitable offers. If there is no suitable offer made by partners the next offer round is started.

5.1 Five steps to establish virtual organisation

At the beginning of collaboration the partners implicitly agree on a common denominator of cultural aspects, visions,

and strategies for creating a basic agreement on mutually shared values. To facilitate this process the VO cooperation can be started on the person to person basis and in parallel should be supported by collaborative system. When the partner's cooperation is established the collaborative system is used to increase the speed of data and information processing.

The Second step is that partners agree on compatible terminologies and common standards in individual processes and technological paradigms. It helps partners to use the same language – in a terminological and technological manner. This task should be fulfilled before to move further in the direction of electronic SOAP messages exchange. Those messages should be described in standard form to enable automatic data exchange between enterprises. The information about required service will be precisely described in the message header. The agent (person or software) will be able to understand what is the required service and startup the appropriate search function.

Third step is selection of infrastructure for data exchange between partners. The web services will enable to send and receive information from different legacy systems used by enterprises. The partners agree on the working rules for setup the required services, and define the actions that the agents will be able to perform in respond to the service.

The steps described so far are required by VBE. After the implementation the partners are ready for collaboration and the network is ready to operatively react to concrete business opportunities.

During the next step the partners apply infrastructures to synchronize their previously independent business processes. The full system is described: participating agents, establishment of web servers, installation of required services and signing of agreements, available actions, messaging rules and

structure of message envelope, selection and installation of the transport protocols. With this step, a collaborative network is configured and ready to handle the first customer order.

The final step is started when an order-specific project plan is developed and implemented and project owner is looking for collaborative partners. The working on the same project improves the collaboration in terms of communication and coordination.

5.2 Enterprise audit

The aim of the enterprise audit is to prepare potential business partner to join VBE. The audit process is the first and unavoidable step for enterprise. It is absolutely necessary for a new enterprise and for the existing VBE members. The audit established in order to collect more information related to the new member and to prescribe what should be done before new enterprise can be accepted as VBE member. After the audit is completed the information related to new member possibilities, capacities and its core activities will be added to the virtual environment. The audit is assessing the following parts of enterprise:

- Management (Strategy, outlook for the future, organization chart, management review)
- Partnership management (the determination of needs and fulfillment of VBE requirements)
- Personnel (resource management, competence, certificates)
- Quality system (quality management, quality policy, quality objectives)
- Risk management
- Production facilities (shop floor, storage, working environment)
- Machines and tools (condition, storage of the tools and maintenance)
- Purchasing (supply policy, supplier selection)
- Production (audit of management systems and dataflow)

- Logistics (shipping procedure, stock)
- Processes (process description, supporting processes, process metric)
- Metrics (on-time-delivery per customer, internal audit, monitoring and measuring of lead time)
- Environmental management

5.3 Audit of management systems and dataflow

The audit of management system and dataflow is made to prepare the synchronization of previously independent enterprise VBE. The main goal of audit is to analyze the existing management and supporting IS of potential partner enterprise and to introduce the Web Services approach. There are a lot of management systems (ERP systems, MS EXCEL, etc.) that can be used by SMEs and appropriate Web services messages should be selected for the fast and safe communication within the VBE members. The system will support the collaboration in traditional way with possibilities of automatic exchange of messaging between partners, and also directly between VO partners. All data movement structure will be documented and available for the new members and existing members of VO [12].

5.4 FRAMEWORK OF VO COLLABORATIVE SYSTEM

This framework was developed to support the needs of VO in case if the big enterprise has subcontractors and would like to see them as supply chain partners in ERP system Figure 4. For example ENT 1 is giving access to the partners ENT 2 and ENT 4 to the Web Server as presented in Figure 5. If case if the partner ENT 3 have own Web Server the communication between ERP systems of partner enterprises can be established directly by messages between WEB Servers and the data exchange process can be automated. It first case the partners will have accounts for requesting

and receiving of information. It later cases the SOAP messages will be used to exchange the data between partner enterprises through the Internet.

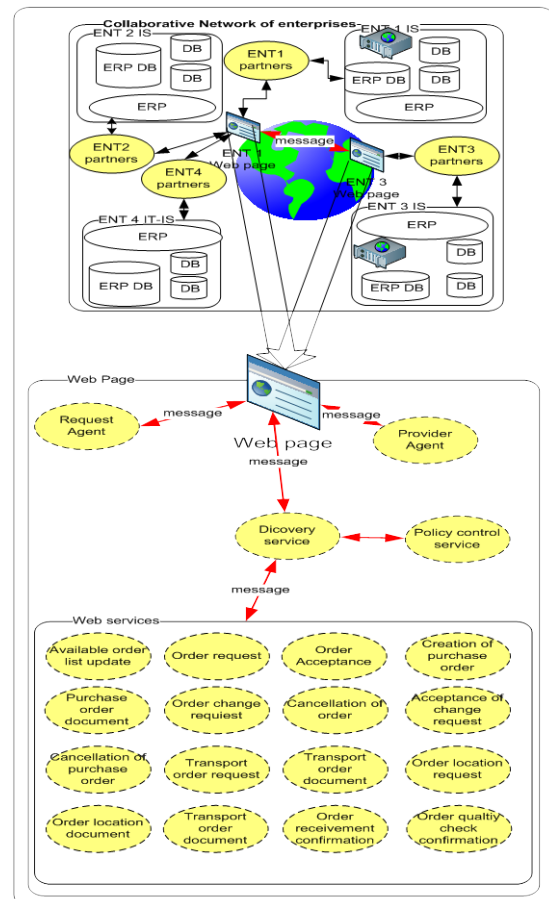


Figure 4. Collaborative Network framework

In both cases to start up communication the Request Agent (it can be either person or software agent) is sending the request message to Provider Agent (which can be also person or software). Provider agent is using the message header information to find the appropriate Web Service by using Service Discovery Service. The Policy control agent is checking if the received message is made accordingly to the agreement with partner, who sent the message, and decides if such information can be provided. Then when the appropriate Service is selected the action will be fulfilled either manually or automatically. When the requested data is collected the Provider Agent will create and send the SOAP message with relevant

information to Request Agent by using the HTTP transport protocol. The agent can be started on the Web Server of main enterprise or on the distributed Web Server of subcontractor. Policy control agent is ensured that the partner has enough permission and that all obligations are satisfied accordingly to contract.

6. CONCLUSION

This paper introduces what should be done before the main enterprise can connect suppliers to own ERP systems. The proposed framework supports the use of legacy software for communication. The data exchange can be done from Web Server of main enterprise or the Web Server of subcontractor can be used instead. This research paper is intended for use by main enterprise interested in establishment of VO with subcontractors.

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