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CHART DEPLOYMENT OF E-BUSINESS APPLICATIONS FOR SUPPLY CHAIN MANAGEMENT

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Igor Novaković, Velimir Deletić

High Business School of Professional Studies - Blace, Serbia
i.novakovic@vpskp.edu.rs, vdeletic@vpskp.edu.rs

Abstract. *Chart of deployment of e-business applications, for supply chain management, is used for reviewing its geographic distribution and complexity. With chart deployment, the connection is established between specified demands for applications, expressed over Use cases and selected architecture for application realization, SOAP, web services.*

Key Words: *Supply chain, portal, chart deployment, SOAP, web services.*

1. INTRODUCTION

The subject matter of B2B electronic market can be very complex since there are many ways in which one can use the Internet as support in goods exchange and payment between companies. Nevertheless, B2B trade influences mostly the change in the purchasing process, i.e. the way in which business firms buy the products necessary for the production of goods which will be sold to buyers. According to professional opinions, one of the ways to get into the area of the Internet based B2B trade is to study the purchasing process. In traditional conditions of doing business, purchasing consists of seven steps: 1. finding relevant suppliers, 2. qualification of found suppliers and products, 3. negotiating about the prices, credit conditions, quality and deployment of delivery, 4. placing orders to the supplier, 5. sending an invoice to the buyer, 6. delivery of goods to the buyer, 7. payment to the supplier. Every single of these steps consists of more sub-activities that must be recorded in informational systems of the seller, the buyer and the supplier. Two significant features of the purchasing process, important for the B2B trade understanding, are the following:

- The type of goods that are bought – purchased from the supplier: **direct,** immediately included with the production process and **indirect,** consisting of products for maintenance, repair and operation which are frequently called MRO goods.

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- Methods used during purchasing: **contracted purchasing**, based upon long-term written contracts containing specified terms or delivery as well as products` quality for a long time period and **purchasing that is paid per delivery** and refers to goods purchasing on a wider market which includes more suppliers. Generally, purchasing of direct goods is frequently based upon long-term contracts, while for indirect goods purchasing that is paid after delivery is used more frequently.

2. MANAGEMENT OF SUPPLY CHAIN

Not only direct suppliers are included in the purchasing process, but also mediate connections, like sub-suppliers, who do their inputs over other suppliers. The number of secondary and third party suppliers can be quite large, where each of them should be modulated according to the production needs of the buyer company. The group of companies that are connected with series of transactions is mentioned as ***the chain of supply*** [5]**.** The supply chain does not include only companies that participate in that chain, but also the connections between them and processes that connect them. Shorted life product cycle, increased competition and increased buyers expectations, push the producers to direct their intention to efficient management of the supply chain. Supply chain management includes coordination of all purchasing activities of a company, from the supplier on one side to the buyer on the other. It is also a pattern that starts and finishes with the buyer, all material, finished products, information, even all transactions are going through this very pattern. Management of the supply chain is a hard task, since in reality, it stands for one complex and dynamic net of various companies with opposed objectives.

Management of the supply chain (Supply Chain Management –SCM) [3] includes and coordinates all the activities directed towards the delivery of a right product to its right place, in the right moment and for a market acceptable price. Globalization of business and application of informational and Internet technologies in all supply chain segments (goods ordering, following – monitoring of order flows, management of supplies, promoting, payment, etc) generate their serious reconstruction that is first connected to the need that certain activities from the chain are completed externally, with specialized providers. Informational systems based upon planning of resources of a whole enterprise (Enterprise resource planning-ERP) [8] that have been so far used as a support to supply chain management, are, first of all, dedicated to the coordination of internal activities, and not to those that happen on the locations of a great number of suppliers, buyers and providers of dislocated activities. By not allowing efficient communication and integration of data, which are found on the locations of dislocated participants, they do not allow easy virtualization of an organization that can be viewed as a trend of modern business.

The main strategic tendency of supply chain management is to provide the proposition of values for the buyer, by which the quality is improved and/or reduce the prices of products and services. Every company has a number of individual chains of supply that are linked to various products, so that instead of the term – chain of supply, the term net of supply chain is used. To manage these nets and to make them optimized, the technologies of electronic communications that allow connections to be established between buyers, suppliers and intermediaries, i.e. their inter-integration are applied. From system perspective, the chain of an organization can be viewed as an acquisition of resources and

their transformation into products and services that are delivered to buyers. As a way of getting close to electronic trade, organizations can organize this process of transformation with the aim to do the delivery of products and services to buyers with more efficiency and a lower price. The boundaries of the supply chain are wider than those of the organization itself, since not only internal processes are included, but also processes that are performed with suppliers, distributors and buyers.

Two strategies can be applied in the supply chain reconstruction process: those that refer to individual activities and have limited reach, or extensive strategies which include complete re-engineering of the supply chain and demand basic changes, before all, the possibility that certain primary activities are completed externally and not internally [4]. As an example of reconstruction of individual activities, frequently stated are the examples in literature of making simple and automatisation of purchasing process and selling of finished products, all aiming at showing extensive strategies the need for dislocation of certain internal activities with provider of applicative services is stated.

Studying the existing literature and accepting recommendations coming from big software companies like Microsoft, it can be concluded that the most applicable integration styles are Service oriented architecture – SOA and Web portals. SOA can be seen as one of the most updated types of integrations at the moment used in B2B trade. It is a type of integration based on the principle of weak connection of inter-active software systems (Web service), and as a platform XML is used (extensible markup language) and HTTP (Hyper text Transfer Protocol). In Service oriented architecture, web portals have the role to demand the services which are provided by other participants on electronic market and information gained at the present moment. Mutual type of exchange between portals that send demand and a provider that provides service is structuralized as SOAP (service oriented architecture protocol) message, the body of which makes a XML formatted document. When the portal accepts an encapsulated XML document as a response to a demand, it can present it to users, transforming it into HTML (Hyper Text Markup Language) portlet or alternatively apply to it WML (Wireless Markup Language) rights for presentation on mobile phones. In order to create a unified, integrated presentation for the user, the portal is responsible also for transformation of contents of various business dictionaries that are used in B2B exchange.

Defining adequate infrastructure for doing electronic trade is of vital importance for all companies that want to adapt to new ways of business. Infrastructure refers to both technological infrastructure that is hardware combination (like servers and PC clients and nets used for their connection), and applicative infrastructure by which the group of software solutions for giving services are taken into account, both to employees in a company and their partners and buyers [1].

Problems that appear during the development of applicative systems by using principles of SOA and implemented usage of Web services are connected for infrastructure. The existing net infrastructure is not capable of supporting granularity of applications that process addressed distributed resources, nor to provide understanding of complex application context. Also, up to now the used applicative infrastructure could not be understood as adequate for application of principle of weak connection, highly distributed and externally heterogeneous models that Web services demand. These problems cannot be overcome by using platform for elaboration of applied integration styles – Service oriented architecture and Web portal over application of XML technologies [6]. This repre-

sents a pre-condition for reaching advantages that allow SOA and has a vital role in using modern applicative solutions. Also, XML infrastructure, as a layer that lies between the traditional net and applicative infrastructure, provides viewing applications like a complex distributed system and overcoming the following problems:

- Limits that exist between various domains which can include more servers, as well as data centers, geographic areas or organizational units
- Difference between heterogeneous surroundings so that the segments of distributed business logic which combine in applicative system can be performed under various net protocols
- Shortcomings connected to traditional operative systems and developmental surroundings that are not efficient enough for distributed and heterogeneous nature of Web service.

3. CHART DEPLOYMENT OF E-BUSINESS APPLICATIONS

UML chart of deployment of e-business applications for chain supply management, shown in Picture 1, serves for analyses of its geographic distribution and complexity. The way in which service type of oriented architecture certain software components applications are shared to processes node are described [2] as well as dependencies that exist between identified components.

Two client types of nodes – desktop PC and mobile phone as well as eight client nodes, which are in distribution architecture placed on various locations, are all presented in this chart. Those nodes are for the following:

- Overview of WEB portal contents (on the location of B2B company)
- Elaboration of Black office applications (on the location of B2B company)
- Downloading or RSS formatting business dictionaries
- Searching the contents of MRO catalogues for products (on the locations of different MRO suppliers)
- Trade with foreign currencies
- Repository schemes searching
- Searching of service register

In this architecture, the connection of all connects between nodes, implies the use of HTTP protocol and for the connections within the nodes HTTP or any other for the platform of specific connections. Although, it has not been explicitly presented in the chart, each of eight server types of nodes has to support HTTP application interface (for example, Apache Web server instance). This does not have to be valid also for two client nodes since they in their architecture participate only as HTTP information searchers [7]. Every direction arrow, with which the dependence between nodes is presented, shows the direction of HTTP request and the title of the arrow is marked by the dictionary used to get the contents of HTTP message that represents the answer.

Node Portal is in the central part of the chart, which aggregates informational contents and services that are available to users` client devices. The portal also serves as a requester of information or mediator for services that are provided by other nodes in distribution type of surrounding. While completing this role, the Portal is also responsible for transformation of the contents of one dictionary into the other, so as to create a unified, integrated presentation for the user.

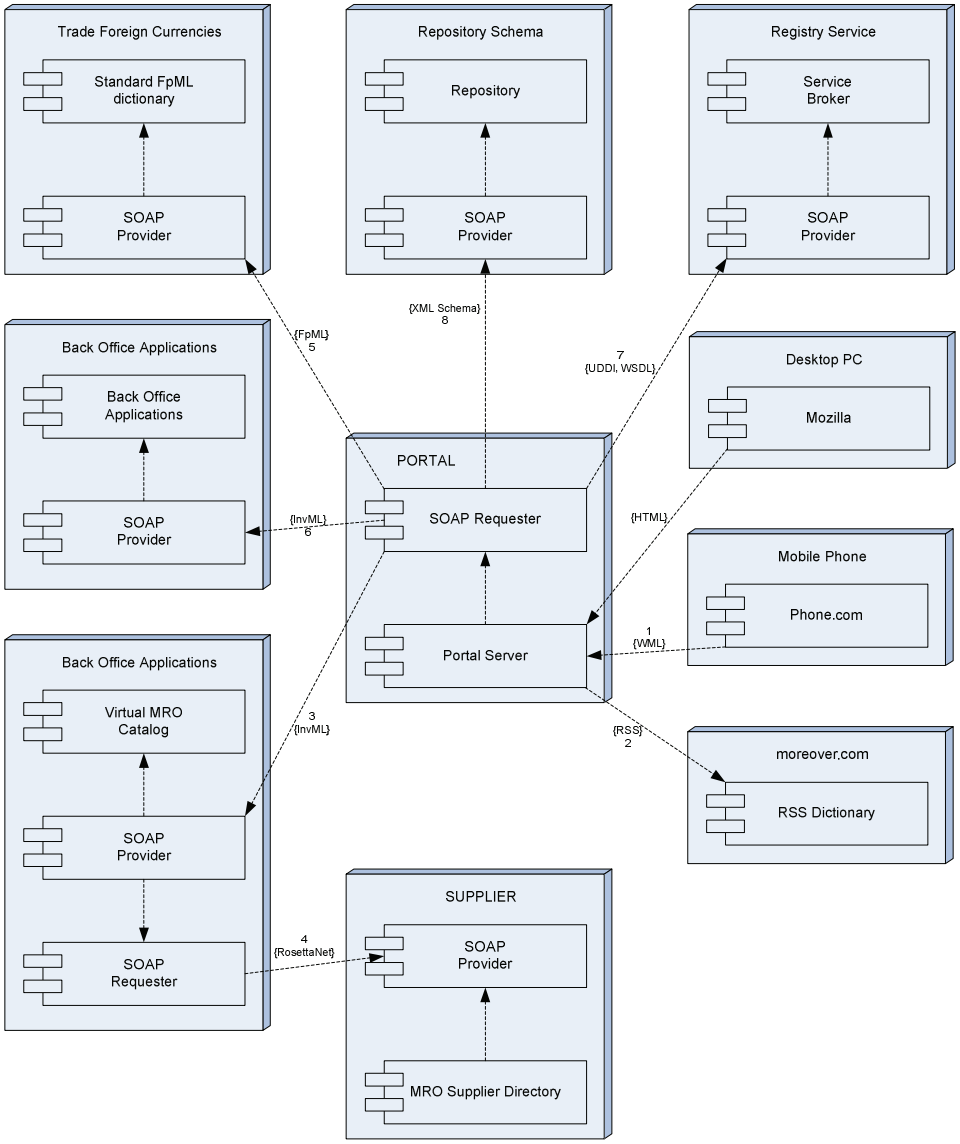

Fig. 1 Chart of deployment of applications for supply chain menagment

According to certain authors, with deployment-distribution chart, a connection is established between specified requests of application, expressed over Use cases and selected architecture for application realization, in this case, SOA. This connection could be defined as: to get successful product, product functions that are corresponding to Use cases and form that is correspondent to architecture, have to be harmonized [8]. The realization with Use cases and form has to be harmonized with architecture and architecture

has to allow the space for the realization of all defined Use cases. The completion of functional requests with application of Service type of oriented architecture could be realized like the following Web services:

- **Web services for portal contents overview:** the task of the portal server is to transform the contents in presentational dictionary that each client device demands. The chart illustrates two types: desktop PC and mobile phone. Each of these client nodes has one component where its web browser functionality is encapsulated. The dependence of browsers components, from the component that is on the server of Portal, is illustrated with arrows and during which every arrow had its name that marks the dictionary for generation of answers to adequate client. It is important to mention that for interaction between clients and server SOAP messages are not used, but they are supported by simple HTTP requests. To avoid large complexity, WAP Gateway is omitted from architecture chart.
- **Web service for taking over-downloading RSS formatted business dictionaries:** as a template for creating XSLT stylesheet, RSS dictionary is frequently used which can be treated like informal standard for the exchange of newspapers headlines. If the channel is publicized on the Internet, then it is up to the one who receives it to decide how to elaborate-process RSS contents. In any case, the biggest profit of RSS application is that many portals, that include their support in the condition, can show the contents of any of new channels without modification and customization. Searching and updating of the documents formatted with the help of RSS template consists frequently of simply sending URL requests to the server where they are and receiving answers in the form of RSS documents. There is no process or dialogue between clients, nor does the server, where RSS formatted business dictionaries are found, expect client confirmation. As a result of this, there is no demand in communication for the use of protocol based on XML messages, but only basic HTTP connection that is illustrated in Picture 1.
- **Web service for searching the contents of virtual catalogue MRO product:** in this case for interface defining from Portal to Provider of application services, where virtual catalogue of MRO products is situated, SOAP Web service is used like it is shown in Picture 1 over the dependence #3. In this scenario, the server of Portal calls SOAP requester component that initiate the request toward the Server ASP where SOAP provider accepts that request for searching The message with which the Portal sends request of Provider on the server of provider of application type of services is structuralized as SOAP message where the body of that message is made up of parameters for searching MRO catalogues. SOAP Provider then returns InvML document to original requester of the message and it is encapsulated into SOAP message that returns as the answer. When server of Portal receives InvML document its contents can be presented to the user in any of the possible ways and is defined by the type of output device. It can be transformed into HTML portlet, which characteristics are customized for certain user profile or alternatively WML stylesheet for presentation on the mobile phone can be applied to it.
- **Web service for integrating catalogue of MRO suppliers:** this scenario combines dependences #3 and #4 illustrated in Picture 1. As the virtual catalogue of MRO product is placed on the server of provider of application services, which contains only metadata about MRO products on every buyer inquiry for search directs to one or more servers of MRO suppliers. The answer from MRO suppliers can be returned from original inquirer of demand, or can be combined with data that are added to it from virtual catalogues.

During specification of system demands for electronic supply of MRO products, it is defined that suppliers respond to inquiry by using RosettaNet dictionary. It means that ASP buyer inquiry by using SOAP service of demands, directs to MRO suppliers and that supplier returns SOAP response that contents RosettaNet document. On the server of ASP the contents of RossetaNet document must be transformed into InvML structure, before the result is redirected back to Server portal. This represents the illustration of the agreements that are implemented within Web service. With implementation of the service the dictionary is taken into account by which its incoming demand is formatted, in this case the parameters for searching MRO catalogues and a dictionary that is used for defining of its output documents. This two level type of demand represents the composition of two services that are elaborated in serial manner. When those services join, the agreement of every service is to be analyzed so as to determine whether its inputs and outputs are compatible, i.e. whether the output can be transformed into dictionary that demands the service that comes after it.

- **Web service for searching repository services gained by transformation of subsystem of Back office applications:** Main characteristics of subsystem `Back office applications` have all functions of operative, internal and informational system of B2B company. It includes: elaboration of external and internal online transactions by which the exchange of information between various services within or out of B2B company are recorded, functions for automation of office business and business function supported by integrated ERP system of company, such as design of products, planning of necessary resources for production, control of quality, marketing and selling, accountancy, purchase, etc. Each of these characteristics can be treated as one Web service which the other components treat as sharing business function, increasing in that way reusability of this system. Every service is represented over contracted interface by which service functions are described so that it can be seen from central service register. All services function according to principle demand-response. In a case when on web portal informational contents could be presented that can be gained on the basis of response from some of the services, the server of Portal over SOAP requester initiates the demand towards the server where ERP system of company is situated that SOAP provider accepts. Inter type of exchange between these two servers that is illustrated in Picture 1 over the dependence #6, is structured over SOAP messages. In a case of demands sending, the body of SOAP message is a command for search of register service Back office applications and in a case of response, body of SOAP message is XML document that returns to message requester. When portal server receives XML document, then the contents can be illustrated-presented to the user in any of possible various ways with transformation in HTML portlet or alternatively by application of WML stylesheet for presentation on mobile phone.
- **Web service for trading in foreign currency:** FpML is a standard for Internet based electronic behaviour and processing of financial instruments that, first of all, refer to interest rate and international products exchange. Subgroup of modules FpML is made of: organization (Trading party), Monetary-international currency amounts and Date - dates, time intervals and division-classification of financial transactions. The scenario is illustrated in Picture 1 as #5. This web service in the body of its demand (request) that is sent by Portal server demands FpML document. The chart shows that for the inquiry toward catalogue in foreign currency trade and searching catalogue of MRO supplier, the same SOAP requester is used. In general, the inquiries within the portal server can be

implemented over various requesters which is the matter of implementation decision. It is important that requester is in condition to send various SOAP messages and that reversal dictionaries InvlML and FpML are elaborated appropriately.

▪ **Web service for searching scheme repositories:** similarly to Web services which use a great number of XML dictionaries, it is useful to have one available repository on the server to search and find the schemes of dictionaries that are demanded by their services. Two widest publicized repositories of schemes are OASIS (www.xml.org) and Biztalk (www.biztalk.com). If the common web service interface was defined, then the server Portal could search both repositories in the same way. In Picture 1, that interaction is marked #8. Since this new W3C XML recommendation represents the scheme as an instance of XML document, the schemes could be exchanged in the body of SOAP messages, as well as any other XML document. With the recommendation to use XML schemes, `scheme for scheme` is also specified which is a proper XML scheme that defines valid dictionary of XML schemes. When a scheme for XML scheme exchanges by using SOAP message, it can be used in order to specify valid types of contents of other SOAP messages. This recursive structure provides very efficient design both for defining and exchanging and manipulating XML documents.

▪ **Web service for searching service register:** similarly to scheme repository, this register for searching and updating Web service description uses SOAP messages which is represented by interaction #7 in Picture 1. SOAP message that contains the response from register has the document defined by UDDI and/or WSLD dictionaries. Described requests for searching service Back office applications, as well as searching contents of MRO catalogue and integration with catalogues of MRO suppliers, are good illustration of using service register. As it has been previously described, virtual catalogue found in provider of applicative services, could provide just-in-time integration of catalogue of more MRO suppliers in a unique view. To provide most flexible integration, Provider of applicative services in described solution uses business register for searching suppliers in desired industrial branch and chooses only those that provide SOAP interface from their catalogue services. With suppliers` description of service the dictionary is specified that is used for presentation of that catalogue, so if the dictionary is different from InvML dictionary, then ASP should make a question to register again so as to find the services for transformation of used dictionary (in this case RosettaNet) in InviML dictionary. This scenario clearly illustrates uses of weakly coupled services that demand little coordination between service and provider. Web portal of application also offers good illustration of service register advantages. Many portals allow each user to search a wide sphere of informational sources that can be added to given user view. The greatest flexibility of portal can be reached if the user is allowed to search global business register, so as to find desired sources and any of them would add to its personalized portal view. Portal server should consult the description of selected service and determine which dictionaries it uses. Since the type of user device is taken into account (example desktop PC and mobile phone), portal server should find the service that can transform source dictionary in demanded presentational language. In spite of certain opposite statements of computer equipment selling, these examples of dynamic configuration and just in time integration are still above the reach of existing technology for Web integration. These examples represent worthy objective to which we should aim and which will be realistic in the near future.

The illustrated chart of deployment can show that service oriented architecture on global electronic market is applicable for integration of ERP system of various companies that participate in the chain of supply. Having in mind also that SOA can be applied also to transformation of infrastructure inherited ERP systems, it is proved that the use of SOA is possible on two levels of transformation activities chains of supply: (1) those that are fulfilled internally, (2) activities that in process of virtualization of company are dislocated to other companies.

4. CONCLUSION

The present relevance of this subject should be found in the fact that, unlike companies in developed market economies that follow the trends and go towards overall application of the model of electronic economy, enterprises in Serbia are still in the starting phases of their application. However, because of the fact that the need for the exchange of business transactions with companies from developed economies will become a must in the nearest future, the acceptance of these principles will be the condition for not only development, but also the very technological and market survival of our enterprises.

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DIJAGRAM RAZMEŠTANJA E-BUSINESS APLIKACIJE ZA UPRAVLJANJE LANCEM SNABDEVANJA

Igor Novaković, Velimir Deletić

Dijagram razmeštanja e-business aplikacije za upravljanje lancem snabdevanja služi za sagledavanje njene geografske distribuiranosti i složenosti. Dijagramom razmeštanja se uspostavlja veza između specificiranih zahteva aplikacije, izraženih preko Use case-ova i izabarane arhitekture za realizaciju aplikacije, u ovom slučaju SOA-e.

Ključne reči: *Lanac snabdevanja, portal, dijagram razmeštanja, SOAP, web servis*