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Web Services, E-Business, and the Semantic Web

Second International Workshop, WES 2003
Klagenfurt, Austria, June 2003
Revised Selected Papers

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Preface

The 2nd Workshop on Web Services, E-Business, and the Semantic Web (WES) was held during June 16–17, 2003 in conjunction with CAiSE 2003, the 15th International Conference on Advanced Information Systems Engineering.

The Internet is changing the way businesses operate. Organizations are using the Web to deliver their goods and services, to find trading partners, and to link their existing (maybe legacy) applications to other applications. Web services are rapidly becoming the enabling technology of today's e-business and e-commerce systems, and will soon transform the Web as it is now into a distributed computation and application framework.

On the other hand, e-business as an emerging concept is also impacting software applications, the everyday services landscape, and the way we do things in almost each domain of our life. There is already a body of experience accumulated to demonstrate the difference between just having an online presence and using the Web as a strategic and functional medium in e-business-to-business interaction (B2B) as well as marketplaces.

Finally, the emerging Semantic Web paradigm promises to annotate Web artifacts to enable automated reasoning about them. When applied to e-services, the paradigm hopes to provide substantial automation for activities such as discovery, invocation, assembly, and monitoring of e-services.

But much work remains to be done before realizing this vision.

Clearly Web services must satisfy a number of challenging requirements in order to be able to play a crucial role in the new application domain of e-business and distributed application development. They should be modeled and designed to reflect the business objectives. Although some progress has been made in the area of Web service description and discovery, and there are some important standards like SOAP, WSDL, and UDDI emerging, there is still a long way to go. There is still a list of issues that need to be addressed and researched in connection with foundations, technology support, modeling methodologies, and engineering principles before Web services becomes the prominent paradigm for distributed computing and electronic business.

The goal of this workshop is to bring Web services, e-business, and Semantic Web technological issues together for discussion and review. This includes new research results and developments in the context of Web services and e-business as well as application of existing research results in this new fascinating area.

Besides very interesting and stimulating research paper presentations, two keynotes were delivered in the morning of every workshop day. Pat Croke addressed the workshop with a keynote titled “Enterprise Application Integration in 2010 A.D.”. He gave interesting insights into past, current and future developments in the space of Enterprise Application Integration.

Robert Meersman reviewed the state of the art with an interesting keynote titled “Old Ontology Wine in New Semantic Bags, and Other Scalability Issues”. The keynote gave important insights and created a lively discussion.

We would like to thank the WES program committee for their hard work in helping make this workshop a success.

June 2003

Christoph Bussler
Dieter Fensel
Maria E. Orlowska
Jian Yang

Workshop Organizing Committee

Program Committee

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Research Paper Track

Enterprise Business Integration in 2010A.D.[1]

Pat Croke

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Abstract. This paper looks at how the use of ontologies to describe businesses and systems may allow a move away from standardization, as a basis for Enterprise Business Integration in favor of mediation between different standards. It proposes the Supply Chain Councils SCOR [1] model as a possible base for an ontology to describe businesses and systems. A workbench is described that would allow automatic configuration of orchestration systems to manage business to business and system to system integration. It also shows how the Semantic Web [2] could be used by agents to identify beneficial changes in a company's supply chain.

To quote George Bernard Shaw:

"*The reasonable man adapts himself to the world; the unreasonable one persists in trying to adapt the world to himself. Therefore all progress depends on the unreasonable man.*"

To date Enterprise Business Integration has tended to take the *"reasonable man"* approach attempting to standardize interfaces between systems. It is the premise of this paper that Semantic Web Services technology and in particular ontology based mediation will allow the "*unreasonable man*" approach where systems are free to use different standards.

Enterprise Business Integration or (EBI) refers to both Enterprise Application Integration (EAI) and Business-to-Business integration. It is the largest area of I.T. expenditure on which $3.9 billion will be spent in 2003 increasing to $5.6 in 2006 according to the Aberdeen Group [3]. The need to do EBI is as inevitable as death and taxes because of:

1. The replacement of old systems for purposes of increasing functionality or maintainability.
2. Companies continuously restructuring to optimize their performance through centralizing or decentralizing activities such as purchasing.
3. Companies merging with other companies.
4. Companies divesting themselves of businesses they no longer consider core or profitable. Conversely they acquire new companies where they see potential.
5. Companies changing which activities they wish to do internally and which they want done by a supplier. In-sourcing occurs where an activity previously done

[1] Opinions and intuitions expressed in this invited keynote address at CaiSE's workshop on Web Services, E-Business and the Semantic Web, are the author's and do not necessarily reflect Hewlett-Packard Company's position.

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by a supplier is brought in-house. Out-sourcing occurs where an activity previously done in-house is carried out by a supplier.

6. Companies changing their distribution strategy. Prior to the Internet a lot of companies used a network of resellers and distributors between them and their end customer. Now they are selling direct to the end customer over the Internet. When a new layer is added this is referred to as intermediation. When a layer is removed it is called disintermediation.

The only companies without a future need to do EBI, are those that have gone out of business. Drivers of cost are: analyzing the impact of a change, and coding/testing the solution.

1 The Unreasonable World

In order to make progress, new methods and technologies are introduced which are better than those that went before. The latest of these is Web Services [4]. New systems under development will take advantage of this technology. However it would be impossible to move all existing systems to use the new technology due to cost. So from an EBI point of view it is just one more technology to be taken care of. This means it will never be possible to use one standard. EBI exists in an unreasonable world.

Businesses use documents such as Purchase Orders or Work Orders to communicate between internal processes, and externally with customers or suppliers. These documents not only convey instructions, but are also the basis of accounting entries within an enterprise's ledgers and sub-ledgers. They are required by law as evidence that a transaction has taken place and are usually required to be retained for a number of years.

Prior to electronic commerce all of these documents were paper based and were as individual as possible to reflect a company's branding and image. This was no problem for humans who are smart and able to select the pieces of information they require from the document.

E-Commerce requires that the electronic formats of these documents be standardized because computers are stupid and the tiniest change in format requires a change to a computer program. An important point is that standardization is only required because of the current low capabilities of computers.

1.1 Formats and Interface Technologies

The number of formats and technologies for communicating between systems continues to increase. These do not tend to replace existing formats. On the contrary they are only used in new system development. They then become yet another technology for the enterprise business integrator to deal with.

There are an ever increasing number of interface technologies used for communicating between systems such as: flat file exchange, messaging, RPC, Sockets, HTTP [5], CORBA [6], DCOM [7], FTP, .NET [8]. There are numerous formats for messages such as: fixed mapped record formats, variable mapped formats, Type Length Value, ASN.1 [9], delimited, XML [10] and so on.

In the area of document formats the world continues to become more unreasonable. With EDI there were two main standards for documents ANSI X.12 [11] and EDIFACT [12]. There are an exploding number of XML document formats:. RosettaNet [13], UBL [14], CommerceOne [15], Ariba [16], OAGIS [17], to name some of the more prominent.

1.2 Optional Documents

Even when businesses agree on the format of the messages they will use to exchange not all businesses will exchange exactly the same messages.

Figure 1 shows a typical message exchange pattern starting with a request for quote and ending with a remittance advice. Obviously purchase order change and purchase order change acknowledgement are optional. In fact depending on the business model any of these could be optional. For example, receiving goods and verifying that they reconcile against the original purchase order can be sufficient for a company to make a payment. In this case the purchase order and the remittance advice may be the only documents exchanged. A large number of companies take orders electronically, but due to the complexity, handle changes by phone or email. Whether an order can be cancelled may depend on where it is in a company's process. If it has already shipped it has to be returned etc.

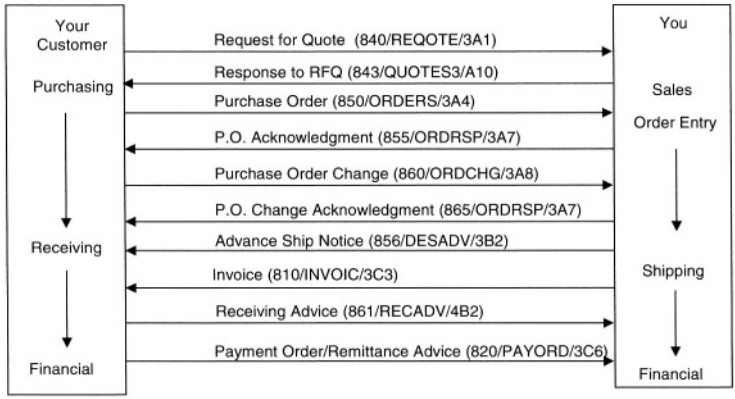

Fig. 1. Standard message exchange showing three message formats (ANSI X12, EDIFACT, RosettaNet)

1.3 Different Business Models

There are many different business models that can exist between companies, which can require greater or lesser communication between them. As well as the traditional purchase order process shown in figure 1 there are many other models such as *consigned inventory* or *call off. Consigned inventory* is where the supplier stores inventory on the customer's site and they only pay for it when they use it. In *call off* the customer gives the supplier forecasts that they build to, for different periods. The customer can then call off inventory, as they require it. Partial liability for part of the forecast is usual and payment is made on delivery. New processes arise all of the

time, often as a result of process reengineering [18], which doesn't change the document formats, but does change which documents are used.

2 Predictions for 2010

Orchestration systems will manage all inter-system communication. Enterprise Business Integrators will have a workbench available to them that will be able to analyze a new system or business that requires integration. It will automatically reconfigure the orchestration system to connect the new system to the existing systems in the appropriate manner. The workbench will be capable of identifying new suppliers and systems on the Internet using agents. It will be able to compare them against its current configuration and recommend changes.

2.1 Orchestration Systems

Orchestration systems are available today such as Microsoft's Biztalk [20]. They manage inter-system communication and security. Adapters are available for all major applications. Documents can be received and transmitted using many technologies including FTP, HTTP, SMTP, EDI, etc. and are readily extensible. Process control languages such as XLANG [21] or BPEL [22] are used to control how a document is routed from one system to another and perform any transformation that is needed. They are able to support standards such as SOAP [23] and WSDL [24] and their support for these and other Internet standards will improve the ease of connecting systems together. However just as important, they will continue to support all of the older ways of inter-system communication providing a bridge between the future and the past. No matter how successful web services become, orchestration systems will still be needed in 2010.

2.2 EBI Workbench

The key technology that will enable the EBI workbench will be Ontologies. *"An ontology provides a vocabulary of terms and relations with which to model the domain. Ontologies are developed to provide machine-processable semantics of information sources that can be communicated between different agents (Software and Human)"* [19]. There are three different types of ontologies in figure 2.

The System ontology will describe the areas of functionality a system has and the document types and formats that the functionality expects. This would allow a workbench to determine whether the new system can communicate with its other systems and reconfigure the orchestration system to include the new system. It would do this by matching the appropriate inputs and outputs based on the existing systems ontologies and the ontology of the new system.

The business ontology will describe the capabilities of the business and the document formats it expects and supplies. Security and connection capabilities will be described. It will contain critical metrics associated with the business capabilities. This will allow the workbench to reconfigure the orchestration system to connect to a new supplier. Agents will be able to find new suppliers on the web who have the desired level of performance based on the metrics contained in the ontology.

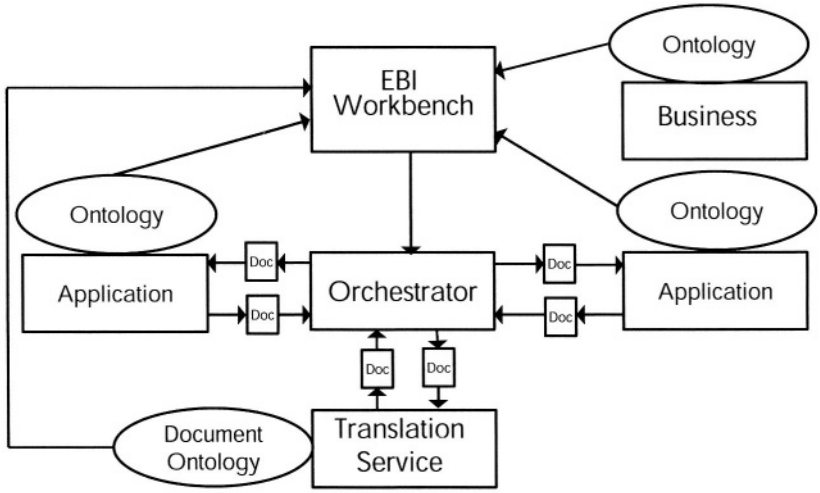

Fig. 2. EBI Workbench and it's Interaction with the Orchestration System

The document ontology will contain a definitive list of business document types and also the web services that will convert between one document type and another.

This will allow the workbench to infer a mapping from one document to another via a third document format.

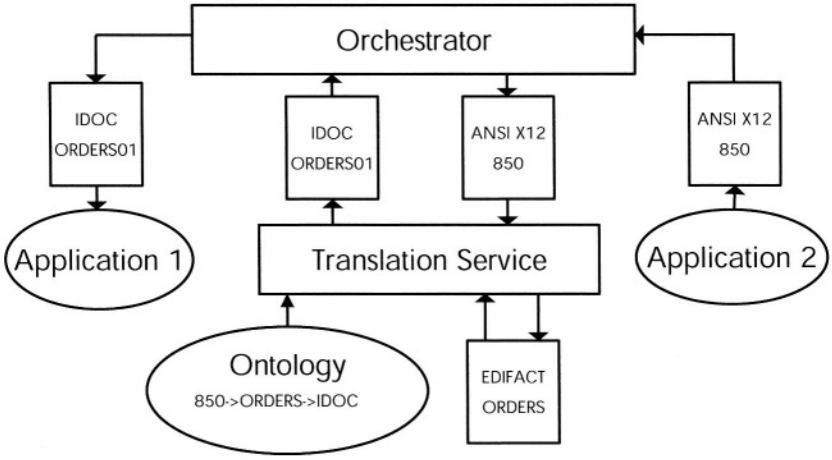

Fig. 3. Document Mediation

Figure 3 shows an example of ontology based mediation. Application 2 can supply an order in the ANSI X12 850 format. Application 1 receives orders in SAP's IDOC ORDERS01 format. The orchestrator receives the order and sends it to the translator. The translator does not know of a service that will translate from 850 to ORDERS01. It then infers using the document ontology that it can use a service to translate the 850

into an EDIFACT ORDERS format and it can use another service to translate the ORDERS format into the ORDERS01 format. It then gives the ORDERS01 document back to the orchestrator, which then passes it to application 1.

4 SCOR a Potential Ontology Base

In order to create an ontology to describe systems or businesses we must first find a vocabulary and a set of relationships that are generally agreed on. The Supply Chain Operations Reference-model (SCOR) is the industry-standard supply chain management framework promoted by the Supply Chain Council (SCC) [25], which is an independent, not-for-profit, global corporation with membership open to all companies and organizations. It has over 800 company members including: practitioners, technology providers, consultants, academics, and governments. They come from a wide range of industries and include: manufacturers, distributors and retailers. SCOR was used by HP and Compaq to plan their merger.

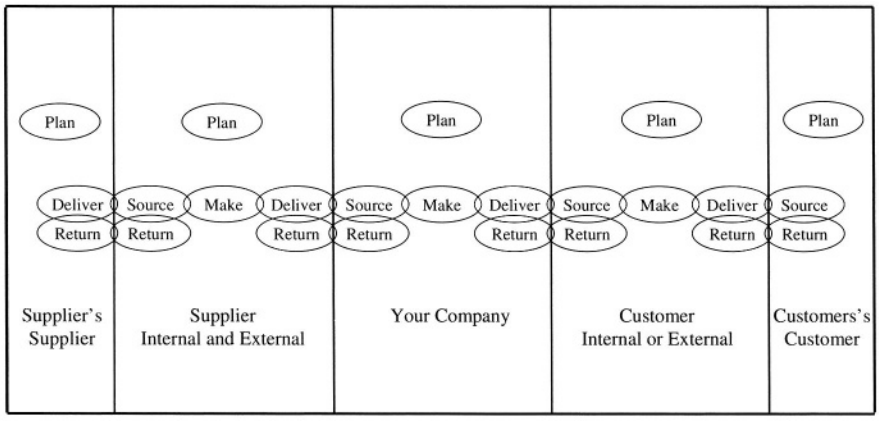

Fig. 4. SCOR Supply Chain

SCOR allows an enterprise to map processes across it's supply chain from it's supplier's supplier to its customer's customer. At SCOR level 1 there are five processes: *plan, source, make, deliver* and *return. Source* is all of the processes carried out with a supplier. *Deliver* covers all of the process carried out with a customer. *Make* is all of the processes involved in manufacturing. These three activities are linked across the supply chain. An end customer would only have a *source* process, whereas an end supplier would only have a *deliver* process. Distributors have only *source* and *deliver* processes, whereas manufacturers have *source, make* and *deliver* processes. *Return* covers all processes involved in the returning of goods. *Plan* processes happen at the intersection of any of the other four processes as shown in figure 4. This is the highest level of the SCOR model. It defines, at this level, metrics that allow the supply chain to be compared against best in class. These are: delivery performance, fill rates, perfect order fulfillment, supply chain response time, production flexibility, cost of goods sold, total supply chain management costs, value added productivity,

warranty/returns processing costs, cash-to-cash cycle time, inventory days of supply, and asset turns.

At level 2 the processes are further broken down into 30 process categories. For example source is broken down into: *source stocked product, source make-to-order product,* and *source engineer to order product.* Each of these processes has a set of metrics associated with them allowing a business to evaluate different links in the supply chain. The process *source stocked product* for example has the following metrics: percentage of orders/lines processed complete, total source cycle time to execution, time and cost related to expediting the sourcing process of procurement, delivery, receiving and transfer, product acquisition costs, and inventory DOS.

Level 3, shown in figure 5, breaks the process down further and adds the expected inputs and outputs along with metrics for each process. This level is very useful for an ontology because it uniquely identifies the processes as in: S1.3 is *Schedule Product Deliveries.*

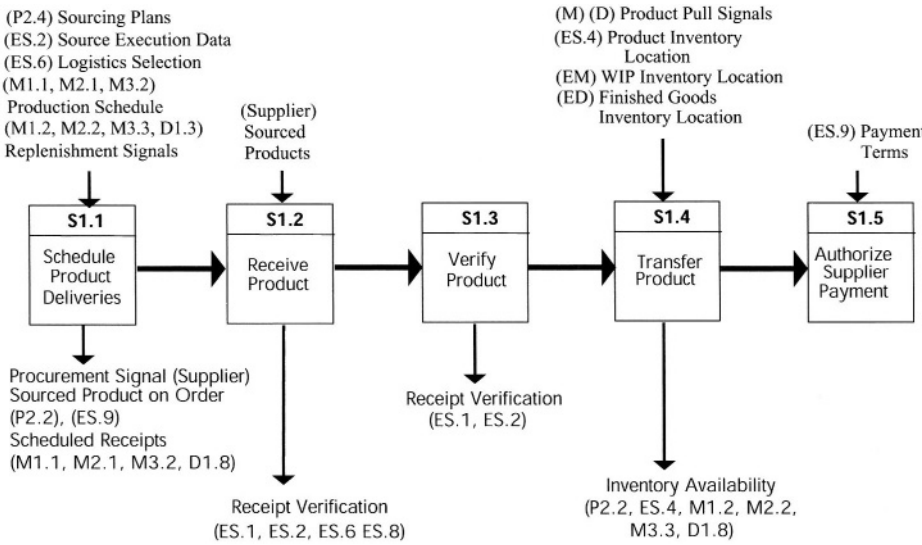

Fig. 5. S1: Source Stocked Product

It also identifies the processes, which supply the inputs and outputs. This allows a thread diagram to be constructed for the whole supply chain. A simple one is shown in figure 6. The diagram shows how SCOR can be used to map the uniquely identified processes and their interactions. In the diagram *Company 1* is purchasing stocked product from *Company 2.* It shows the documents that flow between processes. On a full model there would be one *swim lane* for each internal organization/department and each customer/supplier in the supply chain.

Some members of the Supply Chain Council have been trying to map RosettaNet PIP processes to the SCOR model. This is a very interesting piece of work, which will be useful for companies standardizing on RosettaNet. There also needs to be a way to integrate SCOR with more than RosettaNet to make it suitable for an ontology to describe systems and businesses for the purpose of integration.

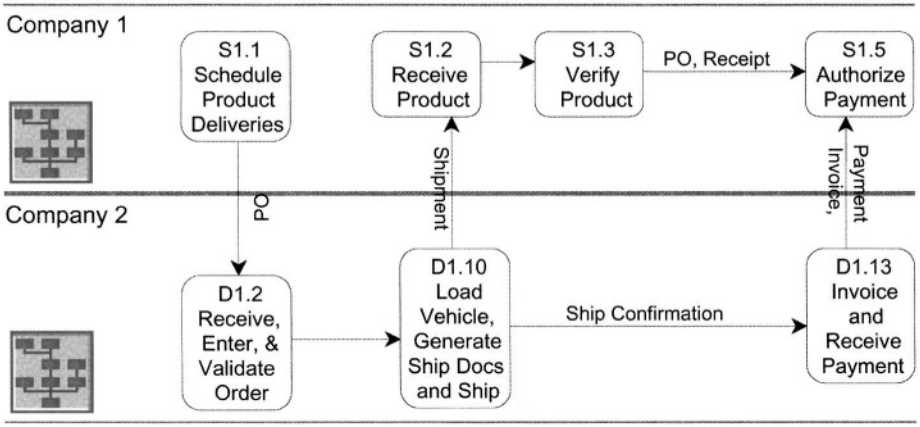

Fig. 6. Simple Thread Diagram

SCOR is, I believe a good candidate for a systems ontology. It has standard descriptions of management processes along with a name for each input and output. Most importantly it uniquely identifies processes and has a framework of relationships among those processes. The description of the capabilities of a business or system and the document formats they have available for each of the input/output types could be structured in an appropriate format such as RDF [26]. This would allow a workbench in conjunction with a document translation ontology to automatically configure an orchestration system to connect to the new business or system. Using figure 6 as an example the workbench would look at *Company 2's* D1.2 process and see that the order format that it required was an EDIFACT ORDERS format and that its equivalent of the order message is produced from it's S1.1 process. It would see the S1.1 process produced an ANSI X12 850 document and use the document translation ontology to determine the mapping.

SCOR has standard metrics to measure process performance. These are used by industry to compare suppliers and evaluate the performance of the supply chain. Structured in an appropriate format such as RDF it would enable web crawlers to look for potential suppliers who fitted or exceeded a business's objectives.

Businesses, once they were aware that web crawlers were looking for them, would use their metrics as an advertisement mechanism, in the same way as today they add keywords to their web pages to increase their prominence in web searches. Certification of metrics will be key. Some SCC members have started to publish their metrics to other SCC members.

SCOR covers all customer interactions, from order through to paid invoice. It covers all product (physical material and service) transactions, from the supplier's supplier through to the customer's customer, including: equipment, supplies, spare parts, bulk products, software, etc. Also covered are all market interactions, from the understanding of aggregate demand to the fulfillment of each order. SCOR does not describe: Sales and Marketing (Demand Generation), Research and Technology Development, Product Development, some elements of post-delivery support, Banking, Education, etc. But it is very widely used by industry and military for evaluating supply chain options and software selection.

4 Going Forward

This paper has identified SCOR as a good starting point for an EBI ontology. One difficulty, is that there is no standardized list of business documents. A new ontology needs to be created, that has a list of standardized document names as explicit as the SCOR process identifiers. It would enable the association of a generic document name with a process, which then can be cross referenced to the equivalent document from a particular standards body, such as: X12, EDIFACT or RosettaNet. The EIDX Business Process Cross-Reference [27], the ebXML catalogue of common business process [28], or SAP's Interface Repository [29], may be a good starting point. As SCOR does not cover all endeavors there will be more than one ontology. The ability to mediate between these will be key.

These ontologies, created and populated, would allow a revolution in the way that Enterprise Business Integration is being done today, by simplifying one of the hardest aspects, which is analysis of the system/business to be integrated and the existing systems. It is my belief that from an EBI point of view, we will be able to accommodate the *unreasonable man* better in 2010 A.D. by shifting from standardization to mediation.

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