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Different Flavours of B2B Web Services Development *

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ABSTRACT

In order to realize successful Business-to-Business integration (B2Bi) the parties involved should agree on a number of business and ICT-related issues. These agreements may be based on bilateral discussions or on proprietary or open standards. The appropriateness of using standards depends on the type of B2Bi under consideration. In this paper we argue that there exist two basic forms of B2Bi, namely Extended Enterprise integration and Market B2Bi. This paper shows that the difference between both types of integration is fundamental, discusses the consequences of the difference for the coordination of Web services development projects and the role of standards for both types of B2Bi. While open standards are *the* way to realize the required network effects in Market B2Bi, Extended Enterprise integration enjoys more freedom and even bilateral agreements may be used in this case.

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I. INTRODUCTION

Information and Communication Technology (ICT) is becoming more and more prevalent in many businesses. In the past many information systems have been developed or bought to deliver some specific functionality. Nowadays, one of the most important tasks of ICT departments is to integrate existing information systems, be it legacy systems or Commercial Off The Shelf (COTS) systems. More importantly the integration of systems is not limited to the inside of the company, but often has to be performed across company borders. Similarly, new information systems often have to deliver cross-company functionality.

Standards are generally believed to play an important role as a coordination device in achieving successful Business-to-Business integration (B2Bi). In this paper we show that the work of coordinating Web services development[1] deserves significant attention, and that standards – although of major importance – are *not always* the way to achieve coordination. Our argumentation is based on the recognition that there exist basically two types of B2Bi, namely Extended Enterprise integration, and Market B2Bi. We show that the Extended Enterprise constitutes a specific context within which information systems are being developed, integrated, and maintained, and that this context entails specific ways of coordination which are different from those that should be used in Market B2Bi.

This paper was written to tackle the idea that B2Bi practices are all one and the same ("We are doing Business-to-Business integration."). As such, this paper is relevant for both researchers and practitioners. For researchers this paper structures the B2Bi domain and positions the role of standards within this area of research. Currently many standards are under development, and many tools are being developed to take advantage of these standards. Unfortunately, information systems researchers usually neglect mentioning for which type of B2Bi their standards/tools are appropriate, obscuring their research. For practitioners this paper reveals what issues they should consider when moving into B2Bi. Especially the discussion concerning the consequences of using proprietary standards vs. open standards should be of practical use.

In what follows, we first present the three basic forms of economic organization discussed in organization theory, namely market, firm, and network. Next, we argue that these three forms of economic organization (and integration) result in three distinct forms of ICT integration. Two of these three forms, namely "Market B2Bi" and "Extended Enterprise integration", concern B2Bi. Subsequently, it is discussed that coordination is required in order to successfully develop Web services for B2Bi. Finally, the role of standards as a coordination mechanism is discussed for both types of B2Bi.

II. EXTENDED ENTERPRISES AND MARKETS IN ORGANIZATION THEORY

For a long time, two basic forms of economic organization have been recognized: markets on the one hand, and hierarchies (firms) on the other (Coase (1937)). This dichotomous view of markets and hierarchies sees firms as separate from markets, and assumes the presence of sharp firm boundaries. However, today these sharp boundaries are not always present any more. More specifically, many organizations nowadays try to cooperate more tightly with business partners. As such, partnering organizations form an Extended Enterprise. The Extended Enterprise can be defined as *a collection of legal entities (N ≥ 2) that pursue repeated, enduring exchange relations with one another* (Goethals et al. (2005)). Transactions in the context of an Extended Enterprise can be seen as taking place in a hybrid form of economic organization. That is, if transactions are distributed as points along a continuum with discrete market transactions located at one end and those occurring in the highly centralized firm at the other end, the Extended Enterprise transactions fall in between these extremes (Powell (1987)). This is illustrated in

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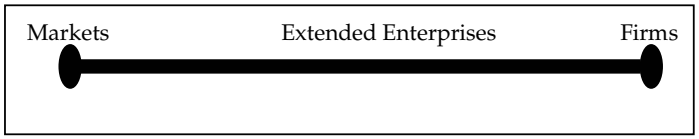
FIGURE 1
The Extended Enterprise as a hybrid of markets and hierarchies



Met opmaak: Engels (Groot-Brittannië)

Three theories are often cited to explain the presence of the different forms of economic organization, namely *transaction cost economics*, *principal-agent theory*, and *property rights theory* (see e.g. (Podolny and Page (1998))). These three theories are basic elements in "new institutional economics". One may conclude from new institutional economics that the efficient design of organizations requires the simultaneous consideration of *coordinational* and *motivational* aspects (Picot et al. (1996)). The coordination problem involves the determination of which things should be done, how they should be done, and by whom they should be done. It is also about who makes decisions, and with what information. The motivation problem is about making sure that the individuals involved in these processes are willing to do their part. Williamson ((1991), p283) refers to the balancing of coordination and motivation as follows: '*As compared with the market, the hybrid sacrifices incentives in favor of superior coordination among the parts. As compared with the hierarchy* [i.e. the firm], *the hybrid sacrifices cooperativeness in favor of greater incentive intensity*'. Transaction cost

economics approaches the problem of organizational design from a coordination perspective; principal-agent theory and property rights theory do this from a motivational perspective. As this paper is all about coordination, it is interesting to shed a light on transaction cost economics.

Transaction cost economics discusses the fact that the cost of organizing a transaction in a market sometimes exceeds the cost of coordinating the transaction within a firm, and vice versa (Coase (1937)). Three critical dimensions of transactions can be defined: their frequency, the uncertainty to which they are subject, and the type and degree of asset specificity. Although all are important, transaction-cost economics attaches special interest to the last one. A resource is defined as specific to the degree to which it loses its value when being used for other than the original task (Picot et al. (1996)). According to transaction cost theory, transactions that involve uncertainty about their outcome, recur frequently, and require substantial "transaction-specific investments" (of money, time or energy) are likely to be executed within hierarchically organized firms. On the other hand, exchanges that are straightforward, non-repetitive and require no transaction-specific investments can be expected to take place across a market interface (Coase (1937)). Furthermore, it is shown that under specific conditions (especially concerning asset specificity) choosing for the hybrid form of economic organization (i.e. forming an Extended Enterprise) is appropriate (Williamson (1991)). Later on in this paper the parallel between transaction cost economics and the use of standards will become clear.

The definition of the Extended Enterprise presented above is very much aimed at identifying the differences between the concepts of the Extended Enterprise and markets. In pure markets companies do not aim at enduring exchange relations (Podolny and Page (1998)). The Extended Enterprise is characterized by a spirit of cooperation, which is very different from regarding the counterparty as a party in a (series of) isolated transaction(s) as is the case in the marketplace (Bowersox et al. (2003)). The cooperation relies on a win-win vision, not on a 'what you win, I loose' mindset. From organization theory it can thus be concluded that there are two basic forms of doing transactions with other firms. First, there is a coupling with other enterprises with which a long-term relationship is pursued (and of which the identity is thus not only relevant, but of major importance). Secondly, there is a coupling with other organizations with which no long-term relationship is pursued, but only short-term benefits are aimed at (and of which the identity is less relevant). Clearly, doing business with partners requires another approach than doing business with other organizations in the market (Bowersox et al. (2003)).

III. EXTENDED ENTERPRISE INTEGRATION VS. MARKET B2BI

The three forms of economic organization recognized above imply three types of organizational integration, namely the internal integration of the different

departments, integration with partnering companies, and integration with organizations in the marketplace (Lawrence and Lorsch (1970)).

From contingency theory it is clear that these three forms of *organizational* integration should be reflected in the Information Technology (IT). Consequently, one may distinguish between three types of computer systems integration: Enterprise Application Integration (EAI) which relates to the internal integration of systems within one firm, and two types of Business-to-Business integration (B2Bi). EAI being beyond the scope of this paper, we focus on the two types of B2Bi.

First, there is the integration of systems of companies within the Extended Enterprise, leading to *Extended Enterprise integration* (EEi). In the context of the Extended Enterprise, companies that dispose of capabilities that are interesting for one another try to cooperate. The partnering organizations already know each other before a partnership is set up, and a partnership is set up to get *more* out of the other company than what is already being delivered. This may involve the creation of new software. It is recognized that some form of coordination is necessary (within the partnership) to realize additional benefits. From transaction cost economics it is clear that partner-specific IT investments can be made and that non-straightforward transactions are possible.

Essentially, this is not the case in the other type of B2Bi, which we call *Market B2Bi.* Companies that do business in the marketplace do not cooperate. Basically, for each transaction they try to find out again who can deliver best what is needed. The integration mechanism used is the free choice to choose the services from any provider (present in the marketplace) which fulfills the company's needs. No thorough coordination among the companies is needed, as every company can freely choose whose services she will use. Of course, providers try to pick up signals from the market so they can deliver services that are useful, and they try to minimize costs, but there is no partnering. In this scenario, no (or only small) transaction specific IT investments will be done. *Market Web services* are mainly being developed in isolation and may be found through a market mechanism such as the global UDDI (Universal Description, Discovery, and Integration) registries. Also, organizations may temporarily do business with many other organizations through an electronic marketplace.

Currently, the boundary between EEi and Market B2Bi is vague. These two types of B2Bi actually cover a whole continuum of B2Bi practices (as is also clear from organization theory). With the current state of technology, we believe that Market B2Bi primarily concerns the indirect integration as mediated by electronic marketplaces. In the future new Web services standards and semantic web standards may be developed that enable software agents to dynamically make direct links to other organizations in the marketplace. Unfortunately, organizations that want a direct link between their systems nowadays are forced to work with a longer term relationship because of the inflexibility and unreliability of IT. This is in contrast to organizations that truly envision a long term relationship (for example with suppliers of

critical, scarce half-finished products). The contemporary ‘long term’ relationship between enterprises may thus become much shorter if revolutionary dynamic technologies become available. The key differentiating characteristic between EEi and Market B2Bi is – in our view – the willingness to make partner-specific IT investments, which is related to the *fundamentally desired duration* of the relationship.

Although the boundary between EEi and Market B2Bi is vague, the distinction between both is useful. For example, nowadays it is often stated that enterprises should be ‘agile’, ‘flexible’, etcetera. The interpretation of terms like agility and flexibility depends on the integration under consideration. Agility in the Extended Enterprise clearly does not involve the flexible replacement of one collaborating partner by a new one. Agility here concerns the ease with which processes can be redesigned, and radically new processes can be implemented so as to better deliver the services the customer needs. In Market B2Bi agility is less on the introduction of new jointly created public business processes, but more on the replacement of counterparties in doing standardized transactions. Please note that this does not imply that no standardized processes can be realized in the Extended Enterprise. Some standardized processes (namely those that require the sharing of private information) cannot even be expected to take place in the Market.

IV. THE IMPORTANCE OF COORDINATION IN B2BI

When developing systems it is important to know the functional and non-functional requirements of the future user of the system. This is, of course, also the case in a Web services world. However, in today's practice the focus seems to be much more on *playing* with Web services technology than to using the new technology in a way interesting to businesses (Frankel and Parodi (2002)). That is, the problem of Business-ICT alignment is challenging the companies once again. Creating an integrated business is a hard task, and translating the total (integrated) business system into an (integrated) ICT system is even harder.

It is a well recognized fact that larger projects require larger teams, what affects the productivity in a negative way. The issue that causes this problem is coordination. The more people are involved in the development of a system, the more time is spent on communication among the staff members. Programmers lose productivity because of the time they must spend coordinating their work with that of the others, and even more important, they lose productivity because of mistakes that are made by failing to coordinate.
The coordination problem has been detected a long time ago, and the solution proposed to resolve the problem was to diminish the need for coordination. The “distributed computing” paradigm was expected to do so. An important building block of this paradigm is the idea of “componentized software” (of which the Web services concept is the latest incarnation). From a technical point of view, cooperating components (such as Web services) can be

developed in isolation. If one component is informed about the interface of another component, it can call this other component. Unfortunately, this fact works as a trap for systems developers. In the past there has been a bad coordination between project teams in that projects that should have had shared data or logic became decoupled, resulting in data and software redundancy. This shows that the distributed computing paradigm did not resolve all coordination problems: there seems to be confusion between 'decentralized' and 'distributed' computing. The term "distributed computing" has often been (erroneously) used as an excuse for a decentralized free-for-all approach. Actually, the term "distributed" implies the '*division of a previous whole*' (Cook (1996), p14)! According to Cook (1996), the concept of distributed computing is similar to Peter Drucker's management concept of federal decentralization, i.e., it requires both strong parts and a strong center. While distributed computing is clearly not a physically centralized approach, it is a logically centralized approach. There needs to be a balance between the flexibility of decentralized computing and the coordination advantages of centralization.

The difference between distributed computing and decentralized computing shows an interesting parallel with the two types of B2Bi presented above. As stated, Web services standards allow for the isolated development of software. In the context of the marketplace companies can freely choose from a plethora of available services, i.e., they expect that some functionality will be delivered by an arbitrary party. The identity of the counterparty is not really relevant, and the required integration and coordination are low. In this case no centralized coordination is needed for the development of Web services. Consequently, the term 'decentralized computing' is more applicable. However, in the context of the Extended Enterprise, the required level of coordination and integration are substantial. The development of Web services can not be left up to coincidence as the necessary functionality and service levels need to be provided by one specific party (i.e., by a fixed partner). In this case one should speak about and live by the rules of 'distributed computing'.

V. CREATIVITY VS. STANDARDIZATION

The question concerning distributed vs. decentralized computing directly shows in a discussion on creativity vs. standardization. After all, standards play a big role in integrating systems: they resolve the need for coordination (at the level at which the standard works). The concept of Web services is currently receiving very much attention as a paradigm that allows B2Bi. The biggest strength of this concept is just that it includes a set of ICT standards. 'SOAP' for example is a standard way to communicate with Web services.

In building a Business-to-Business process, companies need to agree on a number of issues. Agreement is not only needed at ICT level, but also at business level. Above that, it is important to know how to translate the

business agreement into an ICT agreement, and – the other way around – how to use ICT agreements to enable the business. For example, CPFR (Collaborative Planning, Forecasting and Replenishment) is a standardized business practice. However, realizing CPFR is still very hard, as it needs far-reaching changes to the legacy systems companies currently have in place.

It is important to recognize the coordinating role of standards. It can be very useful to standardize issues – be it business issues or ICT issues – on which it does not make any sense to compete. But of course, by standardizing some issues, competition shifts to the other non-standardized issues. Companies still need to make a difference somewhere. From an economic point of view it is clear that something is more valuable if it is scarce, not if it is ubiquitous. The idea that IT would not be valuable because it is ubiquitous is, however, too thin. After all, ICT may become ubiquitous, but the way ICT is used is not always the same. Extracting value from IT requires innovations in business practices. Standards such as SOAP are very useful, and lift the competition to the level of using the standard in a creative way, for example by creating innovative B2B processes.

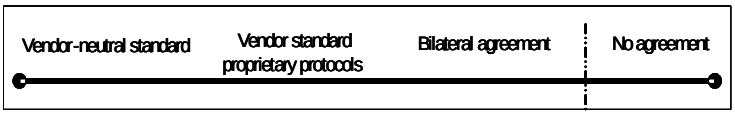
Of course, ideas that were innovative one day may become standard practice with the lapse of time. These standards then in turn form the basis for new developments. Without the standardization of the encoding of characters, there would be no XML; and without XML there would be no SOAP, no WSDL, no BPEL4WS [2], etcetera. The challenge nowadays is to find out how to use these new standards at your advantage. All those people that are involved in architecting the (extended) enterprise (i.e., that determine the architecture of business and/or ICT) need to know which standards do exist and what the existence of a standard implies for their company. That is, they need to find out what opportunities the standard entails, and where competition is moving to.

To realize B2Bi, organizations need to agree on a number of issues. There are different levels of compromise possible among parties. Possible levels of agreement on ICT issues are shown in Figure 2 ranging from fully open standards to bilateral agreements. Clearly, parties at least need bilateral agreements. An active coordination among the parties is, however, not always necessary (nor desirable, see below). Companies can take advantage of the fact that some issues have already been standardized sufficiently at a higher level (for example at the level of the software vendor). Clearly, companies do not have to discuss on the contents covered by a standard anymore if they both agree to use the same existing standard. That is, standards take care of that part of the coordination.

Met opmaak: Niet Hoofdletters

Verwijderd: Figure 2

FIGURE 2
Different levels of compromise



Obviously, not everything is being standardized. When it comes to technology it is only where interoperability is important that standards become required. Features that cause customer dissatisfaction or hinder industry growth evolve into standards, while "customer-useful differentiating features" do not tend to evolve into standards (Cook (1996)). One manifestation of this can be noticed in SAP's software products for example. SAP offers software for 23 industries, meaning that SAP standardizes to some extent the software for each industry, but that differences between industries are respected. Standards are, by nature, a compromise, and compromises are not always practicable.

The demand for standards usually comes from the users and customers of the technology who experience the confusion caused by the lack of standards (Cook (1996)). Employees (be it business or ICT employees) may for example notice that there is no standard terminology in their company, and that this creates communication problems. Companies then consider creating a 'data dictionary' with a standardized vocabulary. At the level of Business-to-Business relations, companies may suffer from a non-standardized vocabulary too. If one company uses the field 'customerno' in its database, and another company uses the field 'customernumber', both companies know the same concept, but have a different name assigned to the concept. In order to have IT systems of such companies talking to each other, a translation will be necessary (from the standardized vocabulary of one company to the standardized vocabulary of the other company). This issue is the concern of 'semantic web' efforts and ontology creators.

In choosing which level of agreement (and which standard) to use, it is important to evaluate the opportunities that are being offered by the different levels of openness (and standards at those levels). Obviously, opting for software which implements proprietary standards or bilateral agreements creates the risk of lock-in. The essence of lock-in is that choices in the future are limited by investments made today (Shapiro and Varian (1999)). Once a technology or a format for keeping information has been chosen, switching can be very expensive.

The practice of Market B2Bi is subject to 'network effects'. Network effects are based on the concept of positive feedback. That is, the value of connecting to a network positively correlates with the number of other people already connected to it, i.e., you can connect to. From the point of view of software vendors, network effects may be elementary for the software market to grow to its full potential. In such a case, innovating software vendors better make sure sales actually do take off. The chance that people will start using their products is bigger if an 'open' approach is used, i.e., if the necessary

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interfaces and specifications are made available to others (competitors and partners). Because the practice of interconnecting systems has become that important most vendors of business software packages are moving to an open approach. They offer componentized software packages with open interfaces which can be called by packages of competing software vendors. Such packages offer for example SCM (Supply Chain Management) functionality, CRM (Customer Relationship Management) functionality, etc.

The presence/absence of network effects should be taken into account when deciding when to use standards. We know of a European bank that has merged with another bank and uses the concept of services to integrate the different systems. One of the former banks already had a service-oriented architecture, and the bank decided to stick with this technology, and not to move to the standardized Web services realm (i.e., they do not even use SOAP for example). Clearly, this bank is not planning to make its services available to third parties. Of course, when integrating systems across companies that do not form one legal entity (unlike the bank), it seems appropriate to use standards at least at a low ICT level (thus standards such as TCP/IP, XML, and SOAP).

Developing Web services in the context of the Extended Enterprise is very different from developing Web services to achieve Market B2Bi. In

Table 1 we show a number of characteristics of both types of Web services development deduced from the discussion above.

Verwijderd: Table 1

A number of issues merit particular attention:

- In the Extended Enterprise, Web services are being developed which might only be used by one specific partner. Market Web services are general services that can be used by many counterparties. At the level of business processes, network effects do play in Market B2Bi, but not in EEi. After all, in the Extended Enterprise companies will not just replace parties in the business process. Consequently, companies can afford not to implement standardized business processes, and they can get competitive advantages by setting up radically new and customized business processes. Still, it seems appropriate to use standards at a low ICT level, as this significantly eases the B2Bi effort without taking away *much* of its power. Using standards may of course result in a loss. For example, using XML is not very efficient with respect to the use of bandwidth. Also, standards are typically a compromise and are thus not perfectly tailored to the needs of the organization.
- In case of the Extended Enterprise, coordination is necessary. Market Web services are rather standardized services and processes. Human coordination is less an issue in that case (and will become redundant in the future when the necessary standards have been developed). Vendor-neutral standards are preferential for Market B2Bi, while bilateral agreements (even at technology level) may be used in the Extended Enterprise.
- The success of developed Web services can be measured by the satisfaction of the users in the case of the Extended Enterprise, and by the usage statistics in the case of Market Web services.
- The life of a Web service created for a specific Extended Enterprise is limited by the duration of the relationship between the companies in the Extended Enterprise. Market Web services are standard services that exist beyond the duration of any single transaction (i.e., the duration of the Market B2B relationship).

TABLE 1
Characteristics of Web services in the Extended Enterprise compared to Market Web services

Characteristic	EE	Market: B2B
User of the Web service	Usually one user-organization. User needs to be identified before the development begins. Partner-specific investments. Counterparty is fixed.	Usually many using organizations. User need not be identified before the development begins. No counterparty-specific investments. Counterparty is variable.
Development coordination	Coordination is needed. Creativity is possible.	No coordination needed. Only standardized processes.
Measure of success	Satisfaction and acceptance	Usage statistics
Life span	Life span Constituting Companies Life span Extended Enterprise Life span EE Web Service	Life span Market B2B Web Service Duration Market B2B Transaction

VI. CONCLUSIONS

There are two basic types of B2B practices. On the one hand, companies within an Extended Enterprise pursue repeated, enduring exchange relations with one another. On the other hand, transactions done in the marketplace are isolated events that are typically straightforward and require no transaction-specific investments.

Companies can use ICT to automate cross-company communication processes. In order to get the systems working together smoothly, coordination is necessary. One way to achieve coordination is through standardization. Standards may seem to take away the freedom to be creative (i.e. they straightforwardly tell you how to do things), but standards enable creativity at a higher level and thus move competition to another level. Above that, successful standards only arrange issues on which it does not make any sense to compete.

As IT-systems should be aligned with the business, standards can only be used to the extent that they allow for such business-ICT alignment. If standards are not desirable/available, another form of coordination is needed. The discipline called Enterprise Architecture is gaining momentum in this context. Basically, an enterprise architecture fulfills the same role as a standard: it restricts the choices of people (where needed) in order to make sure everything will fit together well once everything is implemented.

This paper has distinguished two types of B2Bi. The distinction seems – although neglected in literature – very important and constructive. In the Extended Enterprise companies have a long-term relationship and are willing to make partner-specific investments. They can thus be creative in the Business-to-Business processes they set up. Of course, parties need to coordinate the development of the B2B systems. For example, they need to agree on the terminology they will use in their communications. It should be noted that partners in an Extended Enterprise do *not have to* rely on/wait for a standardized ontology that is appropriate for all organizations (in some sector). The closer companies are cooperating or collaborating, the more freedom they have to opt for a tailored approach, and to use proprietary agreements instead of open standards. However, if companies plan to make their Web services accessible for all companies in the market, they would rather choose for open standards. In Market B2Bi, companies have a loose coupling with each other. Innovative practices are not in order here, standardized practices are. In Market B2Bi network effects are important and open standards are thus the only option. Companies will not make bilateral agreements for example to determine the terminology that will be used, but they will stick to standard ontologies (which are currently being developed and researched) to create direct links between their systems. Clearly, for direct Market B2Bi to achieve its full potential, many more standards will need to be developed. Especially the realization of the semantic web[3] is still in its

infancy. Also, much research is required towards the realization of transactions, standard security protocols, an infrastructure to check the reliability of Web services (and their providers), autonomous software agents that use the standards, etcetera.

Innovative processes developed in creative Extended Enterprises form no ever lasting competitive advantage. Such processes might be copied, and practices that once seemed innovative may thus become *de facto* standard practices, or may even be formalized in formal standards. However, by that time, the Extended Enterprise will have moved on and will show its creative freedom in other practices. The business processes that are executed within an Extended Enterprise do not return *strategic* competitive advantages; it is the capability to creatively use standards that is of strategic importance. It should thus be researched how organizations can acquire this capability.

We remind the reader once more of the fact that the two types of B2Bi mentioned in this paper are two basic types. Real-life practices will often fall in the middle. Besides this, while one company may see some relationship as very important, another company may not perceive the relationship like that. That is, asymmetries are possible between how companies perceive their relationship (often related to how dependent the companies are upon each other). This results in a different willingness of companies to invest time and effort in developing (and coordinating the development of) systems.

NOTES

1. Web services can (simply stated) be seen as computer programs that offer functionality via the Internet to other computer programs.
2. The messages that are used to communicate with Web services (e.g., to ask for the execution of the service) are always built up the same way. Such messages are called 'SOAP'(Simple Object Access Protocol) messages. The information that is to be transmitted in the message (e.g., the productnumber and the quantity are two elements you need to order a product), and other information concerning the service, can be defined in a WSDL (Web Service Description Language) document. Sometimes it is interesting to combine several small Web services into bigger Web services (e.g., to book not only a hotel room, but to book a hotel room *and* an airplane seat at once). BPEL4WS documents make it possible to document how different Web services should work together (Which service comes first? On which condition should the second service be called? Etc.). SOAP documents, WSDL documents and BPEL4WS documents are all formulated in 'XML', the eXtensible Markup Language. This is basically a simple, flexible text format.
3. The semantic web is based on an abstract representation of data on the Internet (e.g., showing that the Jaguar you are talking about is a car, not an animal), which makes it possible for computers to 'understand' the meaning of data, and to reason with the data.

REFERENCES

Bowersox, D., Closs, D. and Stank, T., 2003, How to Master Cross-Enterprise Collaboration, *Supply Chain Management Review* July/August 2003, 18-27.

Coase, R., 1937, The Nature of the Firm, *Economica* 4, 386-405.

Cook, M., 1996, Building Enterprise Information Architectures, (Prentice-Hall).

Frankel, D. and Parodi, J., 2002, Using Model-Driven Architecture to Develop Web Services, IONA Technologies white paper.

Goethals, F., Vandenbulcke, J., Lemahieu, W., Snoeck, M. and Cumps, B., 2005, Two Basic Types of Business-to-Business Integration, *International Journal of E-Business Research* 1, , 1-15.

Lawrence, P. and Lorsch, J., 1970, Organization and Environment: Managing Differentiation and Integration, (Irwin Homewood).

Picot, A., Ripperger, T. and Wolff, B., 1996, The Fading Boundaries of the Firm: the Role of Information and Communication Technology, *Journal of Institutional and Theoretical Economics* 152, 1, 65-79.

Podolny, J. and Page, K., 1998, Network Forms of Organization, *Annual Review of Sociology* 24, 57-76.

Powell, W., 1987, Hybrid Organizational Arrangements: New Form or Transitional Development?, *California Management Review* 30,1, 67-87.

Shapiro, C. and Varian, H., 1999, Information Rules, (Library of Congress Cataloging-in-Publication Data).

Williamson, O.E., 1991, Comparative Economic Organization: the Analysis of Discrete Structural Alternatives, *Administrative Science Quarterly* 36,2, 269-296.