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The Role of Third-Party Service Provider in B2B Integration

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Tietotekniikan osasto

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Yritysten välisen tietojärjestelmäintegraation toteutus kolmannen osapuolen palveluiden avulla

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Sähköisen kaupankäynnin kasvun myötä, itsenäisten yritysten tietojärjestelmien integraation tarve on moninkertaistunut viime vuosien aikana. Yritykset ovat huomanneet, että tilaus-toimitusketjun automatisointiin tähtävällä kokonaisvaltaisella integraatio-ratkaisulla on mahdollista päästä kattaviin kustannussäästöihin sekä tulojen kasvuun. Pääsääntöisesti yritykset kuitenkin etenevät hitaammin, integroimalla aluksi pienempiä liiketoiminnan tietojärjestelmien toimintoja. Positiivisten kokemusten perusteella yritykset ovat valmiita laajentamaan sähköisen kaupankäynnin automatisointia myös muissa toiminnoissa.

Tässä työssä keskitytään tarkastelemaan eri lähestymistapoja yritystenvälisen integraation toteuttamiseen, sekä analysoimaan eri keinojen liiketoiminnallisia ja teknisiä vaikutuksia. Työ on tehty yhteistyössä UPM-Kymmene Wood Oy:n kanssa, jonka tavoitteena oli saada perusteelliset tiedot yrityksenvälisestä integraatiosta ja syventää tietoja sekä integraatio-palveluita tarjoavien kolmansien osapuolten toimintatavoista että heidän tarjoamista palveluista ja niiden käyttökelpoisuudesta puutuoteteollisuudessa toimivassa yrityksessä. Käytännön osuudessa on tarkemmin esitelty integraatio-palveluita tarjoavien operaattoreiden kanssa käytyjen palaverien sekä heidän toimittamien materiaalien perusteella tehdyn tutkimustyön tuloksia, sisältäen yksityiskohtaiset kuvaukset yritystenvälisen integraation mahdollistavista palveluista.

ABSTRACT

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The Role of Third-Party Service Provider in B2B Integration

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The modern business world is seeking ways to automate business interactions, because the companies are more and more aware of the cost reductions and increased revenues derived from the automation of the supply chain. However, there are multiple integration techniques available in the markets, making it difficult to choose the right approach. The companies have become cautious about the new emerging integration techniques, and are alternatively investing more money on third-party B2B integration service providers.

This thesis thoroughly explains the concept of B2B integration, and considers the business and technical aspects related to it. The primary frameworks and techniques for B2B integration are also covered with explanatory figures and examples. This assignment was given by UPM-Kymmene Wood Oy to fully study the possibility of utilising a third-party B2B integration service provider in wood industry environment. The practical part of the thesis introduces detailed description and comparison of the managed services offered by several domestic and international operators.

The objective of this thesis is to form a comprehensive conception of the whole B2B integration area, and to understand what are the benefits and costs of B2B integration, but especially explain the role of third-party service provider in B2B integration.

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1 INTRODUCTION

In a modern enterprise almost all information is digitalised and residing in the company's internal systems that are composed of interconnected laptops, desktops and servers. The trend is to automate the exchange of business events, i.e. purchase orders, quotations, catalogues and payments, in such a way that traditional exchange of paper documents are replaced with digital transactions and human involvement in the process is cut to minimum.

Since the advent of Internet, the results of continuous development in information and communication technology (ICT) has shown its potential to businesses in terms of cost, speed and reach. Today, many companies have adopted the Internet as a communication infrastructure that has the possibility to connect practically any client anywhere at any time to integrate processes and people. This has, in proportion, loosened the boundaries between people and enterprises, and made the collaborations among business communities a driving force of the economy [1]. The corporate bound is no longer a limiting factor, since the internal network and its users can be integrated with trusted business partners' networks to form an extended virtual value chain from which all participating companies can profit.

However, it is not self-evident that participating in electronic business (e-business) will automatically be a success because the old rules of business still apply. The definition of a successful e-business solution almost without an exception includes cost reduction, productivity increase, enhanced product and service development, improved customer satisfaction, and revenue [2]. So, the expectations are high, and can only be achieved by mastering the heterogeneity of various information systems.

The first step in common approach to integration is to manage the integration of company's internal systems, possibly comprising of applications from multiple vendors, to form a consistent infrastructure inside the enterprise. This is also commonly known as Enterprise Application Integration (EAI), but it will be covered only briefly in the following chapters, since the emphasis of this study is on the issues related to inter-enterprise integration. After the internal systems heterogeneity is under control, the next step is to start integrating also the external systems, meaning the information systems of

partnering enterprises. This is also known as business-to-business (B2B) integration.

B2B applications were among the first to exploit the computer networks. At first, the B2B communication methods, such as EDIFACT (Electronic Data Interchange For Administration, Commerce, and Transport), were inflexible and expensive, limiting the participating enterprises only to the largest ones. The invention of the Web (World Wide Web) triggered off the first generation of Web-based electronic commerce (e-commerce) concentrating on business-to-consumer (B2C) applications, like virtual shopping centres. At the same time, B2B e-commerce, less noticed by the public but more impact on the economy, began to reach the expectations set to it due to the use of Web as a conduit for efficient B2B transactions. The consequence of broader connectivity and less expensive connection costs was that also small and medium size enterprises were able to participate in B2B e-commerce and in a short while B2B e-commerce exceeded B2C e-commerce both in the amount of transactions and rate of growth. Enterprises quickly noticed that by adopting the new business methods it was possible to gain more automation, efficient business processes and global visibility. [3]

1.1 Scope and Objectives

This study will concentrate on explaining the methods of B2B integration, and the technologies and standards behind it. Also the possibility to use a third-party service provider for message broking and data translation in external systems integration is thoroughly examined. The objective is to provide an overview of the current state in the B2B integration field, and to introduce some of the most utilised integration techniques and leading third-party B2B integration service providers to guide the decision-making when considering different B2B integration possibilities.

1.2 Overview of the Report

First part of this report concentrates on the theory of B2B integration and the last part deals with practical issues of deploying a third-party B2B integration service provider. The theory part will deal with the business and technical issues of external B2B integration with less focus on the internal integration. The practical part concentrates more on providing a comprehensive study of a third-party service provider's role in B2B integration, and explaining the concept of managed services that are offered by the various service providers and comparing the possible differences of those services.

2 APPLICATION INTEGRATION

A large-scale manufacturing enterprise may consist of many different departments, e.g. sales, marketing, production, and have various external partners and customers. Traditionally, each organisation and additionally each department tend to have its own requirement for the functionality of the information system related to it. The term *application integration* stands for the capacity to integrate a multitude of these system functionalities (their processes and data) [4]. The enterprise application integration (EAI) is concerned with the integration of a company's internal applications, and integration between applications residing in different organisations is the area of business-to-business integration (B2Bi).

During the years of computer evolution, the various departments inside an organisation have managed to build tailored systems that match the needs of each department. Nowadays these so called legacy systems form the backbone of these enterprises by containing indispensable information collected during the many years of use. But the incompatibility issues between these systems contrived enterprise-wide system architectures that comprised of heterogeneous information systems incapable of interacting with each other. However, modern organisations are getting more and more complex and also globally diverse, so it is almost impossible to continue managing and operating such organisations without some sort of integration efforts.

The 1980's concentrated on adjusting the processes to comply with the functionality of the then applications. The need for integration between these applications contrived one-to-one solutions to emerge in the late 1980's. The beginning of 1990's introduced the Enterprise Resource Planning (ERP) approach that focused on operational integration to support daily operations and satisfy the co-operation requirements of various internal systems. At the same time also data warehousing systems drew companies' attention by providing informational integration to support decision making. Enterprise application integration (EAI) techniques emerged at the mid 1990's promising to enable system integration with lower costs and less programming. EAI is based on middleware technology for linking the existing business specific functions together. [4]

Universal guideline to fully benefit from e-business is to first build integrated intra-organisation system architecture, since it facilitates the efforts needed to participate into

the B2B integration scene. This inevitably means that the existing legacy and other applications must be either integrated with the help of EAI technologies or replaced with a new system, such as ERP. Because the internal integration can be seen as a prerequisite for external integration, it is the reason why this study also introduces briefly the main techniques of internal integration. Another reason to introduce these techniques, especially the different methods of application integration, is that they will contain some techniques for external integration as well.

2.1 ERP – Enterprise Resource Planning

When an enterprise decides to implement a new ERP system, in most cases it means the integration of as many internal business processes as possible. ERP was the pioneer approach to enterprise-wide application integration providing a single system that was able to integrate all data and processes of an organisation. The integration is achieved by using multiple components of software and hardware together with one shared database. Implementing an ERP system (i.e. SAP R/3) requires reengineering of existing business processes and the adaptation of ERP standard business processes. [5]

The decision to implement an ERP is a risky step because the implementation project is generally considered to be very expensive and time-consuming. Once the implementation is started, there is no turning back. The most common way to implement ERP is to follow structured approach based on the integration requirements set by the enterprise. Since the ERP systems are expensive by nature, it becomes even more costly to customise these systems to adapt the enterprise's processes. Therefore companies try to reengineer their processes to match with the ERP system's requirements before the implementation project begins, however, this is not always possible and companies are sometimes forced to keep some of the existing business processes and legacy applications. This will often require changes to be made in the programming level of the ERP system and this customisation elevates the expenses significantly. [4]

Before the ERP systems reached popularity among enterprises, the benefits were estimated to appear in the form of improved inventory management and faster order processing. However, the practice has shown that the actual benefits of ERP are attained from standardised business processes, faultless and accurate databases, and decreased data complexity. [4]

ERP systems are often criticised about the internalisation that is the persistent concentration only on internal issues, neglecting the changes related to external environment. Another concern has been the generality of provided applications and their functionality, which is not suitable for company-specific business processes, especially for small and eccentric businesses and their processes. The vendors of ERP systems (SAP, Oracle, Infor etc.) have been forced to react to changes in business environment, and are now adjusting their systems to better match with the needs of modern enterprises, for example, by taking advantage of the popularity of the Internet. [4]

2.1.1 SAP R/3 (mySAP ERP)

SAP R/3 (recently renamed as mySAP ERP) is an enterprise resource planning (ERP) software developed by the SAP Corporation. An independent research made by Gartner in 2005 claims that SAP was then, and evidently still is the worldwide market leader in CRM (Customer Relationship Management), ERP and supply chain software. [6]

SAP R/3 comprises of different modules covering, for instance, such business functions as Financial and Controlling (FICO), Human Resources (HR), Materials Management (MM), Sales & Distribution (SD) and Production Planning (PP). Modules are capable of processing specific business processes individually, but are also linked together according to requirements. The amount of these modules used in the implementation phase may range from just a few to several or all of them. [5]

The SAP R/3 software represents the area of packaged and custom applications that have well defined application interfaces. It complies with the concept of three-tier application architecture (discussed more in chapter 2.3), and when compared to traditional client/server approach it provides better scalability that is required by expanding enterprises. At presentation layer, the SAP R/3 provides the interface for the user. The application layer includes the business-specific logic, and the database layer records and stores all data about the system. [7]

The implementation projects of SAP R/3 system tend to be very complex tasks because the amount of needed customisation varies from enterprise to enterprise. Therefore companies are often forced to rely on a highly skilled SAP consultant to help with the task at hand. However, it often ensures the successful implementation of the ERP

systems that is the most essential issue from the enterprise's standpoint and the additional costs are often acceptable.

2.2 EAI – Enterprise Application Integration

EAI was introduced after ERP to overcome the high costs and time-consuming programming issues that were related to the implementation of ERP and other packaged applications. This was accomplished with the concept of linking the existing applications of an enterprise to form unified and modern system architecture. This approach was particularly designed for enterprises that needed to use the existing customised legacy applications or commercial packaged applications and still add new applications that exploit new areas of business, for example the Web. [4]

Specialised EAI platforms in the markets are usually built on top of a certain middleware technology, such as component framework (.NET framework) or message queuing (JMS - Java Messaging Service). The platform serves as a bridge between the legacy or packaged applications and B2B integration servers, application servers, or web servers. By allowing separate applications exchange information with each other, the middleware jointly implements an internal or even external business process. The middleware provides at least the mechanisms to transport data from one application or component to another, but often these systems are also capable of providing other additional features, such as system administration and management, tracking and tracing, data translation and transformation, development tools, security features and so on. [1]

EAI is often implemented according to either star or bus topologies. In star topology, the EAI system is the centre hub in which all the applications are connected. In bus model, the EAI system can be either the bus itself or a module inside an existing message middleware through which the applications interact with each other. When integrating two isolated systems with EAI technique, both systems are linked to a hub/bus that serves as a bridge between the applications. There is no need to rewrite the codes on either system, which was the case prior to EAI, since legacy application can be “wrapped” with adapters to hide the complexity from other applications. The following picture (Figure 1) illustrates the disposition of various functional entities and the connection arrangements between different elements in the EAI architecture. [8]

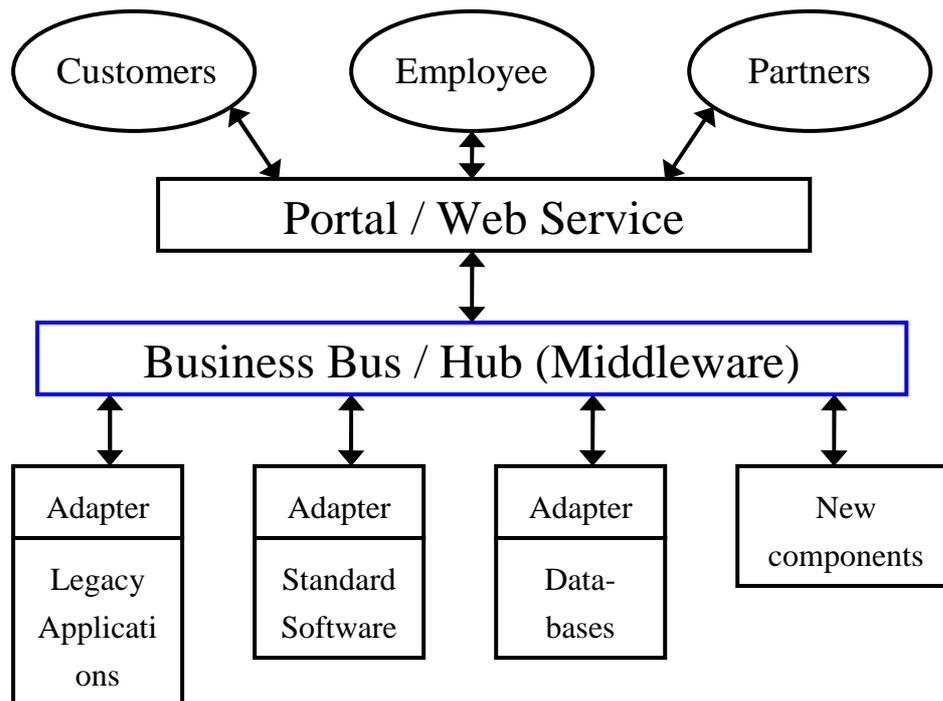


Figure 1: Enterprise Application Integration (EAI) architecture

So, the EAI architecture provides a set of technologies to enable exchange of information between separate and otherwise incompatible applications inside an organisation. Integration solution providers such as WebMethods, Tibco and Vitria have designed products to address this market area, but the solutions tend to be as complex and costly as ERP solutions and therefore only rarely utilised in overall trading networks.

The benefits of EAI include the ability to share real-time information among diverse applications, streamlining of business processes, improved organisational efficiency, and maintaining information integrity across various systems. Although the EAI promises to facilitate enterprise integration, the failure rate of EAI projects is considered to be relatively high. The project requires less time to success than re-engineering of business processes in ERP, but is still very time-consuming and needs a lot of resources. The lack of proper management during the integration process can be rated as the top reason of project failures. To successfully carry out an EAI implementation process, it calls for seamless communication, coordination and co-operation between IT personnel and the business staff. [4]

2.3 Methods of Application Integration

The applications can be integrated at multiple levels, and the classic reference model for application layers is based on the three-tier client/server approach that describes three different application tiers at which the integration can be performed. The first one is called *database* tier that focuses on integrity and consistency of data with the help of various mechanisms, such as SQL triggers, keys and data types. The second layer is called *application* tier that encodes the core business logic. The third layer is the *presentation* tier that provides the graphical user interface separating the interface from the application code. [1]

To better serve the needs of B2B or external integration context, this model must be extended with a fourth layer that is referred as the *service* or *business process* tier, which provides business process-oriented interfaces. As depicted in the following picture (Figure 2), the service tier is considered to be an alternative layer for the presentation layer, so not a higher-level tier. Service and presentation layers access the database through the application tier and may also exploit the functionalities of the application tier. The presentation tier provides the access to the system for the user, and the service tier interacts with external applications. [1]

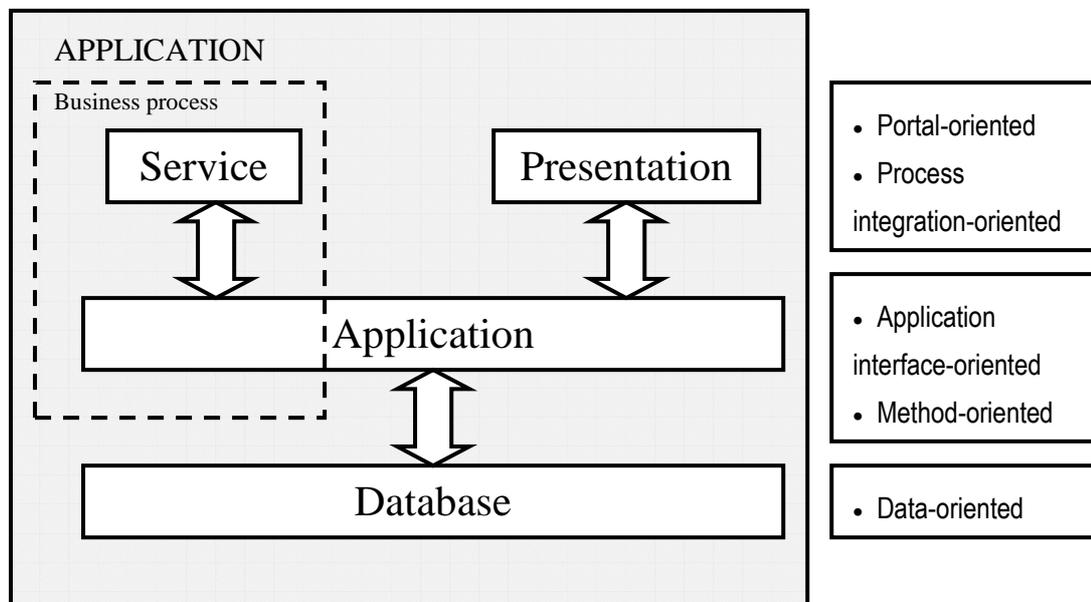


Figure 2: Application tiers and their relation to the methods of application integration

There can be identified five common methods of application integration. According to David S. Linthicum [9] these categories are; data-oriented, application interface-oriented, method-oriented, portal-oriented and process integration-oriented. As it can be also observed from the previous figure (Figure 2), these methods are interlinked with the tiers introduced above.

The simplest form of application integration is data-oriented approach that provides means to exchange plain data between two entities (usually databases). The data can be sent from source entity to destination entity that can reside inside the same organisation or in another organisation. Problems of this approach arise from the vast amount of different databases and from the various applications utilising the databases. Also the different formats and semantics of data may cause additional difficulties. Nevertheless, the data-oriented approach provides a cost-effective integration solution, since it diminishes the need for testing. [7]

Application interface-oriented approach focuses on integrating packaged applications and custom applications to enable enterprises to build completely integrated infrastructure from existing applications that already include the needed business logic, data security and integrity issues. Application interface-oriented makes application specific user interfaces obsolete, since the applications interact with each other through programming interfaces. The middleware technologies mentioned above are the exemplars of application interface-oriented approach and there exists several software vendors that provide effective solutions to this approach. [7]

Method-oriented integration enables the execution of common business functions from various applications. For example, updating customer records can be executed from separate applications or even organisations. Several mechanisms for implementing a method-oriented architecture can be identified; examples of such are application servers, event handlers, application frameworks, etc. Method-oriented architecture is usually utilised inside an organisation, but can be extended to support also inter-enterprise integration. [7]

Portal-oriented integration aggregates the applications in such a way that they can be accessed through a single Web interface. The physical location of the applications may be at separate organisations but they can be accessed through a common interface to give a collective view of the overall information. The portal-oriented approach is usually utilised to integrate the smaller partners that have no possibility or skills to integrate their internal systems, and therefore the adoption rate of the portals has clearly exceeded other methods in terms of external integration. [7]

Process integration-oriented approach is a business centric management system that resides on top of the information exchange systems of communicating enterprises. This approach provides the means to consider the information flows and interactions between the partnering enterprises and usually utilises other integration methods to reach the desired integration level. The process-centric inter-enterprise integration is the main focus of this study, and therefore it will be carefully considered in the upcoming chapters. [7]

Although most of the methods of application integration introduced here are originally intended to use in internal integration, nevertheless, some of the approaches can be extended to cover the external integration issues as well. Especially the portal-oriented and process-integration oriented approaches are commonly utilised when trying to achieve B2B integration.

As this chapter of application integration demonstrated, the line between internal integration and external integration is not so clear-cut, since most of these methods can be applied in both of the areas. B2Bi is considered to be more a high-level approach to application integration than EAI. The following chapters will concentrate more on inter-organisational integration aspects with less focus on the internal integration issues.

3 B2BI – BUSINESS TO BUSINESS INTEGRATION

B2B integration is difficult to explain exhaustively with just few words. C. Bussler makes a broad statement by defining it to cover all business activities of an enterprise that have to do with electronic message exchange between the company itself and one or more of its trading partners [10]. Another widely used definition made by M. Lynne et al. in their study is that B2B integration refers to IT-mediated transactions between independent business entities [11]. Linthicum defines B2B to be “controlled sharing of data and business processes among any connected applications and data sources, intra- or inter-company” [9].

So, the B2B integration and interaction takes place between two or more businesses, for example between customer and supplier. The objective is to electronically connect these businesses, and exchange business related information and utilise it accordingly. The exchanged information may be related to only data but encompasses usually also the sharing and collaboration of processes and applications. The level of integration, varying from business message exchange to business process sharing defines the complexness of the B2B integration process.

Involving enterprises’ information systems are connected to each other over a desired connection network, like the Internet. The business events are then exchanged over that network. Exchange sequences are usually pre-defined and follow a set of rules defined by an e-business standard [12], such as the EDI-standards (EDIFACT and X12), RosettaNet. In order to exchange business information between enterprises, it must first be retrieved from the backend systems (e.g. databases) and therefore requiring also the connectivity of internal systems that can be achieved with previously introduced internal integration techniques (e.g. EAI or ERP).

The previous paragraph radically simplifies the complexness of the actual process that is required when two separate companies try to build an integration architecture that corresponds to each participant’s requirements. The challenge in B2B integration is that the applications inside an organisation and the applications between different organisations are able to operate and evolve independently, but at the same time are able to communicate with each other and utilise each other’s functionalities [3]. A descriptive

view of the whole e-business scene including both intra- (EAI) and inter-enterprise (B2Bi) communication methods is illustrated in the next picture (Figure 3), providing a better view of the different systems and technologies, which are involved in a comprehensive integration process.

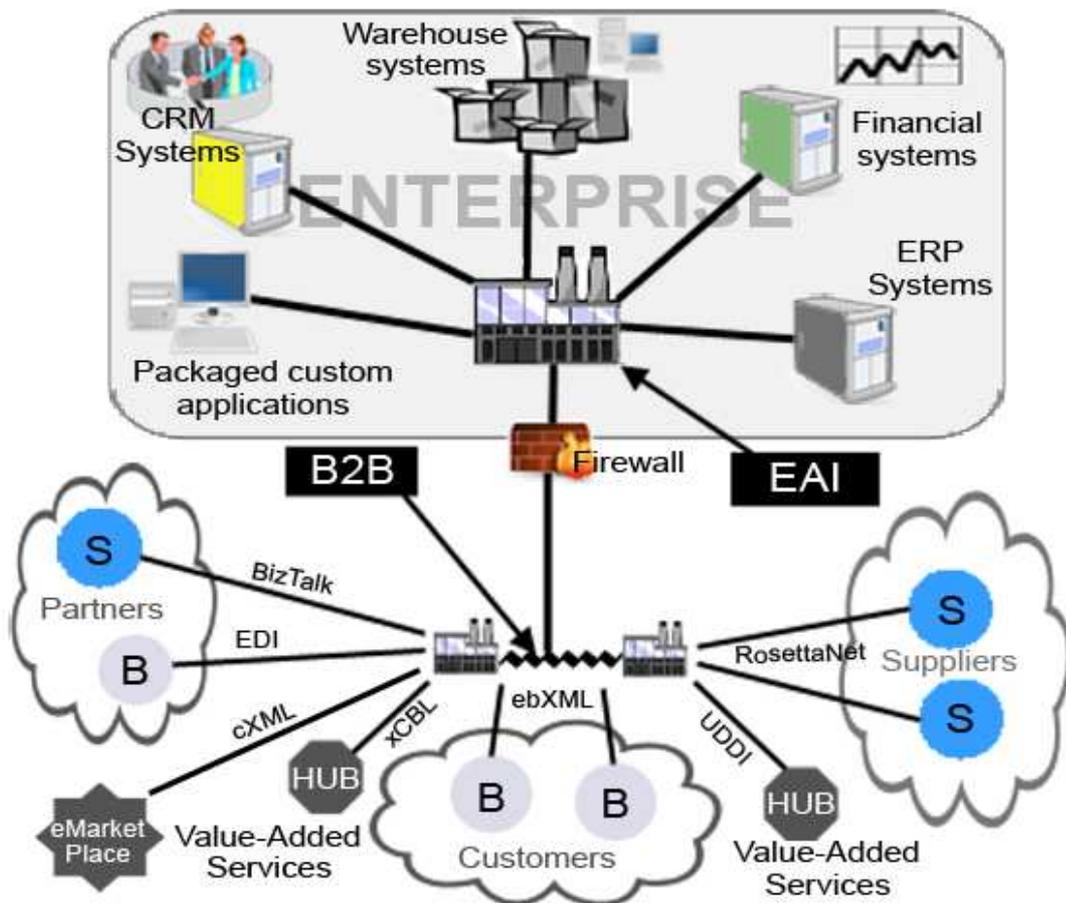


Figure 3: EAI and B2B architecture

As figure 3 above depicts, there exists numerous B2Bi solutions and techniques in the markets, making the integration task a bit more difficult. In addition to the adopted B2B e-business technique (for example RosettaNet), the architecture must also have the support for the other techniques as well. The next sections will introduce the most popular techniques of B2B integration, and providing also some business and technical considerations related to them.

The rough classification of B2B integration methods in this thesis is based on a study made by M. Lynne et al [11]. They have defined the B2B integration methods to fall into two main categories. The first one is called one-to-one or point-to-point approach, which

is the traditional way of integrating two business partners with a single link. The other one is called hub-and-spoke approach, which utilises a central (external) intermediary to connect many companies to several others with one link from each company to hub.

3.1 Point-to-Point approaches

As stated above, point-to-point approach is the most commonly used method in B2B integration. The main reason for this is the wide adoption of EDI-standards, which is the initial B2B communication technique developed over three decades ago. Since EDI can be also considered to be the whole electronic data interchange paradigm, it's important to point out that in terms of this thesis, the term EDI will stand for a certain technical representation of a business conversation between two entities, including standards such as UN/EDIFACT or X12. Biggest disadvantage of one-to-one connection is that it does not scale up well, meaning that while the number of partnering enterprises increases linearly, the number of manageable links increases exponentially, as depicted in the following picture (figure 4). The formula for calculating the maximum number of links between n numbers of companies is $(n^2-n)/2$.

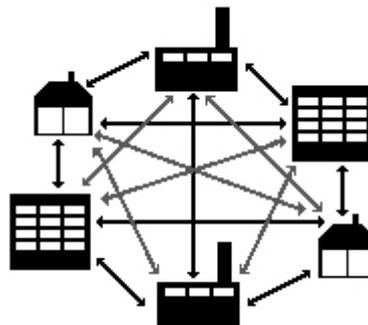


Figure 4: Point-to-Point approach, max number of links = $(n^2-n)/2$

- **EDI – Electronic Data Interchange**

EDI related standards have not achieved the expected popularity, especially among small and medium size enterprises, mainly because the start up and operating costs of the technology are extremely high. EDI-standards define rigid rules for the structure of business documents, i.e. a purchase order. Usually several different business documents are needed to carry out a complete business process, and multiple business processes are required to form a complete business relationship between two enterprises. EDI-standards expect a trading partner agreement of each document to be exchanged in a business relationship. Even minor changes in legislation, business rules etc. may change the transaction formats and require new agreements to be made

all over again. [11]

Moreover, enterprises are often involved in a cross-industry business environment and usually the EDI-format of the same business document varies depending on the industry in question. This leads to setting up and maintaining multiple EDI transaction formats for the same business document, increasing the maintenance costs from before. Traditional EDI-standards operate in batch mode and, therefore, are not able to deliver real-time information, which can be a prerequisite in some of the modern enterprises. All this, and the lack of resources and skills have justifiably caused small enterprises to avoid adopting the EDI-standards, thus generating more costs to the companies that support EDI-standards, since they are required to support multiple transaction methods. [11]

The advent of Internet generated possibilities to reduce the start up and operating costs, which were the main reasons hindering the breakthrough of EDI-standards. Traditional EDI-based transactions are executed over dial-up lines or leased lines, which are operated by an EDI intermediary. Therefore, it is considerably cheaper to use the Web to access, for example, a business partner's extranet.

- **Extranets**

EDI-standards were designed to automate paperwork by sending business documents in batch mode. Extranets took a step further providing a secure private electronic environment for real-time communication up and down the supply chain. The benefits gained from extranet implementations were reduced purchase costs, shorter ordering cycles, reduced errors, instant order-status information and better detection of shortages. [13]

However, extranet is not considered to be a true system integration method, meaning computer-to-computer communication without human involvement, because it does not integrate the backend systems of participating enterprises [11]. Extranets and other lightweight integration methods, such as portal-based solutions, are still popular methods among enterprises that are not willing to spend lots of money and time to integrate with their partners.

Along with the Web emerged also other furthering techniques for e-business. One of the most significant was Extensible Markup Language (XML) that was originally designed by W3C (World Wide Web Consortium) in the mid 1990's for electronic publishing. Since then the XML protocol has achieved a strong ground in the area of Internet-based business interactions and is nowadays used as a standard markup language for exchanging information between diverse applications. Other virtues of the XML protocol are the openness and flexibility issues of the technique that has consolidated its position as the de facto markup language in today's business world. [14]

- **Extensible Markup Language (XML)**

XML is used in B2B transactions to make two disparate application residing in different domains communicate with each other. For example, if company A wants to send a purchase order (PO) to company B, it must extract data from its legacy systems and transform it to XML format using a desired schema. Schema is a definition that describes the basic grammar and data structure of an XML document. After the PO document is generated following the desired XML schema, it is sent to company B. When company B receives the document, it must have the same schema in use as company A to understand the document correctly; otherwise company B is forced to make another transition from XML to XML using XSLT (eXtensible Stylesheet Language for Transformations) that might, in some cases, lose some information of the original document. [15]

To form a human readable presentation of the XML document, for example to be printed out on paper or viewed on a web browser or a mobile phone, it requires the use of XSL (eXtensible Stylesheet Language). XSL describes how the content of an XML document should be displayed at a desired presentation medium, defining exactly the style, lay-out and pagination of the document. [16]

In B2B transactions, XML was planned to lighten the complexness of EDI-standards, such as EDIFACT and X12. Compared to these, XML is optimised to be easy to program at the cost of increased message sizes. It does not require a specialised server technology, like an EDI intermediary, and can be transmitted over the Internet. XML message formats are relatively easy to adopt and there are plenty of tools for generating these messages. The code is both machine and human readable, which in

part makes the error detection easier for the programmer, and it can be generated using various common programming languages, including JavaScript, VisualBasic etc. [17]

XML works well for clean, well-structured data, but problems arise when the data is diversely defined and of low quality. As described in the example above, there might occur a need to translate between XML schemas (translation from the format of one company's internal systems into the format required by the other company's internal systems) when performing B2B transactions. In many cases schemas are industry specific definitions, making it problematic for the companies operating in cross-industry markets, and leading to same kind of maintenance problems as described in EDI section above (need to support multiple XML translators at the same time). Because XML is indeed extensible, some companies have even developed their own translators, due to the uncertainty of which grammar to use, and hence confusing the enterprises even from before. For these reasons it is essential to agree on what schemas to use before exchanging XML-based business events. [11] [14]

XML alone is not capable of building an automated exchange of business documents along the supply chain because in most cases it integrates only data and not the processes of partner enterprises, excluding the possible benefits from streamlining or re-engineering of business processes [11]. So, XML or other data format, such as EDIFACT data format, is useful in syntactic interpretation but not enough for semantic interpretation [14]. In this sense the process integration approach is considered to be preferable but it requires backend system standardisation or modification that can be both difficult and costly to implement.

The XML and other Internet based technologies set off the hype in the area of electronic business in the late 1990's. Consequently, the increasing amount of different e-business techniques started to raise concerned questions among the enterprises. Therefore several cross-industry and industry-specific working groups were formed and they started searching for more uniform approaches to conduct e-business. As it was discussed above, the main deficiency of the initial Internet-based techniques was the inability to integrate processes of participating enterprises. So, the process standardisation efforts based on commonly approved e-business standards was seen as the cure to ease the burden of

process integration.

- **E-business standards**

Many standards for e-business appeared at the end of 1990's, when enterprises begun to realise that standardisation is necessary when trading with multiple partners. In order to benefit from the e-business standards properly, business partners have to be aware of what information to share, when and how. [14]

This effort to standardise the way businesses can automate their B2B interactions is referred in literature in many terms, such as B2B interaction standards [3], industrial standards for e-commerce [18], B2B e-commerce frameworks [19], e-business frameworks [14] etc. One of the most popular and widely adopted frameworks is called RosettaNet in the computer and electronic industry [20]. Another framework similar to RosettaNet and also closely related to this thesis is called papiNet [21] in paper and wood industry. This study will also cover the ebXML framework that is a process-centric framework providing standards for companies operating in cross-industry environment. All of these frameworks are based on XML technology. The functionality, standards and purpose of e-business frameworks will be considered in more details in the forthcoming chapter 3.4.

Alternative approach to process integration in point-to-point techniques is the adapter technologies provided by enterprise software vendors.

- **Adapters**

The adapter technology can be used to obtain process integration if the companies are using ERP (Enterprise Resource Planning) software from the same vendor, for example SAP. Adapters are built in the software and linked directly to the other company's similar adapter [11]. This so called ERP-ERP link can be used to fulfil the process integration requirements of partnering enterprises, but it is considered to be extremely expensive and only rarely implemented, and therefore not covered any further in this thesis.

In point-to-point techniques introduced here, the connections between enterprises must be established and maintained with each partner. Hence, with the help of enterprise

application integration, some companies have developed application platforms that act as an integration hub of an enterprise to cut down the costs related to establishing multiple connections, and to enable connections to both customers and suppliers via Internet with a single trading interface.

Integration hub can support deep integration of the back-end systems, since even the disparate legacy systems can be connected to the company's integration hub to provide one-to-many interface for external connections and at the same time achieve some degree of internal systems integration. But even when considering the integration hub improvements: extending one-to-one connections to one-to-many connections, it does not make it a true hub-and-spoke arrangement, because it lacks the support for many-to-many connections. [11]

From business viewpoint, there can be identified several arguments that support the use of private exchange (one-to-one / one-to-many) technique as the solution for company's external integration. First of all is the need to get into B2B markets as quickly as possible that is supported with the fact that there is uncertainty about the timing, capability and survivors of competing hub-and-spoke techniques (covered in chapter 3.2), for example different e-marketplaces. One-to-one approach gives greater control over certain business relationship because each connection can be personalised to serve the needs of an important customer or supplier. [11]

Perhaps the most significant factor is the competitive concerns, which drives the companies towards the adoption of private exchange methods. Companies fear that participating in hub-and-spoke type of arrangement will force the prices too low, as a result of price competition. Another concern is that the benefits will be unequally distributed among companies that participate in e-marketplaces, meaning that some will eventually gain more benefits than others. [11]

To conclude this section of one-to-one/many external integration approaches, it is easy to say that point-to-point techniques have some benefits, but there are also considerable disadvantages. The main advantages include establishment easiness and the possibility of highly tailored arrangements. The biggest disadvantage is that one-to-one connections are often expensive to set up and maintain, especially when the amount of external

connections increases.

3.2 Hub-and-Spoke approaches

In hub-and-spoke approaches the participating companies utilise a specialised external intermediary or hub that creates many-to-many connections between enterprises and their partners. The hub-and-spoke approach scales up considerably better than one-to-one approach when the number of participating enterprises increases. The maximum number of links is dependent on the number of enterprises, like depicted in the picture below (Figure 5), and it does not increase exponentially when the amount of companies increases, like it does in private exchange approach (see Figure 4). The formula for calculating the maximum number of links between n numbers of companies is $n-1$.

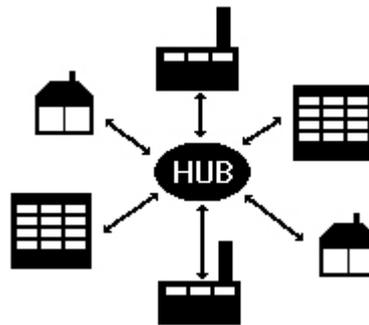


Figure 5: Hub-and-Spoke approach, max number of links = $n-1$

What makes it different from the integration hub mentioned in the previous chapter is the explicit infrastructure, which may be composed of possible or actual business competitors as well as partners. This allows customers to connect to competing companies through the same system, which may also have negative implications especially for the sell-side companies and therefore diminish the participation willingness. [11]

The intermediaries of hub-and-spoke approach are often capable of providing a number of services. First of all is the connectivity, but there is also the support for different data and/or process standards and other value added services. According to study made by Markus et al. [11], there are two flavours of hub-and-spoke approaches. The other supports only data integration, leaving process integration out, while the other approach supports both the process and the data integration. These subjects are compared in the following two paragraphs.

- **Data Integration**

As discussed in the previous chapter about the different data formats used by different companies, it is self evident that the intermediary's duty is to conduct the business transactions between enterprises, but when required it must also translate the data and business documents from one format to another, relieving the companies from doing this translation.

The benefit of data integration comes from the automation of B2B transactions, without the need to change the existing internal systems of participating companies, but also excluding the possibility to gain additional benefits from reengineering of business processes. Most of solutions that integrate only data are based on *translation, standardisation of product data*, such as EAN (European Article Numbering), and *transaction formats*, like EDIFACT or XML. [11]

- **Process Integration**

The integration of external business processes is considered to be one of the most important areas of B2B integration. In addition to data integration, the process integration approach standardises also the sequences of business transactions and events that creates an external business process. External business process has to be coupled with the internal business processes to make the information flow complete to the point where no human involvement is required. [22]

As mentioned before, process integration requires standardisation or modification of backend systems, or adopting an e-business framework suitable for the company's needs. This makes the process integration approach more costly to set up in contrast to data integration, unless it is offered on a service basis, for example, by a third party intermediary company [11]. On the other hand, it also provides opportunity to gain additional business benefits, such as competitive advantage and substantial ROI (Return of Invest) [23] through the re-engineering of company's business processes.

The hub-and-spoke integration approach offers a respectable option to point-to-point approaches. When compared to point-to-point approaches, both hub-and-spoke techniques (data and process integration) have lower establishment and maintenance

costs. The primary reason for this is the possibility to connect to several partners with a single link and managing only one connection to the outside world. [23]

When considering only the business issues of hub-and-spoke approach, there are two arguments that support it against the private exchange techniques. First one is related to acquisitions or mergers, in which two separate companies fuse into one enterprise. Also divestments are similar situations, when one company divides into at least two independent companies, for example to parent company and subsidiary company. The benefits of hub-and-spoke approach in these kinds of business situations can be easily realised when the merging enterprises are involved in a third-party integration service provider or e-marketplace arrangement. In such situations, there is no need to integrate merging enterprises' internal systems since the B2B related functions are handled by the external service hub. In other words, hub-and-spoke approach gives companies a degree of flexibility that allows them to do acquisitions or divestments according to company's strategy and status. [11]

The second favouring argument is related to multi-party business relationships, which include: business process outsourcing, extended supply chain relationships and collaboration facilitation. Multi-party relationships require also system integration that is difficult to achieve using one-to-one or one-to-many type of arrangements. [11]

In the real world hub-and-spoke approach is likely to require also hub-to-hub connections, because it is naive to assume that one hub will be enough for all companies in the world. This leads to some additional difficulties, which mainly derive from the lack of process/data standardisation and co-operation among hubs. It also keeps the one-to-one connections persistently in favour of most companies' integration strategies in the years to come [11]. However, the benefits of this approach speak for itself, and it is recommended to consider the use of an intermediary company before implementing the familiar thing that is the point-to-point approach in B2B integration. The practical part of this thesis will concentrate more on this topic and further analyse the methods and implications of such solution.

3.3 E-business frameworks

As it has been clearly observed, the integration of applications residing in different organisations or even inside a company can be a complex task. In most cases business processes, business documents and applications are incompatible with each other and therefore cannot be integrated or interoperate without specialised interfaces or adapters. Also the existence of various B2B technologies in the markets has made it difficult for the enterprises to decide which one will be suitable for their individual needs. So, the premises are not the most optimal, but nevertheless, several standardisation organisations have been working intensely to address these e-business related problems and succeeded to provide various frameworks to conduct e-business in a standard way.

The collaboration of partnering companies must be based on a mutual understanding of what information they should share, when and how. This statement is the foundation for e-business frameworks, which are standards-based architectures for information sharing and can be applied in both internal and external integration efforts. [15]

It is difficult to define the e-business frameworks distinctively, because the initiators of such frameworks specify their standards in many ways. Industry-specific framework RosettaNet describes itself as follows: “RosettaNet standards and services provide a common language for e-business transactions and the foundation for integrating critical processes among partners within the global supply chain” [20]. The ebXML (Electronic Business XML), more a cross-industry and process-centric e-business framework, is defined to be “a modular suite of specifications that enables enterprises of any size and in any geographical location to conduct business over the Internet” [24]. On the contrary, a cross-industry framework called xCBL (XML Common Business Library) is described as “a set of XML business documents and their components, promoting interoperability between applications” [25].

As these examples point out, the definitions of e-business standards are far from homogeneous, but basically they can be seen as complementary approaches for the same problem and not as competing solutions. [14]

3.3.1 Overview of an e-business framework

Other computerised systems, such as web servers, networks and databases are utilised by B2B applications for conducting business events (e.g. product purchasing or selling, documents exchange, etc.) between partnering enterprises. The required elements for B2B applications are provided in an e-business framework. Such a framework comprises of different functionalities and the main functionalities can be summarised as follows:

An e-business framework;

- Defines, manages, and integrates external and internal business processes
- Supports communications with backend application systems, i.e. ERP, CRM, etc.

Additionally, an e-business framework may also provide detailed instructions how to perform end-to-end interactions between participating enterprises' backend systems, so including also the internal processes as well.

External or public processes determine and execute the business logic of an enterprise with regards to the requirements of its trading partners. This includes, among other things, the appropriate processing of incoming messages sent by trading partners. Interactions between partnering enterprises' public processes are carried out with respect to a specific B2B framework, like RosettaNet, or according to specific agreements between the two enterprises. The standards related to the e-business framework in use specifies the format and semantics of business messages and also defines the communication protocol to be used, for instance HTTP, and some sort of security mechanisms, at least digital signatures to ensure the authenticity of business messages. [26]

The following figure (Figure 6) illustrates the composition of an e-business framework assuming that both of the companies are equipped with fully integrated internal systems, and additionally, their inter-company interactions follow the rules of a certain B2B protocol. It also shows the importance of internal integration, because with EAI the backend systems, which are the source and destination of also external business transactions, are coupled with internal processes, such as workflows and other applications.

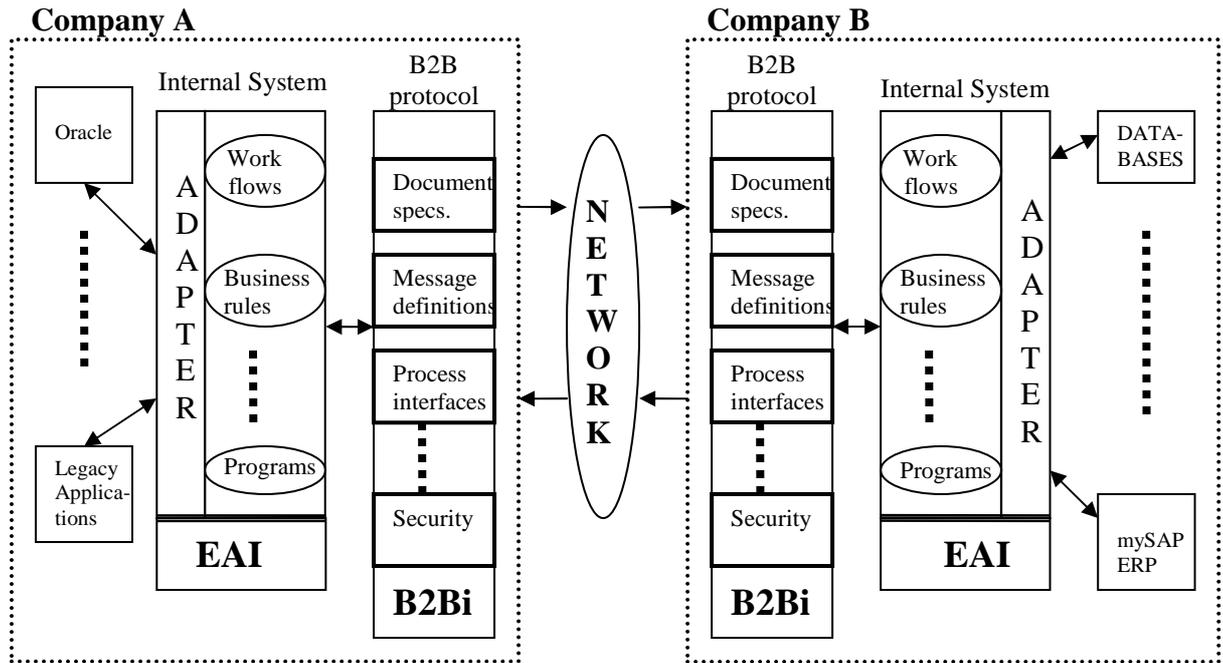


Figure 6: Example of a B2B interaction framework, modified from [3]

3.3.2 General B2B protocol model

A general B2B protocol model is a collection of elements that form a generic protocol for B2B interactions. The model consists of the following elements [26]:

- *Document types* (e.g. DTD in XML) define the structure of B2B events. For example, the document type can define the content of a purchase order. B2B events are created during runtime according to these document type definitions. XML or non-XML language, like EDIFACT, can be used to create these document types
- *Document semantics* defines the acceptable values of document elements, such as the set of possible country names in a delivery address. In terms of consistency, document semantics must define the combination of elements that forms the logical entities.
- *Public process definition* determines which business events can occur and in what order. For example, a purchase order (PO) is an accepted business event and so is the purchase order acknowledgement (POA). However, the sequence of these events is such that the PO must be received from trading partner before the POA can be sent back. Also some retry-mechanisms and time-outs can be used for the events to achieve a reliable communication.
- *Exchange sequence* defines the requirements for acknowledgements. It determines in the transport level (not similar to the POA in business level) when a received

message requires acknowledgement to be returned. This ensures that the message has been successfully transported to destination.

- *Packaging* specifies the packaging of a B2B event, including header information, such as sender identification and other additional elements (i.e. attachments).
- *Transport binding* attaches transport specific headers and trailers to the packaged B2B event.
- *Security* defines the methods used to ensure secured and non-altered transportation of B2B events. For example, encryption can be used to scramble the messages, so that outside entities are not able to read them during their transportation from sender to receiver.

The elements of general protocol model can be depicted as layers (see Figure 7). Security and document types -layers may be consumed by other layers, and therefore these layers must be available for the other layers.

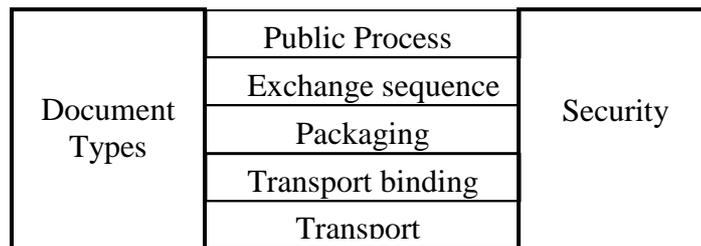


Figure 7: B2B protocol layers [26]

B2B engines are responsible for the communication issues of B2B event with trading partners. B2B engines are deployed at either the company's (point-to-point) or service provider's facilities (hub-and-spoke), and they utilise B2B protocol definitions during the execution of B2B events. B2B engine schemas are used for the B2B protocol definitions. These schemas are created according to the B2B protocol model introduced above. The B2B engine schema must include the modelling of above elements for each supported B2B protocol. To successfully exchange B2B events between trading partners, there must be an agreement that defines which protocol is used for the exchange, which public processes are executed, and which trading partner initiates the exchange. [26]

3.3.3 Interaction layers of an e-business framework

To further elaborate the B2B protocol concept, the study of Medjahed et al. [3] defines the interactions in B2B applications to appear in three different layers, which are communication, content and business process layers. Another similar approach to layers is presented by Nurmilaakso and Kotinurmi [14]. Their approach is based on the following questions: what information to share with business partners, when and how to share it. The questions refer to e-business framework's business and technical aspects of business documents, business processes and messaging. The layers are explained below and depicted in figure 8.

- *The communication layer (Messaging)* is responsible for the security and transportation standards to be used in the exchange of business messages between globally distributed trading partners. This layer may contain also some retry-semantics and time-outs to enhance the reliability of message exchange. The layer's objective is to achieve integration of the communication protocols and it answers to the question how the business partners share information.
- *The content layer (Business documents)* provides languages and models for defining the structures of business documents as well as the meanings of the terms used in these documents. Translation, transformation and integration of business documents are essential for the consolidation of different representations, vocabularies and semantics. This layer answers to the question what information the business partners share and its objective is to achieve integration of data formats, data models and languages. An example scenario of the business message analysing aspects will be given in the next chapter (4) to address what is required to correctly understand the business messages at the content layer.
- *The business process layer* contains the semantics of interactions between trading partners. Meaning that there must be rules that unambiguously define the meaning of messages, allowed actions, expected responses, etc. This layer answers to the question when the business partners share information. The objective of this layer is to enable independent and non-uniform partners to connect with each other to perform e-business in their preferred fashion.

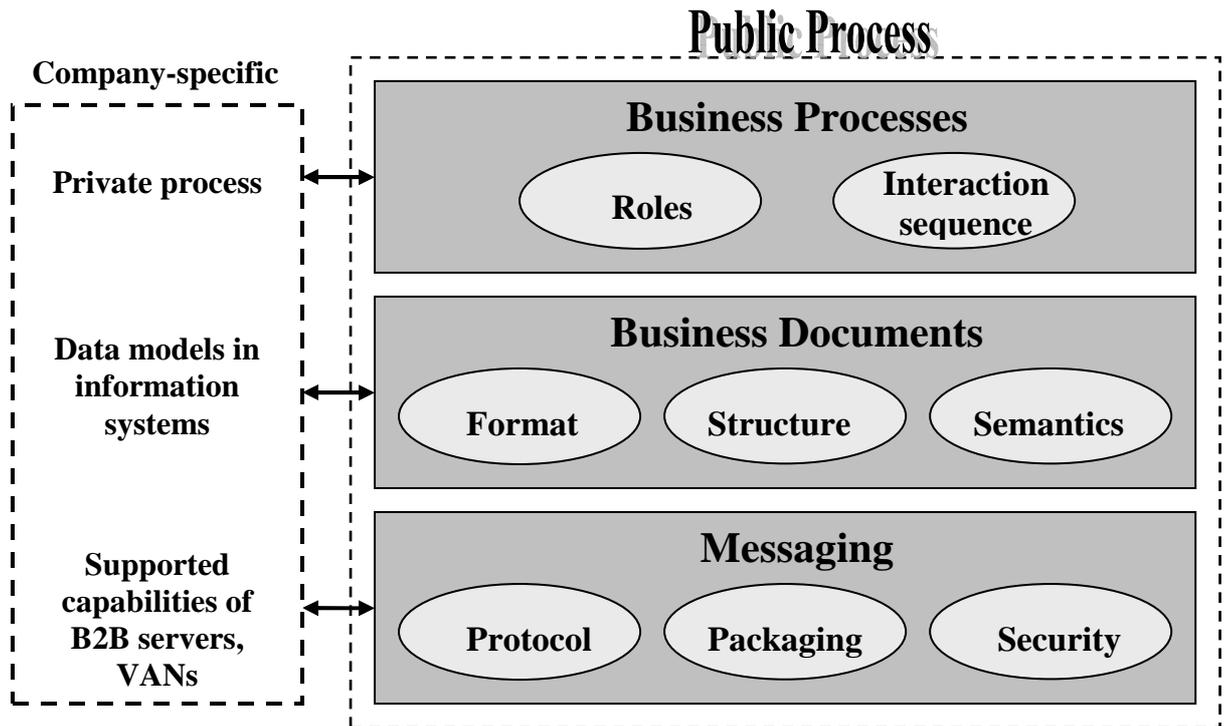


Figure 8: Interaction layers of a B2B application [27]

It can be noted that the higher a company wants to integrate in the interaction layers the more challenging it will become. As stated above, the integration at the business process layer is the most difficult to attain because it requires understanding of the semantics of trading partners business processes. The next chapter (4) will introduce e-business frameworks that focus on integration at the different layers introduced here.

4 XML AND E-BUSINESS FRAMEWORKS

E-business frameworks based on XML are the ones that utilise XML. Alternative approach is EDI-standards based frameworks, which in general do not deal with the messaging and process issues, only documents are specified.

According to Kotinurmi and Nurmilaako [15] automated communication is composed of syntactic and semantic interpretations, which are needed to understand the business documents. Furthermore, the syntactic interpretation is composed of lexical and syntactic analyses, and the semantic interpretation includes semantic and pragmatic analyses. The explanations of these concepts are as follows:

- *Lexical analysis* checks the characters of a business document and compares it to the lexicon, which defines the approved combinations of characters in the language. The framework has to provide schemas to define elements and attribute names, or element content and attribute value.
- *Syntactic analysis* utilises the information from the lexical analysis to check that the structure of elements is valid. It produces a tree of terms based on the grammar, which describes the structure of the language. Again, the framework may need to provide schemas if the meaning of the terms depend on the structure, otherwise XML is enough.
- *Semantic analysis* identifies the terms and binds the possible meanings to the terms in the tree. The framework must explain the meanings of symbols, because the XML and schemas are not always enough, especially if the terms are indistinct or not self-explanatory.
- *Pragmatic analysis* chooses the suitable meaning of terms according to the context. This means that the other terms and their possible meaning are also taken into account in the analysis. The framework must provide some guidance to the choice of the meaning because the XML and schemas are context free languages and therefore are not able to assist.

The following example clarifies these analyses and explains the relation between the framework and the language that is utilised by the framework (i.e. XML).

Company A's backend systems generates a purchase order (PO) that is sent to its trading partner, company B. When company B receives the PO, it is stored to backend system databases. Assuming that both of the companies utilise XML but are not using the same schemas, there is a need to process the PO before it can be stored in the database.

At this point the framework provides a *lexicon* in a DTD (Document Type Definition) or schema and tries to recognise the elements of the PO. If some elements used in the PO are not in the lexicon, the document is lexically invalid. For example, the purchase order may contain an element called BuyerPartyID that defines company A, but the lexicon understands only BuyerParty-element.

The framework must provide also a *grammar* in a DTD (Document Type Definition) or

schema. The syntactic analysis may find elements that are in the lexicon, but their position does not match with the grammar, therefore the document is syntactically invalid.

The framework usually provides also a *vocabulary* that can help to translate the elements correctly. The vocabulary can provide means to correctly map the PO's elements into the corresponding purchase order table, accepted by the company B's backend systems. Semantic analysis may not always be enough to map data into right columns of this table. Therefore, a pragmatic analysis is required to consider the other elements of the purchase order to map the data into correct columns. For example, in XML language the PartyID can be a child member of a parent element called SellerParty, in this case the pragmatic analysis must take the parent element into account and decide that the PartyID element means the seller's PartyID (Company B) and map the data accordingly.

The previous example only reflects the use of different analysis that is required when exchanging incompatible business documents, excluding the equally important messaging and business process issues. The main reason is the limitation of XML, since it was not designed to define message semantics and exchange sequences, or correct interpretation of these messages.

In process definition, frameworks that are based on rough or detailed process approaches (e.g. RosettaNet), utilise diagrams and verbal descriptions to guide the process interoperation among trading partners. XML may be used in some cases to produce machine-executable format of the business process in frameworks that are based on more generic process approach (e.g. ebXML). In the messaging issues XML can be exploited in the headers to aid the routing and processing of the data. The other use of XML in the framework depends on the framework in question.

Kotinurmi and Nurmilaakso [15] also studied and compared the active frameworks based on the document, process and messaging issues. They discovered that the frameworks can be categorised according to their functionalities.

- There were many frameworks that concentrated only on document issues, providing both cross-industry and industry-specific vocabularies for business documents. The

frameworks that fall into this category are defined as *document-centric*.

- *Cross-industry* frameworks, such as xCBL, concentrate mainly on the interoperability of business documents. They offer cross-industry vocabulary, but are not focused on messaging issues and offer only rough process descriptions.
- *Industry-specific* frameworks, such as RosettaNet and papiNet, provide industry-specific vocabulary. These frameworks emphasise more on the business process issues and they offer detailed descriptions of business processes in a specific industry sector. Also the messaging issues are considered.
- Process-centric frameworks, such as ebXML, concentrate on business processes. No vocabularies are provided in process-centric frameworks and the process models are based on generic process approach. Some of the process-centric frameworks put more emphasis on the private process issues, but at least the ebXML considers also the public processes between trading partners.

The following chapters will introduce two of these XML-based e-business frameworks (RosettaNet and ebXML) in details and clarify the functionalities and components that make up such a framework.

4.1 RosettaNet

RosettaNet represents the category of industry-specific frameworks, providing an infrastructure that integrates the processes of trading partners throughout the globally dispersed supply-chains. The RosettaNet project was initially started in the year 1998 when the companies of electronic industry begun searching for common ways to conduct electronic business. Since then, the RosettaNet framework has managed to gather up more than 500 companies worldwide from various industry branches, such as logistics, telecommunications, semiconductor manufacturing, etc. [20]

The main focus of RosettaNet framework is on supply chain. The goal is to utilise B2B integration in such a way that it improves the efficiency and performance of the supply chain. The RosettaNet e-business process standards provide means to efficient business communication across multiple platforms, applications and networks. In other words, the framework provides a common language that guides the trading partners involved in a business process to automate the execution of this process and conduct it over the Internet. [28]

The RosettaNet standards are available for anyone, offering a stable and non-proprietary solution for e-business. By adopting these standards, a company can benefit from a unified framework of common specifications and guidelines that provide real-time and automated connectivity among trading partners of a supply chain, concurrently amending its agility with consistency and visibility across the whole supply chain. The standards are mainly concentrated on providing *Technical and Business Dictionaries*, *Partner Interface Process* (PIP) messages to support specific business processes, and the *RosettaNet implementation framework* (RNIF) to support the packaging, transport, and routing of PIP's [20]. These essential parts of the RosettaNet framework and their functionalities are depicted in the following picture (Figure 9) in contrast to human-to-human interactions.

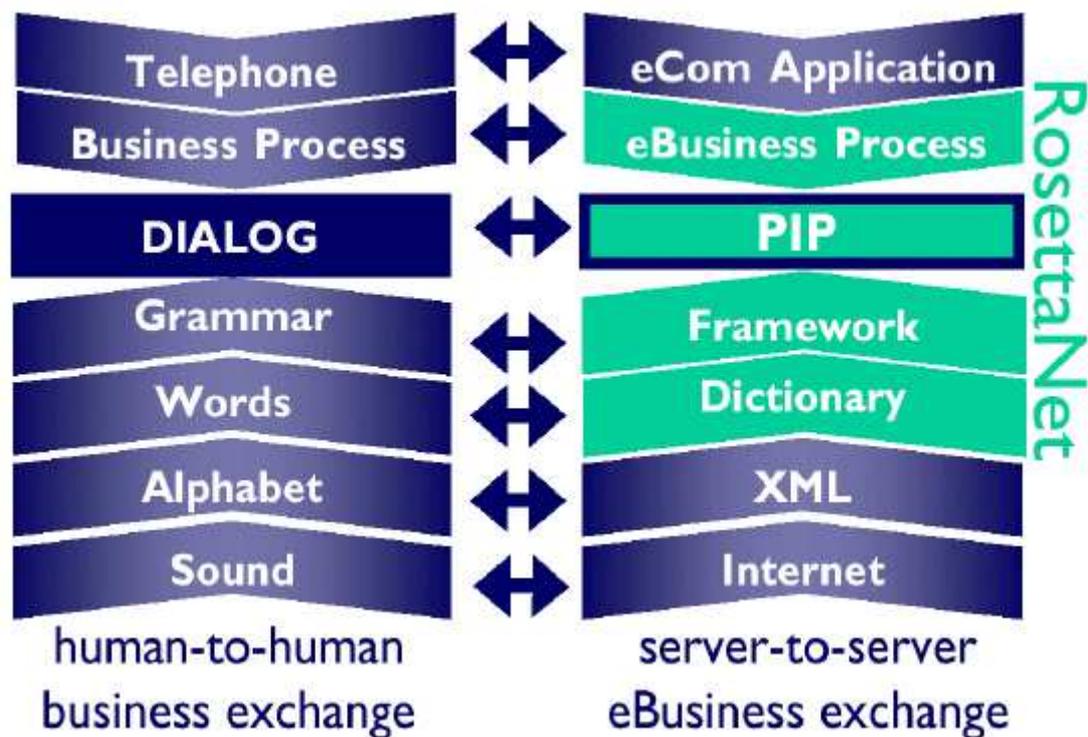


Figure 9: Architecture of RosettaNet [7]

4.1.1 Partner Interface Process (PIP)

The RosettaNet community has created XML-based system-to-system dialogs called PIPs (Partner Interface Processes) to specify the business processes at every level of supply chain (at the moment of writing there were 117 specified PIPs available) and the associated business documents. PIPs interact with the company's internal processes to initiate or receive business documents. Each PIP specification defines the structure and

format of exchanged business documents, specifying also the roles, actions and activities of involving trading partners.

This provides the choreography and message content that is needed to participate in an inter-company business process. The PIPs are divided into eight clusters according to their business functionality and these clusters are further grouped into segments. For example cluster 3 is dedicated to order management processes, including segments like “Quote and Order entry” (Segment A), “Transportation and Distribution” (Segment B) and so on. Segments are groups of related functionality consisting at least one or more PIPs, which are divided into Activities that specify the allowed Actions as described in the following example (Example 1).

```
CLUSTER 3: Order Management
  Segment A: Quote and Order Entry
    PIP 3A1: Request Quote
      Activity: Request Quote
        Action: Quote Request Action
        Action: Quote Confirmation
  Segment B: Transportation and Distribution
  Segment C: Returns and Finance
  Segment D: Product Configuration
```

Example 1: Hierarchical structure of a cluster [7]

PIP specification is comprised of three views that form the complete system-to-system dialog between trading partners. Business Operational View (BOV) captures the semantics of business entities and is responsible for the information flow between the trading partners according to the role they take in that particular process. During the execution of PIP's, the Functional Service View (FSV) describes the interactions between RosettaNet services (e.g. between Buyer and Seller) originated from the BOV. Implementation Framework View (IFV) describes the action message formats (XML Schema) and communication requirements (SSL and Digital Signatures) with respect to RosettaNet Implementation Framework (RNIF). [20]

4.1.2 RosettaNet Implementation Framework (RNIF)

The RosettaNet Implementation Framework defines the messaging issues to help the collaborating companies to build interoperable systems that understand and execute PIPs. The RNIF describes the security issues related to message exchange to ensure authentication, authorisation, encryption and non-repudiation, additionally to the packaging of PIPs. For example, the RNIF specifies exception handling mechanisms to ensure the non-repudiation of the messages. Also the RNIF provides the specifics how to encapsulate the attachment to the business message, and these attachments can be of a random file format. Several software vendors have built-in RNIF support in their products (e.g. Microsoft, BEA). The following picture (Figure 10) illustrates the architecture of a business message with respect to protocols on top of which the business message is deployed. [20]

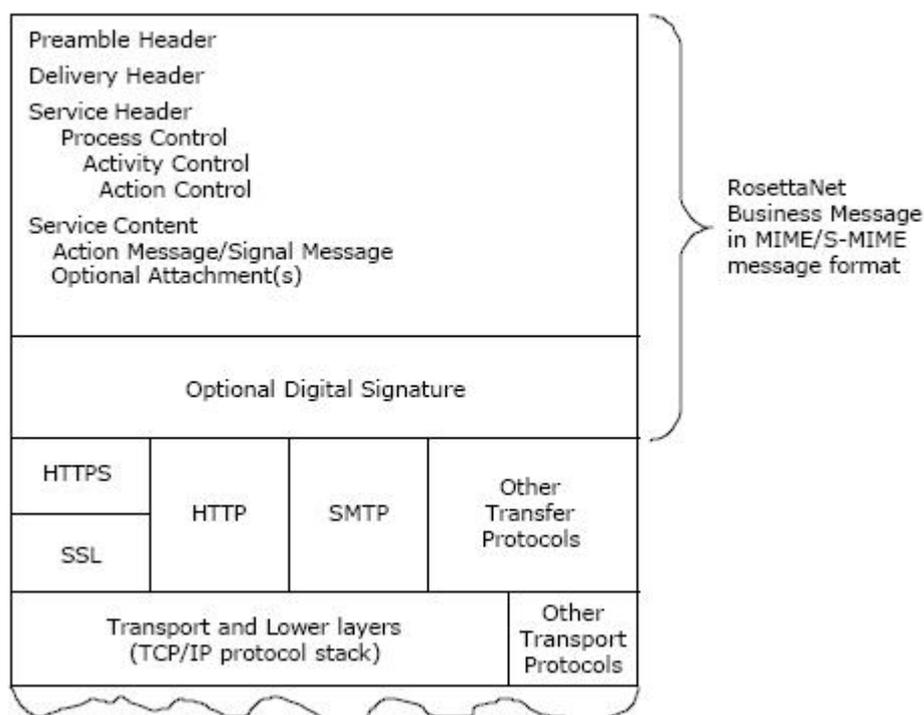


Figure 10: Network Application Model [40]

4.1.3 RosettaNet Dictionaries

To address the terminology difficulties often related to B2B integration, the RosettaNet provides unified business and technical dictionaries to define common product and service properties, and vocabularies for conducting e-business. The RosettaNet Business Dictionary (RNBD) specifies common terms that are used in PIPs, including such business properties as name, address, etc. and business data entities like action identifier,

business tax identifier, etc. The RosettaNet Technical Dictionary (RNTD) describes the characteristics of services (e.g. purchase order) and products (e.g. computer parts). With the help of RNTD, trading partners no longer need to use separate dictionaries when implementing multiple PIPs. The RNTD facilitates the automation of product information exchange by standardising the semantics used to describe product features and information. An example of this is illustrated in the following fragment of XML code (Example 2) that defines a photocopier. [29]

```
<class id="RNIC021" propDefs="RNIS001 RNIS043 RNS-XJA001">
  <identifiers>
    <code>RNIC021</code>
    <majRev>001</majRev>
    <date.def>2000-12-05</date.def>
  </identifiers>
  <names>
    <preferred.name>COPIER</preferred.name>
  </names>
  <definition.short>A machine used to make photographic copies of pages.</definition.short>
  <app.specific name="industry.domains">IT</app.specific>
</class>
```

Example 2: A definition file of a photocopier according to RNTD [29]

RosettaNet standard is mainly utilised in IT industry's supply chains, although the standard claims to have the support for other industries as well. The principal factor for this is the lack of PIP specifications for other than computer and electronic industry, and another concern is that many large companies are often involved in multiple industries, so the vertical integration approach is not suitable for them.

4.2 ebXML (Electronic Business XML)

One of the most attractive e-business frameworks is called the ebXML. The premise of ebXML was to focus on solving the incompatibility issues related to multiple XML-based specifications that emerged in various industry segments in the late 1990's. Two large standardisation organisations, UN/CEFACT (United Nations Centre for Trade Facilitation and Electronic Business) and OASIS (Organization for the Advancement of Structured Information Standards) together started collaborating with several working groups from various industry sectors to find a uniform solution for conducting XML-based electronic business data. The result was an XML-based infrastructure aiming to provide a single global electronic marketplace for all enterprises regardless of their

location, technical abilities and financial resources. [1] [17]

Since the completion of the initial ebXML project, it has attracted significant other e-business frameworks from both industry-specific and cross-industry initiatives (e.g. RosettaNet, OAG). The main reason for this has been the ability of ebXML to provide common functionalities, such as messaging, partner agreements, registries / repositories, and business processes. As a result of that the ebXML framework has earned the status of a core e-business framework on top of which other frameworks can be built. [30][24]

To perceive the functionality of ebXML framework it is essential to consider the components that form the framework. This can be demonstrated with the help of an example scenario that includes all the components needed in ebXML-based solutions. The following example is based on the ebXML foundations book [1] and the example gives a quick introduction to the ebXML concepts. However, the ebXML specifications are by no means limited to this sample scenario.

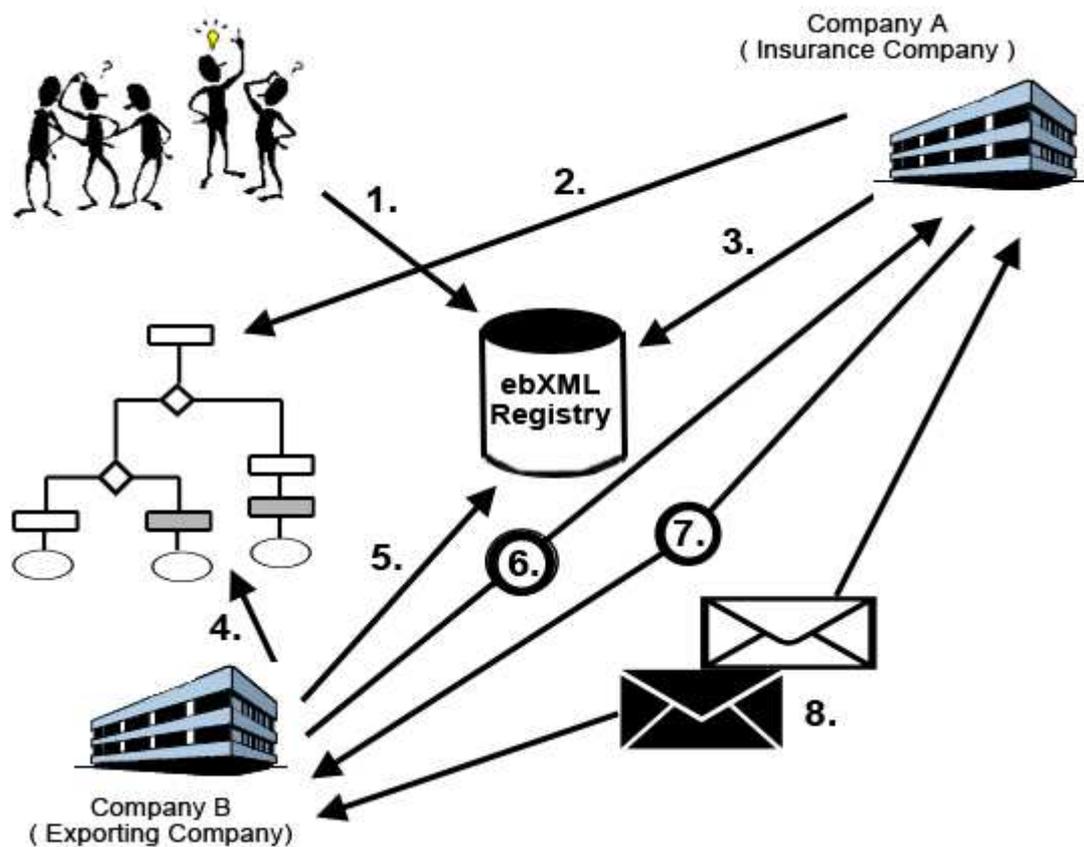


Figure 11: ebXML sample scenario (modified from [1])

1. The first step includes the analysing of a certain B2B business process characteristics to determine the actions needed to successfully implement this process between the enterprises, providing a formal description of the process in the form of ebBP (Business Process Specification Schema).

This XML-based specification schema of the business process is used to define public business processes, describing the roles of the partners (supplier, customer, etc.) and defining the business transaction activities that each participant can perform (e.g. purchase orders, invoice). The ebXML Core Components framework can be used to define the business information in business documents that are exchanged in these activities.

After these tasks have been completed; the ebBP representation, all documentation related to it, and the necessary core components can be stored in an ebXML repository and publish it in an ebXML registry.

2. The ebXML registry has a search functionality that serves companies that are willing to expand their electronic business capabilities. A certain company can search the registry for suitable business processes in which it can play a particular role. For example, the registry may contain a description for international shipping business process in which an insurance company wants to take part by providing shipping insurances for the other participants. To play the insurer's role in this process, the company must determine the ebXML message interactions that it has to support. The company has to make sure that it is capable of supporting the process, which also requires connectivity with the backend systems of the company.
3. A company (in this example the insurance company) can provide a formal (machine readable) statement of its capability to fulfil the desired role in a certain business process. This statement can be described in a document called a collaboration protocol profile (CPP). Additionally, the CPP document contains information about the message payload, packaging, digital signatures, and much more. In other words, CPP describes the capabilities and constraints, as well as supported business scenarios of an organisation in terms of ebXML operations.

4. The fourth step is similar to step 2. Now that the company has registered its capabilities to serve a certain role in a business process, other companies can search the registry to find suitable business processes. For example, in the case of insurance company, an exporting company might search for a company that is capable of insuring its goods during the transportation.
5. If the company decides to participate in the same business process, in which the insurance company is involved, it proceeds with a search for partners that provide the complementary services (e.g. insurance). Now, the CPP document established in step 3 provides all the needed information about the insurance company for the exporting company.
6. Correspondingly to the requirements described in step 2, also the exporting company has to ensure that the company's B2B integration facilities support the ebXML framework in order to take part in the desired business process. This will produce a similar information as described in the CPP document and the company may well generate and register its own CPP, however, it is not essential.

The exporting company can now create a collaboration protocol agreement (CPA), similar to trading partner agreement (TPA) and propose it to the insurance company. Most of the time the CPA is not able to provide sufficient information about the various aspects that needs to agreed between the enterprises, and there is sometimes a need for additional paperwork to further solve all these issues.

7. The company receiving the proposal for CPA (in this case the insurance company) may approve it or reply with a counter-proposal and therefore these two steps (6 & 7) may have several iteration phases until the proposal is mutually agreed.

When the agreement is made between the companies, they can start preparing their systems to support the business interactions controlled by the CPA.

8. Companies can start to exchange business events according to the CPA specification as long as the CPA remains valid. The messages related to interactions in ebXML frameworks can be built upon the facilities of the ebXML messaging services.

As the previous scenario demonstrated, the ebXML framework comprises of various components. Each of them provides certain kind of functionality for the framework. To enable data communication in common terms, the ebXML framework utilises CCTS (Core Components Technical Specification) as a modelling concept for data and objects [31]. A core component is an independent “building block” that contains pieces of business information related to each other and can be utilised in several different areas of business when creating business documents.

To register and provide objects and services of e-business, the framework provides ebXML Registry Services (ebRS) and Registry Information Model (ebRIM) specifications. Registries and repositories are responsible for providing services that register, locate and access information resources as was illustrated in the sample scenario above. Configuring the technical contract between trading partners is handled according to Collaboration Protocol Profile and Agreements (CPP/CPA) specifications. These specifications define the structure of XML-based documents, which provide the e-business capabilities of an organisation (CPP) or specify the agreement details of two organisations (CPA). These files are able to provide configuration information ebXML-compliant B2B integration products with the help of messaging service. Also with help of registry they can support business discovery and the process of establishing new e-business relations. [1]

The ebXML Messaging Service (ebMS) specification is responsible for defining how to provide secure and reliable exchange of e-business messages. It specifies transport, routing and packaging of messages, and is placed on top of SOAP (Simple Object Access Protocol) layer that provides a common transport mechanism independent of the communication protocol and message payload. The main attention in the ebXML framework is its ability to enable collaborative execution of business processes among participating enterprises. This is achieved with the ebBP specification that describes interoperable “public” business processes to allow partners to support process design and description of processes with the help of a common language. Furthermore, it enables collaboration monitoring and validation, and guides the execution of shared processes. Additionally, the security issues must be considered in all of the components to protect the information, from the modelling of business processes through the exchange of

messages. [1]

The current status of ebXML solutions indicates that it has not yet succeeded to achieve the expected goals set to it during the initial project. Despite the advanced and explicit architecture of the framework, the lack of support from the major technology vendors, and therefore the absence commercial solutions has turned out to be the biggest cause limiting the adoption rates of ebXML. Although there are no solutions that utilise all components specified in the ebXML framework, it is undeniable that there exist various solutions that utilise at least some of the ebXML components. Especially the messaging services and the registry/repository specifications are popular. Yet, the latter specification is merely used to store all kinds of online data for public access, and not in the way it was originally intended. This proves that the ebXML specifications are not incompetent, but the initial objectives have not been reached, because the ebXML did not take the prevailing market trends into consideration to stay ahead of the other rising business and technology movements. [32]

In summary, the previous chapters provided an overview of the prevailing e-business framework technologies. A fundamental part of the e-business framework was described to be the generic B2B protocol model that was defined in such a way that any protocol (ebXML, EDIFACT, RosettaNet, etc.) can be modelled independent of the details. The e-business framework was considered to be a detailed instruction for the interactions between trading partners, starting from the backend systems (i.e. ERP) of the initiating trading partner and ending to the receiving trading partner's backend system (i.e. database). The layers of an e-business framework were explained to clarify why the complexity increases when companies are trying to integrate at higher levels.

It is worth to remind that even though there are multitudes of frameworks for e-business, most of them are complementary to each other rather than competing. The decision of which framework to utilise comes somewhat easier when considering which frameworks or standards the other companies at the same industry branch have decided to use.

5 DYNAMIC B2B INTEGRATION WITH WEB SERVICES

The Web services approach has been introduced to address, among other things, the difficulties of external application-to-application (A2A) integration issues. Web services enable platform/framework independent applications to interact over intranets, extranets and across the World Wide Web, specifying the different applications as services residing in various networks. The development of Web services is maintained by the W3C organisation which defines it as follows:

“Web services are characterized by their great interoperability and extensibility, as well as their machine-processable descriptions thanks to the use of XML. They can be combined in a loosely coupled way in order to achieve complex operations. Programs providing simple services can interact with each other in order to deliver sophisticated added-value services.” [33]

As its simplest the Web services are application programming interfaces (API) that can be accessed and executed remotely over a network. Interactions between Web services are comprised of three different elements: service provider, service registry and service requester.

The functionality of these entities is as follows: service providers offer the services for service requester. Service registry is used as a searchable repository of service descriptions. Service providers describe the services that they are able to offer and publish those at service registries. Service descriptions contain information about the data types, operation, and network location used in particular service. Service requester or consumer searches the registries to locate the suitable service from among the descriptions. The service registry returns the appropriate service for the requester, which invokes the related Web service. The following figure (Figure 12) further depicts the functionality of Web services. [34]

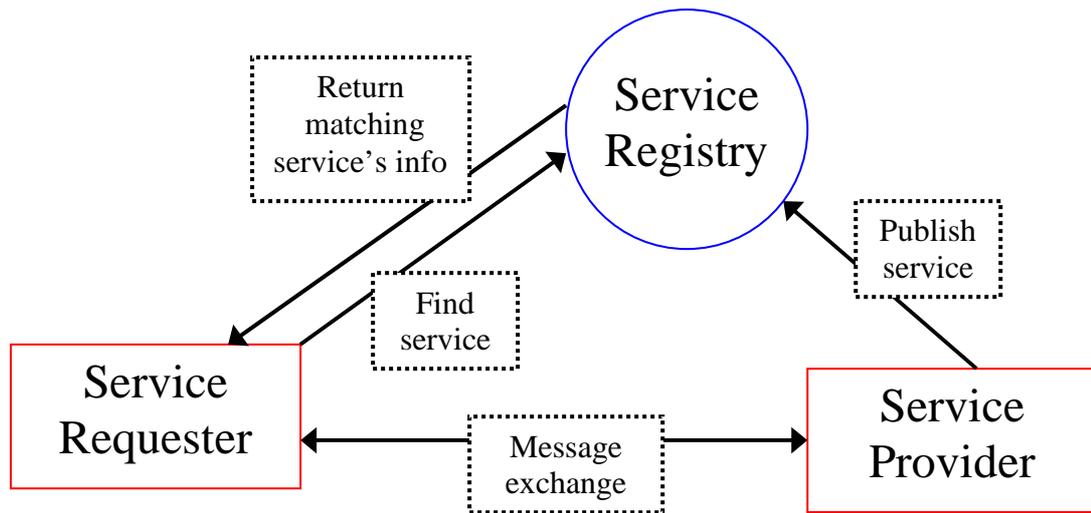


Figure 12: Web service reference model

5.1 Web services in B2B environment

The protocols used in web services are based on open standards. SOAP (Simple Object Access Protocol) is used in messaging to achieve dynamic integration between disparate applications. SOAP uses a simple architecture that comprises of widely adopted XML and HTTP techniques to invoke Web services on remote locations. Service providers use WSDL (Web Services Description Language) to describe the available Web services. The UDDI (Universal Description, Discovery and Integration) is a XML-based registry used for publishing own services and discovering desired services. The registry can be either a private repository that is intended to use inside an organisation, or a public repository available for trading partners. At the process layer, Web services rely on BPEL (Business Process Execution Language) to describe business processes that will be executed over the Web. [35]

Since Web services approach is merely an application level specification, it takes no opinion to the definition of business documents or document semantics, nor does it specify standard B2B processes. It is reasonable to note that Web services technology is not directly a corresponding or competing technique to the xml-based e-business frameworks introduced earlier, but it is considered as an alternative and more dynamic approach to B2B interactions.

The accommodation of Web services into the B2B environment is reasonable to review with respect to some special features of B2B applications. The nature of B2B

applications is so that they are distributed across different enterprises. This leads to the concern of management issues of transactions between disparate applications. Another concern is the security issues because there is always a risk of undesired visitor to delicate corporate information when company firewalls are opened to external parties. Also the business messages must be secured to prevent any outsider to manipulate or misuse the exchanged information. [35]

Dynamic business operations require real-time integration between business partners to succeed that can only be achieved with open standards over the Web, which is also the premise of Web services. The level of integration is the most significant factor when considering B2B integration methods, and at the moment the Web services are not able to offer integration exhaustively to satisfy most of the enterprises. Especially in the industry specific supply chains, where everything is about speed and performance, there is no time to fit every messaging requirement into the Web services approach. [36]

So, the Web services have not yet reached a stable status as a groundbreaking B2B integration method, since the technology needs to advance especially in the transaction management, performance and security areas. But it is still a promising approach at least when considering the dynamic requirements of B2B integration and the openness of standards related to it. Two major standardisation organisations (W3C and OASIS) are involved in the developing of standards related to Web services and are continuously struggling to overcome the limitations of the approach. [34]

6 PROS AND CONS OF B2B INTEGRATION

This chapter will summarise the potential benefits of B2B integration and also discuss the possible costs related to it. In other words this section will consider the outcome of B2B integration: what are the positive and negative effects on the company, and how these can be assessed in contrast to both business and technical issues.

Evaluating the benefits of B2B integration is not a straightforward operation, since not all benefits appear in the form of money and some benefits tend to appear shortly after implementation, while others may occur after a longer period of time. However, it is important to consider all effects of B2B integration project thoroughly to understand the true benefits and costs originated from such a project. A common method used in

literature is to assort the benefits of B2B integration project into operational and strategic categories [11]. Operational benefits are associated with cost reduction that can, for example, derive from improvement in the effectiveness and efficiency of a company's supply chain, while the strategic benefits relate to not necessarily apparent issues like quality of service, competitiveness and flexibility.

Companies from variety of industries and different business situations have their individual reasons and objectives to implement B2B integration infrastructures, and the role of supplier and customer significantly affects on the realised benefits. This also indicates that the consistent evaluation of benefits is very complex, since the benefits related to B2B integration are strongly case-specific.

The cost of B2B integration indicates to all factors that diminish the possible benefits gained from B2B integration, and weakens the further adoption of B2B techniques among enterprises. Similarly as the benefits, also the costs appear in many forms from which many are more difficult to perceive than, for example, investment costs. Some of the other concerns related to B2B integration include information sharing among trading partners, technical problems, and issues related to the size of the company [37].

One of the reasons why the evaluation of benefits and costs is difficult is that the benefits can be overlapping and interlinked. For example, when IT is used in supply chain management it inevitably relates to process changes, so it is hard to precisely determine the source of the benefits. Another reason that was mentioned before is the fact that some benefits will be detected immediately after the implementation and some will take more time to emerge. Also the strategic benefits can not be specified with measurable units because the benefits are rather abstract than actual. Because the effects of B2B integration investment concentrates mainly on the strategic benefits, it is unwise to analyse the benefits and costs using traditional accounting-based measures, which concentrate mostly on inventory turnover, lead time improvements, delivery costs, etc. Instead companies should put more effort on alternative approaches to measure overall benefits and costs. [37]

6.2 Benefits of B2B integration

A study made by Jauhiainen et al. [37] further extends the concept of operational and strategic benefits to be comprised of operational efficiency, quality of service and supply chain agility. This approach emphasises more strategic benefits of B2B integration and thus gives a comprehensive view of the overall benefits.

- *Operational efficiency* is the easiest form of benefits to measure in a B2B integration project. Quite often the cause of operational efficiency derives from the re-engineering of business process. One way to describe the operational efficiencies is to consider them as transactional gains, achieved from automated business transactions eliminating loads of paper work and thus reducing the errors caused by manual data entry. Efficient transactions enabled by B2B integration has often managed to cut also the order cycle times that has in part led to reduction in inventory.

So, the operational efficiency gains are undeniable and B2B integration can indeed offer significant cost reductions and in some cases also provide additional revenues. However, Jauhiainen et al. [37] observed from various other studies an important fact stating that when B2B integration is utilised only as a mechanism to automate business document exchanges and management without any process changes, enterprises are not able to achieve considerable benefits from B2B integration. Further on it is noted that performance improvements are only attained if B2B integration is used for creating new collaborations with trading partners, emphasising that the new collaborations is the real source of benefits instead of electronic connectivity. Collaborative B2B in this context means, for example, the replacement of traditional order placement with real-time information on sales and stock levels between retailer and manufacturer over B2B networks.

- *Quality of Service* covers all issues (excluding operational efficiencies) that provide additional value to participants in B2B. These issues indicate to qualities that make some B2B trading partners more attractive than others. It is difficult to give a general summary of the issues that bring more value to the company, since the B2B solutions are unique and emphasises specific elements of an enterprise corresponding to each company's individual objectives to enhance customer services.

From a retailer point-of-view, an example of a tempting quality might be the possibility to integrate effortlessly but deeply enough to supplier's information systems to ensure better product availability and decrease the amount of products in stock. According to Jauhiainen et al. [37] many B2B integration projects are initiated by important customers who set the requirements for the supplier. The supplier company has to seriously consider B2B integration in order to keep the customer satisfied, and also maintain its competitiveness in modern markets. Especially the small and medium size enterprises perceive the integration effort as an opportunity to build long term business relationship with important trading partners instead of a change to cut down paper work through automation.

Since the customer's role seems to be an important element for the success of B2B integration, there is reason to assume that CRM (Customer Relationship Management) and B2B strategies are tightly coupled together. This approach has been studied by Zeng et al. [38] who argue that integration of CRM and B2B will produce additional benefits in such business areas as sales, marketing, customer service and information support. Examples of such benefits include global reach, cost reductions in quality management, effective marketing efforts, better customer responsiveness, and service improvements through real-time status of the product delivery.

- *Supply Chain Agility* addresses to improvements in the information sharing among supply chain participants as a result of B2B integration. These improvements help participating companies to respond quickly to changes caused by external environment and to control globally dispersed supply chains.

Because the supply chains rely on information sharing, it makes the flow of information a priority issue when considering the benefits of B2B integration. First of all, B2B integration efforts improve the speed of information sharing, so that the information can be exchanged with real-time expectations. Secondly, B2B integration improves the quality of information, since the manual typing process was the main source of errors. Additionally, the improved information flow reduces insecurity issues related to demand because the supply chain partners are more aware of each

others sales and inventories, and so a single company can utilise this information to make more accurate decisions about their own demands. All together, the improvements in information flow and collaboration between trading partners makes the supply chain processes more responsive to market changes and assists to achieve the needed agility in supply chain.

Due to globalisation effects, it has become essential to manage geographically dispersed supply chains, since more and more international companies have production lines and sales offices all around the world, and concurrently the head office resides on the company's home front. This has in part increased the interest in B2B integration as a method of managing such dispersed and complex supply chain networks.

6.3 Costs of B2B integration

Despite all the benefits that are described to appear as a result of B2B integration, there are also some cost factors that need to be identified. According to Jauhiainen et al. [37], the costs can be divided into four different categories that are investment costs, information sharing, technical difficulties, and problems related to organisation's size.

- *Investment costs* comprise mostly of equipments (hardware, software) and skills (set up, testing, maintenance and training) required to initiate B2B transactions. This is the most visible and often quite significant item of expense. Sometimes additional hardware is needed, for example, a B2B integration server, and also the B2B software may require some development and maintenance to meet needs of a certain company. Testing is an important part of the B2B integration, so that the transactions are executed in a desired manner. Also a substantial part of the investment costs originate from the wages of consultants needed to train the personnel that operate the system.
- *Information sharing* relates to competitive disadvantages derived from the sharing of business information among trading partners. Explicit information sharing can diminish the negotiation power of participating companies, which may have negative implications on, for example pricing. Transparency of the supply chain may give the competitors an undesired view of another company's pricing structures and operational capabilities that they can use to their advantage.

According to a study made by Seidmann et al. [39] claims that the negative implications of information sharing relates mostly to supplier rather than retailers and buyers, because the open sharing of information can change the suppliers' marketing and sales strategies, and further reform the competition in supplier markets. Another concern related to information sharing is the possibility to be a victim of a fraud. The misuse of electronic trading makes possible to manipulate business messages to create unauthorised checks and invoices that may be accidentally approved by a company.

- *Technical difficulties* arise from the incompatibility issues between integrating business environments. Companies do not commonly share mutual understanding on business messages, business processes, or intra-organisational infrastructure that causes technical challenges to B2B integration efforts.

A secured data transport channel between two enterprises is required to ensure a reliable transaction of sensitive and essential business data. To build such connectivity, it requires higher knowledge about the transport level techniques, which is not usually mastered in majority of businesses.

Although the standardisation efforts have enhanced the interoperability of different systems and applications, still the majority of companies represent the havoc of different systems using various data formats, messaging protocols and interaction methods. Also the management of transactions contrives technical difficulties in the form of processing required to deliver data. Transaction management must handle long-running transactions, orchestration of business processes and different interaction modes, in addition to basic processes, such as transaction security, directory look-up and routing. Much of the technical difficulties can be overcome with the help of standard technologies and frameworks, but they do not eliminate the necessity to agree on business documents and business processes between integrating companies. [40]

- *Organisation's size* may affect on the willingness to participate in B2B electronic commerce. Especially the small size enterprises are not eager to adopt B2B due to lack of proper IT infrastructure. For small enterprises, the costs (investment and

maintenance) are also considered to be relatively high compared to attained benefits and sometimes the market position may be unsuitable for B2B integration. With the evolution of new Internet-based technologies, this cost argument is coming less accurate, since also the smaller enterprises can now adopt the new B2B methods that require less IT and financial support.

When estimating the possible benefits of B2B integration, it is rational to keep in mind that significant operational benefits are attained from re-engineering of business processes, or else the operational benefits might not be as expected. However, the B2B integration also includes strategic benefits that can not be directly measured in money, and some of the benefits are detectable after a longer period of time. So, it is important to take a view of entirety of the benefits, before making any unreliable conclusions.

There are several costs and difficulties related to B2B integration projects, but nevertheless, there are nearly always risks involved in investment projects. Therefore, if the B2B integration is an essential step for the company to maintain its competitiveness and market position, then there should be a careful consideration how to minimise the risk factors of B2B integration before implementing. The investment costs are inevitable, information sharing involves risks that just have to be taken, technical difficulties can be tackled with standardisation efforts, and organisation size issue is no longer an obstacle in most of the cases.

7 DRIVERS OF B2B INTEGRATION

To conclude the theory part of this thesis, it is reasonable to consider the factors that drive enterprises towards B2B integration. This summarises the previous chapters that dealt with the various aspects of B2B integration.

When reviewing the history of B2B integration from the early days of EDI-standards to the current Web-based technologies, it is easy to perceive a common denominator of the most successful B2B integration techniques. The most widely adopted techniques are promoted by large enterprises, making them the initiators of B2B integration and subsequently forcing the smaller trading partners to adopt the same methods regardless of the quality and expenses affiliated to the technique. This can be concretely noticed in industry-specific supply chains, where the largest company is often the dominant party

making the decisions on standards that the smaller partners must kindly obey or fall out from the supply chain. Although this approach sounds a bit rigid, it has some benefits too; since the industry standards tend to be difficult and time consuming to develop, it is easier to follow specific instructions made by major supply chain partners. [37]

Another driving force is the effect of globalisation that has tightened the business competition even from before. Reasons for this are the improved communication and transportation solutions that have diminished the territorial boundaries and made the geographical distances less significant. Outsourcing has become the prevailing method for cost reductions and more companies are forced to move their production lines into countries that have low labour expenses in order to keep the business profitable. However, this may scatter the company into smaller pieces, which are harder to manage with traditional methods. As perceived so far, the B2B integration solutions provide a respectable solution to overcome the difficult management issues related to distributed organisation infrastructures and dispersed supply chains.

Legislation has an important position to either promote electronic trading with regulations that enable international electronic business, or respectively the regulations can restrain the companies to commit electronic trading with international partners. Since both parties of the trading process must respect the legislation, it is important to make bills that support the improvements to practice international electronic trading.

Benefits and costs of B2B integration are considered to be one (positive/negative) driving force, since the benefits try to convince the companies to participate in B2B efforts and the costs hinders the adoption enthusiasm. As it was clearly demonstrated in the previous chapter, the benefits are grouped into operational and strategic benefits. Operational benefits were easier to measure because of the cost reductions and streamlined processes, whereas strategic benefits concentrated on more abstract improvements, such as quality of service and supply chain agility. Many costs and risks were presented to explain what kind of difficulties a B2B integration project may have. But the bottom line was that the investment costs are the ones that cannot be avoided.

Standards and technologies related to B2B are under constant development and therefore choosing the appropriate method is essential to achieve the full benefits of B2B

integration. It is more and more evident that the XML is going to be the dominant standard in describing the business messages in the years to come, although the EDI-formats are persistently maintaining their position in the B2B markets. The e-business frameworks and standards provided by different standardisation bodies play an important role when considering different B2B integration methods. Some of the frameworks provide a cross-industry solution (i.e. ebXML, xCBL), while the others concentrate on a specific industry (i.e. RosettaNet, PapiNet). These initiatives provide guidelines that help the companies to implement B2B integration, and therefore it is considered as an important driving force.

Jauhiainen et al. [37] claim in their study that the future will introduce graduated increase in the convergence of various B2B integration standards and frameworks, which will lead towards globally unified B2B integration frameworks. It would help the companies to ease the connection establishment with trading partners, decrease the costs of overall solutions, and speed up the integration process.

There are also hints in the current market trends that EAI and B2B integration are progressively uniting, forming enterprise systems that will also concentrate on inter-enterprise integration, in addition to traditional intra-enterprise integration. This has been a predictable development trend, since the most advantage gains derived from intra-enterprise integration are often originated by SCM (Supply Chain Management) [41], and therefore the vendors of enterprise systems are forced to develop systems that will offer connectivity through the whole supply chain. Future will show which B2B integration solutions will dominate the markets and will the EAI and ERP vendors develop their systems capable of external integration to such extent that it will attract the majority of companies to utilise them.

This chapter ends the theory part of this thesis. The following part will concentrate on third-party B2B integration service providers and their possible contribution to the requester of this thesis, UPM-Kymmene Wood Oy, in the case of B2B integration. The service descriptions are acquired from Itella Oy and TietoEnator Oyj, which provided the first hand information on behalf of the service providers.

8 BACKGROUND FOR 3RD-PARTY B2B INTEGRATION SERVICE PROVIDER

Since this work is related to a specific wood industry environment, it is essential to consider the facts that generate problems in the automation of the value chain, and thus support the use of an integration service provider as an enabler of B2B communications among the heterogeneous business environment.

When considering the core business activities of a wood industry organisation, it is fair to note such an industry sector tries to concentrate all possible resources on wood production that is the company's field of know-how, and focus less on IT-related issues that in part includes also the B2B integration efforts. Therefore, it makes sense to consider outsourcing some or even all of B2B related functions to a third-party service provider that already has the required facilities and the needed technology expertise for B2B integration.

Experiences from the real world have shown that the true problem hindering effective B2B e-commerce is not the costs, but the requirement for establishing technical and process agreement among disparate and independent organisations, especially when the participants in a single value chain is comprised of myriad number of suppliers and customers [40]. The complexity of these value chains can be reviewed from four different standpoints, which are related to physical, standards, technical and geopolitical issues [42]. All these standpoints will form an argument base that explains the rationality of utilising managed integration services provided by a third-party operator.

Physical complexity relates to the raw number of partnering enterprises in a specific value chain. When considering a medium or large enterprise that may easily have 1000 suppliers and over 5000 customers, it is obvious that the partner and transaction management in such organisation may easily become infeasible, especially when the trend nowadays is to make everything more rapidly and cost effectively. This example only caters for the first tier of enterprise's partners, and when adding also the partners' partners it is easy to realise how complex the whole value chain might be. A recent research made by the Quocirca-company [42] points out that attempting to control these dynamic value chains is no longer an option, and so the companies have settled for trying to minimise the risk and cost of participating in such trading environments.

Another concern is the *standards complexity* that is derived from the efforts to automate the business message exchange among various companies. Despite the advantages that the standardisation efforts are able to offer in various industry sectors, in the real world there remains multiple enterprises that cannot align their systems to cope with the prevailing standards in that specific industry area. This, in part, will contrive additional complications and costs also to those organisations that have adopted a certain standard as a way of exchanging business events, such as previously introduced RosettaNet or ebXML. So, following only the standards-based value chain automation is becoming less and less a durable solution, when considering the current trend where there exists multiple standards focusing on specific vertical or horizontal industries, and concurrently composing a fragmented multi-standard business environment, which is unable to provide a unified business methods that would enable effortless trading around the globe.

If a company will in any event try to manage the diversity of the standards, it must keep up with the various standards and their versions to ensure smooth co-operation with the trading partners regardless of the possible standard and version conflicts. The management of such standards will require sophisticated in-house systems that are inherently expensive to build and maintain. Therefore, the conclusion gathered in most of the companies is to continue utilising and supporting traditional transaction methods, such as email or telephone. The high utilisation of manual mechanism in modern enterprises emphasise the importance of such ancient methods also in today's B2B interactions.

The emerging technologies and standards are the main source of *Technical complexity*, since maintaining in-house systems that are able to provide a certain level of integration have often turned out to be unworkable. Some companies have decided to support a particular set of standards, trying to press their partners to adopt the same methods, but in most cases with poor outcomes. The evolution of existing standards causes continuous development to the systems, and there is no way to dictate the phase in which the participants of a value chain will update their systems. Therefore, it requires the support for various versions of the same standards and related technologies in all of the participating organisations. According to the Quocircas research [42], over 50% of the suppliers and 40% of the customers stated that dealing with the rate of technology change in B2B transaction mechanisms was a major or significant burden to their business. The

research covered 400 different sizes of enterprises from the US and Europe.

The local regulations and laws of a certain geographic location contrive *Geopolitical complexities*. With the help of Internet, companies are able to search for suppliers from various parts of world to find the most in-expensive partner, and thus decrease the overall costs in a value chain. However, this is not as easy as it sounds because the supplier company may not be able to communicate in any other than its native language, or it is not able to support the needed standards required by the customer. Also the supplier's local laws may differ greatly from the laws of the customer and complicate the trading process from before. There might be additional problems related to the moving of goods, such as import duties etc. which must also be managed. Going through all these issues makes sense if the supplier will be a long-term partner, but it is worth to consider the gained benefits against the needed devotion, if the partnership is only temporary or ad-hoc. Nevertheless, dealing with the geopolitical complexity requires skills and human resources, and therefore causes costs to the enterprise.

Based on these four complexity categories, it can be recapped that the value chain can be extremely complicated and the amount of trading partners in it can increase to enormous extent comprising of both long-term and ad-hoc business relationships. Adding the complexity of standards, technologies, and international trading on top of the complex trading network, multiplies the challenges substantially. Considering also the speed of change in these areas, it's no wonder that the companies are conservative about the B2B integration efforts.

As it has been illustrated in the theory part of this thesis, the B2B integration has undeniable benefits in terms of efficiency in the supply chain, but the complexity of the trading environment restricts the achievable level of automation, because the costs may grow too high and diminish the original objective. Most of the challenges in this deadlock situation can be reduced with the help of a third-party service provider and the means for that will be introduced here.

9 THE CONCEPT OF 3RD-PARTY B2B INTEGRATION SERVICE PROVIDER

When reviewing all the benefits included in B2B integration, it's clear that many enterprises are considering B2Bi as a high priority issue. However, due to the various challenges of B2B integration, the implementation projects tend to achieve only partial integration or fail to integrate at all. The negative experiences of B2B integration projects have labelled B2Bi to be costly and complex task, in which the gained benefits are insignificant compared to the required investments. These problems are addressed by a third-party B2B integration service provider that is the primary focus in the rest of this thesis. The forthcoming chapters will explain the role of such an integration service provider and introduce the virtues with which it can facilitate B2B integration. A descriptive definition of a B2Bi service provider is: a third-party operator that hosts managed services and offers B2B integration solutions to enable enterprises to connect to each other without needing to know the specifics about the integration methods. [40]

A B2B integration service provider usually offers a basic set of tools for managing the collaboration and communication, but often there are additional services that cover also other functions, such as a change to manage and synchronise product catalogues and inventory information. If the service provider manages all the B2B related functions on behalf of the company, it has to have an end-to-end view of the whole exchange sequence in order to track and trace the transaction whenever needed.

In contrast to the two B2B integration approaches (point-to-point and hub-and-spoke) introduced earlier, the B2Bi service provider itself complies with the hub-and-spoke approach by offering many-to-many connections between enterprises operating either in industry-specific or cross-industry markets. However, it usually does not contain the functionality associated with an electronic marketplace, instead the service provider can be utilised to connect the enterprise to such market environment if needed.

From the enterprise's point of view, the use of a third-party service provider eliminates the need to search for the appropriate B2B integration methods, since the service provider can provide solutions that utilise even raw data extracted from the enterprise's back-end systems. After that it is the service provider's responsibility to make the

required conversion and other processing to deliver business messages to correct recipients. However, it is important to recall that the true benefits of B2B integration relies on process integration and previous scenario integrates existing processes, and therefore neglects the possible benefits from the re-engineering of company's processes.

The following chapters will also introduce the players of this field by providing detailed information about the services that are offered to the customers. When choosing the trusted integration service provider for the enterprise, it requires careful consideration of the services and their applicability to the enterprise's needs. Since almost all of the third-party operators in the field of B2B integration are able to offer many-to-many connections between trading partners, it is important to research the aspects that make one service provider better than the others.

9.1 Third-party service provider's position in trading networks

The position of a service provider is always the first external connection point outside the company's internal network (intranet). No specialised connection method is required, and simply a regular Internet connection will be enough. However, when the amount of transactions increases it obviously requires more bandwidth. The bandwidth requirements along with other connection specific definitions (i.e. communication protocols, security issues, responsibilities, etc.) between the enterprise and the service provider will be determined during the initial implementation project.

The following picture (Figure 13) illustrates a more realistic view of the hub-and-spoke architecture that may comprise of existing partners, other service providers, different e-Marketplaces and their customers.

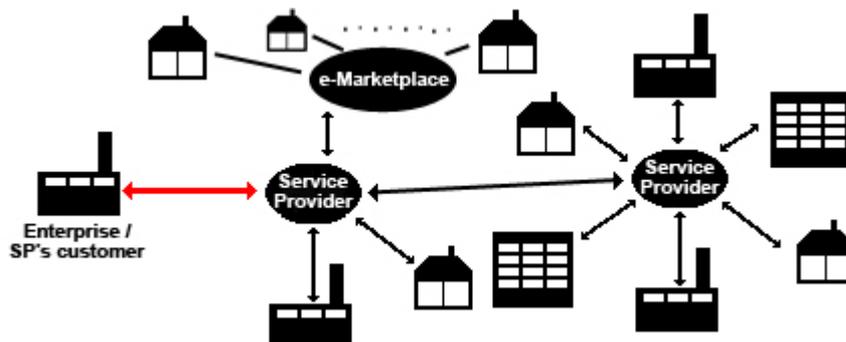


Figure 13: Extended Hub-and-Spoke architecture

Integration with these multiple entities would require tremendous efforts without the facilities of a B2Bi service provider that is able to orchestrate all external connections on behalf of the enterprise. The red connection in the above picture indicates the only required connection from the enterprise to the outside e-business world. Connection methods from the service provider to other entities in the network complies with the B2B integration methods and techniques introduced in the theory part of this thesis.

9.2 Two approaches to utilise an integration service provider

There are two common ways of utilising a service provider. A company can outsource all its B2B related functionalities to a third-party service provider (complete outsourcing solution), or exploit only some of the managed services offered by the operator and continue managing the other functions in-house (hybrid solution). The service provider may well offer some B2B integration solutions that can be implemented in-house style and provide managed services alongside. [42]

If the company has limited resources or skills for managing B2B related functions in-house, the outsourcing option provides an effortless connectivity method, including the support for various standards, transport mechanism, communication and collaboration functions required in comprehensive and efficient B2B interactions. The main advantage of this solution is the service provider's capability to offer a highly scalable trading environment with the possibility to interact with any partner through a single interface in a consistent manner. The modern e-business requires the support for legacy, existing, evolving and new standards. Practically, this can only be achieved with the facilities of a service provider, because with internally developed and maintained systems, the implementation and management costs can be unpredictable.

In terms of legislation and other governance issues, the service provider is usually capable of providing various logs and reports for its customers to support, for example, audit logs and other essential documents. Sometimes the legislation may affect the transactional issues of B2B environment and the service providers are usually the first parties that have to react and make appropriate changes to their systems in order to support and comply with the new regulations of each geographic region. The speed of reacting to these kinds of situations proves the service provider's flexibility and customer-service willingness that is important in the selection of service provider partner.

The major issue that reduces the willingness to utilise such third-party service providers is the cost factor, even though it is sometimes radically overestimated [42]. These costs are mainly composed of transactional charges and subscription fees, and also the use of special value-added services may cause some extra payments to the overall costs. When considering service provider's costs against the project that is needed to implement such connections internally, it is important to keep in mind all the equipment, personnel and management factors, in addition to the implementation project hours, which all are significant parts of the overall costs when connections are established and managed internally. In practice, it is an extremely complicated job trying to estimate the costs derived from internally managed B2B functions against the costs of externally managed B2B functions in beforehand.

The complete outsourcing of B2B related functions is not always a feasible solution, especially if the company has several existing connections with key-customers that are operating smoothly and seamlessly as a result of years of development and investments in a certain technique (such as EDIFACT, RosettaNet, papiNet etc.). In such scenarios the possibility to utilise a third-party service provider is convenient when interacting with temporary or non-standardised partners. With this so called hybrid approach, the enterprise maintains the control over important partner connections and delegates the other partner connections to the service provider's custody. Assuming that the internally managed connections and related systems are also capable of providing automated exchange of information, the hybrid solution has the similar potential to be an effective transaction platform as in the completely outsourced approach [42]. The effort to decrease the internally managed connections to a small amount of partners strengthens the partnership with the existing key partners, since more internal resources can be addressed to these particular business relationships and less efforts is needed to deal with the complexness of the whole trading environment.

The hybrid approach has gained popularity especially among larger enterprises but also in the SME environment. The main reason for this popularity is the relatively low participation threshold that enables companies to keep the strategic management of key partners within the enterprise and still maintain business relationships with less strategic and temporary partners by using a third-party service provider [42]. An enterprise may also decide the degree of outsourcing of the B2B functions, which means that the

company can start from just a few B2B connections and related services, and gradually increase the amount of partner connections and services even to the point where all the B2B related activities are handled by the service provider.

As a conclusion, the managed B2B solution that is offered by a third-party service provider is tailor-made for intricate trading environments where the value chains are long, and consist of multiple partners with various standards in use. However, the internally managed B2B functions may strengthen the co-operation with some important suppliers and customers, and therefore the hybrid solution offers an approach that deserves the extra considerations. Also, if the company's has the appropriate equipment and enough technical skills, and the trading environment is not that complex and comprised of only small number of partners, it may be reasonable to try to establish those connections in-house without outsourcing any of the B2B related functions.

9.3 General description of the managed B2B integration services

The connection between the enterprise and the service provider is generally managed by the service provider. With this connection the internal systems of an enterprise are able to communicate with the service provider's systems and utilise one or more of its services. Before the connection can be utilised, there are several issues that need to be settled. The basic feature associated with this connection is the data connection, but often some pre-processing of enterprise's data is also necessary. It also requires an application interface description, so that the enterprise's applications and the service provider's applications are able to understand each other.

To ensure a reliable and consistent data transfer, it requires several data connection related processes to be defined, agreed and documented during the initial B2B integration implementation project. First of all the transfer protocol used at the messaging level needs to be determined, whether it is FTP (File Transfer Protocol), SSH/SCP (Secure Shell / Secure Copy), HTTPS (secure HTTP), ebMS, or something else and it must be maintained thenceforth. Also the acknowledgements related to a certain transfer protocol needs to be considered, so that there is no misunderstanding between the participants of what messages or signals expect acknowledgements in return. Security issues have to be agreed as well, since the transfer protocols are not always capable of providing sufficient degree of encryption, it may require the use of VPN (Virtual Private Network) or other

more secure transportation methods instead. The parties must also agree on common parameters (hosts, paths, file naming, user accounts) that are used during data exchange and decide which one is the initiating party that opens the connection. If there is a need to schedule the transfers, the agreement on polling times determines the desired time for exchanging data between the enterprise and the service provider. To complete the data connection definitions, the delivery of transfer receipts and possible error messages has to be arranged as well.

In order to utilise a certain managed service, the service provider needs to execute different types of pre-processing functions for the incoming data. To ensure that the data is valid the service provider must check the consistency, format, structure and content of the messages. Data channelling includes the multiplexing of data streams to the appropriate services and recognising the different message types used in these streams. Before the data is converted to other formats, the preparation procedure defines, documents, and stores the application interface description. Application interface description is used for programming all data converters needed for integrating the enterprise to the managed services. On the contrary, the procedures required to deliver information from service provider to the enterprise include also the preparation of data converting and data validation, but additionally also the consolidation of data, for example, to combine the files into batches.

To offer any-to-any connections between enterprises, the service provider must have the resources to make conversions between a myriad of message formats. The service provider may support even the raw data generated by the company's internal applications, but it often requires a longer implementation project that may generate extra expenses. However, once implemented the system can be easily expanded and maintained, and it has no restrictions and compromises that are common in the case of public standards. Additionally, there is no need for stand-alone converters at the enterprise's site. If the company is willing to comply with the specifications of a certain standard (i.e. papiNet / WoodX [12], [43]), the service provider is usually capable of providing the support for the various standards as well. This may reduce the overall costs if there is a wide range of partners utilising the same standards, because the more processing service provider needs to perform on the messages the higher the costs will be. But, since the provider can exploit the 'economy of scale' concept, the costs will

remain reasonable even if lots of processing is required.

Value-added services are services that are offered on top of the traditional message translation and brokering services. These services are the properties that service providers use to stand out from the competitors. However, the resemblance of these services is noticeable, since all service providers tend to offer similar value-added services for their customers. The services that are commonly acknowledged as value-added services are, for example, archiving capabilities that include the storage of sent and received business messages. Storage duration may vary from short-term to long-term according to the nature of archived data and requirements of the customer. If required, the information of stored business messages in the archive can be accessed through, for example, the Internet. Another important value-added service is the reporting functionality, which can report all the possible parameters associated with the business messages that are conveyed via the service provider. It is possible to implement online tracking of the messages to be sure when a certain delicate business message reaches its destination. Additionally, the service provider usually generates log files of the transactions and delivers them to the customer on a regular basis. These attributes cover only some of the main functionalities of value-added services. Practically any kind of functionality that can be imagined, in terms of B2B interactions, can be implemented in either one of the third-party service providing companies.

Evidently, the service providers have to co-operate with each other in order to form a globally connected electronic trading environment. The co-operation is performed with the other domestic and international operators to enable electronic business messages to be conveyed via these networks. Commonly this is achieved by using open gateways and open server technology to access other networks. The utilisation of open servers does not require separate agreements to be made between the parties. In general, the domestic operators in Finland do not collect extra fees from each other for the inter-operator connections, but roaming costs are common when connecting to a partner via international operator networks, or so called tariff networks, such as GEIS (General Electric Information Services) and X.400.

Like it has been observed during this study, the traditional manual transaction mechanisms (letters, e-mail, fax etc.) will not suddenly disappear in the near future, so the service provider usually have the support for these formats as well. For instance, many companies still have their own scanning personnel that may perform invoice scanning all day long. Since most of the service providers are offering also scanning and printing services, it may advocate and rationalise the decision to outsource such services along with the other B2B functions, thereby releasing the personnel to perform tasks that are more focused on core business activities. Additionally, the company is also able to reduce significantly the amount of in-house paper processing. For example, the invoices can be sent in electronic structured form to the service provider that will printout the invoice and forward it, if it's required so by the recipient. The functions related to electronic invoicing will be studied further in the forthcoming chapter 9.4.1.

The service level of the managed services mainly depends on the agreement made by the service provider and its customer during the initial implementation project. The basic service level usually provides sufficient facilities for most of the companies. Some requirements, such as support for real-time message exchange are rarely included in the most basic level of service, because it is challenging to implement and also hardly ever required by the companies. However, the requirements for higher service level can be agreed between the customer and service provider, but specialised requirements will increase the costs of the related connections.

In order to utilise managed services, it requires the establishment of the connection between service provider and enterprise. These issues are considered in an implementation project. The project describes and implements the interface needed to connect the enterprise's systems to the service provider facilities, and the system-to-system interaction channels between the enterprise and its partners are also established. The messaging standards, message versions, application instructions and appropriate transfer methods are also discussed during the project negotiations. According to the project outcomes, the service provider programmes the converters, conveyors and confirmation messages needed for the transaction. After the programming phase, the connection needs to be tested before it can be transferred to production.

Service providers report that the average timeframes for implementation projects are generally around couple of months. But larger project that may contain also the integration of back-end systems and re-engineering of internal processes can take time up to couple of years. The overall costs of managed services are basically comprised of the scope of the implementation project, scale of maintenance, and message transaction volume. Any additional features commonly have their own specific tariffs.

Next chapter introduces electronic invoicing services that are one of the main concentration areas among most of the service providers.

9.3.1 Electronic invoicing services

Since invoicing is essential part of the trading process, especially in B2C, but also in B2B, many service providers are offering electronic invoicing (e-Invoicing) services for enterprises. Thus, it is often considered to be the first logical step towards the use of managed services offered by a third-party operator.

Electronic invoicing services can be divided into four sub-categories or distribution channels. The categories include: traditional paper invoicing, B2B electronic invoicing, electronic invoicing through EDI/XML connections, and B2C electronic invoicing. The following picture (Figure 15) illustrates these different channels of invoicing in more details.

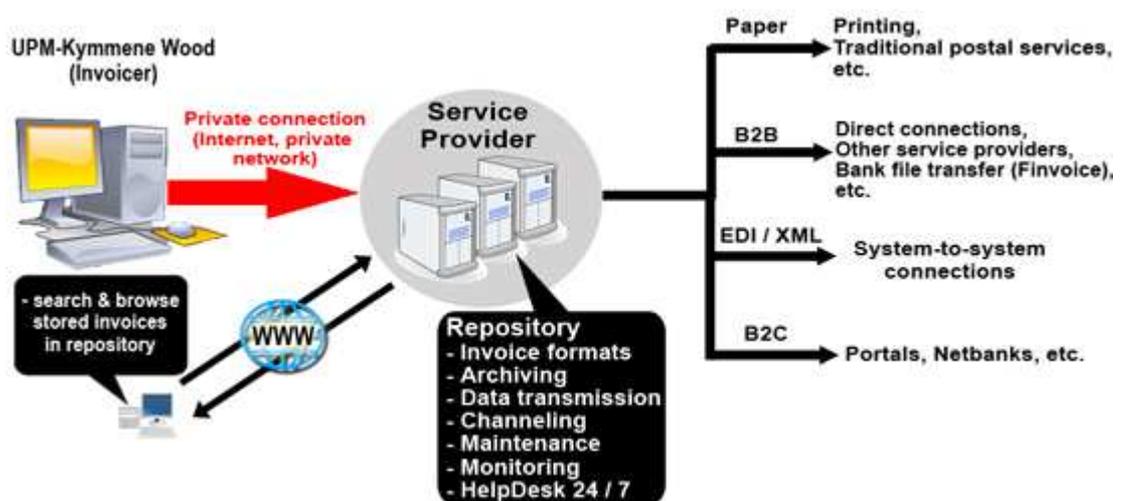


Figure 14: Electronic invoicing service

With the electronic invoicing services which are depicted in the above picture, the enterprise is able to charge all its partners whether they are private consumers, small and medium enterprises (SMEs), or international corporations in a consistent manner.

The service provider receives the invoice data from the invoicing company via the previously established connection. The invoice data can be used to form sales invoices, credit notes, and other invoices. The invoicing company is responsible for the data content of the invoices that has to comply with both national and international regulations and obey the common good trade practices. The service provider will check the invoice data for file layout, minimum content and the value of the data fields for correctness and/or logicalness. Any errors will be reported to the invoicing company in a manner that was defined in the initial implementation project. The invoice data may also contain attachment files if the receiver is able to support them. The invoice may also contain URL (Uniform Resource Locator) links, but the links will not be active if the service provider generates a static image (i.e. TIFF) from the invoice data.

In general, an image of the invoice can be formed from every invoice document according to the customer's visual requirements. The customer can have several forms of invoices that may contain graphical elements, such as logos or pictures. The visual image of the invoice can be produced either in black-and-white or in colour. The invoices can be also stored into a repository that is hosted by the service provider, if it's required so by the customer. Repositories usually have the support for various file formats. For example, Itella's repository supports the following standard file formats; EDIFACT, ecXML, Finvoice (Finnish Bank Association's file format), PDF (Adobe's visual file format), TIFF (Tagged Image File Format), and ZIP (compressed file of the invoice and its attachments). TietoEnator has a similar repository service that is commonly known as eHotel. The repository can contain one or more sales invoice accounts per customer, in which the data is stored for a certain time period (i.e. 1 year). The repository can be also used in archiving the invoices and browsing for stored invoices. It is possible for the customer to utilise the Internet to access its own invoice account and search for invoices to print out a certain invoice, or save it to a private workstation for further processing.

After the service provider has completed the checking and storing procedures, it can proceed with forwarding the invoices to the appropriate distribution channels according to the invoice address and/or channelling information. The receivers address information is controlled by the invoicing company and delivered along with invoice data. Several distribution channels for e-invoices are commonly supported by the service provider, and naturally operators own receiving channels for e-Invoices are also included. The financial institutes in Finland, such as banks (Nordea, Sampo, Osuuspankki), utilise the Finvoice file transfer and, therefore, most of the domestic operators have the support for it. Also the services hosted by other e-Invoice operators (Anilinker, Basware, Elisa, Enfo, Itella, TeliaSonera, TietoEnator, and WM-data) needs to be supported in order to effectively deliver electronic invoices.

Any additional services related to e-Invoicing can be settled during the initial implementation project. Such may include the possibility to archive the invoices for a longer period of time, as set in the Bookkeeping Act (1+6 years in Finland). Another additional service could enable the invoicing company to receive the stored invoices from the repository to its own filing system and process it accordingly.

The desired service level of e-Invoicing is agreed during the initial implementation project between the invoicing company and service provider. At a general service level, the e-Invoicing service should include 24/7 availability, excluding the maintenance and unexpected service breaks. Depending on the service provider, a certain amount of invoice pages can be sent during one day, and it may have some restrictions concerning the amount of pages in one batch and the amount of pages in a single invoice. The lowest service level may also have some limitations, for example, the invoices can not contain attachments and so on. When the invoice data is error-free the service provider is able to forward it straight away, but since the service level requires a time scale to be set, the service provider tends to report the upper limit, such as 24 hours etc.

Like in all managed services, also the invoice service requires an implementation project between the participants. The first goal of the project is to implement the private connection interface between the service provider and the invoicing company. The e-Invoice formats are then settled and the needed interfaces to the repository are established. The average time for these types of projects is from two to three months, but

it may vary significantly depending of the customer-specific details. Changes or additional features to the existing system will normally require a separate project to be established. The overall costs are comprised of the implementation project, needed maintenance, and invoice brokering. The costs of invoice brokering can be based on the amount of invoices and invoice page counts. Additionally, the distribution channels that utilise tariff networks will include a separate roaming payment. The customer-specific changes to the service will be charged individually and the additional services are also priced separately.

The service provider must have strict security policies and regulations, since it has to handle the delicate and valuable information of various corporations safely and reliably. Data must be handled with respect to the secrecy of mail and letters as well as the banking secrecy. Following the instruction of data security representatives is also advisable. The data transfers are generally secured with the standard transfer protocols, such as SSH and HTTPS and if needed the connection can be also completely secured with the help of VPN or other techniques. The information systems are commonly protected with restricted access through firewalls and only certain closed user groups are allowed to access and maintain the systems. The software should be constantly updated and also properly configured, and the hardware should be physically sheltered from unwanted outsiders.

Although receiving electronic invoices (such as purchase invoices) can be perceived as a similar procedure as sending invoices but in reverse order, it can be also considered as a separate service. For example, GXS offers a single service that is contains both the sending and receiving of electronic invoices, whereas Itella and TietoEnator offer separate services for the send and receive procedures.

With the receiving service of electronic invoices, companies are able to receive electronic invoices directly into their purchase invoice system (i.e. Rondo) through a single connection. The main properties of the service are the establishment of recipient specific electronic invoice account, and registering the invoicing address to the routing systems. According to the address in the incoming invoice, the invoices can be routed properly to the recipient's account, from which they can be stored into the repository. Again, the invoice data will be stored for a certain time period, for example 12 months if

the customer will not require a longer period of time. The service providers are commonly capable of supporting various receiving channels. As an example the following picture (Figure 16) depicts some of the channels that are commonly supported. The electronic invoicing services in general support equally the large corporations as well as small and medium enterprises, and the invoice services offered by other operators are commonly recognised. Before the invoices are sent to customer, the service provider makes the conversions to the agreed format and transfers the data into the customer's systems.

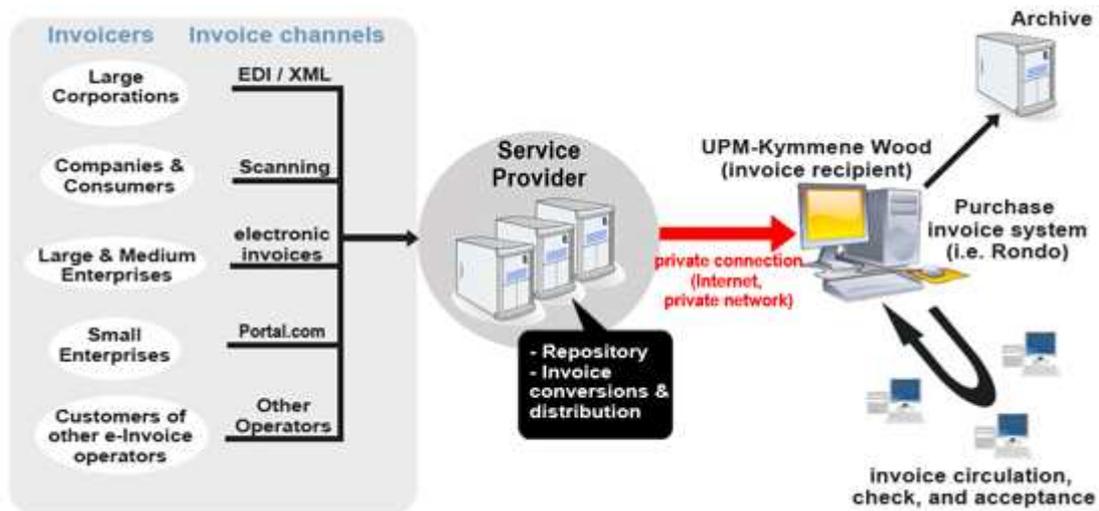


Figure 15: Electronic invoice receiving service

The definitions for the received invoice data complies with the definitions for the sent invoice data introduced previously. The received data may also contain sales invoices, credit notes etc. The responsibility of the content of the invoice is on the sending company and the content must obey the common good practices of trading and adhere to national and international trading regulations, however, the service provider executes certain procedures for the received invoices to check the file layout, minimum content, and the values of data fields for correctness and/or logicalness. Any errors will be reported to the source of the invoice and these invoices will not be forwarded to the recipient. The invoice can also contain URL (Uniform Resource Locator) links but they will not be active, if the service provider generates a static image (i.e. TIFF) from an invoice that contains links.

If necessary, the image of the invoice can be generated also from the received invoices. The visual definitions are based on the customer's requirements, however, if the invoice is received from a service that does not support static images, the image can be generated using an existing template. The images are stored into the repository that may contain one or several customer specific accounts, in which the invoices are stored. The repository can also support the routing of invoices and serve as a back-up for the routing information.

As in the sending service, also the receiving service supports several distribution channels for the incoming messages. The channels can be further explored from the previous picture (Figure 16), but the main channels are operator's own e-Invoicing services, in Finland many operators support the Finvoice services of banks (Osuuspankki, Sampo, Nordea), and also the services provided by other operators (Anilinker, Itella, TietoEnator, WM-data, etc). Any additional services for the incoming invoices can be agreed during the implementation project. For example, Itella and TietoEnator offer a scanning service that digitalises and stores all received paper invoices into customer's account, from which they can be forwarded to the customer's systems in the form of electronic invoice.

The service level in receiving services corresponds to the service level introduced in the previous chapter, the only difference is that here the customer is the receiving party. The overall costs are also comprised of the initial implementation project, required maintenance and invoice brokering. The average schedule for the basic receiving service implementation project is from 1 week to couple of months. The security issues are identical to the e-Invoice dispatch service that was introduced above.

The benefits derived from only electronic invoicing can be specified as follows. From the supplier's perspective, the benefits come in the form of; decreased amount of rejected invoices, more invoices paid on time, reduced DSO (days sales outstanding), increased productivity, and improved customer service. [44]

From the buyer's point of view the benefits are; reduced costs (transaction costs, invoice processing costs, labour costs), increased accuracy (no manual re-keying), increased accounts payable productivity (accurate invoices, minimised data entry errors), improved

cash management (real-time access to invoices, configurable business rules), and maximised discounts (quick processing and approval of invoices). [44]

The previous chapters introduced the main functions (system-to-system integration using EDI / XML connections, and detailed description electronic invoicing services) in which most of the service providers tend to focus their resources on. Of course, like it has been observed, these services are not by any means the only services that the service providers are capable of offering. Practically each and every function that is somehow related to a B2B process can be managed by the majority of third-party service providers. For example, functions such as management of product catalogues, synchronisation of inventory information, and synchronisation of product data are also essential elements of particular business processes and, therefore, potential targets for service providers.

When considering these services from the company's perspective, it is understandable that the smaller companies are hesitating in the adoption of any of the services, especially the comprehensive EDI / XML connections, unless it is fundamental to the company's survival. The medium and large enterprises should profoundly consider the EDI / XML services as primary target in B2B integration, because of its ability to enhance the efficiency and agility of the supply chain that they take part in.

As said before the invoicing services are a safe option for those enterprises that are not quite comfortable with the concept of outsourcing all B2B related functions to a third-party service provider. Therefore, the invoicing services are often considered to be the initial B2B outsourcing step and based on those experiences the company will decide if it will proceed adopting other services as well. When considering utilising managed services for a certain business process, project, or function, it requires the weighing of several factors. After a comprehensive study the company should be able to decide which functions to perform and solution to build internally and which managed services to utilise externally. [40]

The following chapters will introduce the managed services of different third-party service providers in more details. The descriptions comply with the services offered by the leading service providers in Finland (Itella, TietoEnator) and USA (GXS).

9.4 Comparison between different B2B integration service providers

According to the findings made in the theory part of this thesis, to make the whole supply chain or certain functionalities in the supply chain more efficient it was required to have an automated and electronic data communication between the participants of the supply chain in question. This chapter studies several domestic and international operators; introducing and comparing the different ways that they offer to achieve complete automation in the supply chain.

The service providers usually support the establishment of both specific non-standard connections between the partners, and/or follow the definitions of a given standard, such as RosettaNet or papiNet. The other partners can be also customers of the same service providers, but they can be also customers of some other service providers that might be either domestic (Anilinker, Itella, TietoEnator) or international (GSX, ELEMICA, Sterling Commerce). The following figure (Figure 14) illustrates an example scenario where UPM-Kymmene Wood is the customer of a certain B2B integration service provider, which provides the integration services and external connections for UPM-Kymmene Wood and its domestic and foreign trading partners.

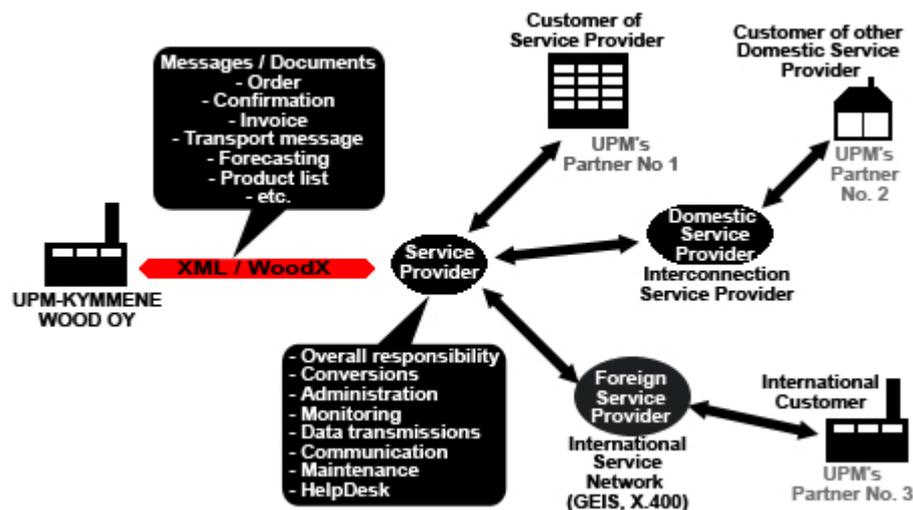


Figure 16: Example scenario describing B2B integration with multiple trading partners

The above example states that the company has outsourced all its B2B functionalities to a third-party B2B integration service provider and is also using the xml-based WoodX (papiNet-based) standard as a preferred message format [12], [43]. However, as it has

been demonstrated earlier, the complete outsourcing is not always necessary, and some of the B2B functionalities can be also implemented in-house. From service provider's point of view, if the translation functionality is outsourced, the format of the message is irrelevant as long as it has the support for it. More important is the required message format at the receiving end, which determines the needed processing for the incoming and outgoing data streams. It is commonly based on the agreement made by the service provider's customer (i.e. UPM-Kymmene Wood) and its trading partners.

Although, all service providers are capable of providing nearly the same functionalities as the others, the methods can be different due to background of the service provider and IT competence of the integrating company. The following paragraphs illustrate the variety of services that the service providers are capable to offer. Itella offers an EDI / XML-service that is based on a completely outsourced approach. This scenario was also illustrated in the previous picture (Figure 14), whereas the GXS's solution will offer an alternative approach that requires a higher level of IT readiness and competence inside the integrating company.

- **Itella's EDI / XML service**

The EDI / XML connections conducted via Itella are part of the ItellaEDI/XML-service. Itella specifies one ItellaEDI/XML connection to be a data stream that is transmitted over the customer connection to a single specific partner in one direction (arrival or dispatch) and consisting of a predetermined message type. The service supports common message formats, such as EDIFACT, ODETTE and ANSI messages, as well as several XML-based messages. This is a common approach to integrate EDI / XML connections that is utilised among most of the service providers.

ItellaEDI/XML service does not include the telecommunication networks used with the service, but it supports several messaging protocols, such as X.400 (standard family), SCP/SSH, SFTP/SSH (Secure FTP / Secure Shell), OFTP (Odette FTP), AS2 (Applicability Statement 2), ebMS (HTTPS). The EDI / XML connections established by Itella comply with the common rules of message exchange, where the message sender delivers the data to the receiver's server. When Itella's customer is the receiver, the partner is responsible for delivering the data to Itella's server or a messaging service agreed with the service provider. On the contrary, when Itella's

customer is the sender, Itella sends the data to the specified delivery point agreed with the customer's partner.

This service can offer deep integration of the internal systems of participating companies and leaves the overall responsibility of the transactions for the service provider.

Since the above service introduces a completely outsourced option for B2B integration, it is reasonable to consider also an alternative approach, where the service provider is offering B2B applications and solutions that are able to perform most of the B2B related functions internally, and provides a global trading environment as an external service. However, as mentioned above, this solution will require a higher degree of competence in the enterprise's IT sector that, in general, is not managed at least in the SMEs. But, the service provider usually participates intensively in the integration process, so that the lack of competence is not a real obstacle, only integration costs will be higher. With this kind of approach the enterprise can decrease the external transaction costs, since the processing of the business messages are executed within the company's own facilities.

- **GXS Enterprise Gateway**

Like other service providers, also GXS provides an automated information exchange for the supply chain with Enterprise Gateway solution, but the main difference is that the Enterprise Gateway solution deploys a single integration platform inside the company and offers the connectivity services as an external service. By deploying the integration platform inside the company it is easier to provide real-time communication along the supply chain when there is no middle-man between the participants. This approach strongly aligns with the integration hub approach that was introduced in the theory part of this thesis. The main distinction is the global trading environment with 40 000 existing customers, which, in part, diminished the limitation related to the original integration hub approach and leverages the competitiveness of this approach when compared to true hub-and-spoke arrangements. Also the commonly associated problems with internally managed systems, such as technical complexity and constant technology change are avoided, since the B2B integration system is constantly updated by the service provider.

In co-operation with WebMethods, which is a business integration software vendor, GXS has developed integration platform that has pre-configured application adapters for connection to back-end applications (i.e. SAP, Oracle, etc), and translation engine that is capable of providing any-to-any transformations. The product suite provides also tool sets for administrating B2B trading partners and optimising business processes that include process automation and monitoring capabilities. Additionally, GXS hosts a trading network called Trading Grid that is comprised of 40 000 customers in 50 countries around the world and, therefore, has an advantage in the scope of the trading environment, when compared to smaller and more regional service providers. GXS also supports the variety of communication protocols and standards (FTP, SFTP, HTTPS, RNIF, etc) to enable and secure the exchange of critical business information.

As an additional observation, the GXS Company has a wide range of different services to both internal and external integration, and it also is able to offer complete outsourcing solutions to B2B integration. With the help of GXS Managed Services solution, the company can outsource all its B2B related functions and utilise the people, processes, and technology offered by the service provider.

The two approaches to B2B integration that was introduced here by Itella and GXS represent the opposite extremities of managed services. Itella's approach was a complete outsourcing option, whereas the GXS's approach utilises the minimal fraction of the managed services, offering only a global trading environment as an external service. The other variations of services place themselves between these two approaches, and commonly the final degree of outsourcing is settled during the initial B2B integration implementation project.

Moreover, the various service providers tend to approach the B2B integration task from different perspectives, depending if the service provider company is originally a software company or a broker company (i.e. traditional EDI intermediary). The previously introduced Itella represents the traditional operator-centric approach to B2B integration. Generally, these kinds of operators do not have their own software development facilities, and so they tend to have less experience, for example, in the internal systems

integration. The tools utilised in B2B integration are generally purchased from companies that are specialised in the development of B2B software. GXS is also originated from a traditional EDI-operator, but due to the collaboration with WebMethods, it has evolved to a more versatile integration service provider that has both the B2B operator services and B2B software development inside the same company.

On the other hand, for example TietoEnator Corporation is traditionally considered as an international software development company, but it has extended its expertise to offer also B2B integration services. This does not necessarily mean that the software-centric companies have developed the applications that are utilised in B2B integration themselves. In most of the cases the core of business integration platforms are obtained from the companies that have more experience in integration software, such as IBM, WebMethods, and only extra functionalities are coded into the product to align the product with their offered B2B services. Since TietoEnator has more experience in the software development area, it is capable of providing a wider range of integration services (internal and external) when compared to, for example, Itella or Anilinker, which are more focused on the external integration issues.

- **TietoEnator's B2B integration services**

Since TietoEnator is indeed a software development company, it has developed comprehensive solutions focusing on specific industries, for example forest industry. In general, these solutions consider both the EAI issues as well as the B2B integration issues. When it comes to only B2B integration, TietoEnator is also capable of providing full scale B2B integration services to the same extent as the other service providers. The system-to-system integration is naturally supported, as well as the other common services related to it, for example, e-invoicing.

When considering TietoEnator as a candidate for providing B2B integration services for UPM-Kymmene Wood, it stands out from the rest of the domestic service providers with the existing partnership with most of the large forest corporations in Finland, and therefore has a range of knowledge in that specific industry sector. Moreover, TietoEnator has existing support for the standards commonly used in forest industry transactions, such as papiNet.

The following table (Table 1) will summarise the properties of the B2B integration service providers based on the studies, interviews and meetings made with the concerned parties. Since many of the operators tend to offer similar properties, this table concentrates on the issues that distinguish one operator from the others.

	Anilinker	GXS	Itella	TietoEnator
Company size	Small	Large	Medium	Medium / Large
Operating region	Finland	Worldwide	Northern Europe	Europe, South Asia, North America
Primary focus on:	Industrial machinery, engineering	Retail/consumer packaged goods, high-tech / manufacturing, automotive, finance/banking	Logistics, plumbing and heating, postal services	Banking & insurance, telecom, forest, energy
Processing technology	NetEDI	Egenera Bladeframe	Illicom TradeXpress	Illicom TradeXpress
EAI support	light	extensive	medium	extensive
B2B support	fair	excellent	good	good
Customers approx.	>1000	>40 000	N/A	>3000
Special features	Concentrated mainly on B2B integration	Trading Grid – extensive trading network, GS1 product coding support	Logistics and postal services	Software knowledge, industry specific customers
Benefits to UPM-Kymmene Wood	Domestic operator, dedicated personnel	International operator with vast technology support and widest trading network	Stable economy, competitive integration facilities, existing partnership	Existing partnership with UPM, complete solutions for forest industry, technology know-how
Facts that may generate costs to UPM-Kymmene Wood	Small operator, unstable economy, not dedicated to forest industry	Foreign operator (language), not dedicated to forest industry	Covers only Northern Europe	Dominant solution provider for forest industry => lack of competition

Table 1: Comparing the properties of different service providers

As the table above demonstrates, the range of operators varies from small dedicated business to large multinational companies. However, both are capable of providing the same functionalities that, in general, are considered to be the ability to deliver business messages (digital or analogue) from any format to any other format regardless of the origin or the destination of the message. The differences can be noticed in the list of customers in terms of industry concentration, and in the amount of alternative integration approaches. Although all operators claim to be industry independent service providers, it is clear that companies of a particular industry sector tend to focus more on a certain operator, which has the existing technology knowledge and customer connections of a given industry. Differences can be also perceived in the size of the trading network. The domestic operators studied here do not host any proprietary trading networks, but, for example, the GXS hosts GEIS network, which is a tariff-based trading environment and other operators need to pay extra fees to deliver messages through these networks.

In the end, the service provider's goal is to convince the company to outsource as much functionalities as possible and also at the most deepest level as possible to form a tight collaboration with the company that will be difficult to replace in future. Since the service provider is also a profit seeking institute, its goal is to gain decent outcomes from the managed services that it offers. So, it is important to choose the partner wisely and decide the degree of integration through a deep analysis of the company's own skills and resources. The following section will cover some important features to look for when comparing the various B2B integration service providers in the markets today.

10 CHECKLIST FOR SELECTING A 3RD-PARTY B2B INTEGRATION SERVICE PROVIDER

The selection of B2B integration solution is nowadays considered to be one of the most important decisions that a company has to make. By choosing the right solution can result in a strategic corporate asset that ensures returns in the years to come, on the contrary, in the case of wrong choice, the integration project might fail miserably [40]. Once the decision to utilise managed services is made, it is essential to compare several service providers to find out which one of them aligns best with the company's own objectives. Since the partnership with that particular service provider will most likely be a long-term collaboration, it is essential to analyse the company's own needs and point out the most important processes or functions and compare those to the provided services. After the choice has been made, swapping the service provider to another will probably be troublesome and expensive.

When comparing the service provider candidates, there are some obvious aspects that probably every company considers automatically, such as cost-effectiveness, deployment speed and company background. However, there are also some other features that are worth considering in the selection process. Like it has been clearly observed during this study, the service provider must have the support for diversity of technologies and standards, and at the same time to be able to offer customised services that preserves the company's independence with respect to their systems and processes. The support for diversity, in particular, means the service provider's capability to offer various connection methods (direct connections, portals, etc.), mediating between multiple security mechanisms, and solving or arranging differing business processes and interaction methods (store-and-forward vs. real-time, atomic exchange vs. long-running transactions) [40]. Wide support for diversity ensures broad customer base and better scalability. Independence, on the other hand, enables companies to stay in control of their own business processes.

Another aspect to examine is the service provider's experience. Since every service provider candidate will probably have several customers and some experience, it is important to explore the customer list to find out service provider's experience in technical areas, industries and processes close to the company. Moreover, the service provider's track record will reveal hints of their customers' satisfaction and loyalty. Asking opinions about the service provider from its existing and former customers may further aid in the decision-making.

The final decision is nearly always based on trust, both on a professional level and from technical point of view. The trust will be built during the search process that is comprised of many different aspects, in which the service provider's public image and previous experiences with your own company serves as a background. Some of the aspects worth considering are listed here:

- estimating the service provider's ability to offer the promised services in a long-term business relationship
- calling for detailed descriptions of the prospective services, and if possible asking for a brief about the operations and technology to ensure the quality of service
- making sure that the infrastructure and processes exists, so that they are not falling behind the marketing
- checking the consistency of the integration platform to find out if it's an integrated entirety or a set of disparate solutions
- considering the security and reliability measures that are offered
- assessing the disaster recovery abilities

Naturally not forgetting the company's own partners, it is fair to make inquiries for them as well to find out their opinion about utilising the managed services of a certain third-party service provider. To conclude this thesis, the next section will recap the most essential observations that was discovered during this thesis.

11 FINAL CONCLUSIONS

One of the most essential observations made during this thesis was to understand the complexity of B2B integration at different integration levels. At the lowest level, data residing in separate organisations can be quite easily exchanged using modern information systems and existing connection methods, but when advancing higher into document or even process levels, the integration task becomes more difficult and sometimes even unmanageable. This is the point where the facilities and expertises of a third-party B2B integration service provider can be used.

Many standardisation organisations are addressing the various difficulties that are related to integration at higher integration levels by publishing frameworks that give guidelines to B2B interactions for companies operating in both industry-specific (vertical) and cross-industry (horizontal) markets. It is a significant movement towards a unified e-business world, where the enterprises are able to co-operate using the same electronic trading language. However, there are still too many standards to choose from, and the various standards are not always compatible with each other. So, in the long run, managing the different versions of a particular standard, and dealing with the other frameworks, which might be utilised by some of the company's trading partners, may also turn out to be difficult to manage. So, even when complying with a certain e-business standard may force the company to utilise the processing services offered by a third-party service provider that will make the required conversions between different e-business standards.

The B2B integration can be implemented also in-house style and nowadays many off-the-shelf B2B integration platforms exist in the markets. However, most of the companies haven't got the resources, facilities, or personnel to perform such a project that incorporates the integration platform into the existing IT infrastructure of an enterprise. Although these kinds of internal B2B integration platforms have shown improvement in the recent years, they have not quite managed to provide the same level of functionalities and connection possibilities that the third-party B2B integration service providers are able to offer. Nevertheless, when implemented properly and comprehensively, the internally managed B2B systems might reach a respectable degree of B2B integration as well, and thus the high transaction costs, which are often associated

with managed services, can be avoided.

When recapping the third-party service provider's role in B2B integration, it can vary from just a small part in, for example, receiving electronic invoices to a comprehensive integration solution covering both EAI and B2Bi. In addition to traditional business message processing and broking, the service providers are also capable of offering various value-added services that support the business message exchange. Commonly perceived value-added services are, among other things, storage capacity and advanced reporting services. When comparing the services of different third-party service providers, most of them offer the same kind of services, so the company has to select the service provider that aligns best with the company's strategy and standards, and on ground of that choose the right partner for this important integration task and long-term collaboration.

Since the costs related to B2B integration are hard to measure precisely, the service providers use it in their favour and argue that it's most beneficial and cost effective to route all external business interactions through the service provider. Before believing this argument blindly, it is reasonable to perform deep analysis of the company's potential to manage the connections internally, and estimate the costs that will be derived from building and maintaining such an environment. Based on this analysis, it is easier to decide whether to utilise the managed services offered by a service provider or implement the B2B connectivity internally.

A common approach to utilise managed services was identified to begin with the hybrid solution, where some of the B2B functions are managed in-house and some are outsourced. In all, the required utilisation degree of managed services, depends on the IT competence, resources, and personnel of the company in question. So, the need for managed services is greater in companies that lack some or all of the previous properties. Also, the business environment, in which the company takes part in, defines the complexity of the whole B2B integration project. More complex environments with intricate value chains advocate the use of third-party B2B integration service providers, whereas small or simple business environments do not necessarily require the use of externally managed services.

When the possibility to utilise a third-party service provider in a wood industry organisation, such as UPM-Kymmene Wood, was examined, the following aspects were discovered. The business environment of a wood industry organisation is clearly concentrated on vertical markets. For this vertical market segment including paper and forest industries, papiNet consortium has provided a specific e-business framework for conducting standardised electronic business messages. Based on these facts, the industry has an existing e-business readiness and fairly homogeneous business environment. Additionally, the size of the UPM-Kymmene organisation indicates that the particular company has a certain amount of e-business knowledge and equipment to implement the B2B connections also internally. Considering these realities, there is no essential need for externally managed B2B services, nevertheless, when the modern trend is to outsource certain expertise that does not directly relate to the core competence of a company, the option to outsource B2B related functions, however, becomes a considerable option also in case of UPM-Kymmene Wood.

If UPM-Kymmene Wood decides to utilise externally managed services, most of the third-party service providers are inherently capable of supporting papiNet-based connectivity. In such cases, the converters between papiNet-based messages and messages of other common standards already exist, so that the implementation project between the service provider and the company does not need to include the programming of these converters all over again, and, therefore, reducing the implementation costs significantly. Also, if the company and its trading partners are all using papiNet-based messages, there is no need for conversions at the service provider's site, and the transaction costs will also be lower, since less processing is needed.

Many forest and paper industry organisation have already adopted managed services as a convenient way of sending and receiving various types of e-business messages. Most of the solutions that have been implemented fall into the category of hybrid solution, meaning that only few have chosen to outsource all of their B2B related functions. The key element to successfully benefit from the utilisation of managed services seems to rely on carefully planned and phased progression towards a convenient outsourcing level of B2B functions that is suitable for the company's strategy and objectives.

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