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TOWARDS MODEL-BASED ASSESSMENT OF BUSINESS-IT ALIGNMENT IN E-SERVICE NETWORKS FROM MULTIPLE PERSPECTIVES

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Abstract

In this paper we align business with IT in a networked setting while introducing innovative e-customs procedures worldwide. We perform the alignment process in a multi-perspective way, guided by concerns of upscale. Scalability is mostly a technical concept and concern. As we show, however, scaling issues are often initiated by business, e.g. by the increase the number of consumers, or by the extension of network of suppliers who use each other core competencies to satisfy a complex, IT intensive consumer need. As a result, it is essential to translate and fit business-driven requirements with system capabilities already during the design phase of such worldwide enrolment of e-customs procedures, otherwise long-term sustainability of the proposed initiative is violated. In addition, understanding financial and technical consequences of upscale for stakeholders is of an importance, too. In this paper we use our aforementioned case study and propose a model-based approach using e^3value and UML modelling techniques to support the alignment process.

Keywords: business-IT alignment, business models, information system architecture, e-services, network of enterprises, case study

1 INTRODUCTION

Commercial services comprise a significant part of the total economic activity. Services can be defined as commercial deeds of a mostly intangible nature (Grönroos, 2000). A specific kind of a service is an e-service. An e-service is just like a normal service, but relies on information technology (IT) for ordering, production and provisioning. e-Services are seldom offered by a single enterprise. Rather, they are provided by networks of enterprises, also called networked value constellations that jointly work on the satisfaction of a customer need. Well-known examples for such networked constellations include Cisco System – actually consisting of a series of well integrated companies –, and the virtual integration of Dell Computers (Tapscott, 2000, Dell, 2002).

All enterprises in a networked value constellation should be able to obtain a net positive cash flow by participating in the e-service constellation; otherwise, the whole constellation may ultimately collapse. Therefore, to design a networked value constellation that remains long-term economically profitable is a daunting task, as many aspects influence sustainability. Consequently, we propose to explore a constellation from multiple perspectives: at least (1) a business value perspective capturing in- and outgoing cash flows with suppliers and customers of e-services, (2) a (cross)-organizational business process perspective to understand significant expenses related to process execution to provision e-services, *and* (3) a perspective of multi-enterprise information systems to find high investments and operational expenses in IT. These perspectives have several cross-cutting *concerns*; one of these is the aforementioned *profitability* concern. We have addressed this profitability concern in e-service networks in (Derzsi et al, 2007) extensively.

In this paper, we consider the *scalability* concern. In brief, scalability relates to the question: "what happens if the offered service scales up from a few users to a few million users". The notion of scalability is multi-perspective, as it incorporates the scale of the business volume (e.g. the number of business transactions), but it also has an information technology (IT) connotation. In case of e-services, business transactions have to be provisioned by information systems, and therefore upscaling the number of business transactions will certainly have its impact on the size and architecture provisioning information systems. The contribution of this paper is therefore a *multi-perspective* and *model*-based notion of scalability of networked value constellations. This not only enables computer-supported reasoning about scalability issues, but provides also an operational way toward the proper alignment of business-scale and IT-scale for the same constellation. Another unique contribution is that we *formalize* the alignment process by means of different modelling techniques. This contrasts to the work of Henderson and Venkatraman (1994), which is usable mostly on the strategic level to explain the necessity of alignment; however, it hardly takes a *constructive* view on aligning business and IT. Our approach takes a more *operational* viewpoint on business-IT alignment and support the design and maintenance of well-aligned businesses *ex-ante* compared to the *ex-post* explanations of the phenomena. In our view, a fundamental problem of the business-IT alignment research is the lack of analytical tools to guide scalability-alignment from multiple perspectives. Despite the availability of several IT-biased modelling techniques (e.g. UML) to understand scale issues for specific software architectures, similar techniques are missing for the business perspective. We show in this paper how a novel modelling technique for the business perspective (e^3*value*) can be combined with IT modelling techniques (UML) to enable a more detailed analysis of the business-IT scalability alignment problem.

The structure of this paper is as follows. In section 2, we present an industry-strength case study on networked e-services for cross-border shipment. Section 3 introduces our model-based approach to facilitate the process of scalability alignment. In order to support our multi-perspective initiative, we employ e^3*value* to describe the business value and UML deployment diagram to describe the information system perspectives. We use the developed models to articulate effects of scale on the alignment process in section 4. Finally, in section 5 we present our conclusions.

2 CASE STUDY: INTRODUCTION OF ELECTRONIC CUSTOMS PROCEDURES DURING CROSS-BORDER SHIPMENT

2.1 The Beer Living Lab

The EU is currently reshaping its customs legislation and practices. The reasons are threefold. First, the threat of terrorism resulted in new control regulations to meet strict security and safety requirements. Second, the increasing excise and VAT fraud in the EU (as for alcohol, it amounts to €1.5 billion yearly, approximately 8% of the total excise duties receipts on alcoholic beverages, and VAT fraud is estimated to be 10% of VAT receipts) calls for the need of reshaping existing control mechanisms. Third, there is an articulated need by EU to reduce administrative burden, and so to keep the EU a competitive economic zone. Efficiency and reducing administrative burden however can easily contradict with increased security, safety and control. To meet all aforementioned requirements, new customs procedures are required (Baida et al, 2007).

The Beer Living Lab (BeerLL) is a pilot of the EU-funded ITAIDE[1] project for redesigning these EU customs procedures in the beer industry, focusing on shipments of excise goods. The BeerLL investigates a specific example for the cross-border trade of excise goods; namely beer shipments of BeerCo. BeerCo is one of the world's leading brewers in terms of sales, volume and profitability, and has a wide international presence through a global network of distributors and breweries. The BeerLL use innovative e-services, such container tracking systems, to meet the above described EU initiatives (see Baida et al. (2007) for more details on the BeerLL). In this paper we explore if the BeerLL pilot concept can be scaled-up to a worldwide setting.

2.2 Current export procedures of excise goods

To motivate why customs practices have to change, we first explain the current export procedure in cross-border trade of excise goods. When beer – an excise good – is sold, the seller needs to pay a special tax called excise. Excise only has to be paid in the country in which the excise good is sold and consumed. If BeerCoNL, a Dutch beer producer, exports beer to a retailer in the UK who also sells the beer to English consumers, the excise has to be paid by the English retailer to Customs UK, and BeerCoNL is exempted from paying excise in the Netherlands. This is only acceptable for the Dutch Customs and Tax Administration (DTCA), if BeerCoNL can prove that the goods were indeed shipped outside the Netherlands.

Using current EU procedures, for every shipment BeerCoNL has to fill in numerous paper documents and to submit electronic messages, containing similar commercial data, to numerous governmental information systems for export, VAT, excise, national statistics and (as an example, BeerCoNL uses 260,000 paper documents yearly for the excise procedure only). This introduces large costs and creates redundancy among governmental information systems. The core document for shipments of excise goods in the EU is the paper-based Administrative Accompanying Document (AAD). Two roles are performed by the AAD: 1) evidence of export, and, 2) identification of the cargo in case of a physical cargo inspection en route. During trade, the AAD accompanies the beer from the Netherlands to the UK and is stamped by Customs in the UK, as a proof that the goods have arrived to their final destination. Customs UK then forwards the stamped AAD back to BeerCoNL. DTCA periodically checks BeerCoNL's excise declarations. For the beer that BeerCoNL sold outside the Netherlands, excise exemption is given based on excise declarations; this will be verified afterwards by comparing these declarations with stamped AADs. However, transferring the paper-based AADs can take months, so the verification is done several months later. In practice, DTCA relies on BeerCoNL to

[1] ITAIDE is an integrated research project (Nr.027829) funded by the 6th Framework IST Programme of the European Commission (see www.itaide.org).

verify AADs. BeerCoNL only submits stamped AADs upon request of DTCA which checks AADs only randomly because controlling each individual AADs is labour intensive.

2.3 Services for Authorized Economic Operators

To overcome these administrative burdens, the EU aims to implement Authorized Economic Operators (AEO) to ensure the safety and security of international trade supply chains. Shipper companies, who prove their full control over their own supply chain, will be awarded an AEO status (DG/TAXUD, 2006). As a result, certified AEOs will enjoy tangible benefits such as fast customs clearance and simplified procedures. In accordance with this vision, DTCA wishes to rely on BeerCoNL's own control of its supply chain, so that BeerCoNL can be seen as a low risk shipper with respect to, among others, excise fraud. As a result, BeerCoNL enjoys simplified procedures, and DTCA can better focus its resources on high-risk shipments.

The introduction of the AEO initiative in practice calls for the support of innovative information technology. The first pillar of AEO is the Tamper-Resistant Embedded Controller (TREC). TREC is a container-mounted device which has a mobile receiver tracking the container's precise location; sensors monitoring environmental parameters in the container (e.g., temperature, humidity), sensors monitoring physical state of the container (e.g., door opening, tampering attempts) and communication modules for exchanging data (e.g., via handheld devices, via satellite, GSM/GPRS or short range wireless). By monitoring a container's position coordinates, an automatic message can be triggered by a TREC device when the container deviates from its predefined route, is being opened by an unauthorized party, or when other predefined events occur. By monitoring and reporting the container's location and combining this information with the route description of shipments provided by carriers, TREC devices could replace the AAD's functionality to provide export evidence. In practice, instead of UK Customs signing off the AAD of a container with beer that has arrived in the UK, signals received from TREC device could replace the signed AAD as proof of export for the Dutch Customs. The information collected by TREC devices is of an interest for both commercial and governmental parties, and opens up possibilities for commercialization of the data provided by TREC. To receive AEO status, trading parties are obliged as well to provide supply chain data besides the shipment data. The second pillar of AEO is the underlying information system architecture that embeds databases of trading parties and includes different IT services that enable data sharing distribution along the supply chain partners and governmental institutes. In a small scale setting (e.g. only national), exchange of information can still be implemented by using proprietary information technology. To enable AEO on a larger (i.e. worldwide) scale, however, different mechanisms are needed.

2.4 Towards a worldwide solution

The creation of a standardized mechanism for data distribution is a prerequisite for a solution which s acceptable worldwide. EPCglobal is a worldwide accepted organization that develops product description standards[2] to facilitate unambiguous product identification. Furthermore, EPCGlobal defines Electronic Product Code Information Services (EPCIS) [3], which are non-proprietary standards to enable data sharing mechanisms between different databases of different trading partners. By locally implementing EPCIS, parties facilitate a service-oriented architecture that includes interfaces for data query and access, data lookup services and data repositories built on these open standards. The service-oriented architecture actually embeds a distributed database of different trading, shipment and governmental parties containing all relevant information about the export.

[2] This product description is based on the product barcode. EPCglobal is also the organization that introduced the barcode worldwide.

[3] For the description of EPCIS standards see http://www.epcglobalinc.org/

In the new procedure, if a trader prepares a shipment of a good, it publishes all relevant data in its own local EPCIS database that is accessible through the Internet for authorized supply chain partners. Information over the state and location of shipment is provided by the TREC device, and is stored again in their EPCIS databases for distribution. For identification, each TREC device assigns a Unique Consignment Reference number (UCR) to containers, which can be used to retrieve relevant commercial data from EPCIS for different procedures, including excise, VAT, statistics and more. Due to the guaranteed data availability, a trader can be audited whenever required; and thus physical control of cargo can be replaced by audit-based control of trader's administration. Whenever Customs seeks for data regarding a shipment (e.g. actual position of shipment, purchase order, content of container) it can use EPC standard-based service-oriented architecture to search for this data through the Web. Each participant in data sharing possesses digital certificates for identification. Authorized data access is essential between parties due to data confidentiality, which is provided by EPCGlobal. This leads us to a new situation where a trader is not required to pro-actively submit declarations to Customs. The new situation is sketched in Figure 1.

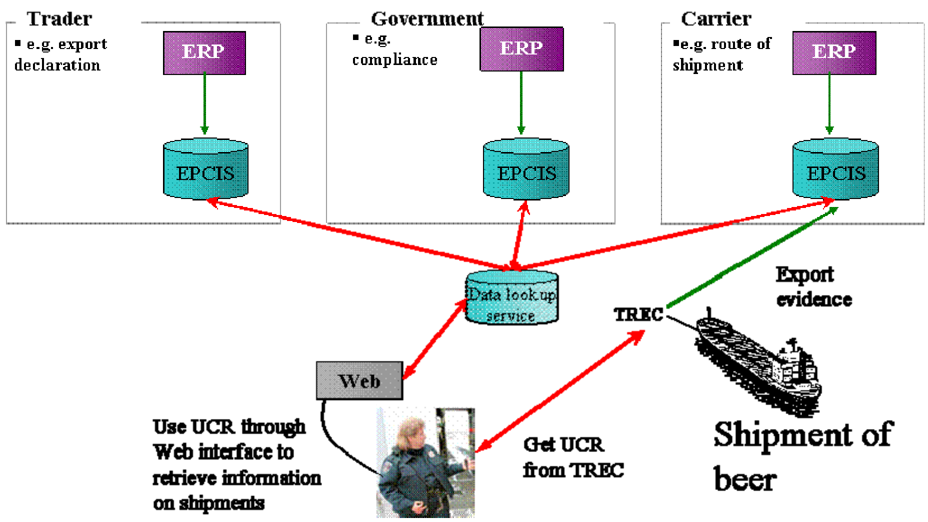

Figure 1. TREC devices and EPCIS databases used to share information and guarantee security and control (Source: Baida et al.)

The BeerLL *pilot* explores an IT-intensive redesign of customs procedures for a specific setting in the Netherlands, such that BeerCoNL can obtain an AEO status once it demonstrates that it is in control of its supply chain, and provides accessibility to data regarding cross-border trade. In case of a successful pilot, the redesigned customs procedures should be scaled-up to a world-wide setting. To assess the effects of upscale we use different modelling techniques that we introduce in the next section.

3 A MODEL-BASED APPROACH TO ADDRESS SCALABILITY CONCERNS

To address scalability issues for the BeerLL case from multiple perspectives, we employ two modelling techniques to represent different characteristics of the case. First, the *e^3value* modelling technique (see Gordijn and Akkermans (2003) for an extensive discussion) is used. An *e^3value* model shows the stakeholders involved, and value transfers they do with each other to exchange objects of economic value. Originally, *e^3value* has been developed to analyze long-term economic sustainability for all actors involved. However, we will show that the modelling constructs of *e^3value* are also of use to articulate scalability issues from a business point of view. Specifically, we consider the *number of stakeholders* in terms of suppliers and consumers of e-services and the *number of transfers* of economically valuable objects (being e-services) among these stakeholders as scale properties of businesses. The former addresses the number of consumer needs that suppliers need to satisfy, which predicts the number of transfers embedding the requested IT services.

Second, at the other side of the spectrum, we employ UML modelling technique and we develop a deployment diagram (see e.g. Fowler, 2003). Such a diagram describes the underlying information system architecture in terms of hard- and software components, and communication means between these components. UML diagram shows IT-specific scale properties. For instance, a specific component may accommodate only a maximum number of value transfers, or supports certain value activities as stated by the *e³value* model. In our earlier work, we have used UML deployment diagrams to reason about economic sustainability of a networked value constellation by articulating investments and expenses in IT (Derzsi et al., 2007). Moreover, the same work presents a way to relate *e³value* and deployment diagrams via their respective meta models in order to show how these financials influence business value of a constellation. In the following sections, we therefore first develop an *e³value* and deployment diagram for BeerLL case. In section 4, we analyze the BeerLL for scalability concerns, using these diagrams.

3.1 An e³value model for the BeerLL

To articulate effects of worldwide scale from its business value perspective, we constructed different *e³value* models (Gordijn and Akkermans, 2001). First, we present a value model in Figure 2 that shows value transfers of a locally implemented BeerLL pilot in order to facilitate the AEO initiative.

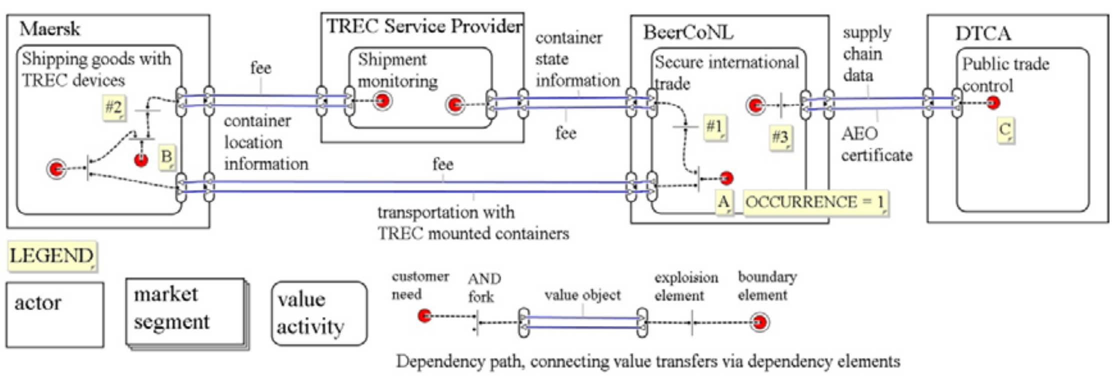

Figure 2. An e³value model of the BeerLL case

Figure 2 depicts the actors and business transfers of e-customs procedures on daily basis. Dependency paths show, how a given consumer need (depicted by a bullet's eye) will be satisfied by exchanging objects of economical value. BeerCoNL aims to receive AEO status for his cross-border shipment. To do so, he needs to fulfil different AEO requirements. The consumer need 'A' represents the need for secured shipment, which occurs once for the modelled time frame. To fulfil the need, the consumption of two different services (shown by the AND-fork in the model) is required. First, BeerCoNL consumes transportation services from Maersk with TREC-mounted containers and pays certain fee in return. By using TREC-mounted containers for transport, BeerCoNL enables Maersk to provide the export evidence of his shipments to DTCA based on (1) the container location information of TREC devices, and on (2) route description of the shipment. To do so, Maersk needs to obtain container location information of the shipment (consumer need 'B') from TREC service provider for a fee in return. Second, BeerCoNL buys container state information (e.g. location, temperature of the cargo, alerting in case of route deviation) of its shipment from TREC service provider, and pays a fee in return. Value transfers with respect to container state and location data represent one invocation of a service. This data, however, requested multiple times per day, e.g. due to the need of continuous monitoring of container movement or due to regular inspections of container temperature. This implies that these value transfers occur not once but more times regarding a specific container during the modelled one-day time frame. Explosion elements (fork #1, #2) represent such multiplicity of occurrences. To receive AEO status, BeerCoNL provides supply chain data to fulfil the need of continuous monitoring and control of data (consumer need 'C'). DTCA gives an AEO certificate in return. As explosion element (fork #3) shows, BeerCoNL provides information multiple times per day.

3.2 A UML deployment diagram for the BeerLL case

The e^3*value* model describes *what* is of value created and transferred between participating stakeholders in order to maintain worldwide scale of the e-customs procedures. Moreover, the model shows how many value transfers per given timeframe occur. The number of value transfers is an important metric to understand the scale of the case at hand. In the BeerLL case, these value transfers are enabled by communicating, multi-enterprise information systems. These information systems consist of software components, which are deployed on computing nodes, interconnected by communication means. Obviously, the information systems should be designed such that it responses positively to the changing characteristics of the business setting (e.g. increase of stakeholders). This is precisely what we mean by an operational perspective on business-IT alignment.

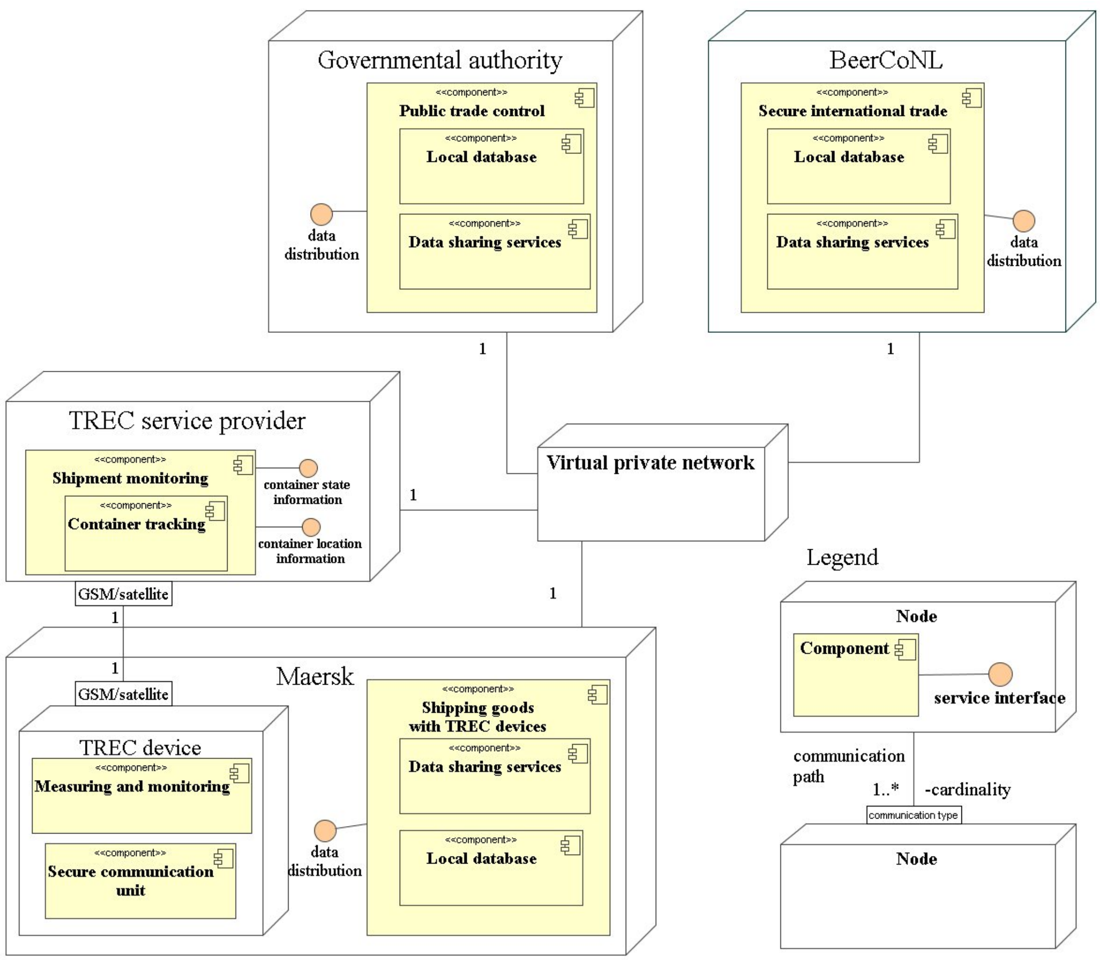

Figure 3. An architectural solution for e-customs procedures to operate in a local setting

Therefore, we have first to understand the information systems in terms of software components and they way they are employed, before we reason about scalability issues. To this end, Figure 3 represents a UML deployment diagram, which describes the software and hardware components of the information system architecture that was designed to accommodate a local solution for e-customs procedures. Nodes (BeerCoNL, DTCA, TREC service provider and Maersk) are named after the actors participating in the prototyping solution, thus correspond to the actors of the *e³value* model in Figure 2. These nodes are connected via a virtual private network, initiating that the data distribution among these parties in this specific setting happens via secured channels.

Figure 3 shows that a TREC service provider hosts container tracking services to maintain the connection with TREC devices. It happens via a sophisticated backend communication application for receiving and uploading data. The connection channel between the TREC devices and the backend is maintained by either GSM or satellite. Data is exchanged using PKI-based security mechanisms. Such solution provides the ability to establish connection independent of location. TREC devices, as earlier explained, embed intelligent metering components to continuously measure the state of the container and detect its location. If any deviation occurs, TREC sends notification to backend via its communication unit. These devices are assigned to the Maersk node indicating their ownership. This further implies that Maersk has additional financial consequences to take into account.

To enable data distribution, BeerCoNL, DTCA and Maersk need to maintain different e-services, which are displayed in the UML deployment diagram as service components. These service components are embedded in *complex components*, which correspond to value activities (see in Figure 2) they facilitate. BeerCoNL, DTCA and Maersk nodes host similar service components, namely (a) ‘local database’ component that stores and provides data of interest and (b) ‘data sharing services’ to maintain the distribution, i.e. the data query and transfer of data. To this end, exchange of information is implemented by using proprietary information technology of stakeholders.

4 SCALABILITY CONCERNS

After exploring the effects of the designed e-customs procedures in a local, pilot, setting from the business value and information system perspectives, the question arises: how to scale up a pilot that was built only for the Netherlands to a solution that works worldwide, and what additional consequences the scale has for the stakeholders involved. The introduction of a worldwide solution results in different concerns that influence the proper alignment of business and IT in the changed business configuration. In the following we elaborate on different concerns and we show how the effects of scale can be reflected using modelling techniques.

4.1 Increase of number of stakeholders due to worldwide enrolment of e-customs procedures

The value model in Figure 4 displays the *daily* value transfers between stakeholders as the e-customs procedures are enrolled *worldwide*. Modifications in Figure 4 compared to Figure 2 represents *how* the business setting has been changed on a daily basis due to worldwide scale. First, the value model displays traders, carriers and governmental authorities as *market segments*, meaning that as a result of upscale there can be more stakeholders involved in e-customs procedures. BeerCoNL, Maersk and DTCA are modelled as instances of different market segments. Scale of stakeholders is then expressed by the *cardinalities* of these segments, i.e. the number of traders, carriers and governmental authorities, which in turn influence the number of value transfers between stakeholders. Second, a new commercial service, namely the *identity management service* emerges due to the appearing need for secure and trusted data sharing. We elaborate on this effect in details in Section 4.3.

In Derzsi et al. (2007) we have shown how concepts of *e³value* can be related to concepts of UML in order to reason over certain feasibility issues. Attributes of *e³value* modelling constructs such as number of value transfers or number of stakeholders influence the design of the underlying architecture. As an example, if the number of service invocations exceeds a certain threshold (software and hardware components can handle only a maximum number of invocations), a different technological solution, in terms of an alternative deployment diagram, has to be found. Additionally, if changing business requirements call for additional IT services, their impact on the underlying information system architecture has to be visualized, too. It is precisely these kind of scalability concerns that we want to analyze in a model based way. To do so, *e³value* allows to model different business settings by modifying different characteristics of the modelling constructs. Cardinalities of explosion elements and market segments allow to express the number of value transactions that occur during the modelled time frame, which estimate also the expected number of service invocations that the underlying information system has to handle. We give a small example with fictitious numbers to demonstrate the effects of upscale of value transfers. The trader market segment integrates 100 traders. As the cardinality of the explosion element shows, a trader requests data over his shipment 10 times per day, resulting in 1000 data requests of traders that the TREC service provider needs to handle.

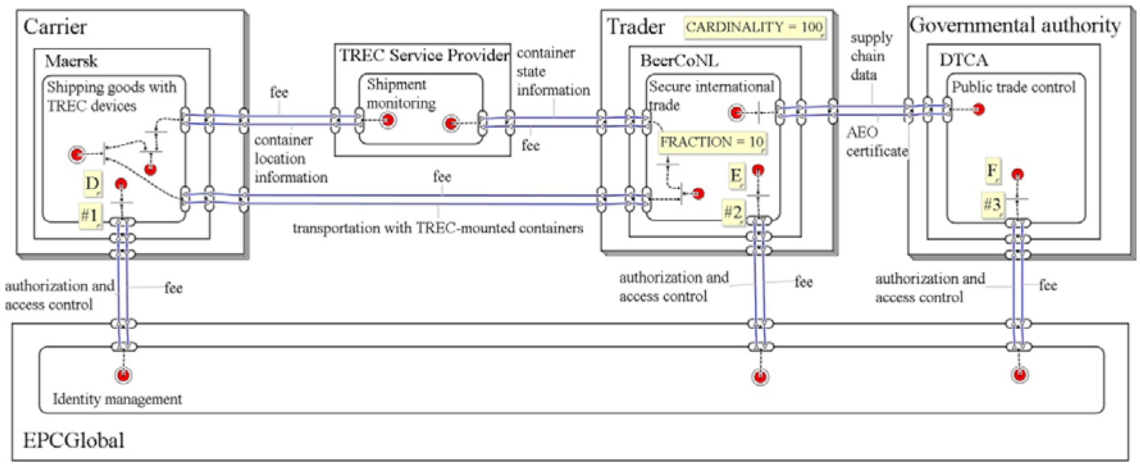

Figure 4. *An e^3value model as a result of upscale, emphasizing the daily value transfers of e-customs procedures*

4.2 Role of worldwide accepted standards for data description and data sharing worldwide

To enrol e-customs procedures, standardized protocols, which are available and accepted worldwide, are used for product description. Without standardization, it would become difficult (and costly!) to trace back a specific item throughout the whole supply chain. As explained in Section 2.4, EPCGlobal provides product description standards to facilitate identification of products for all actors in the supply chain.

As described in Section 2.4, besides product description, data sharing mechanisms between different stakeholders are also built on standards. EPCIS defines non-proprietary protocols (e.g. interfaces for data exchange) that are used to implement a service-oriented architecture to support data sharing. In case of cross-border trade, various Customs offices want to assess and exchange commercial information of companies whose supply chain is crossing various countries, and embed different enterprises (e.g. logistics). This requirement implies that EPCIS-based SOA architecture has to be implemented by each stakeholder who is interested in information sharing. In other words, stakeholders have to be compatible with the EPCIS standards, resulting in a different architectural landscape. Figure 6 depicts a proposed EPCIS/SOA solution. Compared to the locally implemented solution in Figure 4, the effects of worldwide scale on underlying information system architecture can be captured as follows. Stakeholders involved in data sharing host services built on open standards (EPCIS for data sharing) to support data distribution. In addition, data is no longer stored in local repositories; instead, to facilitate interoperability between different databases, all relevant information is stored in EPCIS databases using product description standards. Due to worldwide scale, data distribution happens via open communication channels, as the TCP/IP network node also indicates. As a consequence, employment of *security management* services to encode/decode confidential information is a must. In our analysis we only discuss the security aspects of EPCIS-driven data sharing as also motivated by Figure 6. We assume that TREC service provision embeds proper security measures. We further elaborate on the business effects of security in the next subsection.

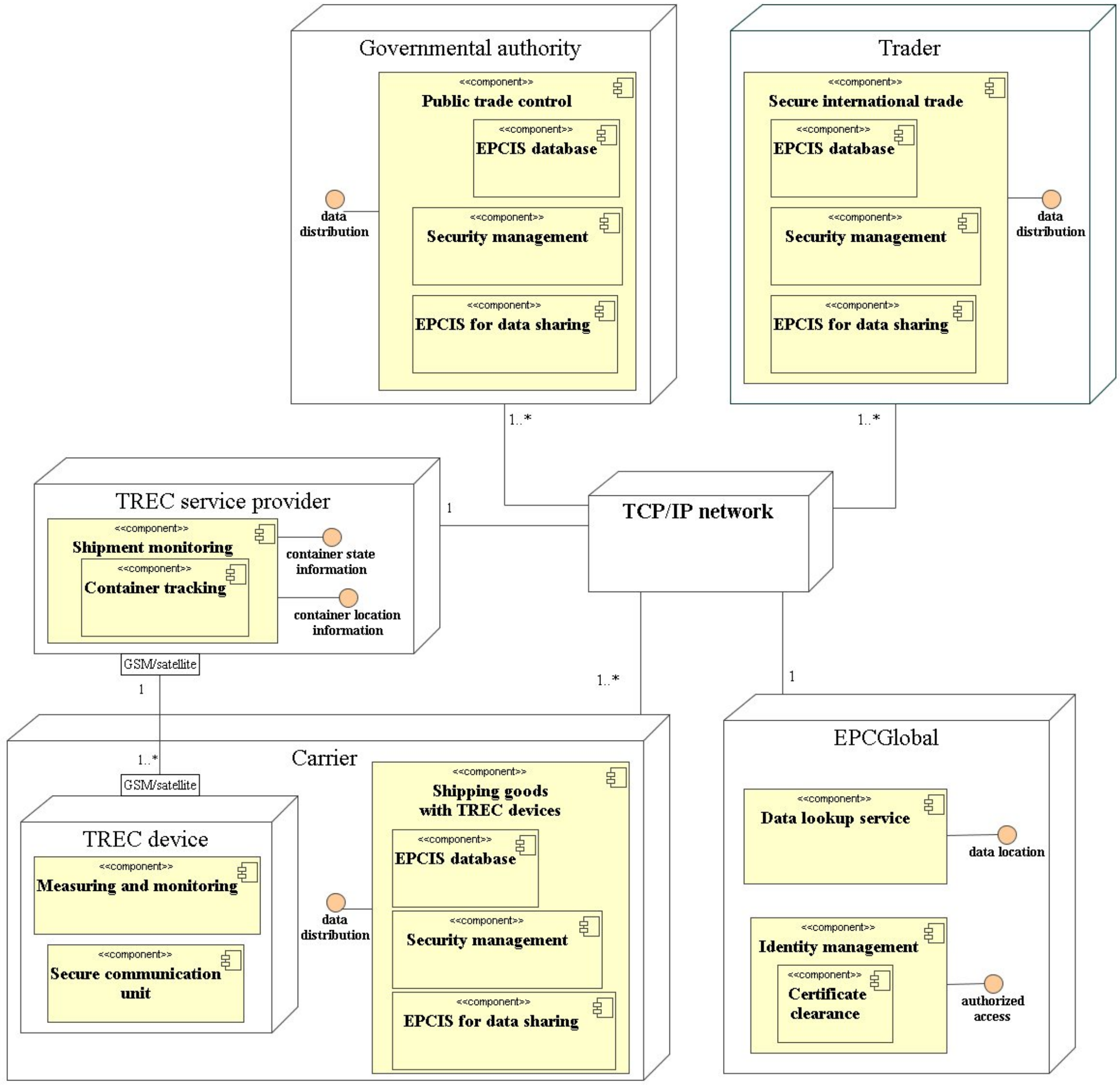

Figure 6. An architectural solution for e-customs procedures to operate on worldwide scale

The introduced service-oriented architecture has one central point to facilitate data distribution. This centralized point is maintained by EPCGlobal, who maintains *data lookup* services to enable locating any required data. As a result, the UML deployment diagram in Figure 6 includes EPCGlobal node embedding this service component. This centralized feature of the architecture gives also the possibility to provide *identity management* services and to ensure authorized access of data. To enable this service, identity management service needs to resolve certificate clearance and interoperability between different security standards. Such system requirement has impact on the business value of the upscaled solution, which we show in the next subsection.

4.3 Role of security standards to enable trusted and secure data sharing worldwide

As emphasized earlier, worldwide solution calls for trusted and secure data sharing mechanisms since confidential data is distributed via open channels. In a small scale setting, exchange of information can be implemented by using e.g. virtual private networks (see Figure 3). Through open networks, only digital certificates guarantee the secure and authorized data transfer and access. Companies that issue the digital certificates, the so-called Certification Authorities (CAs), typically divide the globe in zones (see Verisign as one of the largest CAs). There is not one single CA that has world-wide coverage. In addition, online e-government services typically use in most countries their own CAs. Such a variety of CAs is not due to technical limitations, but motivated purely by socio-economic issues. Hence, exchange and clearing of certificates between the various CAs has to be solved in order to enable the authorized and secure data transfer worldwide and to achieve a scalable solution. Compared to a local solution, the protection of confidential data is thus no longer a purely technical issue; it modifies as well the characteristics of the business setting for all stakeholders involved.

First, to manage security, all stakeholders (both governmental (e.g. DTCA) and commercial (e.g. Maersk)) need to employ digital certificates for data distribution, and they need to renew their subscription on an annual basis. The value model in Figure 5 shows these additional value transfers. It also depicts value transfers related to the annual subscription fees to maintain product description standards, as we discussed in the previous subsection. Only to decrease modelling complexity, we have chosen to depict the effects of upscaling on an annual basis in a different model; nevertheless both value models (Figure 4 and 5) refer to the same, upscaled BeerLL case.

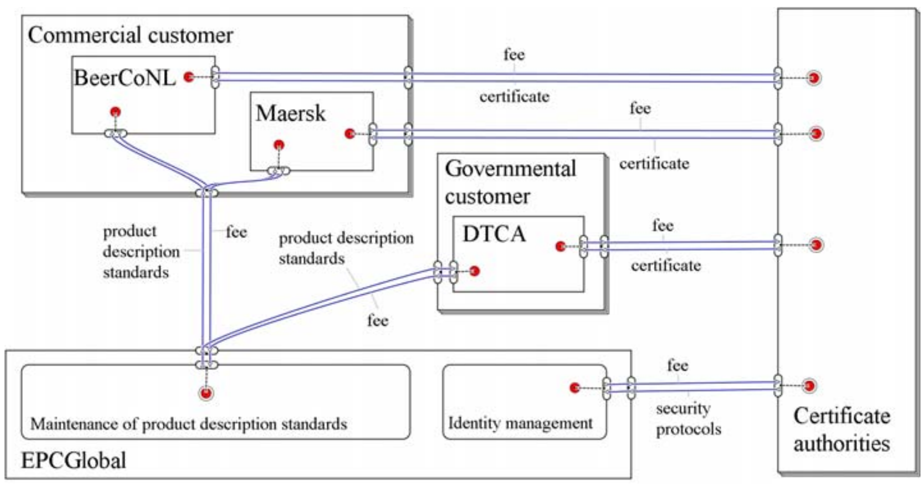

Figure 5. An e^3value model as a result of upscale, emphasizing the yearly value transfers of e-customs procedures

Second, a new commercial service emerges to satisfy the need for secure and authorized data sharing. As explained earlier, the centralized feature of the architecture enables EPCGlobal to provide identity management services by authorizing and controlling any request for data sharing. Such service is of a commercial interest for parties who pay a fee in return. A possible scenario for compensation is based on the number of service invocations per stakeholder, as depicted in Figure 4. It includes value transfers between EPCGlobal and stakeholders of data sharing to satisfy their customer need (bullet's eyes D, E and F). Since data sharing might occur more frequently per day, explosion elements (fork #1, #2, #3) are used again to express such multiplicity. In addition, EPCGlobal needs to consume as well different security standards that exist worldwide to resolve interoperability and clearance between different certificates for the daily operation of its service. This value transfer is shown in Figure 5.

5 CONCLUSION AND FUTURE RESEARCH

The bottleneck of aligning business and IT is often caused by the mismatch between business requirements and technology-given capabilities. While enrolling a local solution to a worldwide scale, both business and information system requirements should be accommodated as a consequence of proper alignment. As a result of upscale, however, different factors emerge that influence the alignment process between business and IT. As demonstrated by the case study, standardized mechanisms and a service-oriented architecture are employed for data sharing to accommodate the initiatives of business. Furthermore, due to worldwide enrolment, commercial services emerge to ensure the secure and authorized data sharing among different parties.

In this paper, we have introduced the first steps of a model-based approach to explore how different factors can emerge due to upscale that violate the alignment process of business and IT in a network of enterprises. Our approach is built on different modelling tools to describe both business value and information system perspectives, and to keep track on the changes of business characteristics and of the underlying information system architecture as a result of upscale. Based on the follow-up interviews, our analysis helped stakeholders to better understand the financial and technical effects of upscale they need to accommodate.

Analytical tools are mostly employed to address technical concerns of alignment. We extended our analysis toward the business value perspective to capture and to relate effects of alignment from multiple perspectives. Hence, the approach we propose enables to model and to analyze business-IT alignment issues at a more detailed, operational level than is typically done in the literature. Our model-based analysis is the first step to gain a detailed insight in the process of business-IT alignment. In the future, research will focus on the conceptualization of the relation between business and IT. Investigations are narrowed down to develop guidelines that help to make both business and architectural design decisions, which are then expressed using the integrated models we have proposed.

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