

A Model-based Approach to Aid the Development of e-Government Projects in Real-life Setting Focusing on Stakeholder Value

Zsófia Kräussl

VU University Amsterdam, Department of Information Systems and Logistics
De Boelelaan 1105
1081 HV Amsterdam
zderzsi@feweb.vu.nl

Yao-Hua Tan

VU University Amsterdam, Department of Information Systems and Logistics
De Boelelaan 1105
1081 HV Amsterdam
ytan@feweb.vu.nl

Jaap Gordijn

VU University Amsterdam, Business Informatics Group
De Boelelaan 1081a
1081 HV Amsterdam
gordijn@cs.vu.nl

Abstract

Recently, there has been put a lot of effort into modernizing the public sector using advanced information technology. The resulting e-government initiatives offer numerous benefits for stakeholders from both private and public sectors, and require solid IT support for operation. The same phenomenon holds for e-customs that we analyze in this paper. In real-life setting different IT-driven concerns emerge that influence the foreseen stakeholder benefits and, as a result, might violate the success of e-customs. Therefore, it is essential to explore and balance the effects of such concerns already during the development phase while constantly considering stakeholder value. We propose a constructive, model-based approach to aid such investigations.

procedures and documents can be supported by information technology, which in turn can be seen as a series of orchestrated e-services themselves, relying heavily on the underlying information technology that realizes such e-services.

In contrast to the piloting, pre-designed environment, in a real-life setting the proposed e-customs procedures operate in a dynamically forming, emerging business network, causing different concerns that have an impact on its long-term sustainability and on its foreseen stakeholder value. First, the *execution* of e-customs requires a joint collaboration of stakeholders from the private and public sector, with different incentives to participate in the network (e.g. reduction of administrative burden and costs for exporters, profit and competitive advantage for e-service providers, transparency of data for governmental authorities). To preserve stakeholder value in such an emerging setting, these incentives should be well-aligned, i.e. there should be a coherent understanding of expected benefits of different stakeholders [12]. Second, the *realization* of e-customs procedures relies heavily on IT. The consumption of different e-services and often, the implementation of an alternative IT architecture are needed, and, as a consequence, it comes at a certain cost. The challenge

1. Introduction

In this paper we consider the introduction of a novel IT-intensive redesign of customs procedures in a real-life setting based on its successful piloting. Customs require complex procedures and associated documents. As the piloting concluded, handling such

is to find a balanced solution between the foreseen value of the proposed e-customs initiatives and the underlying IT architecture that does not violate the incentives to join the network. Third, as the introduction of e-customs procedures calls for the IT-intensive *redesign* of the traditional customs procedures among the whole supply chain, it is essential to find an interoperable solution that coops with the diversity among the existing ERP infrastructure of stakeholders and supports the data sharing along the supply chain. In addition, the proper balancing of stakeholder value and the IT architecture is essential not only per each participating organization, but also, with respect to the network of stakeholders of the supply chain [2].

To reason over the real-life potentials of e-government projects, they should be considered from *at least* two perspectives: (1) a business value perspective, and (2) an information technology perspective. The business value perspective captures and aligns foreseen benefits that different stakeholders expect by employing the proposed e-customs initiatives, and articulates whether there are any violating conflicts. The information technology perspective captures whether there exists an economically and technically feasible solution that realizes the proposed e-customs procedures.

As we argue, introducing e-customs worldwide results in different business and IT-driven concerns that might remain hidden in piloted setting, and have impact on stakeholder value and, as a consequence, might violate the success of e-customs procedures. Thus, it is essential to explore and balance these concerns already during its development phase. We propose a model-based approach using e³value [7] and UML [13] modeling techniques to explore and align such concerns from both (business value and IT) perspectives so that cross-perspective concerns of stakeholder value can be consistently considered.

In our view, one of the fundamental problems during the development phase of complex, e-government initiatives is the lack of analytical tools that supports the long-term maintenance of stakeholder value from multiple viewpoints (i.e. from both public and private sector) and perspectives (i.e. business and IT). The contribution of this paper is that we develop a constructive, value-based approach to aid the realization of e-customs initiatives in real-life setting. As we show, such a value-based approach is useful especially in case of a dynamic, emerging business setting, as e-customs initiatives attract stakeholders with different IT infrastructure, adding yet another complexity to the enrollment process.

The remaining part of this paper is structured as follows. In the next section we describe the

fundamentals of our model-based approach. Section 3 introduces our case study, and elaborates on different concerns of a successful enrollment of e-customs initiatives that emerge in a real-life setting. In section 4 we introduce our model-based approach to investigate the impact of emerging concerns on stakeholder value. In section 5 we conclude and present our future research initiatives.

2. Fundamentals of the model-based approach to aid the development of e-government projects

In order to explore different impacts that influence foreseen benefits from multiple viewpoints and perspectives, we are seeking for a solution that (1) has a sound conceptual notation to represent and to analyze dynamics of value creation and realization in constellations, (2) allows us to address stakeholder value taking different perspectives and viewpoints into account, (3) has the capability to quantify different impacts on value, and (4) remains on a low-level of modeling complexity and is easy-to-use.

To satisfy these requirements, we introduce a joint modeling approach using e³value [7] for the business value perspective and UML [13] for the IT perspective that we use to enable a more detailed analysis of stakeholder value. Modeling tools relate business value and IT perspectives, such that cross-perspective concerns on stakeholder value can be consistently considered. Our approach aims to support finding a balanced solution to resolve possible conflicts on stakeholder value that emerge in a real-life implementation of IT-intensive services, from multiple perspectives and viewpoints.

The e³value modeling tool¹ and the underlying methodology proved to be suitable to address and analyze value in e-business networks (see [3], [8], [9], and [11]). The methodology allows articulating actors of e-business network creating and exchanging objects (e.g. services, money) of value. The e³value tool built on these fundamentals allows visually representing business networks, where different stakeholders perform value activities and engage in business transactions exchanging objects of value. Originally, the e³value methodology has been developed to analyze long-term economic sustainability for all actors involved. Investment costs and other valuation functions, expressed in monetary terms, can be assigned to value activities and transactions, allowing a quantitative assessment of value performance of a

¹ The e³value tool can be downloaded for free from <http://www.e3value.com>

certain business configuration. Based on the valuation functions profitability sheets of stakeholders can be generated that provide a net cash flow analysis of the financial value impact. However, we will show that the modeling constructs of e³value are also of use to formalize the value proposition that stakeholders expect from e-customs initiatives, and help to explore concerns that might violate its realization. In addition, modeling constructs can be used to simulate different value propositions under different network characteristics, which is an especially useful feature in an emerging business setting where different incentives exist to enroll e-customs initiatives.

The UML modeling technique (see e.g. [6], [13]) is used to represent the underlying information system of the value constellation. We intend to use UML diagrams to formalize IT-specific concerns on stakeholder value. For instance, UML deployment diagrams describe the system architecture in terms of hard- and software components, and communication means between these components. As shown in [3], they are also means to articulate potential investments and expenses as a result of IT design. 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.

3. Case study: Design of electronic customs procedures for cross-border trade

3.1. The Beer Living Lab

The EU is currently reshaping its customs legislation and practices. One of the underlying reasons is that 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. However, there is an articulated need by the EU to reduce administrative burden, and so to keep the EU a competitive economic zone. The Beer Living Lab (BeerLL) is a pilot of the EU-funded ITAIDE² project for redesigning these EU customs procedures in the beer industry using advanced information technology, focusing on the export of beer.

When beer is exported outside the EU, no excise has to be paid by the brewery. However, the brewery

has to prove to the national Tax office that the beer left indeed the EU. The current customs procedure to prove that the beer left the EU is paper-based; i.e. numerous paper documents are needed to facilitate customs procedures (for a more detailed description of the current customs procedures with respect to excise goods see [1]). In the BeerLL pilot it is shown how to replace this paper-based procedure by an electronic procedure, where the proof of export is done by electronic means using innovative e-services. The BeerLL pilot proved to be successful and provided tangible benefits for the participating stakeholders.

3.2. IT pillars of the proposed customs redesign

To resolve the contradiction between the reduction of administrative burden and increased security, safety and control requirements, new, innovative e-customs procedures are designed that intensively rely on information technology. To prevent excise fraud, electronic customs procedures (1) monitor and secure cross-border shipment, (2) provide accessibility to information about shipment and supply chain for audit and control purposes, and (3) provide an electronic proof of export.

In the BeerLL pilot we explored a possible IT solution for the required customs procedures. The solution relies on two IT-intensive pillars, (1) the Tamper-Resistant Embedded Controller (TREC) and (2) an advanced service-oriented architecture that facilitates data sharing between the brewery and the Tax&Customs office.

The TREC is a container-mounted device which tracks the container's precise location, and monitors environmental parameters (e.g., temperature) and physical state (e.g., door opening) of containers. The TREC is able to store a pre-defined business logic (e.g. the route of containers), and its communication module sends an automatic message if any deviation occurs (e.g. change in route). IT-services leveraging the TREC technology facilitate e-customs procedures by securing, monitoring and reporting cross-border movements of containers, and are of commercial interests. To distribute relevant shipment and supply chain data, the second pillar of the proposed solution is the underlying, service-oriented information system architecture. It embeds databases of breweries and Tax&Customs offices, and includes different IT services that enable data sharing.

² ITAIDE is an integrated research project (Nr.027829) funded by the 6th Framework IST Programme of the European Commission (see www.itaide.org).

3.3. Toward the real-life employment of e-customs

The basis of collaboration among the public and private sector is the expected benefits of the proposed e-customs initiatives, which was successfully preserved and maintained during the pilot (see [1]). However, compared to the pilot setting, the constellation that facilitates e-customs initiatives worldwide would have different business and IT characteristics, which need to be considered and aligned in order to preserve the value performance of stakeholders. In the followings we restrict ourselves to two major, IT-driven concerns that we use to introduce our model-based approach. These concerns and their impact on stakeholder value are illustrated by a cause-and-effect diagram [10] (see Figure 1).

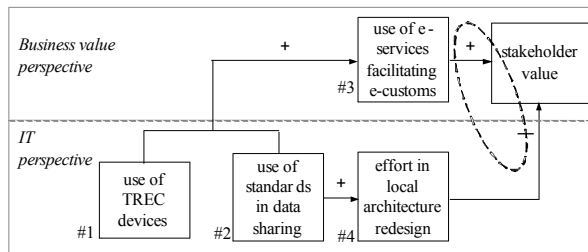


Figure 1. Supporting and violating effects of standard-conform architecture redesign, and the resulting conflict on value performance of traders and governmental authorities

The root causes emerge from the two IT pillars of the proposed solution for customs procedure redesign. First, all containers that are used for export are equipped with TREC devices in order to trace a specific shipping item (see #1 in Figure 1). Second, data sharing on a larger, i.e. worldwide scale requires standardized mechanisms for data description and data sharing (see #2). The standardization body, EPCglobal, develops proprietary product description standards³ to facilitate unambiguous product identification. EPCglobal also defines Electronic Product Code Information Services (EPCIS), which are non-proprietary standards, and describe data sharing mechanisms between different databases of different trading partners. These standards include interfaces for data query and access, and specification of data structures to build up data repositories.

EPCIS thus defines a service-oriented architecture, which actually embeds a distributed data repository of different trading, shipment and governmental parties,

and is built on standards to enable a unified data management procedure. Local data repositories contain all relevant information that is needed during e-customs procedures. As a result of standardized mechanisms, EPCIS services that are responsible for information sharing have to be implemented locally by each stakeholder participating in data sharing (see #4). This effort in local architecture redesign results in additional expenses, i.e. investments and operational costs that might mitigate the benefits offered by the use of e-services maintaining customs procedures.

To leverage the benefits of the introduced technology, different e-services emerge that locate data worldwide and ensure authorized access among stakeholders from public and private sector. Clearly, the use of such services has a positive effect on the foreseen stakeholder value (see #3) of the proposed e-customs initiatives. In the new procedure, EPCGlobal acts as a commercial service provider, besides providing and maintaining the product description standards, she maintains a data locating service and an access authorizing service to facilitate data sharing.

The resulting business network of the proposed e-customs initiatives, in contrast to the designed, piloted setting, embeds concerns that violate stakeholder value that are not yet presented in a limited setting. The constellation that facilitates e-customs procedures worldwide would consist of an increased number of stakeholders: service providers to facilitate e-customs procedures (e.g. TREC service provider, EPCGlobal), carriers who provide transportation services worldwide, enterprises who are active on the international market, and governmental authorities of different countries. In the followings we use our model-based approach to address the impacts of the explored concerns on the proposed e-customs initiatives while continuously considering and maintaining a satisfying value performance for stakeholders.

4. Exploring the potentials of e-customs in real-life setting using the proposed model-based approach

Figure 1 articulates a conflict situation as a result of contrary impacts on the stakeholder value (highlighted with dotted oval). In sum, while business-driven concerns of e-customs initiatives support the realization of stakeholder value (i.e. the use of e-services support the realization of foreseen benefits), IT-driven concerns (i.e. local architecture redesign) might violate its realization. The challenge with these conflicts is to find an acceptable configuration of the constellation where the supportive effects of business

³ This product description is based on the product barcode. EPCglobal is also the organization that introduced the barcode worldwide.

value would not be overbalanced with the negative effects of the underlying IT for its stakeholders involved.

To support finding a balanced solution, we introduce in the following sections two alternatives for a value constellation that realizes e-customs procedures. To limit our investigations, in this paper we focus our model-based analysis on different financial impacts, i.e. how the need of local architecture redesign influence stakeholder value, and how it might influence the incentives to enroll the proposed e-customs initiatives at the first place.

4.2. First alternative: maintaining standardized data sharing mechanisms in-house

In order to simulate a possible trade-off scenario, first we drew an e³value business value model (see Figure 2) that is a snapshot of a configuration of the emerging network that realizes e-customs procedures for a one month time frame. Value activity modeling constructs show what operations (e.g. providing 'Shipment monitoring' service) stakeholders must perform to support e-customs procedures. Value transactions between different actors result from these executed operations, and embed incoming and outgoing value objects. The former represents what is of value an actor receives and the latter represents its compensation, which is of a value for an actor in exchange. Incoming value objects presuppose what benefits different stakeholders expect, which can be as an example an outcome of an e-service (e.g. container state information).

Figure 2 shows that a 'Trader' operates 'International trade using EPCIS' activity, implying that the trader in-house maintains the standardized mechanisms for data distribution to comply with legal requirements. By facilitating this activity, 'Trader' engages in different value transactions. The 'A' dependency path relates transactions that originate from the consumer need 'Provide shipment data'. It splits into two threads explaining that a 'Trader' consumes 'transportation services with TREC mounted devices' from a 'Carrier', and the related 'container state information' from a 'TREC service provider'. 'Trader' also provides the necessary 'trade information' to 'Governmental authorities', so she can comply with the legal requirements with respect to customs procedures. To facilitate data distribution worldwide, 'Trader' pays a fee for 'subscriber maintenance' to EPCGlobal for the issued product standards and standardized data sharing mechanisms (see 'B' dependency path).

Based on the modeled value transactions, the e³value modeling tool provides the support to assess the financial value impacts of a 'Trader'. By adding valuation formulas expressing financials, it is possible to quantify the value effects and to calculate the net cash flow. As the given example in Figure 2 indicates, using TREC mounted containers for transport results in 20 Euro additional costs for a 'Trader'. She also pays 0.1 Euro for receiving container state information per transaction, and 10000 Euro for subscriber maintenance.

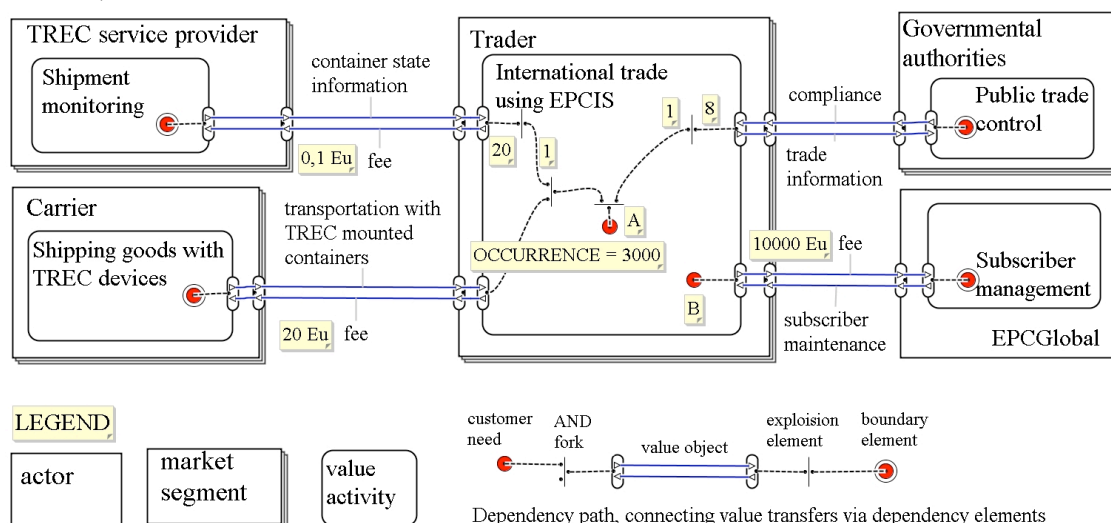


Figure 2. The e³value model showing a possible configuration of a constellation that facilitates e-customs procedures

To arrive to a sound, transaction-based analysis of value impacts, it is necessary as well to articulate the volume of these value transactions for the given 1 month time frame. It can be expressed by attributing the modeled consumer need by the number of its occurrences. As an example, Figure 2 explains that the ‘A’ consumer need is set to 3000 indicating that a ‘Trader’ ships on average 3000 containers that need to go through customs procedures per month. She needs to provide information for each shipment, and as a consequence, each value transaction that this need triggers occurs 3000 times on a monthly basis.

One shipment however triggers more transactions with respect to container state information, since movement of shipments should be continuously monitored and administrated. The e^3 value modeling tool expresses such multiplicity by including *explosion element* in the dependency path. As Figure 2 shows, we assume that a ‘Trader’ invokes TREC e-services on average 20 times for each shipment, resulting in 60000 transactions per month. Similarly, a ‘Trader’ provides on average 8 times trade information to governmental authorities per shipment, resulting in 24000 transactions per month.

Table 1. Summary of cost effects for ‘Trader’, based on the value and UML models

‘+’ effect (incoming value object)	‘-’ effect (outgoing value object)	foreseen costs per month (for illustration purposes only)		
		cost per transaction	transaction volume (e^3 value)	sum
container state information	fee (e^3 value)	0,1 €	60000	6000€
transportation with TREC mounted containers	fee (e^3 value)	20 €	3000	60000 €
subscriber maintenance	fee (e^3 value)	10000 €	1	10000 €
compliance				
investment costs of hardware and software (UML)				30000 €

The value model describes what is of value created and transferred between participating stakeholders in order to maintain value performance of stakeholders. Moreover, the model shows the volume of value

transactions per a given time frame, enabling a transaction-based financial assessment. To analyze the IT-driven costs that are caused by the underlying architecture, we take a similar, model-based approach and draw a UML deployment diagram. Figure 3 depicts the IT architecture on a high-level granularity, with the emphasis on addressing additional financial effects.

Nodes (Trader, TREC service provider, carrier and governmental authority) are named after the stakeholders of the constellation, thus correspond to the actors of the e^3 value model in Figure 2. Software components that are named after the value activities of the value model enable value transaction within the constellation by providing and requesting different web services. Assembly connections connect service interfaces and service ports that facilitate value transactions. Nodes are of interest to us because they express ownership of certain software and hardware assets. Focusing on the ‘Trader’ node, Figure 3 explains that the ‘Trader’ owns different software assets (expressed with component modeling construct) to facilitate her ‘data management using EPCIS’ value activity, namely (a) standardized ‘EPCIS database’ component that stores and provides data of interest, (b) ‘EPCIS for data sharing’ to maintain the data distribution, i.e. the data query and transfer of data, and (c) ‘security management’ component using digital certificates to ensure encryption and protection of data, since distribution of data happens via open channels. Figure 3 also explains that ‘Trader’ offers ‘export data’ to, and receives ‘compliance document’ from ‘Governmental authority’ to realize the corresponding value transaction shown in Figure 2. As dependencies between different modeling constructs represent, the realization of this value transaction cannot happen without the employed software components.

The ownership of components and the financial attributes of UML deployment model constructs allow articulating the IT-driven cost effects on the value performance of stakeholders. Figure 3 exemplifies that to implement the necessary IT assets a ‘Trader’ needs to pay 30000 Euro investment costs. In [3] it was shown how to formally relate UML and e^3 value modeling constructs to enable a more detailed financial value assessment of stakeholders.

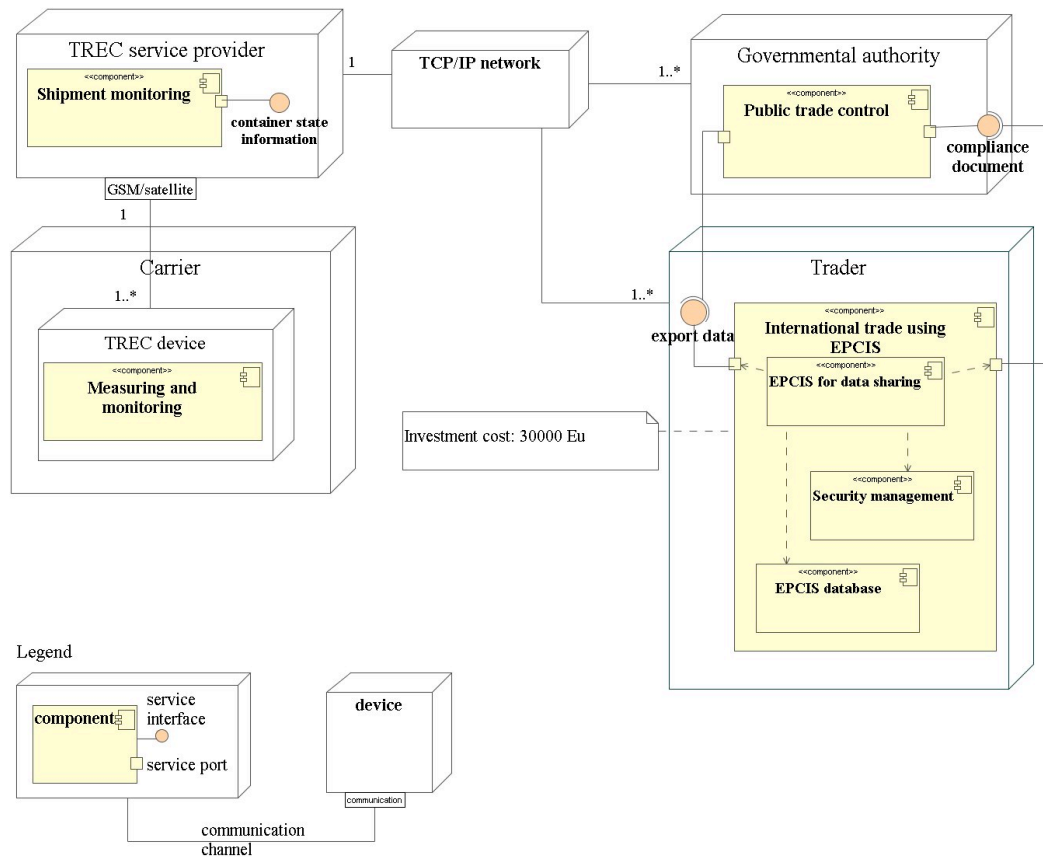


Figure 3. A UML deployment diagram that shows the underlying IT architecture of the value constellation employing TREC and EPCIS for data sharing

Based on the performed model-based analysis, we articulated different financial effects that influence the expected benefits of ‘Trader’. Table 1 summarizes our findings. Similar tables can be drawn for the other stakeholders.

4.3. Second alternative: introduction of data warehouse service provider

To balance the negative cost effects, another business model is drawn that shows a different configuration of value transactions. The value model in Figure 4 introduces a ‘Data warehouse service provider’. She offers the complete data management service to different enterprises, who would like to fulfill their customs obligations electronically as proposed, releasing them from certain financial

consequences. In return, enterprises pay a fee for the provided service.

In such business setting, a ‘Trader’ acts as one of such enterprises. She pays for transportation services, similar to Figure 2, and pays 4 Euro compensation fee per container to ‘Data warehouse service provider’ for maintaining and distributing trade information. The ‘A’ dependency path explains that it is the ‘Data warehouse service provider’ who consumes the ‘container state information’ services after each container, and pays for the standards to maintain the necessary data repository for data distribution. As a result, the ‘Data warehouse service provider’ provides the ‘trade information’ for ‘Governmental authorities’, which in return enables a ‘Trader’ to comply with the customs procedures.

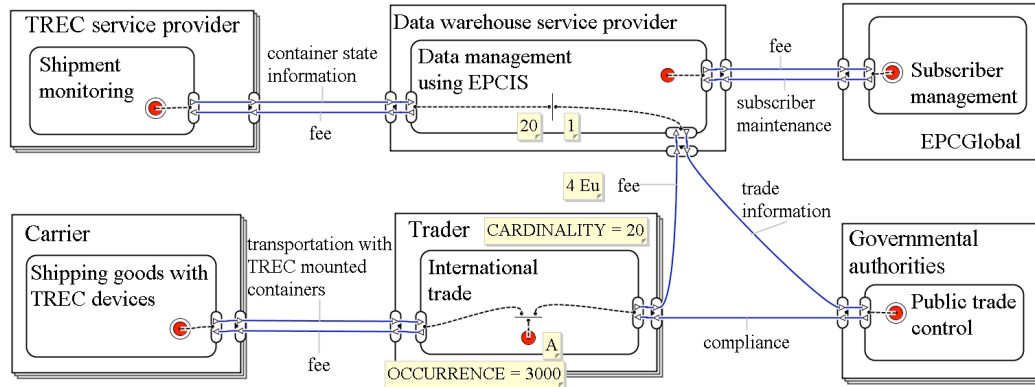


Figure 4. An alternative configuration of the constellation, resulting from the outsourcing

Changes in network characteristics imply changes in the underlying IT architecture as well. The aligned IT architecture that accommodates the alternative configuration is represented in Figure 5. It is the 'Data warehouse service provider' who provides 'trade data' to 'Governmental authorities' thus employs the required software and hardware assets. There is no local effort needed from the 'Trader' to facilitate the EPC-based data sharing mechanisms. Yet, to provide the 'trade data', 'Data warehouse provider' needs the necessary 'supply chain information' from a 'Trader'. The assembly connection between the corresponding service interface and port represents this requirement. Due to data confidentiality, data exchange between 'Trader' and 'Data warehouse service provider' is done via virtual private network, as the UML deployment diagram also indicates.

As the cardinalities of the nodes illustrate, one 'Data warehouse service provider' maintains supply chain data of more 'Trader' nodes. As such, 'Data warehouse provider' acts as a hub that aggregates different data sources and distributes them for customs clearance, implying a more efficient solution for locating and sharing data.

Table 2. Summary of cost effects for 'Trader', concluded from the value and UML models of the alternative configuration

'+' effect (incoming value object)	'-' effect (outgoing value object)	foreseen costs per month (for illustration purposes only)		
		cost per transaction	transaction volume (e ³ value)	sum
transportation with TREC mounted containers	fee (e ³ value)	20 €	3000	60000 €
compliance		4 €	3000	12000 €

Similar to the first business setting, we articulated different financial effects that influence the expected benefits of 'Trader'. For comparison, Table 2 summarizes the value impacts that are articulated via modeling techniques.

Based on the volume of business transactions, the alternative solution would in principle cause less financial effects for a 'Trader'. However, to explore whether and how the introduction of such data management service would be commercially feasible is a non-trivial task. On one hand, the increasing number of enterprises that would consume the service results in higher profit, which, on the other hand conflicted with higher operational costs.

Concluding from the value model, these costs depend on average numbers of TREC service invocations that are consumer-dependent as the 'A' dependency path also explains; hence finding this optimum is a complex task. In addition, 'Data warehouse service provider' needs to deal with higher investment and operational costs to accommodate the increased intensity of data distribution among governmental authorities. It might appear that over certain trading intensity the 'Data warehouse service provider' needs to reconsider her service offering, because her extra operational costs cannot be recovered from the predicted profit.

As shown, the e³value modeling technique allows simulating the volumes of transactions, and enables sensitivity analysis of financial impacts. In this specific financial setting shown in Figure 4, 'Data warehouse service provider' would conclude a positive net cash flow. Assuming the management of data of 20 different enterprises, assuming on average 3000 containers per month for each enterprise, and assuming 4 Euro service fee per container would result in 240000 Euro profit for the service provider. Based on the modeled transactions, the profit is contrasted with service fee paid for subscriber maintenance (assuming 10000 Euro per month) and container information. Supposed that

volume. However, the existence of a reliable IT system that accommodates the increased number of invocations is non-trivial. This can especially be crucial for service providers in order to preserve the level of their service quality. To address such technical concerns, the employed modeling techniques are not suitable; we need to extend our approach to address behavioral concerns (think of e.g. flexibility) of the analyzed information system architecture, in conjunction with our model-based approach. Another line of research is the development of guidelines that help making decisions for business and information systems architects while exploring commercial potentials of an e-service offering, which are then expressed using the integrated models we have proposed.

6. References

- [1] Z. Baida, B. Rukanova, J. Liu, and Y.H. Tan, "Preserving Control in Trade Procedure Redesign - The Beer Living Lab", *Electronic Markets*, 2008, 18(1), pp. 53 – 64.
- [2] Zs. Derzsi, and J. Gordijn, "A Framework for Business/IT Alignment in Networked Value Constellations", In *Proceedings of the workshops of the 18th International Conference on Advanced Information Systems Engineering*, T. Latour and M. Petit (Eds.), Namur University Press, Belgium, 2006.
- [3] Zs. Derzsi, J. Gordijn, K. Kok, H. Akkermans, and Y.H. Tan, "Assessing feasibility of IT-enabled networked value constellations: A case study in the electricity sector", *Proceedings of the 19th International Conference on Advanced Information Systems Engineering*, J. Krogstie, A. L., Opdahl and G. Sindre (Eds.), Springer, LNCS, Heidelberg, 2007.
- [4] DG/TAXUD, "Electronic Customs Multi-Annual Strategic Plan (MASP Rev 7)", Working document TAXUD/477/2004 - Rev. 7 – EN, 24 European Commission, Taxation and Customs Union, May 2006.
- [5] EU Commission, "EU coherent strategy against fiscal fraud – frequently asked questions", MEMO/06/221. Brussels, May 2006.
- [6] Fowler, M., *UML Distilled: A Brief Guide to the Standard Object Modeling Language*, Addison-Wesley Professional, Boston, US., 2003.
- [7] J. Gordijn, and H. Akkermans, "e3-value: Design and Evaluation of e-Business Models", *IEEE Intelligent Systems*, 2001, 16(4), pp. 11-17.
- [8] J. Gordijn, and H. Akkermans, "Value-based requirements engineering: Exploring innovative e-commerce ideas", *Requirements Engineering Journal*, 2003, 8(2), pp. 114–134.
- [9] J. Gordijn, and H. Akkermans, "Business models for distributed energy resources in a liberalized market environment", *The Electric Power Systems Research Journal*, 2007, 77(9), pp. 1178-1188.
- [10] Kan, S.H., *Metrics and Models in Software Quality Engineering*, Addison-Wesley Professional, Boston, US., 2002.
- [11] V. Kartseva, J. Gordijn, and Y.H. Tan, "Towards a Modelling Tool for Designing Control Mechanisms for Network Organisations", *International Journal of Electronic Commerce*, 2005, 10(1), pp. 57-84.
- [12] Tapscott, D., Ticoll, D. and Lowy, A., *Digital Capital - Harnessing the Power of Business Webs*, Nicholas Brealy Publishing, London, UK, 2000.
- [13] Unified modeling language: Superstructure. <http://www.omg.org/docs/formal/05-07-04.pdf>, last accessed November 2007.