However, efficiency and reducing administrative burden can easily contradict with increased security, safety and control. The threat of terrorism resulted in new control regulations. Also from a financial perspective there is a clear business case for increased control. For example, excise fraud for alcohol in the EU 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 (EU Commission 2006).

The Beer Living Lab (BLL) is a pilot project of the ITAIDE project for redesigning EU customs procedures. It focuses on procedures for shipments of beer from the Netherlands to destinations outside the EU (export) and within the EU (intra-community supplies). It serves as a proof of concept for the implementation of the AEO concept, aligning commercial and governmental supply chain benefits, and is also aligned with the SW vision. A collaboration among one of the world's largest beer producers (BeerCo), the Dutch Tax and Customs Administration (further referred to as DTCA), two very large technology providers and universities aims to demonstrate that trade facilitation, reduced administrative burden for supply chain partners and improved control and security are not necessarily contradicting efforts and can actually coexist. The project investigates a redesign of customs procedures such that BeerCo can enjoy an AEO status and related benefits, once it demonstrates by means of innovative IT that it is in control of its international supply chain.

As a theoretical framework we use the e^3-control modeling approach, which specifically focuses on designing inter-organizational controls. Kartseva et al. (2005) suggested e^3-control using a value perspective to analyze control problems. A value perspective focuses on the value that can be lost if no controls exist in an inter-organizational setting. Next, Liu et al. (2006; 2007) showed that a value perspective is not rich enough to reason about actual control mechanisms. They extended e^3-control to include a process level analysis, and suggested that the last step in e^3-control, after a process level analysis, should be going back to the value level to analyze how the network has changed (see Figure 1). However, this last step has not been worked out in earlier papers.

The contribution of this paper is threefold. First, parts of e^3-control have been described in earlier publications. In this paper we discuss the whole methodology. Second, earlier publications focused on steps 1, 2 and 3 of e^3-control. In this paper we discuss step 4 as well. Third, we present here a rich and complex case study in the beer industry. Our paper shows how modeling facilitates achieving innovation in a complex inter-organizational setting.

The remainder of this paper is organized as follows. Section 2 is dedicated to providing the theoretical grounding for this paper. In Section 3 we introduce the Beer Living Lab. Section 4 presents the business result of the BLL: a new trade procedure. In Section 5 we discuss how our modeling approach facilitated achieving this result. Finally, in Section 6 we provide our conclusions.

2 Theoretical Framework: e^3-control

e^3-control is being developed as a conceptual modeling methodology for designing control procedures (Kartseva et al. 2005; Liu et al. 2006; Liu et al. 2007). It captures knowledge on internal and inter-organizational control from academic research and best practices [e.g., Romney and Steinbart (2003), Arens and Loebbecke (1999), Bons et al (1999), Chen and Lee (1992), COSO (1992)]. e^3-control proposes visual-based models as a means for communication between stakeholders, to achieve a shared understanding

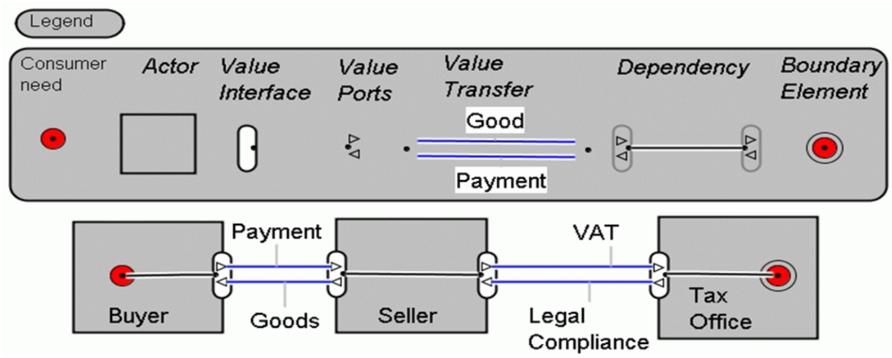

Figure 2 Example of an e³-value business model of a purchase with tax payment

The above terminology is useful mainly for commercial settings though. The definition of value for public sector organizations is different from that of private sector organizations; value is not necessarily money. To this end, evaluating public sector projects cannot focus on financial feasibility only. Therefore we are currently engaged in a study about the notion of value in the public sector, and in establishing value assessment schemes for public sector organizations (e.g., Cole and Parston, 2006; Moore, 1995; Cresswell et al. 2006; CIO Council, 2002). We will embed such schemes in e³-control, to complement the existing profitability analysis functionality.

2.2 Modeling from a Process Perspective

We argued in Liu et al (2007) that to apply governance and control, we have to analyze the detailed process level of business models. The main driver for using a process-level analysis is that the large knowledge base on designing controls, which is the grounding of e³-control, [e.g., Coso (1992); Chen & Lee (1992); Bons et al. (1999); Arens & Loebbecke (1999); Romney & Steinbart (2003)], focuses on analyzing operational tasks, or business processes, and describes control as a process. Process models [which we express in UML Activity Diagrams and Use Cases (Fowler & Scott 1997), but other notations are possible too], enable us to identify control flaws by applying control principles, and to design new business processes based on these principles. For a detailed description of e³-control's process level analysis and its contribution to scientific knowledge base, refer to Liu et al. (2007).

3 The Beer Living Lab: Introduction to the Case Study

The Beer Living Lab (BLL) brought together government and industry to rethink control procedures for international trade. BeerCo has a wide international presence through a global network of distributors and breweries. It owns and manages one of the world's leading portfolios of beer brands and is one of the world's leading brewers in terms of sales, volume and profitability. The main brand of BeerCo is considered almost as sacred within the firm. Accordingly, BeerCo has implemented extensive internal control mechanisms throughout its value chain. As a manager within the firm explained, if a container with beer is stolen, BeerCo does not care so much about the direct financial loss, but rather BeerCo is afraid that the thieves would tamper with the beer, and then introduce it to the market while it does not meet the BeerCo quality criteria, resulting in damage to BeerCo's brand and image. In accordance with EU and WCO (World Customs Organization) visions, DTCA wishes to rely on BeerCo's own control of its supply chain, so that BeerCo can be seen as a low risk shipper, be certified as AEO and enjoy simplified procedures. This results in a tangible benefit for DTCA too.

paper procedure rather than innovate the whole trade procedure. In fact, there already exists a system similar to EMCS, namely VIES for VAT procedures, but VIES fails to achieve its goal, because it does not provide enough information. That information is available in the national statistics (CBS) system, but Dutch law does not allow DTCA to access that system. In fact, different governmental agencies all request from BeerCo the same or similar commercial data for various procedures, resulting in redundancy and fragmentation, while a holistic approach is required. The fragmentation in procedures is caused by fragmented legislation. To the dissatisfaction of businesses, separate information systems have been introduced for every piece of legislation, disregarding existing systems and related regulations. Furthermore, even if DTCA can establish that a company is in control of its supply chain, it cannot provide simplifications (e.g., exemption from export declarations), because the current legislation does not allow that.

4 Redesign of Administrative Procedures

In this section we describe the solution that was designed by BLL participants such that it is satisfactory for all. First, we discussed innovative IT solutions that enabled innovation in the trade procedure. Second, we present the BLL trade procedure. In section 5 we discuss how modeling facilitated the whole process.

4.1 Innovative IT

Information technology provides ample opportunities to introduce efficiency gains, security and visibility. One option is to replace paper-based procedures by electronic ones. This is what the EU is currently doing by introducing EMCS instead of the paper-based AAD. However, much greater benefits can be achieved if a radical rethinking takes place and the assumptions underlying procedures are questioned. The BLL has opted for this approach. Two technologies are used as corner stones in the BLL export procedure: the TREC smart seal for container security and EPCIS databases.

The *Tamper-Resistant Embedded Controller* (TREC)[1] 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 to supply chain partners including DTCA, when the container actually leaves the Netherlands, deviates from its predefined route, is being opened by an unauthorized party, or when other predefined events occur. By monitoring a container's location, TREC devices could replace the AAD's functionality to provide export evidence.

Container Information Services are leveraging the EPCglobal network and EPCIS (Electronic Product Code Information Services) non-proprietary standards currently under definition by EPCglobal[2]. Those standards define interfaces, discovery services, security mechanisms and other infrastructure for capturing and querying supply chain data (and other EPC related data). The EPCglobal network, also called the 'Internet of things', is a suitable backbone for tracking goods moving along a supply chain. It

[1] Further information on TREC is available at http://www.zurich.ibm.com/news/05/trec.html and http://www.research.ibm.com/jam/secure_trade_lane.pdf, last accessed on April 27, 2007.
[2] For further details see http://www.epcglobalinc.org

partners and government systems, also for periodic audits. As soon as a container physically leaves Dutch territory (or: arrives at the country of destination), the TREC device triggers sending a message to DTCA, providing digital export evidence. If the shipment is physically inspected en route, customs officers can use handheld devices to obtain access – via the Internet and using a UCR that the TREC device provides – to the commercial information identifying this shipment in BeerCo's EPCIS. Also the digital export evidence (produced by a TREC device) is stored in the carrier's EPCIS database, and can be accessed by authorized supply chain partners. The Service-Oriented Architecture (SOA) presented in Figure 3 offers two more very interesting opportunities. First, whenever a supply chain participant (including BeerCo, an ocean carrier, DTCA and the buyer) seeks for some data regarding a shipment, they can use the shipment's UCR to search for this data through the Internet, using a discovery service. If the data is available in the EPCIS of *any* supply chain party, and the party seeking the data is authorized to access it, the data will be retrieved and presented through a Web interface. We refer to this mechanism as "googling". Second, the discovery service is informed about the presence of the data in the EPCIS databases. Supply chain participants can register to receive notifications for predefined events. For example, every time a TREC device notifies the carrier's EPCIS that a shipment of beer has arrived in the UK or US, a notification can be sent to DTCA as export evidence, removing the need for the current cumbersome paper-based export evidence procedure.

5 e^3-Control Applied in the Beer Living Lab

We engaged in different modeling efforts in deploying e^3-control (see Figure 1) in the Beer Living Lab case study.

5.1 Step 1 in e^3-control: Value Modeling

First, business (value) models using the e^3-value notation facilitated a discussion between BLL participants, to study inter-organizational relationships, to understand roles and interdependencies between actors. Figure 4 depicts a business model for the supply chain at hand. It assumes a value perspective rather than reflect the business processes behind the supply chain. Actors (visualized as rectangles) exchange (visualized as blue lines) objects of economic value (text labels) such that every actor gives something, and receives something in return, based on the economic principle of reciprocity, or duality (McCarthy 1982). We start our procedure redesign on a value perspective, rather than process perspective, because the value perspective enables us to focus on the purpose of controls: to safeguard from the loss of value. This enables us to zoom in on the most critical processes in step 2.

Figure 4 includes one element of e^3-control that is not part of e^3-value. Namely, dotted blue lines (as seen in the value exchanges between the retailer and Customs UK) denote a so-called *sub-ideal* situation. The UK based retailer has a choice: either it pays excise to Customs UK, and is granted legal compliance (see the value exchanges "Excise payment/Legal compliance" between the retailer and Customs UK), or it does not pay excise (see the dotted exchanges between these actors), i.e., it commits fraud or behaves opportunistically. We used models as the one in Figure 4 to explore with BLL participants this and other control problems in the trade procedures.

5.3 Step 4 in e^3-control: Value Modeling

Third, we explored possible new procedures using business models. Two of the scenarios we studied should be mentioned. In the first scenario we involved the EU system-under-development EMCS to facilitate customs control. While this scenario manages to mitigate excise related control flaws, and it certainly improves Customs control compared to the current situation, it has two limitations. First, EMCS handles the excise procedure only, while BeerCo and DTCA specifically prefer a holistic solution for *all* trade-related procedures. Only a holistic solution can ensure high benefits for all parties involved. Second, EMCS replaces the AAD's role as export evidence, but not the AAD's role to identify cargo during a physical cargo inspection en route. A shipment ID (or: EMCS transaction ID) is still required on a paper document, to identify the shipment (the intention is to automate this is the future). The second scenario (presented in Section 4.2) introduced a radical rethinking of the trade procedure, because control is in fact outsourced from DTCA to a commercial TREC service provider and to BeerCo (subject to audits and certification). As business models showed, this scenario requires that a new actor is introduced to the supply chain: a provider of TREC services (this is not necessarily the manufacturer of TREC devices). As a result, some linkages between actors disappear, and other linkages are introduced. We used e^3-control models to explore these changes using models as the one in Figure 5. By comparing this model with the situation in step 1, the value of performing step 4 becomes visible. First, we identify changes in actor and changes in linkages between actors. Second, the model in Figure 5 also allows us to perform a profitability analysis.

In Figure 5 we did not assign the role of TREC service provider to an existing actor, but rather introduced a new actor. Variations of Figure 5 include scenarios where a carrier, a technology provider or BeerCo itself offer TREC services. One can argue that this service should be offered by carriers, for two reasons. First, TREC devices will be mounted on containers that are owned by carriers, and not by shippers or technology providers. Second, from a technology adoption point of view the number of large ocean carriers worldwide is limited; market penetration can be much faster if they adopt and offer the technology, rather than have BeerCo do so.

Another important observation from Figures 4 and 5 is that in the electronic BLL procedure DTCA introduces two certifications. First, BeerCo enjoys an AEO certificate, which results in tangible benefits including fast customs clearance. Second, because DTCA relies on EPCIS and TREC technology to achieve its control goals, these technologies need to meet DTCA requirements. DTCA certifies the TREC service provider to offer these services. Certification is typically subject to periodic audits.

e^3-control uses e^3-value to draw business models. e^3-value enables generating profitability sheets for all actors involved in the network, as part of step 4 for e^3-control. Naturally, the TREC hardware and software have a price tag. BeerCo could ship its beer either in regular containers or in TREC-armed containers. While the latter will be more expensive per container, it will enable BeerCo to comply with the AEO requirements (which is not the case with regular containers). AEO certification will result in a faster logistical process and in increased control on BeerCo's supply chain. In the BLL solution BeerCo implements an EPCIS database, but it no longer has to maintain expensive information systems to submit declarations to the government's islands of automation.

We are currently collecting data to investigate the financial feasibility of the BLL scenario using e^3-value. This is not a straightforward task, because a number of

6 Conclusions and Future Research

Customs administrations and EU legislators are facing substantial challenges in international supply chains. On the one hand, growing security, health, financial and other threats require increased control on supply chains. On the other hand, growing volumes and ocean port congestion (Crone 2006) make it impossible to exert extensive control inspections at the border, and the administrative burden of businesses should be lowered in order to create and maintain a viable economic zone. New electronic customs control procedures are required in order to cope with above mentioned challenges. Furthermore, important control procedures are still paper-based, while they can be supported much more effectively and efficiently by use of IT. Designing and implementing changes in customs control procedures is a highly complex issue, where technological, financial and political stakes have to be aligned. In order to cope with this complexity we proposed the Living Lab (Tan et al. 2006) as a dynamic research setting.

In this paper we build upon earlier work on e^3-control as a theoretical framework to bring about inter-organizational change in a Living Lab setting. Steps 1-3 of e^3-control have been discussed elsewhere. In the current paper we describe which modeling efforts have been used in the BLL to facilitate all four steps, and we elaborate on step 4. We will continue to develop e^3-control in future case studies.

While in the past customs control has been considered as an issue of customs administrations only, nowadays businesses are seen as partners, and a Win-Win situation is required, such that businesses are responsible for control of their own supply chains, and customs can rely on this control. Because this relieves customs administrations from control tasks, these businesses can be rewarded with simplifications of procedures. Customs administrations can then focus their resources on high-risk shipments.

Bearing these issues in mind, we analyzed existing customs procedures concerning the export of beer from the Netherlands. We examined possible redesigns for current procedures. We showed that the use of advanced container security technology (TREC) with Internet-based EPCIS databases can complement and even replace the EU-initiated system EMCS, and achieve a paperless trade procedure. Finally, we proposed a trade procedure in which businesses make commercial data about the shipment of goods available for government, and any authorized government agency can retrieve this data. Consequently, businesses are no longer required to submit declarations to islands of automation of the government. This realizes the Single Window vision, a key EU goal in the field of Customs and Taxation. Businesses that will use our procedure will greatly improve supply chain and security control thanks to the use of container security technology, thereby qualifying for an AEO status. A pilot implementation of this scenario involved containers shipped from the Netherlands to the UK and to the US in December 2006 – January 2007 and showed that control can be maintained and security can be guaranteed while using the BLL simplified trade procedure.

While the Beer Living Lab is about to end, we identify a number of future research directions. First, as described in Liu et al. (2007), we seek to extend steps 2 and 3 of e^3-control where we analyze business processes. Second, the relation and transition between value and process models has been identified as an important field, with the aim to derive business processes from value models (Weigand et al., 2006). Third, we use the profitability analysis functionality embedded in e^3-value, but acknowledge its limitations. Mainly, when a business models involves public sector organizations, value cannot always be quantified and measured in money. Hence we will focus our future

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