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E-Customs Control Procedures Redesign Methodology: Model-Based Application

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Abstract

Growing trade volumes and increased security, health and financial control regulations require customs administrations to change their working practices worldwide. An existing dilemma however, is that governments would like on the one hand to reduce the administrative burden for businesses and on the other hand to increase security and control. The traditional single side power-posing by customs administrations to trade parties is not appropriate any more. The European Union is now realizing the potential benefits of establishing Customs-and-Business partnerships. To achieve such collaboration, current customs procedures need to be redesigned, and ICT is a key enabler for the redesign. In this paper we present a model-based approach using two levels of abstraction – value and process levels – to support domain experts in investigating how customs procedures can be redesigned while coping with business and administrative challenges. Especially, we focus on a methodological application of control principles from accounting and auditing literature, to redesign procedures. We discuss our "AAD"[1] approach and its application in an e-Customs procedure redesign case study.

Keywords: e-Customs, Inter-organizational control, Procedure design, Conceptual modeling.

[1] "AAD" is a process based approach of designing controls, which includes actors, activities and documents as three basic components. For a detailed discussion see section 3.

1 INTRODUCTION

Inter-organizational networks, often Internet-based, provide competitive advantages that a single organization cannot achieve. Also the public sector can benefit from forming networks with businesses. Potential benefits are visible, e.g., electronic invoicing in Denmark saves taxpayers €150 million and businesses €50 million a year. If this could be introduced across the EU, annual savings could exceed €50 billion (EU Commission, 2006b). However, such networks are only sustainable when all participants benefit from the network. Especially the public sector is interested not only in financial benefits, but also in control and security. Government-to-business (G2B) collaboration is often difficult, as government procedures are often paper based and not harmonized. Redesign of government procedures should use ICT instead of paper documents. Furthermore, if businesses are considered as partners by governments, a radical redesign with higher potential can take place.

Our study focuses on customs procedures redesign, replacing paper-based procedures by Internet-based ones while coping with business and administrative challenges. Currently, for a single container crossing borders, on average 30 documents/signatures are involved (Doing business database, 2006). New ICT-based procedures should replace paper documents and improve the control effectiveness as well as lower the administrative burden for both customs administrations and business.

Due to the complexity of business networks, cross-organizational procedure redesign projects can greatly benefit from methodological and software-aided supporting tools. First, tools help stakeholders from different organizations reach a common understanding about how the network functions. Second, the structured analytical approach enables reducing complexity by focusing on critical elements in the network. In this paper we present such a methodological approach to support domain experts in control procedure (re)design. Our methodology is not a pure redesign methodology, but rather a domain experts' analysis tool to identify control flaws and provide a "template" for possible redesigns.

Business practitioners and researchers [e.g., COSO (1992); Chen & Lee (1992); Bons et al. (1999); Arens & Loebbecke (1999); Romney & Steinbart (2003)] see control as an operational matter, and study it with a process perspective. A process perspective describes how business is operationalized. It is opposed to a value perspective that describes who (which actor) does what in return for what (for detailed differences between the two perspectives, see Gordijn et al., 2001). Kartseva et al. (2005) propose a value-based e^3-control methodology when designing control procedures. While their work is valuable for understanding the purpose and added value of controls, they provide very limited operational solutions for control problems. In this paper, we further develop e^3-control to include both value-based and process-based control modeling, and we elaborate on the process level. We apply control principles from well-known accounting and auditing literature to identify control problems and to redesign control procedures. We develop the "AAD" approach for this purpose, and elaborate on its application in a case study concerning the export of beer from the Netherlands to the UK, where an innovative ICT-based redesign replaces human-based procedures, and results in improved control.

The remainder of the paper is organized as follows. First, Section 2 presents the value- and process-perspective approach for procedure analysis and (re)design. In Section 3, we introduce our "AAD" approach for a process level analysis. In Section 4 we apply this approach to a current e-Customs procedure redesign case. Finally, in Section 5, conclusions and further research directions are given.

2 RESEARCH APPROACH: COMBINING VALUE AND PROCESS PERSPECTIVES

A large knowledge base exists on designing internal and (to a lesser degree) inter-organizational controls [e.g., COSO (1992); Chen & Lee (1992); Bons et al. (1999); Arens & Loebbecke (1999); Romney & Steinbart (2003)], focusing on analyzing operational tasks, or business processes. As opposed to this process-oriented approach, Kartseva et al. (2005) propose that the design of controls should focus on economic value exchanges among organizations. A value perspective helps to understand the primary purpose of control mechanisms. Therefore, they present a value-based e^3-control modeling approach to design inter-organizational control mechanisms. They focus on the

economic interests, network actors, and control mechanisms to safeguard these interests. Kartseva et al. (2005) suggest that inter-organizational controls design should include three steps:

1. *Ideal value model: a business model, assuming that all actors always fulfill their obligations;*
2. *Sub ideal value model: control problem analysis in the ideal business model, i.e. the analysis of possible violations of the original business model;*
3. *Control value model: a business model that includes value-adding inter-organizational control mechanisms (IOCs), to detect and prevent the fraud and opportunism identified in step 2.*

All three steps use a value perspective. We argue that while a value analysis is important to understand the benefits of controls, it is not rich enough to identify control problems and offer solutions. A more elaborate process perspective has to be added to the above approach. A number of reasons support our proposition. First, control is clearly defined as a process issue: "a process… to provide reasonable assurance regarding the achievement of objectives…"(COSO, 1992). Second, the existing knowledge base of control (from scientific research and best practices) assumes a process perspective [e.g., Bons et al. (1999); Romney & Steinbart (2003); Arens & Loebbecke (1999)]. Third, in our experience with domain experts (e.g., business mangers, auditors), the process perspective is more natural for them than the value perspective. Fourth, the two perspectives address different issues, both of which are required. A value perspective describes which value transfers should be safeguarded by control mechanisms. However, as it does not describe how these values are transferred (which is a process element), it is not suitable for describing and designing operational solutions, i.e., control mechanisms.

We therefore conclude that to apply governance and control, we have to analyze the detailed process level. Our four-step approach adds to earlier work by combining analyses at both levels of abstraction: a value perspective (focusing on who provides what to whom and why in a network) and a process perspective (focusing on how the above is realized). In step 1 we use a value perspective to describe an initial business model of the current situation (including ideal and sub-ideal situation). We analyze which economic values are being exchanged by actors in a network, and interview domain experts to identify the critical value transfers that should be safeguarded by means of control mechanisms. Our approach deviates from Kartseva et al. (2005) already in this stage. We consider the current situation where existing controls have already been taken into account, whereas in Kartseva et al. (2005) controls are considered only in the later stages. In the next two steps we perform a process level analysis. By focusing on critical value transfers we reduce the work in steps 2 and 3 to a manageable level. In step 2, with the help of domain experts we investigate the business processes that realize the earlier identified critical value transfers (rather than the whole business model). We study how current controls are applied in a network to safeguard these value transfers, and identify control flaws by applying control principles from auditing and accounting to current processes. In step 3 we add or change control mechanisms according to process-level control principles, resulting in a redesign of the business process. Having introduced new controls may change the related business model, as controls can be offered as commercial services and cause value redistribution in a network. Therefore we finally draw a new business model (value perspective) in step 4, and evaluate its financial feasibility. If the evaluation shows a positive result, the redesign is acceptable. Else, we go back to the first step for a new iteration (see Figure 1). The application of this approach was discussed by Liu et al. (2006). However, the earlier paper does not explain how to apply control principles in the process analysis (steps 2 and 3). We focus on this issue in the next section. The four-step approach is termed e^3-control.

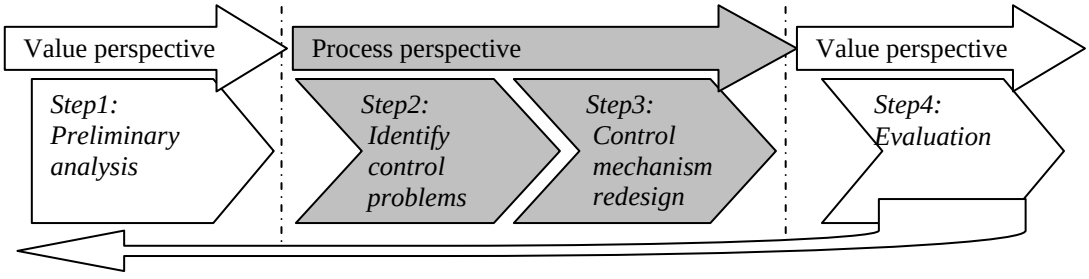

Figure 1. Value & process perspectives combined redesign approach

Note that our methodology serves for *control procedure redesign*, and not for *business process redesign (BPR)*. Control procedures are typically embedded in business processes. We focus on identifying control flaws in business processes and suggesting new, better control procedures. These can either be embedded in existing business processes, or in new ones, in case our methodology is used in the framework of a larger BPR project.

3 CONTROL "AAD": ACTOR, ACTIVITY AND DOCUMENT

We propose a systematic approach – "AAD" – to apply control principles. First, the "AAD" serves as a supporting tool for executing step 2 and 3 in the redesign. Second, our conceptualization of control principles can serve also as a basis for developing IS support for domain experts.

To identify control problems and redesign control procedures we need supporting theories. Chen & Lee (1992) apply auditing control principles to design an internal accounting control system. Seven internal control principles should be followed according to Chen & Lee (1992) (see Table 1):

1. *If an operational task exists, its corresponding control task should exist as well and should always follow the operational task.*
2. *If a control task exists, it must be furnished by supporting documents. These supporting documents should be the result of a previous control task that directly witnesses the activity to be controlled.*
3. *Supporting documents should be generated by a source independent of the source which generates the document to be verified.*
4. *If a control task uses a supporting document, this should be transferred directly from the control task which verified it.*
5. *An operational task and its corresponding control task should be segregated into two different positions and into two different agents.*
6. *The position responsible for a control task must not be lower in the formal power hierarchy than the position responsible for the operating task.*
7. *The agents responsible for the operational task and its corresponding control task should be socially detached.*

Table 1. Internal control principles (based on Chen & Lee, 1992)

Bons et al. (1999) transform Chen's principles to an inter-organizational context and analyze controls for trade. They assume independent and non-hierarchical relationships between organizations (thus, ruling out the above principle 6), and pay special attention to outsourcing activities and to the reciprocal character of contracts. However, there are several limitations for applying Bons' principles in practice. First, though delegated roles with different outsourcing activities are presented, no clear role/activity delegations are defined. Different roles (e.g., role 1, role 2, role 3) related with implicit activities are repeatedly mentioned in the principles. It is difficult already to differentiate primary and counter activities, not to mention adding outsourcing activities and relating them with numerated roles. Second, Bons' principles contain a controversial term "trust", which is difficult to quantify and has numerous interpretations (T3-Group, 2005). "Trust" cannot be controlled, thus considering it as control factor creates barriers for understanding and applying controls and for designing IS support.

Former research [e.g., Mautz & Sharaf (1961), Chen & Lee (1992)] showed that people are the deciding factor for effectiveness of internal control, and that the nature of internal control is people control people (Chen & Lee, 1992). Yet, control is affected by exchanging information repositories, i.e. documents and records, among tasks. Extending this concept into an inter-organizational context, we conclude that an effective inter-organizational control procedure should enable a control actor to carry out control activities by means of sufficient and independent documentary evidence[2]. Three facets, namely, actor, activity and document (AAD) can be identified in this observation. These facets have been discussed explicitly or implicitly in literature, including best practices of accounting and auditing (PCAOB, 2004; COSO, 1992; COSO, 2004), organizational theory (Thompson, 1967),

[2] If the control actor can directly witness the execution of the operational activity (e.g. direct exchange of money and goods) then this documentary evidence will not be necessary. Experience shows that, in most cases under inter-organizational context (e.g. internet transaction and international trade) such direct witnessing is not possible.

transaction cost economics (Williamson, 1985), value chain analysis (Porter, 1985), ISA framework (Sowa & Zachman, 1992; Zachman, 1987), ontology framework (Leppänen, 2005) and network management framework (Riemer & Klein, 2006). Yet, only exchanging documents between actors could not ensure a good control; a constraint of independence needs to be noticed. This constraint stems from one of the most fundamental principles of accounting practice – segregation of duties: "the separation of assigned duties and responsibilities in such a way that no single employee can both perpetrate and conceal errors or irregularities" (Romney & Steinbart, 2003). A further analysis of control literature [e.g., Starreveld (1985), Chen & Lee (1992), Romney & Steinbart (2003) and Schaad (2003)] shows that we can further distinguish three types of each facet: Actor – Responsible actor, Evidencing actor and Control actor; Activity – Operational activity, Evidencing activity and Control activity; Document – To-be-verified Document, Supporting Document and Verified Document. By separating different actors with corresponding activities and documents, effective inter-organizational control can be conducted. A detailed description of the AAD components is given in Table 2.

Actor	An actor is a person, or a group of persons[3] that plays a role or performs certain activities to achieve its objectives based on mutual cooperation with other actors in the network. Actors are responsible for and/or responsive to triggering and causing changes in the states of objects. They are aware of their intensions and able to react to fulfill their goals (Leppänen, 2005).
Responsible actor (R-actor):	The actor who performs the operational activity to be controlled and is responsible for the activity being promised (operational activity).
Evidencing actor (E-actor):	The actor who witnesses the execution of the operational activity and testifies the completeness, accuracy and compliance with organizational policies and rules of the operational activity. (The E-actor can be seen as a delegatee of the control actor)
Control actor (C-actor) :	The actor who has a direct interest of checking the operational activity executed by the responsible actor.
Activity	An activity is undertaken by an actor who is motivated towards solving a problem or achieving certain objectives, and mediated by certain tools (e.g., documents) in collaboration with other actors (Ryder, 1998).
Operational activity (O-activity):	Perform the basic business operations to achieve certain business value or some operational goal, e.g., business transactions.
Evidencing activity (E- activity):	Witness the execution of the operational activity and testify the completeness, accuracy and accordance with organizational policies and rules.
Control activity (C- activity):	Reconcile and verify records, documents or messages sent from the responsible actor and evidencing actor.
Document	Document denotes all information contents interchanged among actors. Each document is directed to a corresponding activity. It includes different forms like paper documents, records, or electronic messages.
To-be-verified Doc.	The document issued by the responsible actor to prove his completion of the operational activity.
Supporting Doc.	The document issued by the evidencing actor after an evidencing activity, which supports the control actor executing control activity if he/she could not directly observe the performance of the operational activity.
Verified Doc.	The document issued by the control actor after verifying/reconciling the To-be-verified Doc. and Supporting Doc., from which a conclusion of an effective control can be drawn.

Table 2. The AAD components

We combine Chen's and Bons' principles using AAD concepts to formulate our AAD control principles listed below. Figure 2 is a UML-like visualization of the AAD control model. Figure 3 is a *use case* description of the AAD control model in case the C-actor cannot witness the O-activity.

1. If an *Operational activity* exists, its corresponding *Control activity* must exist as well and should always follow the *Operational activity*.
2. If a *Control actor* cannot directly witness the execution of the *Operational activity*, the *Evidencing (witnessing) activity* should be delegated to an *Evidencing actor* (trusted third party)
3. If an *Evidencing (witnessing) activity* exists, it must be furnished by *Supporting documents*.

[3] In the inter-organizational context, actors can be seen as different agents/organizations.

4. These *Supporting documents* should be the results of an *Evidencing (witnessing) activity* that directly witnesses the *Operational activity*.
5. *Supporting documents* used by the *Control activity* should be transferred directly from the *Evidencing actor* to the *Control actor*.
6. The *Evidencing actor* who generates *Supporting documents* should be independent of the responsible actor who generates the *To-be-verified document*.
7. An *Operational activity* and its corresponding *Control activity* should be segregated into two different positions and done by two different actors.
8. The actors responsible for the *Operational activity* and its corresponding *Control activity* (respectively, *Responsible actor* and *Control actor*) should be socially detached.

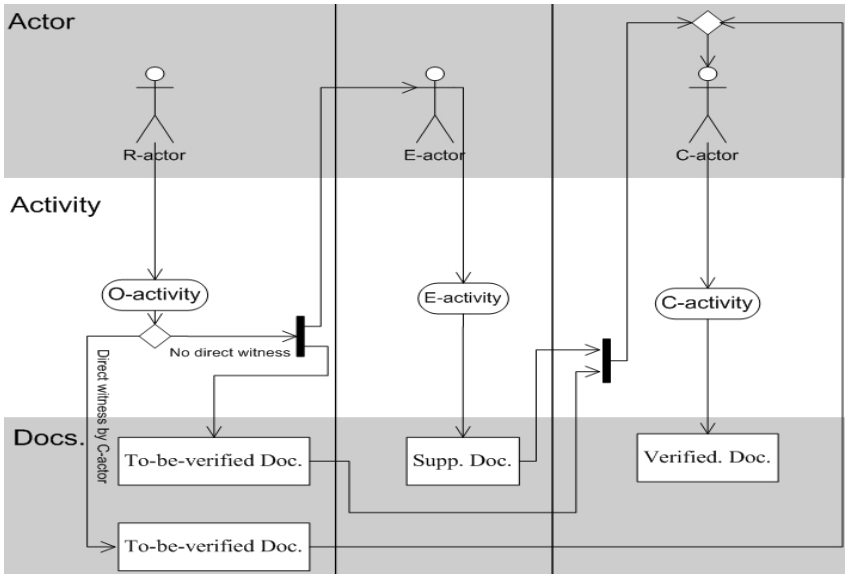

Figure 2. The AAD control model

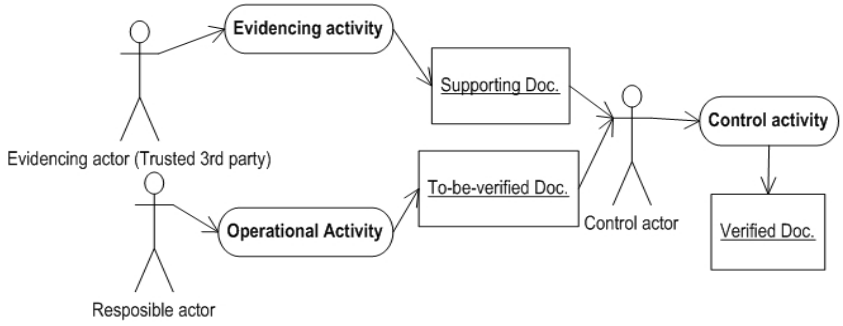

Figure 3. AAD model: use case description

Based on the AAD model we developed a checklist to help domain experts identify control problems and redesign control mechanisms. We refer to the AAD control principles, control model, and the checklist, as the *AAD approach*. The application of this approach is discussed in the following sections.

4 CASE STUDY: CUSTOMS PROCEDURES FOR BEER EXPORT

Our study investigates how to introduce e-Customs for handling excise goods (e.g., alcoholic beverages, cigarettes) in cross-border trade instead of current paper-based procedures. For the current paper, we examine the export of beer from the Netherlands to the UK[4]. When beer is sold, excise duty must be paid in the country where the beer is consumed. Hence, a Dutch beer producer can export beer without paying excise in the Netherlands, if he can prove that the beer has indeed been exported. The

[4] Shipments within the EU are officially not considered export but intra-community supplies. We use the term export as our study encompasses also shipments outside the EU (not described in the current paper).

following actors are involved in this study: (1) BeerCo NL, a large Dutch beer producer; (2) BeerCo UK, the UK branch of BeerCo NL, functions as an intermediary between BeerCo NL and retailers in the UK; (3) Customs NL: the Dutch customs; (4) Customs UK: the British customs; (5) Excise Warehouse (EW) in the UK, a warehouse which has been certified for the deposit without payment of duty of excise goods; and (6) Retailer, a UK-based company that buys Dutch beer from BeerCo UK.

Currently, the core document for excise-free shipments in the EU is the paper based *Administrative Accompanying Document* (AAD-doc)[5]. Two roles are performed by the AAD-doc: one as export evidence when stamped by EW and UK Customs, the other to identify the cargo in case of a physical cargo inspection en route. The AAD-doc accompanies the beer from the Netherlands to the UK and is stamped by the EW, then by Customs UK, as a proof that the goods have arrived in the UK. Customs UK send the stamped AAD-doc back to the EW who will forward it back to BeerCo NL. Customs NL periodically checks BeerCo NL's excise declarations. For the beer that BeerCo NL sold outside the Netherlands, excise exemption is given by default and will be verified afterwards by comparing excise declarations with AAD-docs. As transferring paper-based AAD-docs can take weeks or months, the verification is done several months later. In practice, this checking is often not done at all because it is labor intensive; BeerCo NL only submits AAD-docs upon request of Customs NL. The current paper-based AAD-doc control leads to administrative burden and possible excise fraud (e.g., tampering and missing AAD-docs). According to the EU Commission (2006a), excise fraud for alcohol in the EU amounts to €1.5 billion yearly, approximately 8% of the total excise duties receipts on alcoholic beverages. Therefore the EU intends to introduce e-Customs for excise goods, replacing paper-based control procedures by electronic ones. As a pilot of e-Customs redesign, our case study investigates 1) Which control problems exist in the current scenario and how can they be addressed? 2) How to replace the paper-based solution with an electronic one with effective control? 3) What are the effects of the ICT solution on future government (Customs) and business relationships?

As argued in Section 2, a satisfactory redesign requires four steps of analysis in both value and process perspectives. A preliminary description of this approach was given in Liu et al. (2006), but lacks a detailed discussion on how to perform steps 2 and 3. In the current paper we focus on these two steps, and we apply the AAD approach to identify control problems and redesign procedures. We do not discuss steps 1 and 4 in detail here, but some brief insights are given.

4.1 Step 1. Value perspective: Preliminary analysis

As a starting point we take the current value-based business model that describes a common understanding among stakeholders regarding *who* is offering and exchanging *what* with *whom* and expects *what* in return. We interviewed domain experts to explore which value transfers in the business model may be violated, and what the severity of violations is. By doing so we identified *critical* value transfers: value transfers for which control problems should be tackled. Here we focus on the risk that BeerCo NL will sell beer in the Netherlands, and declare it as exported in order to obtain exemption from excise duties. We specify such violations of the *ideal business model* in a *sub-ideal business model* (see Figure 4). Both models are drawn using a supporting software tool [for details see Kartseva et al. (2005)]. In Figure 4, 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 (the economic principle of reciprocity). The analysis abstracts from the operational view. To see how controls are applied we move to the next step – a process level redesign.

4.2 Step 2. Process perspective: Apply the AAD approach to identify control problems

In order to apply the AAD model to the case study, we first identify the AAD components involved in the beer case (see Table 3). Note that if some AAD components cannot be identified, this is already an indicator for potential control problems. After identifying the AAD components, the following checklist (Table 4) is used to identify control problems. The table consists of three columns:

[5] Note that here the "AAD-doc" is a supporting document; do not mistake it as our "AAD" approach.

interrogatives of the AAD control principles, specification of components and checking of the compliance.

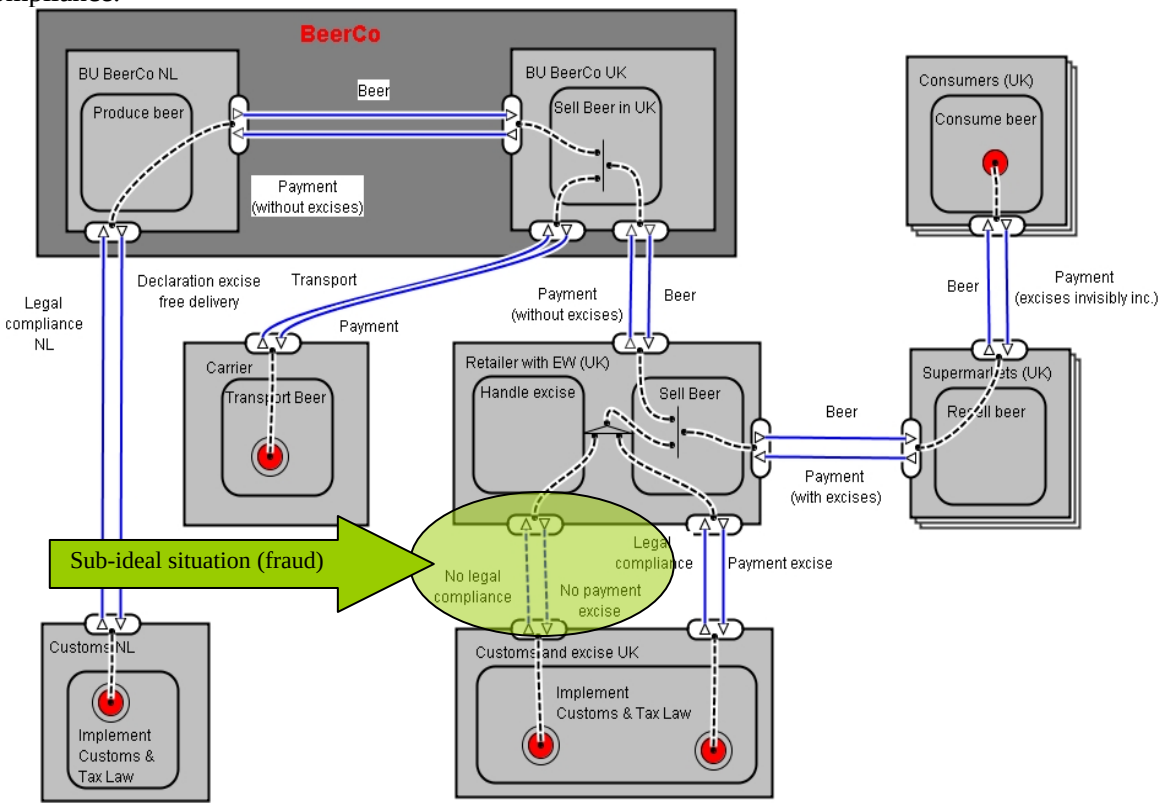

Figure 4. Example sub-ideal business model for beer export: The UK retailer does not pay excise in the UK.

Actors			**Activities**			**Documents**		
R-actor	E- actor	C- actor	O-activity	E- activity	C-activity	To-be-verified Doc.	Supporting Doc.	Verified Doc.
BeerCo NL	EW/ Customs UK	Customs NL	Export beer from NL to UK without excise payment	Evidence/ witness beer exported by BeerCO NL indeed arrives in UK and stamp AAD-doc	Verify excise declarati-on	Excise declaration	Stamped AAD-doc	Excise Declaration Acknowledgement

Table 3. AAD components

	Control Principles	**Specification**	**Check (Yes/No)**
P1	*Does the control activity exist and follow the corresponding operational activity?*	Operational activity: Declare export without excise payment Control activity: Verify excise free declaration	Yes
P2	*Can the Control actor directly witness the execution of the operational activity? If not, is the evidencing (witnessing) activity delegated to an evidencing actor (trusted third party)?*	No direct witness Control actor: Customs NL Evidencing actor: EW/ Customs UK (Trustworthy)	No direct witness. Yes, the evidencing activity is delegated.
P3	*Is there a supporting document furnishing the evidencing activity?*	Supporting doc. : AAD-doc Evidencing activity: acceptance of beer shipment by EW and Customs UK	Yes, but it is only checked upon request.
P4	*Is the supporting document the result of the previous evidencing activity directly witnessing the operational activity to be controlled?*	Supporting doc. AAD-doc is directly stamped after EW/Customs UK witness the import (i.e. completion of the export activity)	Yes

P5	*Is the supporting document directly transferred to the control actor from the evidencing actor who witnesses the operational activity to be controlled?*	The AAD-doc is not directly transferred to the control actor, Customs NL, but via the responsible actor, BeerCo	No
P6	*Is the supporting document generated by an actor independent of the actor who generates the to-be-verified document?*	Actor issuing the document to be verified: BeerCo Actor issuing/ testifying the supporting documents: EW/Customs UK	Yes
P7	*Are the operational activity and its corresponding control activity segregated into two different positions and done by two different actors?*	Operational activity is performed by O-actor: BeerCo Control activity is performed by C-actor: Customs NL	Yes
P8	*Are the actors responsible for the operational activity and its corresponding control activity socially detached?*	Operational activity is performed by O-actor: BeerCo Control activity is performed by C-actor: Customs NL	Yes

Table 4. Checklist for applying AAD control principles

The above checklist shows that the AAD-doc-based procedure violates control principles 3 and 5. Figure 5 shows the control process model in the current situation. The dashed outline indicates control problems: the supporting document (AAD-doc) is not transferred directly from the evidencing actor (EW/Customs UK) to the control actor (Customs NL) and checking AAD-docs is often not done.

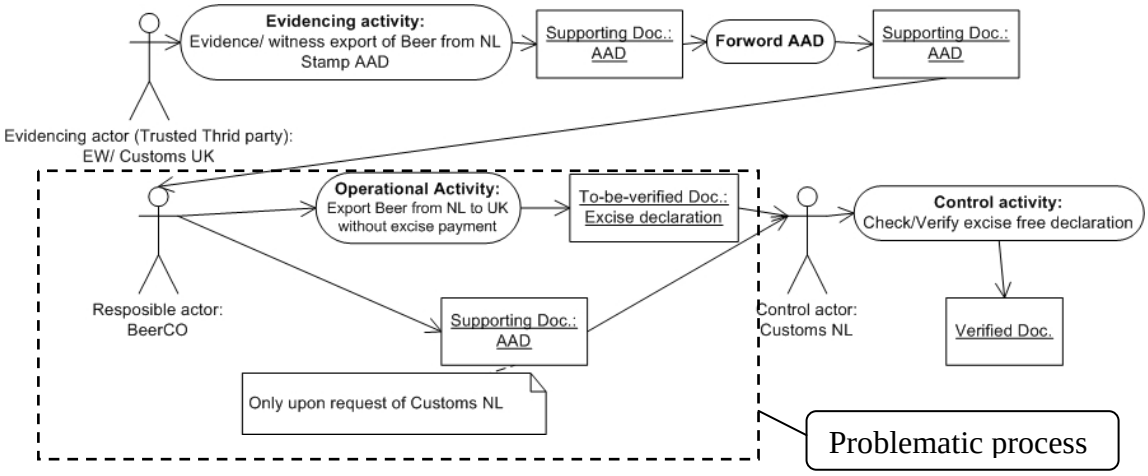

Figure 5. Control problems in the current EU procedures for intra-EU trade in excise goods

Besides control flaws, the current procedure includes an efficiency flaw. Namely, the AAD-doc is used only for excise handling, while separate information flows are required for export declaration, VAT handling and national statistics. These separate information flows involve very similar commercial data, but are processed by different information systems, thereby creating redundancy and high operational costs for businesses and governments.

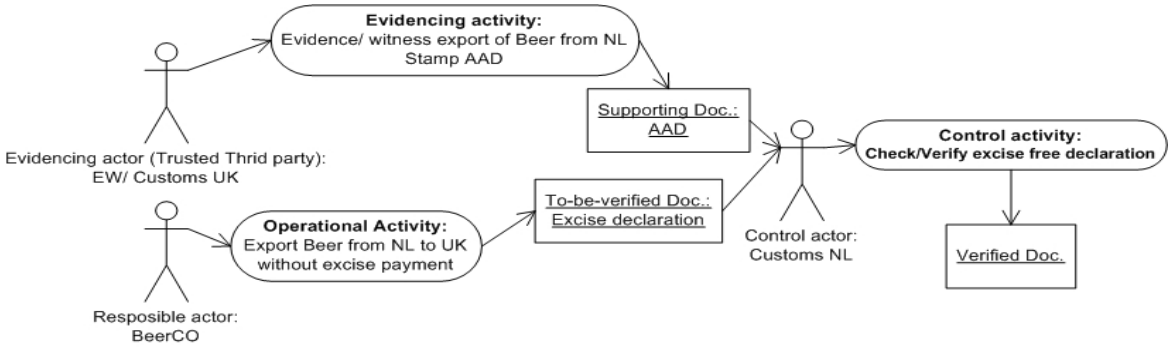

Figure 6. Redesign of the paper-based AAD-doc procedure according to the AAD control model

4.3 Step 3. Process perspective: Apply the AAD approach to redesign control mechanisms

The AAD control model (see Fig. 3) serves as a template for new procedure (re)designs. In the simplest redesign, good control with the paper-based AAD-doc is achieved if AAD-docs are transferred directly from EW/Customs UK to Customs NL and verified (Figure 6). However, there are inevitable drawbacks of the paper-based solution, as it is time consuming, fraud prone, and does not support Internet-based supply chains.

Currently, European governments and businesses are developing ICT-based solutions to cope with these and other deficiencies in international trade. One solution is *smart seals* as TREC devices. The TREC (Tamper-Resistant Embedded Controller) 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 the 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)[6]. By monitoring a container's position coordinates, automatic messages can be sent by TREC devices to supply chain partners and Customs NL, when containers actually leave the Netherlands, or deviate from their predefined routes. TREC devices could therefore replace the AAD-doc's functionality to provide evidence of export.

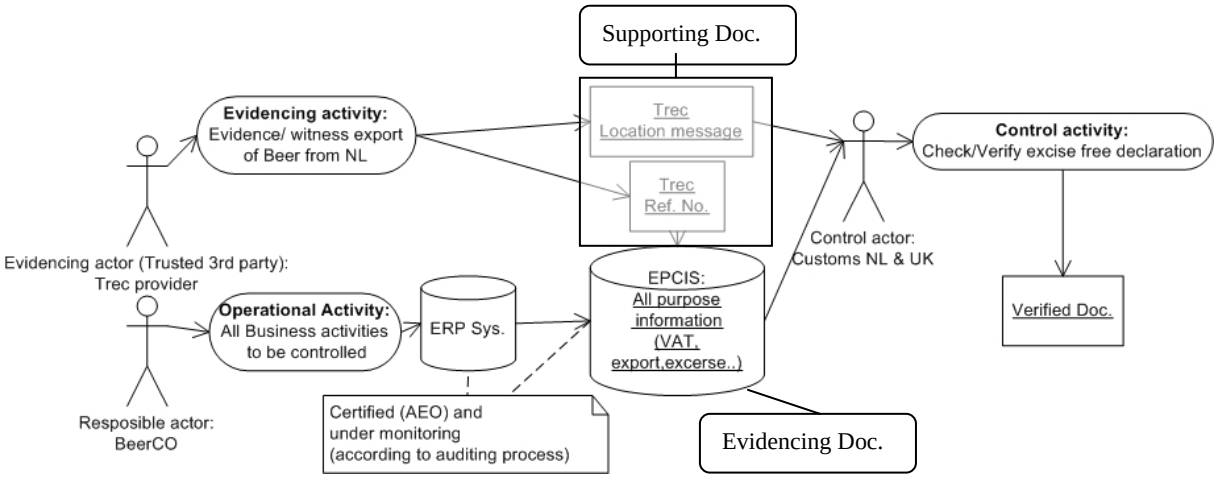

Figure 7. Control with TREC devices and related Internet-based EPCIS technology

Next, we describe the core ideas of this solution. When BeerCo NL prepares a shipment of beer, it can publish the goods' commercial data (originating from its ERP system) in an own database that is accessible through the Internet for authorized supply chain partners, including Customs NL. For the sake of the current discussion, we shall call this database EPCIS[7] without discussing it in detail. As soon as the beer container is closed at the premises of BeerCo NL, the TREC device on that container triggers sending a message to the carrier, and a notification is sent to Customs NL. This message contains a unique reference number, which the carrier and customs can use to retrieve commercial data from BeerCo's EPCIS over the Internet, and use it for all of their procedures, including excise, VAT, statistics and more. Hence, data is kept at BeerCo and is accessible for all relevant government systems, also for periodic audits. As soon as a container physically leaves Dutch territory, the TREC device triggers sending a message to Customs NL, 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 unique shipment reference number that the TREC device provides – to the commercial information identifying this shipment in BeerCo's EPCIS. This solution therefore supports a main goal of the EU: to design simplified customs procedures for businesses that have a high degree

[6] Further information on TREC technology 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 January 12, 2007

[7] The EPC Information Service [EPCIS] is a specification for a standard interface for accessing EPC-related information. An Electronic Product Code (EPC) gives each object a unique serial number, each individual object can be tracked, and fine-grained real-time information about each object can be collected, stored and acted upon. See http://www.epcglobalinc.org/

of control of their supply chain, referred to as AEOs – Authorized Economic Operators (EU Commission, 2005). We visualize the new procedure in Figure 7.

The AAD model serves again as a template to validate that the new procedure complies with theoretic principles and hence does not include control flaws. Namely, *as the new procedure is an instantiation of the model in Figure 3, it complies with the proposed AAD control model*. The evidencing actor's role is assumed by the TREC service provider (that should be certified by the government). The supporting document (electronic TREC location message) is sent directly to the control actor (Customs NL) without possible manipulation by intermediate parties. By using handheld devices, customs officers can access TREC devices and commercial data in BeerCo's EPCIS. This enables customs officers to obtain secured and reliable information about the content of a container. The TREC performs real-time "evidencing" when sending a message to Customs NL as soon as the container has left the Netherlands. It supports an IT-based 100% check of excise-free declarations for Customs NL, because electronic TREC messages will be sent for every secured container to Customs NL and verified. This is opposed to the current situation, where humans do sample testing of the paper-based AAD-docs, and therefore for many companies control hardly ever takes place.

4.4 Step 4. Value perspective – Financial Feasibility Evaluation

The paper-based AAD-doc is replaced by TREC and EPCIS technology. New controls require a new actor – the TREC provider – to be involved. The introduction of the TREC provider may change the roles-linkage among network actors and the structures of the business network. The new actor (indicated in the dashed frame) and change of value transfers can be seen in the value-based business model in Figure 8. From the perspective of Customs NL, the TREC technology and related services are used as a control mechanism, to verify BeerCo's excise declarations. The uniqueness of this business network is that when control is performed by an external commercial party combined with ICT solutions, a higher degree of control is achieved. From BeerCo's perspective, the TREC technology enables more control on the supply chain. Namely, using TREC devices (1) BeerCo can always tell where exactly its shipments are, and (2) theft and smuggling are prevented or detected immediately by detecting unauthorized container openings.

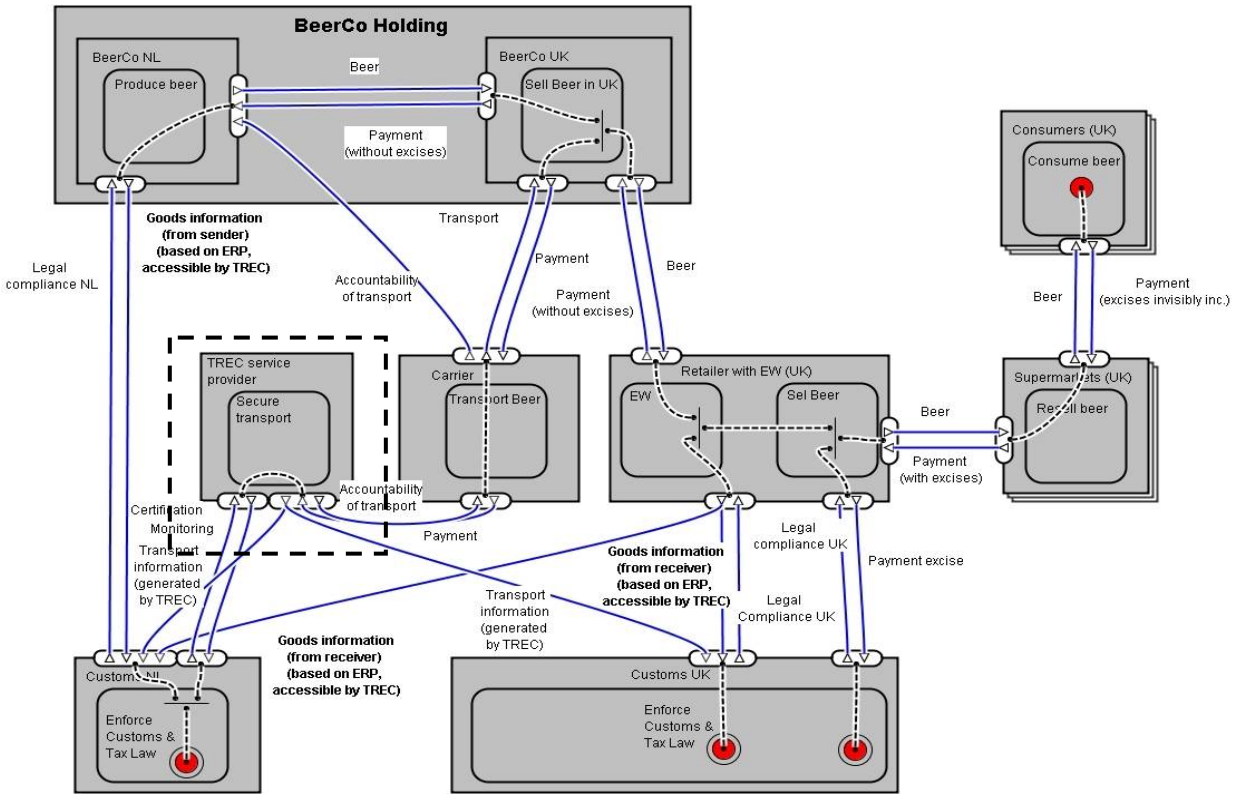

Figure 8. TO-BE business model: with TREC.

The model in Figure 8 is used to evaluate the financial feasibility of the redesigned procedure: whether all actors can make profits or increase their economic utilities. The services of using TREC devices have a price tag, and BeerCo NL will have to pay a fee per shipment for using the device. The new actor – TREC provider – will increase their profit through charging for the services, and Customs NL will enjoy a better control of the excise payment. BeerCo will have to pay for TREC services. Some incentive is required for BeerCo to justify these costs. This incentive can be provided by Customs NL in the way of granting AEO certifications to business partners. The idea of AEO is that if a business can prove to the Customs that it controls its own processes well enough with modern ICT to ensure the safety and security of its international supply chain, the Customs grants an AEO certificate to this business. The AEO status will result in tangible benefits such as expedited processing and less physical inspections by the customs offices. Companies that use TREC or similar technologies have a better control of their supply chain, and therefore can be certified as AEOs by customs offices.

5 CONCLUSIONS AND FUTURE RESEARCH

We present e^3-control, an analysis tool for procedure redesign. Our study contributes to both business practice and research. From a business perspective, our model-based approach is shown to be a useful tool for redesigning customs controls; it enables identifying control flaws and validating compliance of procedures with control principles. Visual models capture business intricacies in a network organization. They therefore serve as a supporting tool in discussions aimed at eliciting knowledge from business experts and exploring possible procedure redesigns. From a research perspective, the contribution of this paper is twofold. First, rather than developing new theories of inter-organizational control, we *conceptualize* existing knowledge, so that it can be used for systematic and structured reasoning. The AAD components, control principles ad control model can serve as logical fundaments to develop IS tools to support domain experts in control procedure (re)design. Second, the combined value and process-based redesign is a novel approach for control procedure redesign, because it takes into consideration control concerns, but also the financial feasibility of introducing controls into a business model, and the shifts in roles when control is offered as a commercial service. The value perspective enables not just financial feasibility analysis, but also reducing complexity by focusing the control analysis on critical value transfers. An in-depth case study of a current e-Customs pilot concerning beer export illustrated this. We use the value perspective (Kartseva et al., 2005) to understand the context, and we extend this research with the structured and systematic AAD approach for analyzing control problems and redesigning control mechanisms in business processes.

Future research efforts will be focused on following directions. First we will study other cases to test the applicability and generalizability of our approach. Second, we will seek to extend our AAD control principles using new insights from accounting and auditing literature. Third, we will investigate the effectiveness of AAD based software tools to support domain experts in designing control procedures.

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