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Towards Asymmetric Information for the G2B Inter-Organizational Networks

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Abstract

With the emergence of innovative (networked) organization forms such as enhanced supply chain collaboration and modern forms of public-private partnerships (PPP), effective and efficient collaboration among network participants becomes crucial but often difficult to achieve. One of the leading factors which cause such defective collaboration is the asymmetric information issue among the network participants. Two identifiable problems resulted by the asymmetric information are the moral hazard and adverse selection problems. Former studies mainly positioned asymmetric information problems within the context of traditional business environment; in this paper we suggest that similar problems may also occur in the Government to Business (G2B) context. We discuss these issues via a collaborative pilot case study (hereafter, Beer Living Lab) between the Dutch Tax and Customs Administration (DutchTCA) and a Dutch beer company (Beer Co.). The paper reveals that both moral hazard and adverse selection problems may occur during the G2B interactions and tamper the relationships between the two. In addressing these problems, we propose an advanced information technology (IT) solution, drawing upon an effective and efficient information sharing schema that can on the one hand minimize the moral hazard by enhancing supply chain management for the business and on the other hand preventing tax fraud for the government. Further we argue that the application of the advanced IT may serve as a strong signaling and screening tool for overcoming the adverse selection problem during the PPP forming and result in a win-win situation. The insights learned should benefit those involved in various inter-organizational business networks, partnership as well as supply chain management settings.

Keywords: Asymmetric information, Inter-organizational networks, Information sharing, PPP, Procedure design.

Introduction

The emergence of new lateral organizational forms (e.g., Internet-based supply chain partnerships) has been a phenomenon for e-business over the last decade. Collaborative and networked inter-organizational forms have provided competitive advantages that a single organization can hardly achieve alone. Not only industry can benefit from such inter-organizational networks, the public sector can benefit from forming collaborative networks with businesses as well. Potential benefits are clearly identifiable, especially in the government tax and customs domain. For example, the estimated annual savings of introducing electronic invoicing systems across the EU governments would exceed €50 billion (EU Commission, 2006b). Somehow, forming such G2B collaborations

are often difficult. Facing the current situation that the government procedures are mostly still paper based and not necessarily harmonized, and different concerns between government and business (e.g., different value perspectives, legislation/political concerns), the problems caused by the information asymmetry are almost inevitable and will temper the effectiveness of the network collaboration.

Different with former studies, we expand the theory of asymmetric information to the IS network research and focus on the role of IT in solving with the asymmetric information problems; in addition, we extend the analysis of information asymmetry from the traditional B2B environment to the G2B inter-organizational network settings. In this paper, we provide clearer insights on: 1) how information may influence organizational behaviour and thus play an important role for setting up the inter-organizational networks; 2) what the special concerns of information asymmetry and its related problems are under the G2B context; 3) especially, we provide a case demonstration on how such problems can be identified in the real world setting and how inter-organizational IT solutions should be conducted to cope with the asymmetric information problems.

With a current case study of the *Beer Living Lab* (*BeerLL*), we identify two typical asymmetric information problems, namely, the moral hazard (happens when collecting business tax) and the adverse selection (happens when government selecting/certifying private partners) problems. A modern IT solution (TREC with EPCIS, see section 4) that may provide an effective and efficient information sharing schema is proposed. The solution mitigates the moral hazard problem by on one hand enhancing supply chain management (SCM) for businesses and on the other hand preventing tax fraud for the government. We further argue that, the application of advanced IT (e.g., TREC device) may serve as a strong signalling and screening tool from preventing the adverse selection problem for the PPP forming. The results from this paper may provide EU governments more effective selection criteria for the AEO certification.

The rest of the paper is organized as follows. First, In Section 2, we give a short introduction of the theory of asymmetric information and the two economic problems (moral hazard and adverse selection) caused by the information asymmetry. In Section 3, we focus on the asymmetric information problems in the G2B relationships and how this may influence the relationship forming. In Section 4, a case study of Beer Living Lab is introduced and recommended solutions are elaborated. Finally, in Section 5, conclusions and discussion about future research are presented.

Information Asymmetry

The theory of asymmetric information has been lively developed in the field of economic research for the last two decades. The prominent foundations for this theory were established by George Akerlof (Akerlof, 1970), Michael Spence (Spence, 1973) and Joseph Stiglitz (Rothschild & Stiglitz, 1976). **Information asymmetry** occurs when one party has more or better information than the other party; it assumes that at least one party to a transaction has better relevant information whereas the other(s) do not. Typically it happens in a transaction that the seller who knows more about the product than the buyer (e.g., selling a second-hand car), however, it is also possible for the reverse to be true: the buyer knows more than the seller (e.g., buying an insurance policy). Information asymmetry has mass effect on the business networks, e.g., supply chains. Fiala (2005) indicates that information asymmetry is a key source of supply chain inefficiency and strategic partnerships and information sharing can help to cope with the "bullwhip effect"[1] (see (Lee et al., 1997b; Lee et al., 1997a)) caused by the information asymmetry in supply chains. Because of lacking information and information lagging among supply partners, the demand/supply in supply chain can not be well managed and the quality of the product is hard to maintain. Mishra et al. (2007) point out that information distortion may reduce the benefit levels or

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[1] It describes growing variation upstream in a supply chain, which is one of the most poignant demonstrations that decentralized decision making can lead to poor supply chain performance. For details, refer to Lee et al. [20, 21].

even stop information sharing in supply chains. There are two typical problems asymmetric information may trigger, namely, moral hazard and adverse selection.

Moral hazard refers to "situations where one side of the market can't observe the actions of the other. For this reason it is sometimes called a *hidden action* problem" (Varian, 2002). In addition, it means the chance, or hazard, that a party in a transaction with more information about its intentions or actions behaves in a way that a party with less information would consider inappropriate, or in the extreme, "immoral". It arises because an individual or institution in a transaction does not bear the full consequences or can hide the consequences of its actions without counter party knowing, and therefore has a tendency or incentive to act inappropriately. An example of moral hazard is when people are more likely to behave recklessly if insured, either because the insurer cannot observe this behaviour or cannot effectively retaliate against it, for example by failing to renew the insurance.

Adverse selection generally refers to a market process in which bad results occur due to information asymmetries between buyers and sellers, where the "bad" products or customers are more likely to be selected and the "good" ones are driven out of the market. It has been discussed extensively in the fields of economics, insurance, and risk theory. An example of adverse selection in the insurance market is when people who are of high risk are more likely to buy insurance, because the insurance company cannot effectively discriminate against them, the same premiums are set by the insurer for both groups with high risk and low risk. The insurance company anticipates or learns that the cost of the combined policy holders exceeds that of the general population, and sets the higher premiums accordingly. The result is that people with lower risks tend to go uninsured. Furthermore, as more low risk people are leaving, the premiums have to be raised further such that more people are driven out of the policy. Another famous example is illustrated by (Akerlof, 1970) for the second hand car market, which is referred as the "lemon market"--people buying used cars do not know whether they are "lemons" (bad cars) or "cherries" (good ones), so they are willing to pay a average price that lies in between the lemons and cherries. As a result, the same situation as in the insurance market happens here, the "cherries" will be driven out and "lemons" will dominate the market. The similar findings are also supported by the recent e-commerce research of Liao & Cheung (2001) that the "poor vendor quality, especially as regards "lemons", is identified as a significant disincentive to virtual retailing over the Internet".

Both moral hazard and adverse selection can be explained in the agency theory [related theory with asymmetric information, more details see (Eisenhardt, 1989)] as agency problems, which comprise two forms that agency problems may take shape. Arrow (1984) equates these two terms with hidden action and hidden information, respectively. Moral hazard arises when the action undertaken by the agent is unobservable and has a differential value to the agent as compared to the principal. Adverse selection problems arise when the agent has more information than the principal.

With the fast development of the IT (information technology), more recently, the theory of asymmetric information has been expanded in the field of economics of information technology and discussed by various researches [e.g., (Garicano & Kaplan, 2001; Varian, 2002; Varian et al., 2004; Wigand et al., 1997; Stiglitz, 2000; Kauffman & Mohtadi, 2003)]. These papers however, mainly focus on the economic impacts of the information technology (i.e., the value of information, information goods and involving transaction costs etc.); very little insights have been given on how IT should be implemented to cope with various asymmetric information problems.

Asymmetric Information Problems between Business and Government

As discussed in the last section, former studies mainly focus on the effect of asymmetric information under the market oriented (e.g., labor market, commodity market, insurance market and stock market) business context. Government, on the other hand was perceived to be out of the scope of the free market, due to its traditional functions of rule setting, intervening and controlling. For this reason, very little attention has been paid to the asymmetric information issues between

profit driven businesses and public good oriented government. However, the recent movement of the public sector transformation of forming the so called public-private partnerships (PPP), which a government and a private entity collaboratively undertake traditionally public activity (Naschold & von Otter, 1996), has made the boundary between the government and private business become less and less obvious. In this section we put our focal point on this transforming regime and discuss whether asymmetric information problems of moral hazard and adverse selection can also be triggered during the business and government interaction.

Moral Hazard in Government Control

One of the most important roles for government in the G2B relationship is the government control role. Such control is especially important for the Tax and Customs Administration, as it is directly related with the national tax revenues. EU governments have been experiencing severe loss from various tax frauds. According to EU Commission (2006a), estimates of tax fraud of 2 to 2.5% of GDP are mentioned, which is about 200 to 250 billion Euro per year at EU level. Such tax fraud is a fitting example and can be interpreted as the moral hazard problem caused by the symmetric information.

An illustrative example is the VAT (Value added tax) collection. Simply two parties are involved here: a private company who is obliged to declare VAT and pay the tax; and a Tax office as a government agency who audits the tax report and control the VAT collection. Under perfect information, tax office obtains complete information and knows about company's exact operation; in the mean time the private company reports and pays full amount of VAT honestly to the Tax office (Figure 1a). However in the real world, the private company always knows better about its own operating details and the real value of transactions, whereas the Tax office does not. Private company has better information than the Tax office and thus has incentives to hide and even falsify certain information from Tax office to get tax advantages. If such incentive is obvious and easy to achieve without tax office knowing, or the penalty of defaulting is not severer enough, the private company will choose to cheat --- a moral hazard problem is caused that the tax office receives less VAT than it should have (Figure 1b).
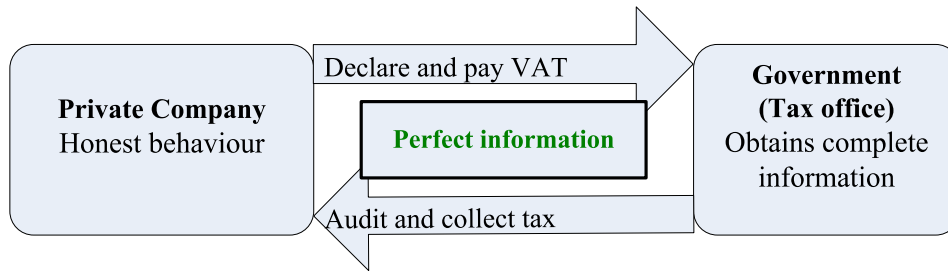

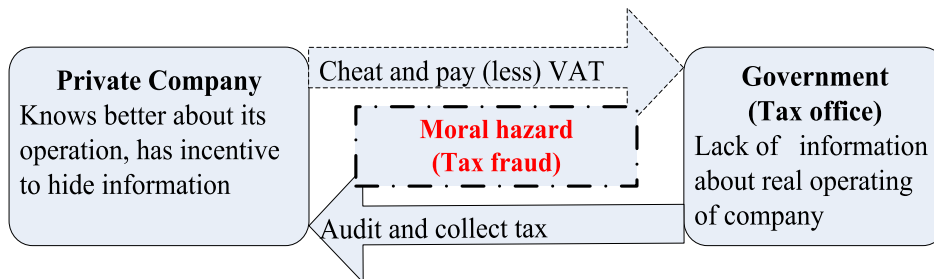***Figure 1a.*** *Ideal situation of tax control under perfect information*

Figure 1b. *Moral hazard of tax control (tax fraud) under asymmetric information*

Adverse Selection in G2B Partnership Forming

The second problem --- adverse selection is more complex than the first one. It happens often when government bodies select private partners and give certificates to these companies. The current in the spotlight Authorized Economic Operator (AEO) certificate may serve here as a good example.

The idea of AEO is that each EU Member State Customs Administration can establish partnerships with private sectors and certify them with AEO certifications. The involvement of the private companies in AEO will enhance the safety and security of international trade and the certified AEOs will enjoy tangible benefits such as fast customs clearance and simplified procedures. According to EU parliament and the Council (2005), "Customs authorities, if necessary following consultation with other competent authorities, shall grant, the status of 'Authorized Economic Operator' (AEO) to any economic operator established in the customs territory of the Community. An AEO shall benefit from facilitations with regard to customs controls relating to security and safety and/or from simplifications provided for under the customs rules."

A critical issue here is that the AEO certificate is quite unlike other governmental requirements; it is voluntary rather than compulsory. It requires "… *no obligation* for economic operators to become AEOs, it is a matter of the operators' *own choice* based on their specific situation. Nor is there any obligation for AEOs to require that their business partners have also to obtain AEO status" (EU Commission, 2007). Companies are no longer obliged but can bargain and make their own decisions whether or not to qualify for the AEO certificate (at the same time also fulfilling the requirements). The increased bargain power from business side makes it rather difficult to promote the idea of AEO, as each individual company has its own concerns and specific reasons of joining or not. It would be convenient for the EU government to set a non-exclusive single policy for all the companies who are willing to participate. However, facing the divergences among multinationals and SMEs (small and median sized enterprises), such a single policy is very difficult to reach. Though a great effort has been made in developing the most recent AEO guidelines (EU Commission, 2007), the implementation of these guidelines still needs to occur.

A problem raised here is that if the government can not effectively differentiate companies and only applies a single standard to all the companies in the certificate market, similar adverse selection problem like in the insurance market may occur: The "good" (compliant) companies tend not to join because the AEO requirement is too strict and they see no fair value for them to participate ---"We are compliant companies with good reputation, and our current procedure is simpler than others anyway, why should we invest more to get the AEO certificate?" (Based on interviews with a Netherlands-based international beer company). On the other hand, the "bad" (cheating) companies may see more visible benefit (less checking and simplified procedure may create an easier way of making fraud) and are more willing the get the certificate (See Figure 2).

The original purpose of the government is to provide minimal physical control and simplified procedure via the AEO certificate to the compliant companies and enforce more control effort on the cheating companies. As indicated in the interview with the Dutch Tax and Customs Administration (DutchTCA) --- "If companies are already in good control themselves, why should we (DutchTCA) waste our resource to exert extra control on them?" However, the consequences of the adverse selection problem may reverse government's expectation: as the "good" companies could not get enough incentive to join and will be automatically driven out of the "certificate market" by the "bad" ones. And a continuous scenario is even worse: as more "bad" companies will take the certificate and commit fraud, the AEO requirement will be set even stricter and become less desirable for any "good" companies to join --- a market failure is created. Nevertheless, there are remedies for adverse selection problem. Further elaboration on this issue will be discussed in later sections of this paper.
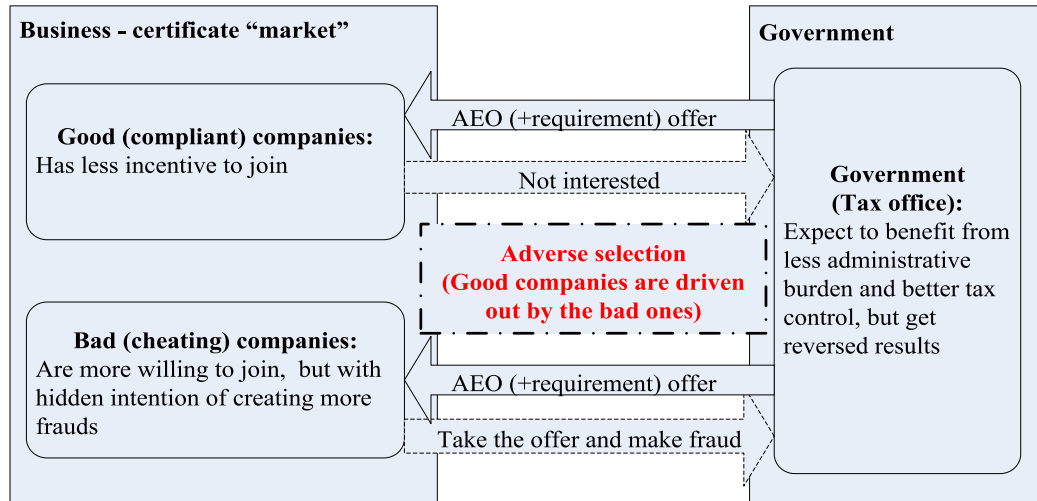
Figure 2. *Adverse selection caused during AEO certification procedure (Market failure)*

Case study: Beer Living Lab

To further elaborate issues discussed above, we present a real life case study of a collaborative project (referred to as the *Beer Living Lab*) between the Dutch Tax and Customs Administration (DutchTCA) and a NL-based international beer company (Beer Co.). The purpose of the *Beer Living Lab* (*BeerLL*) is to create a win-win situation between the business and government that on the one hand the administrative burden will be lowered for business and on the other hand the tax fraud will be minimized and better security and control can be facilitated for the government [the detailed discussion of the living lab concept itself is revealed by (Tan et al., 2006; Baida et al., 2007b)]. The *BeerLL* is a unique case study that provides researchers a great opportunity of carrying out multi-facet researches including eCustoms study (van Stijn et al., 2007), control procedure redesign (Baida et al., 2007a; Liu et al., 2006; Liu et al., 2007) and collaborative network study (Frößler et al., 2007; Rukanova et al., 2007) etc. In proceeding with the research, we found that the informational aspect of the *BeerLL* is rather interesting that it influences not only organizational control procedures but also inter-organizational network forming. We link the underlying phenomenon in *BeerLL* with the theory of information asymmetry and discuss how it may play a role here. Further we elicit how advanced IT solutions (e.g., the *BeerLL* solution) may cope with the asymmetric information problems and create a win-win situation between the government and businesses.

Moral Hazard in BeerLL

Beer Co. (NL-based, but has international subsidiaries like Beer Co. UK, US) as an international brewery company carries out a huge amount of trade everyday, involving with multiple supply chain partners and government agencies. The moral hazard problem mainly appears in two places in its inter-organizational trade procedures, namely along supply chains and between business and government interactions. Along the supply chain, Beer Co. is involved with many suppliers, distributors around the globe. From raw material to the final product at the customers, the amount of information interchanged in Beer Co's supply chain is considerable. To minimize problems caused by the information asymmetry, Beer Co. would like to have an information sharing schema that can provide full control and transparency of its supply chains. Such schema shall not only enhance the order-make management of Beer Co., but also safeguard its brand image and break down possible counterfeit that may be caused by the fraudulent supply chain partners.

The other area that moral hazard problem can be triggered is laying underneath the interaction between businesses and government, especially in the tax report and Customs declaration

procedures when DutchTCA collecting taxes and monitoring business activities of the Beer Co. As we discussed before, businesses always have better information than the government about their own operation. They may have an incentive to hide certain (fraudulent) actions to achieve certain benefits. According to our interview with Beer Co. and DutchTCA, several frauds can be involved in the BeerLL trade procedure. However, the current tax and Customs control procedure is not effective enough to cope with these problems. The main reason behind is that the current Custom control is mainly based on the paper based AAD-doc (accompanying administrative document), EW[2] (excise warehouse) and physical inspections these three methods. Given an example of Customs control procedures when Beer Co. exporting beer from NL to UK. The AAD-doc performs an essential role in this Customs control procedure. 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. For control purpose, 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.

There exist two major disadvantages of this procedure 1) Timeliness: transferring of the paper-based AAD-docs can take weeks or even months, and the verification is done several months later. In practice, this checking is often not done at all because it is too labor intensive. As a result, Beer Co. NL only submits AAD-docs upon request of Customs NL; 2) Too many parties' involvement: the AAD-doc based control relies on many commercial parties (e.g., Beer Co. NL and UK, EW, shipping company) who may have direct interest of violating this control to reach their own financial interests. Each one of them (or colluded) has the opportunities to alter or hidden critical information/actions (especially, paper based AAD-doc can be easily falsified) from the other, which may result in moral hazard and possible control fraud. We interviewed and identify these possible moral hazard problems in Table 1. According to the EU Commission [8], excise fraud for alcohol in the EU amounts to €1.5 billion yearly, approximately 8% of the total excise duties receipts on alcoholic beverages. DutchTCA as a government control agency would like to detect and minimize all the possible tax fraud. It requires an information sharing system with control efficiency and effectiveness that on the one hand can minimize administrative burden and on the other hand may facilitate effective auditing control.

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[2] An excise warehouse is a warehouse which has been authorized by the authorities for the deposit without payment of duty of goods liable to excise duty.

Table 1: Examples of moral hazard in the Beer LL

Moral Hazard Problem	Possible defaulting parties		Description of hidden actions	Current control mechanisms
1.	Single party defaulting		One of the parties along the supply chain does not fulfill(intentionally or unintentionally) its responsibilities and hides this from others	AAD-doc., EW, Physical checks
	1.1	Beer Co. NL	Beer Co. NL does not pay excise of beer within NL (Claim beer selling abroad but actually sells in NL)	AAD-doc.
	1.2	Beer Co. UK	Beer Co. UK sends falsified AAD back to Beer Co. NL, but does not register it in their administration nor reports to Customs. Beer Co. UK sells beer without paying excise	EW
	1.3	Beer Co. NL/ Beer Co. UK	Beer Co. NL/UK presents a product as a product from another category(soft drink instead of beer)	Physical checks (Random checks on Beer Co. NL/UK)
	1.4	Excise warehouse (EW)	EW does not pay or pay less excise (rarely)	EW certification
	1.5	Retailer with EW	Retailer with EW does not pay or pay less excise	AAD-doc.
E.g.	Virtual shipment		A party buys goods from Beer Co. NL and "virtually" ships the goods to a country with low excise percentages (e.g. Poland), but sells them in NL or UK.	AAD(Documentation), physical stop checks
	Fake Beer Co.		Parties impose to be trustworthy companies (like Beer Co.) by sending goods packed with the Beer Co. label and falsely stating that the product is indeed made by Beer Co. By doing so fake parties enjoys less control than it should have and will not pay excises over these products, even	Physical stop checks & Authorization (Possibly Beer Co. AEO certification?)
	Smuggling		Carriers (criminal truck drivers) smuggle illegal goods within Beer Co. containers	Asset safe guard & Physical checks (Random checks on Beer Co. NL/UK)
2.	Multi-party collusion		Parties collude with each other in order not to get advantage of the system (e.g. pay less excises)	Third party checking, and random physical checks
	2.1	Beer Co. NL& Beer Co. UK	Beer Co. NL& Beer Co. UK collude with each other in order not to pay excises	EW
	2.2	Beer Co. UK & Retailer with EW	Beer Co. UK & Retailer with EW collude with each other in order not to pay excises	AAD-doc.
	2.3	Beer Co.(NL+UK) & retailer with EW	Beer Co.(NL+UK) & retailer with EW collude with each other in order not to pay excises	Physical checks
E.g.	Black market		Beer Co. NL ships excisable goods to UK accompanied with an AAD, but Beer Co. UK (can be other companies) colludes with retailer with EW. The goods disappear in the black market without excise payment. Customs will not receive AAD for the goods. The fraud will be revealed but too late-- three month period	EW & Reconciliation (Independent check of performance)

Redesign Solution: Effective Information Sharing Schema with Imbedded IT Based Control

To cope with the problems identified above, Beer Co. together with DutchTCA, academic researchers and interested technology providers designed an innovative TO-BE solutions based on advance IT. This solution has been piloted since year 2007 and has received quite positive feedbacks from various fields in and outside the project. The redesign solution sets up effective inter-organizational information sharing schema as well as imbedding IT based control mechanism into the system.

- First, the BeerLL solution provides an effective and efficient information sharing schema that links Beer Co., its supply chain partners and DutchTCA together. A simple but useful

definition of inter-organizational information system (IOS) is given by Cash and Konsynski (1985) as "an automated information system shared by two or more companies". An IOS is built around information technology that facilitates the creation, storage, transformation, and transmission of information, which differs from an internal information system by allowing information to be sent across organizational boundaries. Wigand et al. (1997) discuss in their book various of organizational boundaries and information models for setting up IOS that can cope with these limitations. The setting up of the BeerLL ISO relies on the Electronic Product Code Information Services (EPCIS) using a Service-Oriented Architecture. Container Information Services (CIS) use the EPCIS non-proprietary standards of EPCglobal3. The data sharing mechanisms use a Service Oriented Architecture (SOA) to allow secure information sharing between supply chain partners as well as government agencies. All supply chain partners (e.g., seller, buyer and carrier) will publish their data regarding a shipment in the EPCIS databases; the data will then be available for other supply chain partners as well as for the government.

- Second, the redesign procedure takes imbedded control mechanism into account. The imbedded control is realized via the application of the TREC[4] smart seal technology for container security, which has the following features: (1) sensors to monitor parameters including humidity, temperature, shock and unauthorized container openings; (2) real-time container location traceability through continuous satellite connection; (3) connection to backend systems during transport; and (4) ability to send information and alerts in case of predefined rules (e.g., container arrives at or leaves a geo-zone; temperature lower or higher than predefined limits). According to the *BeerLL* vision, Beer Co. will ship its goods in TREC-armed containers. Being *smart seals*, the TREC devices can ensure shipment integrity, and enhance security. By means of using handheld devices, customs officers can use TREC devices to obtain access to the EPCIS databases of all supply chain partners, where commercial data about shipments is available.

Instead of setting up separate direct links between each other, above mentioned organizations will set up an inter-organizational information system (IOS) based on the same EPC standards. Each partner in the network will extract the data they would like to share from their own Enterprise Resource Planning (ERP) system to the client EPCIS, from which the shared data can be retrieved. And a central EPCIS is applied as an intermediate, which provides directory service that collecting, matching and submitting information to the connected parties automatically or based on their query. TREC is used as an extra safe lock to ensure that critical information is achieved and sent in real-time without fraud. TREC information is sent to the central EPCIS that can be retrieved in real-time by network partners. If anything goes wrong (e.g., unauthorized opening of container or change of information), TREC will send an automatic alert to the relevant parties. Through such an information sharing schema, real time information sharing will be possible along the supply chains. And for DutchTCA, it will get all relevant control information not only from Beer Co. but also from other supply chain partners and TREC as well, which will make the continuous auditing possible (See Figure 4). This IT solution of TREC (or similar technology), EPCIS and the service-oriented architecture replaces the current situation where the customs data is send from the business to DutchTCA via paper documents. This electronic exchange of data is not only much more efficient than the paper-based exchange, but it also enables DutchTCA to look for all kind of additional business data that can greatly improve the quality of their risk analysis of a business.

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[3] For further details see http://www.epcglobalinc.org, last accessed on Oct 31, 2007.
[4] Further information on TREC is available at http://www.zurich.ibm.com/news/05/trec.html and
http://www.zurich.ibm.com/csc/process/securetradelane.html, last accessed on Oct 31, 2007.
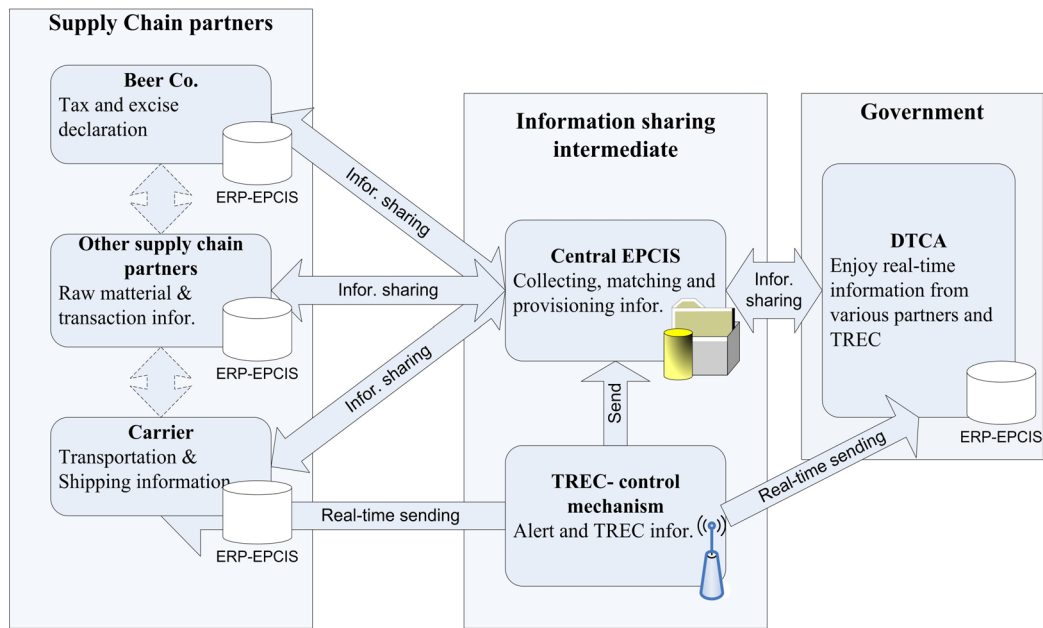
Figure 4. *BeerLL information sharing schema*

Adverse Selection

The second issue as we discussed before is the adverse selection problem caused by the information asymmetry during the public- private partnership (PPP) forming. Typically, when government certifies businesses, such problem often results in a market failure that the "cherries" are driven out and the market will be glutted with "lemons". The adverse selection problem puzzles the earlier discussed AEO certification as well. As the introduction of AEO will take legal effect in the European Community (EC) from 1 January 2008 (Joint Customs Consultative Committee (JCCC), 2007), further developing and guidelining the concept becomes an exigent issue. By studying the *BeerLL* case, we figure out a way out of the AEO adverse selection problem. We find that the application of advanced IT may serve as a strong signaling tool for businesses to show their types, which will enable the government to effectively differentiate "good" and "bad" companies for certification. "**Signaling**" has been considered as one of the most important strategies of solving asymmetric information problems in the job market and capital market [e.g., (Spence, 1973; Gertner et al., 1988)]. The general idea behind signaling is that one party (informed party) conveys some meaningful information (signal) about itself to another party (under informed party); with this extra information, the under informed party is able to differentiate different types of the other party and make sensible selection decisions. O'Reilly (1983) indicates that the quality of decision making increases with the decision maker's information level. However, if the quality of information itself can hardly or not at all be evaluated*, a decision-maker's visible information behavior is often used as an evaluation substitute for the quality of information and therefore decisions* (Feldman & March, 1981). They emphasize that information behavior can have important signaling effects on observers. In the *BeerLL* scenario, good companies like Beer Co. positively signal themselves with the adoption of the EPICS and TREC and the government (DutchTCA) will make the certificate procedure easier and more attractive for them. In the meanwhile, for the "bad" company A, as the signaling cost of implementing the required IT solution will overcome the potential fraud benefit it can get, it will simply decide not to take the AEO certificate. Anyhow, if the "bad" company B would like to have simplified tax and customs procedure and decides to take the AEO certificate, it needs to fulfill the IT requirement by either using TREC or other similar IT support. The implementation of the advanced IT solution itself will minimize the cheating possibilities of the "bad" companies and may finally transfer the "bad" companies to "good" ones. At the same time, instead of passively

receiving "signals" from applicants, DutchTCA can also actively **screen** [5] companies by embedding the application of advance IT in the AEO requirement that all applied companies should fulfill the IT requirement in order to get the certificate. With the IT screening from the government side and positive signaling by using IT from the business side, the adverse selection problem is tackled. The market will automatically correct itself that "good" companies will join and stay and the "bad" ones will be kept out of the market (See Figure 5).
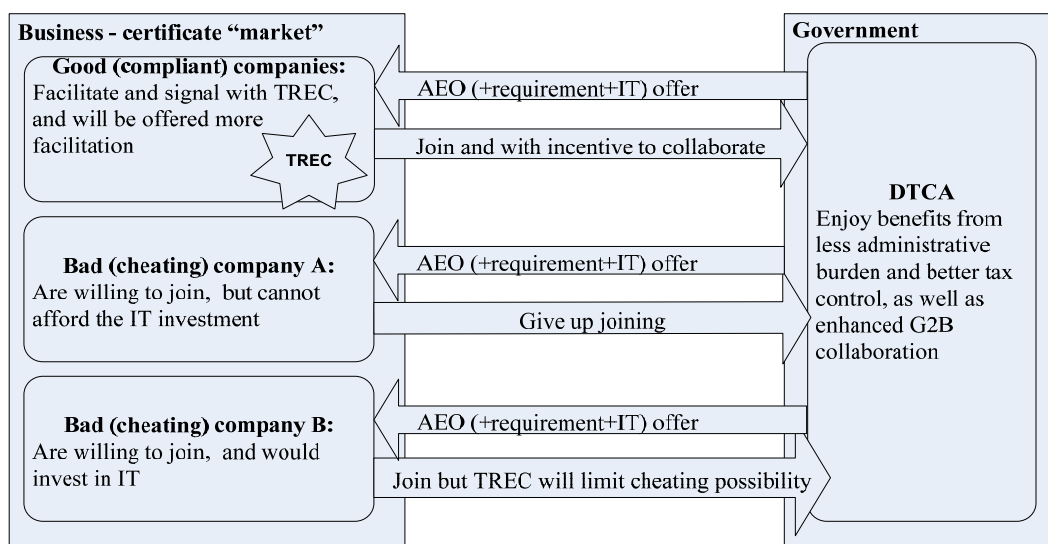

Figure 5. Advanced IT application for AEO certificate (Market correction)

Recommendations

By analyzing the *BeerLL* case with asymmetric information, we realize that procedure redesign is not as simple as process automation or mere replacement of paper documents with the electronic ones. Especially when organizations work together and form an inter-organizational network, special concerns of information sharing need be taken into account: how the information can be shared effectively with the minimum asymmetry, how the "lemons" can be avoided. As long as these problems are addressed, for each asymmetric information problem, there exist (or will be) solutions. Some of the requirements can be abstracted from the *BeerLL* case, i.e. (1) end-to-end security, (2) data sharing with the supply chain and DutchTCA etc. We also suggest that AEO should be protected against the danger of "lemons" that we recommend adding IT requirements to help with signalling and screening.

Conclusions and Future Research

This paper presents a linkage between the economic theory of information asymmetry and IS network and information flow research. Despite the asymmetric information problems in the business world, we find that such problems are also prominent in the G2B context, in particular for Tax and Customs offices. By studying a collaborative pilot between government and business---the Beer Living Lab, we identify two asymmetric information problems, namely, moral hazard and adverse selection. We argue that application of advanced IT may effectively cope with the two

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[5] **Screening** is another way of combating adverse selection, different with signalling, which implies that the informed agent moves first, screening means that underinformed party can induce the other party to reveal their information, for example by providing a menu of choices in such a way that the choice depends on the private information of the other party (Rothschild & Stiglitz, 1976).

above motioned problems: IT based IOS enables network partners effectively sharing information with each other that minimizes the moral hazard problem; and the application of IT itself may serve as a strong signalling/screening tool for the network partners make sensible selection decisions that overcomes the adverse selection problem. The findings from this paper may provide valuable knowledge for the EU governments to further develop the AEO certification guidelines.

The paper at the current stage only reveals the phenomenon of asymmetric information during the G2B network forming, its applications and some recommended solutions. The scope of the paper will be expanded by our future research, which will further develop the conceptual framework and validate it with both descriptive (case study) and quantitative (empirical research) method. Further we will pay special attention to a dynamic network, that is, how changes of IT strategy of one network partner may influence the behaviour and decision making of other network partners; what the new equilibrium will be after this change and how this can be optimized. All in all, research of information economics in the IS field is still under developing; this paper serves as an explorative starting point, and hopefully it can inspire others to pursue research in this field.

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