

MULTI-SECTOR

Innovative ICT solutions for monitoring and facilitating international trade

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The use of information and communication technology (ICT) for international trade is increasingly important. The EU-funded projects ITAIDE and CASSANDRA propose further innovations to solve the trade control and facilitation dilemma.

In today's global, networked economy, goods often travel a long way around the world across the international supply chain from suppliers to manufacturers, buyers, and sellers, before reaching their final destination in our homes and businesses. This movement of goods across national and regional borders is highly regulated: governments seek control to counter issues with for example fraud, smuggling, safety, and counterfeiting. Especially since 9/11 they have also taken additional security measures to limit the risk of (terrorist) attacks. At the same time, governments aim to facilitate trade by reducing administrative burdens, ensuring "smooth" logistics, and increasing competitiveness – a seemingly contradictory objective with accomplishing control (Tan et al., 2011).

To exert its control function, government obliges businesses to submit a large amount of data through the use of documents and certificates, and Customs officials and other agencies conduct physical inspections on the goods. Both come at a price, for government as well as business. Containers that are inspected typically need to be transported elsewhere in the ports and have to stay there longer. In some cases, the shipment might even become worthless: if, for example, the container contains perishable food products, the load might be spoilt before all relevant documents are gathered, all tests are conducted, and the cargo is cleared. The data exchange poses an administrative burden. According to the Asia-Pacific Economic Cooperation Business Advisory Council (1996), each international trade transaction requires an average of 40 documents to meet rules and regulations set for international trade and transport. These documents have a large overlap regarding the data elements: the same data have to be submitted more than once, to different government agencies, and at different points in the supply chain. Costs may also arise from typing and other errors. If something goes wrong with the data exchange, the goods again may be delayed at the border (Tan et al., 2011). The use of Information and

Communication Technology (ICT) has become more and more important in this international trade setting.

ICT for international trade

Let us briefly look into the situation in the European Union (EU). Overall, the existing ICT infrastructure in the EU is highly complex and there is no definitive alignment across the EU yet (Van Stijn et al., 2011). Many efforts have already been made to move from a paper-based exchange of documents, to a paperless environment using ICT. These undertakings have predominantly involved the replacement of paper documents with electronic versions, originally using Electronic Data Interchange (EDI) and nowadays also incorporating web-based solutions. Early on, each Member State essentially developed and implemented its own information systems, without coordination at the EU level. More recently, several programs, including Customs 2013, coordinated by the Directorate-General Tax and Customs of the European Commission (EC), have been set up to implement common EU-wide systems. The requirements for these systems, like the New Computerized Transit System, Excise Movement Control System, the Export Control System, and the Value Added Tax system, are set at the EU-level and Member States – and businesses – are obliged to adopt them. Because each of the common system typically covers only a specific procedure, silo automation remains and businesses have to modify and extend their own enterprise systems every time a new EU-wide system is introduced (Van Stijn et al., 2011). For example, an impact assessment study related to the introduction of only the Export Control System in only one EU Member State (United Kingdom) reveals that the estimated costs for the approximately 83,000 affected businesses are a one-time investment of up to € 7.5 million transition costs, and an additional average annual costs of up to € 1.1 million (HM Revenues and Customs, 2009).

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On top of that, each national Member State still has a certain degree of freedom to adapt these common systems to fit with national legislations, procedures and existing legacy systems. Especially multi-national companies will have to introduce separate interfaces for each EU country (Henningsson and Henriksen, 2011). It also poses difficulties with pan-European interoperability, meaning that the information sharing and coordination between the European government agencies is not yet widely facilitated.

Though the national and common systems contribute towards efficiency improvements, further innovation is deemed necessary. The basic premise is that the use of innovative ICT can improve information sharing between business and government, enable new approaches to monitor and control international trade, and lead to improved trade facilitation. Thus ICT innovation is seen as a means to fulfil the following three goals (Van Stijn et al., 2011):

1. Efficiency improvement (e.g., administrative burden reduction): harmonizing the data used on the different documents to avoid redundancy and ensuring that data can be exchanged electronically among the different actors;
2. Effectiveness improvement (e.g., coordinated inspections): coordinating the processes of all government control agencies involved and performing similar activities only once, specifically regarding the physical inspections of the goods;
3. Strategic changes (e.g., risk-based governance): implementing changes in data sharing processes and control procedures enabled by technological innovations.

Parallel to its own efforts and that of the Member States, the EC has made funding available for several research projects to help achieve these ambitious goals and encourage further innovation. We will provide more detail on results from the ITAIDE project (Information technology for adoption and intelligent design for e-government, <<http://www.itaide.org>>), which ran from 2006 to 2010, and relate to its follow-up, the CASSANDRA project (Common assessment and analysis of risk in global supply chains, <<http://www.cassandra-project.eu>>), a three-year project that started in June 2011.

Risk-based governance and the information pipeline

Given the volumes of international trade transactions and container movements on a daily basis, it is virtually impossible to physically check all goods. Governments want to catch as many as possible of the ‘bad guys’ and interfere as little as possible with the ‘good guys’. In this context, risk-based governance is one of the proposed strategic changes, which means that a distinction is made

between trusted trader networks, with secure trade lanes, versus high-risk flows. Those in a trusted trader network will achieve benefits like faster clearance at the border. Those that are considered high-risk can be better targeted, improving the effectiveness of inspections and leading to higher hit rates.

Trusted traders are considered to be those that are in control of both the physical flow of goods and the information flow. This requires transparency and visibility in the supply chain, which can be achieved by the introduction of ICT innovations. The ITAIDE project demonstrated for example the usefulness of smart container seals in combination with new web-services based on open standards (Tan et al., 2011). The key ideas underpinning these innovations are the piggy-backing and the data pull principle. Businesses in the supply chain already have established their own extensive information systems where they in principle collect all the information relevant for government to monitor trade. Governments can piggy-back on this information, making use of the available business data rather than gathering the government documents. This is also an essential step towards “pulling data”, accessing the information directly from the business source when needed. This would help to counter issues with mistakes and misinformation and make obtaining real-time data a possibility (Tan et al., 2011). The CASSANDRA project sets out to make optimal use of these principles as a prerequisite for establishing the new risk-based approach with its work on a so-called ‘information pipeline’ (Hesketh, 2010; Overbeek et al., 2011) as illustrated in Figure 1.

The information pipeline makes use of transaction-related data – both commercial data and container tracking data – that is fed into the pipeline by the supply chain partners and then shared between the relevant partners in the supply chain and with the government authorities that require this information for risk assessment and other government purposes. Thus, the pipeline is intended to be used for data sharing and crawling. Instead of building a completely new portal or platform, the pipeline is virtual, in the sense that the existing supply chain solutions are taken as the basis and that the CASSANDRA project will work on bridging these heterogeneous systems with ICT innovations in order to achieve a pipeline that consists of interoperable solutions that can communicate in an open, flexible, and standardized manner.

Network collaboration and policy making

Conceptually, the solutions proposed by ITAIDE and CASSANDRA may appear simple, but their actual realization in the EU is a complex task. It concerns not only technological, but also managerial, financial, social, political, institutional, and legal matters. Even more so, a

particularly large and complex network of stakeholders are involved in and affected by the development and implementation of such a solution. Agreement and commitment have to be obtained at the EU as well as at the national Member State levels and with other key players. Though they may be challenging, successful

collaboration and policy making processes are vital (Van Stijn et al., 2011).

Research in the ITAIDE project has yielded a multi-level network model which distinguishes between four levels of stakeholders, namely: 1) national stakeholders, within a Member State, 2) national stakeholders, in another Member State or another region/ economic zone, 3) stakeholders at the

regional/ economic zone, and 4) international stakeholders (Rukanova et al., 2009; Van Stijn et al., 2009). One can think of Tax & Customs, the Veterinary agency, the Ministries of Agriculture, Health, ICT, and Economics, trading businesses (both large multi-nationals and small companies), carriers, shippers, logistic service providers, port authorities, national industry associations, IT providers, consultants, and academics at levels 1 and 2. The Directorate Generals of the EU, and regional industry associations such as the European Shippers Council, the European freight forwarders association CLECAT, are representatives of level 3. Examples of stakeholders at level 4 are the United Nations (e.g., UNECE and UN/CEFACT), the World Customs Organization (WCO), the International Organization for Standards (ISO), and other international standardization organizations such as GS1 (Overbeek et al., 2011; Van Stijn et al., 2011). This level is important to consider because of the efforts to develop for instance a cross-border data model, that can be used to achieve further standardization and interoperability.

Overall, the network is characterized by large amounts of inter-organizational and international stakeholders and by a high diversity amongst them: they come from different backgrounds, sectors, cultures, fall under different

political and legislative regimes in different countries, and have different – sometimes conflicting – understandings and interests. Successful collaboration and policy making is dependent on many things. One of the key vehicles used in the ITAIDE project, which will also be applied in

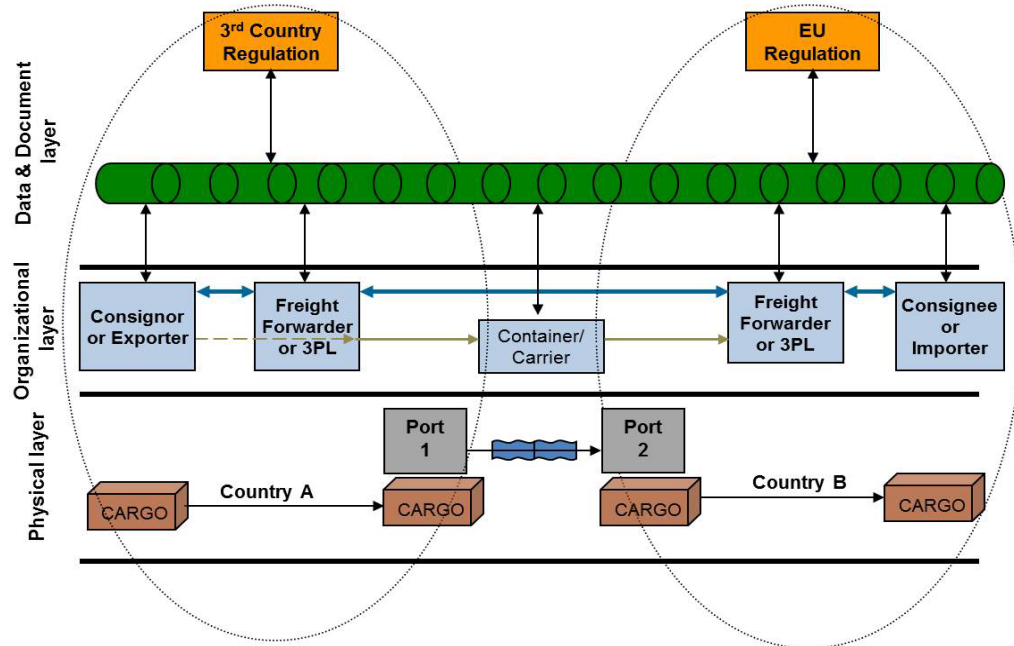


Figure 1 | Visualization of the information pipeline (<<http://www.cassandra-project.eu>>)

CASSANDRA, is the so-called Living Lab approach (Tan et al., 2011). Within Living Labs, actors from business and government cooperate to develop and evaluate new ICT solutions for international trade in a real-life pilot setting. These public-private partnerships are facilitated by the research environment, where partners from academia and other research institutions can provide a “neutral ground” for the interactions, aiming to initiate and facilitate processes of consensus building, networking and policy making. Successful collaboration between stakeholders during the design and piloting phase improves the chances of jointly coming to win-win solutions. Also, these processes ideally pave the way for collective action, to come to institutional change and adoption of the solutions (Van Stijn, 2009). It is essential to formulate the constraints and incentives imposed by government to steer the efforts in the right directions. We consider it highly valuable in this context to build upon the Institutional Analysis and Development (IAD) Framework (Ostrom, 2005). This comprehensive framework provides for example insights in the interactions between actors that occur at different levels (e.g. operational, monitoring, and constitutional), and how rules are employed to order relationships. Ostrom’s work also offers a set of design principles for institutional change.

Conclusion

Governments play a large role in the context of international trade as they aim to safeguard societal values and minimize security risks and so on. Control of the movement of goods across the supply chain comes at a cost, whereas it is also a key objective to facilitate trade. The use of ICT has long been recognized and used as a means to achieve efficiency improvements, but new innovative solutions are seen as enablers to fulfil both objectives. The current European situation is highly complex, not only because of its prior ICT infrastructure and the way in which common systems are developed, which has led to limited alignment. Its organization with the 27 Member States also means that the ICT-related innovations take place in a very large scale, diverse and complex stakeholder network, in which many actors have to be brought together. Next to the efforts of the EU and its Member States, the European Commission has provided funding for research and innovation projects in this area, like the ITAIDE project (2006-2010) and the CASSANDRA project (2011-2013). Based on the ITAIDE principles of piggy-backing and data pull, the latter not only aims to develop and evaluate the 'information pipeline', but CASSANDRA also intends to create an environment in which consensus building, network collaboration, and policy-making can successfully take place. Similar to ITAIDE, real-world research settings that are called Living Labs will be used for this purpose as well. Work on the IAD Framework (Ostrom, 2005), focusing on understanding and changing institutions, is of high relevance and will be further pursued. All in all, the topic of ICT in international trade is of great interest and importance to government, business, and researchers alike. ★

References

- APEC Business Advisory Council (1996), 'APEC Means Business: Building Prosperity for our Community', Report to the APEC Economic Leaders, <http://publications.apec.org/publication-detail.php?pub_id=773>, accessed 20 August 2011.
- Henningsson, S., and H.Z. Henriksen (2011), 'Inscription of behaviour and flexible interpretation in Information Infrastructures: The case of European e-Customs', *Journal of Strategic Information Systems*, advanced publication, doi:10.1016/j.jsis.2011.05.003.
- Hesketh, D. (2010), 'Weaknesses in the supply chain: who packed the box?', *World Customs Journal*, 4 (2): 3-20.
- HM Revenue and Customs (2009), 'Impact Assessment of the Export Control System (ECS)', <<http://www.hmrc.gov.uk/ria/ia-ecs-july09.pdf>>, accessed 20 August 2011.
- Ostrom, E. (2005), *Understanding institutional diversity* (Princeton: Princeton University Press).
- Overbeek, S., B. Klievink, D. Hesketh, F. Heijmann and Y. Tan (2011), 'A Web-Based Data Pipeline for Compliance in International Trade', Paper for WITNESS 2011, Delft, The Netherlands.
- Rukanova, B., E. Van Stijn, H. Z. Henriksen, Z. Baida and Y. H. Tan (2009), 'Understanding the influence of multiple levels of governments on the development of inter-organizational systems', *European Journal of Information Systems*, 18 (5): 387-408.
- Tan, Y., N. Bjørn-Andersen, S. Klein and B. Rukanova (eds.) (2011), *Accelerating Global Supply Chains with IT-innovation: ITAIDE tools and methods*. (Berlin Heidelberg: Springer).
- Van Stijn, E., T. Phuaphanthong, S. Kertho, M. Pikart, W. Hofman and Y. Tan (2011), 'Implementation Framework for e-Solutions for Trade Facilitation', In Tan, Y. et al. (eds.), *Accelerating Global Supply Chains with IT-innovation: ITAIDE tools and methods* (Berlin Heidelberg: Springer), 285-317.
- Van Stijn, E., B. Rukanova, A., Wensley and Y. Tan (2009), 'Moving an innovation from a Living Lab to the real world: Politically savvy framing in ITAIDE's Beer Living Lab'. Bled eConference 2009 Proceedings, Paper 31: 265-285, <<http://aisel.aisnet.org/bled2009/31/>>.

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