Enhancing business and government interactions in global trade

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Abstract. *Government agencies and businesses cooperate and invest heavily to achieve reliable and secure global supply networks. A so-called data pipeline, which integrates data from various parties in the supply chain and incorporates data from new tracking and monitoring technologies, would enable real-time data management for businesses. This IT infrastructure has a global scale, since it has to function both within and across countries and continents. Governments can use this data pipeline to improve the coordination of border management and reduce the administrative burden for businesses. Furthermore, businesses and government can collaborate to capitalize on modern IT and use the innovation for improving risk and data management. This paper explains a conceptual model of the data pipeline and its governance implications. As this global infrastructure cannot be built by government alone but needs to be largely realized by businesses, a public-private governance model is needed. Governments, and even supra-national institutions, would need to create the right technical, organizational, and legal environment (e.g. standards, harmonization of procedures, mutual recognition), and have to provide alternative incentives to stimulate the development of those parts of the pipeline that are without commercially viable business models.*

Keywords. *Global IT infrastructure, data pipeline, international trade, public-private governance*

1 Introduction

In the context of global trade, improving data sharing is deemed highly necessary. Supply chain visibility and transparency along with business-to-business and business-to-government interaction are increasingly important as companies struggle to rebound from the economic recession (Tan et al., 2011; Van Stijn et al., 2011). With internationalization and the increased volume of trade transports moving across the world, both the administrative burden problems as well as the risks associated with trade have increased (CASSANDRA Consortium, forthcoming; Tan, et al., 2011). However, complexities of commercial transactions, logistics and border procedures within international trade require an innovative approach to improve

efficiency and effectiveness (Hesketh, 2009, 2010; Van Stijn, et al., 2011). The data pipeline, one of the key concepts addressed in the CASSANDRA project, is envisioned to address these problems, by integrating data from various parties in the supply chain and incorporates data from new tracking and monitoring technologies, which would enable real-time data management for businesses (Overbeek et al., 2011; Van Stijn, et al., 2011). Governments can use the data pipeline to improve the coordination of border management and reduce the administrative burden for businesses. Furthermore, businesses and government can collaborate to capitalize on modern IT and use the innovation for improving risk and data management. Governments can piggyback on sound, legitimate, business practices and source data in international trade and logistics (Tan, et al., 2011; Van Stijn, et al., 2011).

Seen from a socio-technological perspective, the data pipeline can be seen as a large-scale, truly world-wide IT infrastructure, which is to be developed and implemented in a complex network of actors. This requires a very complex multi-actor governance model of public-private partnership. Multi-actor in this light also means multi-level (Rukanova et al., 2009), because the key actors of this public-private partnership are at various levels: (1) Local and (2) national stakeholders that can be identified range from the seller of goods to the buyer and include the economic operators in-between, such as inland carriers, freight forwarders or logistic service providers (LSPs) (which usually take the responsibility for planning, arranging, and optimizing shipments (Chow et al., 2007)), shipping agents, sea terminal operators, Port Community Systems providers (which enable the links within a logistics chain of a seaport or airport to efficiently exchange information with one another (Toh et al., 2009)), and Customs, inspection authorities and port authorities. But also e.g. ministries and national industry associations. These actors play a role in both the exporting country and the importing country. Between the countries (at sea) the shipping line is an important actor (Baalen et al., 2008). At the (3) supra-national and (4) international level, actors include for example the European Commission and its Directorates General (DGs), the World Customs Organization, United Nations, and also international standardization organizations and the like.

This exploratory paper addresses the data pipeline concept and its consequences for governance. After introducing the data pipeline concept (section 2), we analyze the implications of the data pipeline in terms of business-government interactions (section 3). Section 4 assesses the need for public-private governance as the infrastructure cannot be built by government and needs largely be realized by businesses. Governments, and even supra-national institutions would need to create the right technical, organizational, and legal environment (e.g. standards, harmonization of procedures, mutual recognition), and have to provide alternative incentives to stimulate the development of those parts of the pipeline that are without commercially viable business models. Section 5 provides a further discussion of the role of supra-national and international institutions. The paper concludes with identifying directions for further research and how this is foreseen in CASSANDRA's Living Labs in (section 6).

2 Data Pipeline Concept

The so-called "data pipeline" has originally been proposed by UK and Dutch Customs officials as an innovation to increase transparency, or visibility, of what is happening in global supply chains (Overbeek, et al., 2011). Conceptually, the data pipeline is a means to integrate and interface existing information systems, including enterprise systems for example at the buyer and seller of the goods, inter-organizational information systems that are used by freight forwarders and port communities, and governmental information systems, like Customs systems. Data about organizations and people, the goods and commercial transactions, are envisioned to be captured at the most reliable, original source, as far upstream in the supply chain as possible, and to be enriched throughout the supply chain with other transactional data and data about the movement of the goods (for example using RFID or container seals). These data are shared amongst supply chain actors as well as with Customs and other governmental agencies (Hesketh, 2009, 2010; Van Stijn, et al., 2011). Figure 1 provides a visualization of the data pipeline concept.
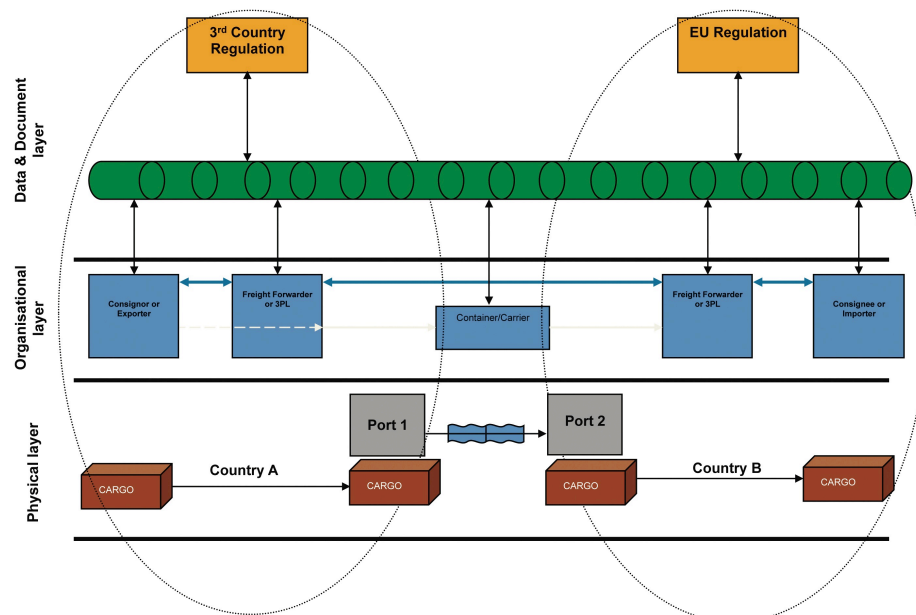

Fig. 1. Conceptualization of the data pipeline (by David Hesketh and Frank Heijmann)

To illustrate, consider a shipment of children's toys made by a Chinese manufacturer that are to be delivered at the warehouse of a Dutch retailer. The producer in China makes use of a logistic service (LSP) provider who arranges the carriage from a hinterland factory to a deep-sea Port in Shenzhen, and the Dutch retailer uses another LSP to ensure that the shipment is picked up in Rotterdam and delivered to the final destination. In this case, when the Chinese manufacturer receives the order and has agreed upon all the terms with the buyer in The Netherlands, data about the transaction, the goods description, weight, amount, etc.,

can be made available in the pipeline. The Chinese LSP can use this data for arranging the contract of carriage and so forth with the carrier. Data concerning certificates and e.g. performed quality checks can also be made available. Chinese Customs and other officials (dealing e.g. with safety of toys) can use the data for pre-departure risk assessment and other export-related procedures. When the goods are stuffed in the container, RFID or container seal could be added for tracking and tracing the movement of goods. The carrier can make stuffing data available and provide updates in case for example the shipment is re-routed. If inspections have already taken place in China, data about that can also be shared. This information, combined with terminal information, would be highly relevant for the planning of the Dutch LSP and at the retailer's warehouse. Dutch authorities can make use of the data for pre-arrival risk assessments and assess the need for inspection at the Port of Rotterdam, or at a later stage, at the premises of the retailer. The data could then in principle be used for import declarations, statistical purposes, VAT declarations, and so on. We like to stress that the data in the data pipeline can be provided real-time, can be enriched throughout the journey, and that they are 'original' data. Rather than that they are data that may be altered to fit the current regulatory documents, they are raw data that are envisioned to be better fit-for-purpose from a government view (Van Stijn, et al., 2011). We will return to this topic and address the perceived benefits for business in the second part of our paper.

From a technical perspective, the data pipeline is based upon a service-oriented architecture (SOA), delivering web-based services to access and exchange the data (Overbeek, et al., 2011; Van Stijn, et al., 2011). One may foresee that more than one actual data pipeline materializes, for example focusing around specific trade lanes or major international players in the supply chains that could offer (part of) the data pipeline services. The SOA architecture can cater for such a multitude of solutions, by means of standardization – or at least interoperability - of data and data sharing protocols (Tan, et al., 2011).

3   Implications for Business-Government Interactions

The implementation of a data pipeline is a complicated endeavour, both it terms of the technical innovation and from an organizational and political perspective. A large number of stakeholders are involved in interfacing existing systems and using the data pipeline. Such a data pipeline needs to be driven by the businesses, as it is based on their data and as it has a global scale. Therefore, there should be clear business benefits for the participating companies if they are to successfully development and adopt the data pipeline. In general, two types of business benefits can be identified:

-   Business-to-business (B2B), for example: the current status of specific goods in international supply chains is often very complex and unclear. Goods traceability and supply chain visibility enables businesses to monitor what is happening and identify what went wrong in the supply chain in case of problems. The data pipeline is aimed to deal with this complexity and to improve supply chain visibility.

- Business-to-government (B2G), for example: ICT is seen as a way to reduce the administrative burden for private organizations and the regulatory burden for public organizations (Bharosa et al., 2011; Janssen et al., 2010; Tan, et al., 2011). These burdens are caused by the introduction of stricter laws and regulations that require private organizations to provide more timely and accurately business information to various public authorities. A data pipeline in international trade is aimed at minimizing the administrative burden for actors involved in global trade and at logically linking the parties involved by providing timelier and better data. Companies that provide such data can receive benefits such as a green lane treatment by government organisations.

Although at the heart of the pipeline development are business interactions and benefits for companies, but we focus on the business-government interaction. The data pipeline is capable of realizing some benefits for government. This has implications for the engineering of the governance of such a pipeline, which we discuss in the next section. In the remainder of this section, we describe the implications of a data pipeline for the interactions that exists between businesses and governments.

The data pipeline enables the principles of piggybacking and increased data pull. Piggybacking means that data are re-used for other purposes than they were originally intended for (Tan, et al., 2011). In the domain of global trade it entails that original commercial data from businesses are re-used by governmental actors for government control purposes such as risk assessment, customs clearance, and coordination of inspections. This means a transformation in the traditional way of working, which was based on paper-based controls, with businesses typically providing data to government focused on specific transactions in a specific predefined format. In the piggybacking principle, the original data that businesses use for their own operational processes are shared with government organizations. As these data are vital to the operations of businesses themselves, they are of better quality than data that is filed in specific formats (which often differ for e.g. customs, bureau of statistics, food inspection agency, and other actors that require data from the supply chain). Governments can piggyback on that original business data and use that as the source for government control purposes (Van Stijn, et al., 2011).

In addition to such piggy-backing, the data pipeline can enable a shift from a situation where businesses are pushing the declarations and other official documents to multiple governmental agencies, the so-called *Data Push* approach, towards an increased *Data Pull* approach, where the governmental agencies can "pull" data out of the systems (Tan, et al., 2011) that the data pipeline comprises when needed. In addition, the data collection in principle should start as early as possible, in other words, as far upstream as possible in the supply chain, up to the point where a consignment is completed, or preferably even earlier, at the original shipper. When the goods are packed in the container and prepared for shipping, the key data that is necessary for trade and transport and that can be re-used for government purposes, is available (Hesketh, 2009, 2010).

In an extended form, the piggy backing principle can also include the re-use of internal control data and mechanisms (e.g. from quality controls or risk assessments)

and even further rely on the internal controls of an organization. To assess whether government can rely on the data it pulls from business systems and their internal procedures, governments can focus on assessing the systems and operations of a company, instead of assessing individual transactions. This is called a *System-Based Control* approach (Tan, et al., 2011). Customs and other government agencies assess the flow of goods by targeted physical inspections and by analyzing the information that businesses are required to submit. This requires accurate and timely data about the goods, about the parties buying, selling and moving the goods and about the location and security of the consignment. Much of that data resides in the commercial parties and is used every day to order and buy goods, ship them from seller to buyer and pay for them. System-based control entails that rather than inspecting goods, the information systems of businesses are audited, i.e. by EDP auditors, in order for companies to demonstrate that they are in-control of the data capturing, data security, and so forth.

4 Need for Public-Private Governance

The various benefits that the development of a data pipeline may offer have a major impact on the boundary between the public and private sectors. Global supply chains are networks with complex interdependence between various stakeholders, including those mentioned in this paper. Transformation towards information sharing between business information systems and e-government systems and infrastructures encounters various barriers (Gil-Garcia et al., 2007). A data pipeline brings changes in the barrier between the private sector and private data and the public sector and data used for the community of stakeholders. The stakeholders come from both the public and the private sector and have to collaborate to realize the pipeline. Consequently, the development of a pipeline has major implications for the organizations involved, especially where the public and the private sector meet. The boundary between the sectors shifts as the current division of public and private functions and roles blur.

One of the major challenges with respect to the pipeline is that the private parties involved in global supply chains have to build the majority of the data pipeline, as it is their data and in their commercial interest. However, somehow, businesses are currently unable to realize such a pipeline and reap the benefits of it. Some parts of the data pipeline may not have a viable revenue model or the current institutional structure may reduce of collaboration for businesses. Therefore, a major question is what governments minimally need to do to enable businesses to realize the pipeline. Say that if businesses build 90% of the pipeline, an important governance question is how governments need to build the 10% in such a way that businesses have an incentive to build the majority. The development of a pipeline therefore needs to be accompanied with a public-private governance instrument in order to realize the data pipeline and to ensure that the benefits for both commercial parties and governments are realized. For the public sector, the instrument may include guidelines regarding the development and operation of those (few) components of the data pipeline that are essential for its functioning, but that do not have a viable business model, such as the

digital government infrastructure to exchange data with the border inspection agencies. Furthermore, regarding data and message standards that need to be further developed and maintained to ensure interoperability of company information systems and the data pipeline on an international scale, e.g. by the World Customs Organization and United Nations, in collaboration with international standardization bodies. Also, governments are expected to, where necessary, regulate and subsidize the private development part of the data pipeline in their jurisdiction such that it becomes a level playing field.

5 Discussion: Role of Supra-National Bodies

As mentioned, when developing and adopting the data pipeline vision, the role of supra-national and international bodies is also to be considered (Van Stijn, et al., 2011). Stakeholders at the supra-national level are for example the European Commission and its Directorates-General (DGs). The Asia-Pacific Economic Cooperation (APEC) and regional associations, like the European Shippers Council and the European Port Community System Association, and their counterparts, are other bodies that are heavily involved in the information infrastructure developments. At the international level, the United Nations (UN), World Customs Organization (WCO), and also the World Trade Organization (WTO), are important players, and, again with a different function and set-up, standardization organizations like ISO and GS1 are of relevant in our setting (Van Stijn, et al., 2011).

One essential role supra-national and international bodies play concerns mutual recognition. Mutual recognition is "a broad concept whereby an action or decision taken or an authorization that has been properly granted by one Customs administration is recognized and accepted by another Customs administration" (WCO, 2011, p. 1). Mutual recognition deals with formally recognizing and accepting procedures, data submissions, certificates, and so on. At the EU level, certification of Authorized Economic Operators (AEOs), trusted traders, is supported by mutual recognition in the sense that a business that has required AEO status in one country is also formally an AEO in other EU countries. Similarly, some EU countries have negotiated bilateral agreements with for example the USA concerning C-TPAT and AEO certificates, or are in the process of negotiating.

In the context of trade facilitation in general, and in support of trends like coordinated border management, the trend is towards increased mutual recognition (CASSANDRA Consortium, forthcoming). Mutual recognition of certificates is one aspect through which further business benefits can be obtained, as acquiring them requires substantial investments and now, companies that trade in multiple countries around the world, typically have to invest in additional, highly similar certificates. The data pipeline in that light could be a vehicle for informal mutual recognition, as through the visibility it would offer, businesses can demonstrate trustworthiness and compliance to standards and regulations, which is the essence of the certification (CASSANDRA workshop, 18-19 October 2011). This could be an important first step. However, to fully support the potential of the data pipeline, we propose that mutual recognition is taken further. For example, it would be important that the data

that are captured in the pipeline are recognized and shared amongst the different governmental actors in different countries, so that instead of requiring the multitude of regulatory documents, they can actually piggy-back on the commercial and each others' data. In addition, as the data pipeline enables a decoupling of several parts of the border procedures from the actual crossing of the border, mutual recognition concerning e.g. export = import processes, green trade lanes, and so forth, would need to be considered in the debate. Whereas initial initiatives may take place on a smaller scale, in the end, they would need to be taken up at the supra-national and international levels (Van Stijn, et al., 2011).

Though mutual recognition is formally a governmental mechanism, the involvement of industry in these developments, e.g. through regional and international organizations, is essential given the public-private nature of the data pipeline: if industry would be left out, there may be a high risk that new disconnects between supply chain activities and governmental procedures, as well as the underlying data and IT infrastructures, arise, rather than that a win-win innovation is realized. In that light, Living Lab research can contribute with initial proofs-of-concepts and demonstrators of technology, but also by providing 'neutral grounds' where stakeholders can engage in such discussions (Tan, et al., 2011). The next section provides a brief background on CASSANDRA's Living Labs and identifies key questions for further investigation.

6 Future Research: Exploring the Implications in Living Labs

The CASSANDRA project focuses on the data pipeline and how the data pipeline could enable a new risk-based approach. We have introduced the data pipeline concept as a new way of data capturing and data sharing amongst commercial parties in the global supply chain, and between business and government actors. Our exploratory study contributes a starting point to gather further understanding into organizational aspects of ICT infrastructures that expand not only beyond organizational and national borders, but also involve interactions between private actors and public actors in a way that their current roles and responsibilities may shift fundamentally. The CASSANDRA research, like one of its predecessors, the ITAIDE project, is set up around so-called Living Labs. Characteristics of Living Labs are (Higgins and Klein, 2011, p. 33):

- "Real-world setting, involving multiple stakeholders from multiple organizations and their interaction;
- Active role of users as co-innovators; exposing technology to the creative & destructive energies of the users; facilitating dynamics of collective action;
- Multi-disciplinary research teams actively involved in the research settings, confronted with the technical, social and political dynamics of innovation, at times even driving the agenda;
- Joint collaboration to create a desired outcome."

The three CASSANDRA Living Labs are different in their focus on specific regions/ countries each made up of different specific trade lanes with different goods and

participants. The first one to start is the EU-Asia Living Lab, which encompasses export and import trade lanes between the EU (the Netherlands and the UK) and Asia (China, Malaysia). Apart from providing an R&D environment regarding the data pipeline technologies and the risk-based approach, the third line of enquiry concerns organizational matters in a broad sense. To conclude, we have identified a set of research topics and questions that we intend to take up in CASSANDRA's Living Labs, and that other researchers may investigate in this domain, and in a later stage, in comparison with other domains. They are:

- Stakeholders analysis
  Questions that can be addressed in the stakeholder analysis are: Who are the actors in the multi-level network? What are their current roles and interactions? What are the interests of actors? Who would need to be involved in which stage of the data pipeline development and implementation? How can we analyze and explain (foreseen) changes?
- Cost-benefit analysis
  Such analyses can be performed regarding different scenario's or use cases based on the LL trade lanes. Costs would include for example the investments needed to develop, implement, and maintain the data pipeline interfaces and service oriented architecture. Benefits include reduced administrative burdens, and improved data quality.
- Business models
  Regarding business models, the essential questions are what would be viable business models for the commercial parts of the data pipeline? And which parts would not be sustainable from a business perspective?
- Public-Private Governance Model (PPGM)
  The challenge is to develop a PPGM that enables the government to design their regulatory frameworks such that they create on the one hand a level playing field, and on the other hand enough incentives for business to make their contributions to the data pipeline commercially viable.

The objective of the PPGM is to provide a means to analyze, explain and design the governance of the data pipeline. In this context, it is critical to obtain a deep understanding of the different stakeholders involved, their interests, and how to mitigate between these stakeholders to ultimately come to implementation and adoption of the data pipeline vision. Another key element of the public-private governance model is to determine the division between those parts of a data pipeline that can be developed by private parties versus those parts that have to be developed by governments (e.g. as part of the digital government infrastructure), because they have no viable business model, but are still necessary to make the data pipeline work.

The research results from these four areas combined can in a later stage be compared to e.g. other research in the domain of international trade, as well as other domains involving large scale and global, IT infrastructures.

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