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Abstract

Regulators in international trade are facing a seemingly impossible challenge of increasing control and security while at the same time lowering the administrative burden for traders. The European Commission has introduced the concept of "trusted trader", referring to a trader that is certified as being in control of his/her business. Trusted traders are supposed to obtain trade facilitations such as periodical reporting of import/export data instead of declaration of every shipment, fever physical inspections, and faster border crossing. To enable the use of trusted traders in practice, changes are required to the information infrastructure of international trade. Following the principles of IS design research, this research-in-progress paper presents a design proposition for the information infrastructure of international trade. Using theories of information infrastructure development and change as kernel theory, our proposition contains redesign suggestion in IT, Organization, Human, as well as Change and Collaboration elements. The design proposition was evaluated and verified with proof of concept installations and a stakeholder value assessment, but lacks real world testing and evaluation. Theoretical contribution is made towards the domain of information infrastructures and how they may be enhanced to meet new requirements.

Keywords: Design Science, Information Infrastructure, Global Information Systems, IT infrastructure.

1 INTRODUCTION

International trade faces a number of major challenges in the immediate future. Increased anxiety over potential terrorist attacks and diseases such as the bird flu in combination with increased tax fraud (estimated to be between 200 and 250 billion Euro/year in the European Union (EC, 2006b)) has made consumers and governmental agencies demand increased control, traceability and security from producer to end consumer (Tan et al., 2006). At the same time, increased global competition is forcing governmental authorities to reconsider the administrative burden put on trading companies to ensure competiveness of national actors. The European Commission has, for example, set a goal of lowering the administrative burden for European companies by 25% by 2012 (EC, 2006a). The demand to increase control, traceability, and security while at the same time reduce the administrative burden of these functions is a seemingly impossible equation facing the actors involved in international trade.

The idea of a “trusted trader” is one of the approaches currently being discussed in the EU and other levels of government. If used to its full potential it can significantly lower the administrative burden for traders, while at the same time ensure a high level of control and security. The concept of trusted trader represents a paradigmatic shift in the relationship between government and traders: instead of governments controlling the businesses, companies accept responsibility of their traded goods and agree to prove them being in control of their processes upon request. If the trader is able to meet the predefined requirements the trader is granted “trusted trader” status (e.g. Authorized Economic Operator (AEO) in the EU, or C-TPAT in the US), which allow for trade simplifications and faster border-crossings. The status implies that governments will perform less physical inspections of the trader and will accept periodical reporting of export and import data instead of declarations in relation to each shipment. These initiatives will ensure faster logistics and reduced administrative burden.

The current process of international trade is supported by an information infrastructure that is not adjusted to the idea of trusted traders, but to transaction based on reporting and a fundamental distrust of traders. This research-in-progress reports on a large collaborative research project in which trade governors, traders, IT supplier, and academic partners redesigned the information infrastructure of international trade to meet the requirements of the trusted trader concept. That the research is in progress means that a first redesign suggestion has been developed, but actual use and testing needs to be carried out in order to assess the impact of the redesign. A poster-presentation will enable a discussion of the suggested constituents, their relationships, and how the redesign suggestion can be validated.

The paper has a dual purpose. First it aims to propose a design theory for how the information infrastructure of international trade can be reshaped in order to better meet the demands of traders and trade governors. Second it aims to use knowledge gained by the hands on work with modification of the infrastructure to reinforce our understanding on what constitute an information infrastructure and how it might be reshaped.

Using the terminology of IS design research this research is founded on the concept of information infrastructures as kernel theory (Star & Ruhleder, 1996; Hanseth & Braa, 2001; Weill & Broadbent, 1998). It is the intention of the paper to eventually make a theoretical contribution to this field of research. The design theory that is presented in this paper concerns the information infrastructural level of international trade and will not present all the constituent elements of the infrastructure in detail. Claims can be made that this gives a superficial picture of the design theory, but we shall argue that both the detailed and the infrastructural view is valuable. This paper is concerned with the elements in the information infrastructure and how the elements are interrelated. The theoretical contribution made in this paper is insight into what makes up an information infrastructure and how to change it. This insight comes from first hand experiences of trying to solve a practical problem by modifying an information infrastructure. As far as the authors have been able to identify, the design science approach has not yet been applied to information infrastructures. The prominent works in information infrastructures (e.g. Star & Ruhleder, 1996; Hanseth & Braa, 2001; Weill & Broadbent, 1998) are all based on traditional case study methodologies where the researchers followed development and evolution of infrastructures from an outsider's perspective. This has led to a basic understanding of what constitute information infrastructures and how they function. Our research builds upon this understanding and eventually increases the understanding of how the infrastructure reacts upon these actions.

Next we present the methodological approach of the research. We then present the kernel theory behind our design proposition; modification of inter-organizational information infrastructures. We then present our redesign suggestion, and describe how it was developed, instantiated, and finally evaluated. Finally we relate our findings to the domain of information infrastructure modification, draw conclusions from our findings and discuss future steps required to validate our redesign.

2 METHODOLOGICAL APPROACH

The view of IS design science underpinning this paper is that it shall not only be about the development of IT artefacts (c.f. Hevner et al., 2004; March & Smith, 1995) but also about how IS are managed and used. Our design theory contains elements of software and hardware artefacts but also "softer" (Baskerville et al., 2007) aspects of information infrastructures, such as collaboration models and how they are modified. The objective of design research is theory for action (Gregor, 2006). The suggested theory should say something on how to do something in order to achieve the expected outcome. In this paper we use the concept of "design proposition" as formulated by Bunge (1967) to frame our design theory. A design proposition is a heuristic rule with the following structure: "If in situation X you want to achieve Y then you should do Z". In our case, X = The current information infrastructure of international trade, Y = the ability to employ the concept of trusted traders, and Z = Our proposed trusted trader information infrastructure.

The research for this paper was carried out in the context of a large collaborative research project with representatives from trade governing authorities, traders, providers of software and hardware components for information infrastructures, and academic institutions. Generally, activities within the project were carried out in a collaborative manor with each of the partners providing their specific knowledge and skills. The research process basically followed the phases of the design research cycle as outlined by Carlsson (2008). The author suggests that IS design research is an iterative process between a) identification of problem and b) appropriate theory to approach the problem, c) development of prescriptive guidelines, d) testing, and e) reflection on the test results.

The initial problem was defined as how to develop an information infrastructure that could support the trusted trader concept. Representatives from international trade were brought together in workshop-like settings. These workshops identified problems and opportunities with the current situation as well as drivers and barriers for redesigning the way international trade is carried out. From these workshops, which all were documented by recordings and minutes, the idea of the trusted trader emerged and an initial understanding of which issues would have to be addressed during the project. Theories of information infrastructures and how they are changed (see Section 3) were used as fundamental kernel theory. For all constituent elements specific theories were applied, for example theories of IT architectures, network collaboration, and inter-organizational systems. However, these theories are not the core concern in this paper which has the information infrastructure as level of analysis.

The design proposition was constructed gradually during a period of four years as problems unfolded. The member organizations in the project each addressed the specific parts of the information infrastructure where they held expertise (see Section 4). Minor iterations and feedback cycles were constantly taking place, but from an overall perspective the project went through four major iterative loops where parts of the design proposition were instantiated into actual, tangible prototypes (see Section 5.1). These prototypes were tested using a specific value assessment framework (see Section

5.1). Testing was made with proof-of-concept installations. Engaging Europe's 2 million exporters would not be possible within the timeframe of the project.

3 INFORMATION INFRASTRUCTURES

The term infrastructure generally refers to any substructure or underlying system. It denotes the "basic physical and organisational structures (e.g. buildings, roads, power supplies) needed for the operation of a society or enterprise" (Oxford dictionary) without which contemporary organisations and societies cannot function (Edwards, 2003). A common use of the term infrastructure is made both by researchers and practitioners in the field of information systems. The concept of IT infrastructure is generally used to describe large and complex technological systems that support the functioning of entire organisations shared by a large number of people. Conventionally, the idea of information infrastructure emphasises the standardisation of systems, data, and communication across the infrastructure (Ciborra, 2000); standardised ways of operating are inscribed in technology, which links applications and people according to predefined notions of business processes, and requires the homogenisation of practices across organisational units (Ciborra, 2002).

3.1 Constituents of information infrastructures

IT infrastructures are generally conceived of as large conglomerations of tangible technological components and human skills that are combined together to serve the corporate needs of an organisation. This type of conceptualisation assumes that infrastructures can be differentiated and distinguished from all that is not infrastructure, and that since infrastructures can be neatly identified, they can be controlled and managed in a fairly straightforward fashion. The presumption is demonstrated in Weill and Broadbent (1997) and Henderson and Venkatraman's work (1999). In these two examples, the authors characterise IT infrastructure by separating the concept into a technical IT infrastructure and a human IT infrastructure. The technical element of the infrastructure is described as a set of shared, tangible IT resources forming a foundation for business applications. The human element of the IT infrastructure includes human skills, expertise, knowledge, norms, and values relevant to the functioning of the infrastructural technology (Broadbent & Weill, 1999). According to Weill (1992) the effectiveness and proficiency of the human IT infrastructure is crucial to the way IT resources are converted into productive outputs.

Although the role of human IT infrastructure to the functioning of IT resources is stressed, the line of thinking outlined above typically treats human actors as mere technology users which follow certain rationalistic norms (Kling, 1992), and assesses their importance to the operation of IT infrastructure based on a predetermined set of skills which they may or may not possess. Furthermore, it explicitly separates the human elements of the IT infrastructure from its technical elements, as explained by Byrd and Turner: "the IT infrastructure concept can be divided into two related – but distinct components – a technical IT infrastructure and a human IT infrastructure" (Byrd & Turner, 2000). While separating the human elements of an IT infrastructure from its technical elements may be conducive to creating an easily measureable analytical construct, it contributes to a narrow conceptualisation of the social processes that are involved in the shaping and functioning of information infrastructures and to an oversimplification of their dynamics.

A number of researchers have outlined an alternative understanding of infrastructures that more broadly acknowledges the interconnectivity of human and technical infrastructural elements and that is more sensitive to the social aspects of IT infrastructures. According to this line of thought, information infrastructures extend beyond mere materiality and predefined human skills to encompass social, organisational, and moral elements and considerations (Krcmar et al., 1995; Bjorn-Andersen, 1980; Kling, 1992; Monteiro & Hanseth, 1996; Star & Ruhleder, 1996). Technically, the construction of an infrastructural system requires the establishment of a scheme of protocols and standards that enable the system to be used and seamlessly connect with other systems. Socially, its construction necessitates the elaboration of a system of classifications that symbolically represent and organise things in society: people, classes, geographical areas, religions, civil status, and so on. As Edwards observes; "…although 'infrastructure' is often used as if it were synonymous with 'hardware'… all infrastructures… are in fact socio-technical in nature. Not only hardware but organisations, socially-communicated background knowledge, general acceptance and reliance, and near-ubiquitous accessibility are required for a system to be an infrastructure…" (Edwards, 2003, p. 3). We will therefore use the term information infrastructure instead of IT infrastructure in the remainder of this paper.

3.2 Shaping information infrastructures

Conceptualised this way, information infrastructures emerge as highly complex systems: "Information infrastructures are puzzles, or better collages, and so are the design and implementation process that lead to their construction and operation. They are embedded in larger, contextual puzzles and collages. Interdependence, intricacy, and interweaving of people, systems, and processes are the culture bed of infrastructure. Patching, alignment of heterogeneous actors, and bricolage (make do) are the most frequent approaches…" (Ciborra, 2000, p. 2-3).

Information infrastructures are evasive phenomena which manifest themselves in ways that are far less tangible and orderly than conventionally assumed. Rather, infrastructures are heterogeneous and dispersed: they encompass both technical and social elements and their boundaries cannot be easily outlined because of the complexity and dynamism of the components that constitute them. This idea is evident in work by Star and Ruhleder (1996) where information infrastructures are described as having the following characteristics: they are "sunk" into other structures, social arrangements, information practices, and technologies; they may extend beyond a single event or one-site practice; and they both shape and are shaped by the conventions of a community of practices.

It is important to stress that the different systems and components of the infrastructure are intricately interrelated; the IT base has sometimes been compared to an investment portfolio, which, however, is a rather simplistic metaphor. "Investment portfolios are usually very flexible and easy to change, manage, and control. […] Infrastructures are different. The individual elements are very interdependent, and their size and complexity make them extremely difficult to control and manage." (Hanseth, 2000, p. 56). The inherent complexity of information infrastructures is additionally apparent in the process of their development, which typically involves multiple narrative voices and groups struggling to shape the standards and classification systems embedded in the infrastructure to reflect their values, ethical principles, and interests (Star, 1999). When it comes to information infrastructures that span over several organizations not only the social and organizational embeddedness makes an information infrastructure difficult to manage. The factor of a lacking common managerial level further adds to the complexity (c.f. Henningsson & Hedman, 2009).

Taking these studies into account brings to the fore a crucial point: working infrastructures inevitably involve the development of standardisation and classification systems. However, such standardisation stretches beyond technological artefacts, platforms and protocols to include people's routines, communicative behaviours, and work practices (Monteiro & Hanseth, 1996; Bowker, 2005). Accordingly, we conceptualise information infrastructure as a system of standardised practices and modes of communication that emerge in relation to a particular set of IT artefacts within organisational boundaries. Such practices are acquired when actors are inducted into a community and undergo a process of socialisation whereby they internalise local knowledge, practices, language, and values. Over time, such artefacts and associated organisational arrangements and practices become taken for granted, at which point they recede into the background and become part of the infrastructure (Star & Ruhleder, 1996).

3.3 Designing an information infrastructure for enabling trusted traders

It is clear that the information infrastructures contain both IT as well as human and organizational elements. IT elements consist of standardized intra and inter-organizational systems (including hardware when needed), data, and communication. Human elements refer to skills and knowledge required to operate the information infrastructure. Organizational elements are processes and the practice in which the infrastructure is embedded into. Furthermore, these elements are tightly knotted and cannot be changed without consideration of one another. Trying to reshape an information infrastructure therefore implies inter-organizational collaboration and realignment of the work processes of all involved organizations. This cannot be achieved without appropriate collaboration models and change management approaches.

Therefore, on a conceptual level, redesigning an information infrastructure to enable the use of the trusted trader concept entails redesign suggestions along four dimensions:

A. IT elements: Hardware, intra- and inter-organizational software, data models, and communication.

B. Human elements: Skills, knowledge, values and norms associated with operation of the information infrastructure.

C. Organizational elements: Processes and practices in which the information infrastructure is embedded into.

D. Change and collaboration elements: Approaches for aligning the three above standing element categories both intra- and inter-organisationally.

In the next section, these four dimensions will be used to present our design proposition of how to enable use of the trusted trader concept.

4 DESIGN PROPOSITIONS: 'THE TRUSTED TRADER INFORMATION INFRASTRUCTURE'

This section presents the Trusted Trader Information Infrastructure as a design proposition to achieve an information infrastructure that enables the use of the trusted trader concept. We will first introduce the idea behind trusted traders and what it will demand from the information infrastructure of international trade. Then we present the design proposition which draws on the theories of information infrastructure above present as IT, Human, Organizational, and Change elements.

4.1 The trusted trader idea and information infrastructure requirements

For centuries authorities have pursued transaction based controls of international trade. In this system every international shipment (transaction) is reported to the authorities and declared at the border. As international trade continuously increases in a globalized world this has led to huge pressure on customs authorities as well as a heavy administrative burden for exporting and importing companies. Estimates claim that exporters may spend 2% of their turnover on export administration.

Throughout Europe work has begun to transform customs control to the model used for VAT reporting. Instead of reporting and controlling every transaction, companies may be certified as trusted traders who may only report export and import periodically. To become certified as trusted trader companies have to prove that they are in control of their business and product flows. Many companies already meet several of the future demands due to other governmental regulation (e.g. in the food industry) and internal efficiency and quality demands.

In the EU a first step towards a trusted trader certification is the Authorized Economic Operator (AEO) certification. However, in its current shape the AEO status enable few trade facilitations and is not very popular among traders. In order to enable a full use of the trusted trader concept, the information infrastructure has to change radically. The proposed information infrastructure addresses the increased complexity of the trade network model, where individual and isolated solutions are insufficient for establishing end-to-end control over the whole network. For example, standardized data/process models and interoperability are essential to connect the different IT innovations of each partner in a Trade Network. Information sharing between companies is essential for these companies to become an efficient and trusted network.

4.2 IT elements: Hardware, inter- and intra-organizational systems, data, communication

Regarding IT hardware, the existing information infrastructure fulfils most needs. The actors in the ecosystem of international trade are already communicating with each other electronically mostly through the Internet. The trusted trader concept requires that upon request the traders are able to prove that shipments are under control and are not manipulated somewhere during the transportation. Thus, one of the technology providers in the project developed a tamper-resistant container security and monitoring device that electronically sealed containers. The device logged information about container opening, temperature, and position. By integration with a supply monitoring software containers could be traced in real time.

The tracing software was part of the inter-organizational software developed as part of the design proposition. The software was implemented as a system to which traders, shippers and trade governors (Customs) had access. Thus trust was built with the ability to show control upon request. Another inter-organizational system was built as a common European hub for export declarations. It was based on the idea that all European actors should interact which each other via this hub, rather than via direct links.

One of the customs organizations made an investigation what they would ask for regarding the traders' own enterprise system in order to grant the status as trusted trader. Eight functions were described, ranging for sending simple statements to Customs that some goods were under "self assessment" to more complex backwards tracing functionality. When applying these functionality requirements on the projects trade representatives internal systems most of the vital functions were already covered. For example, in the food industry backwards traceability of products is already a requirement. Only minor adjustments would be needed to, for example, fetch reference numbers to identify goods.

Highlighted in the work with the hub-software that was to interface all actors related to export in Europe was the need for a common data model. Currently, a trader is required to provide different information depending on the European country from which it is exporting. End-to-end control of the flow of goods requires data to be exchanged between two traders, between traders and authorities, and between authorities. A prerequisite for these exchanges is that all actors employ a standardized data model where the data elements have a universal meaning. The proposed information infrastructure contains a suggestion for a harmonized data model in the form of a UN/CEFACT compliant export schema.

Finally, three parts of the communication were developed in the design proposition. To communicate, the symbols interchanged needed to be understood equally by the ones communicating. However, it was noted during the project that such an understanding already existed. A substantial amount of work on data meaning has already done by UN/CEFACT, ISO, and the EC/TAXAUD to specify the meaning of data. Already in the work on the paper based standard preceding e-Customs standards, the Single Administrative Document, many of these issues emerged and had to be solved. Also for such fairly interpretable fields such as "product description" there are appropriate guidelines on how to provide and interpret data. Less attention had been given to the different modes of communication that exists. Sometimes digital signature or encryption is employed, sometimes not. Sometimes data is pushed to the trade governors, sometimes it is pulled from the traders systems. The design proposition contained specification on suitable signature, encryption, and data retrieval mechanism.

4.3 Organizational elements: Processes and practices

In the EU there are more than 400 Customs offices and more than 2,000,000 exporting and importing organizations spread over 27 countries. Obviously, it is impossible to talk about any common organizational or national culture. Some countries, like the Scandinavian countries and the Netherlands have a long tradition of granting trade facilitations based on certification. Others lack this tradition and generally, even in Scandinavia and the Netherlands, the fundamental idea behind customs control is that traders are expected to violate regulation until proven differently. The trusted trader concept builds upon a completely different foundation: that trusted traders are complying with regulation until proven differently. This new approach must be anchored in the mindset of both customs and traders in order to enable our design proposition. Ultimately this means changes in legislation. The current legislation, as being the formalized interpretation of norms of values associated with export control, echoes the distrust perception. However, changes are already taking place in the EU as a decision has been taken on a modernized customs code that permits use of trusted trader certification process.

Introducing the trusted trader concept means moving some parts of the export declaration processes to become internal of the exporters. Thus the interface between traders and customs is altered. Instead of ping ponging data between organizations, export processes involving trusted traders boxes certain steps of the process, only notifying customs where the self control starts and ends. As the information infrastructure is bundled with the processes that embed it, all suggested innovations have been connected to process models showing the current and future processes.

What was also noted during the work with the information infrastructure was that very few of the potential benefits of being a trusted trader would materialize if the status as trusted trader was not recognized in the target country of the export. In this case the customs of the target country would employ transaction based control and demand that all certifications were provided (for non-carrier of various diseases, of origin, quality, etc.). Thus, most facilitation would be lost. Therefore a overview of the mutual agreements that had to be signed with export countries was created to accompany the information infrastructure.

4.4 Human elements: Skills, knowledge, value, and norms

A shift to control by certification means a need for new knowledge and skills. Thousands of customs officers will have to perform control differently and millions of employees at traders have to perform export differently. Groups such as veterinary and health authorities that become essential in the certification process and IT consultants that assist companies in modifying their enterprise systems to match the requirements for trusted trader certification are also required to perform new tasks. As part of our design proposition we have, together with one national customs organization and one large consulting firm, developed checklist and tools to assess how a company’s enterprise system match customs requirements for trusted trader certification. The proposition also contains learning material. This material could be communicated through trade organizations.

During our workshops the invited traders expressed that the introduction of e-Customs this far had not lead to any relief in the administrative burden. For that being the cause they referred to mainly two reasons. First, as companies increased their ability to keep control of their business the customs organization continuously raised the bar for what should be reported and analyzed by the customs organization. Electronic submission instead of paper based submission of data made analysis of large chunks of data possible, and required. Secondly, the authorities existed in silos and did not align their IT initiatives. As much control as possible and the silo-identification are norms that has to be changed in order for the design proposition to be successful. The existence of the project in which this research was carried out is one of the measures taken to change these norms a values, by "neutral" researchers voicing issues and problems in the existing setup.

4.5 Change and collaboration elements: ecosystem, collaboration, and migration paths

The change and collaboration elements of the proposed redesign can be divided into three parts: ecosystem mapping, collaboration model, and migration paths. An ecosystem analysis of international trade revealed that the trade is dependent on the collaboration of many organizations. Commercial businesses are linked in international supply chain ranging, for example, from the individual farmer via purchasers, food processors, shippers, importers, and retailers to the end consumer. The actors in the supply chains are monitored by a large set of trade governors, such as national authorities for customs, tax, VAT, health, and statistics. Besides traders and trade governors the ecosystem also includes interest organizations for the various actors (e.g. SITPRO for British and EVO for Dutch shippers), and international collaboration and development organizations such as WTO, UN/CEFACT, and UN/ECE. Lastly, providers of IT elements take also part in the ecosystem of international trade. The ecosystem analysis was included in the proposed redesign to highlight which actors needed to be included in any work to redesign the information infrastructure of international trade.

In order to bring all the above mentioned actors into the change process, a network collaboration model was developed as part of the redesign proposal. The model was developed upon the Network Management Framework (NMF) (Riemer and Klein, 2006), representing aspects of the settings and capturing their dynamic and precariously socialised existence. The conceptualisation of the environment as a network and its representation as the NMF is designed to emphasise the importance of governance structures for coordinating exchanges among network members.

Migration paths were also part of the change elements. For example, a non-submission vision was expressed meaning that trusted traders should not submit any export data at all to customs in relation to their shipments. Data should only be pulled by customs from the exporter's internal systems upon request. However, the current legislation in many European countries does not support this pull mechanism. Instead interim scenarios with a minimum data submission were developed as migration paths.

5 EVALUATION AND RECONNECTION OF FINDINGS

The design proposition above outlines a framework for developing an information infrastructure that enables trusted traders in international trade. Although the project is not yet finished some preliminary conclusions can be made.

5.1 Reconnecting findings

In the theoretical section above it was presented and discussed the discrepancy in the views of how easy it is to manage large information infrastructures. One view implicitly presupposed information infrastructures being conglomerates of technology and human components. The second view regarded information infrastructures as embedded into norms, values, processes and practices which had to co-evolve with the technology for functional development of the infrastructure. Based on our work with the information infrastructure of international trade it is clear that at least these kinds of information infrastructures are not easily isolated and managed conglomerates of IT components. The most cumbersome step involved convincing organizations that they have to do something and that change is desirable. Authorities are institutions that are almost carved in stone by tradition. In customs failure is not an option, thus risk taking and willingness to evolve can be supposed to be lower. The current system is, more or less, working. The new way may be better, but there is always a risk of failure. What will then trigger change? External pressure and threat probably.

By a four year long trial and error approach, based on the limited existing research on how to reshape large information infrastructures, to create the Trusted Trader Information Infrastructure we identified many issues that needed to be addressed. These issues included standardized data model, changes in international treaties, standardized encryption of data submission and changes in national legislation. Guided by the tentative framework presented in Section 3.2 we divide our counter measures to address all issues into four categories focusing on Organization, Human, IT and Change (Figure 1). Whereas Section 4 presents the specific design proposition for an information infrastructure enabling use of the trusted trader concept Figure 1 presents how the experiences of developing this specific infrastructure can be abstracted to a general proposition of what is required to redesign a global information infrastructure.

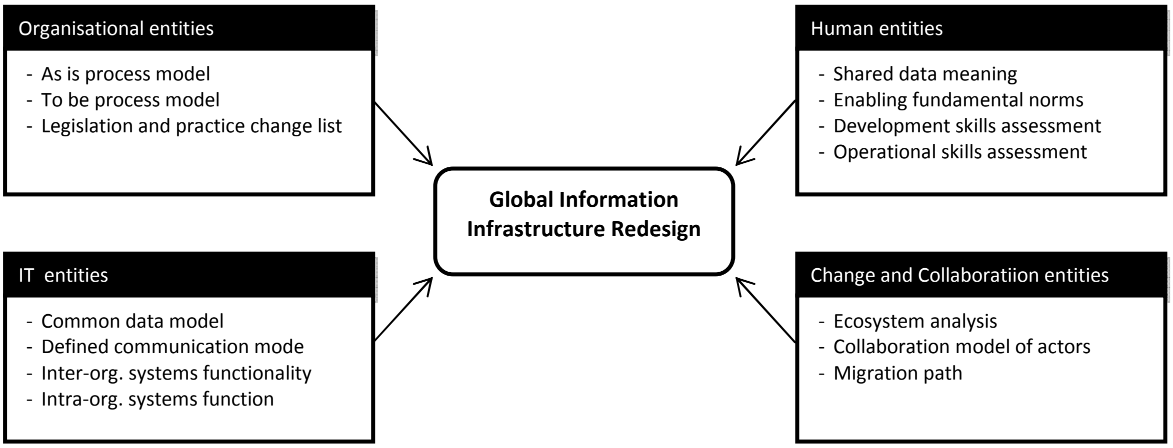

Figure 1 Global Information Infrastructure Redesign

5.2 Evaluation and validation

As mentioned earlier this research took place in four major iterations. Each iteration was associated with a so called Living Lab. The Living Labs were test beds for potential redesign propositions. Solutions to specific problems regarding international trade were implemented and validated as proof of concept-implementations. The implementations run with actual transaction data from the traders and trade governors systems.

Each of the four living labs is evaluated through a predefined value assessment framework based on academic research and best practices. Evaluating the value for governmental actors consisted of a particular problem in that value cannot be measured only in economic terms. Eventually three goal areas were selected as desirable value additions for the design proposition: Security, Reduction of administrative burden, and Reduction of fraud. The ability to add to these goal areas were addressed on four levels: Financial, Social, Operational, and Strategic.

Some parts of the evaluation are still ongoing while others are finished. Generally the evaluation has been positive with substantial value found in all three value categories. However, the evaluation is made on test and proof-of-concept installation and further real world use is necessary to draw final conclusions. The project is currently working on the task of putting the design proposition into real world use. Not at least the collaboration models and migration paths have been found essential here as the shift into an information infrastructure based on trusted traders is a paradigmatic shift that has to be accepted in all of the EU's 27 member states.

6 CONCLUSIONS AND FUTURE RESEARCH

The paper introduced the Trusted Trader Information Infrastructure – a design proposition on how to redesign the information infrastructure of international trade to enable use of the trusted trader concept. The Trusted Trader Information Infrastructure addresses the increased complexity of the trade network model, where individual and isolated solutions are insufficient for establishing end-to-end control over the whole network. For example, standardized data/process models and interoperability are essential to connect the different IT innovations of each partner in a trade network. Information sharing between companies is essential for these companies to become an efficient and trusted network.

To redesign the information infrastructure of international trade organizational (processes and practices), human (knowledge, skills, norms, values), and IT (Hardware, inter- and intra-organizational systems, data, communication) constituents of the infrastructure needs to co-evolve. Our experience from real world use is that the mutual dependencies between different elements in the information infrastructure cannot be over-emphasized. Introducing change is a veritable orchestrating endeavour. A change in e-Customs systems must be matched with a corresponding change in the way the exporter declares export goods. Given that there are two million traders in Europe such an effort is complex and costly. Further, depending on the type of change, modification in legislation may also be required. And if the change is of the paradigmatic kind like the shift to trusted traders will be, change is also required in the fundamental norm and value systems of trade governors. Therefore an elaborated change approach is a fundamental constituent of the Trusted Trader Information Infrastructure.

Beside the contribution in form of a design proposition for international trade, this paper also contains theoretical contribution to the field of information infrastructures. Our conclusions regarding the redesign of a global information infrastructure are summarized in Figure 1. Four categories of measures are required, addressing Organization, Human, IT and Change respectively. In Figure 1 we outline the contents of categories, but whereas the broader categories are general enough to last the test of time the content needs further validation.

Finally, we believe that the actual redesign of the global information infrastructure is becoming an important concern for IS research as globalization and interconnectivity of the world is steadily increasing. Previous research has shown that corporate information infrastructures are hard enough to redesign, but when it comes to global information infrastructures not only the increased scale but also the lack of a common management level is adding to the complexity. Nevertheless, global information infrastructures are already adding substantial value to industries such as aviation and food and have the potential to make contribution to the global trade.

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