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Inter-organizational Information Systems: From Strategic Systems to Information Infrastructures

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Abstract

This paper reports on a series of panels and workshops held at the Bled eConference since 2004. It aims at reconstructing the developing understanding of Inter-organizational Information Systems (IOIS) over the years as evidenced by these workshops, which have been designed to provide a forum to discuss emerging topics, fields, and strategies for IOIS research on a network and industry level. This paper provides an overview of the workshops and a detailed coverage of the last one in order to give a thorough and vivid account of its contributions. The paper not only takes a historical lens in documenting the workshops but also in discussing the transformation from strategic systems to information infrastructures. It reflects the enabling role of the Bled eConference for workshops series and the workshops' contribution to the Bled conference.

Keywords: Inter-organizational Information Systems, Inter-organizational Information Infrastructures, Industry and National Level of Analysis, Evolution of IOIS

1 Introduction

Inter-organizational information systems (IOIS) are widely regarded as key enablers of structural and institutional change. IOIS now have a five decade history and there exists a

remarkable diversity in the forms these systems have taken in various countries, particularly in the extent of standardisation, and in the trajectories along which they have evolved over this period in response to local environmental changes. Moreover their scope ranges from dyadic linkages to industry infrastructures (Lyytinen and Damsgaard, 2011).

With few notable exceptions (Damsgaard and Lyytinen, 1998 and 2001; Johnston and Gregor, 2000; Gregor and Johnston, 2001; Markus et al., 2003 and 2006; Rodon et al., 2008; Reimers et al., 2009; Higgins and Klein, 2011), the IOIS literature has inherited the traditional IS interest in adoption and implementation of systems at the timescale of particular projects (Robey et al., 2008) and therefore falls short of explaining the development of IOIS over long timescales.

A series of six panels and workshops has been held at the Bled eConference between 2004 and 2009, which have addressed the development and indeed transformation of inter-organizational information systems (IOIS). In contrast to the majority of the literature which takes a micro-level perspective, the focus of analysis has been on an industry or national economy level. Over the course of the workshop series the perspective has shifted from strategic information systems to information infrastructures. While the series of workshops reflects the research journey of the authors (Reimers et al. 2010), it has been primarily intended to provide a platform for debate among experts in the field. Theoretically informed analyses of IOIS cases have been presented as evidence and have been critically examined. Renowned scholars, who have shaped the field of IOIS studies and who have held an interest in meso- or macro-level analysis of IOIS dynamics have shared their views and engaged in lively discussions. In this way these workshops have become what we see as a hallmark of the Bled eConference.

Section 2 reflects on the format of the panels and workshops which was enabled by the Bled eConference and has indeed shaped the conference as well. Section 3 gives an overview of the development of themes addressed during the series of workshops. Section 4 elaborates on the theme of the last workshop, 'IOIS in Healthcare - From Systems to Infrastructures', which is then discussed in more detail by presenting the panellists' views. Section 5 provides a summary and conclusions.

2 Format of the panels and workshops

The panels took place at the Bled eConference, which has provided a thematic and organizational platform to discuss emerging research topics in the IOIS field. With its relaxed and collegial atmosphere, the conference provided a fertile environment to invite scholars to reflect on the direction of the field and link theoretical considerations and insights into specific industries, such as health care, logistics, car manufacturing, retail, petrochemicals, or real estate brokering. The panels presented theoretically grounded interpretations of IOIS cases and referred to the conference theme. Regularly, practitioners joined the conversation to share their views and insights.

Initially we used the format of a panel with a set of brief presentations as a starting point for the discussion. Over time we moved to a more discursive workshop format in order to facilitate a more open and thematically focused discussion of the issues under consideration. Moreover, we were able to actually conduct a full series of workshops over a period of six years, which also underscores the role of the Bled eConference for IOIS research.

The panelists include a diverse and international group of scholars, who have worked in, and indeed shaped, the field of inter-organizational information systems and infrastructures (in alphabetical order): Michael Barrett, Stephan Billinger (for Michael G. Jacobides), Jan Damsgaard, Matthew Guah, Christopher P. Holland, Robert B. Johnston, Stefan Klein, Sherah Kurnia, M. Lynne Markus, Joan Rodon Mòdol, Federico Pigni, Kai Reimers, Reima Suomi, Yao-Hua Tan, and Rolf T. Wigand. If we take the panelists' earliest papers on IOIS, we see that they have contributed to the discourse about IOIS for more than 25 years, e.g. Wigand (1980), Klein (1990), Suomi (1992), Holland et al. (1992), Reimers (1993), Damsgaard & Lyytinen (1996), Croson & Jacobides (1997), Foekens, Mitrakas & Tan (1997), Johnston (1998), Kurnia & Johnston (2000), Guah & Currie (2002), Rodon & Christiaanse (2004), Pigni et al. (2005), Markus (2006).

3 Thematic Milestones

This section provides an overview of the themes addressed throughout the workshop series. It illustrates the gradual development of a research program for IOIS and eventually Inter-organizational Information Infrastructures (IOII). The workshops reflect the rationale as well as the methodological and theoretical challenges related to the study of the evolution of IOIS over long periods of time and at a macro level (industry or higher). The discussions eventually led us to reconsider the unit of analysis: while we had started to look at inter-organizational information systems from a strategic point of view we moved to inter-organizational information infrastructures. The view of IOIS as common infrastructures that have been – temporarily – exempt from immediate competition complements the dominant view of IOIS as strategic devices to reinforce alliances or supply chains.

3.1 Issues and Methods for the Study of IOIS Adoption at the Industry and National Level (2004)

The first panel addressed the study of adoption and diffusion of information technology at levels of analysis greater than the firm. This is of theoretical interest due to the possibility of mutual interaction between the shape and degree of adoption of IOIS and the shaping of networks, industries and national economies in which they are adopted. The study of technology adoption by agents engaged in collective action at multiple levels is a challenge that begs for new empirical data and theory building. It is also of interest to business and regional/national industrial policy makers to improve their understanding of the causal influences upon IOIS adoption trajectories at an industry and regional level. Such knowledge can assist in evaluating the extent to which adoption experiences in one industry or country can be validly used to inform policy choices in another industry or country.

3.2 Understanding the Emergence of IOIS from the Perspective of Networks, Industries and National Economies (2005)

The second workshop continued the first workshop's theme. The emergence of IOIS has been typically studied from a company perspective – focussing e.g. on strategic drivers. Yet studies from the US (CRITO, http://www.crito.uci.edu/projectsITIS02.asp) and the EU (eBusiness W@tch, http://www.ebusiness-watch.org/) have shown huge differences in the adoption of Electronic Commerce across industries and across different countries. However, existing studies provided little insight into industry-specific dynamics of technology adoption or the development of vertical standards. Moreover, they did not address the profound impact which technology has had in shaping and indeed transforming industry structures. The workshop

compared examples from the pharmaceutical, retail, banking and real estate industry across different national environments.

3.3 Exploring Inter-organizational Information Systems at the Industry Level (2006)

The third workshop discussed major enabling and constraining forces of the evolution of IOIS at the level of a network of firms linked through long-term relations on the one hand and at the level of national institutions of a whole country on the other hand. Important institutional aspects are often overlooked on the level of networks of firms, for example how economic roles are defined within the industry or which forms of collective action have evolved. Observations on the country level, however, fail to recognize the importance of relationships among firms. Studies of IOIS at the industry level promise to overcome this twofold weakness. However, important conceptual issues remained to be addressed before industry-level studies can realize their full potential. Specifically, the following questions were addressed:

- How can the often-observed divergence between technical IOIS structures and structures of firm networks be explained? Will shifting analysis to the industry-level resolve this divergence?
- How should the unit of analysis for IOIS-studies on the industry-level be defined?
- How are industries shaped by national factors such as national culture, government policy and legal frameworks? Do industries evolve in a path-dependent way or is their evolution contingent but not predetermined? What implications does this have for the evolution of IOIS?
- How can institutional structures of industries be described so as to be meaningful for understanding the structure and evolution of IOIS?

3.4 Modelling Inter-organizational Information Systems (2007)

To continue a discussion on methodological and theoretical aspects of IOIS research which developed in the course of the previous workshops, this workshop addressed the issue of how to model Inter-organizational Information Systems. Extant IOIS research uses a variety of ways of conceptualization and perspectives, for example describing IOIS as initiatives or collectives of participants. Also, a multitude of levels, aspects and dimensions are used to describe the internal structures and processes of IOIS. In order to further the study of IOIS, we felt it necessary to promote a more theory-based and common way of identifying, describing and modelling IOIS. The workshop explored different theoretical bases appropriate for modelling IOIS and describing their evolution. It reflected on the multi-level nature of IOIS and different types of IOIS.

3.5 eCollaboration and Conflict – Exploring divergent development paths in Pharmaceutical Retail (2008)

The development of inter-organizational information systems (IOIS) can be described as a history of collaboration and conflict. Joint activities and solutions are developed while at the same time competition and conflict among competitors or supply chain partners is contained. Yet, latent or manifest conflict often influences the development over time as the partners (re-)consider their positions.

In order to extend the understanding of the dynamics of IOIS, the workshop participants were asked to explore alternative interpretations of the same case evidence. The workshop looked into the historical reconstruction of two sets of case data of divergent development paths of eOrdering systems linking pharmacies and wholesalers in otherwise similar industry environments. The participants provided theoretically grounded interpretations of the findings using different approaches, such as path dependency theory, structuration theory, practice theory, innovation and standardization, strategy theory, systems theory, and institutional theory.

3.6 Inter-organizational Information Systems in Health Care – From Systems to Infrastructures (2009)

Traditionally, inter-organizational information systems (IOIS) have been regarded as systems with defined boundaries and purpose. However, the IS literature increasingly takes an interest in the notion of infrastructures, specifically information infrastructures, which are often shared by multiple, diverse stakeholders. The interest in inter-organization information infrastructures is fueled by observations of large information infrastructures under construction across industries. In health care we see public debate, development or even roll-out of huge collections of patient medication records. They are portrayed as remedies to many of the ailments of national health care systems, such as lack of transparency, redundant procedures, changing demographics, and changing expectations of health care quality. Not surprisingly, some of these initiatives have incurred huge delays, cost overruns, and public critique regarding privacy protection.

Conceptually, we see a huge variety of artefacts being called infrastructures: from corporate infrastructures to international ones, from technical perspectives (communication infrastructures) to a holistic perspective (organizational and societal embedding as prerequisite for infrastructures). Infrastructure development is usually the result of collective action and politics rather than clear-cut strategic rationales. Infrastructures can be seen as platforms which enable and faciltiate multiple forms of use. This calls for a clarification of the perspective and indeed the theoretical underpinning. The issues addressed in this last workshop in our series are further described and discussed in the next section.

4 Inter-organizational Information Systems – From Systems to Infrastructures

When studying historic cases of IOIS, it becomes obvious that strategically-designed systems can turn into industry infrastructures (e.g. computer airline reservation systems), while, at the same time, standardized infrastructures can be appropriated for the development of specific, proprietary, strategically positioned systems. We are intrigued by these transitions, which we believe shed some light on the very notion of infrastructure. Yet, practically, infrastructures are confronted by contested ownership claims. In some cases, differences between the notions of infrastructure and system seem to be primarily perspectival. Retrospective analysis from an infrastructure perspective promises to yield new insights into historic cases of IOIS.

4.1 The panellists' contributions

This section illustrates the format of the workshops, the questions discussed and the contributions by the panel. As the last of the workshop series, it represents the transition to a logical next research question in the IOIS field. The panelists elaborated on three questions

using different theoretical lenses while referring to their own case examples from the health care sector:

- What are the implications of the infrastructure perspective?
- How can we explain change perspectives from an inter-organizational system to an inter-organizational infrastructure?
- What does an infrastructure perspective contribute to explaining industry transformation?

The statements are edited versions of the panelists' contributions that have been documented after the panel.

4.1.1 Michael Barrett

True to the title of this chapter, my journey in contributing to the information infrastructure concept within healthcare followed earlier work on the implementation of EDI applications as inter-organizational systems (IOS) in the London Insurance Market. Like the American Airlines case, these systems were seen as strategic and critical to the ongoing competitiveness of the insurance industry globally. My research highlighted the socio-political challenges of their implementation and use, and drew on structuration theory to investigate these implementation challenges.

At the time, the prevailing discourse on IT infrastructure was focused, at the firm level, on ensuring strategic alignment to leverage the corporate IT infrastructure (II) in maximizing its performance. A parallel stream of work in the mid-1990's by Hanseth, Monteiro and others examined EDI implementation in the inter-organizational context of healthcare. They offered actor network theory (ANT) as a theoretical approach and were early proponents along with colleagues such as Bowker, Star, Ruhleder and others in developing the concept of information infrastructure. I found the relational perspective offered in this concept attractive and the recognition of its key dimensions to include its extensive reach and scope, heterogeneity building on an installed base and embedded into structures and social arrangements involving diverse interests, values, and meanings. This certainly resonated with my experience of industry developments of infrastructure in the London Insurance Market as well as the national information infrastructure developments which received significant attention in the 1990's.

In the Science, Technology, and Society literature, Bowker and Star (1999) have developed a closely allied focus on the negotiability of II, highlighting how the working infrastructure is negotiated on the boundaries, and coined the term boundary infrastructure. As argued by Ciborra and others (2001), the II concept implies an open-ended array of things needing alignment and challenges the prevailing view of alignment and control emphasised in the corporate IT infrastructure literature. Rather, they argued that, in reality, control of II is increasingly infeasible as it is developed over time. Instead the II took on a logic of its own that could not be controlled but at best cultivated. As such, it was inevitable that II's would drift, and in recognition of this they coined the title of their book 'From Control to Drift'.

The development of II in the IS literature has been concomitant not only with the increasing complexity and scope of IS beyond organizations and across industries. The concept has recognized the inevitableness of drift vs. alignment and control, and has been illuminated by a number of theoretical developments including structuration theory and ANT. The relational

focus of II is particularly useful in defining and conceptualizing II. As Star and Ruhleder (1996) highlight, 'II is a fundamentally relational concept. It becomes infrastructure in relation to organized practices'. My recent research on the development of regional information infrastructures in healthcare with Panos Constantinides (2006) builds on the negotiability and appropriation of II, highlighting the related yet distinct notion of appropriability of II by different parties concerning their claims of ownership. Drawing on technology and business policy studies (see David 2001; Weiss & Backlund 1996) the 'appropriability problem of public goods' starts with the extent and impact of private investment in the exploitation of the commercial opportunities of public goods. It points to the paradox brought about by private investors who seek to fully appropriate the economic benefits of public goods, yet these public goods also need to accommodate public interests. Health care information infrastructures with their public-private interests are a prime example in question. As our research has highlighted, there are often negotiations over the development of the II as to how much power principal owners (e.g. R&D developers) and secondary owners (e.g. primary health care providers as users) as well as third parties (regional health authorities, government, EU) should have over the use of II. Should users for example be able to obtain income from the assets incorporated in these goods, and even deny power to principal owners. These different claims to II ownership are of both a pragmatic and moral nature, and can potentially lead to conflict across the different layers (i.e. physical layer, logical layer, and content layer) of the information infrastructure over time. Our research into HEALTHnet, a regional health information infrastructure in Crete, found that the II was appropriated among developers, end users, and governing and funding bodies along both contractual agreements and socio-technical arrangements.

Our approach to II, therefore, examines the dynamic interplay between public-private interests around the appropriability of information infrastructures by focusing on diverse (and often conflicting) ownership claims. We suggest the development of a commons framework for understanding this appropriability problem of information infrastructures. Popularised recently by Benkler (2006), a "commons" is the opposite of private property, in that no single individual or group of individuals has exclusive control over a particular set of resources. It is a particular institutional form for structuring the ownership of resources, which recognizes that constraints cannot be unilaterally controlled by one actor but are symmetric across all actors. Briefly, we argue that, irrespective of whether an information infrastructure is private or public, it is always a commons because of its reach, scope and heterogeneity, i.e. it is potentially accessed by a wide population of users. Our commons framework highlights that there are various mechanisms of control and resistance in appropriating the information infrastructure and examines how tradeoffs between competing public-private interests become mediated over time. The proposed framework can facilitate cooperative public-private strategies that enable interested parties to bargain around the trade-offs inherent in the development of an information infrastructure as a commons and help ensure positive (vs. zero) sum gains are achieved for all owners across the three layers of II. How the II is appropriated and governed over time can have significant implications for both its evolution and for the transformation of the healthcare industry within which the II is being deployed.

4.1.2 Joan Rodon Mòdol

In the following lines, I am going to reflect upon my research on the formation and evolution of business sector information infrastructures (IIs) not only in the healthcare sector but also in the logistics sector. The term II refers to the set of interrelated socio-technical components –

i.e. practices, standards, databases, messaging systems – that collectively underpin cross-company interactions. Those IIs are usually organized and used by organizations in the same sector who standardize and agree on the rules – i.e. meaning of terms, procedures, sanctions – that govern those interactions. This definition of II excludes information systems owned and/or controlled by dominant members of a sector to support their interactions with non-dominant trading partners.

From a theoretical perspective three broad theoretical lenses have illuminated my research: actor-network theory, structuration theory and institutional theory. I opted to draw upon several concepts from these theories as I considered that they helped me understand, reveal and explain the phenomenon under study.

In the case of actor-network theory, it has been used to study how an initial intent to build a system to support the interactions of multiple actors – including humans and non-humans – over time turns into a set of stable interests between them. In that sense, actor-network theory has been useful to track the processes whereby actors – i.e technical artifacts, users, designers, standards, procedures – are aligned and organized into an II, study the strategies that proved successful or fail in enrolling and mobilizing the diverse actors, and identify and understand the unexpected paths that an II may take.

On the other hand, I have drawn upon structuration theory to study the human agency once the II is in-place – namely, the post-implementation phase – but still lacks a critical mass. In that sense, by means of structuration theory I conceive of the post-implementation development as episodes of dialectical tensions between managers and users towards the stability of the II. Structuration theory allows me to examine how users appropriate the II in intended as well as unintended ways, and how managers intervene to influence users' structuring of the II.

Finally, the health care sector is characterized by being highly institutionalized and by the existence of diverse logics that intersect and shape the way in which services are provided. For instance, the market logic guides the pursuit of efficiencies in the provision of services while the logic of professionalism guides the practice of general practitioners and pharmacists. Hence the implementation of II may sometimes entail problems that surface the existence of tensions between the diverse logics. In those cases, institutional theory has proved a good candidate to study how IIs mirror those tensions and how they can handle them. Furthermore, just as the existing cognitive, normative and regulative institutional framework influences the implementation of IIs, its subsequent use may shift the institutional framework; hence institutional theory may be useful to study how IIs structure the relationships within sectors.

Having presented the empirical and theoretical background of my research I next address the questions of the panel. Specifically, I focus on three interrelated implications of adopting an infrastructure perspective: viewing the building process as the integration of existing systems, the limited governance and scope of control of IIs, and the focus on emergent interactions rather than on transactions.

A first implication of adopting an infrastructure perspective is *viewing the building process as the integration of existing systems*. Traditionally, IS implementation literature has emphasized

the development of systems from scratch and from a set of predefined technical and functional requirements, but played down the role of the installed base of systems. IIs, however, are not stand-alone and self-contained information systems; rather they represent large and open socio-technical networks compromised of heterogeneous actors (Hanseth and Lyytinen 2004). IIs are built upon the existing installed base of practices and technologies that are institutionalized. Accordingly, the building of IIs may be better conceived as the integration and extension of existing working systems. I do not intend the reader to imagine the process of integration as creating a puzzle, where the existing systems that constitute the installed base seamlessly integrate with and are highly responsive to each other. Rather, by integration I mean the loose interconnection of the diverse working systems forming complex socio-technical ensembles, which are increasingly connected with and dependent upon one another (Hanseth and Lyytinen 2004). Loose interconnection means that there might be at the same time tight coupling between certain groups of work systems, and non-coupling between others. Whereas the rationale for tight integration is to maximize efficiencies and control, the rationale for loose integration of the working systems is to facilitate growth from an existing base so that the II can bootstrap, hence to reach critical mass. Accordingly, the building and use of IIs is strongly dependent on their capacity to mobilize actors and make the diverse socio-technical installed bases interoperable.

A second implication of adopting an infrastructure perspective is the *limited governance and scope of control of the II*. Multiple actors (designers, users, professional associations, regulatory bodies, etc) with sometimes contradictory interests shape the building process. During the building process, those actors struggle to inscribe certain elements of their institutional context – i.e. power relations, norms and conceptual schemes – into the II. Given the multiple sources of influence, the governance and scope of control of the II is limited. This is specially the case once the II is in-place and its use has started; then the control of the II is beyond the capabilities of any single actor, and managers can only govern part of the II. This means that there are no simple causal relationships between management action and users' behaviour. Accordingly, management must be able to recognize the multiple actors' interests, and enroll and mobilize them into the II. For instance, II management can provide support to users by influencing their institutional context – i.e. meanings, norms and work procedures, control and coordination mechanisms, or habit that users instantiate in their daily practices – or by shaping the features of the II –i.e. technical features, conceptual schemes and processes, or vision and goals. I consider that future research could further investigate sources, targets and forms of interventions and their relationship with the use of IIs.

A final implication of adopting an infrastructure perspective is the *focus on emergent interactions rather than only on transactions*. A great deal of IS implementation literature has focused mainly on the standardization and automation of existing transactions and processes – for instance, through EDI or XML – in order to obtain greater efficiencies and control. This exploitative use of information and communication technologies deals with structured information and routine tasks. Nevertheless, my empirical studies show that the standardization of transactions and processes also carries heterogenizing forces, as local appropriations of IIs may differ from one another and from the standard. Accordingly, not only should research on IIs study the exploitation of technologies to support and homogenize existing transactions but it also should pay attention to the exploration of new forms of interactions between technologies and people and activities – i.e. novel and innovative contextualized practices that may involve new actors. Those explorative interactions are

usually emergent and difficult to anticipate. That is, IIs are built to support existing ways of working as well as enable new ones. Moreover, those emergent interactions trigger constant changes in the boundaries of IIs – i.e. new applications, new users – which means that the boundaries of IIs are not fixed. This implies that the management of IIs must focus on and devote resources to notice, test and stabilize those emergent interactions and hence to expand the infrastructure.

4.1.3 Yao-Hua Tan & Stefan Henningsson

The experiences of IIs that we reflect on are based on our research on IIs in the context of international trade. In the EU-funded research project ITAIDE - Information Technology for Adoption and Intelligent Design for eGovernment (see www.itaide.org, Tan et al. (2011)) the objective was to analyse how international trade could be accelerated using state-of-the-art IT-innovations; accelerate in the sense that trade should be simpler, faster and less costly.

Since the early 1970s, the volume of containers shipped internationally has increased dramatically. Trade is for most countries one of the pillars of their economy. However, today the actors in international trade are facing major challenges. Concerns over potential terrorist attacks, the spread of contagious diseases, and increased tax fraud have caused consumers and governmental agencies to demand enhanced control and traceability of products from producer to end consumer. At the same time, growing global competition is putting pressure on governmental authorities to lower the administrative burden put on trading companies in order to protect competitiveness of national actors. Specifically, the European Commission aims to lower the administrative burden for European companies by 25% by 2012. These seemingly opposing pressures present a significant problem for actors involved in international trade.

The ITAIDE Information Infrastructure framework (Henningsson et al., 2011) claims that cost reduction and increased security will be achieved by establishing trusted trade networks. Trusted trade networks are networks of supply chains or interconnected trusted traders. A so-called *trusted trader* is a trader that can be trusted to have full control of its internal operations and thus is compliant with international and national legislation. Trusted trade networks enable accelerated trade since they can be given trade simplifications and reduced administrative burden.

To be trusted, the trader has to prove end-to-end (E2E) control of shipping through end-to-end information transparency. *End-to-end control* of shipments means control over operations and shipments from initial producer to end customer. However, having this control is not enough for being considered trustworthy. A trusted trader has also to be able to *show* that they are in control of their export goods. *End-to-end information transparency* means that concerned authorities can have access to control-relevant information about a specific shipment at any given time. For example, its physical location and who has had access to the shipment.

We view II as a platform for the control of shipments and information transparency in trade. The II enables capabilities that help companies to fulfil the control requirements for being a Trusted Trader. *Real-time monitoring* is the capability to perform real-time monitoring and logging where a shipment is and how it is handled and stored. *Process control* is the capability of a company to document and evaluate that its own business processes meet control standards. *Information sharing* means the ability to electronically exchange

information regarding shipments with trading partners and authorities. *Partner collaboration* refers to the capability of a company to collaborate with its supply chain partners and IT providers to develop E2E control and transparency. These capabilities enable control, but are in turn dependent on a set of IT-related innovations. The *IT-related innovations* that enable such capabilities are IT artifacts such as, for example, smart seals that are attached to containers and constantly report position, movements, temperature, and exposure to light to enable real-time monitoring, or the use of Web services and service-oriented architectures to enable information sharing between supply chain partners. Furthermore, *standardized data models* are required for *interoperability* and exchange of data. *Redesign methods* are required to simplify customs procedures using these IT innovations. In the I3 framework these methods are supported by the e3-Control software tool for procedure redesign.

However, our experiences are that the IT development challenges of establishing an II that enables end-to-end control and information transparency are relatively simple compared to the challenges of developing innovative network collaboration models. *Innovative network collaboration models* are ways of bringing interested stakeholders in trade together and to create momentum in a collective change process. Examples of such stakeholders are traders, control agencies, IT providers that have conflicting interests, but at the same time can only succeed to innovate customs procedures if they redesign them collaboratively. For example, the customs organization can assess the self-controlling skills of a company to decide whether a company is a trusted trader or not, but they cannot and should not implement these controls in the company themselves. Implementing the adequacy of self-control should be the responsibility of the company, to prove to government that it satisifies the requirements of a trusted company.

We investigated various ways – such as Living Labs (see Higgins & Klein 2011) – of bringing the interested parties in trade together to create momentum in a collective change process. The main implication of changing perspective from an inter-organizational system to an II is that our focus shifts from the individual constituents to how the pieces interact as parts of an emergent whole – the infrastructure. To realize an infrastructure that enables end-to-end control, the efforts and activities of all the above-listed organizations have to be coordinated. The different sub-systems and components of the infrastructure are intricately interrelated and often span multiple organisational and institutional fields.

What we can learn from viewing international trade from an infrastructural perspective is the necessity of a common platform, where all actors with an interest in the infrastructure can meet on neutral ground. The mediator role can be played by academic institutions or international actors, such as the United Nations and the World Customs Organization. The key point is that mediation does not happen by itself. An actor which does not have a vested interest in a specific solution must catalyse the mediation process.

For the development of II in the health sector, the lesson learned is that a profound understanding of all actors who have an interest in the infrastructure is essential, and to find ways to align conflicting interests via mediation. It must be understood what drives actors to engage in infrastructural development, and how the infrastructure will fit into the other developments that are taking place in the sector. A mediating actor is helpful to establish a neutral ground where the inter-dependent actors, of which several are likely not to be aware of

their mutual interest, can meet and align the development of the parts of the II that they control.

4.2 Discussion

In the wider context of information infrastructures, which ranges from corporate infrastructures studied e.g. by Ciborra et al. (2001), to global communication infrastructures such as the Internet, inter-organizational information infrastructures (IOII) appear as a distinct phenomenon, which has not drawn a lot of attention so far. As the example of the eCustoms infrastructure illustrates, IOII cover a middle ground of inter-organizational arrangements, which are built on global communication infrastructures on the one side and link corporate infrastructures on the other side. Thus we can think of infrastructures as building on each other or being nested into one another.

The discussion of information infrastructures illustrates the wide range of theoretical perspectives that are used to study infrastructures. There is a consensus that the socio-technical view of infrastructure is helpful, and provides a productive conceptual lens to study the development, appropriation and use of large scale information systems that encompass complex ensembles of technology and people. Thus, the dynamics and emergent nature of infrastructure development is driven by the heterogeneity and complexity of the artefacts. Infrastructure development yields the emergence of new practices or forms of interaction between technology and people. The theory of the commons highlights the fact that infrastructures regularly address public or essential goods, which need to be reflected in its mode of governance.

A recurrent theme in the study of IOII contributions are transparency and control. IOII have been built in response to the perceived need to extend transparency and – consequently – informational control over complex and distributed systems of production and distribution of products and services and the related bureaucratic systems (Edwards 2003, 221). They enable not only the informatization of processes and practices, specifically real-time monitoring and documentation, but also surveillance and extended control. Consequently, they are subject to conflicting logics and interests regarding information access and use: monitoring vs. surveillance, control vs. privacy. IOII themselves are emerging, multi-dimensional phenomena, which are difficult to control. Their development is characterized by the integration of existing systems rather than development from scratch.

Their development and governance is often contested between and within the public sphere (public administration, national or international, the logic of commons) and the private sphere (corporations, associations, standardization bodies, strategic logic). Thus creating a momentum of collaboration and collective action across heterogeneous stakeholders is one of the key challenges.

5 Summary and conclusions

An intellectual journey

The workshop series looked into explanations of IOIS adoption and evolution at the industry and national level as well as related methodological and theoretical issues. The workshops collected evidence across different countries and industries of how industry-level phenomena

such as the business logic of an industry or the level of standardization, specifically EDI, in an industry have shaped the development of IOIS. Despite increasing globalization across many industries, the workshops provided evidence of the influence of national regulation, e.g. in pharmaceutical distribution, as well as the influence of national traditions and market conditions, e.g. in retailing. In studying IOIS at the industry and the national level, new methodological and theoretical issues arise such as how to model and conceptually bound IOIS at these levels.

When studying the evolution of IOIS at the level of industry and national economies, the notion of infrastructure has gained prevalence, in order to articulate non-strategic initiatives addressing issues of significant societal relevance, such as secure trade, or which require coordinated action across a broad group of diverse stakeholders, such as electronic health records. The study of infrastructure complements the analysis of IOIS as we have evidence of transitions in either direction.

From a theoretical point of view, the workshops have explored a range of perspectives and lenses, such as institutional theory, diffusion of innovation, structuration theory, actor network theory and practice theory. There is no one-size-fits-all theory available; rather the workshops identified promising candidates of theories that shed light on some facets of the phenomena and need to be developed further to suit the study of IOIS and IOII.

A place for exchange

While many conferences benefit from moving around, the Bled eConference is closely linked to a specific location. So we might invoke the *spiritus loci* of a peaceful lakeside resort in the Julian alps, secluded enough to provide a quiet place for concentrated debate and at the same time in Slovenian spirit open for innovation and change. The Bled eConference has not only built a reputation of facilitating presentations and talks, establishing links between academia, industry and government, but importantly in facilitating the unique mode of spirited exchange of ideas, joint exploration of multiple perspectives and collaborative development of knowledge that only panels and workshops enable. The workshop series on IOIS has been one example of these exchanges and indeed a path of conversations over time.

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Appendix: Selected Bled Papers

A selected list of papers addressing issues of IOIS development or inter-organizational infrastructures, providing a glimpse into the intellectual context and ongoing discourse since 1995.

8th Bled eCommerce Conference, 1995	
Graham Costello	Electronic commerce inter-organisational system conceptual models and their applicability to strategic alliances
Ivo Cathomen	Application of life cycle theory to interorganisational systems research
Angele L. M. Cavaye	Participative development of IOS as a way of facilitating implementation success and enhancing co-operation with trading partners
9th Bled eCommerce Conference, 1996	
Ha Tuan Anh, Julie A. James	An investigation of the potential for establishing an electronic trading network for the Republic of Vietnam
Niels Bjørn-Andersen, Akemi Chatfield	Driving organizational transformation through the use of inter-organizational systems (IOS)
10th Bled eCommerce Conference, 1997	
Pat Finnegan, Colin O'Brien	Exploring participant perspectives in an IOS environment: an Irish health care example
11th Bled eCommerce Conference, 1998	
Bruce W. Hunt, Paul A. Swatman	A Comprehensive Framework For The Acquisition And Deployment Of Inter-Organisational Systems
13th Bled eCommerce Conference, 2000	
Shirley Gregor, Don Menzies	The role of the 'honest broker' in the development of interorganizational systems: A case study in the beef industry
14th Bled eCommerce Conference, 2001	
Heli Salmi, Virpi Kristiina Tuunainen	Diffusion of Electronic Business in Networks - Case Autolinkki Teaching Case
15th Bled eCommerce Conference, 2002	
Sean T. McGann, Kalle Lyytinen	Capturing the Dynamics of eBusiness Models: The eBusiness Analysis Framework and the Electronic Trading Infrastructure
Arthur Tatnall, Stephen Burgess	Using Actor-Network Theory to Research the Implementation of a B-B Portal for Regional SMEs in Melbourne, Australia
17th Bled eCommerce Conference, 2004	
Kai Reimers, Robert B. Johnston, Stefan Klein	The Shaping Of Inter-Organisational Information Systems: Main Design Considerations Of An International Comparative Research Project
Martin Fahy,	Complexity, Context, Commoditisation And Cooperation:

Joseph Feller, Patrick Finnegan, Ciaran Murphy	Exploring Emerging XML-Based Inter-Organisational Systems
18th Bled eCommerce Conference, 2005	
Aurelio Ravarini, Federico Pigni, Giacomo Buonanno, Donatella Sciuto	Exploring the Role of Inter-Organizational Information Systems within SMEs Aggregations
19th Bled eCommerce Conference, 2006	
Juan Rodon, Juan Ramis-Pujol	Exploring the Intricacies of Integrating with a Port Community System
20th Bled eCommerce Conference, 2007	
Frank Frößler, Boriana Rukanova, Allen Higgins, Stefan Klein, Yao-Hua Tan	Inter-Organisational Network Formation and Sense-Making: Initiation and Management of Public-Private Collaboration
22nd Bled eCommerce Conference, 2009	
Allen Higgins, Anita Mangan, Angela Kerrigan, Suzanne Laffan, Stefan Klein	Activity, ICT, and Material Infrastructure in Complex Multi-Organisational Settings: An Assessment of Innovation Potential for Pharmaceutical Cold Chain Transport and Handling
Vincent Pijpers, Jaap Gordijn, Hans Akkermans	Exploring inter-organizational alignment with e3alignment – An Aviation Case
Kai Reimers, Robert B. Johnston, Stefan Klein	Challenges in Explaining Structure and Evolution of Inter-organisational Information Systems: Lessons from an Empirical Research Journey
24th Bled eCommerce Conference, 2011	
Kai Reimers, Robert B. Johnston, Xunhua Guo, Stefan Klein, Bin Xie, Mingzhi Li	Novice-based Data Collection Methods for the Study of IOIS: Practice Probes and Learning Communities
Stefan Schellhammer	Studying IOIS as Structurally Coupled Systems