17th Bled eCommerce Conference

eGlobal

Bled, Slovenia, June 21 - 23, 2004

The Shaping Of Inter-Organisational Information Systems: Main Design Considerations Of An International Comparative Research Project

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Abstract

Based on a critical analysis of the literature on the development and adoption of inter-organisational information systems (IOIS) we propose a new unit of analysis for IOIS studies, define levels of analysis based on this unit in order to organize a large set of variables pertinent to the study of IOIS, and show how this design will be implemented within an international collaborative research project. The main goal of our research is to shed light on the interaction between characteristics of IOIS and their development trajectories on the one hand and characteristics of industries and countries on the other hand. We expect that both, industry characteristics and characteristics of national environments have a significant influence on the type and development of IOIS but submit that understanding of these relationships is in its infancy and that significant new insights can be gained by carefully specifying the network level of analysis. Better understanding of the way IOIS are shaped can greatly 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.

Keywords*: inter-organisational information systems, electronic data interchange, unit of analysis, research design, international comparative research,*

1 Introduction

The study of inter-organisational information systems (IOIS)[1] has accumulated a considerable body of knowledge over the past 20 years. Initially dominated by the concept of electronic data interchange, this literature has gained new momentum through the prospect of using the Internet for building inter-organisational information systems. This knowledge pertains to issues such as critical success factors of introducing/promoting electronic data interchange or building inter-organisational information systems and effects of such technologies and systems. As with regard to the development of intra-organisational information systems, we can now, with some degree of confidence, say which factors should be present when embarking on a development project, which constraints need to be considered, and what the likely effects are. However, increasingly evidence is available that shows:

- Institutional factors have a strong influence on the *type* of IOIS being developed (Mansell, 2003; Easton and Araujo, 2003; Wong, 2003)
- Institutional factors have a major influence on the IOIS *diffusion path* (Hsiao, 2001; Tigre, 2003; Palacios, 2003; Brousseau, 2003; Gibbs, 2003, Andersen, 2003a and 2003b; Henriksen, 2000; Teo et al., 2003; Damsgaard and Lyytinen, 1996 and 1998; Thatcher and Foster, 2003; Christiaanse and Huigen, 1997)[2]

Thus, it would be desirable to better understand in detail the relationships between institutional traits of inter-organisational information systems on the one hand and specific types of systems on the other hand and how these types evolve over time. This question, however, cannot be addressed when different types of inter-organisational information systems are combined into one general type by abstracting from their specific characteristics or when focusing on distinct technologies that are but components in resulting inter-organisational information systems. For example, it is often assumed either that critical success factors would be generic with regard to inter-organisational information systems or that electronic data interchange is a distinct technology that could be studied with regard to adoption patterns and effects. By contrast, Alt and Fleisch (2000) argue that success factors are contingent upon types of IOIS while Lyytinen and Damsgaard (1998) show that EDI should not be viewed as a discrete technology that diffuses across a population.

In this paper, we will describe an international research project which is designed to address the question raised above. We think that the main contribution of this paper consists of the definition of a new focal unit of analysis which better than more established units accommodates the requirements implied in that question and to embed this unit in a theory-based schema of different levels of analysis.

This paper is organized as follows. Next, we will outline the proposed new unit of analysis which will be used in our research. In Section 3 the range of variables to be included in our research is presented and related to our unit of analysis via a layered model of socio-economic systems. In Section 4 the way our research design is going to be implemented will be outlined and section 5 summarizes and concludes the paper.

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[1] We prefer to use the acronym IOIS rather than the more common IOS for inter-organisational information system. The reason is that firms engage in ever higher levels of inter-organisational coordination which does not necessarily comprise the use of information technology. Thus, it becomes necessary to make the distinction between inter-organisational work processes and inter-organisational information systems used to coordinate them.

[2] See Appendix for a more extensive summary of the relevant literature.

2 The Unit Of Analysis

So far, the following units of analysis have been employed in IOIS studies:

- A certain technology (mostly EDI) that diffuses across a population of organisations
- An organisation considering to participate in an IOIS or to adopt related technologies (such as EDI)
- A specific IOIS
- An industry with regard to certain technologies (EDI, Internet) or certain forms of IOIS (B2B e-marketplaces)
- A country with regard to certain technologies (EDI, Internet) or certain forms of IOIS (B2B or B2C e-commerce)
- A supply chain

As mentioned above, Lyytinen and Damsgaard (1998) have shown why EDI or other networked technologies should not be viewed as distinct and fixed technologies that diffuse across a population. However, once this assumption is dropped it becomes impossible to use a certain technology as a unit of analysis because the technology becomes a variable and therefore cannot be specified ex ante.

Similarly, Kurnia and Johnston (2000 and 2002) have argued that an individual organisation is not a suitable unit of analysis for IOIS-related studies because this approach assumes that an organisation's environment is unaffected by the organisation's actions which clearly is not true for most instances of IOIS-related decisions and events. For example, industry structure may be affected by the development of inter-organisational information systems.

In the introduction, we have already argued that a specific IOIS cannot serve as a unit of analysis once it is acknowledged that IOIS vary considerably and that different types of IOIS may interact differently with their environment. In many studies of inter-organizational deployment and use of information technology, the notion of inter-organisational information systems has been used as the main unit of analysis. We think there are three interrelated problems with this approach. First, choice of inter-organisational information systems as the main unit of analysis makes it impossible to understand why in some industries no such systems are developed. However, understanding the reasons why firms decide not to invest in the development of inter-organisational information systems is crucial for the task of developing such systems. Note that this aspect is different from the failure of such systems which has been frequently studied (see, for example, Kumar et al., 1998, and Christiaanse and Huigen, 1997). Second, many forms of inter-organisational deployment and use of information technology occur in a decentralized manner which would make identification of "a" system difficult or impossible. For example, in many industries firms rely on bilateral EDI links without any centralized structures or systems. In these cases, one might conclude that either no such system exists or treat each bilateral EDI link as one inter-organisational information system. This, however, would ignore the interdependencies that exist among the many bilateral EDI links. Third, it is very difficult to bound this unit of analysis since it may be argued that an IOIS consists of a certain technical system plus its organisational and institutional context. In that case, however, any line that is drawn in order to separate an IOIS from its environment may seem arbitrary to some extent.

Industries and countries have both been used as units of analysis (see Appendix), mostly with regard to the study of certain IOIS-related technologies rather than IOIS themselves. In some cases, such studies focus on the diffusion of technologies and therefore use these technologies as their main unit of analysis (the industry or the country then is only one way of bounding the population under consideration). However, once specific characteristics of an industry or a country are used to explain either adoption or other behaviour related to a certain technology or IOIS that entity becomes the main unit of analysis. However, this same circumstance also makes these entities problematic as possible units of analysis since it becomes necessary to identify some traits which are common to all acting elements in these entities that, in turn, interact with a certain technology or IOIS. Examples of such traits could be national culture (for the case of countries as units of analysis) or type of product (for the case of industries as units of analysis). We think that such an approach would lack a crucial intermediate level of analysis, namely the concrete interactions among organisations that are involved in the development of IOIS. For example, the concept of industry lumps together all firms that produce the same type of product, whether or not these firms actually interact (for example, they may exist in regionally isolated markets). The same argument holds for a country as a unit of analysis.

Hawkins and Verhoest (2002) have argued in favour of using a whole supply chain as the main unit of analysis in IOIS studies. This approach has the advantage of including interactions between organisations in the main unit of analysis, albeit at the price of bounding it too narrowly since a supply chain comprises only vertical relationships. Clearly, IOIS development processes are also shaped by horizontal relationships between competing firms which are not included in the concept of supply chains.

For these reasons, we propose an alternative unit of analysis which we call an Industry Segment Value System (ISVS). This unit is constructed in the following way. First, an industry segment is determined which serves as a focal unit (similar to the concept of the focal organisation in many IOIS studies). The notion of an industry segment has been coined by Porter (1990) and differs in significant ways from the notion of an industry. While an industry is defined in terms of products, industry segment is defined in terms of interactions among firms. An industry segment is centred vertically on a certain position in the supply chains of a given industry, for instance retailers within the grocery industry. Firms in an industry segment are aware of each other and take the actions and possible counter-actions of each other into account when considering their own actions. These interactions are mediated through their market activities since they act as competitors on a certain product market.[3] However, collaborative interaction is possible within an industry segment and, indeed, a very common feature of innovative industries characterized by intensive product competition (Porter, 1990). Starting from that focal unit, the second step then consists of identifying all organisations that have direct transaction relationships with one or more firms in that industry segment, i.e. we consider all upstream and downstream transaction relationships that start or end in that industry segment. In this manner, vertical and horizontal relationships are included in the unit of analysis while it is still possible to bound the network of transaction relationships (see Figure 1).

This unit of analysis comprises only firms that interact, either horizontally (competing/cooperating) or vertically (transacting/cooperating). More important, it is plausible that these interactions are highly relevant for the process of developing inter-organisational information systems. This unit is also clearly bounded, i.e. it is possible to say whether a firm (or a division of a firm for the case of multi-product firms) is included

[3] This notion is similar to that of organizational fields known from the field of sociological institutionalism (Powell, 1991; DiMaggio and Powell, 1983).

or excluded (although this unit will be revealed only in the course of empirical investigations as generally no prior data will be available which would help establishing boundaries around specific industry segments and also as the composition of this unit may vary over time; the methodological implications of this caveat are addressed in the Method section). This unit of analysis thus introduces a degree or precision in both its vertical and horizontal extent which has been absent from previous work on IOIS, and which is important because IOIS serving different vertical positions within and industry are clearly likely to differ. Finally, this unit allows for variability in terms of types of IOIS and technologies to be considered.

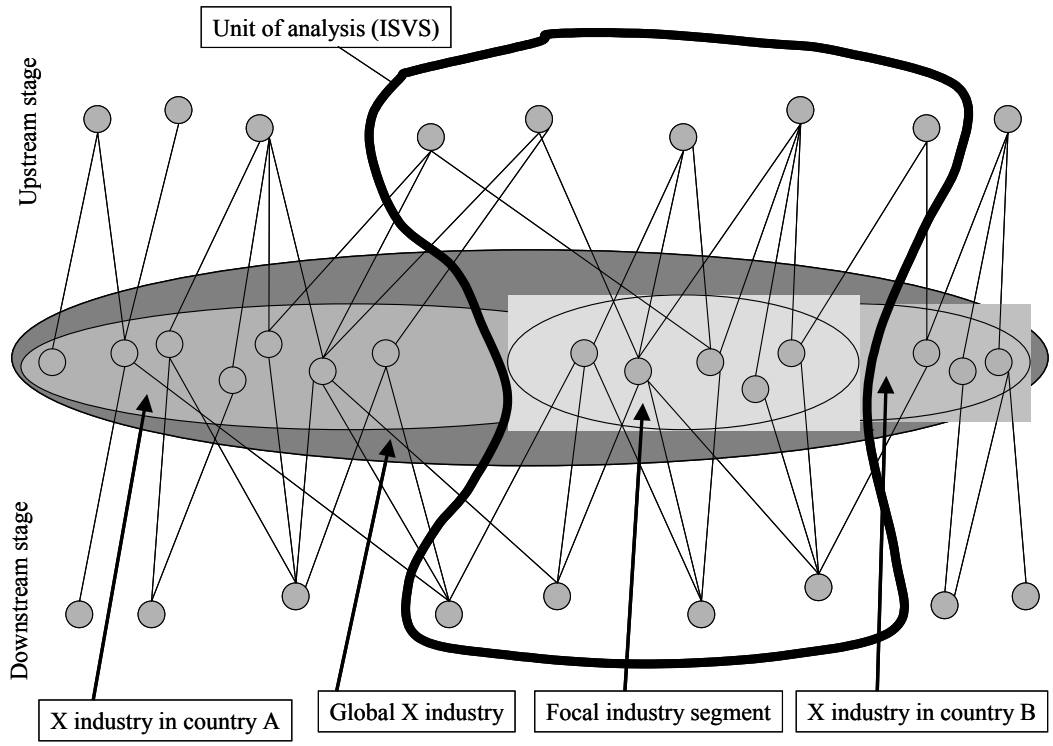

Figure 1: *Schematic Illustration Of An ISVS*[4]

A practical example may serve to illustrate the concept. As will be discussed in the Method section, we use distribution of pharmaceutical products as a calibration case in our research and therefore draw on some initial data collected for this research in order to illustrate the concept here. The focal industry segment in this case is pharmaceutical wholesaling in one country, Germany in this case. There are 16 wholesalers of pharmaceutical products in Germany, five large ones and eleven smaller ones. The large ones operate in the whole country while the smaller ones focus on one or several states or regions. Thus, in any particular region, all five large and a subset of the smaller ones are actively competing on the market. However, the smaller ones are potentially competing in all areas. They are also interacting through a trade association while the large five wholesalers have their own trade association. We thus conclude that the focal industry segment consists of all sixteen wholesalers. On the upstream side, all of these wholesalers maintain business relationships with a set of about 1200 manufacturers of pharmaceutical

[4] IOIS may cover the whole or a part of an ISVS. The scope of our research is to understand the emergence of (alternative) IOIS in the context of ISVS.

products since they are obliged by law to carry the whole product range of pharmaceutical products sold in Germany (about 80,000). These manufacturers are located in Germany as well as abroad. Thus, they belong to the particular ISVS which we plan to study. On the downstream side, about 21,000 pharmacies exist in Germany and these are the only outlets for the sale of prescription drugs. Wholesalers do not, as a rule, sell to pharmacies in neighbouring countries as these have similar regulations as Germany. Thus, these pharmacies constitute the downstream side of our ISVS. Within the ISVS we are planning to build an inventory of IOIS past and present. Moreover we will try to reconstruct development patterns for the existing solutions and in particular identify collective actors who have been influential in shaping the existing solutions.

The strictly regulated nature of this industry makes it relatively easy to define the unit of analysis according to the ISVS concept. In other industries, this task may be much more difficult and often the extent of the ISVS may be revealed only in the course of empirical work. However, this illustration makes it clear that the boundaries of this unit can, in principle, be clearly defined albeit the extent to which this is actually done could vary according to the task at hand and the difficulties of obtaining information about actual business relationships.

The ability to exactly define a unit of analysis is important since we intend to build our project on an international comparison of cases, as will be described in the Method section. Note that the regional scope of an ISVS may vary across industries and supply chain positions. In some cases, the focal industry segment may be global in nature (meaning that it comprises firms that are scattered all over the globe) while in other cases it might be confined to one country or even one local region in a country. Also, varying the vertical position of the focal industry segment may lead to a shift from a global to a local focus or vice versa. For example, while industry segments in pharmaceutical manufacturing are mostly global in nature, pharmaceutical wholesaling is generally characterised by within-country industry segments.

Besides the advantages listed above, this unit also has some drawbacks which need to be mentioned. First, it limits consideration to three supply chain stages as it uses the notion of a focal industry segment for the purpose of bounding the network of vertical and horizontal relationships. Second, it will be much more difficult to collect secondary data since most data have been collected with either an industry or a firm as the unit of analysis in mind. Third, most theories explaining the behaviour of firms refer to either a single firm or an industry as their unit of analysis and are thus only partially applicable.

We submit that the potential benefits of our described unit of analysis outweigh these areas of concern. First, limiting the unit to at most three supply chain stages is, at least at the present level of development, a bearable cost since we do not know of an IOIS which involves more than three stages. The second concern appears less troublesome when taking into account that the study of IOIS will mostly rely on intensive case studies, as we will argue below. The third concern implies that any research effort will become more demanding and difficult but also potentially more fruitful since it may generate insights that could stimulate theory development in reference disciplines. In addition, it may be possible to build on the empirical work of Porter who uses a similar unit of analysis. Studies that focus on shifts in relative bargaining power of firms associated with the development of inter-organisational information systems already implicitly use units of analysis that comprise at least two value stages of interacting firms (such as in Kaplan and Sawhney, 2000) so that it may be possible to build on this stream of research too.

To summarize, the unit of analysis we propose for the study of inter-organizational deployment and use of information technology has the following advantages: it is located on the level of interactions among firms; it captures all relevant interactions among firms, i.e. horizontal and vertical ones; it is bounded; it allows for variability with regard to the

type of network technology used; it captures situations in which no centralized inter-organisational information systems exist; and it captures situations in which no inter-organizational deployment and use of information technology exists. While each of the other units discussed above possesses one or two of these advantages, none addresses them all. The unit we propose here also has some drawbacks, namely limitation to three production/distribution stages, increased difficulties in data collection, and relative lack of readily applicable theories. However, we think that the advantages outweigh these drawbacks since each of the latter can be mitigated while all of the former should be addressed in one unit.

3 Levels Of Analysis

A large number of variables have been studied with regard to the development and effects of inter-organisational information systems. These reside on various levels of analysis such as the firm, an industry, or a country. Clearly, an enormous number of possible interactions between these variables exist complicating any research design. In addition, allowing for many types of inter-organisational information systems characterized by yet another set of variables makes matters worse. One way of dealing with the resulting level of complexity is to organize variables in such a way that certain interactions between variables can be logically excluded. Of course, distinguishing between dependent and independent variables would be the most basic form of organizing variables with this aim in mind since cause-effect relationships leading from dependent to independent variables can be excluded from analysis ex ante. Unfortunately, this is hardly possible with regard to the study of inter-organisational information systems since, for example, technical characteristics of such systems and "environmental" factors such as industry structure may interact in both causal directions (Johnston and Gregor, 2000). From the point of view of statistical analysis, mediating variables become a huge problem too.

In order to reduce the resulting level of complexity for theoretical and empirical analysis, we have built a classification schema for variables that is organized along two dimensions: level of analysis and type of variable (technical vs. non-technical variables). We are most interested in the interactions between technical and non-technical variables but consider it necessary to distinguish between several levels of analysis since otherwise the complexity of interactions between and among these two sets of variables would become unmanageable.

We propose that levels of analysis can be construed so as to correspond with levels of collective action so that each level

- is a precondition for successful collective action on the next higher level and
- takes the results of collective action on the next higher level as its constraints.

For example, when creating a new industry several firms have to cooperate in order to define the product (value proposition, dominant design etc.). This requires that firms exist as collective actors. The interactions with suppliers and customers, however, define another level of collective action the results of which constrain the action of the firms when trying to shape the industry. Although such results act as constraints on the behaviour of firms on the industry segment level, they can still be influenced by firms in that industry segment. However, if firms want to influence these constraints, they have to participate in a different "game" of collective action, one which involves suppliers and customers.

Building on the concept of the unit of analysis defined above, we distinguish between four levels of analysis as illustrated in Figure 2. However, more or fewer levels may be construed based on the purpose of the study. For example, the level of the remote environment may be further differentiated into a sectoral and a national level of collective action. Note that most phenomena that would normally be identified and discussed as distinct inter-organisational information systems are located on the ISVS-level and, in some cases, the level of the remote environment, i.e. they require collective action within an ISVS (e.g. by a group of horizontally and vertically linked firms that may be identified as communities, alliances, or by other labels) and also on the level of the remote environment if other IVs or the government or similar bodies are involved, as would be the case for an inter-organisational information system for customs declarations or the development of cross-industry EDI standards. Also, this schema allows for many different forms of collective action on the ISVS-level with regard to inter-organisational information systems including unilateral approaches. For example, powerful firms that are unilaterally imposing EDI standards on their business partners trigger a certain form of collective action, namely one based on fiat (Olson, 1965). That such behaviour represents a form of collective action is illustrated by the possibility that business partners collectively reject such demands as frequently happens even in cases in which supposedly powerful firms try to unilaterally enforce EDI standards (Monse and Reimers, 1995). Finally, rules and standards may, to some extent, be functional substitutes across levels. For example, EDI standards could be developed by governments (in which case they would be located on the remote environment level) or within an ISVS. However, EDI standards developed by governments may fail to be adopted indicating that a certain minimum collective effort on the ISVS-level is still required (Andersen et al., 2003a and 2003b). Thus, collective action on the remote environment level cannot completely substitute for collective action on the ISVS-level (but it may well trigger collective action on that level).

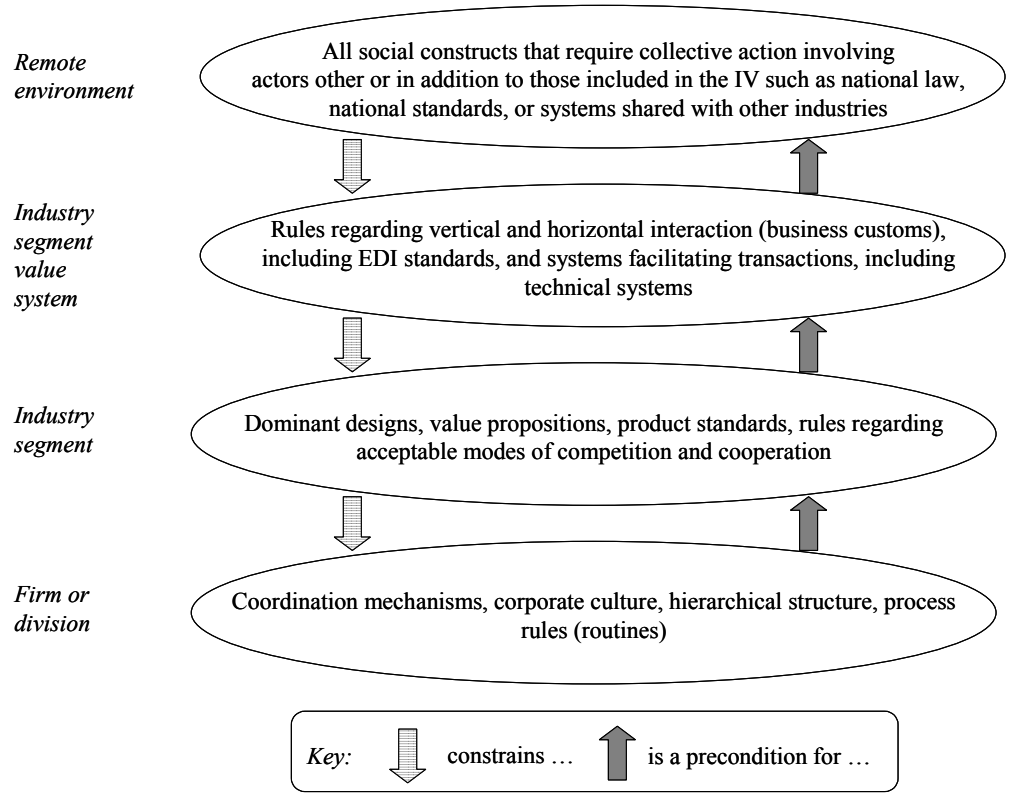

Figure 2: *Schema Of Levels Of Analysis Illustrated By Examples Of Social Constructs For Each Level*

In this way, it becomes possible to treat variables as constraints as well as results of collective action, depending upon which level of collective action one considers. This may be done by sequentially applying theories that pertain to different levels of collective action (explaining the behaviour within firms, industry segments, and values systems respectively, for example). Organizing variables according to this schema allows for selectively using individual theories of social behaviour with regard to subsets of variables and thus reducing the level of complexity involved in any component analysis while still providing for a way to combine the results of these component analyses in a non-ad hoc manner. Of course, the schema itself is based on a certain theoretical assumption as emphasized above and thus the whole approach hinges on the validity of this assumption. However, we think that the required assumptions are plausible and not overly restrictive. Still, it is useful to compare this approach to others that have been used in or proposed for the study of inter-organisational information systems. Three such proposals shall be considered, namely those by Damsgaard and Lyytinen, Johnston and Gregor, and Oliver Williamson.

With regard to EDI diffusion patterns, Damsgaard and Lyytinen (Damsgaard and Lyytinen, 1998, Lyytinen and Damsgaard, 1998) distinguish between three levels of analysis which are called micro, meso, and macro. On the micro level, an individual organisation's EDI adoption decision is considered within the tradition of the Diffusion of Innovations literature; on the meso level networks of organisations are considered, mostly with regard to mutual dependencies and power structures, and on the macro level regulatory constraints for EDI adoption decisions on the other two levels are analysed using institutional theory. Below, it will become clear that these levels are quite similar to those proposed in this study. However, there is an important difference with regard to the way these three levels are treated in terms of theoretical analysis. Damsgaard and Lyytinen analyse EDI diffusion patterns from the same theoretical perspective (diffusion of innovations theory) which is sequentially applied to the three levels of analysis. According to this analysis,-adoption decisions take place on all three levels in the form of decisions about EDI standards and policies on the macro- (country) level, decisions about EDI strategies on the network (meso-) level, and EDI investment decisions on the micro- (firm) level. While these different analyses complement each other, they are not causally linked with each other but treated as different versions of the same story.

Johnston and Gregor (Johnston and Gregor, 2000; Gregor and Johnston, 2001) also distinguish between three levels that are closely related to those distinguished by Damsgaard and Lyytinen and the schema presented here: the firm, its immediate environment and its remote environment. They use structuration theory to motivate these distinctions by proposing that interactions within the immediate environment are characterized by the concept of duality of structure, meaning that actors reproduce those structural features that, at the same time, enable their actions so that action and structure are cyclically related to each other, while interactions with the remote environment are characterized by unilateral cause-effect relationship, i.e. there are no immediate causal feed-back loops from actors to their remote environment. The schema proposed here extends that framework by making the notion of remote environment contingent upon the level of analysis. Thus, on each level of analysis the next higher level would be termed remote environment while interactions on the same level are always characterized by duality of structure.

Finally, Williamson (2000) distinguishes between four levels of analysis: informal institutions and customs, formal rules/institutions (law), contract (governance), and resource allocation. Again, there are strong similarities between this schema and the two discussed above as well as the one proposed in this paper. For example, the level of resource allocation seems to be rather similar to that of Damsgaard and Lyytinen's investment decisions and Johnston and Gregor's firm level while the contract level bears

a strong resemblance with the network levels of the other two schemata. The main difference with the schema proposed here is that Williamson's proposal is crafted on a normative decision calculus: on each level, he asks which factors have to be traded off given the constraints set on the next higher level. In contrast, we have a more positivist intention by asking which types of collective action actually occur on a specific level and why. The resulting set of variables and explanations is identical only in a world where all social phenomena can be explained through independent rational decision making.

To summarize, we find that our schema has similarities to others that have been proposed for the study of inter-organisational information systems while differing with regard to the way variables are related to each other across levels. We hope that this way of organizing variables will help in associating theories with specific levels of analysis and combining results of analyses into an overall picture. However, we are aware of the degree of arbitrariness that exists in associating variables with specific levels of analysis and thus prepared for shifting variables across levels of analysis as might be indicated over the course of our study. The implementation plan of our study takes this caveat into account by providing for an exploratory phase in which our initial schema for organizing variables shall be adjusted (see the Method section). Our schema and our initial proposal of association of levels of analysis with variables is shown in Table 1. In collecting possible variables for our study we have tried to be as inclusive as possible at this stage of our study. One result of our study could be the reduction of this set of variables and thus the level of complexity that has to be handled theoretically.

In contrast to the other three schemas discussed above, we do not include the level of individual organisations in our analysis but start with the notion of an industry segment. Instead, we introduce an additional distinction, namely that between an industry segment and the value system related to the industry segment (our main unit of analysis) as described above.

Table 1: *Structure Of Variables To Be Included In Our Study*

Levels of analysis/ collective action	Variables describing the social sub-system	Variables describing the technical sub-system
Remote	Regulation/laws (Gregor and Jones, 1999; Gibbs et al., 2003) Fiscal conditions (Gregor and Jones, 1999; Gibbs et al., 2003) International competitive pressure (Gibbs et al., 2003) National/regional culture (Gallivan and Depledge, 2003; Gibbs et al., 2003) Geographical setting Demographics (Gibbs et al., 2003) Major industries (Gibbs et al., 2003) Social capital (Fukuyama, 1995)	IT/Telco infrastructure (Johnston and Mak, 2000; Gibbs et al., 2003) VANs/IOIS facilitators (national) (Cash, 1985) IT standards (embedded in software/hardware) EDI standards (national/intern.)
Industry segment value system (network)	Network structure (fragmentation/ concentration on each value stage; modes of vertical and horizontal collaboration on each stage; existence and number of groups (Gomes-Casseres, 1994)) Degree of standardization of transaction processes	VANs/IOIS facilitators (industry) (Cash, 1985; Wise and Morrison, 2000) EDI standards (syntactic,

Levels of analysis/ collective action	Variables describing the social sub-system	Variables describing the technical sub-system
	(Kumar and van Dissel, 1996) Degree of business process alignment between market participants (Hempel and Kwong, 2001) Types and frequencies of transaction processes (Holland et al., 1992) Degree of trust/social capital along transaction relationships (Allen et al., 2000; Gallivan and Depledge, 2003; Putnam, 1993) Coordination mechanisms (push/pull system etc.) (Fisher, 1997) Variability of the degree of IT sophistication of value chain members (Johnston and Mak, 2000) Existence and type of business intermediaries (Johnston and Mak, 2000; Holland et al., 1992; Hempel and Kwong, 2001) No. of adjacent industries involved in the value system (Kubicek, 1992) Geographical extent (local, regional, global) (Riemer et al., 2001) Existence of regional clusters (Porter, 1998)	semantic, pragmatic) (Kubicek, 1992) and EDI software Network cardinality (Fleisch and Österle, 2000) Degree of automation of inter-firm transactions (Fleisch and Österle, 2000; van der Vorst et al., 2002) Modes and frequencies of data exchanges/sharing (Johnston and Mak, 2000) Types of data to be exchanged/shared (Fleisch and Österle, 2000)
Industry segment (focal unit)	Age (development stage) of industry segment Industry culture Value proposition/form/dominant design (van der Vorst et al., 2002; Holland et al., 1992) Variation across business models/value propositions Product variability/compexity (Fleisch and Österle, 2000; Holland et al., 1992; Lamming et al., 2000) Key competencies/resources Success factors Geographical extent No. of firms Modes and history of horizontal collaboration (governance structures) Existence of acknowledged industry leaders Modes/intensity of competition (Johnston and Gregor, 2000) Horizontal power distribution (Johnston and Mak, 2000)	EDI standards Data pools (product data)
Firm	Not included in our study	Not included in our study

As with variables, we propose an initial association between possible theories and levels of analysis (Damsgaard and Lyytinen, 1998). Thus, we opt for an eclectic approach with

regard to the use of theories while employing our schema of levels of analysis as a meta-theory or framework. Theories vary with regard to the range of levels of analysis they potentially span; for example, contingency theory is rather general and potentially applicable to all levels while transaction cost theory has a narrow focus on vertical inter-firm relationships and thus is only applicable on the ISVS level in our theoretical schema. Also, some theories, such as structuration theory, explicitly address the interaction between levels while others are confined to explanation within levels (such as network theory). Our preliminary association of theories with levels of analysis is shown in Table 2. If a theory focuses on the interactions between levels, this is indicated by a bidirectional arrow. If a theory focuses on within level explanations, this is indicated by a cross. In some cases, theories address interactions between levels as well as within levels.

Table 2: *Association Of Potential Theories With Levels Of Analysis*

	Remote environment	ISVS	Industry segment
Structuration theory (Giddens, 1984)	↔	↔	
Network theory (Hakansson, 1987; Hakansson and Johanson, 1993; Johanson and Mattson, 1987; Nassimbeni, 1998)		X	
Industry clusters, market power (Porter, 1990; Porter and Rivkin, 2000)		X ↔	X
Institutional theory (Powell, 1991, DiMaggio and Powell, 1983)	↔	X ↔	X
Organisational environments, "matrix organisations", "organisational federations" (Emery and Trist, 1965; Trist, 1983; D'Aunno and Zuckerman, 1987)		X	X
Resource dependency theory (Pfeffer and Salancik, 1978)	↔	↔	
Negotiated order theory (Strauss, 1978)	↔	X	
Transaction cost theory (Williamson, 2000 and 1987)		X	
Contingency theory (Giaglis et al., 2002)	X	X	X
Industry life cycle theory (Klepperer and Graddy, 1990; Agarwal and Gort, 1998)			X
Social capital theory (Kumar et al., 1998)		X	

4 Method

The primary method of our project will consist of rich case studies on the ISVS-level. The reason for this choice is the complex set of possible interactions between variables that preclude statistical approaches due to limitations of possible sample sizes as the number of IVs that would have to be included in this study needs to be several times the number of variables that we want to study which does not seem to be a doable task. Yin (1994) recommends the case study method in such cases. In addition, mutually causal relationships between variables are only accessible via the process approach (Kurnia and Johnston, 2000) which requires the case study method (Markus and Robey, 1988).

Finally, the choice of our unit of analysis requires a case study method as it will become visible only in the course of data collection (DiMaggio and Powell, 1983; Porter, 1999).

Since the purpose of this paper is to describe and justify design choices for a future international study, we feel it is inappropriate to put forward specific research propositions at this early stage. Instead we describe a "null hypothesis" (one which we expect will ultimately be rejected) which we use to structure the research method. The null hypothesis is that inter-organisational information systems are primarily shaped by forces (interactions) residing on the ISVS and the industry segment levels. Essentially, this hypothesis claims that the industrial environment creates constraints and requirements that are universal all over the globe so that inter-organisational information systems will be similar in similar industries as described by the variables associated with the ISVS and the industry segment levels such as value proposition and type and extent of involvement of intermediaries (cf. Table 1). To explore this hypothesis, we will conduct case studies in several industries across several countries using the ISVS concept as our unit of analysis. These will be selected so as to create maximum variability in industry structures and national environments, i.e. by purposive sampling (Neuman, 2000). We expect that interactions on the national level (i.e. on the level of the remote environment) significantly shape inter-organisational information systems in terms how such systems are characterized by our set of technical variables. Based on the current and previous locations of the authors of this paper we have initially selected four countries for inclusion in this study: Australia, China, Germany, and Ireland. The sketched process of building an inventory of IOIS in the ISVS in the different countries will provide opportunities for comparative studies along the variables we have identified, to build a typology of IOIS and will help us to identify and explain diffusion paths.

This approach bears some resemblance to a recent study by Gibbs et al. (2003). That study also aimed at exploring global vs. local factors in shaping inter-organisational information systems and has used the convergence-divergence debate as its frame of reference. The main difference with that study regards the unit of analysis which has been the firm and the country respectively. As outlined above, we think that focusing on the interactions among firms will allow for significant additional insights into the way inter-organisational information systems evolve and are shaped and have defined a new unit of analysis for this purpose.

We aim at a three-year time horizon for our project which period is divided into two phases, an exploratory and a confirmatory phase. In the exploratory phase (12 months) we intend to validate our theoretical framework (especially with regard to the variables selected for study, their association with levels of analysis, and the theories used for explaining interactions among them). This will be done by selecting a particular industry to provide a “calibration case” which will be the subject of comparative case studies in three to four different national environments. The null hypothesis would imply that cases will describe a similar trajectory of inter-organisational information system design and development and that the cases will only differ in the point that they have reached on this trajectory (regional maturity). More specific research hypotheses will then be developed as a result of the completion of this first stage, as follows.

If the null hypothesis is confirmed then different cases at this stage help specify the dimension of movement along the technological trajectory or, in other words, the nature of maturity in the industry. The emphasis in phase 2 will then be to verify that different trajectories occur in other industries with divergent basic “business models” and to define the causal relationships between business model and trajectory.

If the null hypothesis is rejected then the different cases allow us to define variables other than the basic industry business model (and therefore, either broad environmental characteristics or serendipitous situational differences) that determine different

trajectories in the same instance of an ISVS. The focus of phase 2 will then be to determine whether the same environmental factors have similar effects in other industries within the same broad regional environment

We have chosen distribution of pharmaceutical products as our calibration case. The rationale for this choice is that this industry is still largely domestic in nature so that uniformity with regard to the type and development trajectory of inter-organisational information systems could be attributed to the nature of the industry (value proposition, industry structures, etc.) rather than global competitive and collaborative interaction which would confirm our null hypothesis. In addition, this industry tends to be highly regulated with different regulatory regimes across countries so that a high degree of uniformity in terms of inter-organisational information systems would be even stronger support for our null hypothesis. On the other hand, if a significant degree of variability with regard to inter-organisational information systems can be observed across countries (as we expect it will), this would allow us to develop an initial set of hypotheses regarding the interaction between variables residing on the remote environment level on the one hand and variables on the ISVS-level on the other hand (including technical variables describing inter-organisational information system practices).

5 Conclusions

Study of adoption and diffusion of information technology at levels of analysis greater than the firm is in it infancy, and 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 multiple levels of collective action is currently a challenge that begs for new empirical data and theory building. It is also of interest to business and regional/national industrial policy makers because a greater understanding of the causal influences upon IOIS adoption trajectories at an industry and regional level can greatly 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.

This paper has described and justified the major design choices for an international comparative study of the relationship between organisational and inter-organisational environments and the nature of IOIS that are produced and adopted within them. It has done this by critically analysing the previous studies that have considered IS adoption and diffusion at this broad scale. The main contribution of the paper are new principled proposals for the unit of analysis, levels of analysis, choice of study variables and research method by a detailed analysis of the difficulties of research at this scale.

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Appendix (Relevant Previous Works)

Studies on the diffusion and development of inter-organizational information systems or related technologies

- Andersen et al., 2003a and 2003b; Henriksen 2000 (Denmark; structural/institutional factors may inhibit e-commerce adoption even in the face of massive government support and promotion)
- Arunachalam, 1995 (prime reason for adopting EDI: customer request)
- Brousseau, 2003 (France; e-commerce development paths vary across nations)
- Damsgaard and Lyytinen, 1998 (Finland, EDI is not a distinct technology)
- Gibbs et al., 2003 (10 country comparison; global competition drives B2B e-commerce while local consumer preferences drive B2C e-commerce; however, institutional factors have a major influence on B2B e-commerce diffusion too)
- Hsiao, 2001 (Singapore; institutional factors strongly influence B2B e-commerce adoption)
- Iacouvou et al., 1995 (external pressure explains major part of EDI adoption decision)
- Kim and Umanath, 1999 (the degree of inter-firm electronic integration depends upon contingent factors such as supply chain interdependence, demand uncertainty and product complexity)
- Kshetri and Dholakia, 2002 (analyses global B2B e-commerce diffusion, finds that country-level factors have a major influence)
- Palacios, 2003 (Mexico; large firms are the main driving force while lack of resources among mostly small firms and low incomes among households are the main barriers to e-commerce adoption)
- Thatcher and Foster, 2003 (textile and electronics in Taiwan; organizational, industrial and governmental factors influence B2B e-commerce adoption while cultural factors moderate direct influences of government policies and industrial pressures)
- Tigre, 2003 (Brazil; uneven income distribution major barrier to e-commerce adoption/diffusion)
- Wong, 2003 (Singapore; institutional characteristics influence the type of e-commerce that is adopted)

Studies on the effects of IOIS on industry, organization structures

- Bensaou, 1993 (IT use significantly affects the nature of supplier relationships)
- Cassivi et al., 2002 (e-commerce use strengthens existing relationships)
- Choudhury et al., 1998 (existing models do not adequately explain e-commerce effects)
- Hart and Estrin, 1991 (inter-organizational information systems also create new dependencies/vulnerabilities)
- Holland, 2003 (e-commerce will lead to deepened supplier relationships which effect, however, will be contingent upon industry factors)
- Martinsons, 2002 (China; effect of e-commerce varies by country (no dis-intermediation in China))
- Reekers and Smithson, 1996 (automotive: EDI increases leverage of large firms over small ones)
- Steinfield et al., 1995 (new forms of intermediation may emerge)
- Steinfield et al., 2000 (no additional lock-in related to Internet use)