2009

Challenges in Explaining Structure and Evolution of Inter-organisational Information Systems: Lessons from an Empirical Research Journey

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22nd Bled eConference

eEnablement:

Facilitating an Open, Effective and Representative eSociety

June 14 - 17, 2009; Bled, Slovenia

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Abstract

We have recently undertaken a five year international comparative study of Inter-organizational Information Systems (IOIS) in the pharmaceutical supply chain in four countries, with the initial aim of investigating the relationship between differences at the industry and national level and the structure of the IOIS in these countries. We found because of the large timescale (beyond individual projects) and the large scope of analysis (including firm, industry and national factors) that a new phenomenon of IOIS evolution came into our view. This paper presents the journey we have taken in re-evaluating appropriate theoretical underpinnings for studying and explaining IOIS phenomena at this large scale. We present our insights by relating the series of revisions we were forced by the phenomena to make to our research model, illustrated with two case vignettes.

Keywords: Inter-organisational Information Systems, IS Evolution, IS Theory

1 Introduction: explaining variance of IOIS

The IOIS literature, with a few exceptions, applies traditional IS themes and methods, such as adoption/diffusion, IT-generated value and critical success factors, to the study of information systems which cross organisational boundaries (cf. Elgarah et al, 2005, and Robey et al., 2008). This implies that IOIS are studied at the timescale typical of a 'project' and units of analysis which are not much larger than organisations, namely organisational dyads and hub-and-spoke networks.

In a five-year, international collaborative research project, we set out to (1) explain how IOIS came to be structured differently in different countries even within the same industries and (2) what, if any, is the relationship between structural variables at the organisational, network, industry, and national level and the structure of IOIS. These objectives required that we looked at IOIS at organisational scales above the network level and at timescales beyond the project that are typical for the IOIS literature.

As we proceeded simultaneously with data collection and refinement of our initial theoretical framework, we discovered that we had to abandon certain theoretical commitments that are appropriate for the study of IS and IOIS at smaller scales and to replace them with theoretical commitments that were necessitated by the phenomenon that came into view. This also suggested that we revise our research model and our data collection approach. We finally arrived at a view of IOIS as aligned socio-material practices which we argue is appropriate for theorizing IOIS evolution and their structural changes on long timescales.

In this paper we will make the argument by telling the story of our journey as we grappled with the theoretical challenges of understanding IOIS at larger scales and how this resulted in a new theoretical lens that allowed us to describe IOIS evolution and their structural change on long timescales. The next section describes how we discovered, through a series of revisions of our initial research model, the theoretical challenges implied in our research objectives and the need to replace traditional theoretical commitments. In the subsequent section we present two case vignettes drawn from our empirical studies to illustrate how these changes of theoretical commitment are more consistent with the phenomena that are observed at longer timescales and larger units of analysis. In the concluding section, we summarize the lessons from our journey of discovery and point out their significance and novelty.

2 Discovering theoretical limits in view of the research subject

2.1 A new unit of analysis

As mentioned above, we originally hypothesized that structure and evolution of IOIS were influenced by characteristics of the industry in which they existed as well as by country-level factors such as government action, legislation and national culture. As IOIS had previously mostly been studied on the level of individual organisations, bilateral relationships and hub-and-spoke networks, we expected to considerably increase explanatory power by extending the unit of analysis to comprise a whole industry segment as well as the suppliers and customers of organisations in that segment. An industry segment is defined as the set of organisations that are linked by strategic interaction, i.e. who take each others' action into account when planning their

own actions (Porter, 1990); the concept thus relies on an action-based criterion rather than the usual product-oriented definition of the more general term 'industry'. Our new unit of analysis thus consists of an industry segment and all suppliers and customers of organisations in this segment. We called this unit an Industry Segment Value System (ISVS, see Reimers et al., 2004). Figure 1 illustrates the concept.

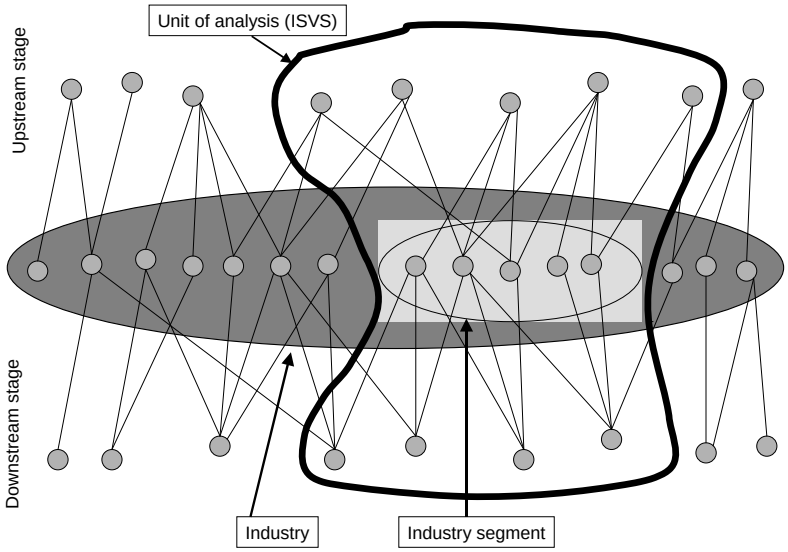

Figure 1: Our unit of analysis (simplified from: Reimers et al., 2004)

2.2 Coping with theory complexity

Initially, we approached our research question in a simple way in that we tried to identify the influence of two sets of environmental factors, those that reside on the industry level and those that reside on the country level, while assuming that the IOIS phenomenon could be clearly separated from these two sets of factors. The overall approach is illustrated in Figure 2.

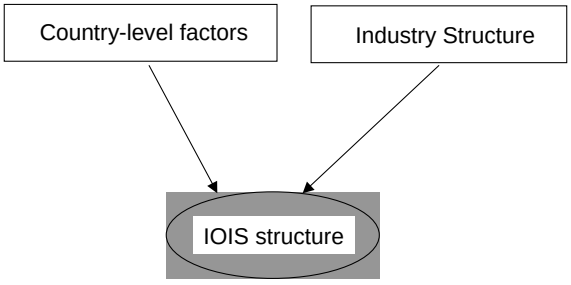

Figure 2: Our initial approach

In line with the definition of our new unit of analysis, we separated the industry layer into two layers, each of which was seen as a possible locus of collective action that may

consist of designing and operating IOIS (see Damsgaard and Lyytinen, 1998, Johnston and Gregor, 2000, and Gregor and Johnston, 2001, for applications of such layered models to the IOIS field). In this way, structural variables on one layer could be causally linked to structural properties of IOIS, i.e. through explaining collective action on each level. This approach implied that collective action on each layer could be explained independent of collective action on the other layers and that all were independent of the phenomenon to be explained. However, we recognized that the several layers also influenced one another; these influences were treated as indirect effects. Figure 3 illustrates this extension of our research approach.

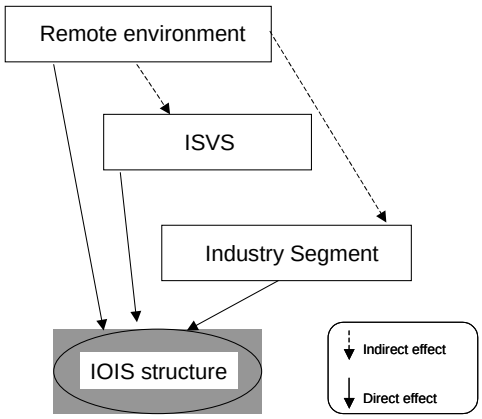

Figure 3: Our modified research model

To facilitate our search for relevant influence factors, we pursued an eclectic approach by considering a number of theories that seemed pertinent to the explanation of collective action on levels higher than bilateral relations of organisations, such as network theory, neo-institutionalism, industry-life cycle theory etc. (Reimers et al., 2004). We mined these theories to extract possible independent variables on each of our three layers and then formulated hypotheses that related these independent variables to aspects of IOIS that we were interested in.

In total, ten theories were used to generate 61 hypotheses, (including 13 hypotheses concerning “indirect effects”) based on 40 variables, including dependent variables. Figure 4 provides a partial view of our theoretical model for the ISVS layer. While this effort was directed at generating a broad set of plausible hypotheses to inform our interviews, it quickly became apparent that this range of hypotheses was too complex to be handled by our research design (multiple case studies with theoretical and literal replication logic, cf. Yin, 2009), even when imposing the additional constrains of our layer model as this measure would have eliminated only 13 out of 61 hypotheses (the “indirect effects”) and none of our variables. Also, a statistical approach was ruled out because we anticipated that, given the limited number of available industry cases, we could not generate a large enough sample to control for all independent variables. In addition we could not justify dropping any of our variables as all had a high degree of face validity and theoretical support in terms of possible impact

on structure and evolution of IOIS. Thus, selecting an arbitrary smaller, more manageable set of variables would have threatened validity.

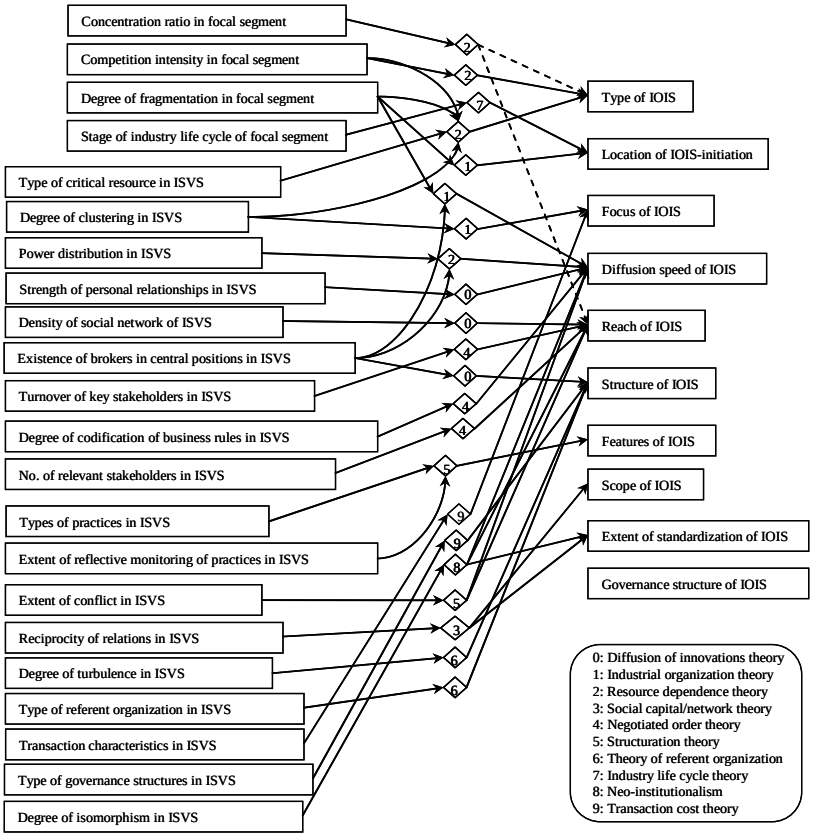

Figure 4: Partial view of our initial theoretical model (showing relationships between ISVS layer variables and IOIS variables only)

To remedy this situation, we attempted to build a theoretical framework that imposed even more a priori structure on our variables by grouping them into a more manageable set of constructs; for example, we distinguished between "normative" and "relational" industry structure with the former comprising variables such as industry standards, business models and dominant designs and the latter comprising variables such as governance structure and transactional structure. In this processes, we drew on an existing framework developed by Child (2000) that specifically aimed at studying and comparing the influence of national culture on organisational phenomena and therefore seemed appropriate for our purpose. That framework distinguished between three broad constructs: institutions, material forces (influence of technology and economic logic) and ideational forces. The inclusion of ideational forces (influence of ideas and discourses) was attractive to us because of the influence of "organisational visions" in IS and IOIS (Swanson and Ramiller, 1997). We further grouped our independent variables into these broader clusters to explain collective action on the ISVS level while associating institutional structure with the ISVS level and ideational and material forces with the remote environment. Figure 5 illustrates this new approach.

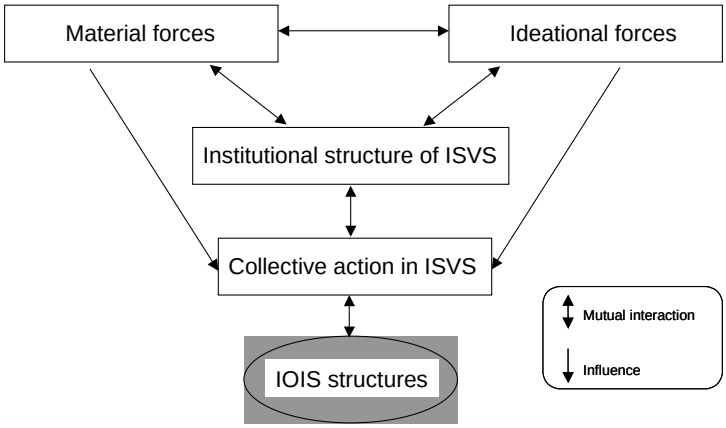

Figure 5: Modified theoretical model based on Child (2000)

2.3 Two theoretical problems

However, in this process, we encountered two theoretical problems that we coin the onion model problem and the episode model problem respectively. The term 'onion model problem' derives from a research design in which the action system, whose behaviour is to be explained, is nested in layers of structural influence. The term 'episode model problem' is derived from a research design in which structure at time *t* is seen as input into an action system and structure at time *t+1* as its output.

The onion model problem

The Child model had allowed us to organize remote environment variables in a theoretically meaningful way by distinguishing between material and ideational forces. In addition, the distinction between material and ideational forces also contains an implicit hypothesis, namely that ideational forces describe the influence of national culture and thus account for diversity between organisational phenomena across countries while material forces describe the influence of globally uniform factors, namely economic and technical logic. While distinguishing between these structural 'dimensions' was thus useful, associating these dimensions with levels of structural influences turned out to be problematic in the context of our study. Regarding ideational forces, the problem consisted of avoiding 'double accounting' of influence factors: arguably, national culture, as a main component of ideational forces according to Child, directly influences the behaviour of agents, for example in their designing and operating of IOIS, through values and ideas, while it also imbues higher level phenomena, such as institutions. This latter relation between ideational forces and institutions was earlier termed the 'indirect effect' of the remote environment. Thus, while with regard to other aspects of the remote environment, such as legal rules, a clear separation between direct and indirect effects may be feasible, for example by delineating jurisdictions, this does not hold for national culture, one of our main explanatory variables in our research model. Regarding material forces, we were confounded by the fact that some of our dependent variables seemed to be components of material forces and thus of the independent variable. For example, the Internet was clearly a global force that should be

considered as shaping IOIS; at the same time, a major aspect of IOIS consists of the technological infrastructure that is used for transmitting data which, increasingly, is the Internet. In short, the onion model problem arose because (1) we had extended our unit of analysis to account for higher level influences, specifically national culture, and (2) because the phenomenon itself is spread across multiple levels.

The episode model problem

The episode model problem manifested itself when we started to time-index the relations between the several structural entities (to keep Figure 5 simple we have collapsed a number of relations into two-way arrows which, in our original model, consist of separate one-way arrows pointing in opposite directions with one operating at time 't' and the other at 't+1'). Moreover, as we started to collect data in parallel to our theory building process, we were confronted with the fact that the origin of several systems that we were studying lay in the 'remote' past. Thus, we had to trace the evolution of these systems over timescales that are rather unusual in the study of information systems. Over these extended timescales, aspects of the systems that we wanted to explain by higher level influences fed back into these very higher levels; for example, codes for identifying drugs were standardized and these standards became an important aspect of industry structure in that these standards were used as entry barriers while also new actors, organisations that maintained and distributed standard product codes, entered the industrial landscape. While episode models -- as defined above -- have successfully been used in the literature (see for example Volkoff et al., 2007, and Orlikowski, 1992), in the context of our research effort use of an episode model became infeasible because of the long timescale that we had to consider.

Analysis of these two problems led us to evaluate the theoretical commitments that such a model implies and to question them. A new model arose which embodies distinctly different theoretical commitments.

Coping with the onion model problem

The onion model problem arises whenever a theoretical model is constructed such that the organisational phenomenon of interest is nested in several layers of structural influence. The organisational phenomenon typically is some change in organisational structure brought about by collective or individual action. Thus, action and change are only formulated as properties of the organisational phenomenon in need of explanation whereas in reality action and change are also part of the structure arranged around it. As a consequence, two forms of interaction have to be distinguished; first, the immediate structure surrounding the organisational phenomenon influences collective action and thus directly explains changes in the organisational phenomenon; second, higher-level structures influence lower level structures and thus indirectly influence changes in the organisational phenomenon. This implies the need to conceptualize the interaction between two structures without intermediation of action (for an illustration of this problem cf. Orlikowski's (2000) discussion of her own model developed in Orlikowski, 1992).

We addressed this problem by eliminating indirect effects from our model, implying that structural influence would only be considered if a direct effect could be modelled. This decision necessitated a reworking of our "layers" of structural influences into

dimensions of structural influences such that a direct effect of each structural dimension could be reasonably assumed. It turned out that Child's model could be seen as an intermediate step as it showed elements of both, a layering of structural influences as well as a more theory-based distinction between structural dimensions. This hybrid character manifested itself as simultaneous existence of direct and indirect effects that originated from the two boxes containing material and ideational forces respectively. By eliminating indirect effects from the modified Child-model (see Figure 5) we obtained a model that distinguished between several structural dimensions which we ultimately derived and retained from Child's model. Figure 6 illustrates the conceptual move from a pure layer model (Figure 6a) to our dimensionalized model (Figure 6b) in a stylized way. However, we did not map layers to dimensions; rather, these two representations are incompatible ways of describing the environment of the organisational phenomenon of interest.

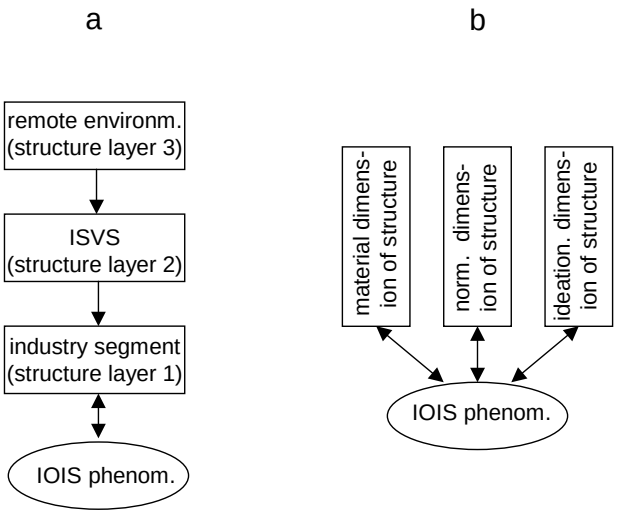

Figure 6: From a layered to a dimensionalized model of structural influences

Coping with the episode model problem

The episode model problem occurs whenever one models two sets of structural phenomena as dependent and independent variables respectively. The problem occurs because, in the social domain, the mechanism between two sets of structural states must always be some type of (social) action which is seen to be influenced by some instance of structure while, at the same time, producing another instance of structure, the dependent variable. This is a feasible approach if one looks at action in a frozen moment of time. However, as one studies organisational phenomena on long timescales, the structural output of action also needs to be considered as its input.

Our solution to this problem was to adopt a structurational concept of action which recognizes that structure constrains/enables action while it is also reproduced by the very action that it enables and constrains (Giddens, 1984). However, we also adapted the traditional interpretation of structuration theory to our research purpose by

conceptualizing technology as social structure. According to Giddens, structure exists only as memory traces; such a conceptualisation seems to stand in the way of modelling technology as structure. We relied on newer culturalist thinking (Reckwitz, 2002) to reconcile technology and structurational notions of structure by recognizing the role of the body in social practice. Once the body is seen as an integral part of social practice, the body becomes the complement of material structure in human environment with which it interacts in the same way that our mind interacts with ideas and morality. This allowed us to treat technology as a structure similar to other forms of structure (while other authors who rely on a structurational paradigm tend to treat technology as external to practice, see e.g. Pentland and Feldman, 2008).

We further relied on the writings of Wenger (2002) to obtain a more detailed description and conceptual apparatus of the process of structural reproduction which is not treated as extensively by Giddens as that of constraining/enabling of action through structure. Wenger developed the notion of communities of practice within which structures are reproduced through both action and perception of patterns of behaviour through members of these communities in a social process. The results of our conceptual decisions are illustrated in Figure 7. The main difference with the episode model of structure (Figure 7a) consists of the symmetric treatment of various instances of structure (Figure 7b) within a framework of two-way causal (simultaneous bi-directional) influence; in other words, we do not privilege one type or dimension of structure over another.

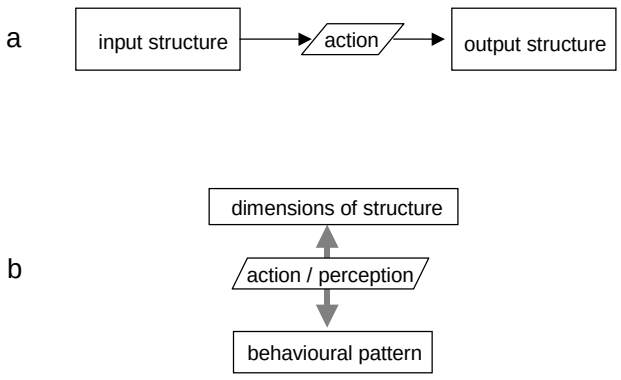

Figure 7: From an episode model to a structurational model

We thus moved away from both an onion model and an episode model towards an understanding in which people building and using IOIS are engaged in constellations of simultaneous practices. In this view, we do not distinguish between dependent and independent variables nor do we distinguish between layers of influence. Rather structure is seen as an aspect of practice which is reproduced through the creation and perception of behavioural patterns. Figure 8 provides a highly stylized schema of this new view which essentially combines Figures 6b and 7b. Corresponding to the three dimensions of structure we have distinguished between three types of behavioural patterns, namely patterns of (body) movements, of sanctions (reward and punishment actions) and of discursive acts in which members explain phenomena important to their practice by identifying cause-effect relationships. In the next section we will describe case vignettes and use these to demonstrate how our new view allowed us to trace

evolution of IOIS over time while we will also draw on these cases to approach the task of defining IOIS in terms of our practice model.

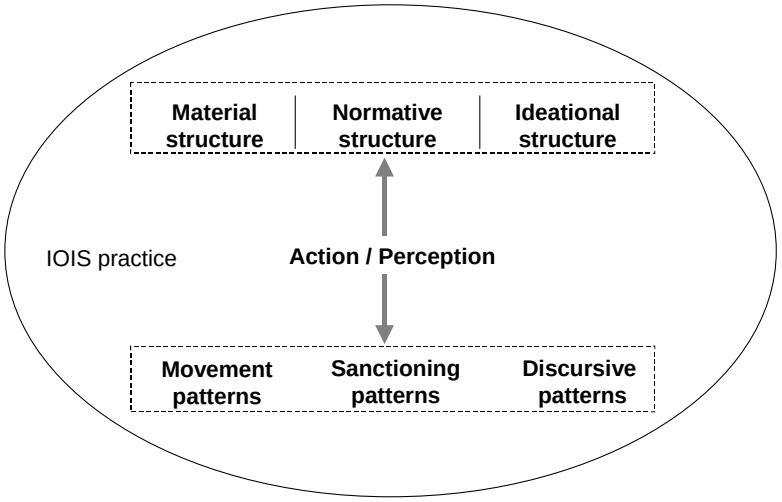

Figure 8: Our model of practice

3 Case vignettes: Seeing the phenomenon in a new light[1]

3.1 From proprietary to (quasi) open systems: IOIS in the Australian pharmaceutical wholesaling industry

In the early 1980s, drug wholesalers in Australia started to distribute handheld computers -- so-called PDE devices -- to pharmacies which they could use for ordering. This was done by holding the devices against shelf labels on which a barcode was printed which identified a particular drug. The required order quantity would then be added either automatically or manually and an order would be sent once the device was placed into a cradle that set up a data transmission connection to the wholesalers' internal systems. The product codes -- which were and still are called PDE codes today -- as well as the communication protocols embedded in the cradles were proprietary to each wholesaler. Thus if a pharmacy wanted to order electronically from multiple wholesalers they needed to install and use multiple PDE systems. From the wholesalers'

[1] The Australian case is based on nine interviews conducted between April 2006 and September 2007, the Chinese case on 14 interviews conducted between October 2004 and July 2007. All interviews lasted between 45 minutes and 2 hours; the Australian interviews were recorded and transcribed; the Chinese interviews, due to concerns by interviewees, were documented by students attending the interviews instead of being recorded; immediately after each interview, all interviewers jointly prepared a single set of interview minutes in Chinese and English. Interviewees were drawn from organisations involved in drug distribution including manufacturers, distributors, pharmacies, IT vendors and regulatory authorities. In addition, we complemented our data by publicly available documents, mostly in the form of websites.

perspective, the measure followed a strategic differentiation rationale as electronic ordering was seen as cutting-edge technology in service innovation.

In the 1990s, pharmacies began to use so-called POS-systems (for Point of Sale systems) that recorded sales and performed some other functions (such as inventory management). For software vendors to be able to sell their systems, they needed to ensure electronic ordering was supported. This was achieved by incorporating the proprietary PDE codes of the several wholesalers into the systems' databases as well as by implementing the several wholesalers' proprietary communication protocols. Maintenance of PDE codes and communication protocols was done by the software vendors; while this task was tedious, it was feasible because of the small number of wholesalers (which has remained stable at three for the main wholesalers -- so-called full-line wholesalers -- over the time that we covered in our case study).

In the first years of the 2000s, several outside attempts to replace this system with a more open-market approach in which drug orders would automatically be routed to the lowest-price offer were fended off by the wholesalers. A government initiative that aimed at linking every member in the drug distribution chain -- manufacturers, wholesalers, pharmacies -- failed to the extent that the system ultimately was only used by manufacturers to 'order' drugs from wholesalers that their sales reps had previously sold directly to pharmacies while pharmacies did not use this system for ordering. Most recently, a group of POS vendors have established a common Internet-based hub which is used to connect POS systems of pharmacies to the wholesalers' internal systems thus replacing the proprietary communication protocols (and, consequently, the need to maintain these in the POS systems). Yet, the proprietary PDE codes are still being used by this new hub (in spite of the fact that the EAN product code is now available on almost all drug packages as well) implying that POS vendors still have to maintain the cross-reference files. Moreover, pharmacies continued to rely on the old PDE devices for stock keeping purposes and partly for ordering, albeit the fraction of electronic orders that are placed through these devices is continuously declining.

This technology-focused account leaves out important aspects of the evolution that became visible once we applied -- retrospectively -- our practice model. As this required laborious coding of interviews and subsequent analysis, we focused on the wholesaler practice while the whole system can be described as three interconnected practices, the wholesalers' practice of maintaining and operating the electronic ordering system, the practice of IT vendors that consisted of maintaining pharmacy software as well as the proprietary communication protocols and a cross-reference database that mapped the PDE codes onto one another. Specifically, we saw how rationales and normative stances cumulated that reinforced changes in the material dimension over the three 'eras'. For want of space we cannot trace all these changes in this paper and must limit ourselves to some poignant examples.

The original rationale -- service differentiation through technology -- was still noticeable in our interviews. However, interviewees conceded that the use of proprietary ordering systems, while effective in the past, was currently not feasible but also speculated that, in the future, that might change again. Moreover, wholesalers expressed dissatisfaction with a decreasing degree of loyalty by pharmacies. In the past, pharmacies often perceived a moral obligation to order from the one wholesaler who has helped them to found their business (e.g. through low-interest loans). However, this moral bond has withered and wholesalers cannot rely on it any longer. Yet, wholesalers

still express their expectation that pharmacies *should* be loyal, thus adding a normative dimension to the original rationale for introducing proprietary ordering systems.

Along with the POS-based electronic ordering facility came a new rationale on the side of wholesalers. They saw a need to demonstrate their service performance to potential customers -- pharmacies -- as they left their original regional niches and invaded one another's markets as they started to operate on a national scale. The proprietary PDE codes printed onto shelves turned out to be a hindrance as a pharmacy first had to 'convert' to a new wholesaler by having all shelf labels replaced (wholesalers would typically offer to subsidize this conversion process which often also involved the replacement of the pharmacies' look-and-feel as wholesalers often also took over marketing functions for pharmacies). Thus, wholesalers saw the benefit of relatively easy switching between wholesalers when placing orders, a capability that came with the POS systems that contained all three PDE codes and communication protocols. Again, we found a normative dimension to this change as well. On the one hand, wholesalers treated POS vendors who maintained accurate cross-reference files with high respect; on the other hand, they expressed disapproval of pharmacies that did not do 'due diligence' when selecting their POS package, specifically with regard to the respective vendor's ability to accurately maintain PDE codes and communication protocols.

From the perspective of our initial, effect-based model one would have to select one or several structural dimensions as independent variables. For example, ideas about IT-based competitive advantage may be perceived to drive technology deployment and use. Alternatively, the initial installed technical basis may be perceived to determine later development stages. However, the above account suggests that ideas were reinforced by norms and moderated by technology. For example, technical barriers of switching between wholesalers softened the strategic rationale of creating competitive advantage through proprietary technology deployment. Likewise, the initial installed technical base did not determine subsequent developments; initially, wholesalers had, de facto, locked-in pharmacies through their PDE systems; however, the appearance of POS systems along with routines of maintaining cross-reference files as well as new strategic rationales and norms has led to a quasi open system in which pharmacies can, with relative ease, route orders to any one wholesaler. Yet, wholesalers prevented establishment of systems that would automatically route drug orders based on price alone.

Overall, we saw how these systems changed in the three dimensions that we have distinguished in our model. Particular instances of rationales, norms, and material structure would either reinforce or, occasionally, contradict one another. Also, elements of earlier periods were still visible in the utterances of our interviewees and co-existed along newer elements. It seems that these non-technical instances greatly contributed to both, the systems malleability and its persistence as, on the one hand, new material structures were complemented by ideas and norms and, on the other hand, these norms and ideas could be extended and modified to provide 'landing strips' for new technical components that, from a technical logic, contradicted earlier components. Over this long timescale, no single structural dimension could be identified as the sole driving cause -- i.e. the independent variable. Rather, all three dimensions were interwoven in a web multiple two-way causal links.

3.2 Hunting for stable states: IOIS in the Chinese pharmaceutical wholesaling industry

In China, the use of IT to support the distribution of drugs began in the early 1990s in Henan province. There, provincial government attempted to centralize all drug procurement, supported by an e-commerce system. While this practice was discontinued soon after its introduction upon intervention of central government (which ruled that governmental agencies should not engage in business activity), the software was sold to a private company which worked to introduce similar systems in other provinces, including Beijing (which is a province as well as a city). The system's function was, roughly speaking, to support a public tendering process in which manufacturers could bid on 'substances' that were required by hospitals.

After three years of preparation, a first bidding round was initiated in Beijing in 2004 based on a modified version of the original Henan system. One addition to the system's functionality was that hospitals could also place their drug orders to wholesalers over the system once the drugs available for procurement had been established in the preceding bidding process. While the industry lobbied against the system, the percentage of transactions that were conducted through the system rose steadily to 100% two years after its introduction (2006). At the same time, however, provincial government discontinued the bidding practice, basing all transactions on the results of the 2005 bidding round. Thus, the system has essentially morphed from a reverse auction type electronic marketplace into a electronic ordering facility.

Again, for want of space, we cannot detail all the facets that became visible once we applied our model to this evolution process and need to confine ourselves to some examples. Regarding the ideational dimension, the rationale underlying the system has changed significantly; initially, it was claimed that centralisation of drug procurement is only feasible with e-commerce; as resistance to the system mounted, a new rationale was offered, specifically that the system was conducive to modernizing the industry; this rationale was followed by the argument that using the e-commerce system would support monitoring of hospital procurement behaviour (hospitals have strong incentives to order high-margin drugs as a significant portion of their revenue stems from the sale of drugs while, in the bidding process, typically low-margin drugs, so-called generics, are be selected). As the number of wholesalers (in the province) dropped significantly -- from around 200 to about 120 -- the system was credited by its supporters with enabling and enforcing this industry consolidation process.

Regarding the normative dimension, we similarly found a succession of expectations as the system evolved from an electronic market towards a transaction platform. Initially, manufacturers were seen as the 'villain' since it was they who bribed hospitals, a practice that was intended to be undermined by the auctioning system; later on, the doctors were accused of being the root cause of China's ailing healthcare system -- concurrent to the shifts of emphasis regarding the system's main rationale as helping to monitor hospital procurement behaviour. Finally, government was blamed for providing contradictory incentives.

Again, we focused on one practice in tracing these changes in the normative and ideational dimensions, specifically that of the newly established intermediaries that operated the e-commerce systems (in total, there were three such intermediaries operating in Beijing over the time covered by our case study). The system contained

three more practices, that of wholesalers dealing with hospital orders, that of hospitals dealing with drug procurement, and that of the 'bidding centre' which was established by nine separate government agencies to run the bidding process.

In contrast to the Australian case, the Chinese electronic ordering system evolved by replacing instances of its (material, normative, ideational) structure in short succession (the Australian system evolved in a more incremental way such that small changes in material, normative and ideational structures were stacked on one another with older ones persisting in a toned down way). Indeed, for the Chinese case it is problematic to speak of an 'electronic ordering system' as this function only recently became the system's focus (initially, one would have more appropriately referred to it as an electronic market). Yet, there are strong elements of continuity, for example through the main actors promoting the system, but also in its material manifestation which has only slightly been changed over the 15 years considered here.

Again, the system's evolution does not allow for singling out one structural dimension as the independent variable. Ideas (of intermediaries) seem to have a much weaker influence than in the Australian case; yet, these ideas have played a crucial role in the system's evolution; for example, centralisation of drug procurement was predicated on the idea that this would become feasible only if based on the (then new) technology of e-commerce. Norms had a probably stronger influence as the system was meant to help fix China's ailing healthcare system; yet, moral expectations have also changed with alternating usage patterns. Monetary and legal measures have played a role but were similarly enforced in a flexible manner that took into consideration changing ideas and moral stances. While the technology often failed to enshrine regulatory ideas, increased efficiency of transaction processing changed the overall attitude prevailing in the industry from resistance to cautious embracement.

Overall, the system's evolution speaks of a volatile and fragile character and can be characterized as hunting for a stable state.

4 Conclusions: the need for a new conceptualisation of institutionalisation in IS

In this paper, we have described how, in a large, collaborative and international research project, we have tackled a series of theoretical problems in our original research design which we discovered are related to the organisational scale and timescale of the phenomenon of interest, structure and evolution of IOIS. This led us to formulate two theoretical commitments which significantly changed our view of the phenomenon. The payoff of these changes consists of a new theoretical lens that brings to the fore aspects of the phenomenon of interest which, we hope, will ultimately improve our understanding of the long-term evolution of IOIS. On the downside, we had to give up our original research question which was targeted at identifying causal influences of structure and evolution of IOIS.

Our first theoretical commitment is that we do not allow for multiple layers of influence factors that directly and indirectly affect the organisational phenomenon of interest. Consequently, layers of organisational influence are transformed into structural dimensions such that no single structural type or dimension -- norms, ideas, and material aspects of technology -- is privileged over others in terms or their explanatory

contribution. Thus, IOIS are not seen as (technical) structures external to social practice but as socio-technical practices themselves.

Our second commitment is that we do not distinguish between independent and dependent structural variables. As a result, notions of one-way causality give way to concepts of two-way causality.

We have argued that these commitments are a result of our decision, partly driven by the phenomenon itself, to consider IOIS at a much larger organisational scale and timescale than is usual in the literature. The paper extends a growing literature applying structuration theory to IS adoption issues at the organisational level, to the study of IOIS evolution at the network and national industry level. It also applies for the first time a practice perspective to the study of IOIS.

We conclude that it is possible to construct meaningful research models based on these new theoretical commitments which allow for a theory-based description of IOIS on long timescales but that the exact implications regarding possible explanations as well as the nature of mechanisms accounting for the dynamic of IOIS evolution have yet to be worked out.

Acknowledgements
The first and the third author would like to acknowledge support by the Deutsche Forschungsgemeinschaft, grant number 1328/2-2.

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