ACCOUNTING FOR STABILITY AND PATH DEPENDENCY IN INTER-ORGANISATIONAL INFORMATION SYSTEMS (IOIS) BY ADOPTING A PRACTICE THEORY PERSPECTIVE

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Abstract:
The explanation of stability and change of inter-organisational information systems (IOIS) still requires further theoretical grounding. This paper sets out to explore and analyse the development and use of an IOIS between the wholesalers and community pharmacies in the Republic of Ireland. The case leads us to theorise that the objects used for connecting organisations (boundary objects) show an unexpected stability. The widespread and consistent use of the IOIS suggest path dependence as a plausible explanation. A core set of standards (product codes, EDI messages and communication protocol) are the focal part of our analysis. We will use a practice theoretical lens to explore and explain how the standards – interpreted as boundary objects – reproduced over time and stabilized within a broader set of related practices. We conclude that the alignment of practices between the respective organisations is a major cause for the observed stability in a situation of technological transformation and change. Therefore we argue that explanations for path dependency should not rest only on technological network effects but a broader conception of positive feedbacks stabilizing a system. In this regard we come to the conclusion that Practice Theory provides analytical devices that offer a richer description of stabilizing elements.

Introduction

Information technology is used to support and facilitate (business) transactions within and across organisations. In this paper we focus on vertical information systems (VIS) as inter-organisational information systems (IOIS) that facilitate data exchange and business process coordination between business partners along the supply chain.
As part of a broader cross country study of the development of IOIS, we have scrutinized the development of an electronic ordering system, linking pharmaceutical wholesalers and pharmacies in the Republic of Ireland over a period of 22 years. The comparison to cases in the US, UK and Australia shows that the implemented and widely used standardised solution has not been the obvious choice. In the mentioned countries wholesaler specific solution have been chosen and are still in place.
In line with the basic framework of path dependence we will look into explanations for the emergence of a path in the mid 1980ies covering the development of the standard and its diffusion (1), the stabilization of the path during a period of substantial transformation of the industry and indeed the technology until today (2) and forces which might suggest a breaking or dissolution of the path in the near future (3).
Path dependency theory has been used to explain lock-in on specific technologies or standards. Positive feedbacks or increasing returns have been identified by authors to be a critical characteristic of path dependent processes. The “history matters” argument is at the core of path dependent explanations. The order of events taking place over time determines the ultimate outcome. We will argue how standards have developed and have yielded positive feedbacks. However, by applying the notion of boundary objects we theorise that positive feedbacks should not be just identified on the level of technical affordances but need to be studied in the wider context of related practices.
In the next section we will briefly introduce the concept of path dependency. We will then motivate the idea of studying IT artefacts as boundary objects. By doing so, we interpret the technological artefact not as a device but an instrument embedded and used in practices of a social community. Thereby we are hoping to gain further insights for causes of stability and positive feedbacks.
After that we will present the Irish case with a special focus on the boundary objects being used. This is followed by our case analysis in which we point out the different development phases of the boundary object. The phase model we are relying on strongly builds on the work of Schreyögg et al (Schreyögg, Sydow & Koch, 2003).

Using and expanding path dependency as a theoretical approach to explain stability

The theory of path dependency has been developed to explain processes of technology adoption and diffusion where in spite of an efficient market an inferior technology prevails (David, 1985). Because traditional economics cannot account for this outcome two assumptions are revised by path dependency theory (Schreyögg Schreyögg, Sydow & Koch, 2003). First, market forces do not aspire to one (optimal) equilibrium but multiple equilibria are possible. Which equilibrium is reached depends on the history of events taken place. This introduces the second revisited assumption. Decisions of the actors are not fully reversible as assumed by traditional economic theory. In short, past decisions impact on future decisions.

This has led to the idea of the emergence of a path that ultimately leads to a path dependency which is characterised by a lock-in of the actors on e.g. a specific technology (David, 1985, Arthur, 1989). The conception is that due to this lock-in actors cannot abandon the path or switch to another technology although the other technology is deemed superior.

The outcome of a path dependent process is neither pre-determined nor totally random. It depends on the order of events over time. Therefore David mentions *non-ergodicity* as a major characteristic of path dependent processes (David 2000). In this vain small events in the past can a have a major impact on future outcomes. This implies that the outcomes of path dependent processes are non-predictable and if a critical mass has been reached *inflexible*. That means they are unable to abandon the achieved outcome or equilibrium. From a normative point of view these first two implications mean that it cannot be guaranteed that the outcome is efficient. Thus, as a third characteristic *potential inefficiency* has been introduced. However as David puts it potential inefficiency is neither a necessary nor sufficient condition for path dependency (David, 1997).

Positive feedbacks have been identified as reasons for the emergence of a path and the subsequent lock-in of a system. Ackermann subsumes different notions of positive feedbacks from the literature by proposing four different sources: (1) dynamic and static economies of scale, (2) direct network externalities, (3) complementary components (indirect network effects) and (4) dynamisms of collective processes of learning. (Ackermann, 2001)

As they have been discussed extensively in the literature we do not want to introduce them but rather relate the reader to the extant literature (David, 1985, David, 1997, Arthur, 1989, Katz & Shapiro, 1985, Ackermann, 2001). Common to all kinds of positive feedbacks is that an increase in the diffusion of a technology leads to further increase of adoption decisions because the perceived utility of a technology is positively related to its proliferation and usage.

From a path dependency theory perspective the existence of positive feedbacks is a major criterion and cause for path dependency. In accordance with Schreyögg et al. we do not regard power as an explanation for path dependency (Schreyögg, Sydow & Koch, 2003). However we argue that the original concept of positive feedbacks is too narrow as it rests only on individual utility rationale. Instead we propose to apply a practice theory perspective to explore other sources of positive feedbacks that conform with Schreyögg et al. broader conception of positive feedbacks as self-enforcing mechanisms.

Such a broader conception allows us to incorporate insights and viewpoints from other theoretical stances that may enrich our understanding of path dependency or more general stability. Thereby we draw on the notion of communities of practice introduced by Wenger (Wenger, 2005). It conceptualizes people as social beings participating in practices of social communities which are demarcated by a common enterprise. It describes how routine action is maintained in social interaction and how it enables people to solve encountered problems in their day-to-day life. Successful actions are continuously reproduced and thereby result in observable patterns that are a characterizing element of a community of practice. Hence, in a community of practice not only patterns of action are emerging but it is also characterized by a shared understanding, a shared cognitive state of mind and a shared world view.

Stability in Practice Theory is therefore a characterizing element of practices or community of practices. This general tendency to stability in form of routines and patterns is not to be equalized with path dependency without reservations. In our case study we are observing the stability of an IOIS over a large period of time in a

technological environment that is subject to quick changes. Thus, we are facing the question whether we are observing a phenomenon of path dependency. Furthermore what is the difference between stability and path dependency? Can it be used synonymous or do we have to differentiate. For example is stability of a system a necessary prerequisite of path dependency?

Practices are evolving and thereby able to adapt to new or unknown environmental changes. That is because the individuals in a community of practice are in a continuous learning process. Therefore we argue that reproduction is not per se yet another type of positive feedback. Instead it is the interaction and connection between different practices that may lead to positive feedback loops between one another. Ackermann has researched this issue in regard to institutions and identified three types of positive feedbacks: (1) coordination effects, (2) complementary effects and (3) reciprocal effects between action and structure (Ackermann, 2001). Especially type 3 strongly resembles the duality of structure in Gidden's Structuration Theory (Giddens, 1984). By citing North, Ackermann follows a broad definition of institutions as the "rules of the game in a society" (Ackermann, 2001 p.85 citing North, 1990).

From our point of view, institutions are part of the structure that enables and constrains the actions of individuals at the same time. Compared to practices institutions can be codified. Instead practices are not explicated but rely on implicit un-codified knowledge. Practices are routine actions that are enabled and constrained by institutions. Through the observation of patterns of action or practices we can infer un-codified institutions that are governing the daily routines. On the other hand analyzing practices may demonstrate how codified institutions, the observer deems working, are disregarded by the actors.

Therefore we argue that by adopting a Practice Theory perspective we gain a much richer understanding of eventual positive feedbacks operating in the field than by simply looking at technological, economical or institutional feedbacks.

Studying the stability of boundary objects

Firms or more generally organisations in a supply chain have to communicate with their business partners in order to coordinate the flow of goods. A successful communication between suppliers and customers needs to cross organisational boundaries. However, the communicating individuals or systems reside in different organisational settings and are involved in different communities of practice. Thus, individuals do not share the same social identity and cannot initially draw on shared routines in their interactions. Rather practices have to become aligned to enable efficient interaction or cooperation across the boundaries of their respective communities of practice.[1]

Carlile identifies different types of boundaries that an effective boundary object has to be able to bridge: syntactic, semantic, and pragmatic (Carlile, 2002). In his study of prerequisites of successful interorganizational communication, Kubicek (Kubicek, 1992) has used the same distinction of syntax, semantics and pragmatics of electronic data interchange, i.e. the exchange of structured business message by means of communication technology.

The first stresses the importance of having a shared syntax attributed to the boundary object. For communication the lack of a shared understanding regarding the "language" is detrimental. Second, despite a shared syntax different interpretations do inhibit successful communication. Therefore the boundary object has to provide means for the partners to specify interpretations or learn about ambiguities that exist across different communities of practice. Third, interacting via boundary objects is not inconsequential. The receiving party interprets the information conveyed by the boundary object and deduces actions that have to be agreed or known between sender and receiver.

In the literature boundary objects are described as translation devices that inhabit intersecting social worlds and satisfy informational requirements of each (Star & Griesemer, 1989). Although boundary objects have different

1 We are extending Wenger's notion of community of practice into the interorganisational field. While conceptually each pharmacy and wholesaler constitute a community of practice, we are focusing on the linkages between those communities.

meanings in different social worlds or in our case communities of practice their structure is common enough to more than one world to make them recognizable. Their main role is to develop and maintain coherence across practices. Hence, practices become aligned through the creation and routine use of boundary objects.

According to Gal et al. boundary objects are embodied in a specific artefact which is recognisable as such by members of more than one community (Gal, Yoo & Boland, 2004). People relate to these and construct meanings which differ to a certain extent across communities. That is because boundary objects are supported by and interpreted in different contexts or communities of practice. This introduces the notion of interpretative flexibility of boundary objects that allows for an individual alignment of practices in their encounter with boundary objects.

In this regard we conceptualise boundary objects as means of communication between practices that are residing in different organisations or firms. The boundary object serves as an interface for the cooperation between practices (see figure Fig. 1). In this paper we define an inter-organisational information system as a set of aligned practices connected through boundary objects.

As we already indicated we are analyzing a set of standards. Syntax and semantics have been specified through collective agreement. However, as we will show the use of and incorporation in practices differ significantly.

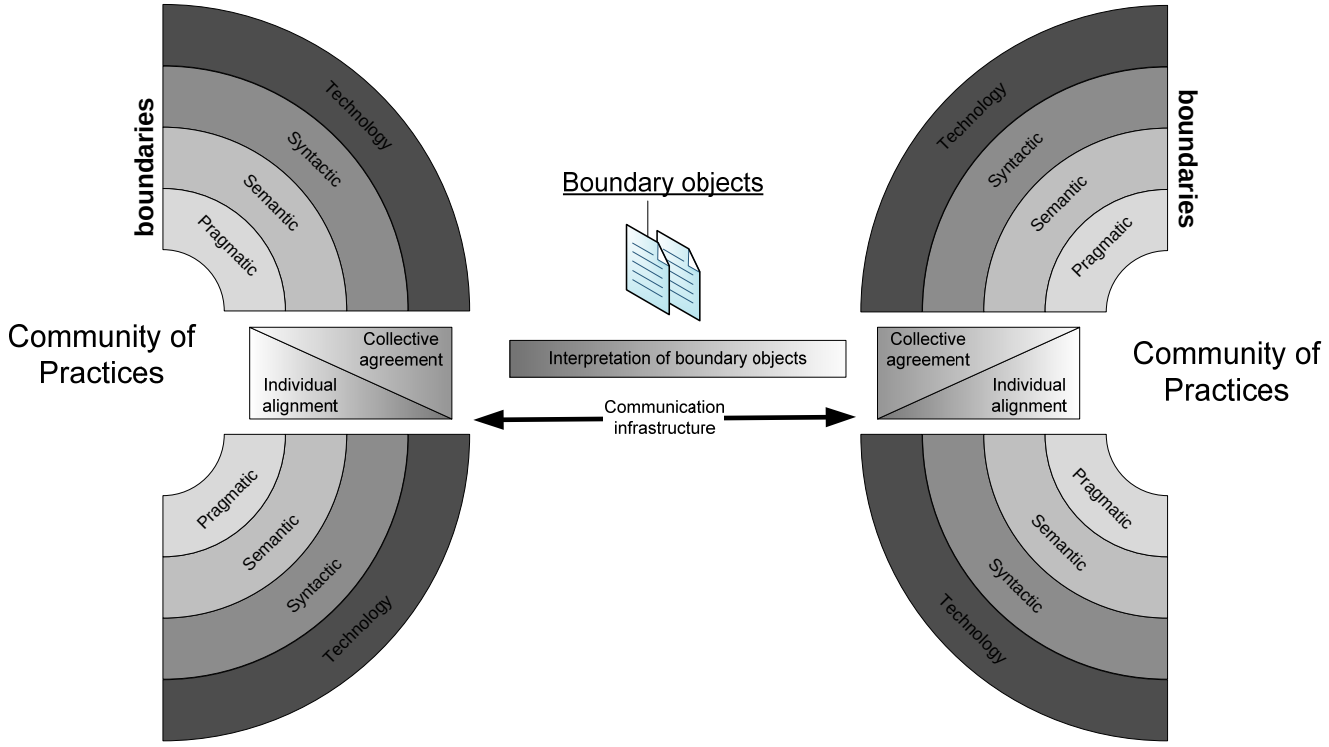


Fig. 1: Collaboration via boundary objects

Standards in the Irish pharmaceutical distribution industry

In this section we want to give a brief overview of the market structure and the division of labour in the Irish pharmaceutical distribution industry as it presents itself today. We will first describe our method of investigation. This is followed by a description of the industry structure. The next two subsections are devoted to a more detailed analysis of the role and business logic pharmacies and wholesalers have assumed. In the last section we document the current usage of electronic ordering standards and practices.

Method

A case study design has been chosen to conduct the research, because of the complexity of the research question and its focus on a rich real-life context (Yin, 2003). In terms of Yin's classification, our case serves as a special

case that shows characteristics (e.g. the industry-wide standard) that are rather unexpected and hence regarded interesting from a research point of view.

Our unit of analysis in this paper consists of the relations between the wholesalers and community pharmacies in the Republic of Ireland. The events under consideration took place in the early 1980s. One of the interviewees provide first hand knowledge, twas already present during this period. Hence, he could provide first hand knowledge. The others relied on documents and the organisational memory. Four semi-structured interviews have been conducted, two with a representative of one of the Irish pharmaceutical wholesalers, one group interview with two leading managers at the Irish body of community pharmacists (IPU) and one with a manager of a large software system vendor. All interviews were tape recorded, transcribed, coded and analysed. The transcribed interview data was evaluated independently by two researchers. This separation of the research team aimed at increasing objectivity and confidence in the findings (Eisenhardt, 1989).. All information presented below has been triangulated by at least two interviewees.

Besides the interview, several other data sources were used; among these are web sites, standards documents, systems documentations etc.

Market structure

As already mentioned above we are focusing on the electronic ordering system between the pharmaceutical wholesalers and community pharmacies in the Republic of Ireland.

The task of the pharmaceutical *wholesalers* is to provide a national wholesale service for pharmaceuticals for community pharmacies and hospitals. The relevant market is demarcated by the national borders. Retail pharmacies in Northern Ireland are not supplied by wholesalers from the Republic of Ireland and vice versa, because of the different regulatory systems and a different set of codes for pharmaceutical products (Fingleton, Purcell & Goggin, 2002). As a result of a consolidation process over the past 10-15 years, the market in the Republic of Ireland (R.I.) is divided between three wholesalers: While United Drug (UD) has the highest market share, Uniphar (UP) comes second with Cahill May Roberts (CMR) being third.

On the customer side more than 1400 *community pharmacies* exist in Ireland. Since the Irish legislation permits the ownership of multiple pharmacies, over the past years pharmacy chains have emerged (e.g. McCabe's) or entered the market (e.g. Boots). However the market remains fragmented as close to fifty percent of these consist of two to four chain stores (IPU, 2006a). Their product portfolio ranges from retail products over pharmacy-only medicines to prescription medicines. Currently nearly 8.000 *pharmaceutical products* qualify as human medicines as licensed by the Irish Medicines Board (IMB, 2007). As non-pharmacy outlets are prohibited by law from dispensing prescription medicines it is estimated that almost 90% of prescription medicines are dispensed in retail pharmacies (Fingleton et al., 2002).

Irish pharmacists are represented by a professional body, the *Irish Pharmaceutical Union (IPU)*. 90% of all Irish pharmacists are IPU members. The mission of the IPU is to promote the professional and economic interest of its members. This incorporates conducting negotiations on behalf of the members and the development and maintenance of a "constructive dialogue with government, agencies and other groups in relation to matters of mutual interest." (IPU, 2006b)

The role of the pharmacies

In case of prescription medicines, the doctor decides about the product to be provided by a pharmacy. Hence, availability of the prescribed medicines is a crucial element of customer satisfaction. The margins on prescription medicines are fixed, yet they are a major incentive to enter a pharmacy in the first place. In addition, pharmacies are permitted to sell non-pharmaceutical products at higher margins. High inventory costs due to high costs for premises in good locations put pressure on the pharmacies to reduce inventory. Therefore a swift delivery has become the important element of the pharmaceutical supply chain. Fast delivery cycles are crucial for the reputation of the pharmacy as well as for the well-being (and convenience) of the patients. This is made possible

by extensive logistics operations. Pharmacies can rely on short delivery cycles of typically two deliveries per day by each of the wholesalers. Wholesalers will ship on the same day all orders that are received by a specified cut-off time late in the morning.
Consequently, most pharmacies today operate on *low stock levels* and are reliant on the service level of their preferred supplier. The pharmacies generally use one wholesaler as the primary supplier and a second one as a fall-back (Fingleton, Purcell & Goggin, 2002). Given the total number of medicines, the pharmacists' ability to forecast the demand for specific medicine is limited. Hence the splitting of orders is an important mechanism to secure fast deliveries in case a particular medicine is not on stock.

The role of the wholesalers

All Irish wholesalers operate as nationwide full-line suppliers. Given that the Irish Medicines Board grants licenses for medicines to be sold in Irish pharmacies, the scope for product differentiation is limited to off-the-shelf products. Price competition is constrained due to regulations regarding the wholesaler margin. The wholesalers de facto pass on a significant part of this margin to the pharmacies via discounts, bonus schemes and other price incentives (Fingleton, Purcell & Goggin, 2002). As wholesalers typically offer volume discounts, pharmacies generally use one wholesaler as the primary supplier and a second one to split purchases and as a fall-back option when supply of a particular product cannot be obtained (Fingleton, Purcell & Goggin, 2002).
The wholesalers are competing for their customers' loyalty in order to become pharmacies' preferred supplier. Therefore the quality of service is important. Fast order-delivery cycles, scarce stock-outs and immediate feedback to the pharmacists in case of a stock-out so that they can pass on the order to a different wholesaler constitute service quality. Hence efficient processes and extensive logistics operations are needed. Moreover, the profitability of the wholesaler and thus, its competitiveness depend on the efficient organization of these processes. In addition, market intelligence becomes very valuable in order get some demand forecast information. This can be used for marketing purposes as well as warehouse and delivery management.

Electronic ordering standards and practices

Throughout this paper we will be focussing on the ordering between pharmacies and wholesalers. Today pharmacies are ordering pharmaceuticals via three channels: electronic orders, phone orders and sales representatives. The latter are out of our scope as they are approaching the pharmacies on behalf of the pharmaceutical manufacturers.
Electronic ordering or eOrdering today accounts for approximately 90% of all orders reaching the wholesalers. Besides, pharmacies are being phoned on a daily basis by dedicated staff on behalf of the wholesalers. Orders placed over the phone make up 8 % (TeleSales). An overview of distribution channels is shown in figure Fig. 2.

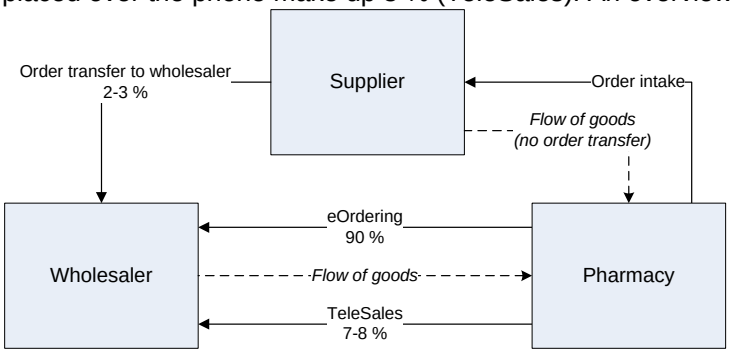


Fig. 2: Information and product flows

The diffusion of the electronic ordering solution happened gradually over a 10 year period; today, all pharmacies are able to order electronically and the transactions between wholesalers and pharmacies are still based on the same system. Surprisingly, even the modem-based communication protocol has survived virtually unchanged. Pharmacies as well as wholesalers have different information systems in place that are able to place or receive

eOrders (see figure Fig. 3). The wholesalers accept incoming orders until about 20 minutes before their delivery vans leave their premises. Each of the wholesalers is able to supply retail pharmacies nationwide by a fleet of delivery trucks and additional transit drivers (Fingleton, Purcell & Goggin, 2002). As stated above, most pharmacies receive deliveries twice a day and have adjusted their stock keeping accordingly.

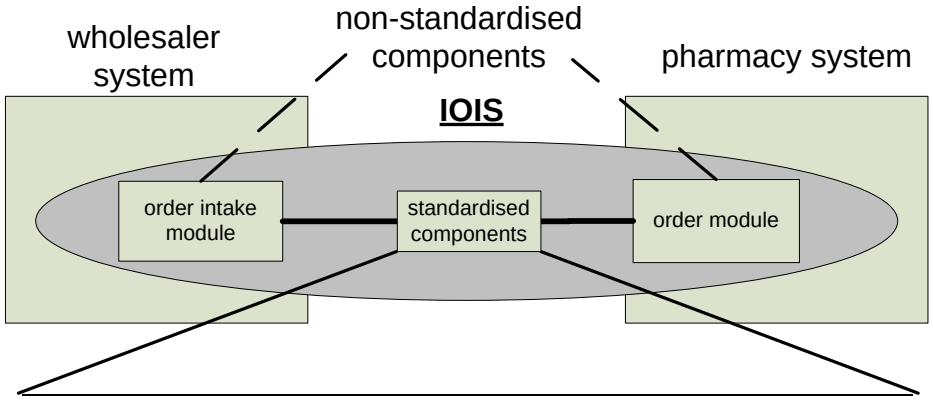
The wholesalers' systems accept incoming orders (wants lists) via a modem connection and initiate the product shipment or send back a list with out-of stock items. If all items on the "wants list" can be supplied no response is sent. In any other case the systems sends back a list with unavailable items. Furthermore bonus items are reported back to the pharmacist in this way. This set-up of the IOIS enables the pharmacy to immediately turn the list of out of stock items into an order with one of the other wholesalers. A set of standards is used for electronic ordering:

The transport of electronic messages is accomplished by modem dial-up via telephone landlines. This requires modems and landline connection on both ends. In fact wholesalers have a whole battery of modems in place to be able to establish multiple connections at the same time.

Pharmacy software packages, so called "patient medication record systems" (PMR), are provided by a small number of software vendors. PMR systems are used to retrieve further product data like contraindications or treatment information. Moreover they provide the pharmacist with information needed for reimbursement. The information is part of a product-file provided by the IPU.

On the wholesalers' side software systems are used for order pooling and processing. These systems do not need to provide dispensing information but sales information used for marketing purposes. Furthermore collected orders are used by the internal systems to feed automated picking & packing systems that ultimately provide delivery trucks with order packages.

A 13 digit code that conforms to the EAN-13 standard provides a unique product identification across the boundaries. However it must not be interpreted as the manufacturer bar-code that is printed on most of the packages nowadays. Instead this code is administered and maintained by the IPU. The reasons for this arrangement will be explained later. The order message contains lists of these codes. Furthermore it is expected by the pharmacy that the ordered items will be delivered according to the cut-off times (next morning or by noon).



Layer	Object/Standard	Function
Semantics	IPU-code	Product identification
	IPU product file	Documents product identification and provides additional data for other purposes
Syntax	Messages	Order, order confirmation
Communication Protocol	IPUComms v 2.4	Message transfer via modem connection

Fig. 3: Components of the IOIS

Case analysis - accounting for stability of standards

In our case analysis we will identify factors contributing to the stability of the standards. First of all we will trace the events leading to the emergence and development of the standards to the 1980s. We will then arrange the events and identify positive feedbacks according to the phase model proposed by Schreyögg et al (Schreyögg, Sydow & Koch, 2003).

Emergence of the standards

According to our data, the practices in the pharmacies in the 1980s were manual and clerical. The records were mainly paper-based. In 1986 only 10 % of the pharmacies had a computer installed. Pharmacists were ordering multiple times a day by phone. According to the wholesalers this habit was due to a lack of stock-keeping discipline that they claim is still valid today. Pharmacists would work on a pack replacement principle which results in an order for every sold pack. The wholesalers on the other hand employed telesales staff who would take the orders from the pharmacies.

At the time, information technology played a marginal role if any. As pointed out in the previous section wholesalers had strong incentives to engage in process innovation by automating labour intensive, repetitive tasks. In 1984 United Drug (UD) studied the emergence of electronic ordering systems in the United States (McKesson, see (Johnston & Vitale, 1988)) and intended to adapt one of the U.S. solutions for the Irish market. The U.S. example was seen as a means to reduce high costs that resulted from the manual and error prone order intake by the telesales staff. It met the intent to streamline processes, save costs and thereby become more profitable. Because pharmacy market regulation varies significantly across countries, UD decided to develop a new solution from scratch. In doing so, UD played with the idea of developing a proprietary ordering system. This would have conformed to the strategic rationale to lock-in pharmacies and subsequently to increase market share. In such a scenario, switching between wholesalers would become more cumbersome for the pharmacies. On the other hand, a closer linkage between wholesalers and pharmacies offered the possibility for improved stock management and coordination between wholesaler and pharmacy. Our interview data indicate that such a proprietary solution was also regarded beneficial by other people in the wholesaling business. The idea was to take the UK market as a blueprint where American Hospital Supply had successfully established ordering software to lock-in hospitals (Venkatraman & Short, 1990).

UD subsequently developed an electronic ordering system in collaboration with software vendor McLernon, which was introduced in 1986. Similar to the UK systems, the system was designed to use product identification codes (PIP) that would be administered by the wholesaler. A new product identification code was necessary because not all products had a manufacturer EAN barcode at the time.

The Irish Pharmaceutical Union (IPU) was very aware of the intentions of the wholesalers and intervened early in the process. In order to prevent a lock-in situation, the IPU facilitated negotiations among the wholesalers to develop a common, standardised solution. Instead of relying on wholesaler administered PIP-codes the IPU had been negotiating with EAN (at that stage EAN UK was responsible for the Republic of Ireland as well, today it is GS1 Ireland) to use the EAN numbering systems. Consequently, the IPU strived for their own batches of EAN numbers, which they could assign to pharmaceuticals. Besides the main motive of establishing an open solution, there were other reasons to opt for an EAN-based solution administered by the IPU: First, at that time only a relatively small number of pharmaceutical companies had introduced EAN numbers. Second pharmacists were confronted with the problem that manufacturers tended to reuse old EAN-codes too fast for new products, resulting in non-unique EAN-codes. Eventually, IPU was granted manufacturer status and allocated batches of numbers. By this incident the IPU initiative gained momentum and finally reached an agreement between the wholesalers and the IPU on behalf of the pharmacies. The commitment of the IPU opened up several opportunities from the wholesalers' perspective. First, it ensured compatibility with pharmacies' practices and systems. Second, due to its neutrality vis-à-vis the wholesalers the IPU was in a position to facilitate negotiations among the wholesalers.

Furthermore the IPU by its mandate was able to provide the wholesalers some assurance that the solution would be adopted by the pharmacies.
This meant, from a wholesaler's perspective, lower negotiation complexity and the prospect of a quicker diffusion among the pharmacies. The area of competition between the wholesalers would remain in their core business and not on convincing pharmacists to adopt their proprietary order system. It promised extensive cost savings due automation of routine mechanical actions for all parties involved.
The agreement encompassed the order protocol including message types (IPUComms v2.4), the product file and the product identification code.
The *order protocol* ensures the proper order transfer from the pharmacy to the chosen wholesaler. It specifies the syntax rules independent of machine or system of sender and receiver. An item list is being transferred according to these rules and record layout. The communication takes place between computer systems at the pharmacists' and wholesalers' side. The maintenance and documentation of the order protocol is incumbent on the IPU. Pharmacists will typically scan the manufacturer barcode at the POS or add the required pharmaceuticals manually to the list. The order protocol is fully integrated in the pharmacy software systems by the software vendors. The wholesalers receive the item list and reply with a back list. The extent of internal integration is not part of the order protocol.
The *IPU product key* is the unique identifier for all pharmaceuticals sold in Ireland. It exists only digitally which means that it is not printed on the packages or blisters. The IPU is in charge of assigning codes to new products. Therefore manufactures will report new products to the IPU which then assigns numbers to these. The IPU product keys are distributed via the IPU product file.
The *IPU product file* comprises all products being sold in Irish pharmacies. It has thus been an early version of a data pool across a wide range of suppliers. Thus, it contains pharmaceuticals as well as CTS products. It categorizes products and provides additional information valuable for the pharmacists like for example: pack size, ingredients or strength. Furthermore it serves as a code pool or translating device. This means it includes not only the IPU product key but manufacturers EAN code and reimbursement numbers as well. The latter is needed by the pharmacists to bill the state-administered reimbursement-schemes. The manufacturer EAN-code is used for scanning the barcode at the point-of-sale. In addition the pharmacist can retrieve pricing information. On the wholesalers' side less information is needed. There it is merely used as a code-translating device. A special unit at the IPU is solely dedicated to maintaining this file and keeping it up-to-date. New versions are issued on a regular basis. The IPU distributes the file as a service to its members. Costs are recouped by membership fess of the IPU. Today the IPU product file is not only used between wholesalers and pharmacies but also by the state-administered schemes in charge of reimbursement (GMS Board) to look up prices. Pilot projects are set forth to use it in hospitals and surgeries.

The IPU took over the role of administering and maintaining the product file. Thereby the IPU was able to provide additional services to its constituencies. The product file not only contains the IPU-code necessary to order products from the wholesaler but dispensary and reimbursement information valuable for the pharmacists. The IPU has ensured the distribution of updates of the product file to all its members. The system vendors who took part as well in the negotiations implemented the standard components into the pharmacy software systems.
After reaching the agreement, the software vendors engaged in the development of new pharmacy software that enabled the pharmacies to use the new ordering module. Intense competition and a swift introduction of new features facilitated a widespread diffusion of pharmacy software. Despite complementary software features, pharmacies only gradually initiated to order electronically. Wholesalers had to give initial discounts as pharmacists perceived all benefits accrue to them. The IPU founded a new organisational unit devoted to maintain the IPU product file and product codes. The wholesalers aligned their whole process resulting in a fully automated order intake and order processing. The role of order takers changed into marketing and sales staff. Their objective was now to stay in touch with pharmacists to foster loyalty, gain market intelligence and do marketing for special promotions. Thus, telesales staff has not been replaced by machines but was enabled to engage in human

interaction with pharmacists in order to build up a closer and personal relationship. This is supported by wholesaler's policy to have the same telesales person calling their pharmacies.
Despite its advantages for both sides to achieve an efficient communication, the diffusion of the electronic ordering solution happened gradually over a 10 year period. Today, all pharmacies are able to order electronically. Software vendors report that the eOrdering module is a "must-have" feature in pharmacy software: "It's a must to have a feature for the pharmacists, they won't talk with you, unless that feature is there." [Carl, (pseudonym chosen for reasons of anonymity)] The product file has as well become to a cornerstone of pharmacy practices as counselling and reimbursement depends on the information as well.

(1) Creating a path

In hindsight, the mid 1980ies appear like a critical period, during which pharmacy wholesalers across numerous countries looked for innovative and strategic solutions to facilitate efficient (electronic) ordering for pharmacies and possibly to create lock-ins. The historical reconstruction provides plausible evidence for a series and sequence of events in the Republic of Ireland which led to a situation where the wholesalers agreed on a set of standards and thereby de facto excluding this specific segment from the competitive arena. The IPU appears to have played a crucial role in facilitating the negotiation and representing the pharmacies interests. The provision of manufacturer status to the IPU by EAN can be regarded as the critical incident that triggered the whole process. It provided a clear signal to the negotiations among the wholesalers.
It looks as if – in the setting of a relatively small country – common sense to create a solution which would be beneficial for the entire industry prevailed. The adoption of the standard appears as a conscious and deliberate decision among the wholesalers within a broader constellation of actors which included the IPU as well as the software vendors. The wholesalers were aware of alternatives (wholesaler PIP codes) and that these were pursued in the US and the UK.

Proposition 1a: A widespread consensus emerged in the mid 1980ies that electronic ordering was an efficient way of managing high order volumes between pharmacies and wholesalers.
Proposition 1b: A combination of institutional and strategic reasons led to the design of a common standard, which created a trajectory of a diffusion and adoption process.
Proposition 1c: The institutional (IPU), technical (software vendors and wholesalers) as well as operational embedding of the standards facilitate the diffusion and adoption of the standard across the Republic of Ireland.

(2) Stabilizing the path

Path dependency theory looks for mechanisms of stabilization. A technical source for stability can be seen in the integration of the ordering modules into internal information systems of the participating organizations. The ordering module is tightly integrated into back-office systems on the wholesalers' side as well as on the pharmacies' side. In regard to the former, protocols have been implemented and embedded into their own information systems for order intake, warehouse management and distribution. Wholesalers are feeding their picking & packing systems with information coming from the order modules whereas pharmacies are using especially the product file as the central file for dispensing and reimbursement. Therefore direct as well as indirect network effects can be identified.

Proposition 2: Technical integration of the standard into back-end systems and deployment in related applications (reimbursement) yielded network effects.

If we use the logic of lock-in, we can identify different technical, economic and institutional lock-in mechanisms across the involved parties, which appear to mutually reinforce each other:

From an economical rationale *pharmacies* are locked-in because the standard-based solution is seen as the most efficient way of ordering, not the least because it has been implemented into the pharmacy software. At the same time it facilitates the practice of order switching. Moreover the IPU product file is also used by the GMS board, which reimburses pharmacies. Thus, the original scope of application has broadened over time and now incorporates other actors in the industry as well.
Wholesalers are locked-in because the standard-based solution has been fully accepted by their client base. Any changes to the standard would either require adjustments across the full installed base (1400 pharmacies) or the break-up of a one-size-fits-all solution in favour of different versions for different customer segments which would have to be administered. The division of labour and the specific design of the warehousing and distribution solution is continually reinforced by the use of electronic ordering.
The *IPU* has been locked-in (or rather willingly locked themselves in) by taking over the role of the standard custodian and setting up an organizational unit to maintain and update the product file. (The remaining components of the standard set are adjusted occasionally). For the IPU the product file has become an important raison d'être: the product file is provided to members only. So the availability of the product code is a strong reason for pharmacies to join and retain membership of the IPU. Thereby the IPU not only receives funding but also legitimacy. The IPU in return stabilizes the product-file by maintaining it, adding services and promoting it in other fields (GMS, hospitals, surgeries).

Proposition 3a: A reciprocally linked set of lock-ins has stabilized the path.
Proposition 3b: The different stakeholders of the IOIS are locked-in for different reasons and within different sets of rationales.
Proposition 3c: Yet these lock-ins are related, referring to common boundary objects and appear to be mutually stabilizing.

While the analysis of lock-ins provides an initial explanation for the stabilization of the standard, it falls short of explaining the dynamics and indeed dialectic of lock-in and flexibility. For that reason we are using a practice theoretical approach and focus on particular on the notion of the boundary object in order to explore the stabilization of the standard across different organizations and institutions with multiple and diverse linkages and relations. In an abstract way, we see the standard set as a stable core which is embedded in a flexible set of practices. Seen as a boundary object, the standard set is open for flexible and diverse interpretations and forms of appropriation.
The standard set provides a quite simple and limited specification. The IOIS presents itself as a strongly coupled system that relies on a running technological infrastructure. Its focus is very narrow. Exchanged messages only consist of lists of items. No further information is being conveyed via this channel. As a matter of fact this communication channel can only be used for very narrow communication purposes. This strong focus enables a high degree of automation and great efficiency. Part of its strengths and resilience might result from this very fact, because it leaves a broad scope of technical developments and adjustments reflecting the often diverse needs of the different stakeholders: Wholesalers have built diverse marketing, warehousing and distribution systems, which provide space for strategic differentiation. Pharmacies can select from various pharmacy packages depending on their needs. Larger pharmacies and in particular pharmacy chains have different needs and strategic intents to position themselves in the market. While the standard is binding the software vendors to some degree it leaves them with sufficient scope for differentiation.

Proposition 4: The limitation of the standard partly explains its resilience and strength. It leaves sufficient scope (and flexibility) for differentiation and strategic manoeuvres.

The argument can be extended further if we look into related practices. The fact that the partly automated order practices (computer facilitated generation of order message and automated generation of response message)

have been complemented by TeleSales (daily phone calls from the wholesaler to the pharmacist to maintain a personal communication channel) practices looks almost like textbook implementation of an EDI solution. It recognizes the continuing need to build and maintain social capital between buyer and seller in order to stabilize the relationship. From a practice theoretical lens this suggests that the standards as boundary object facilitated the linkage or alignment of the ordering and fulfilment practices respectively. The benefits of a standard in terms of predictability and reduced complexity can easily become a burden if the linked parties feel constraint in the conduct of their business. However, as the stable standard was accompanied by much more flexible phone conversations, the latter helped to stabilize the former. A much richer communication was enabled and the narrow focus of the automated channel was broken up.

Proposition 5: The combination of hard and soft coupling of practices is one reason for the stability of the IOIS.

Moreover, while the EAN-13 codes was used as a unique identifier across the industry (including suppliers), the product file had been designed as a much more flexible representation of product information. It includes fields for different numbering systems to cater for specific needs (e.g. of the GMS board) and to facilitate an easier transition, where different numbering systems are used in parallel. The message standard and communication protocol were rarely changed and are obviously in line with the needs of the participants. While the EDI literature suggests that the different semiotic layers and the technical protocol should be separated in order to be more flexible in case of technical changes, the Irish case seems to suggest that the different components of the standards reinforced and stabilized each other. The product file, which is regularly updated is core of this dynamics. The short update cycles allow for some adjustments as long as the IPU product number is maintained and provide requisite flexibility.

Proposition 6: The standard components reinforce and stabilize each other. The regular updates of the product file are the core of this process.

The product file as core boundary object between the pharmacies' and the wholesalers' practices exhibits interpretative flexibility. It means different things to different parties. While the wholesalers primarily rely on the product key and price information, the pharmacist use the extended set of products (cosmetics, toiletries and sundries) for ordering and (even rudimentary) inventory management. Extended product information supports their dispensing and consulting practices. While the reimbursement practice is outside the scope of our analysis, it confirms our argument: the GMS board uses the IPU file as well for their own purposes.

Proposition 7: The interpretative flexibility of the boundary object product file has stabilized the path.

The ongoing use of the boundary objects and their embedding in systems and practices leads to a routinization of processes. This in return makes the single steps and the explicit usage of the boundary objects more and more transparent over time for the actors. The action itself becomes an unconscious routine that is to a lesser extent part of an ongoing reflection. This reduction of reflected action encourages simple reproduction of routines instead of discursive patterns regarding modifications or replacement of the system.
The EAN format, which was in an early development stage in the 1980ies, has become the mainstream standard for product identification and marking backed by a global network of standards organizations (EPCglobal and GS1 global). In the meantime the shortcomings of the UK and Australian solution have become obvious, the benefits of Irish solution have been acknowledged..

Proposition 8a: Routinization has facilitated tacit acceptance and perpetuation of the system.
Proposition 8b: The emergence of the global GS1 organisation has provided additional normative support for the chosen solution.

After having analyzed factors contributing to the stability of the system we still did not call this a path dependent process. As pointed out before path dependency calls for the identification of positive feedbacks or increasing returns. Furthermore we need to examine whether the observed proliferation of the IOIS exhibits the characteristics of path dependent processes. In the 1980s the current set-up of the system and its widespread proliferation has been non-predictable. Instead wholesalers were advocating for a proprietary solution. That the IPU has been granted manufacturer status by the EAN-organisation was a precedent and as interviewees indicated the event that triggered the whole process. The process can be called inflexible as we already demonstrated the extraordinary stability of the IOIS. It has been argued that it is unlikely that unilateral act could alter the current set-up and that collective action is needed. Collective action however can be regarded unlikely to take off as well. The third characteristic put forward by Arthur concerns potential inefficiency. The current solution can be deemed inefficient because no change is possible. New approaches to optimize ordering procedures or the relationship between wholesalers and pharmacies cannot be introduced. The inefficiency lies merely in the foreclosing of new opportunities. From the point of view of an individual company this can be deemed inefficient.
From this perspective we have to diagnose this process as being path dependent. The theory of path dependency however still requires further refinement regarding its borders in order not to deem every process path dependent.

Perspectives – Breaking of the path?

While the IOIS in Ireland has been in use with only minor changes for over 20 years, our research indicates imminent changes:

- Institutional structures: Pharmaceutical distribution happens in a highly regulated environment. Ongoing political pressure to contain the quickly rising costs of health care and an increasing need to establish trackability and traceability throughout the supply chain in order to protect patients from counterfeit drugs let us expect a changing regulatory regime. While the cost pressure would suggest more efficient distribution and inventory management models, the security issue will have – if properly addressed – profound effects on the distribution practices (and revenue streams) of the wholesalers.
- Material structures: The structure of the industry is changing as larger pharmacy chains emerge and one chain has already been taken over by one of the wholesalers. Online pharmacies will yield a shift.
- Ideational structures: In grocery retailing more refined models of inventory management, such as continuous replenishment or vendor managed inventory, have been developed and it is widely recognized that pharmacies are trailing behind with respect to inventory management. Reasons as different as organizational size, ICT support or professional mindset (pharmacist vs. manager) have been given. Changes in inventory management would imply organizational changes in the pharmacies as well as tighter relations with wholesalers. The rise of chains like DocMorris in Germany suggests that the introduction of professional management structure can increase the operational efficiency of pharmacy operations.

As a result and in line with our analysis of practices and the reproduction of structures, we expect a softening of the current one-size-fits-all model of distribution and the emergence of a more differentiated industry segment landscape with larger chains operating in sync with one (or two) wholesalers based on a refined division of tasks among them.

Proposition 9a: Institutional and economic changes in the industry suggest that complementary technical solution will be created to address specific needs of a segment of the Irish pharmacies.
Proposition 9b: The expected dynamics will result from a combination of technical, organisational and strategic components.

Proposition 9c: The underlying standards of the product code will hardly be changed, however, they may become extended (e.g. the serialization of drugs) and (partly) dissociated from the IPU.

However, we cannot say, when and how these changes will happen. Regulatory action might trigger a sequence of changes. Alternatively, an individual player or a small group of players might take the initiative. Regulatory action will increase the likelihood of changes on a broader collective level, while otherwise we expect a stepwise disintegration of the current ordering standard.

Conclusions

We have tried to make sense of a rich case study in the Irish pharmaceutical distribution segment, i.e. our unit of analysis are business practices in an industry segment. Hence we have been looking at the routinized interactions of business partners, supporting organizations such as software vendors, association and health care organizations. Path dependency theory provided the first rough segmentation of phases and we have used different sets of additional theoretical arguments linked to the broader framework of path dependency to explore specifically the mechanisms and dynamics of stabilization.

The core of our argument is built on the conceptualization of an IOIS as an ensemble of practices which are linked by boundary objects or boundary practices. We have studied standards as boundary objects and scrutinized how they have shaped the dynamics of reciprocal adjustment and stabilization of routines.

We found an intriguing dialectic of stability and flexibility which enable and constrain each other. Technology standards are at the core of a path of linked practices, which are stabilized by the institutionalized maintenance of the product file. The use of technology is embedded in different layers of internal information systems of the suppliers and buyers but also other players in the industry segments. And more importantly, the use of technology has become embedded into a broader set of linked practices.

Conceptually we have extended or enriched path dependency with arguments from practice theory and have linked technical, social and institutional arguments.

We have not been able to build causal explanations, rather we have identified (and linked) different types of mechanisms for the reproduction and stabilization of practices.

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