

# COMPLEXITY AND CONTEXT: EMERGING FORMS OF COLLABORATIVE INTER-ORGANIZATIONAL SYSTEMS

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## ABSTRACT

*The paper analyses the collaborative development of emergent IOS in three data intensive industry sectors (telecommunications, news media, and financial services). The findings reveal that environmental complexities (the complexity of data consumption patterns and increased interdependence within value webs) require context-sensitive value exchanges operationalised within co-operatively developed commodity-like IT infrastructures. The paper concludes by examining the implications of the study findings for developing IOS to support pooled, sequential, and reciprocal inter-organisational interdependencies.*

## INTRODUCTION

The potential of inter-organisational co-operation has been advocated since the 1960s by researchers such as Kaufman (1966). From the 1970s to the early 1990s, researchers (e.g. Van de Ven, 1976; Provan, 1982; Borman, 1994) argued that an organisation should link with others in order to cope with its environment and reduce environmental uncertainty, and that inter-organisational systems (IOS) were essential in this regard. Traditionally, IOS operationalised sequential

inter-organisational relationships and supported limited internal processes such as inbound logistics and outbound logistics. Such IOS configurations can be classified as 'value chain' to 'value chain' models involving bilateral relations between two firms (Howard, Vidgen and Powell, 2003). Normann and Ramirez (1993) argue that traditional notions about value creation are based on outdated assumptions with an upstream supplier providing inputs to a value chain, an organisation adding value to the inputs and

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subsequently passing outputs to the customer or next participant in the supply chain. Subsequently, Internet focused research such as Timmers (1999), Kaplan and Sawhney (2000), and Hayes and Finnegan (2005) focused attention on the development and exploitation of new IT-enabled business-to-business models. While the focus was on e-business, the operationalisation of such linkages is characterised as IOS. Timmers (1999) sees new business models emerging from linkages between elements of the value chains of different organisations. Consequently, the boundary between organizations and their supply-chain partners is becoming even less distinct with interdependencies between them being more important (Hughes, Powell, Panteli and Golden 2004; Gulati and Kletter, 2005; Premkumar, Ramamurthy and Saunders 2005). Further, El Sawy, Malhotra, Gosain and Young (1999) argue that organisations that survive in this type of dynamic environment will need to be innovative in order to create new approaches to delivering value and will, as a result, have to employ altered enterprise structures and IT infrastructures. Thus, while increasing environmental complexity and technological innovation have led some organisational networks to explore more dynamic IOS models (Baron, Shaw and Bailey 2000; Howard, Vidgen and Powell 2003), empirical research on such systems is sparse and our conceptualisations of IOS need to be updated to include them (Hong, 2002).

This paper reports on a study that explores the regulatory, economic, socio-cultural, technological and other inter-organisational environments that facilitated the development of IOS in three data intensive industry sectors (telecommunications, news media, and financial services). We firstly discuss the theoretical foundations for the study by examining the need to revisit IOS theory due to changing business requirements and enabling technology. Next, we explain the methodological approach used for the study. The findings illustrate that emerging IOS can help overcome the complexities of data consumption and value webs by facilitating standardisation and customisation for participants utilising context-sensitive value

## CONTRIBUTION

This paper makes several contributions to IS research, particularly in the area of IOS. The paper responds to the need identified by other researchers to update our current conceptualisations of IOS in the context of emerging global environments, by moving beyond the examination of closed ‘hub and spoke’ configurations (a perspective that characterises extant research on IOS). The paper empirically demonstrates how firms in data intensive industry sectors utilise collaboratively developed open standards and commodity-like infrastructures in order to deal with the diverse technological, regulatory, legal and social factors that characterise global collaborative environments. It provides an illustration of how collaboratively developed systems address content management and delivery challenges in real-time multilingual multinational environments. Also, it demonstrates how environmental complexities (reflected in complex data consumption patterns and organisational interdependence) require context-sensitive value exchanges and co-operatively developed commodity-like IT infrastructures.

exchanges. This requires the development of a commoditised IOS infrastructure and higher co-operation levels amongst participants. We conclude by proposing an update to our conceptualisation of IOS by outlining an extension to an IOS framework developed by Kumar and Van Dissel (1996).

## THEORETICAL GROUNDING

Benjamin, DeLong and Scott Morton (1990) concluded that there has been much disagreement about what constitutes an IOS. This is despite the fact that much of the research on IOS has concentrated on similar hub and spoke systems that connect large retailers or manufacturers with their suppliers. The inter-organisational transactional nature of IOS was emphasised by Barrett (1986), who proposed that an IOS “automates some element of work, such as order editing, inventory status checking, or, minimally, transaction transfer,

that would previously have been performed manually or through other media, such as the mail.” Chismar and Meier (1992) and Suomi (1994) avoid referring to the type of organisational activity and concentrate on any system that communicates between independent organisations. More recent studies differentiate between bilateral (dyadic) and multilateral systems and use terms such as ‘electronic network’ (Bakos and Nault, 1997), ‘electronic market’ (Choudhary, Hartzel and Konsynski (1998), and ‘extra organisation system’ (Howard, Vidgen and Powell 2003) in delineating types of IOS. Siau (2003) simplifies the differences created by such terms by representing IOS as an electronic linkage of information systems across organisations. This definition is broad enough to incorporate a wide variety of systems used in modern business networks, and is adopted for this study.

Early IOS were based on EDI standards. Such systems were seen to positively affect inter-organisational transactions by: reducing costs and improving efficiency (Swatman and Swatman, 1992), reducing environmental uncertainty by facilitating communication and providing information (Henderson, 1990; Scala and McGrath, 1993) and affecting the competitive positioning of organisations by encouraging closer relations with suppliers and customers (Cash and Konsynski, 1985; Swatman and Swatman, 1992; West, 1994). Such systems are widely used as part of a supply chain management strategy (Subramani, 2004). Early IOS tended to be developed internally and extended to, or imposed upon, others (Webster, 1995). As such system configurations become more complex, an approach where one organisation develops a system and simply extends it to other organisations is regarded as inadequate, especially when business processes have to be altered (Finnegan, Galliers and Powell 1998; Axelsson, 2003).

It is evident that a combination of business and technological changes is driving the development of more advanced systems facilitating a broader range of inter-organisational inter-dependencies (Axelsson, 2003; Gallivan and Depledge, 2003). Evans

and Wurster (1999) illustrate how IT alters organisational boundaries, value chain activities, and inter-organisational relationships by changing the control and flow of information. Consequently, Tapscott, Ticoll and Lowy (2000) argue that existing value chains will fragment and lead to new Value Webs. In examining technological changes, Hagel (2002) argues that EDI-based IOS are not well suited to complex business networks with dynamic relationships as they suffer from the  $N^2$  integration problem<sup>1</sup> and lead to concerns about lock-in, as well as being costly to implement due to long lead times. However, the international data format standard, XML (eXtensible Markup Language), is seen as having huge potential in facilitating the exchange of information in inter-organisational environments (Reimers, 2001; Lowry and Neumann 2001; Van der Aalst and Kumar, 2003; Gosain, Malhotra and El Sawy 2004). Indeed, Christiaanse, van Diepen and Damsgaard (2004) see open XML-based systems offering three advantages over their EDI-based predecessors; lower cost; lower dependency on proprietary standards; and less mutual adjustment.

Building on the business and technological changes, Hong (2002) argues that our current conceptualisations of IOS are outdated in relation to emerging global networks. He notes that emerging IOS are designed to support partnering among organisations, with a consequential shift in the role of IOS from competitive weapon to co-operation enabler. Thus inter-organisational interdependencies become important in the context of IOS (Gosain Malhotra and El Sawy 2004; Premkumar, Ramamurthy and Saunders 2005) as inter-firm relationships are more important than the development approach (Ibbott and O’Keeffe, 2004). Based on the work of Thompson (1967) and Robey and Sales (1994), Kumar and Van Dissel (1996) propose an IOS topology that categorises systems according to the level of organisational interdependency they facilitate. Interdependency means conditions where organisations rely on, or are influenced by, others. Pooled IOS involve the sharing of IS/IT resources, value/supply-chain IOS facilitate customer-supplier relationships along

the value chain, and networked IOS operationalise reciprocal inter-dependencies such as joint ventures and strategic alliances. These interdependencies range along a continuum from pooled to reciprocal, with those further along the scale inheriting the characteristics of the earlier ones. Further, as organisations may be involved in more than one type of inter-organisational relationship, a particular IOS may exhibit characteristics of more than one type of interdependency (Kumar and Van Dissel, 1996). Kumar and Van Dissel’s concluded that there are pooled, sequential, and reciprocal interdependencies as shown in Table 1. In proposing this topology, Kumar and Van Dissel (1996) recognise the inter-dependencies between inter-organisational structures, and the design, implementation and operation of IOS.

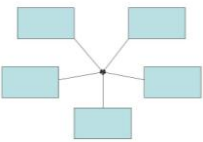

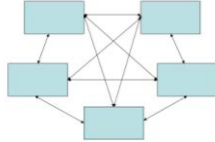
To conclude, much of the research on IOS has concentrated on well-established technology that has been implemented in simple supply chains (e.g. retailer and supplier). Technology, such as XML, presents a potential solution to the dynamic communication and collaboration needs of more complex business webs. Nevertheless, emerging IOS have received little empirical

attention. In particular, “little effort has been devoted to incorporating emerging information partnerships among business firms into an IOS framework” (Hong, 2002). Given the importance of inter-organisational interdependencies as identified by researchers such as Ibbott and O’Keeffe (2004), Gosain, Malhotra and El Sawy (2004), and Premkumar, Ramamurthy and Saunders (2005), we propose an exploration of the inter-organisational environments that facilitated the development of emergent IOS.

**RESEARCH METHOD**

The objective of this study is to explore the environmental conditions that facilitated the development of emerging IOS in three data intensive business sectors. To address this objective, we have adopted a “soft positivist” epistemology (described by Kirsch (2004)). Our methods (cf. Eisenhardt (1989) and Madill, Jordan and Shirley (2000)) are designed to reveal pre-existing, relatively stable and objectively extant phenomena and the relationships among them in a manner that is not limited to examining only pre-identified constructs.

**Table 1: An IOS topology (Adapted From Kumar and Van Dissel, 1996).**

	<b>Pooled Interdependence</b>	<b>Sequential Interdependence</b>	<b>Reciprocal Interdependence</b>
<b>Network Configuration</b>			
<b>Characteristics</b>	Coordination through Standards and Rules  Use of Mediating Technologies (e.g. Database)  High Structurability and Low Potential for Conflict	Coordination through Standards, Rules, Schedules and Plans  Use of Long-linked Technologies (e.g. EDI)  Medium Structurability and Potential for Conflict	Coordination through Standards, Rules, Schedules, Plans & Mutual Adjustment  Use of Intensive Technologies (e.g. Central Repository)  Low Structurability and High Potential for Conflict
<b>Type of IOS</b>	Pooled information resource IOS	Value/supply-chain IOS	Networked IOS

Eisenhardt (1989) advocates the use of multiple case studies as part of a process of theory building, as is the situation here. Case studies are the most commonly used qualitative research method in IS, and are especially useful for studying organisational aspects of IS (Benbasat, Goldstein and Mead 1987). 'A case study examines a phenomenon in its natural setting, employing multiple data collection methods to gather information from a few entities. The boundaries of the phenomenon are not clearly evident at the outset of the research and no experimental control or manipulation is used' (Benbasat, Goldstein and Mead 1987). Cases are most appropriate when the objective involves studying contemporary events, without the need to control variables or subject behaviour (Yin, 1994), are particularly suited to exploring relationships between variables in their given context (Yin, 1994; Benbasat, Goldstein and Mead 1987). Nevertheless, cases studies are weak in terms of statistical generalisation (generalising from a sample to a population), but are useful in the context of theoretical generalisation (generalising from a case to a theory) (Yin, 1994).

Using a multiple case study research design, data was collected over a 15 month period from February 2002 to May 2003. We first conducted a thorough archival search to determine the existence of public domain material on each case. The accuracy of this material was then verified with key staff members within each organisation. This verification was conducted using conference calls and document exchange by email. As a result of this preliminary analysis, we prepared a case study protocol and sent it to the contact person within each organisation. Based on this protocol, interviews were arranged with key personnel. The choice of interviewees was based on a number of factors; including willingness to co-operate, fit between job role and research subject and seniority/responsibilities. A total of 32 hours of interviews were conducted during 2002 and 2003. In addition to interviews, we were also given access to extensive documentation and system demonstrations.

The data was analysed using coding techniques proposed by Strauss and Corbin

(1990), and exemplified by the research of Baskerville and Pries-Heje (2001) and Orlikowski, (1993). Such analysis facilitates the development of substantive theory without the prior hypotheses (Baskerville and Pries-Heje, 2001), and can be utilised in the absence of, or in conjunction with, existing theory (Strauss and Corbin, 1990). The coding was undertaken independently by two of the authors; both of whom are experienced with qualitative data coding. Coding was only accepted where both coders agreed. The first step (open coding) meant that the data from each case was examined to ascertain the main ideas. These ideas were then grouped by meaningful headings to reveal categories and sub-categories/properties. The next step (axial coding) is the process of determining hypotheses about the relationship between categories. Once the coders had determined the hypothesised relationships, the focus returned to the data to question the validity of these relationships. This process resulted in the modification of categories and relationships. The final step (selective coding) is the process of determining the core category; that category that is mentioned most frequently and is usually connected to most other categories. The categories and relationships will be discussed in the findings section.

A limitation of the coding approach undertaken is that of multiple realities – i.e. the understanding of reality is based on an individual's interpretation of the data, and that different individuals may interpret the same data in different ways (Kaplan and Duchon, 1988). We have addressed this problem in the following ways. First, the coding was independently undertaken by two of the researchers, with results reported only when both agreed. Second, the rigorous coding and memoing processes provide a traceable audit trail of the process by which research conclusions are reached (Guba and Lincoln, 1981). Third, results and interpretations were formally discussed through a series of conference calls with the interviewees in order to clarify issues and confirm the accuracy of the data collected, thus introducing a process of venting (Goetz and LeCompte, 1984) to the analysis.

## CASE ENVIRONMENTS

Our first case examines the development of a system to enable global service provision through the seamless integration of diverse content and functionality from multiple international providers in a manner that would (i) meet the requirements of a diverse range of client environments and (ii) ensure an equitable distribution of revenue from this integration back to the original providers. *Digifone* was established as Esat Digifone in Ireland in 1997 and was bought by British Telecom (BT) in April 2001. In November 2001, Digifone completed a demerger from BT and, in conjunction with other European mobile providers, devised plans to re-brand as O2. By early 2002, O2 businesses served 16.5 million mobile customers in the UK, Germany, Ireland, the Netherlands and the Isle of Man. The research took place during Spring 2002 as Digifone was preparing to bid for a third generation (3G) mobile licence. In parallel with this bid, Digifone management introduced plans to facilitate the mobile commerce services of content providers and aggregators and to take a percentage of the resulting revenue. To effectively do this, Digifone needed a way to differentiate the value of content based on factors such as time, location of consumer etc. Our research focuses on the role of an XML vocabulary (IPDR) in envisioning IOS to facilitate such plans.

Our second case examines the development of a system for the financial services sector in Australia to harmonise data provision and decision making requirements across regional and organisational boundaries in the context of global regulatory changes. The *Australian Prudential Regulation Authority (APRA)* was established on 1 July 1998, and charged with the prudential supervision of Australia's regulated deposit takers (banks, credit unions and building societies), insurance companies, and superannuation funds. In total APRA supervises funds that amount to over 1.5 trillion dollars, i.e., more than half Australia's wealth. The research was conducted during Spring 2003, and focused on the development and use of XML-enabled systems to collect data from financial institutions and to process it for use by APRA, the Reserve Bank of

Australia (RBA) and the Australian Bureau of Statistics (ABS). The IOS developed to enable online reporting by the institutions used the XML vocabulary XBRL (Extensible Business Reporting Language), making APRA one of the first organisations worldwide to integrate XBRL into its systems. The study also examined the changes that took place in the aftermath of the systems implementation to allowed APRA to concentrate on regulation rather than data aggregation.

Our third case examines the development of a system for use by the news industry to (i) seamlessly gather multi-lingual / multimedia news content from globally distributed independent reporters and photographers using different technologies and (ii) process, package and distribute this content in real time for use by a variety of clients / client technologies worldwide. *Reuters* was founded in 1851, and has grown into the one of the world's largest and most successful news and financial information organisations. Each day, Reuters manages around 2500 editorial staff based in 190 locations in over 100 countries. Each day, Reuters produce and distribute about 14,000 headlines in 26 languages, over 1,000 pictures, and 23 hours of broadcast quality video. Reuters provides data on more than 960,000 shares, bonds and other financial instruments, maintains more than 200 million data records (which contain over 3,000 billion record fields), and is read by users of more than 900 web sites around the world, with an audience reaching 50 million online users per month. By the mid 1990s, it was clear that the number and diversity of content providers and clients was growing at a rate that made proprietary technology cumbersome for both acquiring and delivering content. Reuters began the development of an XML vocabulary, ReutersNewsML, in 1998 as a response to value chain integration issues. In 1999, the specifications for the vocabulary were submitted to the International Press Telecommunications Council (IPTC). The IPTC then began the collaborative development of NewsML. NewsML is a tool for packaging multimedia news data in a way that makes it easier to transport, process and deliver – whether the destination is a publisher's database or a consumer's mobile

phone. NewsML has become the standard data format for multimedia content in Reuters Internet Delivery System (IDS) and was ratified as an IPTC standard for the entire global news media industry in 2000.

Using the IOS classification of Kumar and Van Dissel (1996), Case 1 may be classified as an example of pooled interdependency. Case 2 may be classified as sequential interdependency, and Case 3 may be classified as reciprocal interdependency, as shown in Table 2.

**FINDINGS AND ANALYSIS**

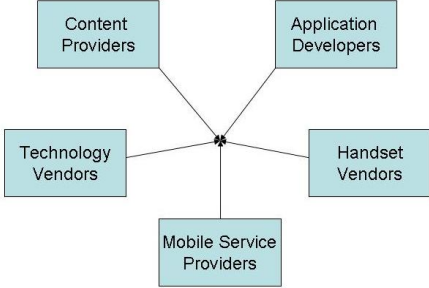

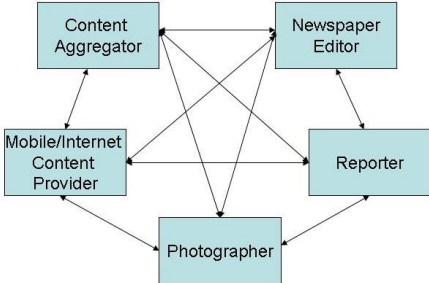
Figure 1 illustrates our analysis of the three case studies. In each case, there was evidence of two kinds of mutually re-enforcing environmental complexity; (1) the increasing complexity of data consumption (e.g. time and location independence, personalisation, aggregation) and (2) the increasingly complex relationships within value webs (e.g. proliferation, multiple positioning and re-positioning of players). In order to meet the demands of data consumers, and in order to

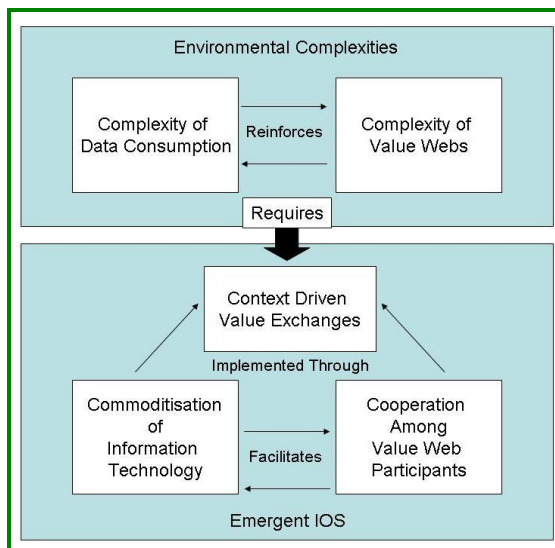
effectively participate in such value webs, value exchanges within IOS required context sensitivity (the ability to both measure and manage both data and metadata in real-time). Support for such exchanges was implemented through a collaboratively developed IT infrastructure, which was not seen to bestow any unique advantage on individual participants. Rather the IT platform was seen to be a commodity, with participants competing on the basis of the value delivered on the platform. The creation of such a platform facilitates and is facilitated by high levels of co-operation between participants. The rest of this section discusses these issues in detail.

**Complexity of Data Consumption**

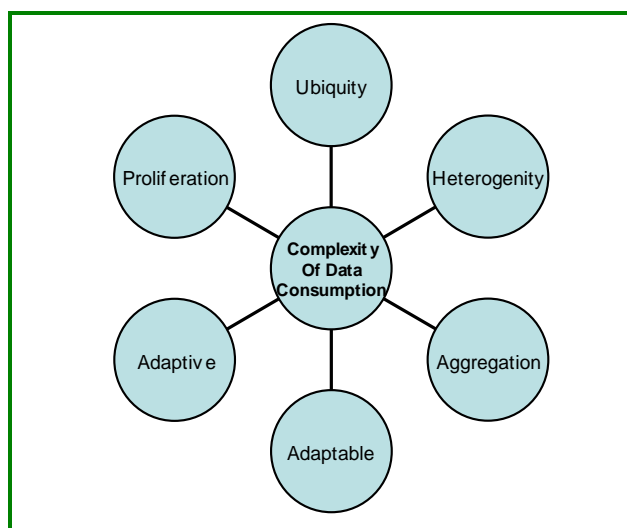
All cases illustrated that the complexity of data consumption was changing the nature of inter-organisational dependencies, and driving the development of more complex IOS. A summary of the factors involved in the “complexity of data consumption” is shown in Figure 2.

**Table 2: Interdependencies/topologies in the networks studied.**

Network	Interdependency
<p><i>Case 1 (3G Network)</i> IPDR-based Mediation, billing and resource allocation system.</p>	
<p><i>Case 2 (Financial Services Sector)</i> XBRL-based data collection, aggregation and analysis system</p>	
<p><i>Case 3 (Media Network)</i> NewsML-based inter-organisational content management system.</p>	



**Figure 1: Overview of study findings.**



**Figure 2: Complexity of data consumption.**

The dominant feature of data consumption was ubiquity, by which we mean the anytime/anywhere usage of information technology for data consumption (either personal or professional). In all three networks, consumers demanded (to varying degrees) that data be available in real-time, and in a location independent fashion. This was most evident with the telecommunications network, particularly in relation to the development of third generation (3G) services, where

consumers were increasingly accessing electronic data sources through mobile devices. For example, a Digifone customer roaming on the SFR network in Paris may use the Yahoo portal to access an Interflora site to send flowers to her partner in Rome. A similar trend was observable in the media networks.

The heterogeneous nature of data consumption in the three networks studied differentiated such consumption from the more structured nature of traditional IOS (e.g. EDI



systems). Such heterogeneity was evident at the organisational level, but also at the level of the individual consumer where a wide variety of devices (mobile phones, personal computers, digital televisions, etc.) are used to consume data. The telecommunications network demonstrated the most variety. For example, the data demands of peer-to-peer video exchange over mobile devices are very different from the demands of booking a hotel and providing driving directions to the hotel using an embedded global positioning system (GPS). Heterogeneity also impacted behaviour in the media and regulatory reporting networks where a single data object needed to be distributed to a wide variety of formats (for the web, for print, as input into another system, etc.).

Another feature of the data consumption within the networks was the need to aggregate disparate data. For example, APRA uses different risk frameworks to assess different types of financial institutions. The risk framework for banks is very different than that for pension funds. It was evident that consolidation in the financial services sector was resulting in one type of institution providing many products (e.g. insurance, pension, deposits) that had traditionally been provided by different types of institutions. APRA thus had to move to integrated reporting treating like risks alike. However, the accounting principles and industry reporting requirements differed significantly for different types of institutions. In addition, the IT systems in the institutions that produced the data were very different. APRA were thus faced with an enormous data aggregation problem. Reuters likewise had to deal with an extremely large number of internal and external content providers, producing data objects in a variety of formats.

Another aspect of data consumption, which deviates from traditional IOS data, was its dynamic nature. In these contexts, data consumption/delivery mechanisms had to be both adaptable and adaptive. By adaptable, we mean that the mechanisms must allow consumers (and others further up the value chain) to manipulate and filter the data according to their preferences. For example, the news network needed to be able to package

news items to meet the consumption preferences of individual consumers (who may want headlines delivered to their phones, full multimedia stories to their office email where they have good connection speeds, and plain text stories delivered at home where bandwidth is lacking). Likewise, consumers expect to be able to set preferences regarding how news is presented to them in each format e.g. sports results first and then the crossword when on the Web, but financial headlines first on mobile phones. APRA also highlighted adaptability as a critical feature of any potential system, as the regulatory 'rule base' was in constant flux and any system needed to accommodate that constant change. The concept of 'adaptive systems' is perhaps more subtle than 'adaptable'. It is generally understood to imply that the system adapts in response to users' behaviour and identity, and various environmental factors, rather than in response to explicitly stated preferences. The process of translation and localisation in news stories is one example of adaptivity. The personalisation (at the organisational level) provided by APRA is another example. APRA provide online reports to institutions for use by senior decision makers. These reports compare the institutions performance with benchmark institutions, and are tailored to each institution and provided in a manner that is readily usable so that decision makers can make timely decisions. Adaptivity in these examples has a high-level of user intervention, but much of the adaptive functionality in data consumption/delivery systems is automated. Finally, the proliferation of consumers requiring adaptable and adaptive data contributed to complexity. This was evident in all three networks.

### **Complexity of Value Webs**

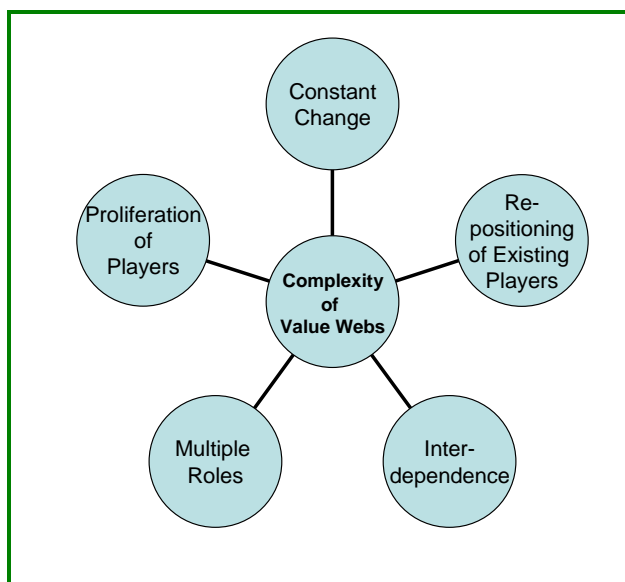
All networks illustrated increasing inter-organisational complexity. This was found to be directly related to the complex nature of data consumption described in the previous section. In particular, organisations experienced greater inter-dependency with a wider variety of network partners. A summary of the factors resulting in this complexity is shown in Figure 3.

Constant change was seen as being the dominant factor in the development of more complex value webs. In many ways the increased networking amongst participants was an effort to cope with the change as it reduced certain elements of environmental uncertainty. The 3G telecommunications environment is a very dynamic one, with a lot of uncertainty. At this point, many factors regarding players, technology and consumer adoption are largely unknown. The news industry and financial services sectors are also changing with increasing competition and regulation.

The levels of change being experienced were clearly seen to result in the re-positioning of existing players. APRA at the time of the study had just undergone major repositioning to become a federal regulator. The organisation was the result of a merger of 11 state based regulators that tended to focus on particular elements of the financial services sector rather than the whole sector. Digifone was in the process of repositioning itself. The European telecommunications sector had experienced a series of mergers and acquisitions after the deregulation of the market. In particular, management at Digifone saw the challenge as “moving up the value chain.” They stressed that mobile operators did not want to repeat the experience of those in

the fixed Internet world, where flat rate pricing and a focus on access speed resulted in ISPs becoming commodity service providers. Management were thus determined to create and aggregate (partner for) content and commerce services, and thus charge a percentage on purchases that customers charged to their phone bills.

A key characteristic of the value webs observed in this study was the high levels of interdependence between participants in the networks. Reuters noted that their internal content management issues were driven by the inter-organisational nature of such content. Reuters adopt a ‘follow the sun’ approach, in which Reuters bureaus in various locations around the world collaborate over time to follow the unfolding of related news stories. On the supply side, there was a need to co-ordinate with journalists and photographers worldwide. The content provided by these journalists / photographer ultimately had to co-ordinated with the needs of the 500,000 professional users in 52,900 client locations, in addition to the 900 Web sites that aggregate Reuters’ content for use by 50 million online users. Similarly, an important driver behind APRA’s IOS was to reduce the data provision burden on financial services institutions which found that they were providing similar, but



**Figure 3: Complexity of Value Webs.**

often subtly different, data to APRA (federal regulator), the Reserve Bank of Australia (central bank), and the Australian Bureau of Statistics.

The observed levels of interdependency were complicated by the fact that some organisations played multiple roles. Reuters experienced multi-point positioning in the value Web. They provided content to other publishers, content aggregators and re-distributors as well as providing corporate and end-user consumers. Reuters also noted this feature in relation to banks. Such institutions are important customers for Reuters as they consume vast amounts of financial data produced by Reuters. However, banks also provide some data in the form of investment reports, economic bulletins etc., which are produced as the banks aggregate the data that they receive from Reuters with data from other sources.

Finally, the proliferation of value web participants was evident in all networks. At this stage it is impossible to predict the number and nature of content providers that will compete in the 3G-application space. However, it is clear that many of these (e.g. gaming and entertainment organisations) have not previously completed in the mobile area. A similar situation is evident with online news providers, with many sites now providing aggregated content. The financial services

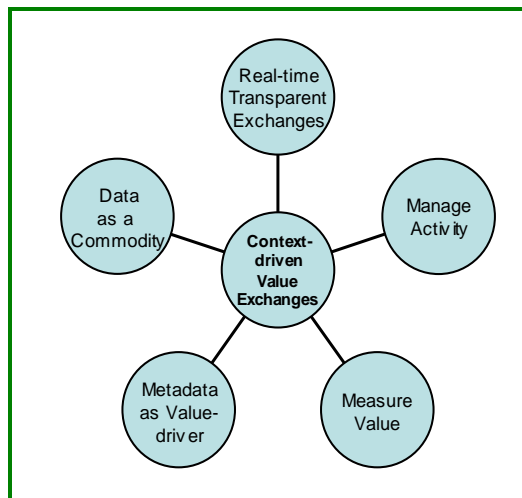
sector is much more regulated. However, increasing internationalisation of the market and institutions providing products that they have not previously offered has resulted in much more data providers for all product categories.

**Context-driven Value Exchanges**

In order to meet the demands of data consumers and to effectively participate in the value webs described in the previous sections, all three networks became increasingly involved in context-driven value exchanges. Figure 4 illustrates the key features of such exchanges.

The creation of context driven value exchanges initially manifested itself as real-time transparent exchanges. Previously we gave the example of a roaming Digifone customer buying flowers while abroad. To service this transaction, value chain participants (Digifone, SFR, Interflora etc) needed to have real-time access to each other’s data. Furthermore it was necessary that this data exchange be characterised by a high level of transparency. This transparency was required to effectively record and reward (allocate revenue to) the ‘value added’ by each participant.

In all three networks, the management of exchanges, and the effective measurement



**Figure 4: Context-driven value exchanges.**

and distribution of their value, required a high-level of attention to the context of the exchanges. For example the value of a data transfer event over a 3G network is determined not just by the size of the data chunk, but also by the type of data being transferred, its vector (download or upload), whether it is ‘pulled’ by the user or ‘pushed’ to the user through an automatic service, etc. In the media network, the context of a news object largely determines its value; e.g. is this today’s news or yesterday’s? Is there a newer image available that supersedes this one? Is this financial data in a raw form or has it been formatted for use in a desktop spreadsheet application? Etc.

To effectively participate in network exchanges, context must be visible. To make context visible, the mechanisms of exchange must support high levels of meta-data (data about data) markup. As discussed in the next section, XML was identified as the appropriate tool for implementing meta-data rich systems. On a higher level, the more important finding is that the value of data – be it wireless content, news media or regulatory reporting – was seen to be increasingly dependent on the effectiveness of meta-data to capture the context of exchanges.

### Commoditisation of Information Technology

To support the emergence of a system of context-driven exchanges, it was necessary

to implement an IT infrastructure in each network. All three networks engaged in multi-lateral development efforts and, increasingly, IT was being treated as a commodity, with participants competing on the basis of the value delivered on the platform, Figure 5 illustrates the primary aspects of this concept.

In all three cases, development efforts began at the organisational level, and with a focus on integration. Reuters sought to develop enterprise-wide systems to more effectively handle the approximately 14,000 headlines (26 languages), 1,000 pictures and 23 hours of broadcast quality video which they produced and distributed each day. APRA’s initial development goal was to integrate the legacy systems inherited from its eleven predecessor agencies. Digifone was initially concerned with internal integration to cope with billing challenges.

The pressures of increasingly networked markets and value webs, and the consequent need for context-driven exchanges, meant that such internal solutions were ultimately limited in value. The problems faced by Reuters, APRA and Digifone were not idiosyncratic to a particular organisation. They were industry wide problems, which required industry wide solutions. In each case, the international data format standard called XML (eXtensible Markup Language) was seen as the enabling technology for developing IOS

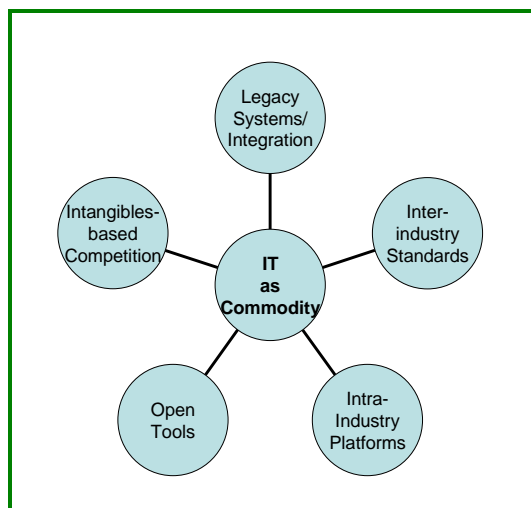


Figure 5: Commoditisation of Information Technology.

solutions to support the network. These solutions were thus doubly reliant on open standards. All three networks utilised an inter-industry standard (XML) but each network specifically utilised an (open) intra-industry ‘vocabulary’ of XML (NewsML, XBRL and IPDR), and were cooperatively developed by several parties in the networks.

In addition to collaboratively developed standards, the infrastructures in the three networks were frequently characterised through the collaborative development and sharing of tools – thus lowering the technical barriers for all network partners. Some of these tools were proprietary in nature but shared, for use by network partners, without cost. Other tools were released under Free Software (or Open Source Software) licenses, which meant that not only could the tools be freely used, but also freely modified at the source code level, and freely redistributed (in modified or unmodified form). The NewsML toolkit, initially developed by Reuters, is an example of this.

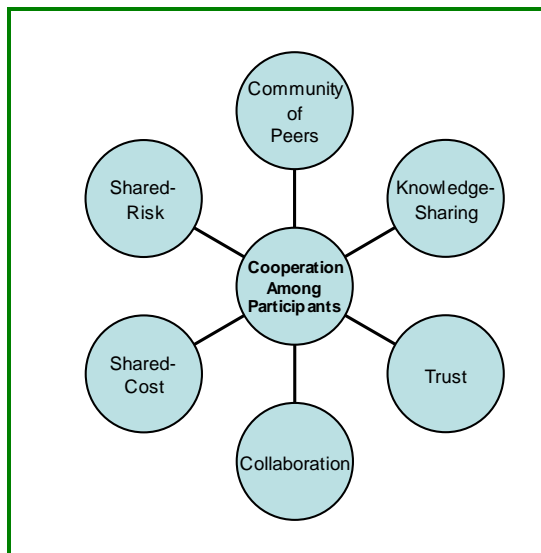
The existence of an IOS infrastructure based on open standards and exploited with shared tools marked a shift in thinking about the information technology. Increasingly, IT was seen as an enabling or ‘hygiene’ factor, and was treated, essentially as a commodity, not as a source of competitive advantage. Such

advantage was instead driven largely by intangibles – competence in managing network relationships and meta-data rich data sets, the (unique) innovative use by single organisations of the shared infrastructure, etc.

**Cooperation among Value-Web Participants**

As noted in the previous section, the development of inter- and intra-organisational standards, and the exploitation of these standards through the implementation of IOS infrastructure, led to extremely high levels of cooperation and collaboration among network participants, thus resulting in the development of new business interdependencies. Figure 6 illustrates the key features of this trend towards cooperation.

In all three cases, the development of IOS began with organisational participation within a community of peers. Reuters brought the concept of NewsML to the IPTC (International Press and Telecommunications Council) who then led the multi-organisational collaborative development of the vocabulary. They did so, driven by the realisation that “today’s world is perhaps a bit less amenable to having standards dictated from a single organization” – and that the industry-wide adoption of NewsML required both an



**Figure 6: Cooperation among value-web participants.**

industry-wide sense of ownership and trust in a neutral party (IPTC). Similarly, IPDR.org, an open consortium of equipment vendors, system integrators, billing and mediation vendors and service providers, develops IPDR. XBRL is likewise developed by global and regional consortia comprised of technology companies, financial service providers and professional accounting bodies, and the APRA initiative that was researched was the result of collaboration between APRA, Reserve Bank of Australia and the Australian Bureau of Statistics (each organisation represented in the 'tripartite data committee' (TDC) which led the initiative).

Membership in these communities was not passive; rather there were high-levels of communication and knowledge sharing between organisations, mediated by groups like the IPTC, IPDR.org, XBRL International and the TDC. Sustained levels of communication and shared goals led to higher levels of inter-organisational trust, even among competing parties. This in turn supported the (necessary) collaborative development process that led to the implementation of the IOS infrastructure discussed in the previous section. The importance of such collaboration is not limited to the value and network efficiencies enabled by the IOS infrastructures. Returning to the notion of IT as a commodity, the shared ownership of a common platform resulted in shared (and therefore minimised) short term costs and longer term risks.

## CONCLUSIONS

This study responds to need identified by researchers such as Hong (2002) and Howard, Vidgen and Powell (2003) to update our current conceptualisations of IOS in the context of emerging global environments. This study contributes to this update process by exploring the inter-organisational environments facilitating the development of IOS in business networks that have not been traditionally associated with IOS research. The findings illustrate the importance of five issues; the complexity of data consumption, the complexity of value webs, the context-sensitive nature of value exchanges, the commoditisation of IT, and co-operation amongst value web participants. It is clear that

these issues are affected by the interdependency supported by the IOS.

The 3G network case was an illustration of an IOS designed to support pooled interdependency. Network participants were varied, with many having no previous business relationship. Such networks are invariably complex as new business models are implemented between participants. In such instances the need to standardise data requirements is clear so that participants can interact with each other. Such complexity can be reduced by the adoption of a standard-based IOS. Participation requires adoption of the standard so that the IOS can be exploited by individual participants. In such cases, co-operation amongst participants may be helped by the involvement of a neutral third party such as a standards interests group. In this way co-operation is achieved to develop the IOS, but individual participants are free to exploit it as they see fit later.

Sequential interdependency IOS, such as the APRA case, generally consist of organisations with an existing business relationship. Our study revealed that sequential interdependency networks exhibit least variety amongst participants due to the 'value chain' nature of the interaction. Emerging sequential IOS may focus on providing more customised data for participants, as participants demand more integration with their internal information needs and greater exploitation of existing systems. Our study illustrates that the data-design process is likely to reduce complexity as participants have to agree on data definitions, usage etc. in an attempt to agree and implement industry (or sectoral) practices. Co-operation may be improved by the creation of a participant body, such as the Tripartite Data committee (TDC), to harmonise requirements.

Reciprocal IOS are the most complex as they have varied participants that require large degrees of customised data. Rather than reducing complexity, a standard-based IOS may help participants manage the complexity better. The NewsML experience illustrates the prevalence of network externalities in the development of reciprocal IOS. Thus, developers and champions should be aware

that their efforts are unlikely to be a source of revenue or of comparative advantage. To exploit their investment, IOS champions need to identify ways of exploiting the competencies that they acquire during the development process. Co-operation is improved under such circumstances if an industry body, such as the IPTC, can co-ordinate adoption.

To conclude, we propose an update to our current conceptualisations of IOS by illustrating and extending the work of Kumar and Van Dissel (1996) as shown in Table 3. This table categorises IOS by type of interdependency, and summarises the associated complexity, context, commoditisation and co-operation issues.

The table illustrates how different types of inter-organisational dependency affect:

1. participants’ needs for standardisation and customisation,

2. the role of IOS in dealing with the complexity of value exchanges,
3. the use of a commoditised IOS, and
4. the establishment of participant co-operation.

In viewing this table it is important to note that the methodology utilised for the study was exploratory, and thus the findings need further investigation. This study should be duplicated as part of the process of validating its findings in a context that is not just exploratory. In particular, further research is needed to replicate the study in a wider variety of networks. Nevertheless, the study has provided empirical evidence of such systems, and is a useful basis for further study.

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**Table 3: Proposed Extension to Kumar and Van Dissel’s (1996) IOS Framework.**

	<b>Pooled Interdependency IOS</b>	<b>Sequential Interdependency IOS</b>	<b>Reciprocal Interdependency IOS</b>
<b>Complexity of Data Consumption and Value Webs</b>	Varied participants. Standardisable needs.	Less varied participants. Large degree of customisation.	Varied participants. Large degree of customisation.
<b>Context of Value Exchanges</b>	Complexity reduced by adoption of standards-based IOS.	Complexity reduced by design of standards-based IOS.	Handling of complexity facilitated by adoption of standard-based IOS.
<b>Commoditisation of IT</b>	Adopted and exploited by individual participants.	Used to implement accepted industry practices	Exploited due to network externalities.
<b>Co-operation amongst participants</b>	Buy-in to neutral 3 <sup>rd</sup> party body (e.g. IPDR.org) to co-ordinate development.	Specifically created body to harmonise stakeholder requirements (e.g. TDC)	Industry body to co-ordinate adoption by peers (e.g. IPTC)

<sup>1</sup> IOS have been based on dyadic links; thus requiring systems to be established to integrate the operations of every pair of organisations in a network.

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