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Abstract

Inter-organisational systems (IOS) have traditionally been characterised as EDI-based 'hub and spoke' models such as those connecting grocery retailers or large manufacturers with their suppliers. Increasing environmental complexity and technological innovation have led some organisational networks to explore more dynamic IOS models. This paper investigates emergent IOS models in three data intensive industry sectors (telecommunications, news media, and financial services). The findings illustrate that the complexity of data consumption patterns is driving increased interdependence within value webs requiring the co-operative development of context sensitive value exchanges and commodity-like IOS infrastructures.

1 Introduction

New development in IT and electronic business pose a significant threat to traditional business models. Such developments affect both how organisations relate to external parties (customers, suppliers, partners, competitors, and markets), and how they operate internally in managing activities, processes, and systems (Rayport and Jaworski, 2001). Timmers (1999) sees new business models emerging from linkages between elements of the value chains of different organisations. Such linkages are often implemented as inter-organisational systems (IOS). Traditional EDI-based systems implement linkages between purchasing and sales in independent organisations. More recent IOS focus on a broader range of value chain activities such as R&D, marketing etc. Emerging IOS, based on open standards such as Extensible Markup Language (XML), will need to support more complex interdependencies. However, empirical research on such systems is sparse.

The paper discusses the use of IOS to support more complex inter-dependencies, and how emerging technology is facilitating such systems. The next section presents the theoretical grounding for the study. This is followed by a consideration of the research method employed and a presentation of the study findings. The paper concludes that the complexity of data consumption patterns is driving increased interdependence within value webs requiring the co-operative development of context sensitive value exchanges and commodity-like IOS infrastructures.

2　Inter-Organisational Systems And Emerging Technology

The potential of inter-organisational co-operation has been advocated since the 1960s. Since then, a number of researchers have argued that an organisation should link with others in order to cope with its environment and reduce environmental uncertainty, (e.g. Kaufman, 1966; Van de Ven, 1976; Provan, 1982; Borman, 1994). "Inter-organisational systems (IOS) are multi-user information systems that are built for a certain purpose, for example, for carrying out formal and structured operative activities like purchasing and order handling. To cover all relevant inter-organisational information transfer between organisations, some less formal applications are included in the concept of inter-organisational information systems…For example electronic linkages that are created through general communication systems or that are not built for a specific purpose" (Kuula, 1995).

Early inter-organisational systems (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; Subramani, 2004). In addition, they reduced environmental uncertainty by facilitating communication and providing information (Henderson, 1990; Scala and McGrath, 1993). Finally, they affected the competitive positioning of organisations by encouraging closer relations with suppliers and customers (Cash and Konsynski, 1985; Swatman and Swatman, 1992; West, 1994; Siau, 2003). 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 will be inadequate, especially when business processes have to be altered (Finnegan *et al.*, 1998; Axelsson, 2003).

Hong (2002) proposes that IOS can be configured in three ways; one-to-one (e.g. buyer seller system), one-to-many (e.g. marketing or purchasing system), or many-to-many (e.g. electronic market). Kumar and Van Dissel (1996) propose an IOS topology that categorises systems according to the level of organisational interdependency they facilitate. Importantly, Kumar and Van Dissel (1996) recognise that inter-organisational structures, and the design, implementation and operation of IOS are inter-dependent. This means that organisational structures affect systems choices rather than the traditional view that technology affects structures only.

Emerging technologies are seen as changing the nature of inter-organisational systems (Gebauser and Shaw, 2002). In particular, 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 (Lowry and Neumann 2001). XML has been identified as a disruptive technology in at least three key areas; EDI, Enterprise Application Integration (EAI) and content management (particularly in heterogeneous client environments) (Goldfarb and Prescod, 2001). XML requires organisations to develop specific vocabularies in order to exchange information. Such vocabularies tend to be industry specific, and their development must deal with complex

inter-organisational dynamics (Nunes, 2000). Complexities that arise when activities cross organisational boundaries include: changes in business competencies and priorities; changes in ones' sense of identity and sense of common purpose; an increased need for co-operative effort for establishing targets; the synchronisation of differing accounting, measuring and reward systems; and the establishment of trust (Ashkenas *et al*, 1995).

Much of the research on inter-organisational systems and business models has concentrated on well-established technology that has been implemented in simple supply chains (e.g. retailer and supplier) (Siau, 2003). Emergent technology such as XML presents a potential solution to the dynamic communication and collaboration needs of more complex business webs (Gebauser and Shaw, 2002). However, the use of XML to support new inter-organisational business models has received little empirical attention. In particular, while studies such as Nelson (2002) have addressed factors influencing co-adoption, the development and use of emerging XML-based IOS has not been extensively studied.

3   Research Method

This study explores the use of XML-based IOS in dynamic inter-organisational settings. Corbitt (2000) advocates the need for interpretative methods in studying IS issues, especially in inter-organisational electronic business environments. Interpretative studies focus on developing a greater understanding of social aspects of the research environment (Walsham, 1993), and are thus considered useful in the context of this study. Case studies are regarded as the most commonly used qualitative research method in IS, and are especially useful for studying organisational aspects of IS (Benbasat *et al,* 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 *et al*., 1987). Cases are most appropriate when the objective involves studying contemporary events, without the need to control variables or subject behaviour (Yin, 1994). The method is considered to be a potentially rich and valuable source of data, while suited to exploring relationships between variables in their given context (Yin, 1994; Benbasat *et al*., 1987). Given the exploratory nature of this research and the need to obtain rich data in complex inter-organisational contexts, a case study approach is adopted.

Case studies were chosen to give diversity in the nature of inter-organisational networks rather than any preconceived notion of best practice. The researchers first conducted a thorough archival search to determine the existence of public domain material on each organisation. 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, the researchers prepared a case study protocol as defined by Yin (1994), and sent it to the contact person within each organisation. Based on this protocol, interviews were arranged with key personnel. These interviews were conducted during between February 2002 and March 2003. In addition to interviews, the researchers were also given access to relevant documentation and system demonstrations. The interviews were followed by several conference calls with the contact person in order to clarify issues and confirm the accuracy of the data collected.

The data was analysed using methods developed by grounded theory researchers. The first step is referred to as '*open coding*' by Baskerville and Pres-Heje (2001) or '*categorisation*' by Dick (2002). Operationally, this 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 is referred to as '*axial coding*' by Baskerville and Pres-Heje (2001), and '*memoing*' by Dick (2002). This is the process of determining hypotheses about the relationship between categories. Once the researchers 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 categorises and relationships. According to Baskerville and Pres-Heje the final step of '*selective coding*' is the process of determining the core category. The core category is that category that is mentioned most frequently and is usually connected to most other categories.

4   Findings

4.1   Case Environment

Digifone was established as Esat Digifone in Ireland in 1997. After a series of share purchases, British Telecom (BT) acquired 100% of Digifone in April 2001. In November 2001, Digifone, as part of the mmO2 set of companies, completed a de-merger from British Telecommunications PLC and devised plans to re-brand as O2. By early 2002, the mmO2 businesses served 16.5 million mobile customers in the UK, Germany, Ireland, the Netherlands and the Isle of Man. The group's mobile businesses in these countries were all wholly owned and together covered territories with a total population of over 160 million people. The research focuses on the role of an XML vocabulary, IPDR, in facilitating next generation mobile services.

Reuters was founded in 1851, and has grown into the one of the world's largest and most successful news and financial information organisations. The company has over 16,000 employees in 220 cities in 94 countries, declared GBP3.6 billion in revenues for 2002, and services nearly 500,000 professional users in 52,900 client locations. 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. This research focuses on the XML vocabulary, NewsML, within the news media sector.

The *Australian Prudential Regulation Authority (APRA)* was established on 1 July 1998 as part of the Australian Government's drive to establish a stronger regulatory regime in the financial services sector. APRA's task is to prudentially supervise 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 focuses on the development and use of XBRL-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).

4.2   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 1.
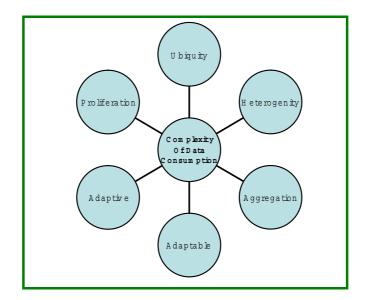

Figure 1: *Complexity Of Data Consumption*

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.

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 has 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, and was evident in all networks.

4.3   *Complexity Of Value Webs*

All networks illustrated increasing inter-organisational complexity. This was found to be directly attributable 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 (see Figure 2).
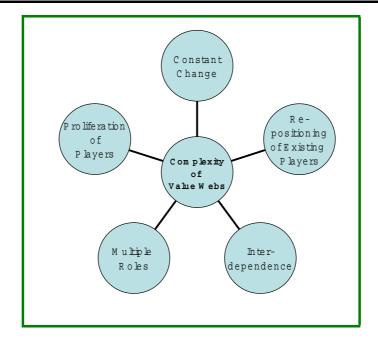
Figure 2: *Complexity Of Value Webs*

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. On the supply side, there was a need to co-ordinate with journalists worldwide. The content provided by these journalists ultimately had to be 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 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.

4.4   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 (See Figure 3).
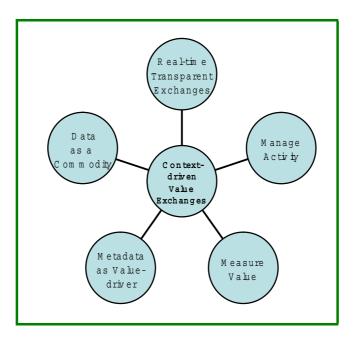

Figure 3: *Context-Driven Value Exchanges*

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 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.

4.5   *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 (See Figure 4).
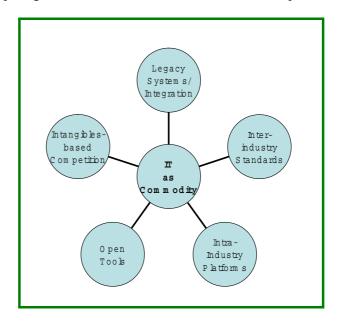

Figure 4: *Commoditisation Of Information Technology*

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 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). These industry-specific XML vocabularies were developed multi-laterally (as discussed in the next section).

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.

4.6   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 (see Figure 5).
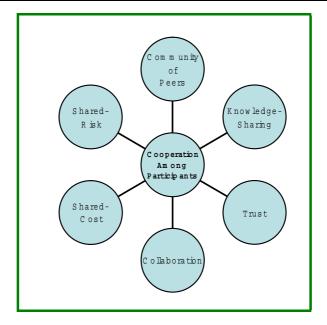
Figure 5: *Cooperation Among Value-Web Participants*

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 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, with shared ownership of a common platform came shared, and therefore minimized, short term costs and longer term risks.

4.7   Summary And Analysis

A summary of the study findings is presented in table 1. The analysis, as shown in figure 6, reveals that in each case, (1) the increasing complexity of data consumption was the

initial driving force behind the network activities. This, in turn, drove (2) the increasingly complex relationships that were evident in the three inter-organisational environments (value webs). In order to meet the demands of data consumers, and in order to effectively participate in such value webs, (3) context-driven value exchanges were required. To support these exchanges, it was necessary to implement an IT infrastructure for the value web. This infrastructure was not seen to bestow any advantage on individual participants. Rather (4) the IT platform was seen to be a commodity, with participants competing on the basis of the value delivered on the platform. The design and implementation of such a platform required (5) high levels of co-operation between participants, and resulted in the development of new business interdependencies.

Table 1: *Summary Of Study Findings*

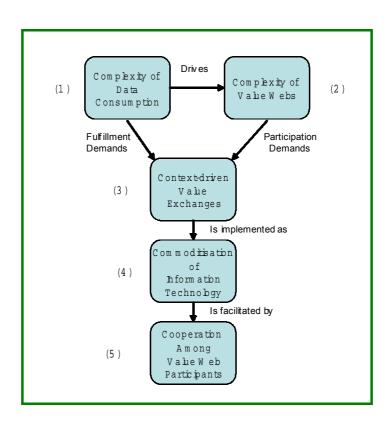|	**Digifone**	**APRA**	**Reuters**
Complexity of Data Consumption and Value Webs	Varied participants. Standardisable needs.	Less varied participants. Large degree of customisation.	Varied participants. Large degree of customisation.
Context of Value Exchanges	Complexity reduced by adoption of standards-based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

Figure 6: *Analysis Of Study Findings*

5   Conclusions

This study utilised an exploratory methodology to study emerging XML-based IOS operating in dynamic environments. The findings have revealed a much more co-operative approach to IOS implementation than was evident with earlier IOS such as those studied by Webster (1995). Such co-operation is in line with the thinking of Finnegan *et al.* (1998) and Axelsson (2003) regarding the need for IOS implementations to become more co-operative in order for more complex systems to be adopted. This may be explained by the apparent change in IOS focus from competitive weapon to competitive necessity, with the proprietary applications that exploit the IOS infrastructure being seen as the competitive weapon. Nevertheless, it is not evident that these changes can be attributed to changes in strategic thinking amongst IOS proponents, but rather a realisation that IOS built on emerging technology such as XML requires a much more co-operative approach to its development. Overall, it must be acknowledged that the results of the study are tentative due to the exploratory nature of the study. Nevertheless, the study has provided empirical evidence of emerging IOS, and a basis for further study.

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