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AN EMERGING VISION OF INTERNET-ENABLED SUPPLY CHAIN ELECTRONIC COMMERCE

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ABSTRACT

Increasingly, large retail companies are finding that the traditional vision of Electronic Data Interchange using a Value Added Network with expensive message translation software and private wide area networks, is unable to deliver its promise of paperless trading with their suppliers. While many have achieved a high level of EDI compliance from large suppliers, many unsophisticated, usually small, suppliers remain outside their electronic commerce network creating a barrier to achieving the most important business re-engineering benefits which require 100% compliance. Many large retailers are turning to the diverse range of Internet-based document distribution and presentation systems which have recently appeared to provide new ways of including unsophisticated traders in their replenishment systems.

In this paper we argue that the traditional EDI vision emerged through the interaction of a number of aspects of the replenishment problem context, namely available technology, transaction cost structure, the power of message transmission intermediaries, notions about how to achieve supply chain cooperation, and the shared understandings of correct electronic commerce practice within the industry. The traditional EDI vision achieved only partial supply chain compliance because it failed to take account of the essential differences between sophisticated and unsophisticated trading partners. We argue that the effect of the commercial availability of the Internet is greater than simply the provision of a cheaper alternative document transmission channel: its appearance has disturbed the balance among these contextual forces to allow the emergence of a new vision of supply chain electronic commerce featuring a backbone any-to-any network of EDI compliant, technologically sophisticated trading partners, with large-player-centered or third-party-centred Internet based sub-networks providing connection to unsophisticated traders using proprietary software, development tools and message formatting.

KEY WORDS AND PHRASES: Internet, electronic data interchange (EDI), supply chain management, small to medium size enterprises (SMEs), intelligent gateways.

1. INTRODUCTION

Many large retail companies have enthusiastically pursued Electronic Data Interchange (EDI) with their suppliers for the reduced transaction cost, increased accuracy, and timeliness that it offers [12,15]. Many have even reached the stage where a large proportion of their replenishment transaction value is controlled by EDI. But the familiar Pareto principle applies: 20% of their suppliers, by number, account for 80% of the transaction value. Thus, a large proportion of suppliers by number, usually small to medium-size enterprises (SMEs) supplying small ranges of products, remain outside the electronic replenishment system. These suppliers often lack the technical sophistication and resources to implement EDI through the traditional approach using the services of a Value Added Network (VAN), expensive translation software usually provided by the VAN, and private wide area networks [11,17,19,21]. Furthermore, with relatively simple business operations and a small number of trading partners, they have little to gain from the integration and connectivity that EDI offers [17]. This makes it difficult for the large customer to achieve 100% EDI compliance resulting in them supporting both electronic and paper based systems which in turn creates a barrier to the implementation of advanced supply chain and logistics management and payment settlement techniques. Evidently, the traditional EDI vision of supply chain electronic commerce has not been adequate in achieving 100% supply chain electronic commerce compliance.

The large EDI players with the most to gain from 100% compliance are increasingly looking to the Internet as a means to solve this problem. The Internet is a world-wide network of networks with excellent throughput capabilities. Internet transmission charges are low compared to those of a VAN and do not depend on the amount of data transferred. More importantly, the Internet provides simple and widely understood new methods for information exchange [10,13]. Non-EDI-enabled trading partners can use a web browser to fill in a form-based web page representing a business document, in order to comply with their EDI-enabled trading partner's information requirements. To access the Internet, they need only a personal computer, a modem and an Internet Service Provider (ISP). They require little more computer expertise than is now becoming common knowledge. The new cost

structure, the new means of digital document presentation, and a global market for new software products afforded by the Internet has led to the development of a large number and wide variety of new products and services for the distribution of business documents between trading partners over the Internet, many of which are specifically targeted to the inclusion of unsophisticated trading partners in the electronic commerce network. Large EDI players are now able to use these new Internet-based products to leverage their investment in traditional EDI through the benefits afforded by 100% supplier compliance [1,18].

In this paper we argue that a new vision of supply chain electronic commerce has emerged which explicitly recognizes the existence of and caters for, the unsophisticated trading partner in the retail supply chain as well as large sophisticated trading partners to which the traditional approach appealed. We argue that the traditional EDI vision of supply chain electronic commerce came about as a solution to the constraints provided by a number of interacting aspects within the context of the replenishment business problem and its solution. These include the available technology, the power of intermediaries, the transaction cost structure, notions about supply chain co-operation and politics, and shared industry understandings about acceptable electronic commerce practice. Through their interaction, these contextual forces have strongly constrained the technological and interorganizational solution. The appearance of the Internet with its new cost structure, new development tools, and new products has upset the balance of these contextual forces through their mutual dependence and has resulted in the emergence of richer conception of the electronic commerce network. The new network will feature a backbone of trading partners and intermediaries providing traditional application-to-application functionality and any-to-any connectivity to technically sophisticated trading partners while incorporating large-trading-partner centered or third-party centered sub-networks to meet the needs of unsophisticated smaller trading partners. The commercial availability of the Internet as a new digital document distribution medium is the enabling technology for this change, but it is not simply that the Internet is replacing expensive private wide area networks. The new vision is based on new attitudes to the power of large players to induce small players to comply with electronic commerce, new modes of

digital document delivery, new cost structures, a new recognition of the differing characteristic of sophisticated and unsophisticated trading partners, and, we predict, new attitudes to the role of EDI standards.

We begin in section 2 by summarizing the results of a comprehensive survey and analysis of 50 Internet-based supply chain electronic commerce products [16,17] and services which allow us to make some observations later in the paper about the new role of intermediaries, new attitudes to traditional EDI standards, and new forms of functionality and connectivity which are embodied in the design of the products and services. We then present a case study of the efforts of Australia's largest retail chain to solve the problem of achieving 100% electronic commerce compliance of their suppliers. This serves to illustrate the problems caused by non-compliant small traders, the inadequacies of the traditional EDI solution, and presents one possible state-of-the-art solution to this problem that typifies the new approach. In section 4 we present a theoretical analysis of how the traditional EDI vision emerged as a result of the interaction between a number of aspects of supply-chain replenishment, and in section 5, why it failed to deliver 100% compliance. We then analyze in section 6 the way in which the commercial availability of the Internet has changed the balance of these forces to allow the emergence of a richer, more realistic vision for supply chain electronic commerce.

2. THE NEW INTERNET-BASED APPROACHES TO DOCUMENT EXCHANGE

In technological terms, the Internet provides a global network of networks with both high throughput capabilities together with very low data transmission cost and flat-rate pricing. Its various transmission protocols are highly standardized making it globally transparent. Internet Service Providers (ISPs) are now providing many of the services formally provided by VANs, such as store-and-forward mail boxes. But most importantly, the Internet community is providing new mechanisms for data transmission and presentation that are rapidly becoming widely used, understood, and highly standardized. These tools (for example HTML, XML, Java applets, Active X controls) are creating new ways of presenting business documents to technologically unsophisticated users, which require minimal hardware (a PC and modem) and minimal software (often just a standard web browser) to use.

The new potential offered by the Internet as a medium with new development tools, coupled with a global market for the new products, has lead to a large number and diversity of products and services purporting to support "EDI" over the Internet which can be shown to represent a number of alternative strategies for digital document delivery appropriate to a wider variety of trading partner capabilities. These products and strategies have been previously reviewed in detail by the authors in [16,17] where a classification of 50 specific products can be found.

These new Internet-based supply chain electronic commerce products and services can be differentiated along two dimensions [17]. The first is whether they make use of third-party Internet-based digital document handling service providers (Internet Value Added Networks, IVANs), or whether they provide software or infrastructure tools to allow large traders to create their own electronic document distribution solutions. Secondly, they differ in their use or non-use of traditional standards for message formatting. Products that allow for uncoordinated selection of the message handling software by separate trading partners generally use traditional EDI messages. However, many of the new products require the trading partners to use proprietary software products or software development environments at both ends, often using client-server technology and hub-spoke topology, and therefore often use proprietary messages or web standards for the document exchange. Some of the new products types include:

1. Products that interface to applications through flat-file exchange using traditional standards-based message mapping, but use the Internet as the transport layer. These products mimic the conventional approach, but because the Internet is already capable of any-to-any transfer, these products threaten to bypass traditional VANs.
2. Internet-based third party EDI services, often run by the traditional VANs, that effectively export the traditional VAN concept to the new medium. These IVANS attempt to add traditional forms of value to the document exchanges, such as secure mail-boxes, control measures, gateways to other traditional VANs, plus new value such as support for non-standard transmissions, for example FAX and web-forms.

3. Development environments and products that allow large trading partners to design custom electronic document exchange systems tailored to the unsophisticated needs of their small trading partners. Document distribution options include: web-servers at the large trading partner site that can be accessed by a standard browser, and proprietary-client server environments which allow tailored front-end document presentation software to be provided to unsophisticated trading partners.

4. "Intelligent gateway" products that allow large trading partners to route electronic documents to or from their applications to a variety of trading partner types, using a variety of media including private networks, the Internet, and FAX, and using message formats appropriate to the functional capabilities of the trading partners. These products give to large players who can afford the development cost, the same mixed-media functionality that the IVANs offer as third parties to smaller trading partners.

5. Internet-based third party sites that enable trading partners to exchange documents entirely using web forms. These are designed for exchanges between unsophisticated trading partners or to allow wide participation of unsophisticated traders in such things as government tenders.

3. CASE STUDY

We now present a case study which illustrates the difficulties faced by large retailers in achieving 100% compliance of their suppliers to electronic commerce, the operational and tactical problems this causes, and one company's state-of-the-art proposal to use some of these new Internet-based products to solve the problem. Further details of the research methods used, which included interview-based case study and participation in evaluation and development of a "proof of concept" prototype system, together with greater detail of the system design and operation can be found in [18].

3.1. Coles Myer Limited

Coles Myer Limited (CML) is Australian owned, and is the largest retailer in Australia. CML's head office is located in Melbourne, Victoria, and operates eleven retail brands over 1,800 stores in Australia and New Zealand, including Coles, Bi-Lo, Myer Grace Bros, Myer Direct, Kmart,

Target, Fosseys, Liquorland, Red Rooster, Katies and Officeworks. It is Australia's largest non-government employer with over 148,000 staff, and annual sales of over $A19 billion ($12.5 billion). CML spends over $A15 billion ($10 billion) each year on buying merchandise and services [6]. It has more than 15,000 suppliers (including merchandise and service suppliers): 1,800 suppliers use the traditional EDI approach, while the rest use conventional paper-based document processes via regular mail, phone calls or fax, to exchange business data with CML.

Recognizing that there is a significant investment in traditional VAN-based EDI with large suppliers, and also significant barriers to drawing small suppliers into this network, CML proposed an "intelligent gateway" between its own diverse systems platforms and its suppliers, which would allow flexible routing of electronic documents via various media (private VAN networks, Internet, Fax, direct lines) using various formatting standards (traditional EDI standards, flat-files, web forms, etc.), based on supplier characteristics. An Internet-based document exchange system for use by small suppliers with little IT experience and at minimal cost to them represented an important element of this new proposed system. Their idea was to use the Internet-based system not to replace the existing system, but rather, to leverage the investment in existing systems with the benefits of near 100% supplier EC compliance. With the proposed new EDI infrastructure, CML could to handle all their merchandise suppliers (approximately 10,000 suppliers) through a single centralized electronic commerce system.

3.2. CML's Current EDI Infrastructure

CML has various business applications for different retail brands, running on different system platforms. Different types of suppliers require different message formats. For example, EDI-enabled suppliers require EDI formats, and non-EDI-enabled suppliers require paper-based formats. CML uses multiple EDI translators to translate the various types of flat files generated by their in-house business applications into EDI formatted documents, and to transmit the formatted data to their EDI-enabled suppliers on a store-and-forward basis via a third party VAN. For their non-EDI-enabled suppliers, CML has to run a parallel manual process to exchange paper-based business documents. A typical document exchange process in the manual system is that CML sends a purchase order to their non-EDI-

enabled supplier by regular mail or via fax. That supplier then sends back a manually prepared delivery docket. CML then manually enters the data from the delivery docket into their in-house receiving application. Figure 1 shows the current EDI infrastructure for CML.

{Insert Figure 1 Near Here}

3.3. Problems with the Current EDI Infrastructure

Since CML needs to use a manual system to exchange business documents with their non-EDI-enabled suppliers, they have to re-enter delivery dockets sent from these suppliers into their in-house business applications. This delays the business process and has the potential to increase document processing errors. Besides supporting the manual system, CML uses a number of different EDI translators for their various types of business applications. Therefore, they cannot use a single EC/EDI system to manage data exchange centrally with all their suppliers.

Small suppliers lack the technical, financial and human resources to develop a traditional EDI system to handle all the functionality that CML requires. According to CML's Electronic Trading Coordinator, the conventional VAN-based EDI development cost for small suppliers, including the costs for purchasing and EDI translator and communication software, is in the range of $A5,000 to $A20,000 ($3,300 to $14,500). Transferring 10 kilobytes of data via a VAN might cost an SME, at list price, $A4 ($2.60) per document, plus a $A100 ($66) monthly VAN subscription fee. While these costs may be justifiable for a larger supplier who can gain mutual benefit from the investment, small suppliers generally have primitive in-house business systems (often manual) and cannot use the potential benefits of application-to-application transfer of data which the traditional VAN-based EDI approach promises, to justify the decision. With very few customers, they also gain little from the global connectivity of traditional EDI. Therefore, the cost and lack of supplier benefits has been a large barrier to CML bringing their small suppliers into their EC network within the traditional VAN-based EDI approach.

Using the manual system, it is very difficult for CML to obtain high standards of data integrity for the delivery dockets received from small suppliers. Small suppliers can alter the ordered quantity,

price, or even the ordered item on the purchase order, intentionally or by mistake, when they are manually preparing a delivery docket. For CML, this may cause internal system accuracy problems, increased costs and business disruption.

While small suppliers may not create significant transaction value, their use of manual systems tends to make it difficult for CML to reap the potential benefits of advanced supply chain reforms. With the manual system, stock cartons delivered to CML's main distribution center must be manually verified and entered into the computer system at the distribution center before they can be delivered to other stores. With a fully computerized system, the details of the delivered stock could be updated into the computer system automatically once an electronic Advance Shipment Notice (ASN) is received. Using the EAN standardized Serial Shipping Container Code (SSCC), each carton can be given an unique bar coded shipment number, which associates it with an ASN. By scanning this bar code, CML can re-direct a specific carton into an appropriate truck, shipping to a specific store, without manual intervention in their carton sortation process at the distribution center. This process is known as "cross docking". For it to work effectively with SSCC numbers as shipping labels, 100% adoption to electronic ASNs would be required. Electronic ASN compliance is also prerequisite to using the Evaluated Receipts Settlement [9] systems which eliminates supplier invoices.

3.4. Business Requirements for New EDI Infrastructure

Because CML and their EDI-enabled suppliers have invested large amounts of money and are obtaining good benefits from their traditional EDI systems, they want to retain traditional EDI operation for these parties. Moreover, a large volume of stock and sales data is being processed by the traditional EDI systems, which might not easily migrate into other EDI or EC infrastructures. The VAN-based approach may well be the most efficient and cost effective way of reliably transferring mission-critical application-to-application data anyway. Instead of using multiple EDI translators, CML is seeking to use one centralized system to perform data translation, while maintaining trading partner profiles and supporting multiple transmission media such as the Internet, VAN, direct connection, and fax.

Since most of the small suppliers have no use for the application-to-application EDI approach, CML is offering alternative methods for their small suppliers. The Internet provides a medium for transferring data at a very low cost. According to the CML's Electronic Trading Coordinator, the incremental cost of transferring a 10 kilo byte message is about $A0.50 ($0.33), which is mainly associated with the telecommunication costs, such as telephone call charge, plus typically, a $A25 ($16.50) monthly subscription fee for an Internet Service Provider (ISP). Small suppliers could use a CML-provided web-form Internet application as a data entry system, not necessarily using the traditional EDI standard format needed for application-to-application data transfer.

Based on feedback from SMEs, CML has projected that the system set-up cost for each small supplier should be less than $A500 ($330) for a manual entry system, or $A1,000 ($660) when bar code scanning facilities are also included. The monthly running cost should not be greater than $A25 ($16.50) for an Internet Service Provider (ISP) subscription plus phone calls. Assuming small suppliers have a PC, modem and telephone line, they can then simply use a web browser or a simple front-end system incorporated with a web browser and Internet connection to exchange their E-form business documents with CML.

Since the data transfers covered by the proposal exclude high-volume and mission-critical transfers, the security and reliability offered by the traditional VAN approach using private wide area networks is not a requirement of the system. Nevertheless, the security of Secure HyperText Transfer Protocol (HTTPS) using Secure Socket Layer (SSL), which enables point-to-point data transmission without storage at the ISP site, together with the password protection and document control facilities provided routinely by third-party Internet EDI development software, will provide a secure and reliable transport mechanism for these web forms and other file types, and may eventually provide a low cost alternative transport system even for standard EDI files.

CML wants to use an electronic "turnaround" document approach with small suppliers in order to achieve greater levels of integrity. CML will send a Purchase Order (PO) using the Internet EDI system to their supplier with the details of ordered items, such as product name, International Article

Number (i.e. EAN-13), product price and quantity ordered. The supplier will then send back an Advance Shipment Notice (ASN), when the shipment is ready. The front-end data entry program should only allow the user to base the ASN on shipment details data from the PO. To enhance data accuracy, a bar code reader may be used as an input device to scan the bar codes directly from the product and shipping cartons into the ASN. After CML receives the ASN, it can then automatically update their in-house business applications. The turnaround ASN data entry should have built-in intelligent data checking to validate the supplier's input, and be able to lock certain fields to prevent unintentional data entry from suppliers. This will ensure that CML receives error free ASN documents and help enable advanced distribution initiatives such as Cross Docking with only minimal inspection.

In keeping with their desire for greater data accuracy, CML expects that the ASN data will be entered by the supplier into the front-end system directly during packing, preferably using bar code scanning. To keep ISP connection cost within the specified bounds, this requirement implies that it should be possible to use the front-end data entry facility for extended periods without being connected to the Internet. Connection should only be required during document download and upload.

3.5. CML's Proposed New Electronic Commerce Infrastructure

CML's proposed EDI infrastructure adopts the "Intelligent Gateway" concept, using a central EDI gateway system to perform bi-directional any-to-any translations. The intelligent EDI gateway will accept flat file formats generated by CML's in-house business applications, and translate the flat files into various formatted messages, such as EDI formatted messages, fax-based messages, e-mail messages, and E-form messages based on their suppliers' requirements, and vice versa. The central EDI gateway system will also support multiple transmission media for transferring formatted messages to CML's suppliers, for example, the Internet, VAN, and direct connection, using a trading partner profile database to make routing and translation decisions. The proposed infrastructure is shown in figure 2.

{Inset Figure 2 Near Here}

An important part of the new infrastructure is the subsystems devoted to transferring data to small suppliers using the Internet (shown shaded in Figure 2). On the basis of their evaluation process

and “Proof of Concept” project, CML has chosen an approach which uses software from a single provider to create both the CML hub and the small supplier front-end data entry application. This allows for document exchanges not structured using traditional EDI standards, and facilitates the participation of SMEs in the EC network, without the need for them to purchase full EDI translation facilities. Given the limited requirements of their small traders, CML has chosen an Internet EDI system based on client-server technology, which was determined to be most appropriate for application-to-person system integration with hub and spoke connectivity [15]. Using this software, CML will create a centralized Internet hub server, interfacing via the intelligent gateway to existing applications, and performing the transmission and receipt of Internet business documents. Small suppliers can then use a low-cost client front-end program incorporating a web browser for document display and data entry. CML will produce customized form-based document templates using tools provided by the software vendor, and these will be distributed with the suppliers’ front-end program.

Having chosen to use a client server approach, CML has to choose between products that use so called “thick client” or “thin client” approaches. In the thin client approach, nearly all the data processing operations are performed by the server (hub) program and the client software may consist of little more than a web browser. In the thick client approach, the client program has some capability of processing the exchanged data, independently of the hub. A typical example is where the client program performs data editing without having to refer back to data stored at the hub. This would generally result in duplicate storage of data at the hub and client which is an undesirable feature of this approach. However, CML had an additional requirement that the small suppliers should be able to perform much of their data entry off-line, that is, while not connected to their ISP. This was considered necessary to limit the connection costs incurred. Consequently, motivated by the desire for high standard of data integrity, CML has chosen to adopt a thick client approach. While not a primary requirement, this choice also reserves the opportunity for suppliers to integrate their in-house applications with the front-end data entry system by re-using the local database or exporting the data from the front-end system.

A typical document exchange sequence is as follows. The CML hub system translates business documents from the gateway system into the web-form file format used for the data exchange and stores them on an Internet server part of the hub. Using the front-end provided, the supplier then retrieves these files from the CML hub through the Internet using Secure HyperText Transfer Protocol (HTTPS). The front-end application stores this data in a local database and allows it to be displayed using pre-defined templates. In the creation of a turnaround document, editing rules specified in the template will be enforced by the front-end software using data stored locally. Upon completion, the turnaround response is translated into the appropriate exchange format and transmitted back to the hub server. The gateway software then translates this data into the appropriate flat file format required by the in-house application to update the central databases.

4. HOW THE INTERNET IS CHANGING SUPPLY CHAIN ELECTRONIC COMMERCE

We now argue, based on our observations of the diverse nature of the new Internet products, the implicit assumptions that these products embody concerning the role of intermediaries and *de jure* message standards, and CML case study and others [1], that we are presently seeing the beginnings of a new era of supply chain electronic commerce which has been catalyzed by the availability if the Internet as an alternate digital document distribution channel. However, the change is not simply that the Internet is replacing privately owned wide area networks: we will argue that what has happened is that the commercial availability of the Internet, with its new solutions to data transfer and systems development has changed the balance between a number of interacting contextual factors that shape the retail industry vision of effective supply chain electronic commerce. These context factors or solution-shaping forces are:

1. The available digital document distribution technology;

2. The power and services of document distribution intermediaries and the products of software providers;

3. The economics of interoganizational message transfer;

4. The views, particularly of the large players, about ways of achieving interorganizational cooperation for electronic commerce. This dimension is largely determined by the politics of the supply chain, particularly the perceived power of large players to influence small enterprises;

5. Beliefs and dogma promulgated within the retail industry concerning what constitutes acceptable practice in supply chain electronic commerce. This dimension can be thought of as the shared understandings or culture of the industry.

{Insert Figure 3 Near Here}

These forces influence each other strongly and mutually as shown in Figure 3. The nature and particularly ownership of the technological infra-structure strongly determines the size and diversity of niches for intermediaries and product providers (1). The technology (2) and the power of the intermediaries (3) determine the cost structure (setup and on-going operation costs) of message transmission. The power of the intermediaries (4) and the available technology (5) shape industry ideas about what is acceptable EC practice, but these ideas in turn affect the diversity of legitimate electronic commerce solutions and thus the niche for alternative distribution channels and development products (6). Views about supply chain cooperation are constrained by technology (7), services offered by the intermediaries (8), transaction cost structure (9), and understandings of valid EC practice (10), but also affect the power of intermediaries (11) by controlling the diversity of possible intermediation. There may be other interactions but these are the ones used in the following arguments, which will also serve to clarify these interactions. There may be a weak influence of the other four factors upon technology development but arguably, for the Internet case, business-to-consumer electronic commerce is more influential in this regard.

A change in technology such as the commercial availability of the Internet can change the balance of these forces through their multiple interactions to produce a new vision of supply chain electronic commerce. We will first consider the nature of this balance in the pre-Internet, or “traditional EDI” era of supply chain electronic commerce.

5. THE TRADITIONAL EDI VISION OF SUPPLY CHAIN ELECTRONIC COMMERCE

The digital document distribution technology of the traditional EDI era was a network of wide area networks, which were largely privately owned, connecting sites using diverse upper-range (mainframe and mini) platforms [14]. Although direct connection between trading partners via the Public Switched Telephone Network or the Integrated Services Digital Networks of the local common carriers was a technical possibility, it was not a viable solution for a vision of any-to-any trading partner connectivity. A strong niche therefore arose for those who could provide store-and-forward distribution hubs (Value Added Networks or VANs) and this niche was taken up principally by the owners of the wide area networks. They were relatively few in number and thus their services were expensive and their products had little diversity.

The prevailing notion of supply chain relations was that critical mass participation in EDI could be achieved through mutual benefit or by coercion from the large players, and that the achievement of critical-mass participation would lead to 100% EDI compliance [8, p26,20,22]. Best industry practice as espoused by technical and trade writers [7,14] was the adoption of international standardized messages that would be translated by message mapping programs which, by virtue of the message standardization, could be sourced by trading partners independently. This non-dependence on trading partner coordination was essential to the vision of global connectivity.

The interactions between these forces can be clearly seen. The technical limitations for wide area distribution of digital documents created a strong niche for the VANs. Technological limitations coupled with the power of the VAN intermediaries enabled them to enforce a simple but expensive “one fits all” approach, to their own advantage. The plausibility of this approach was underpinned by the notion that all trading partners have a sufficiently strong commercial interest in application-to-application data transfer and global connectivity to ensure cooperation, or at least a sufficiently large incentive to comply with the large players as a hedge against the threat of “desourcing” [22]. The assumption that all trading partners are interested in any-to-any connectivity reinforced the industry culture of strict adherence to standards so that translation software could be chosen without regard to

what was used by other trading partners. Although simple data entry interfaces were often provided to the translation software for use by unsophisticated trading partners, their cost was dictated by the transaction economics of the standard VANs based solution. This presented to potential new intermediaries and software providers very narrow opportunities for novel solutions which further entrenched the VANs dominant position. What we call the "traditional EDI vision" for supply chain electronic commerce emerges naturally as a solution to the constraints imposed by the five forces, and its elements are spelled out in detail in Table 1.

{Insert Table 1 Near Here}

As the Coles Myer case study illustrates, while the traditional EDI vision has been widely adopted by large suppliers and retailers, it has failed to provide 100% electronic commerce compliance. Although a large proportion of transaction volume may be processed via application-to-application EDI exchanges between large and technologically sophisticated suppliers and retailers according to the traditional EDI vision, the majority of suppliers have remained outside the system creating the attendant problems of incomplete EDI compliance. In analyzing the failure of the vision, we again see the interaction of the various dimensions. The central problem appears to be the failure of mutual benefit and threats to entice small suppliers into the electronic commerce network. As large retailers such as CML have gradually come to realize, there are (at least) two classes of trading partners: high volume technologically sophisticated trading partners with diverse trading partnerships, who are in a position to enjoy the benefits of the traditional vision, and low volume unsophisticated users, who are usually small, relatively transient, and not widely connected. The traditional vision, with its "one fits all" dogma, implicitly assumes that trading partners are uniformly of the first type, whereas in practice they are overwhelmingly, by number, of the second. The traditional EDI vision is inappropriate to unsophisticated trading partners: the transaction economics are inappropriate to their volume, the VANs solution is unsuitable to their functional requirements, being inherently transient by nature they are not predictably influenced by carrots or sticks, and the standards-based independent-development model is inappropriate to their technological sophistication. What was needed was an electronic

commerce vision that explicitly recognized and catered to the existence of both types of trading partners, but this has had to await the appearance of the Internet to destabilize the dominant vision through its interactions with the major context elements.

6. THE NEW INTERNET-ENABLED VISION OF SUPPLY CHAIN ELECTRONIC COMMERCE

It is clear that the Internet, through its new transaction cost structure and new products, has the potential to disrupt the balance of the forces maintaining the traditional EDI vision. Products and services that do not require third party involvement in the message exchange (other than ISPs, which are considered here to be infra-structure providers rather than intermediaries) threaten to disintermediate the traditional VANs. A similar effect of the Internet in distribution channels has been widely observed and analyzed [3-5]. As a response the traditional VANs are struggling to reintermediate themselves on the new medium by offering Internet versions of the traditional approach together with hybrid products that incorporate new approaches targeted to unsophisticated small traders [16,17]. Again, a similar cycle of disintermediation and reintermediation is observed as an effect of the Internet in consumer-oriented electronic commerce [3]. It is not yet clear whether this attempt to reintermediate will be successful given the low barriers to appropriation characteristic of the new medium. However, the strong investment in the traditional VAN-based approach by the large players creates a migration barrier that the VANs can exploit either to maintain the status quo or reintermediate on the Internet by offering a seamless migration strategy in addition to extra services.

The fate of traditional VANs notwithstanding, it seems clear that the power of intermediaries and the diversity of products and services offered has been permanently altered by the availability of the Internet. This in turn has altered the economics of digital document delivery, not just by lowering data transmission costs, but also through the appearance of new ways for large players or third parties to offer low-end compliance solutions to unsophisticated trading partners. These new solutions recognize that small traders are generally not interested in the application-to-application functionality and global connectivity offered by the traditional vision and therefore may employ proprietary message formats,

and client-server technology, with manual or bar code assisted data entry at the small player's end, in large-player-centred sub-networks. The standards issue which was so central in the traditional era is now seen to be most relevant to the backbone network (private or Internet-based) between sophisticated trading partners. A relaxing of dogma on the standards issue and the appearance of new connection solutions will further erode the power of the traditional intermediaries. While this trend can be inferred from the products themselves, it is yet to be seen in official trade publications [2]. Recognizing the political reality that the large retailers have the most to gain from universal electronic commerce compliance, these new products and services allow the prime beneficiaries freedom to solve the problem of interacting electronically with unsophisticated trading partners quickly and cheaply using intelligent gateways, web-form servers or client-server technology. Others such as Atkins Carlyle in Perth Australia, have opted to use the services of third parties that provide the same rich mix of delivery modalities [1]. The largest players can justify the expense of developing their own solutions for unsophisticated traders through the potential of 100% compliance to leverage their traditional EDI investment, thus changing the transaction economics for the small players.

The basic principle of this new supply chain electronic commerce vision is to achieve universal electronic compliance among a community of trading partners of different degrees of sophistication by providing a network of rich topology whilst still maintaining a backbone of standardized application-to-application any-to-any connection between sophisticated traders, to which unsophisticated trading partners may migrate. The elements of the vision are set out in detail in Table 2. Whether the traditional private wide area networks and VANs will continue to be part of the vision remains to be seen. The issue is not private networks versus the Internet but rather the transition from unrealistic utopian notions about how to achieve universal electronic commerce versus a richer more realistic vision.

{Insert Table 2 Near Here}

7. CONCLUSION

This paper has argued that a new vision for supply chain electronic commerce is currently being shaped by the commercial availability of the Internet as a digital business document distribution

medium, and by the new software products, development tools, and third party services being offered on it to support document exchange and presentation to trading partners with diverse needs and capabilities. The appearance of this new technology is currently destabilizing the traditional EDI vision of universal, standardized, any-to-any, application-to-application, digital document exchange, by disturbing the balance between a number of contextual forces which underpin its plausibility. We base this claim on an analysis of the problem presented by technologically unsophisticated suppliers to large retailers, as illustrated by a case of Australia's largest retail chain and its state-of-art solution to this problem using some of these new Internet products and services. We also draw on an analysis of the products and services themselves, which reveals new attitudes to the use of third party distribution intermediaries and *de jure* message formatting standards. If the argument presented in this paper is correct we would expect to see in the future further cases of large retailers and possibly manufacturers implementing Internet-based sub-networks, in-house or through third parties, with their small trading partners, increased attempts by new Internet-only players to intermediate and by the traditional VANs to reintemediate on the Internet, which are already evident [17], and a debate within the retail industry and changed rhetoric from trade organizations concerning the proper role of standards.

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Figures and Captions

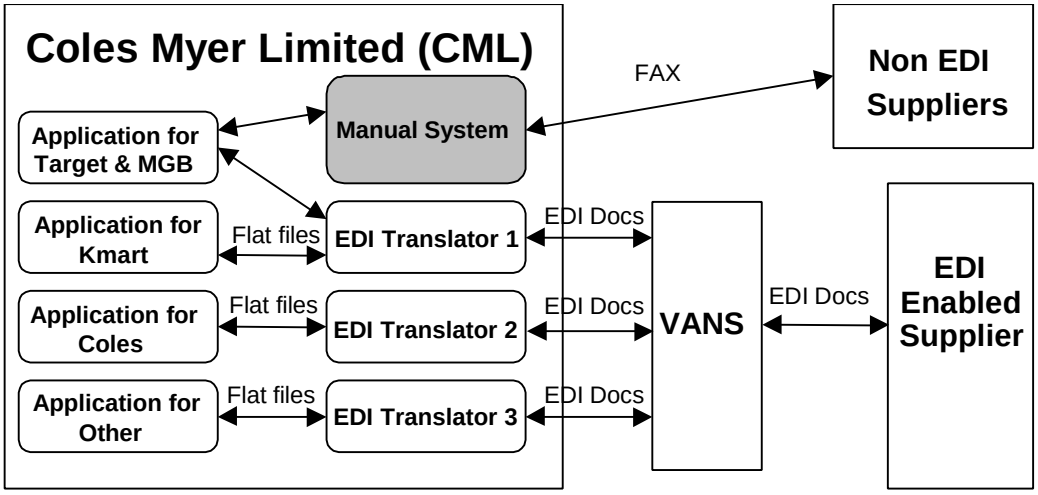

Figure 1: Present EDI Infrastructure at CML

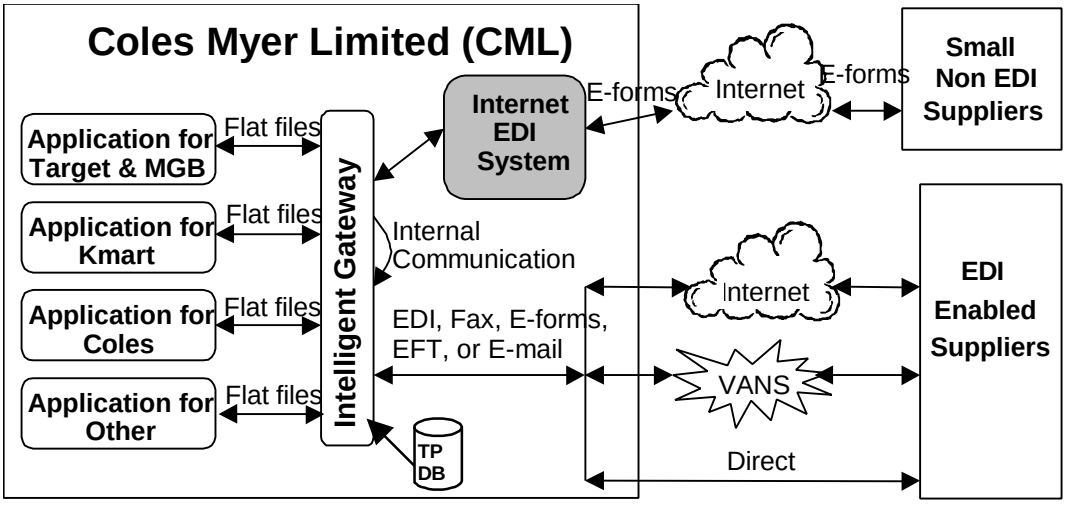

Figure 2. Proposed New Electronic Commerce Infrastructure at CML

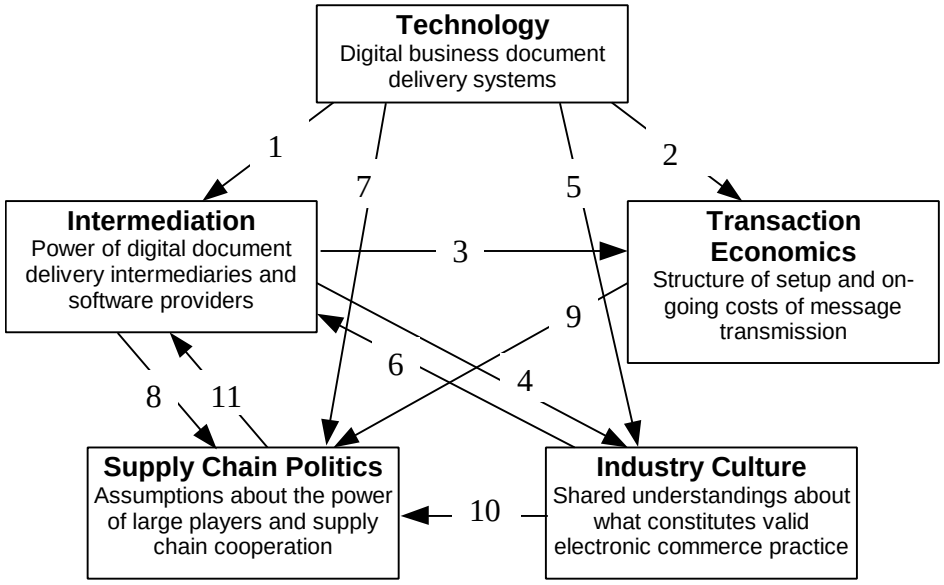

Figure 3. Contextual forces shaping the vision of supply chain electronic commerce and there interactions

Technology	Private wide area networks
Network Topology	Any-to-any mediated by VANs acting as store-and-forward hubs and gateways
Messaging	Specified by *de jure* International Standards
Message Handling Software	Message mapping programs as front-ends for application-to-application transfer. Software chosen independently by trading partners
Functionality	Application-to-application for all
Connectivity	Global for all
Power of Intermediaries	Strong due to ownership of infra-structure and small number
Cost of data transmission	High due to power of intermediaries. To be shared by all trading partners.
Political assumptions	Compliance ensured by mutual benefit or coercion
Cultural assumptions	Correct practice is strict adherence to standards

Table 1. Traditional EDI Supply Chain Electronic Commerce Vision

Technology	Multiple: Private Wide Area Networks Internet Direct connection such as ISDN, FAX
Network Topology	Multiple: Any-to-any on either private wide area networks or Internet, mediated by VANs or IVANs acting as store-and-forward hubs and gateways Direct connection between trading partners using Internet as medium and ISPs as infrastructure providers Local large-player-centred sub-networks with small trading partners
Messaging	Multiple: *De jure* International Standards used for application-to-application exchanges between sophisticated trading partners Proprietary message formats in sub-networks
Message Handling Software	Multiple: Message mapping programs as front-ends for application-to-application transfer between sophisticated traders. Software chosen independently by trading partners Proprietary Internet software, development environments, and infrastructure tools, providing application-to-person data exchange using client server technology necessitating coordinated software choice by trading partners.
Functionality	Multiple: Application-to-application between sophisticated trading partners Application-to-person between large players and unsophisticated small traders
Connectivity	Multiple: Global for sophisticated trading partners Local (bound to main trading partner) for unsophisticated trading partners
Power of Intermediaries	Weaker with greater diversification of products and services.
Cost of data transmission	Much lower on Internet based components due to new technological options and reduced power of intermediaries. Low enough to allow larger players to offer simple compliance solutions to small traders in order to leverage their existing EC investment.
Political assumptions	Mutual benefit and coercion alone are insufficient to ensure compliance. Compliance ensured by mutual benefit between sophisticated trading partnerships but the asymmetry of benefits between large players and small traders is explicitly recognised by large-player provided or subsidizing solutions for small traders.
Cultural assumptions	Messages formatted using proprietary methods are allowable provided they do not compromise the effectiveness of the wider network of sophisticated trading partners. The solution should provide an opportunity for a trader to migrate to sophisticated use of the network.

Table 2. The Emerging Supply Chain Electronic Commerce Vision