
E-commerce in the old economy: three case study examples

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Abstract

This paper reports how three UK "old economy" manufacturers are adapting their operations to meet the challenge of the "new economy", in which it is claimed that dotcoms can deliver virtual products to cybercustomers at the speed of light. Successful manufacturing is not only about producing better goods than competitors but also about delivering a product/service package that solves customers' problems. Although e-commerce can be used to reduce operating costs, any such advantage may be shortlived. The almost limitless connectivity of the Internet offers the opportunity to deliver an enhanced service to customers through improved communication throughout the supply chain. A differentiation strategy based on service enhancement can offer manufacturers a route to sustainable competitive advantage as an alternative to trying to compete on price alone. The cases illustrate how manufacturers can use e-commerce for competitive advantage in the new economy.

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Introduction

Use of the Internet throughout the business world has spread rapidly over the last few years and dramatic claims have been made for its impact. Damanpour (2001), for example, asserts that the Internet has "changed the way companies communicate, how they share information with business partners, and how they buy and sell". Evans *et al.* (2001) argue that it is "facilitating dramatic change in terms of how consumers interact with each other and with companies". Use of the latest Internet-based information and communication technologies (ICTs) enables information to be stored, retrieved and disseminated in almost limitless quantities across the globe, rapidly and cheaply. The increasing exploitation of these ICT capabilities seems to be creating the post-industrial, information society first predicted by Bell (1973).

The use of the Internet to facilitate trade and commerce is generally referred to as e-commerce. Some authors (Chaffey, 2002) seek to distinguish between the terms e-commerce and e-business (terms like Internet commerce, Web commerce, Web-based trading, etc. are also in use). No such distinction is sought for the purposes of this paper and these terms are used more or less interchangeably. E-commerce is taken to mean "the sharing of business information, maintaining business relationships and conducting business transactions by means of Internet-based technology" (Poon and Swatman, 1999 based on Zwass, 1996). Despite the well publicised problems experienced by many dotcoms, the rise in the use of e-commerce seems inexorable. It is forecast that e-commerce revenues will hit around US\$7 trillion worldwide by 2004 (Forrester Research Inc., 2001a) and by 2006 will be US\$7 trillion in the US alone (Forrester Research Inc., 2001b). Markets for e-commerce are usually categorised as either business to business (B2B) or business to consumer (B2C). Although B2C markets capture most public attention through the activities of popular Internet traders such as Amazon and eBay, B2B markets account continue to account for by far the larger proportion of e-commerce revenues (eMarketer, 2001a, b).

There have been many claims that the move to e-commerce has created a "new economy" based on "information industries" where people "work with their brains more than their hands, and enabled by communications technology, pursue global competition" (Fulkerson and Shank, 2000, p. 413). This new economy is commonly portrayed

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as a world in which dotcoms can ship virtual products to cybercustomers “at the speed of light, at almost no cost, to anywhere on the planet” (Negroponte, 1997). As Kelly (1998, p. 74) puts it, “new network technology and globalisation accelerates the disembodiment of goods and services. The new dynamics of information will gradually supersede the old dynamics of industrialisation until network behaviour becomes the entire economy”.

It is difficult to know what place companies rooted in the old economy will have in this brave new world. In particular, how can companies that produce physical, rather than virtual, goods survive and prosper in the information age? How can manufacturers, the epitome of the old economy, respond to the challenges of the new economy? As Spring (2000) puts it, “What does . . . (e-commerce mean for production, distribution and service delivery systems? . . . (In short) can operations deliver (in the new economy)?” However, despite the dramatic increase in information and information-based products evident in the new economy, the need for physical products seems unlikely to abate. As Spring (2000) declares, “Information Society! I can’t eat information, I can’t wear information”. Clearly, the production and distribution of physical goods will continue to take place in the real world of factories, warehouses, vehicles, etc., rather than in the virtual world of the Internet. The real challenge for manufacturers is to determine how they can adapt their operations to gain maximum benefit from the opportunities presented by the Internet-based ICTs of the information age.

This paper reports on research investigating how old economy companies are incorporating the use of new economy Internet-based technologies into their business operations. The responses of three different manufacturers to the opportunities offered by the advent of e-commerce are examined. The paper begins by discussing the potential benefits offered to manufacturing companies by Internet-based ICTs. It proceeds to describe how the three companies have, in their own way, sought to gain a competitive advantage from some of these benefits. The paper concludes by discussing the findings from the cases to see what more general lessons might be drawn for other manufacturing companies.

Potential benefits from e-commerce

Cox *et al.* (2001) point out that the use of Internet can impact business operations in three broad areas: supply operations (including procurement), internal operations, and sales operations

(including marketing). However, as Porter and Millar (1985) argue, ICT based competitive advantage can only be gained from harnessing information flows throughout an organisation’s own value chain and between the value chains of its supply network partners. The almost limitless connectivity offered by Internet-based ICTs offers traditional “bricks and mortar” companies, typified by manufacturers, the opportunity to achieve a competitive advantage by becoming “clicks and mortar” e-businesses. However, as Porter (2001) has more recently argued, use of the Internet *per se* will not of itself confer competitive advantage. He maintains that effective e-business strategies should be based on sound strategic principles either pursuing the lowest possible cost or seeking differentiation from competitors (Porter, 1980). Furthermore, e-businesses should utilise Internet-based technologies to complement rather than replace existing ways of competing.

Clicks and mortar manufacturers have scope for cost reduction in all the three areas of their operations (i.e. supply, internal and sales).

This might be achieved by:

- Reducing the cost of acquisition of inputs (raw materials, components, consumables, etc.) through lower purchase prices, through greater pricing transparency, global sourcing, bigger discounts through consolidation of orders, etc., and lowering transaction costs, through streamlined administrative routines, faster purchasing cycle times, reduction in errors, etc. (Attaran, 2001; Carbone, 2001; Turban *et al.*, 2000).
- Improving efficiency internally, and across the supply chain, through improved information flows, and better planning and control, leading to reduced stockholding costs and greater economies of scale and scope (Kehoe and Boughton, 2001; Soliman and Youssef, 2001).

If production costs can be reduced, there will be scope for gaining a competitive advantage with a cost reduction strategy (Slack *et al.*, 2001). This could enable prices to be reduced, whilst maintaining margins, in an effort to gain or at least defend market share in a competitive environment, or to improve margins, whilst maintaining prices, if the environment is more benign. Cost reduction has been given prominence in the operations management literature as an important strategy for operations in the Internet era (Gunasekaran *et al.*, 2002). The alternative strategy is that of differentiation derived from product quality, from the speed, dependability and/or flexibility of the service element of the product/service package (Slack *et al.*, 2001). As Steinfeld *et al.* (2002) note, in the Internet economy, the basis of

differentiation is most likely to come from offering value-added services to customers. This might conceivably be achieved through harnessing the power of ICT and the Internet to improve supply chain co-ordination to offer customers more make-to-order and customisation, faster response, monitoring of order progress, etc. Whilst not eschewing cost reduction opportunities, a differentiation strategy offers companies the possibility of charging higher prices whilst maintaining market share, even in competitive environments. Differentiation through value-added services requires co-ordinated action in all three areas of operations (supply, internal and sales) to ensure that the entire product/service package presented to customers is coherent (Au and Ho, 2002). There is no agreed model for determining where in their operations manufacturers should start to introduce e-commerce into their operations (Dignum, 2002). Much of the attention of early adopters of e-commerce has focused on sales operations aimed at building relationships with customers. At the other end of the supply chain, progress in e-procurement may be hampered by the unwillingness of many suppliers, who are often small companies, to use e-commerce (Quayle, 2002). Clearly, there are many different motivating and strategic factors which will impact on manufacturers' decisions about where in their operations they will seek to apply e-commerce for competitive advantage.

Theoretical framework

The empirical research for this paper was informed by a theoretical framework developed by Barnes *et al.* (2002), to investigate the impact of e-commerce on the management of internal business processes. The framework draws on literature from the traditions of operations management, especially the business process perspective, and information systems. It identifies three main issues to be considered:

- (1) *Business process integration.* The extent to which an organisation's business processes for its conventional activity and for e-commerce activity are integrated, both internally and externally. External business process integration can occur where business processes extend beyond the immediate boundaries of the organisation; where operations are outsourced, where intermediaries are involved or where processes are shared with other supply chain partners.
- (2) *Information systems integration.* The extent to which an organisation's information systems are integrated internally and externally.

Both internal and external integrations are dependent on the extent to which information systems have been integrated across functions and business processes, which is in turn dependent upon the amount of business process integration which has been achieved externally and internally.

- (3) *The context.* The interaction between an organisation and its environment. This needs to include a consideration of:
 - *the customer context* – the extent to which an organisation is engaged in B2B and/or B2C e-commerce),
 - *the e-commerce context* – the organisation's current e-commerce business model (e.g. pureplay dotcom, clicks-and-mortar) and its path to that model (e.g. a start-up or from bricks-and-mortar to clicks-and-mortar),
 - *the business context* – the organisation's objectives (profit-seeking or not for profits), its size (e.g. multinational, SME), its ownership structure (public limited company, private limited company, partnership), its organisational culture and
 - *the strategic context* – the relationship between organisation's motives and intentions in its use of e-commerce and its corporate strategic objectives.

Methodology

The research uses a case study method based on interviews with company executives. A qualitative case study approach is an entirely suitable method for such an investigation of "a contemporary phenomenon within some real-life context" (Yin, 1994). Furthermore, as Meredith *et al.* (1989) point out "this approach is particularly good for [...] descriptive or exploratory [...] research. It has the advantage that the issues are framed by the participants", which enables this type of in-depth case study research to offer meaningful insights. Its concentration on the depth and quality of data makes the case study potentially very strong in terms of both the construct and internal validity. However, it is often criticised for lacking in external validity due to the limited number of sites that can be studied. Quantitative research can use statistical inference to generalise from a sample to a larger population. However, qualitative research relies on logical inference whereby "case studies are generalisable to theoretical propositions and not populations" (Yin, 1994).

The interviews were semi-structured using open-ended questions based on the theoretical framework described above. The following are the question topic areas included.

The context

- The activities of the organisation.
- The background to its use of e-commerce.
- The proportion of business transacted using e-commerce.
- The e-commerce markets (B2B or B2C).
- The nature and scope of e-commerce activities.
- The motivation for adoption of e-commerce.
- The objectives for the use of e-commerce.

Internal changes arising from e-commerce

- Changes to conventional business operations as a result of e-commerce.
- The extent that e-business processes are integrated with conventional business operations.
- The extent that information systems are integrated within the organisation.

External changes arising from e-commerce

- The extent that e-business processes are integrated with supply chain partners (customers, suppliers, intermediaries, etc.).
- The extent that information systems are integrated with supply chain partners.
- The extent that e-commerce processes remove (or add) intermediaries in the supply chain.

The change to e-commerce

- The most significant issues in managing the process of adoption of e-commerce.
- The barriers to the adoption of e-commerce (e.g. technical, financial, organisational).
- Factors that helped or hindered the process of change.

Evaluation of e-commerce

- The most important operational challenges arising from the use of e-commerce.
- Future plans for the use of e-commerce.
- Assessment of the success of e-commerce activities.
- Measures used to assess the performance of e-commerce activities.

The aim was to gather as much information as possible about the way in which the organisation was using e-commerce, and in particular, the way it was managing its business operations as a result of using e-commerce. With the permission of the subjects, all interviews were tape-recorded for subsequent transcription to facilitate data analysis. Data from the transcribed interviews were coded and analysed using Atlas.ti qualitative data analysis software. This is very similar to NUD-IST software. Once coded, the principal approach to data analysis was to identify the main points and themes emerging from each interview. These were identified and articulated in a descriptive narrative

under a set of broad topic headings. Cross case analysis was undertaken as a final stage to “deepen understanding and explanation” (Miles and Huberman, 1994).

The case companies

The companies in this paper have been given pseudonyms and some details of the cases have been masked to maintain company confidentiality. This section considers each company in turn.

The industrial equipment manufacturer

RER is an £800 million per annum UK-based business that manufactures a wide range of industrial equipment used mostly in fluid processing applications. Its main markets are in Europe and North America. As its products are technically complex, and its customers geographically dispersed, the company mostly sells through agents and distributors, who can offer the level of expertise required to ensure that customers order the most appropriate equipment for their requirements.

The company makes most use of e-commerce in its sales operations. Historically, RER received new equipment enquiries from customers via its sales agents or distributor. The enquiry would be routed to the internal sales office via a letter, fax or e-mail, where an RER engineer would select the correct product for the requirement by using paper-based product performance data. Customers would then be sent a proposal including price, normally via a fax. If customers wanted to proceed, they would need to raise a purchase order, which when received by RER would then be manually entered into the RER central computing system and manufacturing information systems. RER has developed a software tool to assist with equipment selection, quotation and order entry. The tool sits as a web-based interface between the organisation and its customers via an RER password-protected Extranet. By entering relevant required performance factors, the tool then selects the appropriate product, prices it, provides all supporting documentation (engineered drawings, etc.) and generates a fully detailed quotation to the customer. If the customer decides to order the product, the programme creates an order file that can be electronically transmitted to RER’s manufacturing computer system creating the seamless entry of the customer order. The tool is installed on an individual PC, normally that of the sales agent, but some customers have also installed it.

Use of Internet-based ICTs extends into internal operations only to a limited degree. The sales software tool has an additional feature that automatically creates a Bill of Material (BOM) for any new product design. Previously, this had to be done manually by RER staff. The tool now pre-configures the BOM, removing many hours of work from the pre-manufacturing processes. The main function of the software tool is to support RER's local agents, to ensure that the best technical solutions are offered to customers and to reduce lead times. It has also enabled RER to reduce its own headcount. Its sales and manufacturing information systems are not yet integrated, although it intends to develop middleware to facilitate this. At present, the manufacturing process does not distinguish between orders received via the Web and those received by conventional means.

RER has a separate e-commerce tool for spares sales. These are very important to RER, accounting for 25 per cent of sales volume and 50 per cent of profits. Previously, a customer requiring a spare part would need to contact RER's internal sales department via telephone, fax, e-mail or letter, requesting a price and availability. After interrogating the internal computer system, sales would send a quotation to the customer, normally via fax or e-mail. If acceptable, the customer would then send a purchase order for the part via fax or letter. The e-commerce tool enables customers to place orders for spares via the RER Extranet, accessible to RER's registered customers. The Extranet displays real-time data on price and availability of spares. Each customer has his/her own unique password, which enables RER to offer differential pricing to individual customers. Customers can place their orders on the Web site, indicating the selected parts number and quantity. The Extranet then sends a file to RER's central computer system so that the spare part can be ordered, scheduled, and in due course picked and shipped. To encourage e-commerce use, RER also offers a discount on spares ordered via the Web. Over 80 per cent of the orders are now placed this way. Use of the Extranet speeds up the entire order cycle. Customers are also invoiced electronically, and thereby debtor days have been reduced significantly.

The move to e-commerce has been readily embraced by RER's American customers (where the vast majority of new product orders are now processed via e-commerce). To encourage e-commerce use, RER offers a discount on orders placed via the Web. Its use has resulted in significantly reduced lead times, cutting out some 10–20 days of processing time. RER hopes to extend its use of e-commerce throughout all of its

markets. It also envisages that some of its more sophisticated customers will use Web-based ordering software to place their orders directly with the company.

RER does not, as yet, make full use of e-commerce throughout the supply chain. It makes very little use of e-commerce in its supply operations. It recognises that there could be efficiency gains from integrating its purchasing and information systems with those of its suppliers, but many of its suppliers, mostly small companies, make little use of ICT.

RER's main motivation for its use of e-commerce is to differentiate itself from its competitors through service enhancement. Although it is achieving cost savings through its use of e-commerce, it recognises that it cannot hope to compete on price alone. In making an early move into e-commerce, it hopes to stay ahead of its larger competitors, many of whom are making large e-commerce investments. There is a growing demand in the industry for increased use of e-commerce. However, it is difficult to tell whether its online ordering tool is increasing sales, as it is difficult to know if any increase in sales are incremental or substitutional. This makes performance evaluation problematic.

The company believes that once customers adopt e-commerce applications they will become reliant on them and would not like to see them withdrawn. As such, RER sees e-commerce as a means of locking-in customers and distributors to the Web-based ordering process thereby raising the barriers to exit.

The metals manufacturer

ARB is the UK arm of a major European metal producer with a £multi-billion turnover. It serves a specialist market of relatively few customers with a range of made-to-order products. The company saw the Internet as a means of replacing its existing EDI system, which was costly, cumbersome and slow. This has been done by creating a specialist industry portal, developed in conjunction with a number of its European competitors. Its underlying principle is to offer a one-stop shopping facility for users, specifiers and buyers. The portal facilitates access to all the participating companies' Web sites. It enables customers, suppliers and other divisions within the company to communicate with each other, even if they do not share the same communication software. The intention is to offer multiple products via a group of suppliers, in this way offering choice to customers, and also minimising some of the costs of establishing an e-channel for each of the suppliers. This European collaboration is intended to enable all participating companies to compete

more effectively with producers in other parts of the world, and encourage greater use of products based on this material rather than alternatives. Thus, the portal is focused primarily on sales and marketing operations, although it is also aimed at reducing supply operations costs, particularly transaction costs, by enabling better and speedier flows of information with customers.

Once accessed via the portal, ARB's Web site operates at two levels. Entry is via an open area, with general information. The Web site also has a search facility to enable customers to identify which of the portal's suppliers manufactures the product they require. From this Web site, only registered customers are then allowed to access the secure Web sites of each of the portal's companies. The ARB Web site aligns most of the company's order and delivery processes through a business communication tool with its customers. These processes address the needs of a full range of customers' businesses from designers and specifiers, purchasing, accounts payable and so on. From the Web site, approved customers can make enquiries, request and receive quotations, place orders, receive acknowledgements, test certificates, despatch notes and invoices. Additionally, customers can register order queries and complaints, whether these concern the quantity or quality of goods despatched. The Web site is primarily aimed at automating existing processes, thereby taking out costs, increasing the quality of information, reducing errors, and speeding the order and payment cycle. Scheduling will be improved through greater transparency of information. The site initially commenced in pilot form with the ultimate intention of moving all customers to online trading.

ARB's internal processes (primarily its manufacturing operations) are unaffected by the Web site, but customers can track and trace their orders in the manufacturing process. Information on order progress is updated every 24 hours, and late and potentially late orders are flagged.

ARB believes its Web site will offer improved services to its customers and reduce its transaction costs helping it to survive in a fiercely competitive market. It does have a concern that the pricing transparency facilitated by the Internet might benefit its low cost producer competitors. However, it believes that it can gain a competitive advantage by being able to offer a product/service package that will differentiate it from its competitors. This might come from being able to make things that other people cannot, by working closely with its customers to develop a bespoke package as a solution to their specific problems. ARB sees the portal as an area where customer systems can interact with those of the portal

companies to provide the best possible experience for both the supplier and the customer. The portal is also intended to be customer responsive, customising itself each time a registered user logs on as information is built and formatted for that customer over time.

ARB believes e-commerce will enable it to reconfigure its supply chain to be more efficient, reducing costs, and more effective by adding value for its customers, and thereby encouraging customer loyalty. Internally, this has meant changing processes and systems so that they work for the benefit of the customers. This has required a new way of assessing ICT, concentrating on how it can improve operations rather than its technical excellence. Externally, this means having to deal with whatever information systems customers use. To this end, they have been working with various customer data formats, pulling them into their own system via middleware. Integration along the supply chain is a key issue for ARB. The company is trying to draw in those who design, specify and use its products as well as its direct customers. However, incompatibility between different information systems is a major problem in the industry. This is compounded by the fact that some of its customers and other supply chain partners are small and technologically unsophisticated. In supply operations, ARB is collaborating with its portal partners to set up another Web site to purchase raw materials. The interesting feature of the development of the portal is the nature of the direct collaboration with natural competitors. This is an attempt to raise barriers to entry for those competitors who are not taking part.

ARB's e-commerce applications capture a tremendous amount of information and they are developing a performance measurement framework to utilise this resource. For example, every interaction they have with a customer is logged and reported weekly at two levels. At the technical level, there is a need to check the performance of the system to ensure that user experience is satisfactory and that it continues to deliver the operational utility customers expect. At the commercial level, the system provides feedback in terms of customer perceptions. So the thrust of these measures is towards evaluating customer expectations. Whilst no formal investment measures were used, an initial business case was produced prior to system implementation. This centred on gaining significant advantage by improving the customer experience. ARB is interested in understanding the cost that goes into managing a given customer, about what route an order comes through and the through cost for an e-transaction. Although their performance

measures are still under-developed, the system has allowed ARB to analyse sales and orders to a far greater depth than conventionally, and to generate a far clearer picture of process performance.

The pharmaceutical manufacturer

Pharmco is a small company, with around 120 employees, that manufactures highly specialist pharmaceuticals in the UK. However, it operates on a global scale; its main suppliers are in Australia and its main markets are in North America and Europe. The company was founded as a research and development organisation and has only moved to larger scale production in the last few years after it received regulatory approval. The addition of a distinct manufacturing function is significantly changing the company. The main reason for its use of e-commerce is its desire to improve communications, both in terms of real-time data and the secure management of its documents, intra-organisationally and throughout the disparate sites in its entire supply network. Although its use of e-commerce is primarily as a communication tool, it does impact on all three areas of operations (supply, internal and sales).

In sales operations, Pharmco does not use e-commerce to sell directly to its customers. As it does not market its own products but relies on a distributor, its own Web site is primarily used as a PR tool. However, it uses the Internet to communicate with its distributor. This includes the provision of sales forecasts, current and forecast stock levels and dealing with customer complaints.

Use of Internet-based ICTs have enabled Pharmco to improve its internal operations between its global sites, realising benefits that include an improved cost of goods monitoring system, better management accounting, closer co-ordination between the logistics and accounting departments, and better availability of information to all key managers. Information is now more widely available, and this has helped to break down some of the cultural barriers between its various sites, particularly as data can now be transferred from site to site in real time. This has improved efficiency, as decisions can now be taken more quickly. It is also developing e-commerce applications for financial accounting, and setting up a management information system between its operations and accounts department.

Secure document management is very important to Pharmco because its production activity is highly regulated and submissions have to be made to regulatory agencies on a regular basis. It is important that such documents are secure and have been managed in such a way that reviews and

comments are up to date. Regulatory bodies are encouraging electronic submission to use the burden of paperwork where the required submissions can run to over 20 volumes.

In its supply operations, Pharmco deals with up to 200, mostly small suppliers who provide the raw materials and parts necessary for the production processes. The company has not yet been able to integrate its inventory systems to any appreciable extent with those of its suppliers, many of whom operate very different software. Consequently, it still uses manual systems for ordering supplies. However, the availability of information online makes it easier to obtain approved raw materials as it is now possible to interrogate suppliers' Web sites to check certificates of analysis, inventory levels and previous purchasers of raw materials. Online access to certificates of analysis is particularly important as it saves considerable time checking the specification against the criteria. Orders for raw materials can be scheduled to synchronise delivery with UK production schedules. At present, production planning is partly manual and partly software-based, but the company would like to use e-commerce in order to assist production planning. It also plans to incorporate an MRP system.

Although it is operating in a specialist industry, Pharmco's main operational aim at the moment is to reduce its operating costs to bring down its unit cost of production. Although e-commerce cannot impact directly on its factory operations, the use of Internet-based ICTs is enabling Pharmco to improve its efficiency because knowledge and information can now be communicated more widely, and more quickly throughout the company and its supply network. As a new company trying to enter and penetrate the market with a new product, it is important for Pharmco to pursue a manufacturing strategy of cost reduction. As a small company it needs to make sufficient financial returns for its investors and generate an adequate cashflow to ensure business continuity.

The company does not have any formal financial performance measures for e-commerce in place. Projects are reviewed upon completion in order to learn from their success or otherwise. The company's main objective is to bring down its costs of goods sold. One key success factor here would be using an inventory management system to reduce its inventory levels. Whilst focusing on metrics like stock levels the company also recognises that it needs to measure the performance of its inventory information available for all key managers. In a small company with limited revenue, finance is inevitably an issue. The company admits that there are many issues that it is facing in both understanding and implementing

technology, and says that it would tend to spend any additional available resource on increasing manufacturing capacity rather than on implementing new information systems and processes. However, the introduction of its e-commerce systems has been the catalyst for the company to develop a performance management framework where the performance benefits that the system offers are recognised as being interwoven with incremental improvements in other business processes. The performance of radical processes changes, to do with new arrangements for linking the internal processes of the company across geographically spread sites, are proving harder to measure.

Cross case comparison

The three cases of this study offer examples of how bricks and mortar manufacturers from the old economy are adapting to the new economy by incorporating Internet-based ICTs into their operations to become clicks and mortar e-businesses. The main details of the cases are summarised and compared in Table I.

All three companies serve B2B markets. In their sales operations, they all use e-commerce to improve their service to customers. RER uses the Internet to enhance the role of its agents and distributors. The improved communications between the company and its agents and distributors helps improve the service offered to its customers. Its Web-based sales aids give better and faster solutions for purchasers of both new equipment and spares. The industry portal that ARB has developed in conjunction with some of its competitors also improves communications with customers. The speedy access to more detailed information it offers to customers and potential customers, and the high level of interactivity for customers adds value through improved service. Through its use of the Internet, Pharmco has also improved communication with its distributors and can thereby offer a better level of service to its customers.

All three companies are using e-commerce to improve the efficiency of their internal operations. Use of its sales tool enables RER to achieve faster and cheaper internal sales operations. Similarly, ARB is able to lower its internal operations costs through more speedy and accurate transactions. Pharmco uses e-commerce to improve communications between its sites improving efficiency, reducing costs and speeding up decision-making.

However, in supply operations much less progress has been made. To date neither RER nor

ARB are making use of e-commerce with their suppliers. RER assess its suppliers as too unsophisticated. However, ARB does have plans to participate in setting up an industry portal for raw material purchases. Although Pharmco persists with manual ordering (mainly due to integration problems caused by incompatible systems), it does use the Internet for sourcing, interrogating suppliers' Web sites for information on availability, product compliance, etc.

The full potential of Internet-based ICTs can be seen by looking at the use of e-commerce across the entire supply chain of each company. Interestingly, the smallest company of the three, Pharmco, is making greatest use of e-commerce to improve communication throughout its supply chain (i.e. with its distributors, between its own sites and with its suppliers). This is enabling it to improve efficiency, reduce costs and speed up decision-making, which is resulting in a better service to customers. The benefits that result from ARB's portal are mostly realised in sales and internal operations, due to improved communications with its customers. In some ways RER is worst placed as it is not realising the full benefits of e-commerce due to lack of integration between its sales, manufacturing and procurement systems.

The three cases also offer some interesting comparisons in the strategic use of e-commerce in their respective operations. Both RER and ARB are endeavouring to pursue differentiation through value-added service strategies based on service enhancement. Pharmco, on the other hand is primarily looking to achieve efficiency gains. The differing strategies are understandable with respect to the competitive positions of the companies. As a medium-sized player in its industry, RER has decided that it cannot compete on price alone, so a cost based strategy would be unlikely to be successful. As such, although its use of e-commerce has enabled some cost savings to be achieved, its main aim is differentiation based on service enhancement. RER is seeking to add value for its customers through better and faster service and to raise exit barriers to customers. Similarly, although its portal enables ARB to lower costs, its main aim is differentiation. The portal improves communication with customers, adding value through better, more detailed, faster information, and a high level of interactivity. ARB hopes that this will create customer stickiness, raising exit barriers to customers. The portal should also raise entry barriers to e-commerce for competitors not in the portal's consortium. In contrast to the other two cases, Pharmco's use of e-commerce is aimed primarily at cost reduction. This is being achieved through improved communication, resulting in

Table I A comparison of the findings from the three case companies

	Company		
	ARB	RER	Pharmco
Products	Industrial equipment	Metal products	Pharmaceuticals
Sales use of e-commerce	A software tool to assist intermediaries with equipment selection, quotation and order entry Quotation and order entry for spares	A joint venture portal with some competitors One stop shopping facility enabling access to multiple products from a group of suppliers Product information; request and receive quotations; place orders; receive acknowledgements, test certificates, despatch notes and invoices; track and trace orders; register queries and complaints Customised webpage for each customer	Communication with distributors Provide sales forecasts and stock level information? Process complaints Transmission of secure documents and data
Internal use of e-commerce	Automatic generation of technical drawings and BOM for new designs	Inter-divisional communication Information on order progress through manufacturing updated daily	Inter-site communication Management information and cost accounting systems Plans to develop a financial accounting system and extend the management information system Plan to develop online production planning
Use of e-commerce in supply	None	Communication with suppliers Online raw material purchases planned	Interrogate suppliers' Web site for certificates of analysis, inventory levels and previous purchases
Internal integration issues	Needs middleware to integrate sales, manufacturing and purchasing systems		
External integration issues	Potential for some customers to order direct A large supply base of small and unsophisticated suppliers	Use middleware to integrate with customers' systems Suppliers are unsophisticated	Systems integration problems with suppliers A large supply base of small suppliers
Strategy objectives for e-commerce	Service-based differentiation Enhance support for intermediaries Lock-in customers and raise exit barriers	Service-based differentiation Improve interactions with customers (including designers and specifiers) Retain existing customers Attract new customers	Unit cost reduction
Realised benefits from e-commerce	Reduced headcount Faster order cycle Reduced debtor days Lead time reduction Possible increased sales	Reduced transaction costs with customers Improved communications with customers Faster order cycle	Better management and cost accounting Better co-ordination between the logistics and accounting Better availability of information to managers Improved and faster decision-making Reduced lead times

better planning and co-ordination throughout the supply chain. This also enables Pharmco to achieve service improvements for customers with shorter delivery times, and faster and more accurate information flows.

In all three cases, the companies have clear strategic objectives for their use of e-commerce in their operations (service-based differentiation in the cases of RER and ARB; cost reduction in the case of Pharmco). They can all be seen to be successfully aligning both their ICT and operations strategies with their business strategies. Thus, all

three offer examples of the adoption of best practice models of strategy development from both the information strategy literature (Beats, 1992; Earl, 1989; Galliers, 1991) and the operations management literature (Hill, 1993; Platts and Gregory, 1990; Skinner, 1969). Despite their emergence from two different academic traditions, both group of models share the common feature of an advocacy of firms deriving functional level strategy (for ICT or operations) from business level strategy, as evidenced in all these three cases.

Conclusions

This study did not seek to evaluate the performances achieved by companies as a result of their use of e-commerce in support of their strategies. All the companies appeared to recognise the need to enhance their existing performance measurement systems in order to enable them to evaluate the benefits from their e-commerce operations. They all seemed convinced that benefits were accruing, based on improvement in some of their existing performance measures. However, being able to attribute cause and effect to such changes in these measures would be a difficult and contentious task, given the interrelationships of these companies' e-commerce and traditional operations. Such a task was outside of the scope of this research project and is probably best left to the type of longitudinal studies that are difficult to conduct in the dynamic environment of e-business.

Nonetheless, it is possible to speculate about the potential effectiveness of the use of e-commerce in these manufacturing companies. All three companies are endeavouring to seize the opportunities offered by e-commerce to gain a competitive advantage. They all have been able to reduce their cost through the productivity gains available from conducting business electronically. It can be argued that they could do much more in this respect, especially as none has made much progress in the adoption of e-procurement. However, both RER and ARB are clear that cost reduction alone does not offer a route to a sustainable competitive advantage for them. This may well prove to be a sensible conclusion, as neither seems to have inherently lower costs than their competitors. Pharmco is competing on the basis of the uniqueness of their products. They are operating in markets that do not appear to be particularly price sensitive. As such their business strategy is not cost-based. Nonetheless, they do have a commercial imperative to cut their operating costs. Their use of e-commerce is enabling them to do this as well as improving customer service.

E-commerce offers manufacturers opportunities for cost reduction. However, as the same Internet-based ICTs are available to all producers, any advantage from cost reduction based on e-commerce does seem likely to be shortlived. A differentiation strategy based on service enhancement may be attractive for many manufacturers as an alternative to trying to compete on price alone. Such a strategy may be sustainable if Internet-based ICTs can be utilised to deliver a superior service. It offers the possibility of raising entry barriers to potential competitors,

and raising exit barriers and switching costs for customers. Manufacturing is not just about producing better goods than competitors. Rather, it is about delivering an appropriate package of product and service as a solution to customers' problems. The Internet offers the opportunity to deliver an enhanced service to customers. As such it can offer manufacturers the opportunity to use the technology of the new economy to achieve competitive advantage in old economy businesses.

These cases serve as useful illustrations of how manufacturers, doyens of the old economy, can use e-commerce to seek competitive advantage in the new economy. As such, this paper contributes to improve the understanding of the application of Internet-based ICTs in the manufacturing sector. However, it is dangerous to generalise from what is a limited study of only three manufacturers. Consequently, the paper concludes with a call for more empirical research to be undertaken both to track the progress of the use of e-commerce in the manufacturing sector and also seek a better understanding of how the new technologies might be used more effectively.

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