

How World Leading Manufacturers Can Achieve Differentiation Through E-Business: New Services, Enhanced Relationships, and Reduced Costs

Daniel Kindström, Linköping University, SE-581 83 Linköping, Sweden; E-mail: daniel.kindstrom@liu.se

Christian Kowalkowski, Linköping University, SE-581 83 Linköping, Sweden; E-mail: christian.kowalkowski@liu.se

ABSTRACT

E-business development is today driven by mature and established companies and is becoming an important tool to increase competitive advantage and to sustain profitability. This paper investigates how world-leading manufacturers can achieve differentiation through their use of e-business. Many companies use e-business as vehicles to launch new information-based service, as an important enabler to enhance and deepen customer relationships, and to reduce costs associated with customer management. Using e-business in this way will increase the opportunities for differentiation and create sustainable competitive advantage. Successful employment of e-business creates services that retain current customers and attract new ones as well as justifies premium prices and keeps low-cost competitors in check.

Keywords: E-business, Differentiation, Value creation, Offerings, Services

INTRODUCTION

Today mature and established companies, as opposed to start-ups, are driving e-business development and are using these technologies, now often incorporated in the concept of Information and Communications Technologies (ICT), to increase competitiveness by the integration of e-business into their business. Evidence shows that e-business is making big strides into most aspects of companies' businesses and is enabling new avenues in business development (Kindström, 2005; Earl, 2000; Hackbarth and Kettinger, 2000). Using e-business to create new information-based services and offerings to increase possibilities for differentiation and profitability is one of the major areas of interests in industry.

One aspect of particular interest is to study how e-business can increase competitive advantage by the expansion of industrial offering through services. E-business can be used to improve the companies' existing service processes and develop new, more advanced services and solutions (Normann, 2000), thereby increasing customer value and keeping competitors in check. As it is becoming increasingly difficult to maintain market leadership based on product sales, due to the trend toward product commodization in many business markets (Ulaga and Eggert, 2006) and competition from low-cost competitors (Lovelock, 1995) many companies turn to the provision of services in order to increase profits and customer value. On many industrial markets, services are likely to give higher margins than manufacturing activities do and services are becoming a critical factor of competitiveness for targeting new customer segments as well as to retain existing customers (Henkel et al., 2004; Oliva and Kallenberg, 2003). When conducting a quantitative study among purchasing managers in US manufacturing firms, Ulaga and Eggert (2006) found that the core product and its price become less important differentiators for product suppliers and they identified service support, the customer-supplier relationship, and suppliers' know-how as core differentiators. In the context of this study, market leading manufacturing companies pursuing a premium price strategy, this is particularly interesting.

The objective of this paper is to address how market leading industry incumbents can use e-business services to create value through differentiation and thereby increase their competitive advantage. Four world-leading manufacturers are analyzed using a qualitative case study approach.

THEORETICAL BACKGROUND

Early on, e-business initiatives focused on transactions, reducing costs and the relatively low-risk and comparable, easily appropriable benefits that were possible from that perspective (see eg Kindström, 2005). This is to certain extent supported by Dilworth and Kochhar (2004) that found that companies in the UK (in particular large ones) seem to have emphasized a simpler, transaction-focused, use of e-business (such as e-mails and web-site access). Transactional efficiencies and inherent cost reductions are often tangible aspects of introducing e-business into companies (Kaefer and Bendoly, 2004).

However, e-business can also provide the platform for many organizations to engage in new marketplace strategies and to generate and deliver additional value (Amit and Zott, 2001; Zwass, 2003), and increase competitive advantage in novel ways (Fahey et al., 2001; Porter, 2001). Thus, e-business should make it possible for companies to both reduce the costs for providing services (internal efficiency) and increase service revenues by injecting higher value into the customers' value-creating processes (external effectiveness) (Anderson et al., 1997; Kowalkowski, 2007). When discussing value creation, Wikström and Normann (1994) refer to these two dimensions as cost efficiency and market efficiency. Market efficiency can be achieved by either relieving the customer (i.e. reducing customer costs) or enabling the customer (i.e. increasing customer business performance) (Ravald and Grönroos, 1996). Thus, a premium price can be justified through the use of either of the two mechanisms (Porter, 1985).

Because e-business has become commoditized and is not a differentiator by itself (Carr, 2003), differentiation lies in the new practices it enables (Brown and Hagel, 2003). Many processes can be dematerialized and services can be unbundled in terms of where and when they take place and who performs them, and thereafter be re-bundled into new offerings (Normann, 2001).

Hence, e-business, as a resource, may initiate a radical transformation of traditional customer-provider relationships (Nambisan, 2002) and the company's internal service processes through standardizing (and possibly automating or eliminating) processes (Koskela, 2002). Close proximity to the customer enable bonding and thus customer lock-in possibilities (Hax and Wilde, 1999), and customer relationship longevity improve the efficiency and effectiveness of service provision (Grönroos and Ojasalo, 2004). A perennial problem with differentiation is to make it sustainable. By using e-business technologies as vehicles for new services (based on knowledge residing within the company) and differentiation purposes (Kim et al., 2004), companies are also effectively raising the barriers for imitators as well as locking out competitors.

In the framework proposed by Porter (1985), *differentiation* is one of three distinct, generic strategies, the other two being *cost leadership* and *focus*. Treacy and Wiersema (1993) argue, close to Porter's discussion, that there are three competitive advantages that companies can pursue; *operational excellence*, *product leadership*, and *customer intimacy*. Both product leadership and customer intimacy holds great potential for e-business through new information-based services.

Hax and Wilde (1999) argue that Porter's strategic framework is insufficient to describe all the ways companies compete and instead they suggest three strategic options; *best product* (representing a continuum from low cost to differentiation), *customer solutions*, and *system lock-in* (by e.g. proprietary standards). Hence, the best product option includes Treacy and Wiersema's operational excellence and product leadership whereas customer solutions bear a close resemblance to customer intimacy, with focus on customer economics and lifetime value. Consequently, differentiation possibilities consist not only in enhanced product attributes.

To sum up, four main competitive advantages can be derived. The system lock-in dimension has little bearing on mature, established manufacturing companies' offerings (the context of this study) if related to e-business, as e.g. few dominant design proprietary standards for offerings exist. The remaining three dimensions are presented in Table 1. Offering leadership is not only goods-oriented, but refers to parts of or the total offering. For market-leading industry incumbents, low cost differentiation is not a strategic option (although cost efficient operations are critical) and the main potential for differentiation lays thus in offering leadership and customer intimacy.

It is especially worth noting the fact that customization is now possible without the often associated cost increase (Hitt et al., 2001). When focusing on customer intimacy and relationship longevity (in opposite to arm's-length relationships), emphasis lies on retaining customers (Grönroos, 2000). Accordingly, attracting new customers is achieved mainly through offering leadership.

According to Huizingh (2002) there are four strategic choices a company has when using e-business for value creation and thus differentiation purposes; *customize products*, *attract new customers*, *retain current customers* by providing added value, or to *reposition the company* in its business network. These choices primarily aim at increasing profitability through increasing revenue streams and adding value as opposed to decreasing costs. Amit and Zott (2001), in their useful framework, come close to the same notions when forwarding their four dimensions *novelty*, *efficiency*, *complementarities*, and *lock-in*.

RESEARCH METHOD

The research approach was, largely, exploratory and for our purpose, case study research was considered a useful strategy (Gummesson, 2000; Yin, 1994). The research process was an iterative process matching theory and reality, where advantage of the systematic combining of both the empirical world and the theoretical models was taken (Dubois and Gadde, 2002).

A multiple case study was adopted because, compared to a single case study, a multiple case study is often considered more compelling and robust (Yin, 1994). Specifically, cases were chosen that met four primary criteria: (1) the company is an international market leader, (2) the company pursues differentiation strategies, (3) e-business is used to increase the competitive advantage, and (4) access to key informants was possible. Eventually, four multinational, Swedish companies were selected for in-depth studies. Thus, the choice of companies was a deliberate research design parameter to ensure some degree of general applicability (Glaser and Strauss, 1967; Gummesson, 2000) and replication logic may be claimed (Yin,

1994). Accordingly, our findings are believed to apply also in other companies and industries.

The interviews were loosely structured with the help of an interview guide (i.e. a semi-structured approach) (Yin, 1994). Respondents were managers that worked with developing e-business and/or services within these companies. Furthermore, intranets, internal documents, project meetings and discussions were used as sources of information. In total, more than 30 meetings with respondents took place. Data collection and data analysis did, to a certain extent, overlap and thus a fruitful interaction resulted (Eisenhardt, 1989). A case study protocol was established to increase reliability and validation of the cases has been made with key respondents in order to ensure correctness (Pettigrew, 1997; Yin, 1994).

VOLVO BUS AB

Volvo Bus is the world's second largest bus manufacturer and most of their business is directed to large customers with extensive fleets of buses. In total, Volvo Bus estimates that there are approximately 130,000 company buses in operation worldwide.

Volvo Bus creates new information-based services (such as e.g. advanced on-line search functions for lead generation and skill location) through analyzing, understanding, and supporting customers' processes and needs. Volvo Bus does not just deliver "raw" information to their customers; instead, they provide ways and functions to use the information for e.g. business intelligence purposes. For example by allowing service bulletin (both tentative and official) to be distributed online turn-around time in workshops, both Volvo's own and independent, is reduced.

One of the most obvious added value for Volvo Bus internally as well as the customers is the fact that ICT has the potential of speeding up processes and making them easier, faster, more accurate, and hence cheaper. The better use of information as well as the new services has cut calls and created more trust between the parties, and is thus also strengthening the relationship. Furthermore, by empowering its customers by shifting information and tasks to them, Volvo Bus frees up time internally and instills a sense of ownership of the process and activities in the customers. Through this Volvo Bus manages to achieve lock-in effects and also switching costs can be raised. One example is allowing customers to print out their own bills directly from the system instead of sending them via fax/mail/e-mail reducing enquiries.

SANDVIK COROMANT AB

Sandvik Coromant is the world leading manufacturer of cutting tools and inserts for the metalworking industry with a catalogue of more than 25 000 products. They have a wide range of customer organizations ranging from major automotive companies to small metal workshops with just a few employees.

Sandvik Coromant's range of customers and products creates challenges since different customers demand different things from an e-business solution. For example, large customers, having their own e-exchange systems, have diametrically different demands than small metal work shops. Sandvik Coromant has not been efficient at handling very small customers (called micro customers). By adding e-functionality for e.g. credit card payments and making small orders directly on the Internet (in their web-based Shop-Online solution) Sandvik Coromant is able to capture the unrealized value that these small customers hold. Earlier these smaller orders were made through the telephone on an ad hoc basis making it hard to understand, and

Table 1. Strategic options for industry incumbents

Cost efficiency	Offering leadership	Customer intimacy
Cost leadership (Porter, 1985)	Differentiation (Porter, 1985)	Differentiation (Porter, 1985)
Operational excellence (Treacy and Wiersema, 1993)	Product leadership (Treacy and Wiersema, 1993)	Focus (Porter, 1985)
Low cost (Hax and Wilde, 1999)	Best product (Hax and Wilde, 1999)	Customer intimacy (Treacy and Wiersema, 1993)
		Customer solution (Hax and Wilde, 1999)

profit from, this group of customers. Because of this added information, a better segmentation of the customers also becomes possible. For the larger companies Sandvik is able to provide customized catalogues with a richness of details and information not possible without a sophisticated e-business solution.

By developing new e-enabled tools for the sales force that provide direct links to the company's legacy system as well as business intelligence applications Sandvik are able to increase productivity of the sales force and thus become more profitable.

BT INDUSTRIES

BT Industries Group is a global manufacturer and supplier of warehouse trucks and services, and part of the Toyota Group. Often, contracts with customers are gradually becoming increasingly advanced as the relationships develop and mutual knowledge improves, and customers are used in the service development process.

Since 2002, BT's service organization is using EASY, a mobile business system. Service technicians each have a PDA linked to the ERP system through GPRS where they receive and report work orders and have access to customer fleet data and spare parts information. While BT benefits from reduced administration cost and increased cash flow, customers have benefited from faster response to service calls. Administration is also reduced for the customer, who signs the completed work order digitally directly on the PDAs display. Several synergies have derived from the EASY implementation and one of the most appreciated things was the possibility for customers to receive work reports electronically.

Furthermore, value can be created by offering report packages and consultative services that enable customers to view the real-time utilization of the fleet, to view how trucks are driven, and how different customer sites perform.

ELECTROLUX LAUNDRY SYSTEMS

Electrolux Laundry Systems (ELS) is a worldwide supplier of professional laundry products and services. Managers have pointed at opportunities to increase the knowledge component in the service offerings through e-business. ELS has also recognized a need of knowing the knowledge profile of each individual, authorized service technician. Therefore, an online certification program has been launched to assure a homogeneous service quality worldwide.

ELS' management information system for laundries, CMIS, substitutes personnel for dematerialized information. With a CMIS port on the machine, it is possible to make changes to the laundry processes and still obtain more laundry per day, thereby obtaining better process optimization. Either CMIS can be run as a local network only or there can be a gateway to ELS so the company can monitor the processes. By governing the customer's process through CMIS, ELS can help to improve the laundry programs and maximize equipment uptime.

The creation of an installed base database, which provides the company with information about machinery type, actions taken, etc., has given ELS better knowledge about the customers and the database can thereby be used to support the provision of customized services.

DISCUSSION

E-business has a substantial effect on the Offering leadership dimension in establishing a differentiated offering to, especially new, customers (see Figure 1 below). This can probably be attributed to a traditional focus in most companies of emphasizing tangible offering features based e.g. on what technology allows. Furthermore, this has a primarily inside-out focus with companies creating services in a rather traditional fashion resembling product development. That is e-business is used to create *new services* from a perspective of what is possible and not necessarily what is needed and value creating. These new services can also either be bundled with existing offerings or provided as stand-alone unbundled services to both the installed-base and previously unrelated customers.

In the Customer intimacy dimension we see many activities regarding the *enhancing*, and deepening, of the *relationship* with the customer. This implies that companies are not just creating new services and offerings (as hinted above) but also addressing specific customer needs and processes, customization, with new services and offerings and are thus unlocking the true potential of e-business as a vehicle for value creation by both relieving customers (ie reducing cost)

and enabling customers' business (ie increasing productivity) (cf Ralavd and Grönroos, 1996).

Finally we can see that e-business refines and extends the companies' core business (cf Kraemer et al., 2000) and is used to create new customized offerings and create new value not only for external customers (cf. Huizingh, 2002), but also internally (e.g. mobile business systems) through process automation and elimination, i.e. *cost reductions*. The cost reduction aspect also means that a company can profitably approach previously unprofitable customer segments such as small customers with low transaction value versus cost ratio.

By adding new value-creating services to the company's core products and enhancing the relationship with the customer, it seems possible to reduce the changeability of the offerings by e.g. increasing switching costs. This is possible due to e.g. increased lock-in effects as well as an enabling of deeper relationships between buyer and supplier, thus increasing customer retention. We can also see that this enables the companies to escape the product commoditization trap by establishing themselves as solution suppliers and thus creating new differentiation opportunities. Many companies do indeed try to differentiate themselves through improved customer interactions instead of through product features (Vanderbosch and Dawar, 2002).

E-business can improve relationships in two distinct ways touched upon above. First, it decreases the cost of upholding an existing relationship and secondly, it

Figure 1. The effects of e-business on differentiation within the studied companies. The upper part of the figure shows the general aspects and the lower part some specific examples. 1) – 3) are the synthesized mechanisms

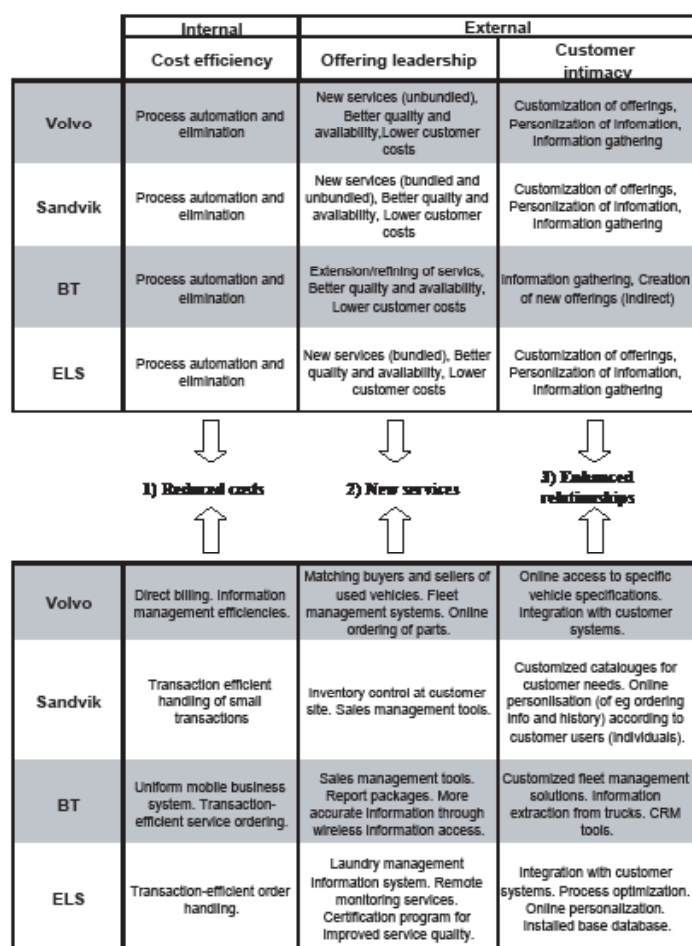
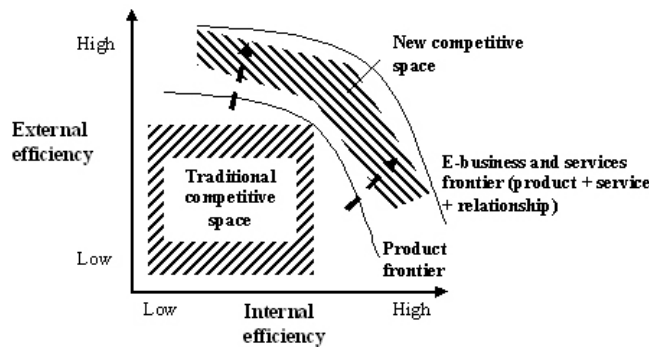


Figure 2. E-business and services can shift the competitive space



expands the width of the relationships by increasing contact points and integration by e.g. the inclusion of value-adding services in the offerings (based primarily on information gathering, analysis and distribution).

Through e-business, the case organizations have been able to cut administrative costs by re-engineering and even eliminating some administrative processes, typically the order process. This last point also has effects on the customer since an automated order process often can reduce costs for the customer as well. Furthermore it also increases the availability and simplicity of the interaction with the supplier thus creating value.

The three mechanisms discussed are not unrelated and can provide positive feedback loops to each other. For example, a customized solution provided to one customer can be generalized, and to a certain extent standardized, and rolled out as a new service in the company's total offering thus having a positive effect on offering leadership.

NEW COMPETITIVE SPACE

By using e-business and services, the studied companies stay ahead of competitors by effectively moving the competitive frontier further out into areas not covered by product features (these features are increasingly seen as qualifiers) but by "softer" issues (cf. Ulaga and Eggert, 2006). This new frontier is out of reach by low-cost competitors since they lack the necessary resources, such as well-functioning distribution and service networks, and can thus constitute a sustainable competitive advantage. If staying in the traditional competitive space, competitors will move closer and closer to the product frontier and thus erode any competitive advantage, whereas focus on service flows and customer processes (cf. e.g. Day, 1994) enables companies to cross the traditional, technology-oriented chasm and increase both internal and external efficiency (see Figure 2) (cf. also Normann, 2000).

In the traditional competitive space, value is largely created by technological advances regarding the products, and thus rather easily imitated, whereas in the new competitive space new services, information, and relationships (e.g. knowledge of customers and their processes) become of essence (Vargo and Lusch, 2004). Naturally, the company must have a reasonable cost level as well, thus not neglecting the cost-reduction aspect. This however is not a differentiator for the premium price strategy that the companies in this study have.

CONCLUSIONS

E-business can be used as a driver for new value in order to support differentiation strategies towards new customers as well as to retain current customers. Furthermore, e-business strengthens and adds value to the business model and enables its expansion and extension. An increasing part of all business development within companies today can be attributed to the development and inclusion of e-business and associated services into any companies (cf. Kindström, 2005).

One of the main purposes of e-business in this study is to create new services, for differentiation purposes, based on information gathering, analysis, and distribution. E-business supports and furthers the competitive position because it makes it possible to strengthen differentiation strategies (cf. Hackbarth and Kettinger, 2000). By using e-business to create new, often information-based, services and

by tying customers closer, the companies establish and position themselves better on the marketplace by focusing on the customer relationship. This in turn enables the companies to understand their customers and the processes better and thus construct more attractive offerings tailored to the specific needs.

E-business can also enable the creating of more business and expand sales, i.e. increasing revenue, by e.g. being able to address previously unprofitable smaller customers with low transaction cost solutions and also to sustain new revenue streams based on services and complete offerings.

REFERENCES

- Anderson, E., C Fornell and R. Rust (1997). Customer Satisfaction, Productivity and Profitability. *Marketing Science* 16(2),129-145.
- Amit, R and Zott, C (2001), Value Creation in E-business, *Strategic Management Journal*, 22(6-7),493-520.
- Barua, A, Konana, P, Whinston, A and Yin, F (2001), Driving E-Business Excellence, *Sloan Management Review*, Fall,36-44.
- Brown, J. and J. Hagel (2003), Does IT Matter?, *Harvard Business Review*, 81(7),109-12.
- Carr, N. (2003), IT Doesn't Matter? *Harvard Business Review*, 81 (5),41-49.
- Coltman, T, Devinney, T, Latukefu, A and Midgley, D (2001), E-Business: Revolution, Evolution, or Hype?, *California Management Journal*, 44(1),57-86.
- Day, G. (1994), The capabilities of market-driven organizations, *Journal of Marketing*, 58(4),37-52
- Dilworth, J and Kochhar, A (2004), Hype or Reality? A Survey of E-business, *IEEE Manufacturing Engineer*, April/May, 16-19.
- Dubois, A. and Gadde, L.E. (2002), Systematic combining, *Journal of Business Research*, 55(7),553-560
- Earl, M (2000), Evolving the E-business, *Business Strategy Review*, 11(2),33-38.
- Eisenhardt, K, Building theories from case study research, *Academy of Management Review*, 14(4),532-550.
- Fahey, L, Srivastava, R, Sharon, J and Smith, D E (2001), Linking E-business and Operating Processes, *IBM Systems Journal*, 40(4),889-907.
- Glaser, B. and Strauss, A. *The Discovery of Grounded Theory*, Aldine, New York
- Grönroos, C. (2000), *Service management and marketing*. Wiley, Chichester
- Grönroos, C and K Ojasalo (2004). Service productivity. *Journal of Business Research* 57,414-423.
- Gulati, R and Garino, J (2000), Get the Right Mix of Bricks & Clicks, *Harvard Business Review*, May-June,107-114.
- Gummesson, E. (2000), *Qualitative Methods in Management Research*, Sage, Thousand Oaks
- Hackbarth, G and Kettinger, W (2000), Building an E-business Strategy, *Information Systems Management*, Summer,78-93.
- Hax, A and D Wilde (1999). The delta model, *Sloan Management Review* 40(2),11.
- Henderson, J and Venkatraman, N (1999), Strategic Alignment: Leveraging Information Technology for Transforming Organizations, *IBM Systems Journal*, 38(2-3),472-484
- Henkel, C, O Bendig, T Caspari and N Hasagic (2004). Industrial Services Strategies, Monitor Group.
- Huizingh, E (2002), Towards Successful E-business Strategies: A Hierarchy of Three Management Models, *Journal of Marketing Management*, 18,721-747.
- Kaefer, F and Bendoly, E (2004), Measuring the Impact of Organizational Constraints on the Success of Business-to-Business E-commerce Efforts, *Information and Management*, 41,529-541.
- Kim E, Nim D and Stimpert J (2004), The Applicability of Porter's Generic Strategies in the Digital Age: Assumptions, Conjectures, and Suggestions, *Journal of Management*, 30(5),569-589.
- Kindström, D (2003), *Rearranging a Business Model towards Market Orientation*, Licentiate Thesis, Linköping Universitet.
- Kindström, D (2005), *Integrating E-business into Mature and Established Companies*, Dissertation, Linköping Universitet.
- Koskela, H (2002), *Customer Satisfaction and Loyalty in After Sales Service*. Dissertation, Helsinki University of Technology.
- Kowalkowski, C. (2007 in press), Service Productivity Gains through Information and Communication Technology Applications, *International Journal of Knowledge Management Studies*.

506 2007 IRMA International Conference

- Kraemer, K, Dedrick, J and Yamashiro, S (2000), Refining and Extending the Business Model wit Information Technology: Dell Computer Corporation, *The Information Society*, 16, 5-21.
- Kumar, R (2004), A Framework for Assessing the Business Value of Information Technology Infrastructures, *Journal of Management Information Systems*, 21(2), 11-32.
- Matthyssens, P and K Vandenbempt (1998). Creating competitive advantage in industrial services, *Journal of Business and Industrial Marketing* 13(4/5), 339-355.
- Nambisan, S (2002) Designing Virtual Customer Environments for New Product Development, *Academy of Management Review* 27(3), 392-413.
- Normann, R (2000), *Service Management*, Wiley, Chichester.
- Normann, R (2001), *Reframing Business*, Wiley, Chichester.
- Oliva, R and R Kallenberg (2003). "Managing the transition from products to services." *International Journal of Service Industry Management* 14(2), 160-172.
- Pettigrew, A (1997), What is processual analysis, *Scandinavian Journal of Management*, 13(4), 337-348.
- Porter, M (1985), *Competitive advantage*, Free Press, New York.
- Porter, M (2001), Strategy and the Internet, *Harvard Business Review* 79(3), 62-78
- Porter, M and Millar, V (1985), How information gives you competitive advantage, *Harvard Business Review*, 63(4), 149-160.
- Subramaniam, C and Shaw, M (2002), A Study of the Value and Impact of B2B E-Commerce, *International Journal of Electronic Commerce*, Summer, 6(4), 19-40.
- Treacy M and F Wiersema (1993), Customer intimacy and other value disciplines, *Harvard Business Review*, Jan/Feb, 84-93
- Uлага, W. and A. Eggert (2006), Value-Based Differentiation in Business Relationships, *Journal of Marketing*, 70(1), 119-36.
- Vargo, S. and R. Lusch (2004), Evolving to a New Dominant Logic for Marketing, *Journal of Marketing*, 68(1), 1-17
- Venkatraman, N and Henderson J (1998), Real Strategies for Virtual Organizing, *Sloan Management Review*, Fall.
- Weill, P and Ross, J (2004), *IT Governance*, HBS, Cambridge.
- Wikström, S. and R. Normann (1994), *Knowledge and Value*. London: Routledge.
- Yin, R. (1994), *Case Study Research*, Thousand Oaks, Sage
- Zwass, V (2003), Electronic Commerce and Organizational Innovation, *International Journal of Electronic Commerce*, 7(3), 7-37.

0 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/proceeding-paper/world-leading-manufacturers-can-achieve/33122

Related Content

New Efficient Evolutionary Algorithm Applied to Optimal Reactive Power Dispatch

Provas Kumar Roy (2014). *Contemporary Advancements in Information Technology Development in Dynamic Environments* (pp. 321-339).

www.irma-international.org/chapter/new-efficient-evolutionary-algorithm-applied-to-optimal-reactive-power-dispatch/111617

Human Supervision of Automated Systems and the Implications of Double Loop Learning

A.S. White (2013). *International Journal of Information Technologies and Systems Approach* (pp. 13-21).

www.irma-international.org/article/human-supervision-of-automated-systems-and-the-implications-of-double-loop-learning/78904

Exploration on the Operation Status and Optimization Strategy of Networked Teaching of Physical Education Curriculum Based on AI Algorithm

Yujia Wang (2023). *International Journal of Information Technologies and Systems Approach* (pp. 1-15).

www.irma-international.org/article/exploration-on-the-operation-status-and-optimization-strategy-of-networked-teaching-of-physical-education-curriculum-based-on-ai-algorithm/316892

Linking Research and Teaching: An Applied Soft Systems Methodology Case Study

Lynda Holland and Joy Garfield (2016). *International Journal of Information Technologies and Systems Approach* (pp. 23-38).

www.irma-international.org/article/linking-research-and-teaching/152883

Towards a General Theory of Information

Laura L. Pan (2018). *Encyclopedia of Information Science and Technology, Fourth Edition* (pp. 4459-4469).

www.irma-international.org/chapter/towards-a-general-theory-of-information/184153