The digital economy relies tremendously on the technologies on which e-commerce innovations are built. However, today, most senior managers face difficulties as they attempt to formulate strategies to compete in this new and highly technological environment. They include understanding the relevant technology trends, identifying appropriate technologies, and effectively harnessing them to improve their firms’ position in the market. Making sense of the underlying technologies, without the requisite managerial ability to utilize them correctly, will rarely provide a firm with competitive advantage. We now know better that the inverse is true too: firms that lack technological understanding will not be able to compete successfully, even if their management teams have substantial business acumen.

For this issue of *Electronic Markets*, three books were selected that spotlight technology issues faced by industry professionals and e-commerce researchers. They are:

- **Competing in the Age of Digital Convergence** (Yoffie 1997) analyses how the convergence of digital technologies affects competitive marketplaces, and helps senior managers tackle the resulting new challenges. Once you understand the general perspective that Yoffie outlines, it may change your way of thinking about where your firm’s next arch-rivals will come from.

- **Intelligent Information Agents: Agent-Based Information Discovery and Management on the Internet** (Klusch 1999) provides an overview of the kinds of impacts that software agents are making on mercantile processes in e-commerce by reducing information overload for consumers. Klusch argues that the even greater impact, though it has yet to materialize, should be expected when the new agent technologies come into more common use in business-to-business marketplaces.

- **Information Technology and the Productivity Paradox: Assessing the Value of Investing in IT** (Lucas 1999) argues that both traditional quantitative measures and qualitative factors should be considered in the information technology investment decisions of managers. Failure to make decisions on the basis of a balanced evaluative perspective will lead firms to miss important opportunities or fall prey to exaggerated expectations.

The invited reviewers for this issue’s books are second-year and third-year doctoral students who participated in the ongoing ‘Doctoral Seminar in Economics, IS and Electronic Commerce’ at the Carlson School of Management, University of Minnesota. (See ids.csom.umn.edu/8801 for the syllabus materials and learning goals of the course.) The approach that we have taken to this doctoral course is to make it a ‘production seminar’, where there are clearly defined goals and processes to bring rough ideas about interesting topics for research to fruition through writing. In the Spring 2002 course, 15 students were asked to review books on current themes and topics in the management of technology and e-commerce. Since the theoretical perspectives of the seminar are taken from economics and management science, we further required students to evaluate the authors’ contributions in the light of relevant theory from this body of knowledge. We took the students’ essays through a number of reviews that were aimed at emulating (albeit in reduced form) the feedback–response loop that academic authors experience when they submit journal papers for peer review. Once the instructors felt comfortable that the students’ work was of high quality and likely to be worthwhile for the journal’s readers, we forwarded them to EM’s editorial staff for final decisions on acceptance for the journal.

We sincerely thank Beat Schmid and Lucia Pavlikova for their kind sponsorship of this ongoing project. We also appreciated the efforts that our soon-to-be-faculty student authors made to deliver interesting perspectives on the selected books. We trust that *Electronic Markets* readers will find the perspectives to be timely and insightful.

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**Competing in the Age of Digital Convergence**

David B. Yoffie (ed.)


Technological advancements in the fields of communication, computer science and semi-conductors have revolutionized how firms do business. Rapid developments in these fields are driving them towards a ‘digital convergence’ – a unification of the functions, and a coming together of the previously distinct digital technologies. The issue of
primary concern now is how companies and managers should prepare themselves for this rendezvous. How and when will the digital convergence occur? What are some of the managerial challenges facing companies in this rapidly changing environment? What are the economic, legal and managerial obstacles to digital convergence? How should companies design and develop their products in such competitive markets? David B. Yoffie addresses some of these issues in a collection of articles by various authors in his 1997 book, *Competing in the Age of Digital Convergence*.

The Internet and digital technologies have led to the emergence of e-commerce. Convergence in Internet and digital technologies has rendered feasible various business-to-business (B2B) and business-to-consumer (B2C) transactions over the Internet. However, the new markets that have emerged on the Internet are different from traditional, physical markets. As a result there are a number of issues that have arisen relating to the impact of these e-commerce technologies: on market structure; significance standards; the business value of these e-commerce technologies for adopting firms in the presence of network externalities; and the role of intermediaries in this B2B and B2C electronic markets. These are shown in Table 1.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Description</th>
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<tbody>
<tr>
<td>Market structure</td>
<td>What is the impact of the e-commerce technologies on market mechanisms? What market structures are favoured? What are the roles of the different players involved? What are the decisive factors?</td>
</tr>
<tr>
<td>Network adoption, externalities, standards</td>
<td>How do standards and compatibility issues affect the network adoption? What are the factors affecting the network externalities?</td>
</tr>
<tr>
<td>Business value</td>
<td>What B2B business models can lead to success in the digital economy? What are the key value propositions? How do they serve the firm’s needs?</td>
</tr>
<tr>
<td>Disintermediation</td>
<td>When are the traditional middlemen eliminated? How are their roles altered as electronic marketplaces emerge?</td>
</tr>
<tr>
<td>New intermediation</td>
<td>What are the factors that support reintermediation?</td>
</tr>
<tr>
<td>Convergence</td>
<td>How will communication media converge in computer-like devices?</td>
</tr>
</tbody>
</table>

By examining the current battles for converging industries and exploring the reasons why companies have failed or succeeded in prior transitions, this book provides a starting point to analyse the issues in e-commerce identified above. Although the book is focused on the computer industry, it also covers a wide range of industries and companies and provides a strong base from which to obtain insights from both an economics and an e-commerce perspective.

E-commerce technologies affect the market mechanisms by favouring electronic markets over electronic hierarchies (Malone et al. 1987). Overall the evidence supporting or rejecting this hypothesis is still inconclusive. For example, Hess and Kremer (1994) find preliminary evidence against it in their case analysis of the mortgage industry. For successful business performance, it is imperative for firms to understand the market structure, the forces affecting it, the dominant players involved and appropriate strategies that can be applied. To address this need, Yoffie analyses the resources and capabilities that firms will require to compete successfully in consumer markets that converge around telecommunications, computing and entertainment industries. Further, he hypothesizes that the consumer multimedia industry will be changed from three vertical businesses into five horizontal segments and suggests that content providers are in the strongest position to prosper, while hardware companies face more limited prospects.

Yoffie also identifies how the convergence of technologies affects the structure of the hardware, software and communication industries in complex ways. Public policies can do much to facilitate or hinder the restructuring of these industries in response to their changing technological opportunities. Addressing the issue of intellectual property and its impact on an industry’s structure from the context of other emerging industries – especially software and biotechnology – Yoffie also contends that broad patent protections are in the interest of industries in their formative stages.

The issues of externalities, network adoption, standards, compatibility and information transparency assume prime significance in the context of electronic markets. Incomplete contracts, trade-offs involved with information sharing, lack of standards and compatibility are some of the factors that have been studied by researchers in this area. The author highlights the significance of creating value and setting standards in the age of digital convergence by analysing the failure of PDAs in comparison with the evolution of other consumer electronic products in the twentieth century. Yoffie suggests that first-movers in the consumer electronics markets will achieve sustained competitive advantage if they offer an open architecture, promote widespread adoption of complementary
infrastructure and ensure compatibility with the installed base of market-leading microcomputer software.

The book also provides some insight into the issue of adoption of new technologies within the corporate settings, which is central to the problems of digital convergence, by looking into the case of delayed adoption of client-server technologies in the corporate world. Yoffie identifies that there is a lack of clearly-defined interface standards and market boundaries and that only those organizations that find a compelling strategic rationale will be early adopters.

By identifying two distinct types of convergence – convergence in substitutes and convergence in complements – the author also stresses the importance of where in the value chain of a firm the convergence takes place. He further identifies how the boundaries between industries evolve to characterize how firms’ incentives for cooperation and competition differ.

Another issue of prime significance in light of the converging information technologies is the role and function of intermediaries in electronic markets. New Internet technologies provide different ways of interacting for all market players. As a result, traditional intermediaries risk being eliminated from the electronic markets, because buyers and suppliers are able to interact more easily using the new technology (Malone et al. 1987). However, electronic markets have specific intermediation needs, such as aggregation, one-stop shopping, trust provision and filtering (Bailey and Bakos 1997). Thus, although contrasting theories exist regarding the need and role of intermediaries in the markets, some of the recent work by Chircu and Kauffman (1999) suggests that the Intermediation/Disintermediation/Reintermediation cycle sheds some light on this subject. In this respect, Yoffie fails to provide any insight into the significance of intermediaries and their role in the marketplace.

This book provides a useful introduction to some, but not all, of the current issues that are prevalent in business situations where digital convergence is occurring. It offers readers a good place to start in order to understand how digital convergence may impact the digital economy.

References

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Intelligent Information Agents: Agent-Based Information Discovery and Management on the Internet M. Klusch (ed.) Springer-Verlag, Berlin, 1999

The unprecedented growth of information technology has made numerous web resources instantly accessible to various user communities. The emergence of the Internet has also significantly increased the scope and scale of data distribution. From the user’s point of view, this large number of information sources makes it increasingly difficult to search for and retrieve desired information. Confronting this challenge of information overload, users need assistance to identify the most interesting and valuable information, enabling savings of money and time. Intelligent agents for the Internet can provide such assistance. Among the many recent technical innovations associated with e-commerce we have seen the emergence of information agents that have been created to meet these needs and manage the explosive growth of information on the Internet (Jennings and Wooldridge 1998).

Matthias Klusch, the editor of Intelligent Information Agents, has brought together a broad range of state-of-the-art research on advanced systems, methods and tools of information agent technology. He defines intelligent information agents as autonomous, computational software entities that provide proactive resource discovery, that resolve information impediments for information consumers and providers and that offer value-added information services and products. Klusch, similar to Jennings and Wooldridge (1998) and other authors, further categorizes the agents into several classes according to their functionality characteristics: cooperative or non-cooperative, adaptive, rational and mobile. Based on his classification shown in Table 2, I will analyse and explore the relevance of information agents in more detail.

Cooperative information systems and agents

In one chapter of this book Papazoglou and Heuvel, who coined the term cooperative information systems, describe these systems as advanced middleware infrastructures
based on the inclusion of information agents that support higher levels of cooperation and provide required services. Thus, cooperative information systems can be defined as agents operating with other agents to analyse, design and integrate distributed systems. The cooperative agents share an interaction protocol to communicate with each other, but each agent decides upon its own strategy. Thus, coordination, negotiation and collaboration between agents are crucial to achieve goals and avoid conflicts. To address the challenge of building coordinated and integrated information agents, artificial intelligence (AI) techniques have been used in combination with methods from other fields, such as economic theory, game theory, social sciences and operation research. Interactions among self-interested agents have been widely studied in the subfield of cooperative game theory (Rosenschein and Zlotkin 1994). In another chapter of the book, Huhns and Singh describe social abstractions for agents that explicitly constrain agent interactions and that enforce coordination and cooperation. Consequently, the coordination and cooperation activities among information agents can be viewed as a process for increasing social welfare, i.e., the sum of all agents' payoffs or utilities in a given environment.

### Progressive information agents

**Adaptive information agents**

Learning and adaptation are significant issues in the design of information agents that interact in the presence of situational uncertainty about other agents' strategies (Kephart et al. 2000). Confronted with the difficulty of incorporating the issue of bounded rationality into their analyses, most economists have simply avoided questions concerning economic agent decision-making in continuously changing situations (Holland and Miller 1991). However, it is possible to draw inferences about a user's direct utility by observing the behavior of the agents, which repeatedly perform similar tasks (Vulkan 1999).

This book presents several ongoing research efforts regarding adaptive information agents in e-commerce environments. These agents have the capability to respond to unexpectedly changing situations, to learn from user profiles in the e-commerce site, to adapt the interface to show current information and to make recommendations to the users. This book also discusses widely-used and effective techniques in developing adaptive agents, including personalization, collaborative filtering, relevance feedback and machine learning techniques such as genetic algorithms. Adaptive agents also employ some economic thinking, such as expected utility maximization, to gather useful information by repeatedly querying multiple search engines.

**Rational information agents and electronic commerce**

In recognition of the rational individual behavior assumption upon which much economic theorizing is based, rational information agents act and may even collaborate to increase their own benefits as if they were real business people with economic incentives. These information agents typically use incomplete information that is subject to change. In this context, game theoretic models may be appropriate for the design of automated interaction mechanisms among information agents in e-commerce markets. Additionally, trust mechanisms, in terms of incentive compatibility mechanisms and the revelation principle, are clearly critical in the human-agent interaction for the success of agent-based applications (Vulkan 1999). A mechanism is incentive compatible if it is direct and if truth-telling is a dominant strategy for every player. The revelation principle promotes truthful reporting in game-theoretic analyses of incomplete information. One of the key features of rational agents is to reduce transaction costs (e.g., search costs) that may be too high for either consumers or suppliers in real-world negotiations.

From the consumer's perspective, rational agents act as personal assistants to reduce the amount of human–computer interaction, providing convenience while saving time and money. From a business perspective, rational agents act as a tool to perform complex tasks, which helps in reducing operational expenses. Such agents are used, for example, on the Internet in electronic auctions. This book discusses a number of research efforts with rational information agents and
Mobile information agents

The explosive expansion of the Internet enables nomadic users to connect to the network from diverse access points (e.g., laptops while travelling). Mobile information agents provide a single, general framework in which distributed, information-oriented applications can be implemented efficiently and easily, with the programming burden spread evenly across information, middleware and client providers. The asynchronous and autonomous properties of mobile agents offer benefits in dynamic and flexible distributed information retrieval and negotiation in the electronic marketplace. More generally, mobile agents offer practical advantages such as network traffic reduction, protocol encapsulation, asynchronous and autonomous execution, dynamical adaptation, seamless system integration and robustness and fault tolerance (Lange and Oshima 1999).

While mobile agents provide many such useful capabilities, their use on the Internet is still very limited. This book raises several critical issues regarding the use of mobile agents, such as security, coordination and compatibility among varied mobile agents and agent spawning. The latter mechanism resolves agent overload problems by passing tasks to other agents or deploying agents across remote hosts. Also discussed are coordination patterns, which reuse software patterns of coordination among mobile agents suitable to a given application. From the perspective of software economics, agent reuse is an efficient solution for minimizing an agent’s development cost over multiple uses.

Conclusion

Information agents have made significant impacts on the Internet-based economy by managing and overcoming information overload problems. They also promise new ways for consumers and businesses to interact by enabling them to participate in electronic marketplaces. The articles in this book are based on the author’s classification of information agents. As in most of the research on agent classification (e.g., Jennings and Wooldridge 1998), however, the author’s categories are not mutually exclusive, but overlap somewhat. For example, rational agents should do whatever action is expected to maximize their performance measure on the basis of the evidence provided by the percept sequence and whatever built-in knowledge the agents have (Russell and Norvig 1995). In spite of the overlapping classification, this book captures the significant characteristics of information agents and provides good insights into information agents.

References


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Information Technology and the Productivity Paradox

Henry C. Lucas, Jr.
Oxford University Press, New York, NY, 1999

Far from being a death-knell for e-business, recent dot.com failures have served to remind us that the basics of good business practices and valuation never go out of style. This holds true whether you are an investor looking to purchase stock or a manager deciding whether to fund an e-commerce technology initiative. Quantitative tools such as ROI and cost/benefit analysis are more than just a hook to hang your ‘decision hat’ on. They are time-tested, proven ways to determine the value of an investment.

Or are they? Henry C. Lucas, Jr. in his book Information Technology and the Productivity Paradox, suggests that although these tools have their place, they should not be the only basis for valuing IT projects. Rather, a combination of quantitative and qualitative factors need to be assessed in order to avoid both missed opportunities and exaggerated expectations. Lucas provides a framework that managers can use to evaluate an investment’s potential for economic and non-economic returns and in the process, get their next e-business project funded.
The depth and breadth of expenditures needed for e-business IT projects have always provided a challenge for managers trying to demonstrate traditional, financially based returns. The difficulty lies in trying to capture the benefits of an investment that is often a combination of competitive necessity, organizational transformation and new strategic direction mixed with leading-edge technology and uncertain market conditions. For Lucas, the key to valuing these investments is in understanding this diversity. Different types of IT applications exhibit different types of returns. Specifically, Lucas states that there are IT applications where you cannot expect to obtain a measurable financial return that warrants investment. He identifies eight types of technology investments and suggests that each type has its own probability of return. Not surprisingly, many of today’s more popular e-business applications are a blend of investments that have no predictable financial return. Table 3 presents Lucas’ investment categories and probabilities of return, along with several e-business-related examples. While you may not agree with the exact figures Lucas assigns to the likelihood of returns, what is important to note is that different types of investments warrant different expectations.

<table>
<thead>
<tr>
<th>Type of investment</th>
<th>Probability of return</th>
<th>E-commerce examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>0.2 to 1.0</td>
<td>Wide area networks; firewalls and other security; XML conversions</td>
</tr>
<tr>
<td>Required managerial control</td>
<td>0 to 0.5</td>
<td>EDI mandated by supplying or purchasing firm; regulated electronic reporting</td>
</tr>
<tr>
<td>No other way to do the job</td>
<td>0.5 to 1.0</td>
<td>Mass e-mail marketing; concurrent sale and delivery of electronic goods</td>
</tr>
<tr>
<td>Direct return from IT</td>
<td>0.7 to 1.0</td>
<td>Just-in-time inventory systems; online transaction processing</td>
</tr>
<tr>
<td>Indirect return</td>
<td>0 to 1.0</td>
<td>Airline reservation/check-in and other self-service websites</td>
</tr>
<tr>
<td>Competitive necessity</td>
<td>0 to 1.0</td>
<td>Bank ATMs; some websites such as BN.com, Borders.com</td>
</tr>
<tr>
<td>Strategic application</td>
<td>0 to 1.0</td>
<td>Dependent upon the firm, e.g., Schwab’s e-trading and Wal-mart’s B2B systems</td>
</tr>
<tr>
<td>Transformational IT</td>
<td>0 to 1.0</td>
<td>Virtual organizations; mortar-and-borderless firms</td>
</tr>
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</table>

Recognizing the type of investment proposed and its potential for financial return is the first step in successfully funding e-business initiatives. In a survey of e-business IT funding practices at 30 companies in the US and Europe, Ross and Beath (2002) found that the majority of the companies said they traditionally relied on a financial-based business case to justify investments. However 27 of the firms funded at least one e-business initiative without a business case. Aiding the funding decision in several firms was an approach based on investment types, similar to Lucas’ categories, where separate budgets were established for different kinds of investments. Twelve of the firms had even created a separate budget for what they considered to be experimental e-business projects. Ross and Beath note that by classifying investments and allocating funds by investment type, companies reduce the potential for under-funding any specific type of project and reverting to the old ‘ROI-or-nothing’ business case.

Yet if so many of these projects have no predictable financial return, why are companies still investing in them? Lucas’ answer is that since IT is such an integral part of business, it often exhibits value that has only a remote connection with money. In a market-based economy, prices are established and value is typically measured in dollar terms. However, computing a monetary value for a return from IT investments can be challenging. Lucas’ stance is particularly true for firms competing in today’s electronic marketplace, where the value of speed and improved information are especially difficult to quantify.

For GE Plastics, the retooling of GEPlastics.com was less about increasing its $2-3 million per week sales revenue and more about protecting the way it does business (Levinson 2000). With plastics aggregators beginning to come online, the company realized that increasing customer loyalty and differentiating itself from competitors would be key to ongoing success. Although the firm’s online design centre does not directly generate sales, the site offers new functionality to existing customers and exposes thousands more potential customers to the benefits of doing business with the firm. GE Plastics’ insight illustrates how managers investigating how to fund e-business initiatives must consider all the ways that an IT investment can contribute to success, regardless of whether that contribution is direct, indirect or even unanticipated.

An early example of unanticipated benefits is the airline industry’s investment in travel agency automation, which Lucas notes...
created not only direct benefits from booking fees, but also indirect benefits through biased markets and improved customer service. Since that initial application, the airlines’ use of electronic channels has exploded to include direct customer electronic sales and online check-in. In addition to boosting service to another level, the individualized customer information these new channels provide can form the basis for future price and market discrimination. Shapiro and Varian (1999) also remark on the difficulty of determining future benefits, particularly those derived from e-business technologies that exhibit positive network externalities. They note that network effects in these technologies tend to manifest long lead times that are often later followed by explosive growth. Much of today’s continued investment in wireless technologies, such as Wireless Application Protocol (WAP) and Bluetooth, is based on the belief that exponential growth for those applications is just around the corner. Equally difficult to quantify, according to Lucas, are the benefits derived from IT investments that are an integral part of company strategy. Such close coupling makes it difficult to measure the exact contribution of IT in financial terms, but value can often be measured qualitatively. Lucas notes that IT is a key component of Federal Express’ corporate strategy to compete in the new electronically enabled marketplace. Spending $1 billion a year on items, including a website where customers can track packages, FedEx has used IT to transform itself into a package and information delivery business. Lucas’s position is also supported in an interview of Rob Koch, Vice President of Finance at OfficeDepot. Remarking on the company’s decision to implement a full-blown B2C retail website in 1997, Koch stated: ‘ROI’s a good tool, but it’s not the be-all and end-all. Some decisions are purely strategic’ (Berkman 2001: 96). By the year 2000, the site was generating 9% of OfficeDepot’s total annual revenue, in a sector where many firms are still hesitating to make a commitment.

Lucas also points out that major changes in organizational structure can often be attributed to IT. Interorganizational systems are redefining the concept of what constitutes a firm by enabling what Lucas terms ‘virtual components’, traditional parts of companies that no longer exist physically. Chrysler’s virtual inventory, enabled by just-in-time ordering and delivery, is one example of this type of component. Riggins (1999) has reported that Security First Network Bank, the first all-Internet bank, operated for several months without any physical branch office. Electronic business channels are also enabling closer integration of steps in the value-added chain (Malone et al. 1987), at times almost erasing the boundaries between firms. In a survey of 120 CEOs of e-commerce firms, Kickul and Gundry (2001) found that the enterprises studied had formed innovative, fluid external relationships with suppliers, customers and even competitors. One CEO in the study remarked (p. 357): ‘We have no competition, just resources we haven’t used yet.’ Such comments are not just mere bravado. Today’s successful e-business firms are busy transforming themselves from click-and-mortar to mortar-and-borderless.

Lucas argues that cases such as the ones above demonstrate strong qualitative evidence that there is benefit from IT investments, even though the quantitative returns remain difficult to calculate. Although these successes cannot be totally attributed to IT, the business strategies undertaken could not have existed without the supporting technology. Where would eBay be without the Internet and e-commerce software? Would Sam Walton be a household name today without the market-altering ability to electronically integrate suppliers? Despite the recent downturn in economic activity, including e-commerce, it is certain that technology will continue to transform the landscape in which we do business and the ways in which we add value to our firms for many years to come.

Of course there are times when the value of an IT investment can be measured quantitatively and certainly qualitative value does not preclude monetary returns. For these situations, Lucas provides several techniques for capital budgeting analysis, including an approach based on options pricing models. The options pricing method of valuation is especially well-suited to e-business initiatives, since they are typically implemented in phases or as separate, yet dependent projects. For example, a firm may need to evaluate both a current e-commerce infrastructure initiative and a future B2C website project that relies on that infrastructure. Options pricing models explicitly address the opportunity costs and benefits associated with this type of coupled investment. The options framework is also useful for assessing when, in the future, to invest in a technology. Investment in still-evolving technologies, such as web services and peer-to-peer e-commerce applications, are potential candidates for this type of forward-looking valuation.

In all, Lucas makes a persuasive argument that there is value in information technology, both in economic and non-economic terms. While some managers may already be familiar with the concepts presented, Lucas combines them into an overall assessment framework and offers insights into the more subtle sources of IT worth. With most of the e-commerce market still in its infancy, estimating the direct financial return on any technology investment is problematic at best. Thus the future of many electronic market technology initiatives will continue to rely on the insight...
and vision of managers who are aware of the hidden value of IT.

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