Electronic Commerce and Organizational Innovation: Aspects and Opportunities

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ABSTRACT: Over the past decade, electronic commerce on the technological foundation of the Web-Internet compound has entered extensive areas of organizational and social activity. This broad-based organizational and technological development requires categorization in order to be understood in its entirety and exploited fully. The principal aspects of e-commerce are identified in five domains: commerce, collaboration, communication, connection, and computation. These aspects lead to specific innovational opportunities that can be exploited to organize and address marketplaces, offer innovative products, collaborate with business partners, transform business processes, and organize the delivery of information-system services. The result is a comprehensive framework of e-commerce as a technologically based means to business transformation and a metadisciplinary research field.

KEY WORDS AND PHRASES: Conceptual frameworks, electronic commerce, innovation, Internet, World Wide Web.

A decade has elapsed since the recognition of electronic commerce as a distinct and important phenomenon. This occurred when the invention of the World Wide Web and the fielding of browsers combined with the pre-existing capabilities of the Internet to offer a platform for innovation in the way organizations arrange their business processes, address their marketplaces, and partner with other enterprises. Sweeping process innovation is frequently accompanied by product innovation. Often, e-commerce is understood very narrowly to mean retailing over the Web or the activities of firms whose sole presence is on the Web (and whose once-so-desirable designation of dot-com has become a mark of opprobrium). In order to apprehend the nature and scope of the opportunities offered by e-commerce, it is necessary to organize them categorically and see them fully. Therefore, the objective here is to show the broad spectrum of innovation activities fostered by e-commerce. As will be discussed below, many of these opportunities have been enacted in practice. Others are being introduced or are the subject of concept-proven research.

The opportunities discussed below stem from the diverse aspects of the enterprise of e-commerce, ranging from those inhering in the Internet-Web infrastructure all the way up to its deployment as marketplace and universal value-chain linkage. These aspects fall into five broad domains: commerce, collaboration, communication, connection, and computation. It needs to be stressed, time and time again, that opportunities, including those that are technologically based, do not translate into realities without the necessary organizational processes, such as entrepreneurship and intrapreneurship, organizational learning, adoption, diffusion, and infusion of innovations, the culture of individual and group creativity, and executive support for change. There is no technological imperative. However, transformational technologies do change the force field and cannot be ignored.

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This paper will analyze the eleven fundamental aspects that the Internet-Web compound offers to the needs of e-commerce. Although the Web is not the only application of the Internet, clearly it is the one defining many of these aspects. The compound has been stable even though the Web may be replaced by or submerged under another layer of software functionality.[1] Here, the aspects of the compound will be categorized within the five activity domains stated above and viewed through the lens of opportunities for innovation in organizational settings. The opportunities are analyzed, and emblematic examples of their organizational exploitation are offered. As will be seen, an extensive analytical and research literature on e-commerce has been developing. Only the indicative works will be cited, for it is already virtually impossible to encompass within a single paper a fully representative, much less inclusive, literature review.

The Emergence and Scope of Internet-Based E-Commerce

Electronic commerce is defined here, following the author's earlier discussion [105], as the sharing of business information, maintaining of business relationships, and conducting of business transactions by means of telecommunications networks. A decade ago, in the spring of 1993, e-commerce acquired the vehicle of the accessible Web-Internet compound through the confluence of a series of technological, organizational, and societal developments. The principal outcomes were the transformation of the Internet from a cloistered ARPANET into a publicly accessible and commercially available network of networks carrying e-mail and open to global organic growth, the invention of the Web as a distributed hypermedia database for this network, and the opening of the Web to easy access with the fielding of browsers. The facilities of the Web-Internet compound, and the technological and organizational structures superimposed on it, can be considered within a hierarchical framework of e-commerce consisting of infrastructure, services, and products and structures [105]. A related framework, serving to systematize the economics approaches to e-commerce, has been proposed by Kauffman and Walden [54]. E-commerce activities include the interorganizational processes of market-based sell-buy relationships and collaboration (known as business-to-business, or B2B, commerce) and consumer-oriented activities (business-to-consumer, i.e., B2C, and consumer-to-consumer, or C2C), as well as the intraorganizational processes that support them.

E-commerce activities have shown a steady and rapid growth. The number of Internet users worldwide at the end of 2002 was estimated by the International Telecommunication Union at 655 million, as reported in UNCTAD's *E-Commerce and Development Report 2002* [26]. While the developed countries showed a slowdown in the rate of increase associated with saturation, the developing countries accounted for about one-third of new Internet users worldwide in 2001. This is, of course, an estimate of global connectivity, which relates to, but does not determine, e-commerce volume. Thus, although e-commerce is growing in the developing countries, its growth there is much

slower than the rate of increase in the number of Internet users [26]. As what is encompassed by e-commerce differs widely among estimators and prognosticators, so do their estimates and forecasts. According to Forrester Research [33], the total volume of global B2B and B2C e-commerce at the end of 2002 would reach approximately $2.3 trillion, projected to reach about $12.8 trillion in 2006, which would then comprise 18 percent of the world's sales of goods and services. The difference between the current volume and the projection is daunting. At present, B2B e-commerce constitutes about 94 percent of the total. A much lower estimate, including only B2B commerce, is that of eMarketer, which placed the figure at about $800 billion at the end of 2002 [28]. The UNCTAD report notes the wide discrepancies between the available forecasts but stresses their agreement on the very rapid combined annual growth rate of B2B and B2C e-commerce, ranging between 53.8 percent and 70.1 percent a year [26]. Along with the fact that market-oriented commerce is concentrated largely in the B2B sector, one must point out that the preceding estimates do not include the large component of intraorganizational e-commerce, which is difficult to estimate.

Electronic commerce as we know it today is based not only on developments pertaining to the Web-Internet compound, but on prior technological and organizational developments arising from the combination of telecommunications and computing. The more important of these are interorganizational information systems, standards for exchanging business documents, such as electronic data interchange (EDI), distributed database management systems, and collaboration technology.

The Domains of E-commerce

Electronic commerce encompasses a set of aspects, derived from the properties of the Web-Internet compound, that should be recognized in their entirety. These aspects furnish opportunities for organizational innovation and marketplace competition. The aspect-and-opportunities framework goes beyond the hierarchical framework proposed a decade ago [105] to recognize the specific facets of e-commerce, and it is from understanding and innovatively exploiting these facets that the opportunities derive. The hierarchical framework of e-commerce views e-commerce as consisting of three metalevels, each building on the one below it. The top metalevel encompasses the marketplace and the hierarchical (in the sense of a lasting interorganizational supply chain) coordination of delivery of products and services, as well as the final products and services themselves. The intermediate metalevel is that of business services facilitating the exchange of business documents via EDI, electronic funds transfer (EFT), and e-mail. The bottom level is the infrastructure, delivering the functionality of the Web over the Internet, including the Internet itself, as well as other value-added networks, and the wired and wireless telecommunications networks providing the connectivity.

From the organizational point of view, there is value in recognizing the various aspects of the Web-Internet compound in e-commerce,[2] for they help to make sense of the phenomenon. They can further an understanding of the

facets of e-commerce within the terms developed for their study in the appropriate disciplines and continue the study within this broad area. They can serve pragmatically to establish strategic directions for organizational initiatives, innovating in directions seen as organizationally desirable, and developing the processes and metrics needed to evolve and track the initiatives. It is important to understand e-commerce whole.

As shown in Table 1, the aspects of e-commerce fall into five activity domains: commerce proper, collaboration, communication, connection, and computation. Within this 5Cs framework, the activity domains progressively underlie one another. To a large degree, however, they are separate pursuits. Thus, just as successful commerce is based on collaboration on multiple levels, so collaboration is supported by communication, which in turn requires connection and computation across the Internet. At the same time, the deployment of the Web as a universal supply-chain linkage is not based on its use as an interactive medium.[3] This classification makes it possible to see the aspects of e-commerce that give rise to specific innovational opportunities. The activity domains and aspects within them are considered as starting from the highest level of commercial activity in the marketplace and in stable supply chains to the foundations of the telecommunications infrastructure and the emerging computing utilities.

We shall now proceed to discuss the multiple aspects of e-commerce, concentrating on the specific opportunities deriving from them and devoting concentrated attention to the higher levels of the framework. Although it is important to recognize the individual aspects of the larger phenomenon, it is also vital to see that many existing and future organizational innovations derive from a combination of the aspects under discussion.

Commerce

The domain of activities here called commerce includes a variety of arrangements through which goods and services are offered in the marketplace, ranging from pure spot markets to long-lasting supply chains involving the value chains of multiple organizations. Serving as the marketplace and providing a universal value-chain linkage are the high-level aspects of e-commerce.

Marketplace

Marketplaces are physical or virtual places where sellers and buyers come together and exchange is facilitated. More specifically, markets facilitate the matching of sellers and buyers with respect to product-price combinations and the terms of transactions, and they also facilitate the transaction of exchanging product for payment [6].[4] The Web, with its supporting business services, has emerged as a *potentially* global marketplace. It actually provides a marketspace (to use Rayport and Sviokla's neologism [83]) where virtual marketplaces with desired properties can be created. The advantages are those of eschewing the geographic tethering and other spatial limitations of bricks-and-mortar, as well

Activity domain	E-commerce aspect of Web-Internet compound	Opportunities
Commerce	Marketplace	Creation of virtual marketplaces with desired rules Flexible pricing, including price discovery Multichannel marketplaces, including bricks-and-clicks Customization New business models
	Universal supply-chain linkage	Concentration on core competencies Use of best-of-breed processes Rapid reconfiguration of supply chains Disintermediation or electronic reintermediation
Collaboration	Network of relationships	Forming business ecologies to deliver complex client support Long-term binding of customers
	Collaboratory	Collaboration on continuing innovation Virtual expansion of organizational knowledge Ability to meet time-to-market demands
Communication	Forum	Customer communities as source of innovation Customer communities as binding mechanism Communities of practice as source of elaborated knowledge
	Interactive medium	Development of media products Support for communication of tacit knowledge Knowledge management via tool-equipped portals Marketing and selling opportunities, with rich information to and about customers
	Delivery vehicle	Delivery of digital goods and of services Digitalization and delivery of formerly physical goods Variety of delivery and payment regimes

(continued)

Table 1 (continues)

Activity domain	E-commerce aspect of Web-Internet compound	Opportunities
Connection	Anytime-anywhere connectivity	Location-sensitive products with customer intimacy Field-based access to information systems Remote monitoring, tracking, and diagnosis Autonomous activities in environment
	Development platform	Intra- and interorganizational system integration Foundation of information-system architecture Software reuse Common development environments
	Universal Telecommunications Network	Interoperability Rapid deployment Moving all formats of mediated communications to Internet
Computation	Computing utility	Large-scale sharing of computational capacity Cost-effective allocation of computing resources Ability to handle extreme computational problems

Table 1. Aspects of E-commerce and the Innovational Opportunities They Engender (the 5Cs Framework).

as the displacement of the attendant costs. It did indeed appear to some, in the first stage of Internet-driven e-commerce, that these advantages were absolute imperatives. They have not proven to be so. Pure virtuality has its costs. These include the opportunity costs of not reaching customers who may be reached in the physical world in a revenue-generating way and the costs of doing business on the Web, which are highly significant. The expanding core of e-commerce could, from the point of view of pure virtual play, be considered that of virtual (digital) products delivered by virtual players (economic actors) through digital processes [18]. Although such a trend may prevail in the end, it has been argued that the present stage of e-commerce involves a much slower embedding of the virtual in the physical [106]. Therefore, marketspace entry by the adoption and infusion of Web technologies and Web-based processes needs to be creatively combined with recourse to traditional marketplace structures.

Both B2B and B2C (e-retail) marketplaces have been beneficiaries of the innovational possibilities offered by the Web. As discussed above, these possibilities have largely borne fruit in the B2B segment. Opportunities exist in architecting the marketplace as supplier-, buyer-, or intermediary-owned, direct or cybermediated, catalog- or auction-based, public or of limited access, pure spot versus contract-based, trading-only or providing a range of services, with barter versus financial settlement, trading bundles or individual items, and so forth. Innovational opportunities exist at every stage of marketplace transactions: searching for a partner, negotiating terms, delivering the good or service, settlement, and post-transaction service. The specific sources of opportunities include the altered cost structure of market transactions and relationships, the relatively low threshold of a modest entry into the marketplace, the flexibility of collaborating across a number of dimensions, and cost-effective mass customization. The ability of the parties in a marketplace to extract benefits from these opportunities differs across industry segments and requires much further research. Several theoretical perspectives may be seized upon to classify B2B marketplaces [91].

Web marketplaces lend themselves particularly well to flexible pricing. Flexible pricing includes a variety of differential pricing schemes, with different customers receiving different prices in an attempt by sellers to capture a greater part of the customer surplus by discovering the customer's valuation (e.g., [12]). Menu costs of changing prices are lower in the marketspace. Opportunities in this area of flexible pricing are especially broad in the B2B domain and find greater acceptance there. Flexible pricing also includes price discovery in auction-based markets, an area of extensive practice and research.

Indeed, on-line auctions have found early and, as a category, continuing application in the Web environment. An iconic success in the consumer-oriented segment of the Web is eBay, a singular beneficiary of network effects (in the economic sense). Several types of auction mechanisms may be enacted (see [56] and [102] for classifications). Auctions may be conducted by a buyer (or a consortium of buyers), a seller (in these reverse auctions, a consortium may also be effective in realizing economies of scale and scope, and in expanding the repertoire), or an intermediary. Since intermediaries have found it quite difficult to insert themselves into supply chains as auction-market

makers, the sources of success (and switching costs) here could lie in expanding the range of intermediary functions offered by a market-maker well beyond price discovery. Suppliers generally have limited incentives to participate in auction marketplaces run by buyers. The power of attraction of the large buyers notwithstanding, Covisint (www.covisint.com), a marketplace jointly run by Ford Motor Company, General Motors, and DaimlerChrysler (which does not rely exclusively on the auction model), has encountered difficulties in attracting suppliers [55]. Notable successes in auction marketplaces of physical products entail the introduction of a trustworthy inspection system. By this means, the AUCNET used car auction in Japan has been able to extract higher prices than traditional auctions for cars of similar quality [59]. With a reputational system, eBay now auctions $3 billion of used cars and auto parts a year [30].

By various estimates, e-retailing constitutes between 1 and 2 percent of total retail sales in the United States. Therefore, larger B2C marketplaces cannot limit themselves to pure play virtuality. Multichannel retailing offers diverse opportunities for innovative surfacing and exploitation of synergies between clicks and bricks. For instance, the clothing retailer Gap has been conducting campaigns in its retail stores to collect customers' e-mail addresses so as to broaden its e-channel. E-customers making returns in the physical stores have been effectively encouraged to make further purchases there. Opportunities to cross- and up-sell are actively exploited across channels [1].

Product customization is another innovational opportunity. For example, Lands' End (owned by Sears, Roebuck) has achieved impressive results in the mass customization of trousers [95]. A simple user interface (www.landsend.com) and pricing competitive with, even if higher than, that for off-the-rack products is credited with its success. The software supports finding the right fit against user-entered data. The custom lines generate higher profit, and there is no inventory of products to maintain. Advertising is conducted exclusively in the company's direct-mail catalog, another example of cross-channel synergy. This innovation, which follows the well-known success of Dell in the B2C and B2B domains, is expected to be expanded to other garments. General Mills is planning to introduce customized cereals (Web-site customers will be able to choose from more than 100 ingredients to create their own cereals). The risks are pointed up by several notable failures in mass customization, such as Levi Strauss in women's jeans. Vicarious learning from these is vital for further advances. Moreover, economic modeling shows that competing mass-customizers run the risk of competing by over-customization, to the detriment of their profits [22].

New business models like e-storefronts, e-malls, industry exchanges, catalog aggregators, and intelligent agencies, as well as others, are continually tested. They can be categorized with respect to the way the marketplace is addressed, revenue options, and asset categories [3]. Electronic communications networks (ECNs), such as Bloomberg Tradebook LLC and Archipelago, match buyers and sellers of financial instruments within 100 to 150 milliseconds. They handle a trade if they can improve on the price offered by the more traditional exchanges and clear, at present, 40 percent of NASDAQ trades [96]. New national and international marketplaces are being created—the job

market has been restructured by the emergence of such marketplaces as Monster.com.

Using technological feasibility as the deciding argument for action is, as ever, not the approach to take in the marketplace. Many public exchanges, a number of demand aggregators (offering lower prices from the suppliers for larger numbers of buyers), e-retailers of bulky and perishable items are some of the categories that have not met with marketplace success. The predicted effects do not always materialize. For example, no dramatic price competition and a large price dispersion were found in the electronic marketplaces for commodity goods [14]. Worldwide price dispersion for an individual product (a camcorder model) was found to be far larger, with prices differing by more than three times [103]. Innovation opportunities need careful investigation before fielding. Dynamic pricing, for example, can have adverse effects of several kinds in the B2C marketplace, as discussed by Kannan and Kopalle [53]. The great variety of product offerings that is possible in virtual consumer marketplaces at a relatively low cost may lead to increased consumer welfare in the case of books, for example [50]; in other cases, it may cause confusion.

Universal Supply-Chain Linkage

In delivering the final product, there is a multiplicity and variety of governance arrangements between the "market" (purely buy-sell relationship between firms) and the "hierarchy" (internal production of goods and services), to employ the terms used by by Malone, Benjamin, and Yates, and by Williamson [70, 101]. Within this spectrum, the firm can concentrate on what it considers its core competencies. A firm delivers value to its customers through the business processes that form its value chain. This chain has traditionally constituted a part of the supply chain for the industry, where the primary goods (e.g., raw materials) would enter the back-to-back value chains of a number of producing and intermediary firms. This would result in the product or service being supplied to the right place at the right time (e.g., to the consumer touchpoint).

Many of today's goods and services are complex system products, requiring specialized inputs from multiple firms. As companies increasingly specialize, and as information technologies make intercompany coordination increasingly feasible and cost-effective, the processes in corporate value chains can be outsourced to their most efficient sources. Here, the Web is becoming the universal value-chain linkage, as corporate business processes are supported with Web-enabled information systems. Extensive and standardized software infrastructure is necessary for further proliferation of this aspect. Such infrastructure is emerging with Web services, based on the eXtensible Markup Language (XML), as standardized applications to deliver common business functions. Together with the Simple Object Access Protocol (SOAP) for communication on the service level, and with the Universal Description, Discovery, and Integration (UDDI) registry for accessing services, this new and higher level of infrastructure, when commonly adopted, will make it possible to set up dynamic interconnections among business processes with mixed

ownership. Business processes themselves are generally built around several Web services that are composed into a workflow [65]. The business-process infrastructure relying on Web services will enable adaptive supply networks. Owing to the Web-based linkage of business processes, the duration of the business arrangements needs not to be driven by the information-technology imperative, with extensive costs and time needed to change the arrangement.

Process specialists have emerged as firms that package their competencies into processes that can be relatively easily inserted into supply chains. The most prominent process specialists include FedEx, delivering logistics and inventory management, Rosenbluth Travel, offering a range of complete corporate travel-management processes, and a large and diverse complement of manufacturing enterprises whose products or services are marketed under the labels of their customers. For example, Cosmed Group of Jamestown, Rhode Island, is one of the largest contract sterilizers of foodstuffs and medical products. A great many firms outsource this industrial process to the company. Cosmed Group makes real-time data from the ongoing sterilization process available over the Web to the client companies, which are able to feed the data directly into their own information systems, which support second-level quality control, payments, and other processes [47].

With the myth of disintermediation as an imperative laid to rest, innovative solutions are sought in structuring the distribution channels. Disintermediation remains an option, of course, facilitated by the Web. Because of the relative power of the upstream supply-chain participants, some of the well-established players in the marketplaces for digital goods face abiding threats [19]. Market intermediaries continue to play essential roles, however, in matching buyers and sellers, demand and supply aggregation, trust agency, and facilitation of exchange [5]. Indeed, the greater complexity of information, the greater number of transacting entities, and the trust deficit present in the virtual world, all call for expanded and modified intermediation. A spectrum of purely Web-based intermediaries (informediaries) has emerged. Far beyond this, in a general process known as reintermediation, Web-based intermediation is replacing the roles and structures of traditional intermediation. A number of factors and innovative ways through which reintermediation can occur are discussed by Chircu and Kauffman [17].[5] They show that traditional intermediaries, owing to the co-specialized assets they possess, are able to exploit new technologies to keep their place in the supply chain. Indeed, manufacturers generally prefer to maintain the stability of their downstream chains. Maytag Corporation supports the distributors of its appliances by routing visitors to its own Web site over to the authorized dealers' sites, which it also supports [99]. Maytag's site conducts the e-selling process up to the checkout point, transferring the customer to the local retailer's site to complete the transaction and arrange for delivery. This approach supports Maytag's product-distribution system, affords the firm an opportunity to collect customer data from its own touchpoint, and is obviously attractive to the firm's distributors. Since various points in the market-hierarchy spectrum may be advantageous to a firm in its sourcing of different inputs, all-in-one markets emerge as intermediaries that offer various trading mechanisms on a single platform [52].

With the Web as universal supply-chain linkage, a newly emergent process innovation can be relatively rapidly brought to bear on the functioning of the owner company and the partnering firms. Best-of-breed processes can be deployed, consistent with maintaining the firm's strategic capabilities. A framework for assessing the strategic value of the processes in the corporate value chain with a view toward outsourcing is offered by Fine et al. [32]. Applied in the context of the General Motors Powertrain division, the method usefully separates secondary processes from the firm's essential knowledge-based processes, such as the engineering of engines. After the evaluation is concluded, the universal supply-chain linkage of the Web can be deployed to link to the outsourced processes.

Among the drawbacks of process outsourcing are performance risks beyond the firm's control and being subject to gauging when in need of a critical resource. Such monopolistic behavior has been noted in the healthcare and computer industries, for example [41]. Beyond these risks, a firm may define its core competence too narrowly or with such lack of foresight that it will find itself without the ability to innovate in a market-responsive fashion.

Collaboration

As a means of establishing long-term relationships and enhancing them over time, and as a collaboratory, the Web can serve to develop and deliver complex system products and complex forms of customer support, built around evolving packages of goods and services. Collaboration is supported on the individual, group, and organizational levels.

Network of Relationships

The definition of e-commerce used here places the development of long-term relationships before the transactional use of the Web. Transactions are but multiple consummations of a successfully evolving long-term relationship. The forming and honing of durable relationships is a source of trust and, further, of social capital [37]. The relationship aspect of e-commerce emerges from the variety of interactions among people and organizations, and has a bearing on both B2B and B2C commerce. It also emerges from the virtual communities that are a forum for individuals, as discussed below.

Relationship networks emerge as long-term alliances of companies that aim to gain access to best-of-breed business processes and core competencies, as well as to achieve economies of scale and scope that are not possible for them individually. The crucial advantages are capital economies and, even more decisive in the rapid-cycle business environment, major savings in lead time to the roll-out of a new good or service. Even when the trend to outsourcing is distinctly occasioned by information and telecommunication technologies, it expresses itself to a large degree in what Clemons, Reddi, and Row call the "move to the middle" [20], that is, the companies' establishing marketplace relationships with a limited number of suppliers. Among the principal motivations are

the needs to invest in relationship-specific assets that have to be amortized over a period of time and to minimize risk through trust-building mechanisms that call for information sharing. Reflexively, the necessity of sharing information limits the scope of collaboration. Value systems emerge as webs of corporate processes with mixed ownership. Many different arrangements are possible, depending on the aspects of e-commerce to be exploited [94]. Such value webs may be orchestrated by a firm that itself supplies only the core competence of extensive knowledge of the industry on the supply and demand sides, coordination capabilities, and the ability to aggregate, disaggregate, and allocate orders [43]. The development of "deep" (rather than sloganized sham) relationships with consumers, the ultimate customers of most supply chains, is hailed by Zuboff and Maxmin [104] as the hallmark of the "support economy." The support furnished to consumers has to rely on established relationships among the companies delivering it.

Relationships with consumers are developed through a long-term process of using the Web to establish mutual familiarity, trust, and loyalty. Reputations and brands are built over time. Electronic Commerce Customer Relationship Management (ECCRM) systems support relationships with individual customers by maintaining rich and longitudinal data about them and rendering it useful at the touchpoint—when the customer calls or sends an e-mail [86].[6] The ties that bind a customer include financial bonds (with personalized financial incentives), social bonds (e.g., communitarian features on Web sites), and, stronger than either of these, the structural bond of service that is not readily available elsewhere. A long-term view of the individual customer worthy of retention is the foundation of such relationships [60]. Self-service technologies of the Web can, under many circumstances, be antithetical to this objective, and the savings may prove illusory in the longer term [79}.

A potent network of relationships, indeed an extensive business ecology, has emerged over time around eBay. Firms that facilitate all stages of selling and buying have sprung up. These include firms that facilitate listing products for sale, successful bidding (thus, snipping by inserting last-second bids, and proxy bidding), settlement (especially notable is the highly successful emergence of PayPal, as well as escrow services), and delivery. Amazon.com has built up an extensive and well-structured web of affiliates, reviewers, second-hand bookstores, all with documented reputations that accrete over time. Reputational systems have made eBay's customers part of the ecology.

Relationships rely on memory, for it is largely memory that distinguishes them from transactions. The network of relationships in e-commerce, formed at all levels from the interpersonal to the interorganizational, is reflected in the distributed repositories of structured and unstructured data accumulated and processed by information systems. On the organizational side, such memories can be purposely organized into organizational memory information systems [93]. These collective memory tools can be used to perpetuate and elaborate relationships by maintaining, in conveniently accessible form, detailed information about meetings, teams, discussions, customer interactions, experts and contact people, and similar multimedia records of people in interaction with others and with events as they unfold.

The reputational systems deployed in e-commerce use the memory of long-term relationships as trust-building devices and in related recommendation systems. Consigners on eBay acquire reputations over time, and these (if positive) build up the value of the sellers—and of eBay. Recommendations based on collaborative filtering make it possible to infer an individual's preferences from those of others with overlapping tastes or from the preferences of former purchasers of the same item (item-to-item filtering).

It is appropriate to note that the network-of-relationships aspect of the Web coexists in B2B commerce with the ability to rely on the Web as the universal value-chain linkage in order to rapidly switch process suppliers. Much research remains to be done to evaluate the economics and comparative strategic advantages of these postures under different sets of circumstances. Certain elements of such an analysis, as applied to the dynamics of disintermediation and reintermediation, have been captured in the work on the "undulating distribution channel" [39].

Collaboratory

Collaborations of knowledge workers by means of e-mail, and of the Web-based group-support systems, and workflow systems constitute an aspect of e-commerce. These tools can be integrated over the Web and combined with task-specific software supporting computer-aided design (CAD), simulation, and visualization. Intraorganizational collaboration can be conducted over an intranet, and interorganizational collaboration over extranets or the open Internet. Going beyond and overlapping with the intertwining of the business processes of a single organization is the interorganizational collaboration of knowledge workers within a process and across processes. Agile corporations are expected to respond rapidly to market opportunities and reversals. As stated before, interorganizational collaboration is crucial to rapid response in an environment where few products are fully produced and distributed by a single manufacturer. The collaboration extends forward to the customer in order to ensure responsive conceptual design and backward to the suppliers. "Collaboratory," a term coined several years ago, is a useful neologism for this aspect of the Web.[7] From the knowledge-management point of view, collaboratories are a means to the virtual expansion of organizational knowledge, with the attendant economies of time and capital.

An example of a very large-scale interorganizational collaboratory project is the Integrated Development Environment for shipbuilding, developed to achieve cost reductions across shipyards and product life-cycles. This is an initiative of the National Industrial Information Infrastructure Protocols (NIIIP) Consortium, which aims to introduce the Web-based infrastructure into multiple industries in the United States [23, 77]. Several other industries, notably the automotive sector, have seen a greater degree of Web-based collaboration among firms [36, 82]. Collaborative development of new products can be fruitfully based on the agent paradigm, with a design of this type described by Liang and Huang [66]. Agent technology makes it possible to

address customer requirements through collaborating software modules with separate ownership, geographic distribution, and operation on different computer platforms.

Timex Corporation employs Web-based collaboration software to support the design cycle for its new products [57]. All of the concerned knowledge workers in the firm have access to computer-aided design files, supported by document-version control and routed via workflow systems. Marketing and manufacturing specialists can collaborate with designers to avoid expensive rework. By using this organizational innovation, product-development cycles of new fashion watches and athletic timing devices linked to the Global Positioning System have been cut by up to 40 percent. As an example of interorganizational collaboration, Bechtel Corporation has led the development of a $4 billion petrochemical plant, a project that involved direct partnership and supply relationships with 23 other firms, as well as with governments and regulatory agencies in 12 countries. An extensive collaboratory was deployed to facilitate document handling and routing, as well as task scheduling among the 800 registered users, going through multiple national and organizational borders. Among the business results are firmer schedules and faster decision-making, with clear traceability.

Open-source software development, steadily gaining importance, is primarily done "in virtual environments, using Internet tools" [31, p. 125]. Most of this development, which has begun migrating from noncommercial to commercial environments, is performed in on-line collaboratories. Such collaboratories may be seen as precursors to other and broader forms of work in the organizations of the future [73].

Communication

The Web-Internet compound is a highly accessible means of communication between and among people. In contrast to the means available before its existence, the compound empowers individuals to associate into forums and interact through the medium of the Web or the Internet (e.g., via e-mail), altering the prior space-time relationships. The delivery of digital products is another aspect of activities in the communication domain of e-commerce.

Forum

The Web is ubiquitous and commonly accessible, yet makes it possible to create private group spaces, or spaces with a desired degree of public access and a set of technological or normative rules of membership[8]—or with no apparent rules at all. This makes the Web into a forum, a place of virtual assembly, with novel properties.[9] There are no other places of potential mass assembly that can be so easily joined, whose sessions can be conducted asynchronously and with no time horizon (if so desired), and which are embedded in so large a space offering visibility and the ability to draw participants. When placed in

the perspective of Habermas [42], the availability of such a publicly accessible

agents endowed with personal memory and social intelligence that will be able to act on behalf of the individual members of the community as appropriate in the community's context [78].

Interactive Medium

The Web is a globally accessible means of mass—or selective—communication. As a medium for human communications, the Web is unique for its combination of accessibility and interactivity with the shared or fully open virtual knowledge spaces that can be carved out and elaborated over time by individuals, groups, and organizations. As opposed to other media, the Web has continually expandable memory space. The Web as hypermedia renders the structure and elements of an accessed virtual document mutually independent, subject to the trajectory of a given access [71]. The taking up of the Web as a medium has been unprecedented in its rapidity. A variety of media companies relying on the Web have emerged, and new media products are being delivered over the Web, with some notable intellectual (if not financial) successes, such as Salon and Slate, and the on-line editions and supplements to a

facility that may be based on a specialized taxonomy [67]. They may offer visualization tools to reduce information overload, and automatic summarization of documents. The portal facility can be a powerful tool in providing validation to some of the massive amounts of information available on the Web, either simply by means of inclusion versus exclusion, or in greater depth, with annotation by recognized experts. Ever more sophisticated search engines are tools native to the Web that enable knowledge work. Such engines as Google offer a measure of reputation-based recognition to Web sites more frequently linked to by users. A rich area of pursuit, KM offers multiple directions in the furthering of corporate objectives [40].

As a medium of communication, the Web is also a marketing medium. The original function of commercial Web sites, before the transactional component was added, was to bring business information to Web users. This remains a very important part of image building, branding, and informing potential and existing customers. The interactive nature of the medium affords an opportunity to give the customer a voice via e-mail, Web surveys, virtual focus groups, and the like. Advertising on the Web has not fulfilled its potential. In the B2C domain, the ubiquitous banners have brought far more annoyance to surfers than revenue to the sites. Indeed, click-through rates have been falling precipitously, together with advertising rates, and most business models built on e-advertising as the primary or essential source of revenue have collapsed. At the present time, B2C advertising constitutes about 90 percent of on-line advertising, with B2B accounting for only 10 percent—almost exactly in inverse proportion to the revenues of the respective sectors. There is potential for innovative advertising in the B2B domain, where the emerging ads tend to be far more informative [11]. Multimedia, narrowcasting, opt-in push, cost-effective personalization, are all tools that need to be exploited in innovative business communications. With the ever increasing bandwidth and the supporting database and streaming-service technologies, corporate communications are moving to multimedia [75]. Anecdotal evidence points to the expanding domain of C2C advertising, also known as personals, which help individuals find partners for a variety of pursuits. Spamming and indiscriminate banner proliferation are the undesirable epiphenomena. In the specific environment of mobile commerce, close opt-in personalization has to allow for the necessary concision of the promotional messages, while sensitivity to the user's current context has to ensure the salience of the message.

The varieties of media specific to the Web-Internet compound suggest that it should be considered as a media generator rather than a single medium. The study of the varied media evolving here may begin with the attributes of the technical media offered by Thompson [98], who argues that a technical medium should be considered in the context of the institutional arrangements of its use and the space-time distantiation it engenders. Further, the media themselves differ with respect to storage capability, ability to reproduce information, and participation. Looking at the media that have emerged with or been transformed by the Internet and the Web, essential differences can be seen. Reciprocal media, such as chats, differ from nonreciprocal ones, such as blogs. A blog or an individual's Web page is a means of communicating one's persona, thinking, and sensibilities to the world. With respect to the context

and attributes identified by Thompson, both have some commonalities, but even greater differences, when compared to, say, WSJ.com. The interactive nature of the Web removes some, but far from all, asymmetry in the relationship between the organizational (or otherwise established) producer of information and others with access to the Web. Thus, extensive further study and experimentation may be expected in the commercial exploitation of the medium aspect of the Web.

Delivery Vehicle

The Web is a delivery vehicle for digital products. Digital products are categorized as tools and utilities (including software), content-based products, and on-line services [48]. Some traditionally physical products have been cast into a digital form, although at a slower rate than predicted. These include tickets, cash, stamps, greetings, and other tokens. Electronic prototypes of products can be delivered as well, substituting for the physical ones and shortening the design cycles. With the proliferation of broadband services, videocassettes and compact disks will be yielding ground to videostreaming. As another example of reintermediation, the Movielink service is beginning to provide a substantial number of popular films on demand over the Web [44]. Many services have limited requirements for tangibility and can be delivered over the Web. Among these are education, banking, investment, reservations, and advice.

The Web can deliver a digital product in full with the transaction consummated via a download or can offer it as a service over time via interactive access. A software product may be downloaded, and access to a data warehouse or a game may be offered for a given time with a variety of options and payment arrangements, including a combination of subscription fees and pay-per-use. A purchase may be combined with extended-term service through the provision of new releases, new editions, and incremental upgrades (e.g., for digital entertainment). Content aggregation is another avenue to creating value—the well-targeted less is definitely more when the individual's attention is the scarce resource. Content syndication is used to disperse digital products to many providers. Digital rights management (DRM) schemes allow for a fine discrimination among various forms of use and payment for digital products. Technologies furnished by such companies as Digimarc and InterTrust allow for digital watermarking of media and for the enforcement of a given set of access privileges [24, 49]. These schemes have to coexist with a variety of protection-breaking means that can be enacted anywhere and rely on the Web as a ubiquitous medium and delivery vehicle. DRM will have to be combined with greater pricing sophistication, since, to give an example, perceived high prices are the primary incentive for the copying of software [16]. Peer-to-peer technologies are a very potent means of deploying the Web as a delivery vehicle in counteraction to DRM [58].

Digital goods, whose replication and delivery costs are close to zero, yet whose development costs may be large, display certain specific properties. For example, bundling of the appropriate goods can be a profitable business

tactic [7], multiple versions can be marketed to sell customer value [88], but this tactic should be avoided when a cheaper product may seduce potential customers of more expensive versions [10], and time-limited trials can be offered. Advice and information still need to be productized by a degree of standardization and by quality control. Find/SVP, for example, is beginning to offer research services in a wide range of complexity and with differentiated prices on the Hoover's Online site [38]. Pricing schemes, which both depend on and condition the development of markets, still find limited acceptance. The appropriate combinations of prices and products (including both digital and physical, as in a combination of digital singles, physical albums, and live performances) are necessary to stabilize the markets for many goods that can be digitized.

Connection and Computation

The Internet and the Web provide the connective tissue for intra- and interorganizational systems, and for the individuals who access the services facilitated by these systems. The aspects in this domain of activity are anytime-anyplace connectivity exploited in m-commerce, the use of the Internet-Web compound as a common systems-development platform, and the deployment of the Internet as a universal telecommunications network. More recently, the Internet has also emerged as the enabler of large-scale computing utilities.

Anytime-Anywhere Connectivity

With the build-up of wireless communications, including the wireless network infrastructure, Internet-enabled mobile devices, and mobile services, the anytime-anywhere connectivity of the Internet enables mobile commerce, or m-commerce.[10] Of primary importance as access devices employed by individuals are mobile telephones. Access is also made with pagers, personal digital assistants, and laptops, and with the emerging wearable devices. Beyond this, a number of more recent products, from cars to refrigerators, have the capability to communicate over the Internet as part of a development known as ubiquitous computing, which ultimately aims to equip a great variety of devices with URLs. A move has been taking place from the slower second-generation (2G) technologies to the faster 2.5G and 3G technologies. At present bandwidth limitations and lack of standardization limit the services offered to mobile users. The 3G technologies known as advanced digital cellular support rich media, such as video, but are still largely unavailable. Interconnectivity is pursued by greater protocol uniformity, with the United States lagging behind Europe in this respect.

In the consumer-oriented domain, the innovational potential of m-commerce stems from its ability to offer location-sensitive services. The user's geographic position can be established because his or her access device has a built-in Global Positioning System (GPS) chip or owing to a network-based positioning technology. Therefore, location-relevant content, such as directions,

vendor information, weather forecasts, or activity planning can be provided, and tokens such as tickets or discount coupons can be served. Services that can be rendered include traffic information, roadside assistance, notifications, and just-in-time concierge help

Interaction with the user of a mobile telephone handset, the most common access device, is limited by its small screen, the communication bandwidth, and, last but not least, time and attention constraints. Overcoming these limitations requires a greater degree of customer intimacy: The more the system knows about users, the more aptly and rapidly it can interact with them. Thus, more of the customer's private information, including locational information, has to be stored in the databases of organizations representing "the system." Privacy concerns are and will remain a significant obstacle to the proliferation of the technology. Solutions that minimize intrusiveness have to be found, and trust will have to be built up or transferred from trusted entities. New interfaces that support rapid adaptation to the context of a given access are being developed [13].

In the intra- and interorganizational domains, m-commerce offers varied opportunities where access to information systems has to be provided to workers in the field, and where remote monitoring, tracking, or diagnosis are needed. The salespeople at the client site can gain access to the enterprise resource planning (ERP) or to the customer relationship management (CRM) system. Automobile fleets can be tracked and dispatched to maximize the utilization of resources. Mobile telemetry may be used to monitor power stations and replace failure management with preventive maintenance [87]. Applications begin to spread. Office Depot has a signed invoice logged onto the system via a handheld device as soon as the retailer's vehicle delivers merchandise to the customer, thus enhancing its own cash flow. Insurance-claims adjusters using laptops with software from Mitchell International are able to settle claims in the field by accessing their firm's information systems, experiencing significant increase in productivity [25].

Given the need to combine a number of services into a very brief transaction-oriented interaction, much more corporate collaborating will be necessary to provide meaningful services over the mobile interface. Browsing the Web for a service is not a convenient option. At the same time, the potential for customer lock-in is very significant. Integration with other commercial channels, including the wired Internet, will be needed. Services will have to be provided across a great many access devices. A general solution to this problem is offered by IBM's Whale architecture, deployed initially in Swissair's Easy Check-In service [45].

The advancing realization of the concept of ubiquitous computing deploys sensors, tags, actuators, and microprocessors throughout the environment. One of the objectives is autonomous operation that removes humans from many parts of the overall system. Embedded devices communicate over the Internet and enable remote monitoring, tracking, controlling, guiding, and other functions under computer control. The elements of ubiquitous computing are a subject of extensive research [29]. Context awareness combines with mobility to offer novel opportunities for wearable devices that do not require

the wearer's attention while offering services appropriate to the context, whose understanding is also expanding [89].

Development Platform

The effectiveness and efficiency of organizational information systems can be significantly enhanced by a move to Web-Internet technologies. The spread of Internet-centric applications has created a universal development platform for organizational systems. Enterprise-level systems like ERP or CRM can be introduced into a firm with the expectation that they will be able to interact with the systems of the firm's business partners. Business software, including Web services, can be reused and amortized across multiple user organizations. Development environments and methodologies can be applied across the business units of an enterprise and across enterprises. Interoperability of Web services permits the creation of enterprise-wide information-system architectures that link all the corporate core business systems to the firm's Web site and expose the desired interfaces for communication with partners' systems [35].

Enterprise application integration is based on several allied technologies, mentioned above. XML is becoming the common language for representing structured and unstructured data, as well as metadata. Interapplication messaging is moving to SOAP, while endpoint discovery is supported by UDDI. Adapter technologies have been developed for migrating legacy systems to Internet foundations [65]. Informational Web services are being developed to provide information to the requesting endpoint, while transactional Web services are being made available to invoke business processes. Transactional Web services are themselves being standardized—an important international effort is the electronic business XML (ebXML), aiming to facilitate dynamic interorganizational commerce. However, Web-services standards are only one step toward integration, for the fruition of several major initiatives is necessary, including support for business processes that span multiple business partners, transaction controls, and service-quality monitoring [4]. Work is progressing on a semantic Web that would allow a higher level of system integration, based on common ontologies and schemas.

Software reuse enables companies to be more responsive to marketplace demands by faster rollout of new capabilities within the company-wide system architectures. Internet-centric software components are being inventoried for reuse with software-asset management tools marketed by such firms as Flashline and LogicLibrary. New business processes can be supported more rapidly and more reliably. For instance, the support engineers of Diebold, the supplier of automatic teller machines and voting devices, use software-asset management to assemble into programs the firm's internally developed C# components in order to customize equipment features for its customers [85]. Internet-centric development environments leverage the developer skill base across organizations.

It must be stressed again that the availability of technologies does not make for integration. Opportunities for system Balkanization will always exist, and

the many independent actors have to take measures to ensure that these are not seized upon. The availability of technological standards does not automatically result in their deployment. Market pressures and corporate effort harmonization are the principal forces at play in the move to the Internet-centric platform.

Universal Telecommunications Network

As a universal internetworking technology, the Internet enables comparatively rapid deployment of networks that gain global access. Internet connectivity can be deployed cost-effectively as compared to most alternatives. The simplicity and ubiquity of the network-layer Internet Protocol (IP) have fueled global connectivity and enabled the anytime-anywhere connectivity discussed above. As EDI moves to the Internet, and as Voice-over-IP technologies move voice services into the digital domain, far greater integration of services becomes possible. The integration of data, voice, and video over an IP network infrastructure can simplify the delivery of a consistent customer interface over multiple touchpoints through CRM systems.

Integration can simplify many interactions and collaborative styles. MasterCard International has rolled out an IP-based global payment processing system to simplify data transfers among retailers, banks, and the credit-card company's clearing offices. Designed as a virtual private network with enhanced security, the system gives the company, for the first time, a globally integrated operations platform [74]. On the personal-productivity scale, Cisco Unity (a component of Cisco IP Communications) affords users the capability to combine in the uniform message management all their e-mail, fax, and voice communications via a single interface. A move to a digital home media network built around an IP network and integrating all the media devices is being envisaged [8].

The continuing development of the Internet as a universal telecommunications network includes work on the next-generation IP, known as IPv6, on the development of generalized content delivery over broadband (e.g., the Prism architecture [21]), and on enhanced quality of service (i.e., availability, response time, throughput, etc.). The planned launch in 2003 of broadband wireless LAN Internet access by deploying Wi-Fi (Wireless Fidelity, also known as 802.11b) technology to cover 50 urban U.S. areas initially, with subsequent expansion, offers the promise of widely available access to broadband Internet services [81]. As a universal telecommunications network, the Internet is thus further leveraged into a vital means of economic development.

Computing Utility

The Internet makes accessible, via uniform protocols, vast numbers of computers and associated resources of software, data, and specialists. These resources can be harnessed for distributed computing and problem-solving on a very large scale, with the Internet becoming a computing platform. Com-

puting services may be delivered as a utility with continuous on-demand access across these multiple resources, maximizing their use and lowering the costs of computation through economies of scale. One emerging infrastructure for such computing utilities is known as grid computing. It is now migrating from the scientific and technical environments into the general commercial domain. Through coordinated sharing of available computing capacity, grid computing has enabled such computationally demanding tasks as simulation, visualization, and data analysis. In the e-commerce domain, grid computing will enable data mining and access to federated databases for CRM and supply-chain management as well.

The Open Grid Services Architecture (OGSA) was designed largely on the basis of the Globus Toolkit to facilitate the development of grids as distributed computational platforms composed of heterogeneous computers with mixed ownership [34]. Supported by extensive software, the resources available and needed for a given task can be assembled dynamically. Business models of computational utilities are emerging. Gateway Inc. has linked the 8,000 PCs deployed in its stores into a grid and makes their 14-teraflop capacity available, on per-hour payments, to corporate users (such as a pharmaceutical company that used it for a pilot test in bioinformatics) [15]. A number of firms, including Ford, Boeing, and Motorola, deploy internal minigrids [69]. Future combinations of grid computing with collaboration environments offer a number of possibilities for intra- and interorganizational collaboration.

IBM, in its Utility Management Infrastructure, has adopted the computing-utility approach on a more immediately pragmatic scale. The technology enables a novel approach to outsourcing and was recently used on the largest-ever IBM outsourcing contract (with J.P. Morgan Chase). Instead of consolidating computing facilities at the outsourcer's sites, a virtual pool of computing resources is created, to offer on-demand computing services on a pay-as-you-go basis. The networked facilities of IBM's clients are incorporated into the firm's computing infrastructure to create a computing utility with flexible user costs [51].

Conclusion

Five compressive activity domains within e-commerce have been identified: commerce, collaboration, communication, connection, and computation. So have the aspects of the Web-Internet compound that support activities in these domains. These aspects lead to specific opportunities for organizational innovation. As a marketplace and universal supply-chain linkage, the Web can serve to create virtual or hybrid marketplaces and flexible distribution and procurement channels, as well as to enable business-model and product innovation. As a network of relationships and collaboratory, the Web enables lasting business ecologies to deliver complex client support and sustains task-oriented collaboration within and across organizations. As a forum, interactive medium, and delivery vehicle, the Web-Internet can support communities of various sources of cohesion, including those of customers and those of practice. It can be a source of innovative media products and a vehicle for

the delivery of digital goods, can enable the management of both codified and personalized knowledge, and can become a means of multifaceted communication between customers and their suppliers. In the connection domain, the Web-Internet compound enables m-commerce through anytime-anywhere connectivity, and as a common development platform and a universal telecommunications network it can enable intra- and interorganizational information-system integration. Computing utilities delivering services on demand by distributing workload across networks to multiple computational resources enable cost-effective computation on a large scale.

The unpacking of various aspects underlying the broad phenomenon of e-commerce helps to bring the appropriate instrumentalities to practice and research in this metadisciplinary field. Innovation does not stem, of course, from isolating these aspects, but rather from creatively combining them to exploit the multiple opportunities they offer. As an example, take systems-on-a-chip (SoC), which may combine most of the circuitry of a cellphone on a single integrated circuit [63]. The complexity of many such chips far exceeds the design capabilities of a single team. Multiple intellectual-property providers have to supply component designs. Software tools for integrating the designs contained in multiple libraries need to be accessed and properly deployed. Moreover, the SoC designs themselves are developed by fabless enterprises that transmit them, when completed, to highly capital-intensive chip foundries for fabrication. Opportunities exist here for e-commerce deployment. With the Web as the supply-chain linkage, customer-oriented supply chains can be rapidly and flexibly constructed. Any constellation of SoC providers would be well supported within the collaboration domain of e-commerce, maintaining and expanding the network of relationships and collaboratories cutting across organizational lines. The use of the Web as delivery vehicle can be enhanced by interorganizational workflow systems. Computationally intensive tasks may be distributed across multiple platforms.

Broad practice and research agendas within the 5Cs framework need to address the all-important issues that condition the organizational deployment of innovation opportunities. Entrepreneurial firms are seizing upon some of these opportunities. Most of the exploration and exploitation of the opportunities is being done by established organizations. Business models need to be built and strategies developed with a full consideration of the aspects and opportunities in light of the ability to appropriate financial benefits. Organizational processes to support e-commerce-based innovation need to be developed and ingrained in the corporate culture. Organizational structures that would leverage existing capabilities but vigorously innovate need to be created. Organizational learning is necessary to maintain a high level of innovation. On the policy-making level, the larger issue of the changing public versus private sphere—in intellectual property, media access, and personal privacy—needs to be considered in the light of various aspects of e-commerce. As the activity domains of e-commerce expand, security issues come into sharp focus at all levels of decision-making and technology deployment. The large contribution that researchers will make to the field of e-commerce can be seen from this discussion. An expanding and evolving area of research lies ahead.

NOTES

1. Important work is being done on the semantic Web. Its goals, as outlined by Berners-Lee, Hendler, and Lassila, include the capability of automatic analysis of the meaning of the content and of hyperlinks [9].

2. Further in the paper, as most appropriate in the context, the terms "Internet" and "Web" are used instead of "Internet-Web compound."

3. This fact is not recognized, for example, in Slevin's otherwise valuable analysis of the medium and forum aspects of the Web [90]. Admixing the value-chain linkage aspect of the Web with its analysis as a medium sheds little light on what can be done to link companies' value chains effectively and efficiently.

4. Bakos also sees the legal and regulatory infrastructures as inhering in a market [6]. The varied and weighty issues in this domain, many of them as yet unresolved, do not inhere in the aspect of e-commerce discussed here.

5. Chircu and Kauffman consider reintermediation to be the reentry of the disintermediated physical intermediary in a form of infomediary, i.e., as a virtual intermediary [17]. A broader sense of the word is used here.

6. Such support will not result in a satisfactory relationship, of course, if the opportunities are squandered by long telephone selection trees, tardy and formulaic e-mail responses, or unknowledgeable human responders.

7. Formed originally through the elision of "collaboration" and "laboratory" to signify a Web-based scientific collaboration environment, the word's meaning has been expanded to other Web-based collaboration environments.

8. Thus, to use Lessig's term, the rules are enforced by code in either case [62].

9. The *Oxford English Dictionary* defines "forum" as "the public place . . . ; the place of assembly. . . ; a place of meeting for public discussion" [80]. All of these meanings are significant in seeing the Web as forum.

10. M-commerce also includes a large array of wireless technologies that are not based on the Internet.

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