

## **DEVELOPING E-BUSINESS DYNAMIC CAPABILITIES: AN ANALYSIS OF E-COMMERCE INNOVATION FROM I-, M-, TO U-COMMERCE**

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*This study uses an electronic commerce (E-commerce) innovation model to analyze the differences in technological knowledge, business model, and dynamic capability aspects used in Internet-enabled commerce (I-commerce) versus mobile commerce (M-commerce) versus ubiquitous commerce (U-commerce). The results indicate that the innovation from I-commerce to M-commerce is radical, leading to drastic changes in the business model. However, from M-commerce to U-commerce, disruptive changes occur in both technological and business model dimensions. A set of critical dynamic capabilities for each innovation is identified. These results provide great insight for practitioners and scholars for enhancing their understanding of E-commerce innovation, and provide guidelines to help practitioners adapt from one type of innovation to another.*

**Keywords:** *dynamic capabilities; E-business; E-commerce innovation; I-commerce;  
M-commerce; U-commerce*

### **INTRODUCTION**

Over the past decade, rapid developments in information and communication technologies, such as the Internet and mobile computing, have substantially changed the landscape of both the established and emerging commercial world. Electronic commerce (E-commerce), as we know it today, such as Internet-enabled commerce (I-commerce) and mobile commerce (M-commerce), is based on developments pertaining to the Internet, and on prior technological innovations arising from the combination of telecommunication and organizational computing. In recent years, recognized shifts in E-commerce have taken place from I-commerce, to M-commerce, and to ubiquitous commerce (U-commerce) [1].

Firms that have embraced these E-commerce technologies are called “electronic businesses” (E-businesses). They execute transactions, communicate, and innovate to support commerce through cyberspace. E-businesses have created unprecedented new channels for accessing customers, integrating supply chain partners, and offering new products or services to expand business areas. However, these E-businesses are likely to

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be more sensitive than traditional businesses to changes in information technology (IT). In fact, rapid technological changes have evolved from communications and commerce being tied to fixed Internet and wireless computing to ubiquitous wireless network computing. The rapidly increasing affordability of innovative technologies has stimulated a series of E-commerce innovations and created new opportunities and challenges for E-businesses [2]. Wireless technology has altered the existing capabilities of incumbent E-businesses [3].

To embrace these opportunities, managers in E-business must constantly reconfigure organizational resources and renew rather than protect their capabilities along with technological and business expertise to sustain competitive advantages in an increasingly shifting E-commerce environment [2], [4]. It is necessary for E-business managers to recognize and evaluate changes in the business and technological landscape and to be concerned with the extent to which the company meets emerging capability gaps in a timely manner. Possessing this knowledge is crucial for managers to successfully adapt from one type of E-commerce innovation to another. However, research on these issues is extremely limited [5]. Therefore, this study utilizes an E-commerce innovation model, adopted from the Abernathy and Clark model [6], with secondary data analysis and comparative analysis to analyze the differences in technological and business model dimensions and to explore the core dynamic capabilities in both dimensions for E-commerce innovation.

The remainder of this article is organized as follows. First, we briefly describe the evolution of E-commerce innovation and introduce the E-commerce innovation model. Second, we compare the differences among E-commerce innovations: I-commerce, M-commerce, and U-commerce in the technological knowledge and business model dimensions. Third, we analyze the impact of E-commerce innovations on incumbent E-businesses and identify the specific capabilities necessary to cope with these changes. The article concludes with a summary that discusses the implications for E-commerce innovation and further research.

## E-COMMERCE INNOVATION

### **Evolution of E-Commerce Innovation**

E-commerce is defined as sharing of business information, maintaining business relationships, and conducting business transactions using digital networks [2]. In recent years, recognized shifts in organizational computing technology have taken place from Internet computing, to mobile computing, to ubiquitous computing [7], [8]. Because organizational technologies have become a dynamic force that changes all types of business operations, the organizational applications of these novel technologies have caused a significant wave of E-commerce innovations [9].

In the past decade, we witnessed the emergence of the Internet as a means for I-commerce. In the I-commerce world, the traditional marketplace, in which physical goods and services are exchanged via face-to-face human interaction, was supplemented or replaced by the virtual marketplace that enabled the exchange of goods and services through the Internet [10]. This change leads to a radical overhaul of existing ways of doing business for brick-and-mortar firms.

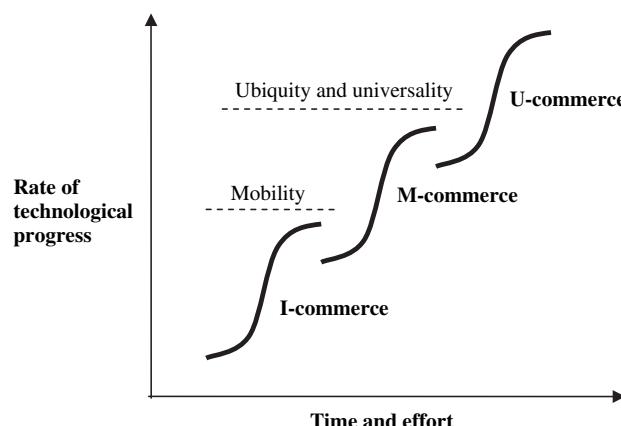
Today, wireless technology is emerging even faster, producing significant advances that enable the next generation, M-commerce. It has been estimated that by the year 2006,

\$230 billion would be generated from M-commerce [11]. M-commerce refers to any transactions with monetary value conducted over a wireless telecommunication network [12]. The linkage between wireless devices and the Internet has enormous potential to increase the overall volume of I-commerce. It also creates an unparalleled opportunity for E-business to leverage the benefits of mobility. M-commerce will pressure current E-businesses, engender a stream of changes among established E-commerce paradigms, and lead to business model reconfiguration.

Ubiquitous computing has been triggered by dramatic developments in wireless IT, continued chip and embedded device miniaturization, and new software service models [7]. With this progress in IT, a new breed of E-commerce that scholars call U-commerce is developing in which the *u* stands for ubiquity and universality [1]. Ubiquity means that systems can support a rich set of computing and communication capabilities and services for nomads as they move in a transparent, integrated, convenient, and adaptive manner. Universality means that these systems provide a universal service channel that enables users to stay connected anywhere, anytime, using any devices. Consequently, U-commerce is a dynamic convergence of physical, digital, and traditional commerce with ubiquitous computing technologies to support personalized, uninterrupted communications and transactions [8].

U-commerce will usher a new business world that presents an alternative view of space and time in a form that goes over, above, and beyond traditional commerce [1]. The age of U-commerce will emerge in the next 5 to 10 years [7]. Predictably, the challenge of U-commerce will substantially change the business and marketing landscape and lead us to rethink many fundamental aspects of E-business operations, business models, and capabilities.

The evolution of E-commerce innovations can be illustrated using the S curve [13], as shown in Figure 1. An E-commerce innovation takes place when an E-commerce application shifts from one S curve to another. I-commerce was implemented based on a fixed wired network using the Internet until the ability to connect started approaching a physical limit—mobility. M-commerce based on wireless infrastructure gave rise to a new S curve, with the new physical limits being a higher level of ubiquity and universality.



**Figure 1** S Curves of E-commerce innovation from I-, M-, to U-commerce.

### Categories of E-Commerce Innovation

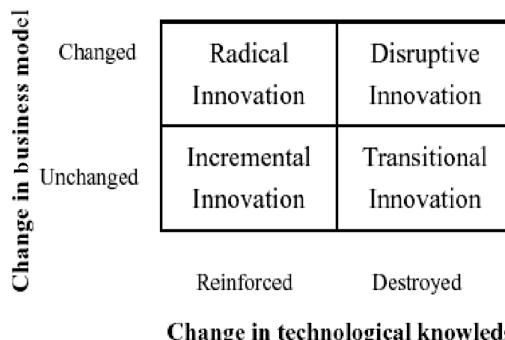
To comprehend the scope and impact of E-commerce innovations, it is necessary to organize them categorically and to understand them fully [2]. From a business perspective, an innovation is the use of new technological and business knowledge to offer new products or services that customers want [14]. The Abernathy and Clark innovation model classifies innovations according to their impacts on the existing technological and market/business knowledge of the innovating firm [6]. E-commerce innovation is fundamentally an innovation arising from new organizational application of E-commerce technologies. Hence, the principal aspects of E-commerce innovation can be identified in two principal domains: technology and business models [2], [9] which underpin capabilities of an E-business. Therefore, this article proposes a two-dimensional E-commerce innovation model, shown in Figure 2, to exploit E-commerce innovations.

The taxonomic model considers that an E-commerce innovation can be described in terms of its technological knowledge and business model. The possible changes of E-commerce innovation can be categorized into four types: *incremental*, *transitional*, *radical*, and *disruptive* depending on the extent to which the innovation impacts the existing technological knowledge and business model. An E-commerce innovation is incremental if it conserves the existing technological knowledge and business model, transitional if it destroys technological knowledge but conserves the business model, radical if it destroys the business model but preserves the technological knowledge, and disruptive if both the technological knowledge and business model become obsolete.

Technological knowledge is defined as the technical ability to mobilize and deploy the innovation. There are three areas of knowledge that cover the technological knowledge [2], [9], [12], [15]:

- IT-infrastructure: consists of a network infrastructure and development platform.
- Content: consists of content design and content delivery.
- Services: consists of the nature of services and transaction mechanisms.

A business model is a coherent framework that converts the E-commerce technologies through markets into business value [16]. A business model is often used to describe the key components of a given business: value proposition, market segment, cost structure, profit potential, and value network [17].



**Figure 2** Categories of E-commerce innovation.

### Dynamic Capabilities Perspective

To cope with rapid, dynamic changes in its business environment, a firm must constantly reconfigure, gain, and dispose organizational capabilities and resources to match the requirements of a changing environment [18]. The ability to recognize and identify a firm's new market opportunities, determine the potential strategic importance of these capabilities and resources, and renew its competencies, is called "dynamic capabilities." Dynamic capabilities vary with environment dynamism. That is, the dynamic capabilities are essentially change-oriented capabilities that help the firm redeploy its resources and renew its competences to sustain competitive advantages and to achieve congruence with the shifting business environment. However, the development of dynamic capabilities reflects an organizational ability to cope with the change in a timely way.

Dynamic capabilities theory has been applied in the E-business field. For example, Rindova and Kotha [19] employed the concept of dynamic capabilities to examine how the organizational form, function, and competitive advantage of E-business dynamically coevolves. Daniel and Wilson [20] identified eight dynamic capabilities that are necessary for E-business transformation and identify practices in developing these capabilities that are both effective and common across firms. Wheeler [3] proposed the Net-Enabled Business Innovation Cycle (NEBIC) as an applied dynamic capabilities perspective for measuring, predicting, and understanding a net-enabled organization's ability to create customer value through the use of innovative IT. This approach incorporates both variance and process views of net-enabled business innovation and defines four essential capabilities: *choosing new IT*, *matching economic opportunities with technology*, *executing business innovation for growth*, and *accessing customer value* for net-enabled business innovation that creates customer value. The strengths or weaknesses of these capabilities can be used to predict the firm's ability to create value in face of technological change.

## ANALYSIS OF E-COMMERCE INNOVATION AND IMPACT

Understanding the nature of innovation is a crucial first step in managing the changes associated with any innovation [14]. To understand the nature and possible impact of E-commerce innovations, we utilize an E-commerce innovation model, adopted from Abernathy and Clark's model [1]. We use the model to frame a comparative analysis of the extant literature that analyzes differences in technological and business model dimensions and explores the core dynamic capabilities in both dimensions for E-commerce innovation.

### Changes in Technological Knowledge

Initially, to understand the technological changes among E-commerce innovations and how they differ from earlier technological knowledge, we identify the key differences in the core technological knowledge (i.e., IT-infrastructure, content, and services) based on an analysis of extant literature on E-commerce technologies. Table 1 summarizes the E-commerce innovation difference based on the technological knowledge dimension.

Table 1 shows that I-commerce technologies are embodied in Internet desktop computing technology, which is supported using the standard protocol, TCP/IP, and global wired networking infrastructure. By relying on the World Wide Web, I-commerce provides an interoperable networking model that offers an open and standardized software

**Table 1** Critical Differences in Technological Knowledge.

	I-commerce	M-commerce	U-commerce
<b>IT-Infrastructure</b>			
Network infrastructure	<ul style="list-style-type: none"> <li>• Internet</li> <li>• Wired networking</li> <li>• Global coverage</li> <li>• Abundant bandwidth</li> <li>• Standard protocol: TCP/IP</li> </ul>	<ul style="list-style-type: none"> <li>• Proprietary networks</li> <li>• Wireless networking</li> <li>• Local and regional coverage</li> <li>• Limited bandwidth</li> <li>• Diverse protocols: GPRS, CDMA, TCP/IP (v6), WLAN, Bluetooth, or 3G.</li> </ul>	<ul style="list-style-type: none"> <li>• Public channels</li> <li>• Ubiquitous networking</li> <li>• Pervasive coverage</li> <li>• Broad bandwidth</li> <li>• Nonavailable protocol</li> </ul>
Development platform	<ul style="list-style-type: none"> <li>• Desktop computing</li> <li>• Open interoperability</li> <li>• General development tools</li> <li>• Easy to integrate with legacy systems</li> </ul>	<ul style="list-style-type: none"> <li>• Mobile computing</li> <li>• Device-dependence interoperability</li> <li>• Specific and limited development tools</li> <li>• Difficult to integrate with legacy systems</li> </ul>	<ul style="list-style-type: none"> <li>• Mobile and pervasive computing</li> <li>• Open interoperability</li> <li>• Specific development tools</li> <li>• Seamlessly integrate with other systems</li> </ul>
<b>Content</b>			
Design	<ul style="list-style-type: none"> <li>• Hypermedia</li> <li>• Information-intensive</li> <li>• Hypertext (e.g. HTML, XML)</li> </ul>	<ul style="list-style-type: none"> <li>• Dominated by voice, text, and graphics</li> <li>• Short and critical message-based information</li> <li>• Compact hypertext (e.g. WML, CHTML)</li> </ul>	<ul style="list-style-type: none"> <li>• Cyber media</li> <li>• Need-based information</li> <li>• Nonavailable standards</li> </ul>
Delivery	<ul style="list-style-type: none"> <li>• Transaction information</li> <li>• Pull oriented delivery</li> <li>• Full output model: dominated by personal computers (PCs)</li> </ul>	<ul style="list-style-type: none"> <li>• Transaction and location information</li> <li>• Push oriented delivery</li> <li>• Limited output model: dominated by handheld devices</li> </ul>	<ul style="list-style-type: none"> <li>• Transaction and context information</li> <li>• Seamless delivery</li> <li>• Diverse output model: multiple devices</li> </ul>
<b>Services</b>			
Nature	<ul style="list-style-type: none"> <li>• Geographic dispersed</li> <li>• Transaction aware</li> <li>• Global scale</li> <li>• Mass customization</li> </ul>	<ul style="list-style-type: none"> <li>• Mobility</li> <li>• Location aware</li> <li>• Regional scale</li> <li>• Personalization</li> <li>• Simple and critical product messages</li> <li>• Transaction via virtual channels</li> <li>• Simple transaction mechanisms</li> <li>• Digital or built-in carrier payment</li> </ul>	<ul style="list-style-type: none"> <li>• Omnipresent</li> <li>• Context aware</li> <li>• Specific scale</li> <li>• Uniqueness</li> <li>• Heterogeneous product information and easy to search</li> <li>• Transaction via virtual channels or physical brick-and-mortar stores</li> <li>• Multi-discipline transaction mechanisms</li> <li>• Diverse payment systems</li> </ul>
Transaction mechanisms	<ul style="list-style-type: none"> <li>• Rich product information and easy to search</li> <li>• Transaction via virtual channels</li> <li>• Sophisticated transaction mechanisms</li> <li>• Third-party payment systems</li> </ul>		

development platform. Legacy information systems (IS) and databases are easy to integrate with the Internet via Web-based applications and middleware [21].

In contrast, M-commerce originates from proprietary mobile networks implemented by a variety of wireless networking protocols ranging from regional coverage, such as General Packet Radio Service (GPRS), Code Division Multiple Access (CDMA), TCP/IP (v6), and 3G to local wireless LANs (WLAN; IEEE 802.11) and Bluetooth. Contrary to the abundant bandwidth of the wired Internet, wireless bandwidth is limited by the signal frequency spectrum [22]. The lack of unified interoperability standards makes mobile application development and IS integration much more complex than I-commerce.

U-commerce originates from the integration of mobility and a pervasive computing functionality. It entails the omnipresence of intelligent and internetworked microprocessors, embedded in all devices and artifacts, enhancing and extending every possible interaction between people and the world around them [7]. This integrates wired and wireless networks into a broadband and single channel that provides full interoperability and pervasive coverage can enable seamless IS integration [23]. However, the software must deal with a diversity of devices that continue to shrink in size and weight. Taking the complexities of the context into account, the development of applications is a very challenging task [24].

In the Internet environment, the design of information-intensive and multimedia content follows the HTTP standard. Accordingly, hypertext can easily be edited, combined, and customized using standard description languages such as the hypertext markup language (HTML), extensible markup language (XML), or Java. Moreover, content delivery utilizes pull-oriented navigation and a client-server accessing model via Web sites.

In the M-commerce environment, mobile content is push-oriented and message-based, such as Short Message Service (SMS) and Multimedia Message Service (MMS). This involves primarily text, voice, and pictures. Recently, several techniques such as Wireless Markup Language (WML) and compact HTML (CHTML) have been developed for shrunken Web pages that fit handheld devices such as mobile phones or PDAs. However, these handheld devices impose limitations such as small screen size and cumbersome input/output mechanisms. Thus, mobile content must have a compactly designed, device-dependent, thin format. In essence, the content design and delivery concept is the same in I-commerce and M-commerce [12].

As mentioned previously, ubiquitous networking will support the delivery of heterogeneous information. This cybermedia content can vary continuously because of changing circumstances and differing user needs. The U-commerce environment promises to deliver transaction, context, and person-specific information in multimedia form anytime, anywhere, and by any means [8]. Such context-aware content can be seamlessly distributed through multiple devices (known as sensors, effectors, or wearable devices) at different sites and on the move.

Services are online transaction applications. Essentially, the nature of online services is “transaction-aware” in the I-commerce environment. The services mainly focus on detecting what activity customers are performing at a given time in a stationary location. They involve a set of emerging standards and provide a total solution for online transactions. For example, Web pages construct a worldwide channel by which customers can easily perform a transaction without geographic or time limitations, using sophisticated digital transaction mechanisms and third-party payment systems, such as the Secure Socket Layer (SSL) or Secure Electronic Transaction (SET).

In contrast, mobile services are predominantly simple, less information-intensive, and usually available only in a specific region. Additionally, M-commerce provides “location-aware” services that focus on accurately pinpointing the customer’s location and proactively pushing relevant messages [25]. Popular mobile services now include mobile advertising, mobile financial applications (MFA), SMS, MMS, and location-based services such as Global Positioning Systems (GPS). For example, NTT DoCoMo’s iMode service is one of the most successful M-commerce applications in Japan.

U-commerce is built on the concept of “context-aware” services that include spatial (e.g., the specific position and orientation of a customer) and temporal awareness (e.g., the scheduled time of public and private events) [24]. Ubiquitous services focus more on actively sensing the customer’s needs using time and location specificity. In addition, the services can be dynamically configured and migrated through several mediums to meet the customers’ dynamic needs and accommodate changing interactions with the customer [1], [8]. This implies that U-commerce may provide highly personalized services that allow consumers to dedicate their attention to the context with minimal distraction and to perform transactions easily in any channel from any location (i.e., visual or brick-and-mortar stores). However, ubiquitous services will be fundamentally advanced marketing and operation methods [24] that provide greater choice, more convenience, more personal attention, and more adaptation [1].

### **Changes in Business Model**

A business model is a mediating construct between technologies and business value [16]. In this section, business model differences among E-commerce innovations are analyzed in terms of five components: value proposition, market segment, cost structure, profit source, and value network [17]. Table 2 summarizes the key differences.

The Internet breaks physical restrictions and time limitations, providing an open and less limited bandwidth to easily attract customers to enter the global commercial world. Rich information exchanges, facilitated by the Internet, reduce or eliminate information asymmetry between customers and sellers. In this marketplace, where sellers and buyers are directly connected, E-businesses realize the value arising out of reduced search costs, transaction costs, and lead time, or improved responsiveness [21]. In general, I-commerce can be classified into four modes: Business-to-Consumer (B2C), Business-to-Business (B2B), Consumer-to-Business (C2B), and Consumer-to-Consumer (C2C).

M-commerce relaxes the independent and mutual constraints of space and time for many commercial activities [26]. It provides a superior value-for-time offering that I-commerce cannot achieve. Hence, the value propositions for M-commerce are mobility, localization, personalization, and convenience [27]. The agility and accessibility provided by mobile devices is convenient for users in retrieving information and performing transactions from virtually any location on a real-time basis. The location-aware services create new advantages for M-commerce over I-commerce. Additionally, M-commerce is ideal for personalized marketing services through use of customer profile data stored in the individual handheld device. Generally, current M-commerce applications include B2B, B2C, and Business-to-Employee (B2E). B2C currently dominates these applications [12].

U-commerce features high levels of mobility, large-scale services and infrastructure, and a diversity of ways in which content and services are processed and transmitted. The additional values created by the U-commerce include ubiquity, universality, uniqueness, and unison [1]. U-commerce is a seamless integration of virtual and physical channels as a viable

**Table 2** Critical Differences in Business Models.

	I-commerce	M-commerce	U-commerce
Value proposition	<ul style="list-style-type: none"> <li>• Open standards</li> <li>• Low-cost</li> <li>• Global communication</li> <li>• Information asymmetry eliminated</li> </ul>	<ul style="list-style-type: none"> <li>• Mobility</li> <li>• Localization</li> <li>• Personalization</li> <li>• Convenience</li> </ul>	<ul style="list-style-type: none"> <li>• Ubiquity</li> <li>• Universal</li> <li>• Uniqueness</li> <li>• Unison</li> </ul>
Market segment	<ul style="list-style-type: none"> <li>• Global market</li> <li>• PCs users with Internet connection</li> <li>• Wide customer base</li> </ul>	<ul style="list-style-type: none"> <li>• Regional market</li> <li>• Dominant by mobile device users</li> <li>• Targeted customer base: mobile workers and young people</li> </ul>	<ul style="list-style-type: none"> <li>• Universal market</li> <li>• Heterogeneous users</li> <li>• Heterogeneous customer base</li> </ul>
Cost structure	<ul style="list-style-type: none"> <li>• Low content design cost</li> <li>• Low cost for networking, application development, and content delivery.</li> <li>• High logistic cost for physical products, low logistic cost for information services</li> </ul>	<ul style="list-style-type: none"> <li>• High cost for networking, application development, and content delivery</li> <li>• Low content design cost</li> <li>• High logistic cost for physical products and information services</li> </ul>	<ul style="list-style-type: none"> <li>• High cost for application development and content design</li> <li>• Low networking cost</li> <li>• Low logistic cost for physical products and information services</li> </ul>
Profit source	<ul style="list-style-type: none"> <li>• Revenues of servicing, advertising and content subscribing</li> <li>• Lower transaction, labor, promotion, service and inventory costs</li> </ul>	<ul style="list-style-type: none"> <li>• Revenues of mobile servicing and networking fee</li> <li>• Improve efficiency of mobile workforce and task</li> </ul>	<ul style="list-style-type: none"> <li>• Revenue of value-added servicing and product selling</li> <li>• Lower cost, improved trust, enhanced differentiation, market extension</li> </ul>
Value network	<ul style="list-style-type: none"> <li>• Key stakeholders: backbone operators, Internet service providers (ISPs), application providers (ASPs), content providers, network infrastructure providers, Internet portals, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Key stakeholders: telecom operators, mobile service providers, application providers, content providers, mobile device manufacturers, Internet mobile portals, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Key stakeholders: ubiquitous service providers, application providers, content providers, network operators, ubiquitous device manufacturers, Internet and mobile portals, geo-positioning service providers, brick-and-mortar stores, etc.</li> </ul>

market form—a universal marketplace—that expands over both I- and M-commerce [24]. It thus provides a level of value over, above, and beyond the traditional commercial activities.

In terms of market segment, I-commerce consumers are mainly PC-literate users that are self-selected from a stationary population with Internet connections. In contrast, most

M-commerce users are mobile phone adopters. Previous investigations show that modern young people and mobile business workers that are functionally computer illiterate and technologically unsophisticated are the primary M-commerce consumers [25]. Additionally, an M-commerce market area is regional and narrower than global I-commerce; the size of the customer base is much smaller [21]. With respect to U-commerce, because it is considered an integration of different channels (from Internet to brick-and-mortar stores), the size of the potential customer base is greater than that for I- and M-commerce markets. Hence, the consumer demographics in U-commerce are more heterogeneous than in the other E-commerce markets.

The development of I-commerce was stimulated primarily by the net-wide use of open IT standards, low networking fees, and free Internet overhead costs. All these factors reduce the networking and application development costs. Conversely, M-commerce is rooted in paid-for infrastructure, bandwidth, and services in the private telecom operator industry. Hence, a firm that attempts to enter an M-commerce market may require high development and investment costs when negotiating with the mobile operator industry. According to a survey of 270 IT professionals [28], high start-up cost is one of the most prominent barriers to M-commerce adoptions. Predictably, the growth of ubiquitous computing technologies will create a highly interoperable and open IT-infrastructure, such as the Internet.

Meanwhile, the underlying cost structure behind the various types of E-commerce innovations is different. I-commerce allows companies to link directly to customers, thereby significantly reducing transaction, labor, promotion, service, and inventory costs [2]. However, the delivery cost for physical products from a remote site in I-commerce is higher than offering products locally or contextually in M- and U-commerce. Conversely, for information services, because the content design is simpler in handheld devices, the initial cost for content design of I-commerce is much higher than that in M-commerce. The cost for content delivery of I-commerce is much lower than that in M-commerce [21]. Content delivery savings become possible in a ubiquitous environment based on an open network, but the cross-media content design cost may be dominant for U-commerce [23].

In I-commerce, servicing commissions, advertising revenue, and content subscriptions are the main revenue sources compared with brick-and-mortar stores. In contrast, limited transaction processing capabilities and high mobile networking costs prevent M-commerce from taking relative revenue advantages today. However, M-commerce offers tremendous profit potential by expanding the existing I-commerce market by providing mobile services to improve the efficiency of traveling workers and mobile tasks. Networking fees and paid-for service operations will generate extra revenue for mobile service providers and telecom operators in M-commerce [29]. Additionally, U-commerce operations that rely on the integration of physical and virtual markets will provide essential benefits for an E-business, including lower costs, improved trust, differentiation through value-added services, and geographic and product market extension [30]. Thus, innovative E-business can reap profits from the successful exploitation of the synergies between multiple channels [24].

The value network created around a business shapes the role that suppliers, customers, and complementors play in influencing the value resulting from an innovation [16]. In the value network of I-commerce, the key stakeholders include backbone operators, Internet service providers (ISPs), application service providers (ASPs), content providers, network infrastructure providers, Internet portals, and so on. In the case of

M-commerce, the increased level of mobility will intensify the scope of competitive environments and complexity of interorganizational coordination involving diverse stakeholders, such as telecom operators, mobile service providers, application providers, content providers, and handheld device manufacturers. In fact, the arrival of M-commerce has accelerated the desegregation of the value network in I-commerce [29].

While open standards are encouraging in U-commerce, penetration by companies in totally unrelated markets have resulted in blurring E-commerce industry boundaries [8]. Access to ubiquitous service for diverse devices introduces a more complicated value network. Given the need to combine a number of online services into a very ubiquitous interaction, much more corporate collaboration is necessary to provide meaningful services over the various networks. This scenario leads to horizontal and vertical mergers of related stakeholders [31]. Accordingly, we contend that a U-commerce value network and the relationships among key stakeholders within the value network will become more complex and tighter than I- and M-commerce. One of the significant trends among stakeholders in the U-commerce market is that collaboration and partnerships are becoming increasingly important.

### **Impact of E-commerce Innovation**

As mentioned previously, wireless technology has overturned the Internet infrastructure while the design knowledge of mobile content and services are nearly the same as those already in I-commerce. However, mobile services reinforce Internet services and trigger changes in business model components, such as value propositions, market, and value network. Significant differences in business model components between I- and M-commerce, as shown in Table 2, are evidence that M-commerce is a radical innovation. It conserves the existing technological knowledge of incumbent E-business, but obsoletes the business model.

U-commerce is a disruptive innovation for incumbent E-businesses, especially when it involves technological knowledge such as ubiquitous networking, pervasive computing devices, heterogeneous content design, and context-aware service design and delivery. U-commerce also involves a fundamental change in business operations, customer relationship management, and collaboration with alliance partners. The prospect of U-commerce depends on technology, service, and content providers agreeing to open their proprietary technology to common standards that enable transparent network services and interconnection. Such scenarios bring direct competition among incumbent E-businesses that currently have larger overlapping market segments. This affects whole-business model components, involving how and when they are constructed. In sum, U-commerce is a disruptive innovation that destroys both technological and business model knowledge for the incumbent E-businesses [32].

## **DEVELOPMENT OF DYNAMIC CAPABILITIES IN E-BUSINESS**

A firm's ability to embrace and exploit an innovation is a function of the extent to which the innovation renders the firm's existing capabilities obsolete [6], [14]. While an E-commerce innovation introduces huge changes to organizations, such innovation will fail to contribute to organizational capabilities and performance unless organizations are capable of appropriating it. Accordingly, in the face of E-commerce innovations

(M- and U-commerce), an E-business must be aware of the capability-destroying changes; otherwise, any attempt to exploit the innovations may be doomed to fail. However, to successfully cope with such innovations requires careful coordination with the development of organizational dynamic capabilities [18].

Based on the E-commerce innovation model, previous IS capabilities studies [33], [34], and the dynamic capabilities perspective [3], [20], the ability of an E-business to exploit an E-commerce innovation rests on two basic capabilities: technological and business. The two basic capabilities combine, along with organizational routines, to form the dynamic capabilities of E-business. The technological capabilities include planning IT-infrastructure, integrating software platform, designing content, and delivering new services. The business capabilities are envisioning customer value, executing business innovation, matching with economic opportunities, and building relationships. These broadly defined dynamic capabilities can be further divided into some practical indicators for each particular E-commerce innovation: M- and U-commerce, as discussed below. These indicators are developed based on the literature review, observation, and discussions with practitioners.

### **Core Dynamic Capabilities for M-commerce**

As explained above, the change from I- to M-commerce is regarded as a radical innovation. This implies that M-commerce creates unparalleled business value and market opportunities for E-commerce to leverage the benefits of mobility [3], [17]. To this end, identifying the customer value frontier and conveying new value propositions to market should be given a high priority. Research indicates that demonstrations of mobile value propositions are helpful for enhancing customer understanding of the usability of M-commerce and consequent customer willingness to use it [35]. The implication for E-businesses is that the products or services offered to customers must match the prevalent value proposition of M-commerce: mobility, localization, personalization, and convenience. An important capability is accurate identification of market segments that could best utilize these benefits provided by M-commerce marketing strategies.

Furthermore, B2C and B2E dominate the M-commerce niche. In general, the major user groups are primarily time-pressed consumers and the mobile workforce. They may use M-commerce based on lifestyle, segment application, or professional need. Thus, the capability to estimate profit potential can help a firm match new market opportunities early.

With the emergence of M-commerce, many E-businesses receive their profits from providing novel mobile services or products, especially from low value and low involvement product categories. Moreover, location-aware services, such as dynamic promotion and dynamic pricing, are likely to significantly increase revenue and transaction frequency. Here, the increasing level of mobility intensifies the complexity of the industry value network [26]. When new collaboration and networks of relationships must be reconfigured to facilitate the commercial environment, the capability to appraise the position of an E-business in an attractive area and aligned with diverse stakeholders must be considered seriously. Table 3 identifies indicators and descriptions of core business capabilities for M-commerce.

**Table 3** Core Business Capabilities for M-Commerce.

Business capabilities	Indicators/Descriptions
Envisioning customer value	<ul style="list-style-type: none"> <li>• Convey new customer value propositions of M-commerce (e.g., mobility, localization, personalization, and convenience) to market.</li> <li>• Improve customers' understanding of the usability of M-commerce.</li> <li>• Leverage the prevalent features of M-commerce to make the customer willing to use it.</li> <li>• Invest in reducing switching costs that customers consider for migration.</li> </ul>
Executing business innovation	<ul style="list-style-type: none"> <li>• Design marketing strategies based on mobile technologies to differentiate the firm from competitors.</li> <li>• Implement price discrimination between mobile channels and other channels (e.g., Internet).</li> <li>• Provide novel mobile services or products, especially for low value and low involvement product categories.</li> <li>• Integrate new location-aware and existing services to extend profit potential.</li> </ul>
Matching with economic opportunities	<ul style="list-style-type: none"> <li>• Identify market segments that traditional commerce is unable to cover.</li> <li>• Focus on the B2C and B2E niche markets.</li> <li>• Segment markets based on lifestyle, segment application, or professional use.</li> <li>• Target time-pressed consumers, mobile workforce, young, and mobile phone users.</li> </ul>
Building relationships	<ul style="list-style-type: none"> <li>• Reevaluate existing industry relationships for controlling emerging technologies and acquiring new expertise.</li> <li>• Reconfigure new alliance relationships with diverse stakeholders.</li> <li>• Position in an attractive location within a new value network (e.g., mobile service providers).</li> <li>• Align with key stakeholders held key complementary assets (e.g., bandwidth and customer information).</li> </ul>

### Core Dynamic Capabilities for U-commerce

The move from M- to U-commerce is a disruptive innovation that makes established technological and business capabilities obsolete. This may lead to a drastic overhaul of existing ways of doing business. Thus, an incumbent E-business must seriously rethink how to rebuild new technological and business capabilities. The increasing degree of ubiquity from dynamically changing networking environments will make such capabilities mandatory. Here, E-businesses will need the mature abilities of upgrading IT infrastructure to develop appropriate services that meet a rich variety of demands for applications across an array of wired and wireless networks deployed intra- and inter-organizationally. To truly build U-commerce, it is critical to erect common platforms and service protocols that include support for interoperability and transparency.

In a U-commerce context, because varied services and heterogeneous content will be delivered through multiple devices, an integrated solution is needed that recognizes the differences in the deployed devices and thus adjusts the content and rendering mechanisms to fit specific devices [5]. The development and construction of content, services, user interfaces, and layout are major technological topics for U-commerce adopters. Indicators of the core technological capabilities are summarized in Table 4.

U-commerce is a universal convergence of brick-and-mortar and digital markets [1]. This indicates that the new market capabilities needed are very broad. Hence,

**Table 4** Core Technological Capabilities for U-Commerce.

Technological capabilities	Indicators/Descriptions
Planning IT infrastructure	<ul style="list-style-type: none"> <li>• Integrate wired and wireless networking into a common infrastructure.</li> <li>• Create global communication environments to support interoperability and transparency.</li> <li>• Enable a universal and standardized network protocol.</li> </ul>
Integrating development platforms	<ul style="list-style-type: none"> <li>• Configure open information system architectures to assemble heterogeneous computing platforms.</li> <li>• Develop new solutions and methods for intra- and inter-organizational system integration.</li> <li>• Use new approaches and tools for software development.</li> </ul>
Designing content	<ul style="list-style-type: none"> <li>• Combine transaction information and customer needs into context-aware content (e.g., physical location, physiological state, emotional state, personal history, and behavioral patterns).</li> <li>• Deliver multimedia content across multiple input/output devices.</li> <li>• Develop novel means of content layout and user interface design for dynamic service offering.</li> </ul>
Providing new service	<ul style="list-style-type: none"> <li>• Furnish specialized context-aware services that must be dynamically modified with time-to-market systems that meet the customer's personal needs.</li> <li>• Offer value-added personalized service at the point of need by tracking personal identity.</li> <li>• Integrate on-line and off-line services into a service channel.</li> <li>• Develop security integrated transaction mechanisms and solutions.</li> </ul>

changing some subset of business model components, or reinventing the entire business model to offer customers better value, is important for U-commerce. In addition, other fundamental capabilities must be developed; for example, how do we recognize potential value propositions and business opportunities and employ effective strategies to gain first-mover advantages? Or how do we seamlessly blend the established market-places (e.g., brick-and-mortar and digital markets) to realize the profitable opportunities and harmonize multi-channels (e.g., virtual and physical channels) to minimize channel conflicts [30]?

Because of the chain of different stakeholders involved in U-commerce scenarios, configuring new strategic alliances and implementing interorganizational collaborations with them will become increasingly important. E-businesses must critically position themselves at advantageous locations in viable value networks to gain access to core competencies and maintain existing advantages. Table 5 summarizes the core business capabilities for U-commerce.

## DISCUSSION AND CONCLUSION

This study describes the E-commerce innovation model. The model is used to frame an analysis of differences in technological and business model dimensions and then explore the core dynamic capabilities in both dimensions for E-commerce innovation. The results indicate that the impact of the innovation from I- to M-commerce is radical and from M- to U-commerce is disruptive. The innovation from I- to M- and U-commerce should not be simplistically regarded as an extension of prior innovations because the intensity and nature of the impacts of the innovations is different. Therefore, attempting

**Table 5** Core Business Capabilities for U-Commerce.

Business capabilities	Indicators/Descriptions
Envisioning customer value	<ul style="list-style-type: none"> <li>• Recognize the potential added value and business opportunities of U-commerce initiatives.</li> <li>• Convey new value propositions and usability of U-commerce (e.g., ubiquity, universality, uniqueness, and unison) to market.</li> <li>• Iteratively integrate IS/IT effort with the new value propositions of U-commerce.</li> <li>• Redefine metrics tied to assessing new customer value.</li> </ul>
Executing business innovation	<ul style="list-style-type: none"> <li>• Integrate new and existing channels into a universal market and unified channel.</li> <li>• Use each channel's strength by specializing across channels to avoid channel conflicts.</li> <li>• Reengineer the business processes that new IT makes possible to exploit new channel capabilities.</li> <li>• Invent flexible pricing models (e.g., price discrimination, and mobile pricing) and develop new marketing skills to serve U-commerce market.</li> </ul>
Matching with economic opportunities	<ul style="list-style-type: none"> <li>• Be early to identify new market opportunities that existing E-commerce is unable to cover</li> <li>• Segment different markets by using each channel's strengths.</li> <li>• Focus on the existing customer base and geographical communities served.</li> <li>• Provide unique products and services to generate increased purchase in existing physical or virtual markets.</li> </ul>
Building relationships	<ul style="list-style-type: none"> <li>• Recognize the attractive locations in new industry value networks.</li> <li>• Build commitment to strategic change both within the business and with other stakeholders.</li> <li>• Form strategic alliances and collaborate with key stakeholders to obtain core complementary assets (e.g., distribution channels and complementary technologies).</li> <li>• Harmonize and tightly couple the business and alliance strategy formulation.</li> </ul>

to duplicate the previous technological knowledge and business model is impractical. Moreover, it also implies the organizational capabilities of incumbent E-businesses tend to be much more obsolete in the innovation from I- to M-commerce than in the move from M- to U-commerce.

To cope with the innovative changes, high priority should be placed on assisting E-businesses in strengthening or reconfiguring their technological, business model, and dynamic capabilities to exploit these new opportunities. For example, for M-commerce, the major change in a business model can be facilitated through a combination of four core business capabilities (see Table 3). Yet, both technological and business capabilities (see Table 4 and 5) play a critical role in the E-business transformation for U-commerce.

It is helpful to understand what capability obstacles an E-business faces in transitioning to a new E-commerce context. E-business managers and consultants should pay attention to improving their product/service functions and dynamic capabilities. The indicators presented can be utilized as a diagnostic tool for practitioners to assess and analyze what aspects of their E-commerce applications are most problematic. Practitioners can compare the current level of each element in their E-commerce model with the expected

levels to understand their relative effectiveness or ineffectiveness and take the necessary corrective actions to successfully make the E-business transformation.

This study is exploratory research in the direction of developing a systemic model to analyze E-commerce innovations. It provides several inductive results to enhance our understanding and management of E-commerce innovation. Several issues deemed worthy of future research are noted in the body of this article. For example, the inference we drew from the secondary data analysis and comparative analysis is based on the assumption that the further evolution of E-commerce innovation does not deviate from the expected course herein. It is not easy to exactly recognize the trajectory of the innovations; hence, the limitation of contextual uncertainties may influence the validity of this study. As more and more E-businesses implement E-commerce innovations, future empirical research should refine and extend the results and continue to seek better means of assisting E-business transformation in coping with rapid E-commerce evolution.

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## REFERENCES

- [1] R. T. Watson, L. F. Pitt, P. Berthon, and G. M. Zinkhan, "U-commerce: Extending the universe of marketing," *Journal of the Academy of Marketing Science*, vol. 30, no. 4, pp. 329–343, 2002.
- [2] V. Zwass, "Electronic commerce and organizational innovation: aspects and opportunities," *International Journal of Electronic Commerce*, vol. 7 no. 3, pp. 7–37, 2003.
- [3] C. Wheeler, "NEBIC: A dynamic capabilities theory for assessing net-enablement," *Information Systems Research*, vol. 13, no. 2, pp. 125–146, 2002.
- [4] P. Jackson and L. Harris, "E-business and organizational change: Reconciling traditional values with business transformation," *Journal of Organizational Change Management*, vol. 16, no. 5, pp. 497–511, 2003.
- [5] M. L. Markus, "Technocharge management: Using IT to drive organizational change, " *Journal of Information Technology*, vol. 19, no. 1, pp. 3–19, 2004.
- [6] W. Abernathy and K. B. Clark, "Mapping the winds of creative destruction," *Research Policy*, vol. 14, no. 1, pp. 3–22, 1985.
- [7] K. Lyytinen and Y. Yoo, "Issues and challenges in ubiquitous computing," *Communications of the ACM*, vol. 45, no. 12, pp. 63–65, 2002.
- [8] K. Lyytinen and Y. Yoo, "Research commentary: The next wave of nomadic computing," *Information Systems Research*, vol. 13, no. 4, pp. 377–388, 2002.
- [9] J. H. Wu and T. L. Hisa, "Analysis of E-commerce innovation and impact: A hypercube model," *Electronic Commerce Research and Applications*, vol. 3, no.4, pp. 389–404, 2004.
- [10] J. Rayport and J. Sviokla, "Managing the marketplace," *Harvard Business Review*, November, pp. 141–150, 1994.
- [11] "Mobile commerce market to reach \$230 B by 2006," *Microwave Journal*, vol. 44, no. 5, p. 272, 2001.
- [12] S. J. Barnes, "The mobile commerce value chain: Analysis and future developments," *International Journal of Information Management*, vol. 22, no. 2, pp. 91–108, 2002.
- [13] R. Foster, *Innovation: The Attacker's Advantage*. New York: Summit Books, 1986.
- [14] A. Afuah, *Innovation Management*, 2nd ed., New York: Oxford University Press, 2003.

- [15] C. Schlueter and M. J. Shaw, "A strategic framework for development of electronic commerce," *IEEE Internet Computing*, vol. 1, no. 6, pp. 20–28, 1997.
- [16] H. Chesbrough and R. S. Rosenbloom, "The role of the business model in capturing value from innovation: Evidence from Xerox Corporation's technology spin-off companies," *Industrial and Corporate Change*, vol. 11, no. 3, pp. 529–555, 2002.
- [17] A. Afuah and C. L. Tucci, *Internet Business Models and Strategies: Text and Cases*. New York: McGraw-Hill, 2003.
- [18] D. J. Teece, G. Pisano, and A. Shuen, "Dynamic capabilities and strategic management," *Strategic Management Journal*, vol. 18, no. 7, pp. 509–533, 1997.
- [19] V. P. Rindova and S. Kotha, "Continuous morphing: Competing through dynamic capabilities, form, and function," *Academy of Management Journal*, vol. 44, no. 6, pp. 1263–1280, 2001.
- [20] E. M. Daniel and H. M. Wilson, "The role of dynamic capabilities in e-business transformation," *European Journal of Information Systems*, vol. 12, no. 4, pp. 282–296, 2003.
- [21] M. G. Zhang and Y. Yuan, "M-commerce vs. Internet-based e-commerce: The key differences," *Working paper*, McMaster University, Canada, 2002.
- [22] U. Varshney and R. A. Vetter, "A framework of the emerging mobile commerce application," *Proc. 34th Hawaii International Conf. on System Sciences*, Hawaii, January, 2002.
- [23] G. Banavar and A. Bernstein "Software infrastructure and design challenges for ubiquitous computing applications," *Communications of the ACM*, vol. 45, no. 12, pp. 92–96, 2002.
- [24] A. Fano and A. Gershman, "The future of business services in the age of ubiquitous computing," *Communications of the ACM*, vol. 45, no. 12, pp. 63–87, 2002.
- [25] B. Anckar and D. D'Incau, "Value-added services in mobile commerce: An analytical framework and empirical findings from a national consumer survey," *Proc. 35th Hawaii International Conf. on System Sciences*, Hawaii, January, 2002.
- [26] S. Balasubramanian, R. A. Peterson, and S. J. Jarvenpaa, "Exploring the implications of M-commerce for markets and marketing," *Journal of the Academy of Marketing Science*, vol. 30, no. 4, pp. 348–361, 2002.
- [27] I. Clarke, "Emerging value proposition for m-commerce," *Journal of Business Strategies*, vol. 18, no. 2, pp. 133–148, 2001.
- [28] L. C. Ware, "Wireless update—slow and steady progress," *CIO*, September, 30, 2002, <http://www.cio.com/research/surveymreport.cfm?id=36>.
- [29] V. Grover and K. Saeed, "The telecommunication industry revisited," *Communications of ACM*, vol. 46, no. 7, pp. 119–125, 2003.
- [30] C. Stenfield, H. Bouwman, and T. Adelaar, "The dynamic of click-and-mortar electronic commerce: Opportunities and management strategies," *International Journal of Electronic Commerce*, vol. 7, no. 1, pp. 93–119, 2003.
- [31] B. E. Mennecke and T. J. Strader, *Mobile Commerce Technology, Theory and Applications*. Hershey, PA: Idea Group, 2003.
- [32] J.-H. Wu and T.-L. Shiah, "Analysis of E-commerce innovation and impact: A hypercube model," *Electronic Commerce Research and Applications*, vol. 3, no. 4, pp. 389–404, 2004.
- [33] A. S. Bharadwaj, "A resource-based perspective on information technology capability and firm performance: An empirical investigation," *MIS Quarterly*, vol. 24, no. 1, pp. 169–196, 2000.
- [34] D. F. Feeny and L. P. Willcocks, "Core IS capabilities for exploiting information technology," *Sloan Management Reviews*, Spring, pp. 9–21, 1998.
- [35] S. L. Javenpaa, L. R. Lang, Y. Takeda, and V. K. Tuunainen, "Mobile commerce at cross-roads," *Communications of the ACM*, vol. 46, no. 12, pp. 41–44, 2003.

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