MIS Quarterly

ISSUES AND OPINIONS

DIGITAL INNOVATION AS A FUNDAMENTAL AND POWERFUL CONCEPT IN THE INFORMATION SYSTEMS CURRICULUM[1]

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The 50-year march of Moore's Law has led to the creation of a relatively cheap and increasingly easy-to-use world-wide digital infrastructure of computers, mobile devices, broadband network connections, and advanced application platforms. This digital infrastructure has, in turn, accelerated the emergence of new technologies that enable transformations in how we live and work, how companies organize, and the structure of entire industries.

As a result, it has become important for all business students to have a strong grounding in IT and digital innovation in order to manage, lead, and transform organizations that are increasingly dependent on digital innovation. Yet, at many schools, students do not get such grounding because the required information systems core class is stuck in the past. We present a vision for a redesigned IS core class that adopts digital innovation as a fundamental and powerful concept (FPC). A good FPC serves as both a foundational concept and an organizing principle for a course.

We espouse a particularly broad conceptualization of digital innovation that allows for a variety of teaching styles and topical emphases for the IS core class. This conceptualization includes three ***types*** *of innovation (i.e., process, product, and business model innovation), and four* ***stages*** *for the overall innovation process (i.e., discovery, development, diffusion, and impact). Based on this conceptualization, we examine the implications of adopting digital innovation as an FPC. We also briefly discuss broader implications relating to (1) the IS curriculum beyond the core class, (2) the research agenda for the IS field, and (3) the identity and legitimacy of IS in business schools.*

Keywords: Fundamental and powerful concepts (FPC), digital innovation, IS core course, pedagogy

[1]Detmar Straub was the accepting senior editor for this paper. Peter Gray served as the associate editor.

The appendices for this paper are located in the "Online Supplements" section of the *MIS Quarterly*'s website (http://www.misq.org).

Introduction

It is not too much of a stretch to think we have entered a golden age of digital innovation. Owing to the 50-year march of Moore's Law, we have witnessed the creation of a relatively cheap and increasingly easy-to-use world-wide digital infrastructure of computers, mobile devices, broadband network connections, and advanced application platforms. This digital infrastructure has, in turn, accelerated the emergence of new technologies—social media, cloud computing, analytics and big data, wearable devices, 3D printing, and intelligent autonomous systems, to name some recent ones—that enable transformations in the way we live and work, how companies organize, and the structure of entire industries (Agarwal et al. 2010; Brynjolfsson and McAfee 2012; Dhar and Sundararajan 2007; Lucas et al. 2013; Mithas 2012; Yoo 2009).

As a result, it has never been more important for all business students (both MBAs and undergraduates) to have a strong and appropriate grounding in information technology in general and digital innovation in particular. This is true for two reasons. First, aspiring managers have to understand the true nature of the aforementioned transformations (what is driving them, where they are headed) if they are to effectively direct the management and strategies of modern organizations.

Second, managers have increasing opportunities to become digital innovators themselves as the barriers that once prevented ordinary people from becoming innovators have fallen away. Digital innovators are marked by their ability to join two things together—(1) an understanding of what has become possible due to advances in technology, and (2) an astute insight into some unmet organizational or societal need—in order to create something new and valuable with digital technology. Due to the wide diffusion of cheap digital infrastructures, every business professional has some giant digital shoulders to stand upon when conceiving and developing innovative organizational processes, products, and business models. We see this in the rapid rise of innovative digital business models being pioneered by firms like Quirky.com and Threadless.com, where communities of self-selected individuals perform invention and development processes previously reserved for professionally trained designers (Brabham 2010; Kuang 2013). But we can also see this in efforts to democratize innovation within traditional firms using idea management platforms (such as Whirlpool's Innovation E-Space; Snyder 2006). Indeed, even the broader "design thinking" movement, which encourages ordinary mangers to bring a designer's sensibility and methods to innovation and organizational problem solving (Brown 2008), is promoted by the increasing diffusion of digital infrastructures and associated technical knowledge. This means that just about every business professional today has the opportunity—or even the obligation, given the growing importance of digital technology to organizational success—to become, in some form, a digital innovator.

However, while a strong grounding in IT has become increasingly important for business education, at many schools the required IS core class is not very effective at teaching aspiring managers what they most need to know about IT in the age of digital innovation. Hence, the primary purpose of this article is to present a roadmap for the required IS core class that teaches students what they need to know about IT to be effective managers and leaders. Specifically, we propose that digital innovation be adopted as a *fundamental and powerful concept* (FPC)[2] in the IS core class that is required for all MBAs and undergraduate business students. A good FPC serves as both a foundational concept and an organizing principle for a course.

We define digital innovation quite broadly as a *product, process, or business model that is perceived as new, requires some significant changes on the part of adopters, and is embodied in or enabled by IT*.[3] We believe that a well-designed IS core course with digital innovation as its FPC will, in addition to teaching all business students what they most need to know about IT, make it easier to communicate to business colleagues the value of what we teach in the core and why it is essential to modern business education. This could have the secondary effect of helping to preserve the presence of an IS course in the core at business schools that currently include one, or to provide a compelling rationale for introducing (or reintroducing) such a course at schools where IS is not now part of the core. If it were typical for such courses to have a clear and easily understandable conceptual focus, and to be among the most highly rated courses in the core, we expect that deans and other stakeholders would favor inclusion of IS in the core.

And make no mistake: the decision to include or exclude IS from the business core can be a watershed moment for an IS department. Of course, the presence of IS in the core gener-

[2]A fundamental and powerful concept is "one that can be used to explain or think out a huge body of questions, problems, information, and situations." (Nosich 2005, p. 104).

[3]This definition is by intention broader than the one offered by Yoo et al. (2010), which focuses exclusively on product innovations. We should note that the IT artifact is a critical element in our definition of digital innovation. Consequently, it encompasses what Benbasat and Zmud (2003) have argued should be central to the identity of the IS discipline.

ates demand for IS faculty lines to teach those sections, helping to create or preserve a critical mass of IS scholars in the school. However, a healthy core class also provides other key advantages, including a stable base level of demand for IS teaching (which moderates the effects of the swings of interest in IS that inevitably follow the boom-and-bust cycles in the IT industry), a platform from which to generate and maintain interest among students in IS programs and electives, greater legitimacy of IS in the eyes of business school colleagues, and last, but not least, an ongoing opportunity for IS faculty to communicate and evolve an understanding of what the IS field is all about among students and other stakeholders.

While we mainly address the implications of digital innovation as an FPC for the IS core class, we believe that adopting this foundation has broader implications for the IS curriculum, for IS research, and for the identity and legitimacy of IS within business schools. Therefore, we address these additional issues in the discussion section.

Digital Innovation as a Fundamental and Powerful Concept

In this section, we make the general case for adopting digital innovation as a fundamental and powerful concept (FPC) for the required IS core class. An FPC is a concept that can be used to explain or think through a vast body of questions, problems, information, and situations in a subject area or discipline. FPCs can be contrasted with individual bits of information, or with less general concepts (Nosich 2005). FPCs make it much easier for students to learn to think critically about what they read or hear. For example, consider history, a discipline that is constantly changing. How the past explains a historical event is a central concept in the discipline (an FPC). It is one thing to be presented with historical information, but it is another to learn how historical events are explained by the past from which they emerged. In IS, we have always presented students with technology-related information, but have not had one or two FPCs that students can use to think through what they read.

Getting students to think critically in business contexts is an important goal of business programs. Critical thinking is reasonable, reflective thinking that is focused on what to believe or do (Ennis 1987). It is the art of using the best thinking one is capable of at any point in time (Paul and Elder 2006). In management education, it is the art of learning to make rational decisions in business contexts and to avoid making irrational ones (Paul and Elder 2006). It is the logic of thinking in the discipline. For example, critical thinking in sociology involves learning to think as a sociologist does (Nosich 2005). Likewise, in business, it involves learning to think like business managers do. Consequently, learning to think critically goes beyond problem solving. Some questions or situations are too ill-formed to be classified as problems to be solved. Asking good questions (identifying problems to be solved) is a fundamental part of critical thinking (Nosich 2005). FPCs make it easier for students to ask good questions as they are exposed to new technologies, because everything they read and learn is, in some way, related to an FPC.

FPCs also help to provide a discipline with an identity, which many have argued is vital for IS (Agarwal and Lucas 2005; Benbasat and Zmud 2003; Larsen and Levine 2005). They can serve as signposts for teaching and research. Course content, design, and delivery can be more easily determined by seeking to relate candidate materials to an FPC. Courses are no longer composed of topics with little or no connection; rather, each segment is woven into an FPC. An FPC can be particularly useful in core IS courses because it can ensure that rapidly changing technical topics are discussed in a business context, and can help students to think critically about what they read and hear about IT artifacts and processes.

We believe that for digital innovation (or any other concept) to serve as a good candidate FPC for the IS core class it should meet the following three criteria. First, it must have high face validity, that is, faculty, students, business colleagues, and business executives must believe that the FPC is salient and important in a business context. When an FPC has face validity, topics only need to be credibly connected to the FPC to be viewed as valuable. It is not necessary to justify the inclusion of a topic in the course on some other basis. For example, once a student accepts the importance of the risk–return relationship in finance, it is easy for the student to see the importance of a topic (e.g., different types of debt or equity) if it affects risk. We believe that innovation is widely accepted as an enduring driver of value in the world of business. Moreover, digital innovation has grown steadily to become the primary driver of business innovation, and will continue to maintain or increase its salience as prices for key IT components continue to fall and the vast infrastructure of computers, networks, and digitally enabled devices continues to diffuse. The central question proposed by Dhar and Sundararajan (2007) for core education in IS (i.e., how does IT transform business and society?) is tightly related to digital innovation, in that digital innovation is the means by which these transformations occur.

Second, a good FPC should serve well as a persistent, organizing concept for the IS core course. Along these lines,

we believe that from the beginning, IT has been a driver of process innovation within firms. We use the term *process innovation* (discussed in greater detail below) broadly to mean new ways of doing things in an organizational setting, and as such, the term encompasses not just new business processes, but also the creation of new capabilities, strategies, and structures that are in some way digitally enabled. Virtually any significant new use of digital technology by a firm can be seen through an innovation lens. For example, CRM is about how to use technology to change the process of customer identification, acquisition, and retention. The core of all major CRM suites (e.g., Salesforce.com) lies in sales force automation, which has the potential to radically change the way marketing divisions interact with customers (Zablah et al. 2012). ERP systems have reshaped enterprise-level processes and SCM has facilitated innovation throughout the supply chain. With SoA, cloud computing, and SaaS, companies have new opportunities that were barely conceivable a decade ago. Emerging 3D printing and other desktop manufacturing technologies could radically change production processes and supply chains. Clearly, process innovation goes well beyond efficiency considerations, and, in this respect, digitally enabled innovation has always been the key to exciting stakeholders about IT value creation. Looking beyond process innovation, digital technologies have become increasingly important as an enabler of *product* and *business model innovation* (discussed below).

Third, a good FPC should provide an identity for the IS core course that is distinct from other core courses. While the core courses for other disciplines (particularly marketing and strategy) often connect to innovation in some fashion, none have a special focus on digital innovation *per se*. In fact, there is evidence that non-IS scholars tend to give too little attention to technology in general. For example, a review of articles appearing in four leading management journals between 1996 and 2005 found that only 2.8 percent focused on the relationship between technology and organizational form or function, even though IT has arguably had far-reaching impacts on these aspects of organizational life (Zammuto et al. 2007).

This lack of attention to technology is especially surprising given that digital technologies possess some highly distinctive characteristics that have important practical and theoretical implications for innovation. We organize the implications of three highly salient characteristics under the short-hand labels *digitalization, Moore's Law*, and *network effects* (see Table 1). From a pedagogical standpoint, these distinctive characteristics make it easy to convince business students that digital and digitally enabled products and processes are "different" in fundamental ways, and to motivate interest in IS as a general subject of study. From a research standpoint, these and other distinctive characteristics can and should play a key role in the contextualization process of theorizing and research design. They help to answer the question why it matters, theoretically, that we are studying a digital innovation here rather than something else. Additionally, digital innovation is often affected by IT-related factors (e.g., a firm's IT assets) that non-IS researchers are ill-equipped to consider.

These are not the only distinctive characteristics potentially worth highlighting in making the case that digital innovations are different from other sorts of innovations and therefore worthy of focused attention and study. For example, while Dhar and Sundararajan (2007) agree that digitalization and Moore's Law are central, they place *modularity* as their third characteristic. Other distinctive characteristics include the especially high *switching costs* often imposed by digital products and processes (Shapiro and Varian 1999); the fact that much of the business value from IT investment flows from *complementarities* (Melville et al. 2004); and that information technologies *informate* processes as a side effect of automating them (Zuboff 1988). Nevertheless, we have found that the three characteristics we have highlighted prove particularly compelling in a classroom setting in that they have high face validity among students, and also have intriguing managerial implications.

While we believe that digital innovation is an ideal FPC for the IS core course, we acknowledge other candidates exist, such as *IT-driven organizational change*, *IT-enabled business value creation*, and *IT-driven transformation of business and society*. In fact, we have discussed these three and other candidate FPCs in seminar presentations at multiple business schools.[4] In the context of the IS core course, any of these three could easily be positioned as a closely related FPC. We have included the notion of "significant change" (which encompasses organizational change) in our definition of digital innovation (see below). Value creation and transformation are among the impacts that reside in the fourth stage of the innovation process as we define it (see Table 2). That said, we don't think any of these three would serve as well as digital innovation as the central FPC for the IS core class (and neither did any of our seminar audiences).

As one final point, we note that the broad adoption of digital innovation as an FPC could help to counter a key challenge posed by The INFORMS IS Society on teaching,[5] which is

[4]We thank the seminar audiences at University of Maryland, Michigan State University, and Boston College for their input on this issue.

[5]For information, go to https://www2.bc.edu/~fichman/Chair-Feb08.pdf.

Table 1. Implications of Digitalization, Moore's Law and Network Effects

Characteristic	Explanation and Implication
Digitalization	*Digitalization* refers to the practice of taking *processes*, *content* or *objects* that used to be primarily (or entirely) physical or analog and transforming them to be primarily (or entirely) digital. The effect of digitizing *processes*, aside from potential efficiency gains, is to make processes more tailorable and malleable. The advantageous effects of *digitized content* (images, video, and text) are well known. They include the ability to make unlimited perfect copies; dramatic cost reductions for content storage, duplication, and transmission; enhanced ability to search, analyze, correct, and improve content (Negroponte 1995). Perhaps more profoundly, digitizing content breaks the historically tight coupling between information types and their respective devices, storage media, and transmission formats, resulting in digital convergence (Tilson et al. 2010). Digitizing (or digitally infusing) *objects* gives them new properties—programmability, addressability, communicability, memorability, sensibility, traceability, and associability—that together make digital products (like digital processes) highly malleable, and also opens up large new domains of potential functionality (Yoo 2009).
Moore's Law	We use the label *Moore's Law* to refer to the rapid, often exponential, price–performance improvements that characterize many kinds of IT components (memory chips, microprocessors, hard drives, routers and other communication and networking devices, LCD panels, etc.). The main implication of Moore's Law is to rapidly increase the range of what it is technically and economically feasible to accomplish with IT. It explains why IT has become the dominant enabling force for both product and process innovations today. In fact, Moore's Law can be seen as a fundamental enabler of many instances of disruptive innovation (Christensen 1997) and creative destruction (Schumpeter 1950). For example, the combination of the enhanced quality and lower price of digital photography eventually led to the demise of the film photography industry.
Network Effects	We use the label *network effects* to capture the tendency of many digital innovations to become more valuable to any individual adopter as the size of the adopter network grows. Network effects arise from direct network externalities among users (i.e., the ability to communicate or share digital assets), and also indirectly from various supply side mechanisms (i.e., complementary goods, economies of scale, learning-by-doing) that allow firms with large networks to more rapidly decrease cost or increase functionality (Shapiro and Varian 1999). The main implications of network effects are to add value to IT innovations (as network benefits accumulate in a growing adopter network); to alter diffusion dynamics (e.g., to provoke self-reinforcing adoption cycles, critical mass thresholds, standards wars, lock-in); and to complicate technology adoption decisions (especially timing of adoption) (Shapiro and Varian 1999).

"the large variance (across universities) in the core MBA IS class. On the other hand, the variance in other disciplines (e.g., Operations Management, Marketing, Finance, Accounting, Organizational Behavior, etc.) is much less."

Scope of the Digital Innovation Concept

Rogers defines an innovation as "an idea, practice or object that is perceived as new by an individual or other unit of adoption" and goes on to note that "it matters little, so far as human behavior is concerned, whether or not an idea is objectively new as measured by the lapse of time since its first use or discovery" (2003, p. 11). Following this, and definitions from Zaltman et al. (1973) and Downs and Mohr (1976) that similarly focus on newness to the adopting unit, we, as previously noted, define digital innovation as a *product, process or business model that is perceived as new, requires significant changes on the part of adopters, and is embodied in or enabled by IT.* We add the caveat about "significant changes" to exclude mundane sorts of innovations, such as to install a simple, well-understood software package that automates some narrow task and does not require significant organizational changes to gain intended benefits.

Based on our definition, any digital technology that is new to an organization and requires significant change qualifies as an innovation for that organization. However, we suggest that instructors give greater attention to emerging technologies that are in the earlier phases of diffusing through the adopter population, as technologies at this stage are of greater general interest to students, and require the most thought and analysis to understand and interpret. For similar reasons, we suggest disproportionate attention to more radical/discontinuous innovations (as opposed to incremental extensions).

For digital innovation to serve well as a widely accepted FPC for IS, the scope of the concept has to be broad enough to provide a foundation for a variety of teaching styles and topical emphases for the IS core class. As a result, we include within our scope of the concept three *types* of innovations (*process, product,* and *business model innovation)* and four *stages* for the overall innovation process (*discovery, development, diffusion,* and *impact*), as described below.

Process, Product, and Business Model Innovation

Process versus *product* innovation has been a central distinction in past scholarly work on innovation (Utterback and Abernathy 1975). In more recent years, *business model* innovation has garnered increasing recognition as a third class of innovation (Teece 2010). While the main focus among IS scholars to date has been on process innovation, we argue for a more balanced focus on all three forms of innovation in IS teaching and research going forward.

Digital Process Innovations

Digital *process* innovations are significantly new (from the perspective of the adopter) ways of doing things in an organizational setting that are embodied in or enabled by IT. Research on digital process innovation uses adopting firms as the focal point (i.e., *organizational innovators*), and investigates when and why firms adopt new technologies, and how they can successfully assimilate them. Such firms could be adopting technologies supplied by the market, or developing and deploying internally developed technologies.

Over time, digital process innovations have affected how transactions are processed, how decisions are made, how office work is done, how firms deal with existing customers and suppliers, and how firms entice new customers. A firm that adopts warehouse automation technology to substantively change how they manage inventory or uses a new social media platform to change how they solicit new product ideas from customers has experienced digital process innovation. Beyond these sorts of changes to the *technical* core of the organization, digital process innovations can also lead to changes to the *administrative* core, such as new organizational forms or governance structures, as described in Daft (1978), Markus (2010), and Swanson (1994).

Recall that according to our definition, we can view something as a digital innovation so long as it is embodied in, or enabled by IT. This means that depending on our purpose, the boundary on what constitutes a given process innovation can be drawn narrowly to focus on the core technology at hand (e.g., a CRM package) or more holistically to encompass the core technology together with related elements—both technical (e.g., analytics software) and organizational (e.g., new marketing strategies, processes, skills)—that together form an ensemble with the core technology in support of some business strategy or initiative.

Applying these distinctions to the Harrah's case (see Table 5), the first approach might have us draw our boundaries around the WiNET infrastructure and focus on that. Alternatively, WiNET and one-to-one marketing (and other changes) can be viewed as collectively constituting a digital innovation that enables Harrah's new marketing strategy for creating and reinforcing customer loyalty. In sum, just as in the world of hardware and software, where we can look at components, assemblies, and assemblies of assemblies as each constituting a distinct innovation at multiple different levels (i.e., a new chip, a new tablet computer incorporating the chip, a new classroom technique incorporating the tablet computer), the same is true when we allow organizational elements to be part of the assemblies. This is by no means a novel idea. It has long been observed that many (or even most) innovations are actually recombinations of existing elements, some of which are (or once were) innovations themselves (Arthur 2009).

Digital Product and Business Model Innovations

Digital *product* innovations are significantly new (from the perspective of a particular community or market) products or services that are either embodied in IT or enabled by IT. Examples include new enterprise platforms (ERP, CRM), new consumer products (smartphones, Amazon's Instant Video service), and existing products substantially enhanced by the addition of digital technology (GM's OnStar service).

Unlike research on digital process innovation, which focuses mainly on technology adopters, research on digital product innovation focuses on firms that produce new digital products (i.e., *product innovators*) and on the various supply-side processes, institutions, structures, and market dynamics that support and shape the product's development and diffusion. As with process innovations, the boundary on what constitutes a given product innovation can be drawn narrowly around a core technology (e.g., the iPhone), or more broadly to also encompass complementary products and services (e.g., iTunes, network service, iPhone applications and accessories) that are necessary to fulfill the value proposition for intended users, or what has been called the *whole product solution* (McKenna 1985 p. 918).

In recent years, an increasing number of scholars have recognized *business model innovation* as a third class of innovation. According to Teece, a business model "defines how the enterprise creates and delivers value to customers, and then converts payments received to profits" (2010, p. 173). Following Teece, we define digital business model innovation as a significantly new way of creating and capturing business value that is embodied in or enabled by IT. As noted by Teece and others, advances in IT have become the primary driver of business model innovation in recent years. Examples include Google's ad-sponsored search business, Netflix's DVD-by-mail subscription service, and Zipcar's auto rental business. As with product innovation, research on business model innovation typically focuses on the supply side of innovation. For this reason, and also because business model innovations usually involve product innovations as well, we tend to group the two types of innovation together in subsequent discussions.

Although process, product, and business model innovation are each distinct ideas, they entwine in important ways (Carlo et al. 2011). Emerging commercial technologies are simultaneously a product innovation from the perspective of the supplier (e.g., a new analytics tool), and the core of a process innovation from the perspective of the customer (e.g., a firm adopting that analytics tool for the first time). Also, firms can choose to "productize" their internal process innovations and thereby create product or business model innovations. For example, Pixar developed a technology called Renderman to help create 3D images for their own movies, but then licensed this technology to many other companies.

In a related idea, one kind of digital innovation often enables or becomes a component in other digital innovations. In the mammography field for breast cancer detection, digital detector technology has enabled radiologists to replace film cassette-based analog mammography, and this results in a new product: digital mammography. Using digital mammography, a radiologist on a computer can focus in on an area, enhance it, change the contrast settings, and do a variety of things that were not possible with analog mammography. A new collection of "best practices" that arise from these capabilities—including possible changes to the organization of work to bring into the process specialists working remotely—can also be viewed as digital innovation. Returning to the Pixar example, to make their digitally animated feature films come alive (product innovation), Pixar has constantly pushed the envelope on the digital animation technologies they use to create those films (process innovation).

With some innovations, the lines between process, product, and business model innovation become very blurred. Open source software can be viewed as innovation in the process that firms and individuals use to create IT products, as a new kind of product or business model in itself, and as a trigger for administrative and process changes within the consumers of open source software (e.g., relating to the traditional buy-versus-build calculus).

As a result, it is important to acknowledge that all three forms of innovation may intertwine, and that the same firm can engage in all three forms. That is, firms not traditionally thought of as digital innovation suppliers can create new digital products or business models, as in the case of GM's OnStar service. Also, digital product innovators often find themselves engaging in process innovation. Likewise, the same commercial technology can often be viewed as either a product or process innovation depending on whether the focus is on the supplier or adopter.

Digital Innovation Process Stages

We define the scope of the overall digital innovation process as spanning four stages: *discovery*, *development*, *diffusion,* and *impact* (see Table 2). We intend these stages to be general enough to reflect innovation processes for both product/business model innovators and organizational (process) innovators. The first three stages roughly correspond to Schumpeter's (1950) classic three stage model of innovation (i.e., invention, innovation, and diffusion), while the fourth breaks out impacts from Schumpeter's diffusion stage to be a separate stage. We also see some correspondence between these four stages and the four activities in Wheeler's (2002) net-enabled business innovation cycle framework, that is, *choosing enabling/emerging technologies* maps to discovery, *matching with economic opportunities* maps to discovery and development, *executing business innovation for growth* maps to development and diffusion, and *assessing customer value* maps to impact.

For each stage, we identify two key activities, either or both of which will be salient depending on the type of innovation (product/business model innovation versus process innovation) and on the particular managerial and research issues at hand. As one final note, while we portray the stages as sequential, in reality they can be overlapping or iterative (for example, some development activities typically continue throughout the diffusion and impact stages).

The stage(s) where a technology currently resides within a population of firms can be determined by which managerial questions are garnering the greatest attention among leading-edge product and organizational innovators. Table 3 provides examples of questions that managers need to answer in each stage.

Table 2. Stages of Digital Innovation

Stage	Explanation
Discovery	In this stage, new ideas are discovered for potential development into a process, product, or business model innovation. Key activities in this stage include *invention*, which means the creation of something new through a firm's own creative process, or *selection*, which means finding and evaluating an innovative technology in the external environment to potentially develop or adopt. Product and business model innovators tend to actively engage in both invention and selection (because innovations are often based on existing ideas that have yet to be developed), whereas organizational innovators tend more toward selection rather than invention, due to the rise of commercialized technology solutions such as software packages.
Development	In this stage, an idea for a core technology is developed into a usable innovation. For product and business model innovations, this involves developing and refining the core technology plus an activity we call *packaging*. Packaging means surrounding the core technology with complementary products and services that together form a solution that can be effectively used for a given purpose by a target adopter (McKenna 1985; Teece 1986). For process innovations, activity in this stage involves a task we call *configuring*, which means deciding which technology features will be used, whether they will be used as is or with adaptations, how the technology will be integrated with other technologies the organization already has in place, how related organizational elements (e.g., structures, processes) will be changed, and how the organization will absorb and make use of the technology.
Diffusion	In this stage, an innovation diffuses or spreads across a population of potential users. From the perspective of product and business model innovators, the central activity in this stage is *deployment*, by which we mean marshaling the resources necessary to persuade and enable a population of firms or individuals to adopt and use the innovation. From the perspective of organizational innovators, deployment is also a relevant idea, except the relevant population is composed of people and units within the firm. When deployment goes well, the result is *assimilation*, which happens when individuals and other units absorb the innovation into their daily routines and the work life of the firm.
Impact	In this stage, the focus is on the effects (intended and unintended) that digital innovations, once diffused, have on individuals, organizations, markets and society. Within organizations, digital innovation can positively impact the cost side (via improved efficiency) and the revenue side (by enabling differentiated products and business models.). Key activities in this stage include *value appropriation* and *transformation*. For product and business model innovators, appropriation involves such tasks as managing intellectual property and the ecosystem of complementary products and services so that profits are protected from suppliers, customers, and imitators. For organizational innovators, value appropriation involves continuously *transforming* the technology and organization to take advantage of the new opportunities brought about by the innovation. Transformations can also happen at the market and societal levels.

Table 3. Evolution of Managerial Questions by Innovation Stage

	Questions
Discovery	What is the nature of the core IT underpinning the digital innovation? What problems or needs can the technology address? Should the innovation be a major focus of attention or a minor focus?
Development	What constitutes the digital innovation's core feature set? To what potential organizational uses can it be put? What complementary products and services are needed to flesh out the "whole product solution" for different kinds of adopters? From a process innovation perspective, what other elements (organizational, technical) comprise a sound innovation system incorporating the digital innovation?
Diffusion	What is the digital innovation's diffusion trajectory? Who is adopting, how, and why? What kinds of firms are more prone to adopt the innovation? What kinds of deployment barriers are most salient, and how can they be overcome?
Impact	What sorts of impacts are being seen among adopters, and what contingencies affect these impacts? What transformations resulting from the digital innovation are being observed at the level of individuals, firms, markets, and society? How can adopters appropriate maximum value from the innovation?

The above stages are defined to be generic rather than specific to digital innovation in order to reinforce the linkage of digital innovation to the broad domain of innovation as a whole. However, this raises some interesting questions.[6] If these stages are the same for digital innovations as they are for other kinds, then does this mean that digital innovation is not really a distinctive class of innovation in its nature or its effects? Does embracing digital innovation as an FPC perhaps open up the IS core class or maybe even the IS field as a whole to an "envelopment" challenge (Eisenmann et al. 2006) from other disciplines that have some claim to the innovation concept, especially our colleagues in the field of technology and innovation management?

We address these issues as follows. On the first question, while it is true that the stages of innovation can be generalized across a wide diversity of technologies, this does not mean the stages unfold in the same way for all innovations or that all classes of innovation are the same in *other* ways. Nevertheless, this does raise the question of *how* digital innovations are distinctive as a subclass of innovation, and *why* these differences matter. Much of the answer to this lies in our prior discussion of the three distinctive characteristics of IT in general—Moore's Law, digitalization, and network effects. Specifically, we believe these characteristics have implications for how the four innovation stages unfold and other aspects of innovation.[7]

This is probably easiest to see in the case of network effects, in that a large research stream (sometimes referred to as the *economics of technology standards*) has explicitly examined the implications for innovation of network externalities and other drivers of network effects (Shapiro and Varian 1999). Network effects, by definition, add substantial value to digital innovations (due to the accumulation of network benefits in a growing adopter network), thus changing the dynamics of the fourth stage of innovation (impact). They also alter diffusion dynamics (stage three), for example, in order to provoke self-reinforcing adoption cycles, critical mass thresholds, standards wars, and lock-in. This, in turn, has implications on the strategic decision making of product innovators (e.g., how to win a standards war, how to manage lock-in) and technology adopters (e.g., how to optimize adoption timing). Finally, network effects complicate decisions related to technology development (stage two), such as whether to privilege performance or backward compatibility in the design of new generations of technology (Shapiro and Varian 1999), and whether or how to leverage an existing installed customer base to enter an adjacent technology market (Eisenmann et al. 2006).

If the implications of network effects have been the most systematically codified in prior research, we believe the implications of Moore's Law and digitalization, individually and in combination, have the most diverse and profound implications. At the most general level, Moore's Law and digitalization have rapidly rolled back the frontier on what is technically and economically feasible to accomplish with IT. It is the reason for the rapid diffusion and increasing ubiquity of cheap (and in many cases, effectively free to the user) digital infrastructures, which, in turn, have amplified the scope and accelerated the pace of digitalization of processes, contents, and objects. Further, network effects are often enabled and expedited by Moore's Law and digitalization. The quick emergence of Facebook as the world's largest social network can also be attributed to the reduced networking cost (Moore's Law) and digitalized social networking services (digitalization) it provides.

While a detailed examination of the implications of these characteristics is beyond the scope of this paper, Table 4 gives a flavor of the myriad implications, which, besides clarifying how digital innovation is "different," also nicely illustrates why it represents such a compelling FPC for aspiring managers. Note that in the table the symbol ➔ should be understood as enabling or encouraging rather than deterministically causing.

A Word about Theory

We have just offered a simple innovation typology and a sketch of innovation stages in order to place coherent boundaries on the digital innovation concept. We have not, however, attempted to propose a general theory or framework for digital innovation, in part because the phenomenon is simply too broad and diverse for this to be a feasible undertaking.

That said, we do think it is appropriate to reflect on the link between our proposed FPC and theories of digital innovation. To date, IS innovation scholars have mainly employed what we think of as a perspective-centered approach to theorizing, where concepts and assumptions from some existing research stream (e.g., network economics, organizational learning,

[6]We thank the review team for bringing this to our attention.

[7]See Dhar and Sundararajan (2007) for an alternative analysis of how characteristics of digital technology (which they refer to as "invariants") map to various consequences. Our analysis, which focuses on innovation as the link between characteristics and consequences, can be seen as complementing theirs. As they note: "There clearly is a process of innovation by individuals, firms, and decentralized groups of individuals acting collectively, that connects the invariants to these consequences. Although we acknowledge the importance of such innovation, we do not describe it in this paper" (p. 129).

Table 4. Implications of Moore's Law, Digitalization and Network Effects for Innovation

Summary Impact	Chain of Influences Leading to an Implication or Impact	Examples
Industry transformation	**Moore's Law and digitalization** → device and network convergence → destruction of tight couplings between service modes and underlying technologies → **industry and market convergence; transformation of whole industries**.	Apple, Bonnier, Netflix, GM OnStar, 3D printing, digital convergence (Applegate et al. 2012; Lucas et al. 2013; Tilson et al. 2010; Yoffie 1996)
Distinctive diffusion dynamics	**Network effects** → critical mass diffusion dynamics, path dependency, winner take all, lock-in → **standards wars, risk of stranding**.	VHS versus Beta; Apple Mac versus Windows; iPhone versus Android; HD-DVD versus Blu-Ray (Eisenmann et al. 2006; Shapiro and Varian 1999)
Greater diversity of products and services	**Moore's Law and digitalization and network effects** → widespread diffusion of cheap digital infrastructures → increased ability to aggregate product demand through online channels + increased ability of consumers to find niche products suited to their tastes → **greater diversity of products and services developed and offered** ("long tail" effect).	Netflix, Amazon, Hulu's customized ads, Zara's quicker and more localized market, social media/user generated content (Brynjolfsson et al. 2003, 2010)
Greater personalization of products and services	**Digitalization** → programmability, memorability, associability → **greater personalization of novel processes, products and services**.	Personalization, mass customization, gamification (Adomavicius and Tuzhilin 2005; Salvador et al. 2009; Yoo 2009)
Faster innovation cycles and processes	**Moore's Law and digitalization** → dramatically lowered cost/ increased ease of experimentation + complementary changes to innovation processes, structures, incentives → **more rapid development and evolution of innovative processes and products**.	Capital One, Shinsei Bank, Enterprise IT at SYSCO, Zara's Fast Fashion, CVS (Davenport 2009; Fuller and Upton 2007; Hopkins 2010; McAfee et al. 2007; Thomke 2001)
Faster/ broader product diffusion	**Moore's Law and digitalization** → rapid price/performance improvement of physical digital products; near zero cost of duplication and distribution for pure information products → **accelerated emergence and faster/broader diffusion of new products and business models**.	DVD players, iPhone/Smart phones, tablet computers, Facebook/social networking (Thierer and Eskelsen 2008; Van den Bulte 2000)
Product pricing and delivery flexibility	**Digitalization** → near zero cost of duplication and distribution; digital rights management → **intellectual property threats; increased control over how digital products are used, when and by whom** (e.g., bundling, trials, "freemium" models); **greater pricing flexibility** (e.g., how much is charged, to whom, when, by what mechanism, and for what level of functionality).	Napster, Rhapsody, Hulu, YouTube (Bakos and Brynjolfsson 1999; Hitt and Chen 2005; Shapiro and Varian 1999; Smith et al. 2000; Smith and Telang 2009)
New ways to market new products	**Moore's Law and digitalization and network effects** → widespread diffusion of cheap digital infrastructures → **new avenues for marketing and supporting new products** (e.g., sponsored search and context-based ads, social medial marketing/online word-of-mouth).	Google, Facebook, Twitter (Gallaugher 2012, Chapters 7, 8 and 13; Ghose and Yang 2009)
Move to smart technologies and servitization	**Moore's Law and digitalization and network effects** → increased feasibility of embedding digital sensors and processors in a wide range of everyday items and then connecting them up into an "Internet of things" → **widespread emergence of "smart" technologies; accelerated move to servitization** (converting products into services) **and other kinds of new business models enabled by smart technologies**.	Rolls-Royce "power by the hour," Progressive Insurance Snapshot program, Zipcar, RFID, Smart Hospitals (Chui et al. 2010; Davies et al. 2006)
Move to real-time question answering systems	**Moore's Law and digitalization** → feasibility of understanding natural language questions and rapidly searching and then extracting knowledge from huge troves of structured and unstructured data → **new organizational process and business models based on generalized real-time question answering systems**.	Apple Siri, Streaming data analytics, IBM Watson (Shih 2012)
Creation of analytics-driven digital innovation opportunities	**Digitalization** → informating processes as they are automated → automatic capture of vast new stores of detailed data about processes → pervasive opportunities for analysis of all technology-mediated processes → **increased opportunities for process and product/business model innovation**.	Amazon, Capital One, Harrah's, Business Analytics (Davenport and Harris 2007; Zuboff 1988)
Democratized innovation	**Moore's Law and digitalization** → widespread diffusion of cheap digital infrastructures → increased ease of distributed collaboration and peer production → **process and product innovation discovery and development becomes more open, democratized, and user-driven**.	Innocentive, P&G connect&develop, open prize competitions, Dell Ideastorm, Whirlpool's Innovation E-Space, Threadless (Boudreau and Lakhani 2009; Brabham 2010; Enkel et al. 2009; Huston and Sakkab 2006; Malone et al. 2010; Melymuka 2004)

theory of reasoned action, institutional theory, adaptive structuration, real options, resource-based view, economic complements, information cascades, managerial fashions) are used as a foundation for model building in some particular diffusion context. There is certainly nothing wrong with this approach, but it does tend to leave IS instructors (and their students) without a more holistic view of the phenomenon akin to Silver et al.'s (1995) well-known IT interaction model for MBA pedagogy.

However, there are a few examples of approaches to theorizing about digital innovation that are more holistic, process oriented, and rooted in practice—and that could be used as a structuring device in an IS core class as an alternative to our process stage model (Table 2). These include Wheeler's (2002) theory of the net-enabled innovation business cycle, Swanson and Ramiller's (2004) work on innovating mindfully with IT, and Sambamurthy et al.'s (2003) model of the link between IT, digital options, and firm performance. The commentary on experiential computing by Yoo (2009) is also promising as a basis for this sort of holistic model. While none of these models aim to be general "theories of everything" for digital innovation, they provide a diverse menu of options for instructors desiring an alternative to our stage model to serve as a theoretical framework for the IS core course.[8]

Implications for Teaching

An examination of textbooks aimed at IS core courses is revealing. Topics typically include organizational use of information systems, IT strategy, a variety of technology segments (e.g., hardware, software, database, data warehousing, business intelligence, telecommunications, security, etc.), web-enabled systems, systems development, various application systems (e.g., CRM, ERP), ethics, international issues, etc. Often, there is no unifying theme/framework across topics, and when there is, it varies from text to text and edition to edition. In Appendix A, we provide a chapter-by-chapter assessment of whether the content in four textbooks aimed at IS core courses (Applegate et al. 2008; Gallaugher 2012; Laudon and Laudon 2011; Oz 2008) is, can, or cannot be linked to digital innovation.

[8]We have found that scholarly articles of this sort do not go over very well with students, so we suggest that any instructor adopting one of these frameworks will need to write a short lecture note to communicate the essentials in a more student-friendly way.

We postulate that IS core classes should focus on topics that can be linked to the discovery, development, diffusion, and impact of digital product, process, and business model innovations. Business students in the IS core class should not be asked or required to learn about the details of any given technology just because it is "important" or part of the standard IT landscape in organizations. Rather, students should be asked to learn such details as an occasion to better understand some key aspect of digital innovation. Nevertheless, once a technology or case example is introduced as an example of digital innovation, it is easy to use it as a springboard for engaging other themes. Table 5 illustrates what we mean. This table shows how case examples of digital innovation can be used to explore a great variety of themes often found in IS textbooks. Of course, with digital innovation as an FPC, one can also easily assimilate emerging topics. For example, if one is asking students to read about cloud computing, SaaS, or like topics, the intent should be to have them understand how these technologies can enable product or process innovation and what the impediments are to successful innovation based on these technologies.

Even though many technology topics do eventually filter out to classes in other disciplines (e.g., some recent operations management textbooks have a chapter on ERP, and some recent marketing texts have chapters on digital marketing), we disagree with the position taken by 27 percent of the deans surveyed by Dhar and Sundararajan (2006), who felt students can and should learn what they need to know about IT in the core courses for other disciplines rather than in a course dedicated to IT. Rather, we see many reasons why IS scholars should take the leading role in teaching business students about digital innovation, and should do so within the confines of a dedicated IS core course.

First, digital innovations have theoretical and practical commonalities (see Tables 1 and 4) that transcend any given technology. These commonalities argue for the topic to be consolidated into a single class, where that body of knowledge can be applied across a range of digital innovations. But probably more important, IS scholars have (or should have) a greater absorptive capacity when it comes to recognizing and appreciating digital innovation as it relates to managerial practice. Due to our strong grounding in technology, we should be better able to (1) detect the emergence of potentially important digital innovations; (2) achieve an early understanding of key features of nascent digital innovations, how they work, and how they are related to IT assets already in place; and (3) recognize when an emerging IT could become "the next big thing" that has a great potential to affect managerial practice in important ways. Moreover, we should be better able to identify the challenges and opportunities

Table 5. Mapping Digital Innovation to Traditional Course Themes

Exemplar	Overview	Elements of the IT Innovation System	Potential Pedagogical Themes Related to IS Core Class
Harrah's Database Marketing Strategy (Davenport et al. 2001; Hopkins 2010; Lal 2002; Watson 2001)	In the 1990s, Harrah's initiated a new corporate strategy to embrace database marketing (Lal 2002; Watson 2001). Harrah's CEO hired leading DBM scholar and proponent Gary Loveman to be the firm's chief operating officer. In this role, he orchestrated a $100 million investment in a data warehouse infrastructure called WiNet designed to (1) allow real-time gathering of detailed customer-level gaming behaviors; (2) merge that data with demographic data; (3) store the data in a way that was accessible throughout the organization for analysis; and (4) provide sophisticated tools for the analysis itself.	**Core Technology:** WiNet infrastructure. **Other Elements**: New strategy (to emphasize database marketing); new structures (a centralized marketing function to replace the marketing "fiefdoms" at each Casino); new skills (a database marketing expert as COO, and new specialists with deep statistical training); new processes (a data-driven decision process based on results of the analytical models rather than managerial experience and intuition); new programs (a robust loyalty program spanning gaming across all casino properties, the first of its kind in the gaming industry).	IT assimilation, IT strategy, IT for competitive advantage, IT complements, IT business value, customer relationship management, data warehouses, business intelligence, analytics, ethical issues and IT
General Motors OnStar (Koudal et al. 2004; Yoo 2009)	OnStar, introduced by General Motors in 1996, is a combination of factory-installed telematics equipment and a subscription service intended to provide drivers with hands-free, eyes-on-the road access to variety of services related to safety, security, information and communication. Initially targeting the luxury car market, OnStar was soon expanded to other cars in the GM line, and later GM began offering the service to other car makers. At the touch of a button, drivers can initiate a phone call to OnStar representatives to report an accident or get assistance with various tasks (such as calling a tow truck or rebooking a flight). Other features include the ability to gather automobile status and maintenance information from the in-car network. This allows remote diagnostics and automatic notification that a crash as occurred or airbags have been deployed. It also allows tracking of stolen vehicles.	**Core Technology:** OnStar telematics and infrastructure. **Other Elements:** OnStar services and applications, OnStar call centers, linkages with local public safety organizations, integration with in-car sensor network.	Digitally infused products, "productizing" IT assets, IT for competitive advantage, IT-driven industry transformation, telematics, emdedded systems
ITC eChoupal Initiative (Annamalai and Rao 2003; Upton and Fuller 2003)	Starting in 1999, the international business division of ITC sought to improve India's archaic soybean supply chain (and thereby grow their soybean export business) by empowering rural farmers with information about market conditions, weather, and farming practices. Previously, villagers sold their crops at the government sanctioned open-air markets, where they were powerless price-takers. ITC developed and deployed (to thousands of villages) a solar powered, satellite-linked e-commerce workstation that allowed farmers to make informed choices about farming practices, to discover where to go to get a good price for their crops, and (eventually) to conduct e-commerce transactions.	**Core Technology**: E-commerce workstation. **Other Elements:** Other technologies (servers, satellite links), new roles (caretakers for the workstations), changed roles (for ITC's own supply chain middlemen), new non-IT infrastructure investments (to create a network of ITC-run hubs to serve as an alternative to open-air markets), and new policies (to give price guarantees and travel reimbursements to farmers that used ITC hubs).	IT assimilation, IT deployment, IT strategy, IT for competitive advantage, IT business value, e-commerce, supply chain management, IT-enabled social entrepreneurship

Table 5. Mapping Digital Innovation to Traditional Course Themes (Continued)

Exemplar	Overview	Elements of the IT Innovation System	Potential Pedagogical Themes Related to IS Core Class
Pixar, Inc (Afuah 2009; Catmull 2008)	Starting in the mid-1990s Pixar Animation Studios pioneered the use of digital animation, starting with award winning advertisements, and then moving into feature films. Pixar supported these efforts with an internally developed suite of digital animation process technologies, including Marionette (manipulating images), Renderman (rendering photorealistic images), Ringmaster (managing digital production), and Pixarvision (recording digital images to film stock). Through a combination of these process technologies, visionary leaders, and a unique creative process, the firm managed to produce, from 1996 to 2010, a perfect record of 11-straight critically acclaimed blockbusters in a field where even 3 hits in a row is noteworthy, and only about 1 film in 20 achieves blockbuster status.	**Core Technology:** Digital animation process technologies (Marionette, Renderman, Ringmaster, and Pixarvision). **Other Elements:** A unique creative process in which (1) all projects arise from internally generated story ideas, rather than being purchased from outside, (2) a strong peer culture is reinforced through mechanisms like daily work-in-process presentations from each individual to the whole team, (3) great autonomy is given to team members on how to accomplish the director's vision, and (4) a rigorous post-mortem is performed on all projects.	Digital goods, "productizing" IT assets, digital business processes, IT for competitive advantage, IT-driven industry transformation
Shinsei Bank (Fuller and Upton 2007; Upton and Staats 2008)	In the early 2000s, Shinsei bank developed, as part of a company revitalization effort, a new enterprise system to support retail banking operations. Distinctive aspects included a highly modular architecture and heavy reliance on standards (including use of the Internet for all networking).	**Core Technology:** Retail banking enterprise system. **Other Elements:** Customer service-oriented marketing strategy (free 24-hour ATMs, Internet banking, longer hours), distinctive service operations ("cashless" tellers who do not do transactions directly, but instead help customers do their own transactions), novel systems development process (based on rapid iterations and reusable components).	IT assimilation, IT strategy, IT for competitive advantage, IT business value, software development, IT architecture, user interface design
Whirlpool Innovation E-Space (Melymuka 2004; Snyder 2006)	In the early 2000s, Whirlpool implemented an intranet infrastructure tool called the Innovation E-space to help ordinary employees throughout the firm to become product innovators. The tool helps employees to manage the evolution of their ideas from initial insight generation through to (potentially) product development and manufacturing. The tool links prospective innovators to insight libraries, innovation templates, and potential mentors. It also provides a dashboard view of the innovation pipeline for management.	**Core Technology**: Innovation eSpace. **Other Elements:** New roles (ordinary employees encouraged take on the innovator role); new structures (an I-Board in each business to set goals, allocate resources and review ideas for funding); new processes (a formalized employee-driven innovation process consisting of discovery, ideation, idea market, business concept, experiment and prototype, and scale up); new skills (all employees go through a mandatory innovation curriculum).	IT assimilation, product innovation, "productizing" IT, product life cycle management, knowledge management systems
Zara "Fast Fashion" retail strategy (Gallaugher 2012; McAfee et al. 2007)	Over the course of many years, Zara (a division of INDITEX) developed an IT SCM infrastructure that allowed them to achieve a design-to-store cycle time for new fashions of several weeks (versus the nine month cycle seen at rivals). At the same time, Zara typically has 3 or 4 times as many unique SKUs as their rivals moving through stores in a given year. Key parts of the infrastructure include design workstations, highly automated warehouses, and pioneering use of in-store PDAs (and supporting systems) to streamline the store -level recording process.	**Core Technology**: IT SCM infrastructure. **Other Elements**: Fashion merchandising strategy (rapidly sense-and-respond changes in consumer tastes rather than predicting and shaping consumer tastes), marketing strategy (high reliance on retail location, low reliance on advertising and sales), manufacturing strategy (tightly vertically integrated), HR practices (high autonomy in merchandizing decisions at the store level).	IT assimilation, IT strategy, IT for competitive advantage, IT business value, IT selection and justification, supply chain management

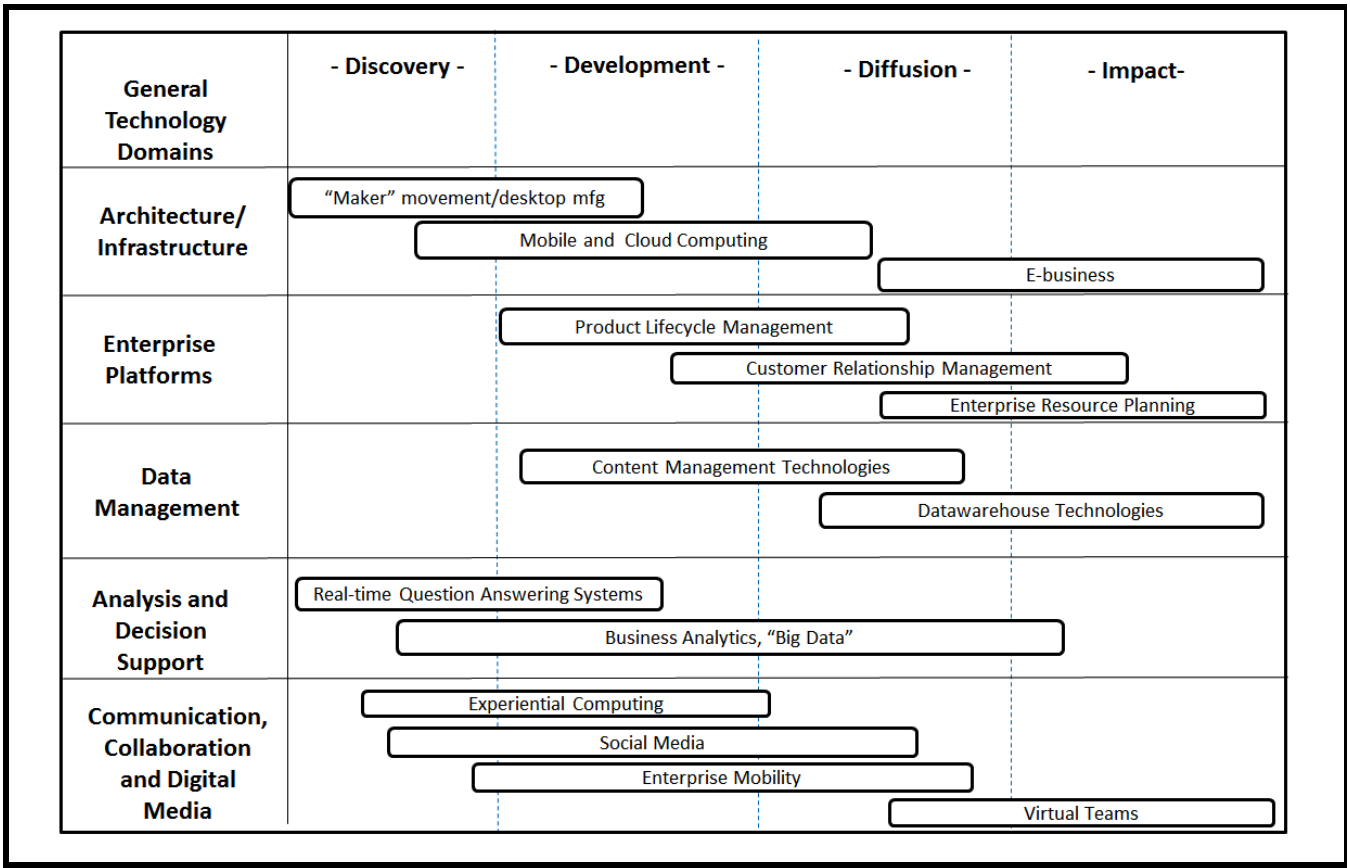


Figure 1. Focus of Teaching and Research

(related to discovery, development, implementation, and diffusion) that firms may face in their innovation efforts, in part due to our deeper understanding of how innovation is affected by technology assets already in place.

Furthermore, as IS scholars, we are less encumbered by switching costs related to existing course content when engaging emerging IT. Many of us are already accustomed to the practice of revising course content as necessitated by the latest technological developments. For example, we feel comfortable having early conversations with our students about how Internet search and social media are affecting marketing practice. This is because we are in a stronger position to understand the details of how search engine advertising works when the topic is new, and we are not concerned about how a topic like search engine advertising should be rippled through the larger scheme of a core marketing course.

To sum up, we believe IS scholars can and should be on the forefront in helping business students make sense of important digital innovations, and that the IS core class is the right place to do it (Appendices B and C provide an example of how the readings and cases in a core course could be organized to achieve this goal[9]). However, what it means to be on the forefront will change as any particular digital innovation progresses through the innovation cycle from discovery to impact. Some examples of managerial questions that are salient in each stage were presented earlier in Table 3. Figure 1 provides a current mapping of a representative collection of technologies to innovation stages. In 2014, we might argue that for a concept like SaaS, leading edge organizations are mainly engaged in questions related to discovery and development of innovations that enable, and are enabled by SaaS technologies. In contrast, for a widely institutionalized technology such as ERP, the key questions for leading edge organizations now revolve around diffusion and impact.

[9]We should note that these readings and cases are primarily aimed at an MBA audience. While an undergraduate course will have the same focus on digital innovation, the syllabus will have to be adapted to take into account an absence of work experience.

Of course, students should have some awareness of any IT that is in widespread routinized use, and we should require business students to acquire (in some fashion) a literacy-level understanding of standard technology terms and concepts. However, that is different from it being a focus of pedagogy. In 2014, it makes sense for students to be expected to understand in some detail how social media "works" because it is impossible to properly engage issues related to discovery, development, diffusion, and impact for this technology without such an understanding. We can, therefore, imagine the IS core class devoting significant attention to the details of social media independent of some particular innovation problem or issue. By contrast, for technologies that are already widely institutionalized, the IS core class need only provide a basic literacy level understanding of how it works.

Discussion of Broader Implications

While our main focus in this article is on digital innovation as an FPC for the IS core class that all business students take, here we briefly discuss some potential broader implications of a move in this direction—for the IS curriculum, for IS research, and for IS identity and legitimacy.

Broader Implications for the IS Curriculum

Elective courses in business disciplines prepare students for work in specific functional areas within a firm, or in an industry that specializes in the discipline. In IS, we prepare students for work in departments charged with managing a firm's digital initiatives and resources, or in firms that provide digital products and services (including consulting services). Because of the broader training they receive in management and strategy, it seems natural that IS students in business schools—as compared with students in computer science and engineering—should be encouraged to have a stronger career orientation toward digital innovation as a force in business and society. We see three ways this goal can be supported beyond the IS core course.

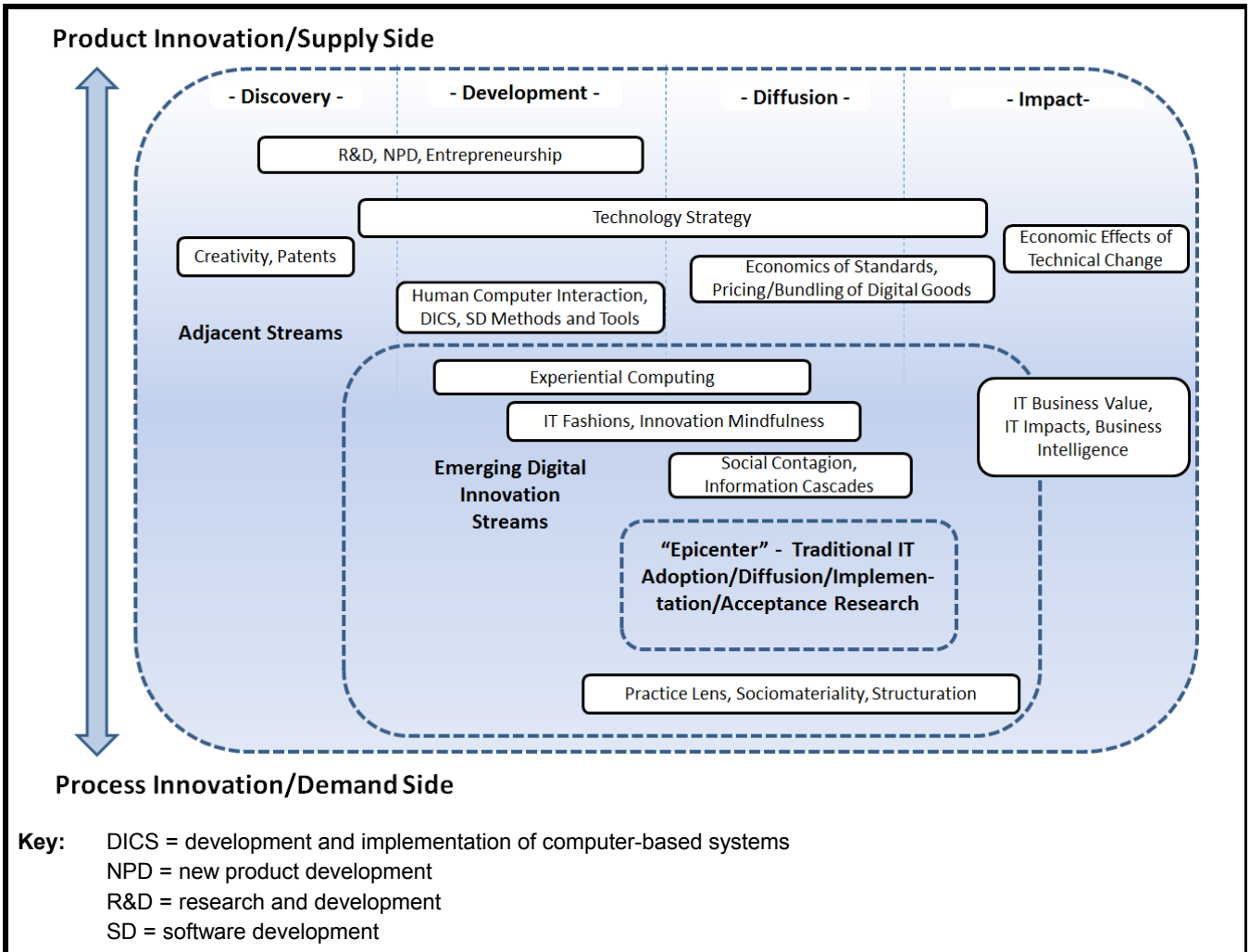
First, new electives could be developed that have an explicit digital innovation orientation. These could include courses on digital entrepreneurship, strategic analysis of emerging technologies, and IT for organizational transformation. Second, IS faculty could be quicker to rotate through the curriculum focused electives that provide a deeper treatment of particular emerging digital innovations, such as social media or cloud computing. Third, those courses that traditionally anchor the IS concentration could be adjusted to reflect a greater innovation orientation. For example, a traditional course on SA/SD could position analysis and design activities within the innovation stage framework (the development stage), and explain the special challenges that arise in the development of innovative digital applications and products. Greater emphasis could be given to instruction on techniques (e.g., prototyping, agile development) that are better suited to situations where requirements are changing and unclear, as in the early stages of the innovation cycle. Students could be given more exposure to how trends in software development (e.g., packages, open source, outsourcing, crowdsourcing, virtual teams) tend to trigger innovations in the processes that firms use to acquire and deliver IT solutions.

In a similar fashion, an introductory course on databases and data management could be motivated by a discussion of business analytics as both a hotbed of innovative product and services development, and a tool by which organizations are transforming internal decision processes. A traditional IT project management course could frame IT solution delivery (on any significant scale) as fundamentally a process of organizational innovation and change, and situate this activity in the third and fourth stages of the innovation stage framework. A traditional course on management of IS could be reoriented to give more attention to issues related to digital innovation, such as (1) how digital innovation relates to corporate strategy and competitive advantage; (2) how IT architecture and assets enable and constrain innovation; and (3) how to develop an organizational culture and processes that are more conducive to digitally enabled innovation.

Research Implications of Digital Innovation as an FPC

Although our focus in this article is on teaching, if digital innovation is to be an FPC for the IS core class, then we as a field could benefit from more research that advances our leadership in this area. Quality teaching and cutting-edge research can and should form a synergy, as is the case in other disciplines.[10] Dhar and Sundararajan echo the same in stating: "the core body of knowledge that is imparted to students should have its foundations in the primary (current or past) programs of research that engage the scholars of the field" (2007, p. 132). Therefore, if digital innovation is to have durability as the FPC for the IS core class, it will help if the IS research agenda surrounding digital innovation is made as broad and compelling as possible going forward. Here we outline three recommendations to attain this end.

[10]For example, in Finance, the very best journals are devoted to problems related to such FPCs as the time value of money and the risk–return relationship.



Key: DICS = development and implementation of computer-based systems
NPD = new product development
R&D = research and development
SD = software development

Figure 2. A Mapping of Digital Innovation and Related Research

Recommendation 1: *Accelerate efforts to broaden IS innovation research beyond the traditional focus on process innovations in the diffusion stage.*

One advantage of digital innovation as an FPC is that it can reasonably be linked to a great variety of past and potential future research. We illustrate this linkage in Figure 2. This figure arranges a number of past and emerging digital innovation and related research streams on a grid that has the four innovation stages moving left to right, and product/business model versus process innovation moving top to bottom. We extend a topic horizontally to indicate with which innovation stage or stages it is mostly associated. Topics for which scholars have focused mostly on product/business model innovations are placed toward the top, those for which scholars have mostly focused on process innovations in organizations are placed toward the bottom, and those with relatively equal treatment of both kinds of innovation are placed toward the middle. In Table 6 we provide, for each research stream, a brief explanation of what it encompasses, key citations, and how it relates to digital innovation.

To date, IS researchers have traditionally focused on process innovations in organizations and the diffusion stage, as reflected by the placement of this stream in the lower part of the diffusion column (with some overlap into the design and impact stages). We think of this as the epicenter of research to date. Around this epicenter we arrange *emerging digital innovation* streams and *adjacent* streams in two (roughly) concentric regions demarcated with dotted lines. We treat a stream as adjacent if it is either IT-but-not-innovation (i.e., IT research that has not been specifically viewed through an in-

Table 6. Digital Innovation and Related Research

Research Stream	Description	Relation to IT Innovation	Example Citations
Traditional IT Adoption/Diffusion/Implementation/Acceptance Research	Examines the factors that affect the adoption, implementation and acceptance of emerging technologies. Analyzes the patterns that these technologies take as they diffuse across a community of adopters. Researchers most often employ survey methods and case studies.	This constitutes the dominant stream of research related to IT innovation to date.	Cooper and Zmud 1990; Fichman 2000; Gurbaxani 1990; Swanson 1994; Venkatesh et al. 2003
IT Structuration, Practice Lens	Elaborates Giddens' structuration theory for the specific case of IT to develop a general theory of the relationship between technology and organization in organizations. Examines how human actions are both enabled and constrained by organizational structures (i.e., rules and resources, including IT), which are themselves continuously produced and reproduced through human action. A later extension examines how individuals, through their use of IT in practice, create structures that shape their own emergent use of the technology.	Provides a rich, interpretive perspective that encompasses the processes by which novel IT is created and comes to be appropriated and used in organizations, and the potential consequences of that use for organizational structures.	DeSanctis and Poole 1994; Giddens 1984; Orlikowski 1992, 2000
Social Contagion	Examines the contagious social influences that earlier adopters can have on later adopters. Among other things, considers why some adopters are more "infectious" and why some prospective adopters are more susceptible to contagion. Researchers most often employ survey methods, although there have also been some simulations.	Provides an alternative to network effects as an explanation for IT bandwagon adoption behaviors.	Angst et al. 2010; Greve et al. 1995
Information Cascades	Examines situations where individuals make inferences about the desirability of some decision or behavior by observing the decisions or behaviors of others. Researchers use analytical models, simulations, and empirical studies.	Can be used to analyze and explain the phenomenon of "herding" behavior in IT adoption and diffusion.	Bikhchandani et al. 1998; Duan et al. 2009; Walden and Browne 2009
IT Fashions	Examines how the forces of fad and fashion influence the spread of new ideas through a community. Especially interested in why some ideas with unproven efficacy nevertheless become popular so fast. Research methods usually focus on discourse analysis and diffusion pattern modeling.	Provides concepts and tools to examine how the popularity and fashionability of IT innovations may affect the adoption and impact of those innovations.	Abrahamson 1996; Wang 2009
Innovation Mindfulness	Examines the implications of innovation mindfulness (defined by Swanson and Ramiller as the extent to which a firm attends to innovation with reasoning grounded its own facts and specifics) for innovation processes and outcomes within firms, and patterns of diffusion across firms.	Provides a conceptual framework for understanding how firms can innovate more effectively with IT.	Fiol and O'Connor 2003; Swanson and Ramiller 2004
Experiential Computing	Focuses on emerging digital technologies as they mediate everyday life experiences by individuals outside a work setting.	Provides a counterpoint to the traditional focus among IT scholars on instrumental technologies used in work settings.	Yoo 2009
IT Business Value	Examines the effects of IT investment and use on a variety of measures of firm performance. The work has largely been empirical, most often using secondary data sources.	The ultimate goal of most IT innovations in firms is to create business value.	Barua and Mukhopadhyay 2000; Brynjolfsson and Hitt 1996; Melville et al. 2004
IT Impacts	Examines the effects of IT on individuals, groups, firms, markets and societies.	IT innovations can have a variety of potential consequences (related to skills, organizational structures, culture and norms, etc.), both positive and negative.	Attewell and Rule 1984; Markus and Robey 1988; Robey and Boudreau 1999
Business Intelligence and Business Analytics	Examines the design and use of business intelligence systems (and enabling technologies) that allow analysts to develop mathematical models to make predictions or draw conclusions about some entities of interest (customers, suppliers, products, processes) based on detailed transaction level data related to those entities.	The pervasive digitalization of products and processes has led to a vast expansion of the transactional data that forms the foundation of business intelligence/analytics, which, in turn, supports an experimental/data-driven approach to assessing organizational innovations.	Davenport 2006; Shmueli et al. 2006

Table 6. Digital Innovation and Related Research (Continued)

Research Stream	Description	Relation to IT Innovation	Example Citations
Human Computer Interaction	Examines the effects of the IT interface on individuals and groups. This work has largely involved laboratory experiments.	The interface is known to be an important determinant of adoption and realized value.	DeSanctis and Gallupe 1987; Shneiderman 1997
Software Development (SD) Methods and Tools	Examines the creation of new SD methods and tools, and the effects of SD methods/tools and other aspects of SD processes and structures on project costs, speed, and other success measures. Research methods have included surveys and other primary data gathering approaches.	SD can be seen as a variant of the general new product development process. Historically, SD has been very expensive and the source of many challenges in getting innovative IT implemented and exploited.	Brooks 1987; Faraj and Lee 2000; Hevner et al. 2004; Kemerer 1987
Economics of Standards	Examines the distinctive patterns of adoption and diffusion of technology standards, with a special focus on the implications of network effects.	Standards and associated network effects are pervasive in the IT domain.	Arthur 1994; Kauffman et al. 2000; Shapiro and Varian 1999
Pricing/Bundling of Digital Goods	Examines the effects of pricing strategies for digital products and services on producers and organizational innovators. Mathematical modeling has been the primary research method.	IT is enabling new pricing strategies for digital and non-digital products, providing new innovation opportunities.	Bakos and Brynjolfsson 1999; Sundararajan 2004
Creativity	Examines the factors that promote creativity in organizations, and the effects of creativity on organizational performance.	Creativity is a primary driver of innovation in organizations. IT may be providing new avenues for ordinary employees to be more creative.	Amabile et al. 1996; Woodman et al. 1993
Patents	Examines patents as a key measure of innovative activity/capability, including the causes of patenting activity and effects of patenting (such as on firm performance).	IT may enhance firms' innovation capability measured by patent outputs. Software has some distinctive properties that may have implications for patenting.	Ahuja and Katila 2001; Bessen and Hunt 2007; Hall et al. 2005
Technology and Innovation Strategy	An umbrella term we use here to refer to work by a diverse collection of management scholars (e.g., Robert Burgelman, Clayton Christensen, Kim Clark, Gary Hamel, Rebecca Henderson, David Teece, Kathleen Eisenhardt) examining the management of technology and innovation from a strategic perspective.	The "technology" in technology strategy is increasingly IT-oriented.	Afuah 1998; Teece 2006
Economic Effects of Technical Change	Examines the effects of technical change on markets and economies, particularly with respect to productivity and growth.	IT is seen as driving increased productivity in the US starting in the 1990s. IT is having transformation effects on certain industries (e.g., media, advertising and publishing).	Dosi 1988; Jorgenson 2001; Romer 1990
New Product Development	Examines NPD processes within firms, and associated success factors and performance impacts.	IT products have distinctive characteristics that may influence NPD processes, success factors, or impacts. IT itself is having effects on how NPD is accomplished in firms.	Brown and Eisenhardt 1995; Thomke 2003
Entrepreneurship	Examines the sources, processes and effects associated with entrepreneurial activity (i.e., creation of new businesses and new business opportunities) by individuals and organizations.	Entrepreneurs are a major driver of innovation. The widespread diffusion of IT appears to be lowering barriers to entrepreneurial activity.	Blank 2013; Lumpkin and Dess 1996; Shane and Venkataraman 2000

novation lens but could be) or innovation-but-not-IT (i.e., innovation work that is not specific to IT but could inform future work by IT innovation researchers). As we move away from the epicenter, we see that researchers have paid increasing attention to the other stages of innovation (besides diffusion) and to product/business model innovation.

Our first recommendation is for IS scholars to accelerate their efforts to push the IS research agenda out from the traditional epicenter of IT innovation research. For example, we believe that IS scholars potentially have much more to contribute to the research conversations related to digital innovation that are already happening in the top part of Figure 2, mainly in the fields of strategy, economics, and the management of technology.

Recommendation 2: *Focus more attention on distinctiveness and heterogeneity when examining IT innovation artifacts and processes (rather than just standardization and homogeneity).*

Going forward, research domains that inform and/or are strongly motivated by our understanding about how digital innovations are "different" will be especially compelling, as this provides much of the underlying motivation for adopting digital innovation as an FPC for the IS core class. Toward that end, we note that digital innovations tend to be particularly flexible and even radically tailorable (Malone et al. 1992), which means there is a much greater opportunity for organizations to develop and employ unique variations.

Despite this fact, prior work by IS innovation scholars has implicitly focused on homogeneity and standardization in the adoption and diffusion of IT innovations, addressing such questions as

- Why do people differ in their propensity to adopt or accept a particular technology (EDI, ERP, etc.)?
- How can adoption barriers be lowered over time as a particular innovation diffuses?
- What are the implications of network effects among users of an innovation standard (e.g., communication technologies, operating systems, game consoles)?

While this prior work has been appropriate and valuable, we believe there should be much greater attention to distinctiveness and heterogeneity in digital innovation research going forward. Toward this end, we distinguish four domains of distinctiveness, including

- Creation of *new kinds of core IT* by organizational innovators (e.g., Zara's PDA-based application for managing store inventory replenishment as part of its "fast fashion" strategy).
- Creation of *new IT innovation ensembles/systems* by organizational innovators (e.g., Harrah's system of changes to technology, processes, organizational structures, and employee skills to support their customer relationship marketing initiative).
- Creation of *new mechanisms for promoting IT assimilation* within organizations (e.g., Fidelity Investment's Center for Advanced Technology, FCAT (Gibson 2003)).
- Creation of *distinctive patterns of IT use* within organizations (e.g., incorporation of social media platforms as a teaching tool in higher education (Haverstein 2007)).

A focus on these facets of distinctiveness would suggest attention to the following sorts of research questions:

- What are the key dimensions of innovation distinctiveness within firms, and how can we measure where a firm resides (from low to high) on these dimensions? What are the implications of an organizational innovator's relative emphasis on innovation distinctiveness (versus standardization) for firm performance?
- Under what circumstances should firms be developing differentiated innovations for internal use rather than adopting standard technologies supplied by the market? Is it possible for firms to be ambidextrous—that is, equally adept at developing/packaging differentiated innovations versus adopting/configuring off-the-shelf innovations?

We believe that the increasing availability of low cost digital infrastructures is making heterogeneity in digital innovation more common, feasible, and desirable. This suggests a shift to give more attention to inventiveness and creativity in the introduction of new core technologies, innovation systems, use patterns, and deployment mechanisms.

Recommendation 3: *Focus more attention on how digital technologies are transforming the process of innovation itself.*

IS researchers have studied a wide diversity of factors that promote or hinder the adoption and diffusion of digital innovations. Ironically, digital technology itself has not generally been included among those factors. Put another way, IS researchers have given comparatively little attention to how the increasing availability and use of digital technologies and infrastructure in organizations and society is affecting innovation processes themselves. We concur with the call from

Lucas et al. (2013) for more attention to IT-enabled transformations in economic and social systems—including those related to innovation—with a goal of informing policy makers, managers, and decisions makers in order to make IS research more impactful.

Despite the relative lack of attention, there are good reasons to believe that innovation processes are indeed being transformed in many organizations, and that new IT is playing a critical role. Thomke (2001) has argued that the cost of experimentation—which "lies at the heart of every company's ability to innovate" (p. 67)—has been dramatically reduced by digital simulation and prototyping tools. For companies willing to rethink their R&D processes in light of the new capabilities, the result has been not only lowered innovation costs, but increased opportunities for innovation and entirely new ways of discovering novel ideas.

Scholars have observed that innovation processes are becoming more open, democratized, and user-driven (Chesbrough 2003; Von Hippel 2005). While these trends have been present for many years, the widespread diffusion of digital infrastructures as an enabler, particularly social media, has accelerated this trend. For example, Proctor & Gamble's "Connect+Develop" platform (www.pgconnectdevelop.com) allows the firm to solicit business ideas from the general public, resulting in increased R&D efficiency and new product success rates (Enkel et al. 2009). Whirlpool's Innovation E-Space platform enables ordinary employees throughout the company to create and champion new product ideas (Melymuka 2004). Threadless has developed a business model in which all new product development is performed by their community of users (Brabham 2010).

IT is also affecting how product innovation occurs. Today, producers can adapt their products more frequently (e.g., iPhone or Android applications) in response to the continuous flow of information from customers. Social media makes such strategies easier as producers are able to gather useful information more rapidly and deploy new versions of their products much more frequently than they could in the past. This raises many interesting questions for producers and organizational innovators.

- How should firms manage processes of innovation that have been made more open, democratized, user-driven, etc. through the use of digital technologies? Does this change how managers should think about technology infrastructure investments, human resource policies, or project structures?

- What are the second-order effects of innovation processes that are made more open, democratized, and user-driven through digital technologies? For example, do such processes become more ubiquitous? More rapid? More efficient? More incremental and continuous?

- What are the advantages and disadvantages of various democratizing mechanisms (e.g., innovation prizes, innovation marketplaces, employee engagement platforms, customer engagement platforms) for innovation discovery and development? What principles should govern the design and use of these mechanisms for innovation discovery and development? What circumstances make one mechanism more beneficial than another?

Broader Implications for the IS Field's Identity and Legitimacy

In the prior section, we suggested that adopting digital innovation as an FPC for the core class has implications for IS research. We also believe it could have some positive spillover effects on the identity and legitimacy of Information Systems in business schools.

We perceive that a negative reinforcement loop at some schools has led to devaluation of IS and even dissolution of some long-standing IS departments. The loop goes something like this. Through a combination of lack of understanding among stakeholders of what IS is about in a business context (i.e., the identity problem), questions about whether IS is a genuine discipline (i.e., the legitimacy problem), and low historical student interest in and/or evaluations of IS core classes at the school in question, key stakeholders develop low opinions of the value of IS in the business core. These perceptions lead to the IS core class being diminished or removed. The reduced presence in the core triggers a number of further ill effects. It directly reduces demand for IS faculty because there is no longer a large cohort going through a required IS core class each year. It indirectly reduces demand by removing the opportunity to use the required course to promote other IS courses and programs to students in each cohort. It also removes the stabilizing effect on overall IS student contact hours that comes from having a large portion of an IS unit's teaching demand arise from required courses. This is an even bigger problem for IS because organic student interest in IS electives already varies widely depending on where we are in the seemingly inevitable boom-and-bust cycles that characterize the IT industry. We speculate this leads some stakeholders to wonder, should a real discipline experience such wild swings in aggregate student demand for course offerings? Such questions negatively affect legitimacy. Finally, absence from the core robs IS faculty of the opportunity to evolve students' and other key stakeholders'

understanding of IS and why it (still) matters, which has further negative implications for identity and legitimacy.

We believe that adopting digital innovation as the FPC for the IS core class—in combination with an emphasis on quality teaching[11] and putting the best available instructors in the IS core—can help counter this cycle, or even lead to a positive reinforcement cycle, as follows. For both students and other stakeholders, adoption of this FPC by skilled instructors helps to clarify why every business student should be learning about IT in the core. It also contributes to improved student evaluations by countering student complaints, such that the IS core course covers an ever changing jumble of topics, including many that are not clearly relevant to general business managers. This leads to a stronger place for IS in the core, which in turn increases demand for other IS course offerings and smooths overall demand for IS instructors. Higher and more stable demand for IS courses together with improved student ratings serves to reinforce legitimacy of the IS unit as representing an important academic discipline.

Conclusions

Our entry into a golden age of digital innovation provides an unprecedented opportunity for the IS field. In the past, major waves of digital innovation—those associated with technologies like mainframe-based management information systems, PCs, artificial intelligence for business, ERP, and the Internet—seemed to arrive at a rate of only one or two per decade. As each wave flowed through the popular imagination, we saw major bursts of student interest in IS and increased enrollments in IS courses and programs, followed by periods of sometimes painful retrenchment as the underlying innovations either took their place as broadly institutionalized technologies or got sent back to the labs to possibly rise another day. Yet now we can see perhaps a half dozen or more innovation waves approaching or already crashing upon the shore: mobile and cloud computing; digital and social marketing; "smart" business enabled by smart devices and technologies, analytics, and big data; a resurgence of AI and machine intelligence; augmented reality interfaces; business models, technology platforms, and other mechanisms for the democratization of innovation; and the "maker" movement based on 3D printing and other technologies, which may one day disrupt the manufacturing industry, the world supply chain and world trade.

Someone needs to prepare the managers and business leaders of tomorrow to thrive in and contribute to this golden age of digital innovation, and it would be a shame if we in IS did not stand up, seize this opportunity, and lead the way forward. Now—while the attention of the world is especially fixed on technology and innovation—is the time to rethink what it is that students most need to know about IS in a business context, and we believe that a redesign of the IS core class that all business students take is clearly the place to start. In this article, we have offered a vision and roadmap for such a redesign that puts digital innovation front and center as a fundamental and powerful concept. If we as a field can execute on this vision, the upside is very high. A rejuvenated IS core class not only better serves those students at schools that currently have a place for IS in the core, but provides an occasion to introduce (or reintroduce) IS to the business school core at schools that do not. This, in turn, can promote the health of the IS field overall, as a strong IS core course also means additional faculty lines for IS, increased opportunities to promote IS electives and programs, a moderating force against swings in aggregate demand for IS courses, and enhanced legitimacy with business school colleagues, deans, students, and employers.

[11]What constitutes "quality teaching" varies from school to school and from audience to audience. However, we think the following principles should work especially well in a course that has digital innovation as an FPC: (1) maintain a clear business (rather than technical) focus, (2) develop a strong motivation surrounding the ways in which digital innovation directly affects students (i.e., by affecting the nature of work they will do, the competitiveness of their future employers, and the structure of entire business sectors they may work in or have to analyze), (3) make heavy use of examples and cases that illustrate intrinsically compelling instances of digital innovation, and (4) find ways to incorporate digital innovations into pedagogy itself. As an example of the latter, we have made good use of wikis and other social media as a mechanism for students to find and highlight current examples of digital innovation for the benefit of fellow students.

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MIS Quarterly

ISSUES AND OPINIONS

DIGITAL INNOVATION AS A FUNDAMENTAL AND POWERFUL CONCEPT IN THE INFORMATION SYSTEMS CURRICULUM

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Appendix A

A Text Book Assessment: Linkage to Digital Innovation

Textbook	Ch. #	Title	Content	Related to Digital Innovation?	Assessment of Linkage to Digital Innovation
Applegate et al. (2008), *Corporate Information Strategy and Management: Text and Cases*	1	IT and Strategy	The relationship between IT and business models & strategies	Partially	The effects of IT on business models are relevant, but overall it lacks a specific focus on digital innovation
	2	IT and Organization	The effect of IT on an organization's capability, coordination, learning, etc.	Partially	Some of the discussions are relevant to how IT can enable innovation in an organization
	3	Extending the Enterprise	Challenges of IT in enterprise, how IT creates new opportunities, reduces cost, helps gain sustainable competitive advantage	Yes	Concise discussions of the new opportunities that IT enables in an enterprise
	4	Making the Case for IT	Highlights the importance of IT in organizations	Somewhat	Some discussions touched on digital innovation
	5	Understanding Internetworking Infrastructure	Networking, Internet infrastructure and management	No	Focus is on technology itself, not how network technology enables innovation
	6	Assuring Reliable and Secure IT Services	Security, backup, recovery etc.	No	Very detailed discussion of the technology (e.g. security management), but not much on how technology enables innovation

Textbook	Ch. #	Title	Content	Related to Digital Innovation?	Assessment of Linkage to Digital Innovation
Applegate et al. (2008), *Corporate Information Strategy and Management: Text and Cases*	7	Managing Diverse IT Infrastructures	The management aspects of IT infrastructure	No	Not an innovation-focused presentation
	8	Organizing and Leading the IT Function	IT management, governance and functions	Partially	Some of the IT governance discussion and the Enron case are relevant, but the chapter as a whole does not address digital innovation
	9	Managing IT Outsourcing	Outsourcing	Very little	The part on the new service model is related, but the bulk of the discussion on outsourcing, vendor selection and contract management are not innovation-related
	10	A Portfolio Approach to IT Projects	IT project management	Very little	Some discussions of project management and system analysis & design are relevant, but much of the discussion lacks an innovation focus
Gallaugher (2012), *Information Systems: A Manager's Guide to Harnessing Technology*	1	Setting the Stage: Technology and Modern Enterprise	Introduction on how technology is re-shaping business disciplines such as finance, marketing, operations, and IS	Yes	A nice, brief overview on how digital innovation is enabling changes across the board
	2	Strategy and Technology	Competitive advantage, resource based view, value chain and role of IT	Indirect	IT-enabled value creation and competitive advantage using fairly standard strategy concepts (including traditional competitive analysis and value chain frameworks)
	3	Zara: Fast Fashion from Savvy Systems	Zara developed an IT SCM infrastructure that allowed them to reduce the design-to-store cycle time for new fashions to several weeks versus the nine month cycle seen at rivals	Yes (core)	Related to IT assimilation, IT strategy, IT for competitive advantage, IT business value
	4	Netflix in Two Acts	The evolution of the online DVD rental business at Netflix; how Netflix's Cinematch recommendation technique creates value	Yes (core)	Related to digital business transformation, IT-enabled value creation
	5	Moore's Law: Fast, Cheap Computing and What It Means for the Manager	Moore's Law and its role in IT management	Yes (core)	IT fundamental characteristics
	6	Understanding Network Effects	The role of the network effects in IT management	Yes (core)	IT fundamental characteristics
	7	Social Media, Peer production, and Web 2.0	Various web 2.0 phenomena (blog, wiki, microblog, twitter, crowdsourcing, etc.)	Peripheral	Focus is on emerging IT and what they can enable
	8	Facebook: Building a Business from the Social Graph	The history and business model of Facebook, its open platform strategy for developers	Yes	IT-enabled development (through open platform)
	9	Understanding Software: A Primer for Managers	A simple introduction to software components (application software, operating systems, distributed computing etc.)	No	Discusses the technology without a focus on how it enables digital innovation

Textbook	Ch. #	Title	Content	Related to Digital Innovation?	Assessment of Linkage to Digital Innovation
Gallaugher (2012), *Information Systems: A Manager's Guide to Harnessing Technology*	10	Software in Flux: Partly Cloudy and Sometimes Free	Open source, cloud computing, SaaS etc.	Marginally	Discusses new ways of developing software, how cloud computing enables lower capital cost investments etc., but little on how they enable digital innovations
	11	The Data Asset: Databases, Business Intelligence and Competitive Advantage	Data, database, data warehouse, BI	Somewhat	Mainly focuses on the technologies without a clear digital innovation emphasis, but the discussions on using the data asset as a vehicle for digital innovation and the two cases are relevant
	12	A Manager's Guide to the Internet and Telecommunications	Internet and Telecommunication technologies	No	The focus is on introducing these technologies such as TCP/IP, protocols. Very little on how they enable digital innovation
	13	Information Security: Barbarians at the Gateway	Security, threats and vulnerabilities	No	A nice, brief introduction to security issues but lacks digital innovation focus
	14	Google in Three Parts: Search, Online Advertising and Beyond	Google's search technology and online advertising models (adwords, ad network, adsense etc.) and others (e.g. behavioral targeting)	Somewhat	Innovative technologies (search) and business models (online advertising) are discussed
Laudon and Laudon (2011), *Management Information Systems*	1	IS in Global Business Today	IS as sociotechnical systems, how IS transforms global business	Indirectly	Necessary to define IS, the IS transformation (of global business) is related
	2	Global E-business and Collaboration	Business process, e-business, collaborative systems	Partially	Understanding business processes is necessary for process innovation, but the material on e-businesses and systems for collaboration is tangential
	3	Information Systems, Organizations and Strategy	How IS impact organizations and how to use IT for competitive advantage	Yes	Focuses on IT-enabled organizational innovation
	4	Ethical and Social Issues in IS	Social issues in IS	Remotely	Does not take an explicit innovation perspective
	5	IT Infrastructure and Emerging Technologies	Components of IT infrastructure, contemporary hardware and software platform trends	Peripheral	Basic understanding of IT infrastructure is necessary to appreciate innovation opportunities
	6	Foundations of Business Intelligence: Databases and Information Management	Database and using database to manage business	Peripheral	The focus is on the technology itself rather than how database systems, BI etc. enable innovation
	7	Telecommunications, the Internet and Wireless Technologies	Communication networks, the Internet, wireless technologies (e.g. RFID)	No	Focus is on the communication technology itself
	8	Securing Information Systems	Information securities	No	No discussion on how security relates to product/process innovation in a firm
	9	Achieving Operational Excellence and Customer Intimacy: Enterprise Applications	SCM, ERP, CRM, enterprise systems	No	Offers a very brief introduction on these systems but without an innovation orientation
	10	E-commerce: Digital Markets, Digital Goods	E-commerce and mobile-commerce	Yes	These are IT-enabled new forms of business
	11	Managing Knowledge	Knowledge management systems	No	Focus is on technology itself

Textbook	Ch. #	Title	Content	Related to Digital Innovation?	Assessment of Linkage to Digital Innovation
Laudon and Laudon (2011), *Management Information Systems*	12	Enhancing Decision making	Decision making, BI, DSS and GDSS	No	Does not have an innovation orientation
	13	Building Information Systems	Systems analysis and design	Partially	Does not have a specific innovation focus, but rather, seeks to train business students on systems analysis and design
	14	Managing Projects	Lifecycle project management	No	The focus is on traditional project management without an explicit innovation orientation
	15	Managing Global Systems	Organizing international information systems	No	Provides context, but not how IS enables global business
Oz (2008), *Management Information Systems*	1	Business Information Systems: Overview	Does IT matter, data, information and IS, TPS and beyond, IS in business functions	Peripheral	Has some reference to innovation but that is not the main focus
	2	Strategic Use of IS	Strategy and competitive advantages, eight initiatives of strategic IS, JetBlue case	Yes	With minor tweaking, this chapter can serve as a good one on digital business model innovation
	3	Business Functions and Supply Chains	Introduction on individual business functions (from accounting, finance to supply chain management)	No	Not focused on supply chain innovation.
	4	Business Hardware	Computers, input & output devices, storage	No	The focus is on technology, rather than how IT enables digital innovation
	5	Business Software	Application software, system software, open source software	No	Focus is on technology itself
	6	Business Networks and Telecommunications	Network structures and protocols	No	Focus is on technology itself
	7	Database and Data Warehouse	Database models, relational DBMS, data modeling, data warehouse	No	Focus is on technology itself
	8	The Web-Enabled Enterprises	HTML, XML, web-enabled businesses, supply chain on the web	Partially	For the most part not related to digital innovation, but how the web technology enables new businesses is relevant
	9	Challenges in Global IS	Multinational organizations and challenges (e.g. technology, culture etc.) of IS in global business	No	Not an innovation-focused presentation
	10	Decision Support Systems and Expert Systems	Decision process, DSS, GDSS, ES and GIS	No	It only serves as an overview of different forms of (conventional) IS, not how they enable innovation
	11	Business Intelligence and Knowledge Management	BI and KM tools	No	Not an innovation-focused presentation
	12	Systems Planning and Development	Variety of systems development approaches	Slightly	Some of the presentation is related to the development stage of digital innovation
	13	Choices in System Acquisition	Outsourcing, SaaS, user development application	Slightly	Some of the presentation is related to the development stage of digital innovation
	14	Risk, Security and Disaster recovery	Security etc.	No	Not an innovation-focused presentation

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Appendix B

Modules for "Information Technology in Business: A Digital Innovation Perspective"

Note: In our own core courses, technology topics (infrastructure, applications, emerging technologies) are generally discussed as an adjunct to an innovation-related topic (e.g., part of the discussion of an ERP implementation case is devoted to ensuring students know what ERP is). We sometimes devote a whole class or two to a general discussion of an important emerging technology (e.g. social media analytics), especially if no suitable managerial case can be found that centers on that technology. Also, because few business students become IT specialists, we tend not to address topics related to the management of the IS function in a core course. However, we see two potential approaches to addressing these topics within an innovation framework. One is to include a module on innovation in IT management processes. The second is to include IT management innovations in each module (2–5), and treat innovation in IT management as just another set of digitized process innovations. Alternatively, these topics can be included as stand-alone topics residing outside of the main course framework.

Module I: Fundamentals of Digital Innovation

Topics: Introduction to digital innovation, distinctive IT characteristics, process/product/business model innovation, cycles of digital innovation
Learning Objectives: Be able to explain what IS/IT is fundamentally about in business; be able to link past, current, and emerging IT in business to digital innovation; be able to explain the three distinctive characteristics (Moore's Law, digitization, and network effects) and how they relate to digital innovation and affect the value-producing potential of IT; be able to elucidate the digital innovation cycle at the four stages (discovery, development, diffusion, and impact); be able to discern some broad factors affecting the success and failure of digital innovations (e.g., health of the ecosystem); be able to explain firms' strategy, organization, governance and operations from the perspective of digital innovation.
Candidate Readings:

Topic	Article/Case	Source	Description/Relation to Digital Innovation (*italicized*)
Introduction to Digital Innovation	Lecture Note: Learning to Think Like a Digital Innovator	Fichman 2012b	*The Note introduces the topic of Digital Innovation and explains why it is essential for aspiring mangers today to understand digital innovation, and to be able to think like a digital innovator.*
	Winning the Race With Ever Smarter Machines	Brynjolfsson and McAfee 2012	Describes how Moore's Law and pervasive digitalization are allowing machines to do intelligent tasks previously reserved for people (e.g., drive cars, play Jeopardy!). *Makes the argument that these advances serve to expand the range of opportunities available to organizations, and that firms must foster organizational innovation to exploit these opportunities.*
	The Discipline of Innovation	Drucker 1998	Drucker offers his classic view on what innovation is about, the scope of innovation, and factors driving successful innovation. *It provides a foundation for understanding digital innovation.*
	Ten IT-Enabled Business Trends for the Decade Ahead	Bughin et al. 2013	*Describes several business trends enabled by or embodied in emerging digital technology.*

Topic	Article/Case	Source	Description/Relation to Digital Innovation (*italicized*)
Distinctive IT Characteristics	Lecture Note: Distinctive IT Characteristics: Implications for Innovation and Value Creation	Fichman 2012a	*The Note elaborates on distinctive characteristics of IT that drive much of the innovation-enabling potential of IT (i.e., Moore's Law, digitization, and network effects)*.
	Moore's Law: Fast, Cheap Computing and What it Means for the Manager	Gallaugher 2012, Chapter 5	This chapter describes Moore's Law and how the price elasticity associated with faster/cheaper technologies opens new markets, creates new opportunities for firms, and can catalyze industry transformation. *In-depth discussion on one distinctive characteristic of IT that drives digital innovation – Moore's Law*.
	Understanding Network Effects	Gallaugher 2012, Chapter 6	This chapter describes network effects (a.k.a. Metcalfe's Law), how products and services are subject to network effects and their impact on innovation and competition. *In-depth discussion on another characteristic of IT that drives digital innovation – network effects*.
Product vs. process innovation	Deep Change: How Operational Innovation Can Transform Your Company	Hammer 2004	This article addresses *process innovation* from the perspective of how it can transform a company. Process innovation (i.e., how a firm's work is done) affects the very essence of a company. It also addresses the factors affecting successful process innovation and the disruptive nature of innovation. *It analyzes the process component of digital innovation*
	General Motors OnStar	McCormack and Johnson 2002	As an example of product innovation, OnStar telematics and infrastructure integrate the GM call center with in-car sensor network and local public safety organization. *Example of digitally infused product (innovation) in the automobile industry*.
	How Pixar Fosters Collective Creativity	Catmull 2008	An exemplar for innovating both products and processes in the animation industry. Pixar pioneered the use of digital animation. It standardizes and commercializes digital animation in its four process technologies: Marionette, Renderman, Ringmaster, and Pixarvision. *Example of both product and process innovation in the animation industry in the digital era*.
Innovation Cycles	The Manager's Guide to Innovation Waves	Swanson 2011	Describes the process by which recurring waves of IT innovation flow through the world of business. *Provides a framework managers can use to make sense of IT innovation waves.*
	Impact of Fashion in IT	Wang 2009	IT innovation resembles the life cycle of fads and fashions in the apparel and entertainment industries. Eight digital innovations such as ASP, ERP, CRM, etc. are examined. *Empirical analysis of the digital innovation cycle.*
	Aiming for an Evolutionary Advantage	Hamel and Breen 2007, Chapter 6	The article discusses how Google constantly innovates to maintain an evolutionary advantage. *It discusses Google's new organization to foster continuous innovation.*
Managerial Issues	Investing in IT That Makes a Competitive Difference	McAfee and Brynjolfsson 2008	An article on how IT investments can make a competitive difference. *How to invest wisely to ensure successful digital innovation.*
	Netflix in Two Acts: The Making of an E-Commerce Giant and the Uncertain Future of Atoms to Bits	Gallaugher 2012, Chapter 4	With its innovative online rental process, Netflix transformed the movie rental industry and used IT-enabled analytical capabilities to its advantage. *Example of digitally enabled analytical capability in Netflix.*
	Information Technology and Innovation at Shinsei Bank	Fuller and Upton 2007	How the implementation of a retail banking system transformed the Shinsei Bank. *Example of digitally transformed business in the banking industry*.
	Transforming Ecosystem Relationships in Digital Innovation	Selander et al. 2010	It describes the ecosystem for IT innovation and how innovation transforms the ecosystem. *Digitally transformed ecosystem*.
	Match Your Innovation Strategy to Your Innovation Ecosystem	Adner 2006	How to adapt a company's innovation strategy to the innovation ecosystem it is embedded in. *Aligning digitally enabled inside innovation with the outside ecosystem*.

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Module II: Digital Innovation at the Discovery Stage

Topics: Identification of innovation opportunities, invention, and selection.

Learning Objectives: Be equipped with the skills to identify digital innovation opportunities; grasp the essence of successful discovery; be able to explain when and how to invent or select; have good IT knowledge to enable the discovery of digital innovation opportunities; be able to describe the essence of building a discovery-ready organization; keep abreast of emerging digital technologies and identify opportunities enabled by them.

Candidate Readings:

Topic	Article/Case	Source	Description/Relation to Digital Innovation
Identify Innovation Opportunity	Innovation Democracy	Melymuka 2004	Whirlpool implemented an intranet infrastructure tool called the Innovation E-space to help ordinary employees throughout the firm become product innovators. The tool helps employees manage the evolution of their ideas from initial insight generation to (potentially) product development and manufacturing. *It discusses how Whirlpool adopts digital innovation to discover new opportunities.*
	Zara: IT for Fast Fashion	McAfee et al. 2004	How Zara uses its IT SCM infrastructure to rapidly sense-and-respond to changes in consumer tastes and discover opportunities for fast-fashion innovation. *It discusses how Zara achieves fast discovery and response to new fashions through digital innovation.*
Invent or Select	Business Intelligence Software At SYSCO	McAfee and Wagonfeld 2004	This HBS Case focuses on SYSCO's choice between inventing or buying BI software. Innovation enabled by the BI system includes identifying new customers, generating cross-selling opportunities and predicting future demand. *It discusses SYSCO's emphasis on achieving higher firm capabilities through IT in discovering new business opportunities.*

Topic	Article/Case	Source	Description/Relation to Digital Innovation
Various Innovation Strategies (open vs. closed, etc.)	Connect and Develop: Inside Proctor & Gamble's New Model for Innovation	Huston and Sakkab 2006	P&G offers a "Connect + Develop" platform that enables it to solicit business ideas from a network of affiliated partners and the general public, resulting in increased R&D efficiency and an increase in new product success rates. *A classic success story of P&G in revamping its R&D process through digital innovation*.
	Harnessing the Power of the Crowds with Corporate Social Networking tools: How IBM Does It	Majchrzak et al. 2008	IBM harnesses the power of crowds with corporate social networking tools. *It discusses a new business model—crowdsourcing—that is enabled by web 2.0 technologies.*
	Social Media, Production, and Web 2.0	Gallaugher 2012, Chapter 7	Gallaugher discusses how to use social media and Web 2.0 for peer production, including the discovery of new ideas. *It provides an overview of social media-enabled innovations.*
Building Innovation capabilities	Harrah's Entertainment, Inc.	Lal 2001	Harrah's adopted a new strategy which emphasized database marketing powered by its WiNet datawarehouse and the analytical capability enabled by WiNet. This DBM enabled discovery of the best marketing programs and tactics to support their new loyalty program. *A widely cited success story on an analytics-driven business that eventually inspired thorough (digital) innovation in the gambling industry.*
Opportunities enabled by Emerging IT	Ten Emerging Technologies	Namterme and Cole 2013	This article describes emerging information technologies including social media, cloud computing, etc. *It discusses opportunities enabled by emerging IT.*
Managerial Issues	How to Design Smart Business Experiments	Davenport 2009	Davenport discusses how to design experiments to enable a firm to discover innovation opportunities. *It discusses digital innovation through experimentation to explore new opportunities.*
	Enterprise 2.0: New Collaborative Tools for Your Organization's Toughest Challenges	McAfee 2009	McAfee shows how using Web 2.0 technologies as a knowledge management platform can help a firm to identify new opportunities. *It discusses web 2.0 - enabled innovation for new opportunity exploration.*

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Module III: Digital Innovation at the Development Stage

Topics: Developing ideas into usable innovations, packaging versus configuration.
Learning Objectives: Master the fundamentals of developing digital innovations; be able to explain the essentials of packaging product innovations and configuring process innovations; learn to decide, based on the business context, the best options for developing IT platforms (open versus closed innovation, outsourcing, open source, experiments, etc.); be able to discuss the related organizational (and technical) issues to ensure successful development of innovation; have good knowledge on the related basic IT knowledge for developing digital innovation.
Candidate Readings:

Topic	Article/Case	Source	Description/Relation to Digital Innovation
Development	Information Technology and Innovation at Shinsei Bank	Fuller and Upton 2007	Shinsei developed a retail banking enterprise system to innovate its banking process. Several innovative processes included customer service-oriented marketing strategy (free 24-hour ATMs, Internet banking, longer hours), and distinctive service operations (e.g., "cashless" tellers that do no transactions directly, but instead help customers do their own transactions). *It offers an example of developing an IT-driven banking process and packaging IT into online banking.*
Packaging	Building Watson: It's Not So Elementary, My Dear!	Shih 2012	The case illustrates the major design decisions IBM made, and the development challenges they encountered, in developing a system capable of answering general natural language questions in real time, one that plays the Jeopardy! game show at the level of human champions. *It provides a nice illustration of the challenges companies face in developing a radical digital innovation, and gives students the chance to evaluate the novel project management tactics IBM used to overcome those challenges.*
	Enterprise IT at CISCO	McAfee et al. 2004	The case illustrates the challenges associated with developing a centralized enterprise system after a decade of decentralized planning and project funding. It raises issues about change management, centralized planning, IT prioritization and resource allocation, enterprise cooperation, and project funding. *It discusses the process of developing enterprise-wide system.*
Configuring	Competing on Analytics	Davenport 2006	Davenport's influential article on how to develop analytical capability for firms. *In-depth analysis on innovating firms through developing digitally-enabled analytical capabilities.*
	Zara: IT For Fast Fashion	McAfee et al. 2004	Zara developed an IT SCM infrastructure that allowed them to reduce the design-to-store cycle time for new fashions to several weeks versus the nine month cycle seen at rivals. *Zara's success story in developing an innovative digitized SCM.*
New IT platforms	What's Your Google Strategy?	Hagiu and Yoffie 2009	*How to utilize the platform offered by Google to innovate your own business.*
	Peer Production, Crowdsourcing at Threadless	Charkin 2008	The customer is the company. *Threadless involves customers at the development stage of innovation.*
	Facebook: Building a Business from the Social Graph	Gallaugher 2012, Chapter 8	*How to develop new IT artifacts (e.g. social gaming) based on the new platform provided by the popular social network.*
Managerial Issues	Options Thinking in IT Project Management	Fichman et al. 2005	A real options view on project management. This requires managers to learn what kinds of options can be embedded in IT investments. *It offers a real-options perspective on developing IT systems to innovate a business.*
	The Four Ways IT Is Revolutionizing Innovation	Hopkins 2010	An interview with Erik Brynjolfsson on how IT changes the way innovation works. IT enables firms to revolutionize innovation. *A thought-provoking article on the managerial issues of digital innovation.*

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Module IV: Digital Innovation at the Diffusion Stage

Topics: Deployment and assimilation of innovation.

Learning Objectives: Master the fundamentals to ensure the successful diffusion and assimilation of digital innovations; be able to explain the individual, organizational, and societal factors affecting successful deployment of IT innovation; grasp the knowledge necessary to ensure successful assimilation of process innovations; learn about various business decisions on how to appropriately adjust processes, operations, and management (e.g. governance) at the diffusion stage; be able to identify the new diffusion patterns in the Web 2.0 era; be able to avoid the common pitfalls at the diffusion stage.

Candidate Readings:

Topic	Article/Case	Source	Description/Relation to Digital Innovation
IT adoption and diffusion	Lecture Note: Tools and Tactics for Analyzing Diffusion Trajectories	Fichman 2012b	*Discusses the factors affecting IT adoption and diffusion and how to analyze them.*
	ITC e-Choupal Initiative	Upton and Staats 2008	ITC developed and deployed (to thousands of villages) a solar powered, satellite-linked e-commerce workstation that allowed farmers to make informed choices about farming practices, to discover where to go to get a good price for their crops, and (eventually) to conduct e-commerce transactions. *It discusses the challenges (and some success) of the rural Indian villagers in adopting the ITC eChoupal system.*
	BP's Office of the Chief Technology officer: Driving Open Innovation Through an Advocate Team	Wolcott and Lippitz 2008	In the early 2000s, British Petroleum launched the office of the Chief Technology Officer with a relatively small staff and budget. The purpose of the new unit was to help transform IT from being a cost reducer to also being a driver of business innovation. *The case illustrates a number of principles and tactics (e.g., for environmental scanning, identifying opportunities, enlisting the help of the external ecosystem partners, motivating internal champions) to help drive digital innovation adoption and diffusion in a large multinational.*
IT deployment and assimilation	Lecture Note: Digital Innovation Deployment: Barriers and Tactics	Fichman 2012a	*Discusses the barriers that can impede the implementation of digital innovations in organizations, and tactics for overcoming those barriers.*
	Rich-Con Steel	McAfee 1999	It shows how an ill-planned, forced implementation eventually led to the demise of Rich-Con steel. *A classical failure story of process innovation implementation.*
	Information Technology and Innovation at Shinsei Bank	Fuller and Upton 2007	*It illustrates how a new enterprise system is adopted and assimilated through the retail bank.*

Topic	Article/Case	Source	Description/Relation to Digital Innovation
Emerging IT	Mt Auburn Hospital: Physician Order Entry	McAfee et al. 2002	Hospital administrators are confronted with the question of whether to implement a complex new Physician Order Entry System to help address the problem of adverse drug events arising from medical errors, and if so, how. *Provides an occasion to analyze the likely barriers to IT innovation implementation, and to identify tactics for overcoming those barriers.*
	Cisco Systems: Implementing ERP	Austin et al. 1998	It shows how a number of factors need to be considered in implementing enterprise systems, including organization structure, culture, legacy systems, datawarehouse in use, etc. *The complex ERP implementation at Cisco is illustrated.*
	Peer Production, Social Media, and Web 2.0	Gallaugher 2012, Chapter 7	*The penetration and diffusion of social media across individuals and businesses are discussed.*
Managerial Issues	The Dark Side of Customer Analytics	Davenport and Harris 2007	Issues such as privacy, legality and ethics are discussed in the context of a fictitious grocery store and an insurance company. *It highlights the non-business challenges that may hamper the adoption of promising IT innovations such as new business analytics tools.*
	Cooperation and Compatibility: How to Approach Standards Setting	Shapiro and Varian 1999, Chapter 8	Standards change the nature of competition and affect the positions of complementors, incumbents, and innovators. It explores tactics in the formal standard setting process, including building alliances and advocating open standards. *It discusses the role of standards in affecting the adoption, diffusion and implementation of digital innovations.*

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Module V: Digital Innovation at the Impact Stage

Topics: Value appropriation and transformation.

Learning Objectives: Be able to describe the process of creating and realizing value from digital innovations; be able to measure the success of innovations; be able to evaluate the impact of innovation on the whole ecosystem; be able to discuss the importance of continuously transforming the organization to be ready for the next innovation; be able to discuss non-economic values, such as privacy and ethics; be able to explain value appropriation from the perspective of different stakeholders; be able to discern the factors that foster/hinder value appropriation (e.g. Intellectual Property, IT governance); have good knowledge of the related IT for value appropriation.

Candidate Readings:

Topic	Article/Case	Source	Description/Relation to Digital Innovation
Value Appropriation	Lecture Note: Digital Innovation Value Maximization	Fichman 2012	*This note addresses the value appropriation of IT, factors affecting IT business value, etc.*
	Value Creation: Can Hulu Save Traditional TV?	Salter 2009	Kilar, CEO of Hulu.com, sets out to create value from traditional TV: a new and better way to watch TV shows. The goal is to make Hulu the online authority on TV videos. *It discusses value creation through digital innovation (e.g. customized advertising) in the TV industry*.
	Virgin Mobile USA: Pricing for the Very First Time	McGovern 2007	In an industry characterized by high customer dissatisfaction and churn rate, Virgin Mobile attempts a bold strategy to cater to targeted customers (14–24 year olds). *A case on realizing value by employing IT to target customers.*
Value Transformation	ITC e-Choupal Initiative	Upton and Fuller 2008	eChoupal reengineered the soybean export supply chain in India using digital technology and incentives for various players. *It discusses how IT (the eChoupal system) transformed the antiquated supply chain and re-distributed value along the supply chain.*
Emerging IT	Stakeholder Value (How to Jump Start The Clean-Tech Economy?)	Johnson and Sukewicz 2009	The transformation from a fossil-fuel economy to clean-tech economy is being led by Silicon valley venture capitalists, who have pumped more than $20 billion into clean technology startups. However, clean tech can be disruptive and various stakeholders value it differently. The article provides a transformation framework that focuses on the whole rather than the parts. *It discusses how to use clean-technology to increase values for various stakeholders.*
Managerial Issues	Ethics: How RFID and I Got Personal?	Graafstra 2007	How does human implantation of RFID change the life of individuals? While it gives doctors, patients real time access to critical information, it raises ethical, religious, and social issues. *It discusses the impediments of value realization when applying new IT.*
	The Starbucks Case	Moon and Quelch 2008	Starbucks tried to add value through innovation, offering Wi-Fi services and selling its own music. A leaked memo by founder Howard Schultz indicated that "stores no longer have the soul of the past...the warm feeling of a neighborhood store." *It discusses how traditional values are affected by new innovations.*
	A Matrixed Approach to Designing IT Governance	Weill and Ross 2005	IT governance affects the outcome of IT innovation and can be assessed by determining how well it enables IT to deliver on four objectives: cost-effectiveness, asset utilization, business growth and business flexibility. *It addresses IT governance issues that are key to realize value from digital innovation*.

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Appendix C

A 15-Week Sample Syllabus

Course Title: "Information Technology in Business: A Digital Innovation Perspective"

Course Description

Information technology (IT) permeates the strategy, structure and operations of modern enterprises. Today, IT forms a key foundation of most business innovations, including both novel products and revamped organizational processes. In fact, IT projects now account for half of all capital spending in the U.S. At the firm level, IT has become a major generator of business value, especially for organizations with the right set of resources and capabilities to exploit it. At the economy level, the marked acceleration in worker productivity in the U.S. in the last 20 years can be attributed to the cumulative effects of heavy IT investments begun in the 1990s. IT is transforming the way we live and work, how companies are organized, and the structure of entire industries. Thus, it is increasingly essential that managers become fluent with IT, both to become more astute individual observers and users of the technology, and to become more effective leaders of innovative business initiatives that are increasingly IT-enabled.

In this course, students will obtain a broad overview of IT fundamentals, key emerging technologies, and IT managerial frameworks, with an emphasis on how IT enables organizational innovation. Through a combination of readings, case studies, lectures and team projects, students will gain an appreciation for the transformative effects of IT on businesses, industries, and society, and will develop the ability to identify new opportunities presented by IT, and to manage the challenges associated with conceiving, justifying, and implementing IT-based initiatives.

The course is designed for students with various backgrounds; the class does not require any technical skills or prerequisite courses on IT, organizations, or innovation.

Textbook:
John Gallagher's free online book *Information Systems: A Manager's Guide to Harnessing Technology*, V1.4, August 2012 (available for downloading at http://catalog.flatworldknowledge.com/catalog/editions/gallaugher_1-4-information-systems-a-manager-s-guide-to-harnessing-technology-1-4).

Schedule

Week	Modules	Topics	Readings/Assignments
1	Over view of Digital Innovation	Class overview.	• Read syllabus • Read "Lecture Note: Learning to Think Like a Digital Innovator" (Fichman 2012e). • Read "Winning the Race with Ever Smarter Machines" (Brynjolfsson and McAfee 2011) • Optional: "Ten IT-Enabled Business Trends for the Decade Ahead" (Bughin et al. 2013)
2		Distinctive characteristics of IT: Moore's Law, digitization (information goods), and network effect.	• Read "Lecture Note: Distinctive IT Characteristics" (Fichman 2012d) • Read Gallaugher Chapter 5 on Moore's Law • Read Gallaugher Chapter 6 on Network Effects • **Assignment**: Network Effect Game
3		Strategy and IT in organization, product vs. process innovation, emerging IT (web 2.0) enabled innovation, discuss the Pixar case.	• Read Gallaugher Chapter 7 on Social Media and Web 2.0 • Read Gallaugher Chapter 2 on Strategy and IT • Read Pixar Case (Afuah 2009, Case #5) • Skim "The Four Ways IT Is Revolutionizing Innovation" (Hopkins 2010) • Skim "What's Your Social Media Strategy?" (Wilson et al. 2011)

Week	Modules	Topics	Readings/Assignments
4	Digital Innovation Discovery	IT-enabled innovation at the discovery stage, identification of innovation opportunities, invention and selection in organizations. Discuss the Zara case, discuss Google's flat organization to embrace new discoveries.	• Read Gallaugher Chapter 3: Zara - Fast Fashion from Savvy Systems • Read Chapter 6, "Aiming for Evolutionary Advantage" (Hamel and Breen 2007)
5		Innovation strategy (open vs.closed), P&G case on open innovation, Whirlpool innovation case.	• Read P&G Connect+Develop Case (Huston and Sakkab 2006) • Skim Whirlpool Innovation (Link 2)
6		Emerging discovery models, Crowdsourcing (Dell Ideastorm, Zhubajie, Crowdspring, Threadless).	• Read Case on Dell's Ideastorm (Di Gangi et al. 2010) • Crowdsourcing Research Zhubajie vs. Crowdspring • Skim Threadless (Afuah 2009, #4 and Link 2)
7	Digital Innovation Development	Developing ideas into usable innovations; packaging. Infrastructures necessary for development, discuss General OnStar case, Shinsei bank case.	• Read General Motor OnStar Case (Farris et al. 2000) • Skim Shinsei Bank (Fuller and Upton 2007) • Read Gallaugher Chapter 11 on Data Assets
8		Configuring, analytics-driven development, business analytics, developing analytical capabilities, discuss Capital One, competing on analytics, Harrah's case.	• EBay Experiment, HBR11 • Skim Competing on Analytics (Davenport 2006) • Capital One (Hann, Bill Kahn) • Harrah's Case (Lal 2002)
9		Platform based development, discuss Apple and Facebook platform for developers, platforms competition, two-sided markets, special topic on social mobile gaming development (Shengda and Tencent).	• Read Gallaugher Chapter 7 on Social Media • Read Gallaugher Chapter 8 on Facebook • Discuss Platform Competition Between Shengda and Tencent • **Assignment**: Two-Sided Market Game
10	Digital Innovation Diffusion	Deployment and assimilation. Discuss eChoupal case vs. China's Project of bringing supermarket to villages	• Read "Lecture Note: Tools and Tactics for Analyzing Digital Innovation Trajectories" (Fichman 2012a) • Read "ITC e-Choupal Initiative" (Upton and Fuller 2008) • Introduction of China Commerce Bureau's Project "Bringing Supermarket to Villages"
11		Implementation and assimilation, discuss Rich-Con Steel (orTektronix ERP implementation, or CICSO ERP).	• Read "Lecture Note: Digital Innovation Deployment: Barriers and Tactics" (Fichman 2012b) • Read Rich-Con Steel (McAfee 1999)
12		Adoption of emerging technologies (Social media adoption), special topics on healthcare information system adoption.	• Read "How Large U.S. Companies Can Use Twitter and other Social Media to Gain Business Value" (Culnan et al. 2010) • Discuss EMR Adoption (Agarwal et al. 2010) or other papers
13	Digital Innovation Impact	Value Appropriation, discuss the Netflix case on value creation with online DVD rental, discuss Hulu.	• Read Lecture Note: Digital Innovation Value Maximization (Fichman 2012c) • Skim Gallaugher Chapter 4 on Netflix, Blockbuster and Redbox • Read Netflix Case (Afuah 2009, Case #3) • Read Value Creation At Hulu TV (Link 3)
14		Business change and transformation, discuss Ericsson's success story on business transformation with ERP, value creation in Virgin Mobile, societal transformation, IT governance to embrace value.	• Read Inside Ericsson IT Enabled Change (Iveroth 2010) • Skim Virgin Mobile Case (McGovern 2007) • Read IT Governance (Weill and Ross 2005)
15		Issues with IT value creation, Starbucks reverse IT-created value, Rich-gets richer in recommendation systems, RFID got personal, ethics/privacy/security/piracy.	• Skim HBS Starbuck's Case (Moon and Quelch 2008) • Research on Recommendation Systems (Diversity vs. Accuracy) • RFID Got Personal (Graafstra 2007)

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Link 2: Threadless, the customer is the company. http://www.inc.com/magazine/20080601/the-customer-is-the-company.html
Link 3: Can Hulu save traditional TV? By Chuck Salter, 2009 http://www.fastcompany.com/magazine/140/the-unlikely-mogul.html

Grading

Class presentations and discussions	Individual grade	15%
Two short case analyses	Individual grade	20%
Two small economics games	Group grade	15%
Project 1	Group grade	20%
Term project or final exam	Individual grade	30%
TOTAL		100%

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