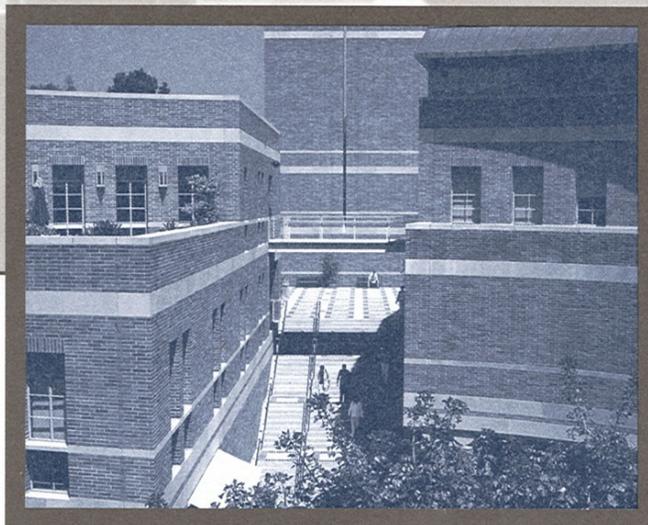


UCLAAnderson
School of Management



INSIDE THE IT INNOVATION WAVE MACHINE

E. BURTON SWANSON

UCLA ANDERSON SCHOOL OF MANAGEMENT
110 WESTWOOD PLAZA | LOS ANGELES, CA 90095

JANUARY 4, 2010

INFORMATION SYSTEMS | WORKING PAPER 1-10

INFORMATION SYSTEMS WORKING PAPER SERIES

The IS Working Paper series is a publication of the Information Systems Research Program (ISRP). It provides for the early dissemination of research by the IS faculty, students, and visitors, usually prior to its more formal publication elsewhere. The IS Reprint series includes these more formal publications, many of which supersede the original working papers. To obtain a downloadable index to both series, please visit our website at:

<http://www.anderson.ucla.edu/documents/areas/fac/isrp/wp-index.pdf>

Comments and feedback on our working papers are welcome and should be directed to the authors. Because their authors typically revise working papers within months of their issuance, we maintain only the most recent three years of the series for distribution. Most of these are downloadable from our website (see above). For copies of older papers, please contact the authors directly.

Publication of the IS Working Paper Series is made possible in part through the generous support of the ISRP by the IS Associates. For further information on the IS Associates, please visit their website at:

<http://www.anderson.ucla.edu/x574.xml>

Inside the IT Innovation Wave Machine

E. Burton Swanson
UCLA Anderson School
110 Westwood Plaza
Los Angeles, CA 90095
Email: burt.swanson@anderson.ucla.edu

January 4, 2010

Copyright © 2010 by E. Burton Swanson

Acknowledgement: I'm grateful to Ping Wang for his comments on a draft of this paper.

Inside the IT Innovation Wave Machine

Abstract

With the rise of modern information technology (IT), managers face seemingly one wave of IT innovation after another. At any one time, the executive is likely to feel more or less inundated by a current wave, unsure of what all the commotion is about, unable to avoid the topic in conversation, and suspicious that it merely reflects the latest marketing hype. How should this apparent IT wave phenomenon be understood by managers? Drawing from our own and others' research, we provide an answer, explicating here the workings of an institutional apparatus that we term the "IT innovation wave machine," which carries an innovation through five stages: (i) ground breaking; (ii) vision launching; (iii) attention gathering; (iv) bandwagon building; and (v) momentum riding. Each individual wave is further revealed to comprise a wave complex, where technology adoptions and implementations are pulled along by the community's attention to an organizing vision, which promises value from the innovation, but which will typically dissipate long before such value is fully achieved. By understanding these dynamics and particulars, executives can better position themselves and their own decisions to innovate.

Introduction

Over the last half century, with the rise of modern information technology (IT), managers have faced seemingly one wave of IT innovation after another, each promising to change the way they do their business. Indeed, there has been no respite and looking back much can be seen to have changed, the sheer ubiquity of computing and communications devices and people's devotion of their time to them bearing witness to the transformation. Still, at any one point in time, the executive is likely to feel more or less inundated by a current wave, unsure of what all the commotion is about, unable to avoid the topic in everyday business conversation, and suspicious that it merely reflects the Next Big Sell by those who will shortly arrive at his or her door. Today, for instance, an executive may understandably feel drenched by the hoopla surrounding "Web 2.0" and the promise or perhaps threat its associated social networks are claimed to pose for business everywhere. Will this too soon pass?

Some years ago, Neil Ramiller, in his doctoral research at UCLA, undertook to ask a number of managers how they "made sense" of the new in IT. He found that they struggled in this endeavor. Often hopeful early on that a new IT would deliver on its promise, as was true then in the mid-1990s for electronic commerce, managers often came later to be disenchanted, as was true then for CASE (computer aided software engineering) technology. Something of a wave phenomenon is suggested here, as managers, working with an apparently limited reservoir of hope and enthusiasm, transfer it progressively from one emergent technology to another. Reflecting on this, one manager lamented with some personal insight, "...I keep waiting for a *silver bullet*, a

magic formula, an answer to all my prayers, and it never happens!” Still, for this manager and most others, the promise of the newest IT seems always to beckon.ⁱ

Many executives are also now familiar with the concept of the “hype cycle” introduced by technology assessment firm Gartner, to describe how new IT innovations break upon the business scene in a wave-like, attention-grabbing fashion. In this model, each noteworthy new technology is portrayed as taking off and gathering mounting interest, only to reach a “peak of inflated expectations,” falling then into a “trough of disillusionment,” from which it slowly recovers to follow an upward “slope of enlightenment.” The cycle itself posits a wave of interest and commitment to the innovation, driven by human preference for novelty, the phenomenon of social contagion, and short-cuts taken in decision making. Since it was first introduced, in 1995, it has remarkably become Gartner’s most popular analytic tool for assessing the progress and acceptance of new IT.ⁱⁱ

How then should managers understand this apparent IT wave phenomenon and come to terms with it? For more than a decade now, in a program of research at UCLA’s Anderson School, we have sought to answer this question. In the present article, I attempt to integrate from some of our findings, as well as those from others’ research, and present for managers what has been learned.ⁱⁱⁱ

We note at the outset that the notion of IT innovation waves suggested here has roots elsewhere. The concept was employed by James McKenney and colleagues, for instance, in their historical account of industry-transforming IT such as airline reservation systems. Even apart from IT, the notion of innovation waves is a popular one among technologists. Among scholars, it is widely identified with the influential work of the economist Joseph

Schumpeter. Our own concept is but distantly related. The waves suggested by Schumpeter and others are economic “long waves” generated by innovation clustering, while the waves of interest here are comparatively “short waves” that lap or break continuously on business shores. Much like Schumpeter, however, we have been very interested in the entrepreneurial forces giving rise to IT innovation.^{iv}

The notion of IT innovation waves invokes a metaphor to suggest a “natural” phenomenon that just happens to us, and indeed it may feel that way to many executives, as just suggested. But, of course, it is not at all “natural” in the sense that it is explainable apart from humankind’s purposeful endeavors. Rather, the IT innovation wave phenomenon is obviously a consequence of such endeavors, although the extent to which it is somehow a natural consequence or an orchestrated consequence is open to question. Much is involved in the IT innovation wave phenomenon, and in this article to be provocative I suggest that a “machine” is at work within it. Essentially, this is an argument for IT innovation waves as orchestrated consequence. To explore this argument, I attempt to open up and look inside the so-called machine, to reveal its workings. First, however, I consider the alternative argument that IT innovation waves are simply a “natural consequence” of an underlying process known in the literature as “diffusion by contagion,” although this process too is subject to attempts to orchestrate it.^v

The Simple Contagion Model

In academic studies, the theory of innovation diffusion has arguably borrowed its primary model from the life sciences, in particular, likening the spread of an innovation among potential adopters to the spread of a particular disease by contagion among humans or

other species. More than four decades ago, the researchers William Goffman and Vaun Newill suggested, “People are susceptible to certain ideas and resistant to others. Once an individual is infected with an idea he may in turn, after some period of time, transmit it to others. Such a process can result in an intellectual ‘epidemic’.” The dynamics of such epidemics have been much studied. The cumulative incidence of a disease, spread most typically by a virus, follows the familiar S-shaped curve. As exposure to the virus increases, so too does the incidence rate, accelerating the process, until natural limits such as remaining susceptible subjects, eventually force the rate into decline, as the virus “runs its course.”^{vi}

As diseases are thus communicable, so too are innovations, as posited by the simple contagion model. Diffusion here is defined as the process by which an innovation is communicated through certain channels over time among the members of a social system. In the simplest interpretation, early adopters put the innovation into play, and others follow their lead at an increasing rate as more are exposed by “word of mouth” to the technology, until again certain limits eventually force the adoption rate into decline, as the innovation runs its course. Indeed, extensive research confirms that the diffusion of many innovations follows an S-shaped curve similar to that which describes the spread of a communicable disease. Still, where innovation is concerned, the underlying phenomenon remains rather vaguely described, unlike the communication of a virus. What about an innovation is communicated, exactly, and how? To what extent is the associated process “natural” or somehow orchestrated? The recent research literature suggests that innovation diffusion is indeed a much more sophisticated process than is reflected in the simple contagion model. Diffusion is substantially influenced, if not

exactly orchestrated, through a variety of human agency. In particular, the role of the change agent is now widely recognized. In our own research, we have sought to explore this phenomenon in the domain of IT. We find that certain IT innovations, in particular, diffuse as if orchestrated in part by what we will term a “wave machine.” We explore this next.^{vii}

The Wave Machine

The IT innovation wave machine, as imagined here, is a kind of institutional apparatus that serves to produce waves of innovations as just described. To understand how it works, I examine how individual waves form, surface, gain force and break with consequence upon the business scene. The idea is to reveal the diverse agency that underlies a phenomenon which otherwise appears to unfold naturally, of its own accord, as if it were largely untouched by human hands, as the metaphor suggests. As we shall see, when examined closely, this “natural unfolding” is illusory in that it leaves identifiable fingerprints in its wake. Many largely “invisible hands” are at busily at work inside the IT innovation wave machine. The ways in which these hands work together or not has much to do with an IT innovation’s destiny.

The IT innovation wave machine will be seen to carry the innovation through five stages: (i) ground breaking; (ii) vision launching; (iii) attention gathering; (iv) bandwagon building; and (v) momentum riding. As also will be seen, the innovation wave forms as a wave complex, with internal workings among related phenomena, rather than as a single wave, representing cumulative adoption, as classically described in the literature. But more on this later.

1. Ground breaking

To begin, imagine something like a placid sea of business activity subject to little innovation disturbance. Consider that for an individual wave to form, a kind of “ground breaking” must first take place. By this we mean that something novel to the business playing field, typically a new artifact of some kind, is introduced. In the IT context, this is often a new device, such as a new hand-held or other computing, communication, or storage device, which provides a new application platform. But in the business context, it is frequently new business application software, which exploits developments in both the more basic IT software and hardware, and the particular business opportunities and imperatives of the day. While often first written to meet one firm’s needs, such software may subsequently be seen as useful to others, and adapted and packaged for a broader market. When technologists say they are on the look-out for the “next killer app,” which breaks new ground and drives the market for IT in a big way, it is business apps that they are often talking about. It is these that are looked to as important sources of disturbance in how business gets done.

But how would we know that new application software breaks new ground on the business playing field? Certainly not by looking at the software code itself, which however novel the composition, is largely devoid of business implications on its own, apart from the “functional specifications” to which it is presumably written. Rather, the breaking of new ground is demonstrated when the software is executed in practice, typically as part of a business process involving people, where its contribution is illuminated.^{viii} Even then it may be hard to discern whether a single revamped business process, driven by novel application software, has wider and compelling business

implications. For of those business apps that do break new ground, most will do so in small ways and go largely unnoticed as a consequence. They may remain confined to one or at most a few organizations. Most will generate no IT innovation wave whatsoever. Consider then, the dilemma of an entrepreneur in possession of new application software that arguably breaks new ground and that he or she wishes to package and bring to market. But what market, really?

2. Vision launching

In 1998, Farzad Dibachi, founder of Niku Corporation, faced just this problem.^{ix} His firm offered new project management software, originally composed for his personal use, for what he now termed “professional services automation (PSA).” Seeking exposure for the product, Dibachi approached several IT research and analysis firms. Such firms, among them Gartner, Forrester Research, and Meta Group, monitor new IT, vendor products and services, and the marketplace, providing assessments that they then sell to their own subscribers, principally those who buy IT products and services.^x Dibachi sought coverage for his product. But what was its potential market exactly and with what other products did it in effect compete? At Aberdeen Group, research analyst R. David Hofferberth took an interest in these questions, responding to Dibachi’s initiative. He ultimately produced a “white paper” on PSA as not just a single vendor’s product, but as a new class of enterprise software with its own market, which included a number of competing products, from firms such as Novient, Changepoint, and Evolve, in addition to Niku. In thus introducing the PSA concept to the wider community, Hofferberth articulated the beginnings of what is termed an “organizing vision” for PSA.

An organizing vision is defined as a focal community idea for the application of IT in organizations.^{xi} Broadly, it explains what the innovation is and why it should be undertaken. The need for an organizing vision arises because the applications of new IT are not at all self-evident. Nor is the market for new application software self-apparent. Rather, the notion of a market is typically advanced by individuals such as Hofferberth in the case of PSA who identify it as emergent in the broader marketplace. Whether there is in fact such a market is in the beginning typically arguable. Its identification is more an interpretation, than a simple observation. Analysts such as Hofferberth take a risk when they venture such an interpretation, but then that is what they are expected to do, as they and their firms can earn substantial reputations by becoming the principal authorities on new technologies which do become the high-flyers.

And so, in the case of another innovation, with a very different fate, in early 1990, three analysts from Gartner Group reportedly met over pizza and beer and from their discussion identified “enterprise resource planning (ERP)” software as a new emergent class of application software. The first white paper sketching the vision for ERP, written by one of the three analysts, appeared shortly thereafter. Several years then passed, however, before SAP’s new R/3 product emerged and came to exemplify ERP, catching wide attention and igniting a hot new market. Whereas SAP’s prior R/2 product ran on mainframes, R/3 exploited new client/server and relational data base technologies. The rest, as the cliché goes, is now history. ERP adoption swept quickly across the business landscape in the late 1990s, driven in part by fear of the millennium bug in older legacy software. As for Gartner, “We drove the market (for ERP),” recalled Erik Keller, looking back on his days as one of its principal ERP experts.^{xii}

3. Attention gathering

Of course, providing a vision for a new business application by means of a white paper is not sufficient to accomplish a launch. Such a white paper must also find an audience.

Beyond the immediate subscribers to an IT research and analysis firm's publications, the problem is to gain the attention of a wider and often skeptical IT community, one accustomed to being besieged by extravagant claims for "break-through" products and concepts, even as it anxiously awaits and yearns for the Next Big Thing. Importantly, one way to gather the community's attention is through the many conferences, expositions, and symposia that bring participants together for a few days where they update themselves on new developments and further "network" under a common roof. Some of these meetings are organized by the IT research and analysis firms themselves, and typically address a range of topics, within which new concepts are easily introduced. Gartner's meetings are among the best known of these meetings. However, conferences are also organized by firms that specialize in bringing new technologies to wider attention.

Thus, in November 2001, the firm First Conferences, based in London, put on the first conference on PSA, discussed above. By chance, our research team came to know about this conference in advance and undertook a project to study the launch of PSA. The conference itself was an obvious venue for attracting attention to PSA, before, during, and even after it was held. It also served to mobilize individuals and firms to attend and thus provisionally commit to the technology. In advance, it was billed as a can't-miss event with the principal players all in attendance. During the event, attendees could focus intently on the technology and its promise. They could also swap stories and network

with each other to mutual advantage. Afterward, conference success was declared by the organizers and a second meeting was promised for the next year. Alas, it did not come to pass. PSA failed to achieve sufficient adoptive momentum, and attention to it withered, rather than grew. As an organizing vision, it faded rather quickly from the scene. PSA's proponents moved on to other endeavors.

The PSA story illustrates well the challenges of attention gathering for those who would promote a new IT innovation. Since Herbert Simon first identified attention as a notoriously scarce management resource, its role in explaining events continues to be underestimated.^{xiii} In the case of IT innovations, management is generally under constant siege by claimants to the Next Big Thing, as already suggested. More broadly, management attention is most often directed toward putting out today's fires, more than setting tomorrow's directions. The irony is this: one manager's attention is most likely to be drawn to a new technology when he or she finds another manager already drawn to it, signaling its importance. The challenge for promoters of a new innovation is to bootstrap this process.

In the case of PSA, it did have its brief moment in the sun. It was featured in an *Information Week* article, for instance, a trade publication directed to senior IT managers.^{xiv} But the vision began to fray, and the PSA name itself was not embraced by all. Gartner, for instance, a little late to the game, preferred the term SPO (Service Process Optimization). Perhaps more important, the promoters of PSA could point to few compelling success stories from actual adoptions of the technology, the kind of stories that managers look for to convince them that something real and important is happening that should not be ignored.

4. Bandwagon building

Beyond giving an organizing vision their attention, for an IT innovation wave to form and gain size, individuals and firms must also commit to it. More specifically, some firms must lease or buy the new business application software and commit budgeted monies toward implementing it. When they have done so, they may be said to have “adopted” the associated innovation, although much more remains to be accomplished. Firms that sell this software must also market it under the banner of the promulgated organizing vision, enabling it to gain recognition and acceptance in the marketplace. In this fashion, a bandwagon for the IT innovation is built by the simple device of recruiting individuals and organizations to commit their resources and publicly join it.

Building a bandwagon is important for two principal reasons. First, as is well known where new IT is introduced, there are often positively reinforcing *bandwagon effects*, meaning that an adopter benefits in part as a result of others doing the same thing, either as a result of network externalities, where adopters are linked, or from resulting complementarities, where a widely adopted IT attracts the introduction of still more IT, adding further value.^{xv} With wide adoption, a new IT can sometimes achieve the status of a de facto standard, creating in effect a new “platform” for value-added products and services.

Second, a bandwagon serves to attract further attention in the community, according to the rate of current adoption, the higher rate signaling both the likelihood of securable benefits for adopters, and favorable marketplace prospects for those offering the associated software and related goods and services. The securable benefits signaled to prospective adopters may be both direct, deriving from the virtues of the innovation

itself, and indirect, associated with the legitimacy gained from joining the bandwagon. Too, the building of attention can feed on itself, as through contagion (“Have you heard about X?”) it brings the non-initiated into the process. The resulting swell in attention, for as long as it can be maintained, provides a stimulus to both marketplace demand and supply, with the result that the rate of adoption increases further, a consequence of the positive feedback loop.^{xvi}

And so we see how bandwagons are built and how an IT adoption wave gains strength and propels ahead according to the attention given the innovation. It should be understood that this is a process which may unfold either rather slowly or very rapidly. Importantly, where the innovation becomes a *management fashion*, the process is likely to be speeded up, in particular. Management fashions are in Eric Abrahamson’s words, “relatively transitory collective beliefs, disseminated by the discourse of management-knowledge entrepreneurs, that a management technique is at the forefront of rational management practice”.^{xvii} While not all management fashions pertain to IT innovations, some do. An important aspect of fashionableness is that by definition it cannot be indefinitely sustained. Eventually, any IT innovation will lose its fashionableness even as it may continue to diffuse. Nevertheless, its period of fashionableness may be important to the momentum it achieves and its ultimate impact on practice. Unlike some management fashions, which may disappear from practice altogether, IT innovations, once undertaken, frequently have irreversible qualities, even where they do not (and they often do not) meet the expectations raised for them.

5. Momentum riding

Once IT innovations achieve a certain adoptive momentum, bandwagon participants can ride and exploit it, positioning themselves to reap rewards. Purveyors of related products and services can push to extend their markets, much as ERP vendors sought to leverage their success with large customers and penetrate the mid-size and even small business markets. Adopters can move to achieve desired business solutions, often with the aid of consultancies, in particular those specializing in system integration, such as Accenture and Deloitte, who in the 1990s rode the ERP wave to achieve large revenues and profits for themselves. Such consultancies can be reluctant to join bandwagons without momentum, as their lines of practice are often built to exploit economies of scale associated with wide adoption. Now, however, with momentum and many implementations underway, the IT innovation will be put by the committed to a kind of reality test. For in implementing new IT, notoriously, things do not always work out as foreseen.

Indeed, an important characteristic of IT innovations is that implementation is frequently costly, time consuming, and highly problematic. One consequence is that adoptions, which are essentially commitments to implement, may outstrip implementations achieved, resulting in a worrisome “implementation gap” that calls for explanation, and can serve to dampen enthusiasm for the innovation. And so, shortly after the ERP wave peaked, the consultant Tom Davenport called attention to the now noticeable implementation problems, remarking, “The growing number of horror stories about failed or out-of-control projects should certainly give managers pause.”^{xviii} But did these stories suggest that ERP was a flawed vision pushed upon a naïve management to widespread ill effect, or did they merely reflect the inevitable learning difficulties faced by those who

early on had thin skills and experience in doing the work needed to realize the ambitious vision? In the case of ERP, the latter was certainly a large part of the problem, as the implementation consultancies rapidly scaled up their practices, staffing many of their engagements with an abundance of relatively raw new recruits, to the inevitable consternation of their clients.

Beyond implementation that eventually gets new systems up and running, whatever the cost and schedule overruns, the IT innovation is further put to the reality test by the usage made of the new systems. For the organizing vision has promised accomplishments and ultimate benefits to the enterprise. Are these to be seen? As it turns out, much as implementation lags adoption, successful organizational usage must lag initial implementation. Indeed, in the case of ERP, firms were often made worse off with initial implementation, before they could be made better off. Assimilating the new systems into the firm proved to be more of a challenge than was anticipated and achieving the promised benefits remained elusive for many. Gradually, enthusiasm for ERP wore off, even as it became an institutionalized practice.^{xix}

While a new IT's momentum cannot be sustained indefinitely, it can nonetheless be extended for the benefit of those who ride it. Community participants have various stakes in the technology's continued success. These include those individuals and firms who have built their own knowledge and expertise around the technology. Some work directly on the technology's promotion. Thus, in one illustrative study, we observed how proponents of CRM (Customer Relationship Management) developed and published a special advertising section on the technology in *Business Week* over several years, exploiting CRM's momentum while serving importantly to extend it. They did this in

part by serializing the content of their articles and accentuating the evolution and progress of the technology and identifying promising new developments to keep the CRM organizing vision fresh and responsive.^{xx} CRM's continued momentum and promise was in effect built into the articles' ongoing story line. The case illustrates how a technology's momentum can be in part reinvested so that it may be extended.

The Wave Complex Discerned

The workings of the wave machine as just described suggest that many IT innovations generate a wave complex, rather than a single adoption wave as classically understood. Our own studies suggest that for such innovations the adoption wave itself is substantially driven by an attention wave, in which an organizing vision is launched for all players to see and grapple with. The aim of those who advance this vision is to build excitement and support for the innovation, to capture management's interest and attention, and to engage widespread comprehension of the innovation as a solution to problems recognized as important. It is the attention wave that is the most discernable to managers as they attempt to make sense of the new and cope with the associated hype as suggested at the outset of this article.

Much as cumulative adoption of the innovation follows an S-shaped curve, so too we suggest does cumulative management attention to the innovation's organizing vision. This attention curve is likely to form some time after initial adoptions have taken place, when there is some evidence that an innovation is underway. With good fortune, attention will then build rapidly in concert with subsequent adoptions and will reach its peak about the same time adoptions themselves crest. With sufficient momentum thereby achieved, subsequent adoptions may continue even after the community's attention to the

organizing vision has dwindled. And so the shorter wave of attention serves to pull the longer wave of adoption along.

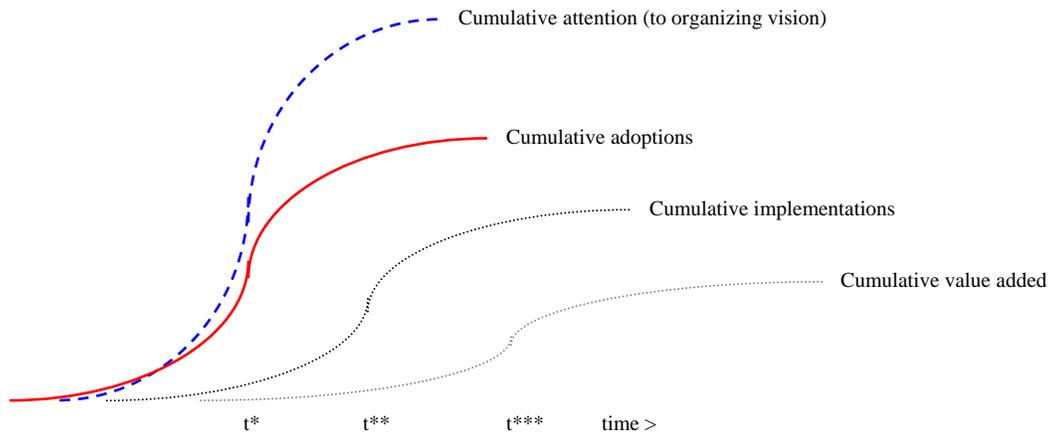
As also discussed above, adoptions of IT innovations do not equate to implementations, which form a third wave in the complex, a still longer one than that for adoptions, as implementation is often a lengthy process. Implementations are likely to peak some time after attention and adoptions have been on the wane. However, until they do peak, attention to the organizing vision is likely to remain active, as the vision over its own life is transformed to guide them.

And finally, the cumulative value achieved from the IT innovation forms a fourth wave in the complex, a longer wave yet, a product of substantial learning-by-doing subsequent to implementation, and extending some time after adoptions have run their course. Indeed, with some irony, the rate at which value is achieved by the innovation is likely to peak long after the community's attention to the organizing vision has dissipated.

Figure 1 summarizes the four-wave IT innovation complex. The basic insight here is the distinction drawn between the attention wave that forms around an IT innovation, and the actual adoption, implementation, and value gained from its use. At any one point in time, then, it is important for managers who seek to understand the innovation's progress to grasp it on all four dimensions, so as to avoid misinterpreting it by focusing on just one of these. To illustrate, consider the three points of time in Figure 1 marking the inflection points in the S-shaped curves, where at t^* attention and adoptions are both at their peak rates of accumulation, while the implementation rate is still growing, peaking later at t^{**} , and with the innovation's value added barely discernable, its rate peaking later still at t^{***} . Note that managers have much to learn from the innovation's progress subsequent

to t^* , even though the community's attention to the organizing vision will be on the wane. In particular, they have much to learn about the value they should be able to achieve through their implementations.^{xxi}

Figure 1
The IT Innovation Wave Complex



Conclusion

What have we thus learned about the IT innovation wave machine? We find first and foremost that it is substantially an *institutional* apparatus, erected to further progressive change in business practice. That IT innovation is a good thing on the whole is largely taken for granted. Many individuals and enterprises find themselves attracted to this broad proposition, even as they compete and squabble around individual innovations and their particulars. They find themselves attracted in substantial part because they can profit and make their livings from the process itself. Most obviously, they can catch an individual wave complex early on, help it achieve scale, and with good fortune eventually ride its momentum. But too, they can invest themselves in catching a series of such wave

complexes, and it is in this sense that I suggest that they become part of an apparatus that is itself institutional in character.

Who are these institutional participants? They are the IT research and analysis firms such as Gartner that monitor the industry for new developments, the vendors that brand and re-brand their offerings under successive innovation banners, the consultants and managers who move among firms and lubricate the IT adoption and implementation process, the conference organizers who bring everyone together to talk and further their prospects, the publishers and writers who ferret out and convey the cautionary tales and success stories, and the gurus and academics who extract the wisdom of it all for the broader audience. Through their ongoing collective action, formed largely from the coincidence of their interests, they serve to activate what is termed here the IT innovation wave machine.

We find too that the IT innovation wave machine has a certain limited capacity in terms of the attention of its institutional participants. It is therefore largely devoted at any one time to but a few of the many innovations that compete for its support and these are those that promise the most returns for their efforts to the individual players. As a consequence, the launch of any new IT innovation is always problematic, as a relatively few devotees seek to turn already-occupied institutional attention to it, competing with other hopefuls who also clamor to be the next new favorite. At the same time, with a seemingly never-ending stream of such new prospects, the wave machine may choose to release its grip on those innovations which seem to have lost whatever adoptive momentum they managed to achieve, whether the waves they generated were large or

small ones. In this way, the machine frees capacity to accommodate the most promising among the newest.^{xxii}

And so we have explained the basic dynamics of the IT innovation wave machine. What lessons then follow for the executive who inevitably confronts these waves, one after the other, as his or her industry is pummeled by the promise of the new in IT and told that its future hangs in the balance? As we have already suggested, a first lesson lies in recognizing the differences among the components of a particular wave complex, and discerning, for example, whether actual adoptions of a new IT measure up to all the talk about it, or whether adoptions seem to be plentiful enough, but successful implementations are suspiciously few, or whether anyone is really gaining value from their implementations. In an earlier article, we have also suggested that executives can face each new IT innovation either *mindlessly*, for example, by jumping on an innovation's bandwagon without giving much thought to the unique circumstances of his or her firm, or *mindfully*, taking these unique firm circumstances into careful account in deciding whether, when, and how to join others in embracing and undertaking it. While it at first seems obvious that executives should proceed mindfully, rather than mindlessly, this is easier said than done.^{xxiii}

The IT innovation wave machine presents a powerful institutional force that can be difficult for an executive to resist. Most executives would like to be known as innovators, if the amount of business press devoted to the subject is at all an indicator. Within the firm, many IT executives can build their professional reputations by being an IT leader, pushing the firm to embrace technological change, rather than cling to its old ways. And when it becomes apparent that a particular IT innovation seems destined to

sweep the field, few executives want to be in the position of being left behind, risking the competitive survival of their firm.

A considerable amount of mindlessness in innovating with IT thus accompanies the workings of the wave machine, as described here. A last lesson for us follows directly from this fact. The mindful executive can achieve advantage for his firm, not only by attending to the unique circumstances of his or her firm, but by seeing the mindlessness of others for what it is. When one's peers adopt a new IT, do their reasons for doing so make sense? Do they reflect well-considered circumstances of their own, beyond the boiler-plate benefits promised by vendors and consultants seeking a piece of the action? Asking such questions is a worthwhile exercise. Where innovating with IT is concerned, we are reminded that fashion bubbles form with some regularity, and distinguishing mere hype from reality remains an especially challenging task for executives.

ⁱ See Ramiller, N. C. and Swanson, E. B., "Organizing Visions for Information Technology and the I.S. Executive Response," *Journal of Management Information Systems*, 20, 1, 2003,13-50, as well as Ramiller, N. C., "The 'Textual Attitude' and New Technology," *Information and Organization*, 11, 2001, 129-156, and "Airline Magazine Syndrome: Reading a Myth of Mismanagement," *Information Technology & People*, 14, 3, 2001, 287-303.

ⁱⁱ See Fenn, J., and Raskino, M., *Mastering the Hype Cycle: How to Choose the Right Innovation at the Right Time*, HBS Press, 2008.

ⁱⁱⁱ The research on which this article is principally based has been done in collaborations with Neil Ramiller, Ping Wang, Yutaka Yamauchi, David Firth, and Arnaud Gorgeon, supported in substantial part by the UCLA Anderson School's Information Systems Research Program.

^{iv} See McKenney, J. L., Copeland, D. G., and Omason, R., *Waves of Change: Business Evolution Through Information Technology*, HBS Press, 1995. IT innovation waves were also identified by John King in his keynote address to the International Conference on Information Systems (ICIS) in Brisbane, 2000, as a phenomenon central to the field. The role of technological innovation in generating long waves of economic activity is assessed in Mansfield, E., "Long Waves and

Technological Innovation,” *American Economic Review* 73 (2), 1983, 141-145. The notion of long waves in the IT innovation context is introduced in Lyytinen, K., and Rose, G. M., “Disruptive Information System Innovation,” *Information Systems Journal*, 13, 4, 2003, 301-330.

^v A recent illustration is the “viral model” employed in Web-based advertising. A more pernicious example would be a terrorist attempt to spread a deadly infectious virus. In general, the attempted orchestration of a “natural” contagion can of course be for good or for ill.

^{vi} See Goffman, W., and Newill, V. A., “Generalization of Epidemic Theory,” *Nature*, 204, October 17, 1964, 225-228, quoted from p. 225. The logistic curve provides perhaps the simplest form of the S-shaped curve, with wide application to dynamic processes beyond the present discussion. In the business context, it is used in marketing to describe a product lifecycle and in operations management to characterize the manufacturing learning curve, for instance.

Contemporary epidemiological models in the life sciences are rather more sophisticated, taking into account a number of important factors. For a synthesis of models, see Dodds, P. S., and Watts, D. J., “A Generalized Model of Social and Biological Contagion.” *Journal of Theoretical Biology* 232, 2004, 587-604.

^{vii} See especially Rogers, E. M., *Diffusion of Innovations*, 4th Edition, Free Press, 1995, for an authoritative synthesis of research on innovation diffusion. The role of change agents in the management innovation process is newly illuminated in Birkinshaw, J., Hamel, G., and Mol, M. J., “Management Innovation,” *Academy Management Review*, 33, 4, 2008, 825-845. In the IT context, the technology champion provides a special case of the change agent. See, e. g., Beath, C. M., “Supporting the Information Technology Champion,” *MIS Quarterly*, 15, 3, 1991, 355-372.

^{viii} For this reason, firms purchasing new enterprise software often present competing vendors with their own case particulars and require that each undertake a demonstration project that shows how the software would work in this context.

^{ix} This illustration is adapted from Wang, P., and Swanson, E. B., “Launching Professional Services Automation: Institutional Entrepreneurship for Information Technology Innovations,” *Information and Organization*, 17, 2007, 59-88.

^x Firth, D.R. and Swanson, E.B., “How Useful are IT Research and Analysis Services?,” *Business Horizons*, 48, 2005, 151-159.

^{xi} Swanson, E. B., and Ramiller, N. C., “The Organizing Vision in Information Systems Innovation”, *Organization Science*, 8, 1997, 458-474. See too Swanson, E.B. “Talking the IS Innovation Walk,” in Wynn, E.H., Whitley, E.A., Myers, M.D. and DeGross, J.I. (Eds.), *Global*

and *Organizational Discourse about Information Technology*, Kluwer Academic Publishers, 2003, 15-31. For recent studies, in addition to those discussed here, see Currie, W. L., "The Organizing Vision of Application Service Provision: A Process-oriented Analysis," *Information and Organization*, 14, 2004, 237-267, and Reardon, J. L., and Davidson, E., "How Do Doctors Perceive the Organizing Vision for Electronic Medical Records? Preliminary Findings from a Study of EMR Adoption in Independent Physician Practices," *Proceedings of the 40th HICSS*, 2007.

^{xii} Personal interview, April 12, 2000. See also Keller, E., "Lessons Learned," *Manufacturing Systems*, November 1999, 44 ff. Gartner's first ERP publication was Wylie, L., "ERP: A Vision of the Next-Generation MRP II," Scenario S-300-339, Gartner Group, April 12, 1990. The excitement associated with SAP's R/3 system in the mid-1990s is conveyed in "Here Comes SAP," *Fortune*, October 2, 1995, 122-124. For a substantial compendium of research on ERP and its implementation, see Shanks, G., Seddon, P. B., and Willcocks, L. P. (Eds.), *Second-wave Enterprise Resource Planning Systems*, Cambridge University Press, 2003. Our own research examined the "know-how" and "know-why" associated with ERP adoption in Swanson, E. B., and Wang, P., "Knowing Why and How to Innovated with Packaged Business Software," *Journal of Information Technology*, 20, 1, 2005, 20-31. More recently, this is extended to community learning about ERP more broadly in Wang, P., and Ramiller, N. C., "Community Learning in Information Technology Innovation," *MIS Quarterly*, 33, 4, 2009, 709-734.

^{xiii} Simon's interpretation of attention as a scarce resource is nicely stated in the article, "Designing Organizations for an Information-Rich World", in Greenberger, M., (Ed.), *Computers, Communication, and the Public Interest*, The Johns Hopkins Press, 1971.

^{xiv} See Turek, N., "Automation Tools Map Careers for IT Professionals," *Information Week* 764, 1999, 170-176.

^{xv} Our interpretation of bandwagon effects comes from Rohlfs, J. H., *Bandwagon Effects in High-Technology Industries*. Cambridge, MA: MIT Press, 2001. See too Shapiro, C., and Varian, H. R., *Information Rules*. Boston, MA: HBS Press, 1999.

^{xvi} That adoptions may signal likely benefits to others is fundamental to the formation of an informational cascade as described in Bikhchandani, S., Hirshleifer, D., and Welch, I., "A Theory of Fads, Fashion, Custom, and Cultural Change as Informational Cascades," *Journal of Political Economy*, 100, 5, 1992, 992-1026. Facilitating the formation of a supportive informational cascade, and thereby leveraging current adoptions to extend them, provides one interpretation of what bandwagon-building is all about.

^{xvii}See Abrahamson, E., "Management Fashion," *Academy of Management Review*, 21, 1996, 254-285, and Abrahamson, E., and Fairchild, E., "Management Fashion: Lifecycles, Triggers, and Collective Learning Processes," *Administrative Science Quarterly*, 44, 1999, 708-740. Fashion researchers often track the wave of discourse associated with a fashion, as reflected in the published literature. See, e.g., David, R. J., and Strang, D., "When Fashion is Fleeting: Transitory Collective Beliefs and the Dynamics of TQM Consulting," *Academy of Management Journal*, 49, 2, 2006, 215-233. Because the attention given to an IT innovation is rooted in beliefs and discourse around the organizing vision, it is particularly subject to the fashion phenomenon, even as it contributes for a time to the innovation's adoptive momentum.

^{xviii} Davenport, T. H., "Putting the Enterprise into the Enterprise System," *Harvard Business Review*, July-August, 1998. The important notion that the deployment of an IT innovation can lag its adoption is articulated in Fichman, R. G., and Kemerer, C. F., "The Illusory Diffusion of Innovation: An Examination of Assimilation Gaps," *Information Systems Research*, 10, 3, 1999, 255-275.

^{xix} The observation that with the implementation of ERP, organizational performance will often get worse before it can eventually get better is articulated in Ross, J. W., "The ERP Revolution: Surviving Versus Thriving," MIT Sloan School of Management Working Paper, 1998. See too Markus, M. L., and Tanis, C., "The Enterprise System Experience- From Adoption to Success," in Zmud, R., (Ed.), *Framing the Domains of Information Technology Research*, Pinnaflex, 2000, for a similar view. The broader issue in assimilating an IT innovation is one of organizational learning, mostly by doing. See, e.g., Swanson, E.B., "How is an IT Innovation Assimilated?," in Fitzgerald, B., and Wynn, E. (Eds.), *IT Innovation for Adaptability and Competitiveness*, Kluwer Academic Publishers, 2004, 267-287. A related study of one firm's attempt to assimilate a new CRM system is described in Yamauchi, Y., and Swanson, E. B., "Assimilating New IT in the Workplace: A Study of Situated Learning, Academy of Management Meeting, Philadelphia, 2007.

^{xx} Wang, P., and Swanson, E. B., "Customer Relationship Management as Advertised: Institutional Entrepreneurship for Sustaining Technological Momentum," *Information Technology & People*, 21, 4, 2008, 323-349.

^{xxi} The innovation wave complex essentially builds on the distinction drawn by Fichman and Kemerer, cited above, between adoptions and deployments, interpreted here as implementations. To these two waves, we add cumulative attention to the organizing vision, as a driver to the process, as well as the value added by the innovation once it has been put to use. Because the

four waves develop on different dimensions, their magnitudes as shown in the figure are merely suggestive of the dynamics, and are not directly comparable.

^{xxii} While I have portrayed the IT innovation wave machine as a singular institutional machine with a certain capacity to process the various innovations of the moment, it might also be argued that this is an overly simple interpretation, and that one in which multiple machines are deployed specialized to different types of IT innovations might present the better picture of what goes on.

I'm grateful to Ping Wang for making this point.

^{xxiii} Swanson, E. B., and Ramiller, N. C., "Innovating Mindfully with Information Technology," *MIS Quarterly*, 28, 4, December 2004, 553-583. For an addendum, see too, Ramiller, N. C., and Swanson, E. B., "Mindfulness Routines for Innovating with Information Technology," *Journal of Decision Systems*, 18, 1, 2009, 13-26.