Riding the Waves of Emerging Technologies:
Opportunities and Challenges for the CIO

John C. Henderson
Nalin Kulatilaka
N. Venkatraman
Jim Freedman

Boston University School of Management
595 Commonwealth Avenue
Boston, Massachusetts 02215

BOSTON
UNIVERSITY
SCHOOL *of*
Management

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Executive Summary

Recent surveys confirm that many CIOs are having difficulty balancing the pressures of tightly controlling IT spending while continuing to provide leadership in leveraging information technology to gain strategic advantage (May 2002). Given the uncertainty of the economy and perception of past overspending on information technology, there is a strong inclination to "wait and see". Yet there are equally strong arguments that this is the time that the future industry leaders will begin to invest gaining substantial competitive advantage (Saffo 2002). Some researchers suggest that the challenges that we face today were reasonably predictable. (Arthur 2002) reflects on the cycles of boom and bust that the emergence of major innovations over the past century has created. The conclusion is that we may in fact be at the onset of the growth phase of a new age that was heralded in the 90's.

However it is clear that taking past approaches will result in more of the same. We suggest using the concept of *strategic learning* through experiments orchestrated to dynamically align business opportunities with technology functionality. Success in the future will be dependant upon how to approach investments in what has been described as disruptive technology. The key to success is not in treating technology in isolation but in leveraging technology to radically change the way a firm competes. We begin by discussing the differences in types of innovation and how the differences lead to important implications for management to understand. We then explore the concept of platforms as a framework for making sense of disruptive technologies. We pay special attention to the recognition that information technology does not create advantage by itself but rather provides a mechanism for changing firm processes that may lead to sustainable competitive advantage. We discuss an approach that assists the CIO to take control over the investments in technology beginning with the identification of what may constitute the best opportunity for their firm. We review the results of research done in three different disruptive technologies that leverage the network foundation provided by the Internet. This research provides relevant real world examples of how the ideas we put forth make sense in today's environment. We then conclude by providing some pragmatic approaches that CIOs may take to provide leadership today.

1.   Introduction

Innovation is at the heart of most organizations including IT organizations. From programmers to the CIO, the profession of IT prides itself on innovation. We design new programs, build new systems, install new hardware and in our most ambitious role, create new futures. And yet, the IT field is plagued with doubts about value creation. What is the return on investment in information technology? Do IT solutions and the process changes they enable truly create competitive advantage? If so, when and with what certainty can such investments be made?

Warren McFarland [McFarlan, 2002 #349] provided a useful perspective on the strategic use of IT: "the firm must do things differently with IT not just the same things better". In the language of innovation, strategic investments in IT are often described as either disruptive innovation or sustaining innovation. Christensen (1997) defines a sustaining innovation as one that improves an existing product or enhances an existing service for an existing customer. Such innovations may be small or big, complex or simple but in the end, they build on existing skills and knowledge and serve the interest of existing key stakeholders.

In contrast, a disruptive innovation targets non-customers and delivers a product or service that fundamentally differs from the current product portfolio.
"In almost any industry you care to examine, the most dramatic stories of growth and success were launched from a platform of disruptive innovation" (Christensen, Johnson and Rigby 2002).

The difficulty in managing product innovation is that much of the investment in research and development are driven by the values of the scientific community. For such a community the goal of research is to stretch the limits of knowledge. That is, to build or invent products or services that are ever more sophisticated, ever more powerful.   Such research has its place. If not for these types of inventions we surely would not have the TV, radio, or the computer. However, the value life cycle of such inventions is often measured in decades and their market success often depends upon many complimentary products and services emerging within critical time periods. For example, the car was invented in the late 1800's but did not become a dominant product until the mid 1920s. Success for this product required not only design and manufacturing capabilities but a supplier network, a distribution

system and a customer context i.e., highway system, that enabled value to be created and captured. The history of business is replete with such examples.

Disruptive innovations have life cycles that are measured in years but this cycle does not have to become decades. Further, disruptive innovations create new markets and, in doing so, can generate profitability early in the cycle.

How does an understanding of disruptive innovation apply to our concerns in information technology? Given the vast amount of investment in this technology and the obvious spread of the use of information technology by companies and consumers alike, will emerging IT give rise to disruptive business products and services? And if the potential for disruptive innovations exists, how could executives structure their investments to increase the likelihood that they will be able to successfully launch such a disruptive innovation? We will explore these two questions in this paper.

We take as our focus the customers of the information technology industry. That is, we do not examine the likelihood of a disruption in the information technology itself. In fact, we base our discussion upon a view that the convergence of content and the emergence of ubiquitous connectivity through the wireless Internet is such a disruption. Our focus will be the consequences of this disruption for businesses and their customers. We will describe the nature of disruptive innovations enabled by emerging information technology, explore how new value is created and captured during this disruption and end with a process model that the firm could use to enhance their ability to successfully launch a disruption I/T enabled product or service.

2. The Challenge of Disruptive Innovations

The classic view of a disruptive innovation is illustrated in Figure 1. The first S-curve represents the life cycle of a product or service class. It is important to recognize that this life cycle involves substantial innovation. Throughout the cycle, firms compete by enhancing functionality or scope/price of their products. New versions replace old ones and often provide new features, styles or price/point that are clearly better than those of current models. These innovations are sustaining in nature. That is, they move along the existing product class s-curve to improve performance. However they don't change the context of the curve itself.

The core challenge of a disruptive innovation is shown by the second curve in figure

Disruption As Seen Through S-curves

Performance

Maturity

A

C

Takeoff

B

Ferment

Time

1.

Figure 1
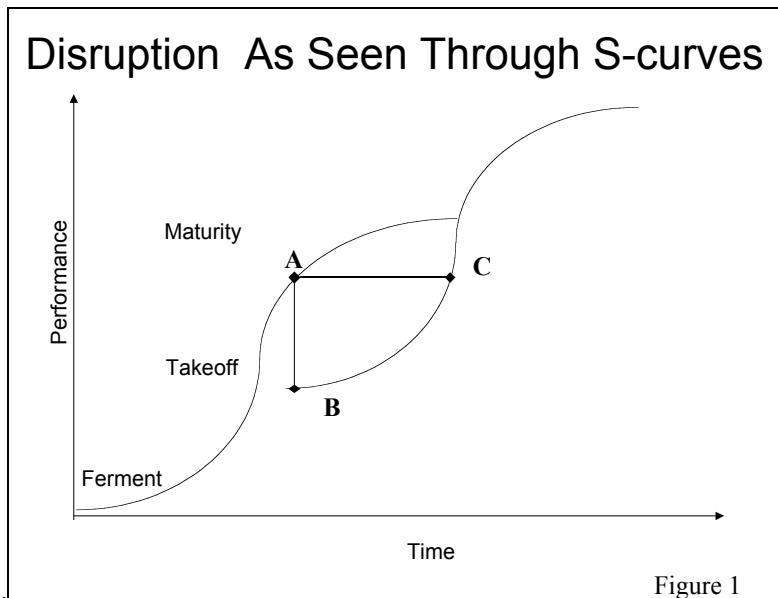
A disruption is the launch of a new s-curve destined to out perform the existing product or service class. Note, however that in the early stage of this new product class, performance is often below that of the dominant product shown by the first curve. This is the essence of the innovators dilemma as discussed by (Christensen 1997).

The dilemma is characterized by the difference in point A (current product class) and point (B disruptive product class). For a given level of effort X, performance at point A exceeds that of point B. Most existing customers are willing to pay a premium for this difference in performance. Therefore, the dominant firm is motivated to serve their best customers. By doing so, the dominant firm achieves good margins and is motivated to invest in innovations that enhance this dominant product class. In order to compete, the firm offering a new product class must discount their product or service to attract initial users. This discount attracts non-customers, often "bottom feeders(Christensen, et al. 2002). These customers seek to avoid the premium price of the dominant product even at the cost of service quality. The disruption occurs when the existing product class begins to reach maturity for the dominant product class (represented as a flattening of the s-curve). This maturity begins as the dominant product reaches a physical limit or simply outpaces the ability of the customer to effectively use the enhanced product. However, the new product class can still realize significant improvements per unit effort. This steep learning curve will

eventually result in the new product class exceeding the performance per price of the original s-curve (See Figure 1).

Christensen describes the difficulty for a dominant firm facing this dilemma: "All ideas for new products and businesses emerge from innovators' minds only partially formed. Middle managers then oversee the shaping of these ideas into full-fledged business plans in an effort to obtain funding from senior management. They typically hesitate to throw their weight behind new product concepts *whose market is not assured*, fearing their reputation for good judgment may be compromised" (Christensen, et al. 2002): italics added p.24.

The key concept in this quote is "*whose market is not assured*". It is quite easy to examine retrospectively the evolution of a product class and determine when the dominant firm should have invested in a new product class. However, in real time, the executive is faced with the basic question "Is this new curve real?" "Will this new product class emerge as a dominant design? Will I be more competitive by focusing on sustaining my current advantage?" In fact, at any point in time there are likely to be several possible emerging new product S-curves. Which product innovation should the firm choose?

It is important to understand the nature of this uncertainty. To be successful with an innovation the firm must meet two basic requirements: They must create value as perceived by their customers and they must enact mechanisms to appropriate or capture a fair share of this new value. Achieving the first does not guarantee achieving the second. In fact, capturing a fair share of value is one of the particular difficulties of disruptive innovations enabled by IT. IT is replete with investments that create efficiencies and new functionality. The innovation creates value in the eyes of the customer. However, it is often difficult to ensure that the firm that creates this value does, in fact, appropriate a fair share of this prize. In the extremely competitive technology marketplace, competitors quickly match most new innovations. As a consequence, the value created quickly flows to the consumer or to a third party, leaving the firms with this new capability at competitive parity. Parity in the face of a competitive market offers little ability to achieve a significant return on this investment. In fact, many IT strategists advocate a "fast follow" option for this reason. They argue that an effective IT innovation strategy is to allow competitors to invent and test new technologies. The "following" firm then imitates this invention thereby achieving a new performance level with substantially lower investments. In essence, this strategy argues that there is little or no first mover advantage emanating directly from technology investments. To the extent that

this argument is true, it further motivates the dominant firm to sustain their investment in the current product class rather than switch to the emerging IT enabled product class. A consequence of this behavior is the new product class is often under funded and is doomed to failure.

Disruptive Innovation cannot be easily see ex-ante; one way that IT managers can recognize the value is to think about the range of options created by emerging technologies through the idea of "platforms". Although "platforms" have been used with different meanings, we use it here to describe, "enabling conditions offered by IT" to create new ways of doing things. As we had discussed earlier, the charter is to leverage IT to do chart new territory, not just incrementally improve what already exists.

3. The Concept of a Platform

In order to estimate the potential economic value of a technology enabled disruption, we need to introduce the concept of a platform. The concept of a "platform" connotes different meanings based upon the perspective of the researcher. The term platform is commonly used by information technologists to convey a set of standard technical components that create value by enabling future options in two basic ways. First, a platform is a shared resource across multiple parties. Secondly, a platform provides a flexible starting point for a wide range of innovations. Value is created because the innovations do not have to replicate the functional capabilities provided by the platform. Thus, part of the value of a platform arises from the ability to use it as a foundation for follow on investments. Ozzie (2002) for example, observes:

"A platform is defined to be a relevant and ubiquitous common service abstraction. A platform's raison d'être is to create value by generating significant leverage for a variety of constituencies. Software platforms, for example, create leverage for many parties such as hardware developers, software developers, content developers, purchasers, administrators, and users." Ozzie argues the value of a platform is found in the ability to provide flexibility in managing uncertainty and ultimately in accelerating the process of innovation.

4. Platform Value from Managing Uncertainty

Economists have also considered the value of a platform. In general, technology is viewed by an economist as an input to the production function of a firm. Technology investment is, in simple terms, a substitution of capital for labor. But if a platform offers the potential to give access to new innovations, the investment can be viewed as a "real

option"(Kogut and Kulatilaka 1994). A real option is the application of financial option theory to real (non financial) assets of the firm (Amram and Kulatilaka 1999). Important insight to the concept of an option is that it *gains increased value as uncertainty increases.* This added value arises because an option gives the right to execute the option at a time in the future but not the obligation. Therefore, when the future arrives, if the value of executing the option exceeds the cost of execution, (i.e., the option is "in the money"), the owner would take action. If not, the owner absorbs the loss (hopefully a small fraction of the initial "bet the farm" investment) that was required to purchase the option. Thus, a real option is a hedge against uncertainty. If the idea works, the owner executes the option and captures the benefits. Otherwise, the owner incurs a small, acceptable loss. In this way a platform can be viewed as a purchase of the right to commit to follow on investment. Note that the cost to initially put the platform in place may exceed a simpler, less flexible solution. But, once in place, the platform provides a hedge against the highly uncertain marketplace because it supports a wide variety of innovation initiatives thereby enhancing the likelihood that substantial value will emerge.

5. Platform Value from Exploiting Network Effects

A second source of value for a platform *arises from network effects.* A network effect is value that occurs because someone else adopts the same technology platform. For example, consider the value of owning a phone, particularly a phone that is a standard on a platform that allows wide spread usage. Obviously if there is only one person in town that owns a phone it is of little value. The more people that connect by owning a phone, assuming it is compatible with mine, the more there is potential value created. This network effect, often referred to as connectivity or direct effect (Shapiro and Varian 1999), increases roughly as a function of N^2, where N is the number of people in the total system. It is a non-linear increase in value function. Needless to say, the owner of a platform that creates network effects is a big winner. Examples of platform owners include AOL and Microsoft.

Network effects also arise from complementary products or an indirect effect. In this case the potential buyer will perceive more value if the number of potential complementors is higher. Thus, one source of value to the owner of a windows operating system is the large number of third party software companies working hard to invent new and useful products that use windows. The buyer will value Windows over a competitor that does not have this ongoing source of innovation. These network effects can create such non-linear value

growth over time that a market may "tip"(Shapiro and Varian 1999). Tipping is when the market reaches a point where the probability that the next buyer will choose the dominant platform approaches 1.0. In a tipped market, the dominant firm has tremendous power and can really extract premiums for their production services. While uncertain, the prize is enormous.

6. A Tri-Partite Platform Classification

Formalizing, the concept of a platform by combining Ozzie's view and this economic perspective leads us to the following working definition of a platform:

A platform is a set of functionality available to multiple parties that gives rise to both real options value and network effects.

In the next section, we will use this definition to suggest three specific interpretations of a set of platforms that are consistent with technology-enabled disruption.

1. Intra-firm Scope: Technology Platform

One way to establish boundaries for the scope of impact enabled by a technology-based innovation is to focus on those platforms that enable the changes within the firm. We use the term **Technology Platform** to refer to a technology investment that creates a "within firm" platform. Creating this platform requires technology, process and governance components. However, we restrict these changes to have impact only within the firm. That is, it is not directly apparent to the buyer or the market. With this limited view, investments for a Technology Platform, will, by definition, not be disruptive. But investing in a Technology Platform may still create sustainable value. For example, standardizing a component of the infrastructure may enable individual business units to share services. Similarly implementing a data architecture may enhance the firm's ability to monitor and manage distributed processes for a national sales force. Therefore, a Technology Platform can meet the definitional requirements for a platform. A Technology Platform may serve multiple parties, i.e., multiple business units, create flexibility and therefore have option value and have a network effect for all those users within the firm. For example, standardizing on a common e-mail system creates network effects and allows the organization to quickly respond to market innovations, e.g., easily introducing instant messaging. Development of a Technology Platform provides great opportunity for the organizational learning that will be required to move to the next step. However, it is easy to see that by bounding the concept of a Technology Platform to be within the firm, the scope of potential value is quite limited. In

fact, this internal efficiency view of a platform is a basic reason why investment in technology infrastructure, when justified strictly as a Technology Platform often fails to meet necessary return on investment hurdles.

2.   Inter-firm Scope: Capability Platform

The second level of platform is termed a **Capability Platform.** We use the term capability to emphasize that this investment has a direct impact on customer value. Therefore, the boundary of a **Capability Platform** extends to external stakeholders such as customers or suppliers. A capability platform has the potential to redefine processes and relationships across a value chain. An investment in a "SAP Platform" is, at least implicitly, an attempt to redesign the supply chain process in ways that significantly change both internal processes and external processes. It is a means to change relationships with suppliers and related third party organizations. Changes that cross elements of the value chain alter performance measures that are directly perceived by the customer e.g. delivery time. Given this cross value chain perspective, the scope of potential value is much broader. Such a platform clearly provides functionality to multiple users. An effective capability platform creates options value by virtue of providing flexibility on both the customer and supplier sides of the value chain. UPS for example, introduced a Capability Platform to track and monitor the flow of packages across their logistics system. As a result, UPS could continually innovate around value added services offered to their customers and suppliers, e.g., give the customer the ability to locate and track a package. Furthermore, by providing a global platform, potential users enjoyed a connected network effect. For example, UPS customers could use the UPS system to track and monitor material flow between themselves and their customers. Thus the package location monitoring capability platform is an example of a classic network effect that creates substantial value in the eyes of UPS customers. The fact that package location monitoring can be seen to directly effect external parties in the value chain is what makes this an example of a Capability Platform.

3.   Ubiquitous Scope: Business Platform

Finally, the third level of platform is a **Business Platform.** A **Business Platform** is an innovation in process, technology and governance that impacts across multiple value chains. A classic example of a Business Platform is the introduction of the Uniform Product code (UPC) and the technology of the bar code (Abernathy, 1999).   To implement bar coding, a distinct process for encoding all new product introductions had to be agreed upon

by suppliers, shippers, retailers and a wide range of third party organizations that made devices for bar-code management e.g., scanners. Today, we understand how profoundly bar-code platform affects many industries. Based on this platform, many innovations occurred ranging from supply chain management to sophisticated category management processes. The bar code literally enabled a revolution in retailing that some argue resulted in a permanent shift in power from the manufacturer to the retailer (Brown 1997).   Many of these innovations were not conceived of when the bar-code platform first was conceptualized. But as with any true Business Platform, the scope of impact, while initially uncertain was ultimately huge. The combination of options value, i.e., direct follow on investments, and network effects were significantly more valuable than the direct strategic effect of improving the efficiency of the check out processes and gaining efficiency in inventory management (Holmes 2001).   So, while the early promoters of bar-code technology saw a benefit in inventory management, no one truly foresaw the role that the UPC/bar-code platform would play on the power relationship between manufacturers and retailers. Likewise, the evolution of inventory management to the current processes wherein manufacturers actually stock and manage categories at the aisle level was also never truly imagined. This is the unique feature of a platform. The potential value is likely to be beyond our current perception.   The challenge is to understand if an emerging technology is a platform or just a pipe dream.

7. **Benefits of this Tri-Partite Classification**

These three levels of platforms, **Technology, Capability** and **Business** build upon each other. In many ways, they reflect a learning curve wherein a firm first understands how to use a new technology or a set of disruptive technologies to improve internally focused processes and then systematically extends this insight in ways that affect first those in their own value chain and then, ultimately, adjacent industries. Why then would firms hesitate to invest? Wouldn't the firm recognize the need for this learning curve and, thus, be aggressive in their efforts to be the first to learn and, therefore, the first to exploit a new platform? The answer lies in the reality that there are many possible disruptive curves at a given time. Which to choose is far from obvious. Furthermore, while a possible disruption may be evident, it is often unclear who will benefit from this disruption. Where will the cash register sit? Who will appropriate the value that is created? After all, the UPC/bar-code business platform enabled retailers to directly capture consumer behavior but only over time did they learn to

use this insight to exact price concessions from manufacturers. For example, today Wall Mart will not share point of sale data with traditional market information firms. Instead the manufacturer must buy it directly (another form of price concession). Wall Mart's investment in their Capability Platform has created the ability to use the UPC/bar-code data to see across all manufacturers with little extra investment.

Not surprisingly capturing the value of the network effect created by bar-code data turns out to be very sensitive to who controls the point of sale (and, thus, captures the data). Since the manufacturers participate in the bar-code process through an open standards body, i.e., UPC, they have little or no leverage point. As a result, much of the value of the UPC Business Platform has flowed to those retailers that invested early in a Capability Platform based design to exploit this open Business Platform. Those retailers that did not invest in this Capability Platform are playing a frantic catch-up game, which is not only expensive but may be futile. And as we speak, a new version of the UPC/bar-code is emerging, e.g., RFID. Not surprisingly, Wall Mart is at the forefront in the early experimentation on how RFID will enable the creation of a distinctly new Capability Platform.

8. Enabling a Business Platform

We utilize Kogut and Kulatilaka (1994)'s perspective on the issue of achieving value from IT investments argues that value arises from the creation and execution of distinctive business capabilities. They identify a distinctive business capability as the combination of technology, process and organization structure that creates an outcome or service that is valued directly by the customer. The technology alone seldom creates lasting value. In fact, the technology elements themselves are easily obtained via the market and, thus, the argument is that the ability to capture a premium arises from how this technology is used to execute new and distinctive business processes. Because these new processes are often not observable by competitors, they can offer a defendable advantage (Barney 1991). Creating a distinctive process requires significant change across an organization and tasks that are quite difficult to accomplish. In effect, it requires an alignment between the business and technology strategies at a firm wide level. It is this ability to embed the IT into the processes and products of the firm that gives rise to competitive advantage.

But many innovations or process changes enabled by technology do not constitute a disruption. They may be difficult to implement but in the end, they represent a sustaining innovation. That is, these innovations still focus on enhancements to an existing product

class or service an existing customer. Given the scope of possible IT investments, determining which innovation might enable a disruption becomes all the more difficult.

Christensen (1997) suggests two types of disruptive innovation and proposes some tests that can help determine the extent to which a given investment will likely lead to a disruption. The first type centers on the customer experience. Will the innovation change the customer experience in a meaningful way and to what extent will this change be attractive to current non-customers? He suggests three types of changes: (1) disintermediation, (2) simplification and (3) usage. Disintermediation eliminates the middleman in a value chain that connects the customer and the firm. It allows the customer control over decisions or resources that had previously been in the decision realm of another firm. Disintermediation can create value in several ways. The ability to order directly over the Internet rather than interact with a sales person can lower costs, increase the speed of the order cycle and reduce the likelihood that the goals of the sales person (to maximize their personal income) will distort the exchange process. Not surprisingly, the ability to disintermediate brokers or distributors offers an opportunity for disruption in many industries. Such a shift can also be perceived as a burden to the buyer. As an example, for the Internet based ordering process to be more effective than the previous ordering process requires that the buyer have the expertise and access to relevant knowledge in a reasonable manner and timeframe. Without an understanding of how the technology will be utilized, such a burden might increase complexity or increase the cost of usage thereby offsetting any gains from disintermediation. Dell understood the customer's perspective when initiating such a disintermediation strategy with their process to configure and order PC's directly over the Internet (initially by phone). Dell simplified the ordering process by embedding information that guides the user to select workable configurations for a PC. The ability to check for proper configuration in order to avoid incomplete orders removed a major source of customer dissatisfaction. In essence, it not only simplified the process, but also enhanced the usage factor for the customer. Over time the Dell system has become widely accepted. However, their advantage lies not just in their Internet based ordering system. It would be relatively simple for a competitor to replicate that technology. Rather the true distinction of the Dell business model extends deep into their unique processes for managing vendor relationships and consequently the dynamics of the overall supply chain. The key point is that a disruptive technology must be embedded in the processes and structure of the firm to create a significant advantage. If the

technology is not truly embedded, it will be quickly imitated by competitors (unless protected by patents) and the value creation will flow to the consumer.

9. Relating Research Initiatives to the Concept of Platforms

Research initiatives sponsored by the SIM APC examined three new emerging technologies; 3G Mobile Technologies, Application Service Provision (ASP) or Web Services Technologies and Peer to Peer (P to P) Technologies. Each of these technologies is clearly a candidate to be a new technology platform. That is, they will offer an attractive substitute for existing technologies and, therefore, create an internal efficiency impact. Our research initiative was to explore the potential that these new technology platforms may have a broader scope, i.e., that of a Capability or Business Platform. In the next section, we briefly review the results of each of the workshops conducted to explore these three emerging technologies. For a detailed review of these workshops, the reader is referred to the individual papers describing workshop results. In the final section we considered the implication of these workshop results on the CIO Role.

1. Emerging Technology: 3G Mobile Technology

The first research session focused on emerging 3 G mobile technology. The 3G Mobile Technologies platform creates a continuous connectivity. In essence, the 3G technology removes the constraint of the "last mile". The customer or user is truly untethered from the desk or telephone. Furthermore, the shift to packet switched technology, ubiquitous connectivity plus enhanced bandwidth combines to provide an "always on" capability with high data transfer rates. The result is a product or service that provides pervasive connectivity. There is little doubt that customers will pay for immediacy. Smith, Kulatilaka &Venkatraman (2002) summarize the 3G discussion in their paper *Developments in IS Practice III: Riding the Wave: Extracting Value from the Mobile Technology.* The session used the concept of real options to examine the potential value of this technology. The real options methodology is the application of financial options theory to non-financial assets. The key concept discussed in this session is how the real options logic could be used to explore sources of value that arise from flexibility. Since an option is the right but not the obligation to exercise a fixed price investment at some future date, one way to view investments in the early application of mobile technology is that these experiments are providing an ability to more easily and quickly make follow-on investments. Of course, these follow-on investments would be made only if the results of the early pilots demonstrated

potential valuable. The key insight is that traditional evaluation methodologies such as Net Present Value can understate the true value of an option. Traditional methods are strategy specific. That is, they assume a given strategy and make no allowances for mid course corrections. The options methodology approaches these investments as a multistage investment in which management can change course at any of the intervening decision points. The real options approach brings to bear modern finance theory to discipline this decision process (Amram and Kulatilaka 1999). As Kulatilaka and Venkatraman (2001)describe, this decision flexibility allows the firm to use some IT investments as a hedge against market uncertainty.

The session identified six types of options: growth, staging, exit, sourcing, scope, and learning. A growth option is the right to invest in a follow on project that leverages the assets created in the initial investments. Platform investments such as infrastructure often create growth options. The staging and exit options reflect the ability to model the decision process as a multistage decision process that could include choices to continue, delay or abandon. Sourcing and Scope options address variety in either inputs or outputs. Sourcing options allow the firm to explicitly model alternative sources of inputs (supplier relationships) while Scope options can reflect the ability to alter product mix. These two options have been particularly useful in modeling technologies that provide operational flexibility such as flexible manufacturing. Finally, learning options reflect the ability to use initial investments as experiments. The intellectual capital created in these experiments provides the asset that is leveraged in future investments. The session discussion highlighted the fact that these are *often assets that are never valued in the financial assessment for IT investments.*

IT executives have used option like practices for many years. Prototyping and the use of beta tests are examples of investments that are staged. However, the discussion pointed out that while these processes appear to be option like methodologies, there is often a lack of financial discipline in the process of managing investment in IT initiatives. It is difficult to kill these projects once started and scope creep can often undermine the effectiveness of the hedging concept. The real options approach provides a consistent means to structure these types of multi stage investment processes and use market based indicators to help discipline the investment decision process (Amram and Kulatilaka 1999).

The session developed a range of implications for the role of the CIO (Smith et al. 2002). These implications reflected the need for the CIO to take leadership in exploring the

full potential value of the emerging mobile platform. The focus of the investment should be targeted at high value business opportunities and designed to maximize the learning from both technical and business process perspectives. Perhaps most important implication is the need to stay performance focused and use market tests to determine success or failure rather than technical criteria.

2. Emerging Technology: Application Service Providers

The decision to make versus buy has been important to the IT executive for many years. The late 1980s saw a fundamental shift in the proportion of applications that that were bought (prepackaged) versus developed in-house. The notion of an Application Service Provider (ASP) or a Web Service is a logical extension of this trend. The essential idea of an ASP is the ability to rent the use of an application. However, the object of rental is not a general-purpose system but rather a specific business process or capability. Gillan, Graham et al. (1999) defines the ASP as a third party service firm that deploys, manages and remotely hosts a prepackaged software application in a rental or lease arrangement. The service enables the buyer to pay on a usage basis, saving not only the initial investment to build and maintain the system and its supporting infrastructure but also the costs of ongoing operations.

The second session explored the rise of the service and the likelihood that ASP would evolve into a widely accessible platform. The notion of a third party providing a service is not new. Service providers have long been a fixture in the IT industry. However, the availability of the core communication network i.e., the Internet, has radically changed both the accessibility and the economics of this business. More importantly, the general trend toward process objects and increased modularity in both system and business architectures create an opportunity for the notion of ASP to be extended across many parts of the business. In fact, the terminology used in the session was XSP to emphasis the true scope of impact for this platform.

(McKeen, et al. 2002) review the focus of the discussion by APC members in a detail SIM report. The essential decisions for an XSP initiative are *what* and *how*. The "what" question focuses on the decision to decompose an integrated business capability and source out component pieces. An XSP is an intermediate solution between complete outsourcing versus complete insourcing of a business capability. This intermediate point allows the firm to select components for the process for which they maintain all decision rights. These

choices not only increase control, but also may be a source of competitive advantage. For example, a bank may source out the process of direct mail advertising but retain the part of their process where they perform customer profiling to determine whom to contact. This choice could be made to ensure their customer list is tightly controlled or even to protect a unique methodology for determining high probably sales opportunities.

The "how" decision is seen as a continuum of contracting relationships that range from those for which the contract can be fully specified to those that have incomplete terms. Services that can be fully specified are or will quickly become commodity services. Contracts should be short and processes should be designed to maximize the competitive interaction among several possible suppliers. Examples include communication network services, hardware maintenance or simple transaction processing. An interesting area of growth in this arena is customer service centers.

An incomplete contract arises when the complexity of the service results in a working relationship that cannot be fully defined. Sourcing a data center operation or providing supply chain processing might be good examples. The key insight for these services is that customization is often required to initiate the service and the ability to quickly adapt to change is uncertain. These services carry a high coordination cost so the business case normally extends from merely efficiency or cost savings to a market place advantage, e.g., global reach.

The session surfaced a range of benefits as well as risks. As might be expected both the risk and the benefits grow as the complexity of the service increases (McKeen, et al. 2002). Several implications emerge for the CIO. The most challenging task facing the CIO is the need to understand when the market for XSP truly becomes robust. There is no doubt that many firms are attempting to offer XSP services. However, the initial wave of XSP offerings, e.g., supply chain services and even web hosting services resulted in many suppliers going out of business. Such an outcome could obviously leave a customer in a very difficult position. One reaction is to wait and see. However, the ability to leverage this emerging platform requires both new skills in the buyer organization and, most likely, the need to re-architect major business and process capabilities. A wait and see choice means the firm is not exercising any learning options. The risk in this case is that competitors will move up a learning curve and over time develop an ability to transform their business in ways that can not be matched. This is truly a leadership issue for the CIO. The challenge is to create an

internal ability to quickly adapt and reconfigure processes moving capability out to or in from the market.

3. Emerging Technology: Peer-to-Peer Systems

The final session explored the potential for the emerging technology of Peer-to-Peer (P2P) systems. The P2P concept is the ability to directly share computing resources and services by direct exchange between networked but independent systems (Ziegler 2001). It is a label that has been used to represent a variety of work sharing collaboration activities, from sharing computer capacity, to sharing storage and bandwidth. One perspective is that P2P is a post web platform that challenges our previous assumptions about the allocation of decision rights surrounding the management of computing resources. For example, the web is a highly distributed access and communication model that relies on a very familiar pattern of decision rights allocation. That is, the owner of a site controls the resources of that site. The visitor to a site controls his/her resources. In the end, the site owner has many controls over intellectual property as well as physical property. The user or customer of the site has little or no direct rights. P2P uses the technology embedded in the web to allow each user to assume control over another resource. So for example, if an individual is part of a P2P community and has an idle machine, another member of that community may appropriate his/her resources and use that capacity for their own purpose. The key concept is that this action does not involve a delegation, but rather a direct ability to assume control over another set of resources.

The power of this concept is that wasted resources across a large number of users can now be leveraged. While each individual user might have limited total capacity, the sum of all available capacity for the community can be significant. The net result is that P2P communities can appear to have vast resources and operate very efficiently. The history of MP3 as a technology for sharing music is a good example. Thousands of individuals made available their assets, i.e., music and computing resources, to a broad community. The result was highly efficient and wide spread sharing. Copies of music became instantly available to anyone if a single person in the community had a copy. Not surprisingly, many music lovers rapidly took advantage to free access to such a broad selection of music. However, the owners of the music never actually gave away the decision rights to that asset. That is, the music companies sold a single copy of the song. They did not give the right to share it with thousands of people. While the courts ruled MP3.com was an illegal operation and effectively

shut it down, P2P sharing of music continues to resurface. The P2P technology allows the users to easily collaborate without need to receive permission from a governing body. And the level of investment is minimal for each individual party.

The implications of P2P technology are both exciting and a little terrifying. The concept of easy collaboration and efficient use of highly distributed resources holds substantial promise for value creation. Without doubt, the implementation of a P2P platform would have both option value and network effects. MP3.com clearly demonstrated that fact. However, the inability for adequate control also raises substantial risks. Most obvious is the risk of loss of intellectual property. However, perhaps most uncertain is understanding how value will be appropriated in a P2P community. Without some architectural control point, the owner may not receive any of the benefits. This dilemma serves as the basic challenge for the CIO. It is not clear how best to utilize this emerging platform. However, it is also clear that a firm is not well served by ignoring its potential disruptive power.

10. How should CIOs Ride the Wave?

This project explored three emerging technologies; (1) 3G Mobile Technology, (2) ASP or Web Services and (3) P2P Technologies. As summarized above, the presentations and discussions reach two basic conclusions for all three.

1. Each has the potential to enable a major change in capabilities, possibly a sufficiently important change so as to qualify as disruptive. For example, 3G mobile technology could give rise to a new payment process that would dislodge the current role of the banks as the primary provider of payment clearing capability. Such change would significantly disrupt current business models for many banks.

2. While the potential of the three technologies are apparent, there is still significant uncertainty i.e., how big an impact actually will occur, when it will occur and who will appropriate the value that is created? For each technology to reach its potential, solutions must create mission critical capabilities, i.e., impact across the value chain, and to be truly disruptive, extend beyond the value chain to create a Business Platform, i.e., impact across multiple value chains. To achieve an impact of this scope many organizations will be required to coordinate investments and establish new relationships. The complexity and timing of these types of cross industry alignments further increases the uncertainty. Furthermore, a shift in industrial arrangements also introduces uncertainty as to who will be positioned to capture the value created.

When these levels of uncertainty are sufficiently high one rational choice for the firm will be to "wait and see".

We will conclude that a major leadership role for the CIO will be to educate the executive leadership with respect to the potential of these technologies and to help institute a "strategic learning" process that moves the organization forward in the face of this uncertainty. This strategic learning process should be designed to:

1. Test the technical viability of emerging technology

2. Experimentally determine where and how they will impact key business capabilities and

3. Help foster the inter-organizational relationships that will be necessary to effectively exploit these technologies.
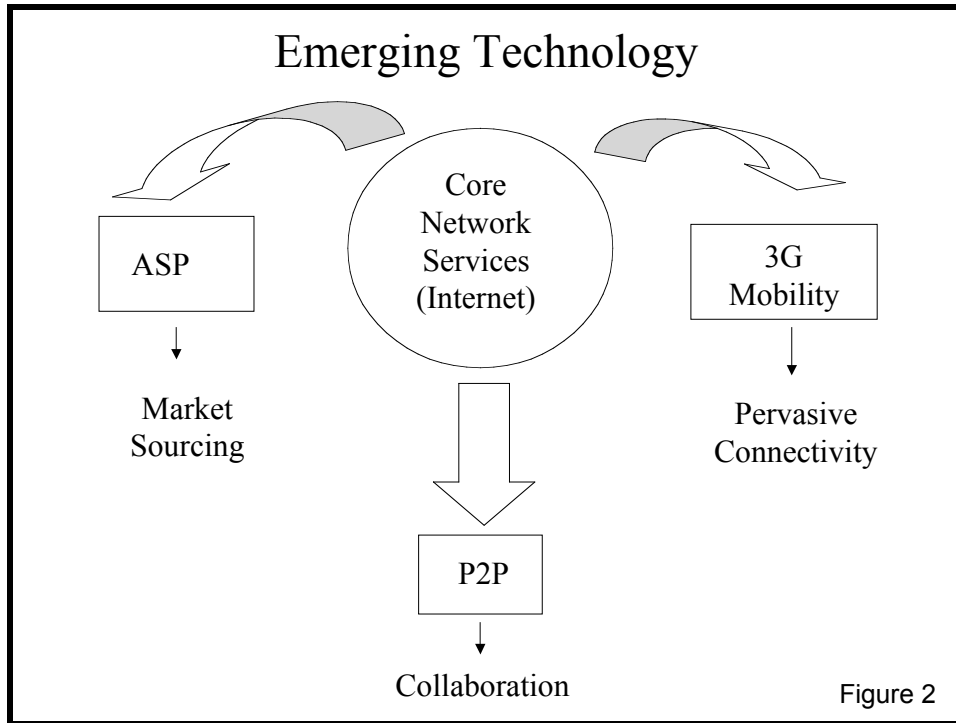
In the following section, we expand on this general conclusion.

11. Core Drivers: A Shift to Network Centric Strategy

The three emerging technologies have the common feature that each builds upon the existence of a core communications network. During the 1990's, a global communication network, i.e., the Internet, provided connectivity for millions of people. Once the reserve of large companies, today even the smallest firm or single individual can have access to a global communications infrastructure. This reality has changed the competitive landscape forever. Now, one advantage of scale, the ability to reach far off markets, has been somewhat diminished.

Our view is not so extreme. It is true that small firms and individuals can use the Internet to achieve global communications but a large firm can also exploit this resource. Competitive advantage will arise not from the existence of a core network, but rather, with how each firm, large or small, adapts their work environment and ultimately, their business model, to leverage this asset. This is the potential for each of these three technologies (as shown in figure 2). Each technology leverages the core communication network to extend this infrastructure into a capability that could directly add value to the market. The history of information technology is replete with investments to improve response time. But at issue for 3G is how immediacy will create value as perceived by customers and who will capture this value. The example of Sears Home Repair provides one illustration as to how immediacy creates value. Using mobile WiFi networks mounted on their truck and maintaining the connectivity to the truck through the cellular system there is always a connection to the Sears

service person. The power of this connectivity and the immediacy of knowledge transfer and real transaction processing has transformed the Sears repair business (Henderson and Kulatilaka 2002). Other enterprise solutions using this platform will also have the power to transform a business. A firm with this power will increase both options value and network

Emerging Technology

Core Network Services (Internet)

ASP

3G Mobility

Market Sourcing

P2P

Pervasive Connectivity

Collaboration

Figure 2

effects.

ASP or Web Services also build upon a global communication infrastructure. Given the access enabled by this network, any firm can rethink the classic question of what to own verses what to source from the market. The concept of web services builds on this access by providing process modules rather than just physical components. The trend toward sourcing processes from the market rather than owning them has been evolving over many years. However, the core network now enables a much broader access to customers of all sizes and significantly reduces the cost of accessing a computer-enabled service. The new price point and essentially free access will greatly increase the magnitude of sourcing across many industries. As we discussed earlier, the key to the success for a firm that seeks to leverage ASP or web services will be the design and implementation of modular business architectures. This modularity will create the logical "service space" in which outsourced services on demand can be delivered.

Finally, the core network is leveraged by the emergence of a P2P application architecture. A peer-to-peer architecture holds the promise of both the efficiency gains in

utilization of highly distributed computers and better "sharing" between distributed workers or computational agents. In essence, the P2P concept is a collaboration model that leverages the core network (see Figure 2). It provides for connectivity without assuming a hierarchical control. The potential disruptive impact of P2P has been clearly demonstrated by the impact of MP3 on the music industry. However, as we discussed earlier, the uncertainty about how value will be captured is a particularly important concern for the capabilities created through the use of P2P technology. Never the less, the potential for value creation appears sufficiently large to justify attention by the leadership of the firm.

The emergence of these three technologies provides strong evidence that there is a fundamental shift toward a network centric view of both the firm and the market. No longer will it be sufficient to formulate and execute a firm strategy with a "firm specific" perspective. Rather, strategy must embrace the existence of both the opportunity and threat of a highly networked environment. This new reality will place increasing importance on the ability to adapt. As a consequence, both the firm and the products and services produced by the firm, must be designed for agility.

12. Implications for the CIO

The rise of a new organizational form that is network centric places new challenges on the role of the CIO. First, we believe the strategic importance of architecture and its operational context, the infrastructure, will increase in the next decade. The CFO and line leadership of the firm will look to the CIO to educate non-technology leaders on the business impact of this trend.

Ultimately, the CIO will play a critical leadership role in the design and implementation of a new architecture for the business. In the past, architecture and infrastructure followed the strategy of the firm. However, since a key strategic requirement in the 21st century will be flexibility, the CIO must ensure that the flexibility created by IT architecture actually translates into a more flexible business architecture. In many ways, the current decisions that create modularity in today's processes and products will make this need for alignment with the modularity in an I/T infrastructure all the more critical.

A related but equally challenging task will be to develop a practical and effective process for establishing the business case for these infrastructure investments. The creation of an effective architecture, business or IT, requires explicit articulation of the key principles that underline this infrastructure. The CIO must ensure these principles exist and that

investments use these principles to create a steady path towards agility. Finally, the CIO must use these principles to discipline the debate surrounding infrastructure investments. As we will discuss later, this challenge will require the development of new approaches to the economic analysis of infrastructure investment.

We see these challenges occurring simultaneously with a need to downsize the IT staff. This move toward a smaller, more capable staff will result from two major forces. First, the technology itself will continue to merge into the mainstream of work life. The technology will be easier to use and more intelligent. Users will have an increasing comfort level and basic competency in information technology. Therefore, just as with accounting and other professions, the day-to-day management of IT will become either highly specialized or increasingly distributed. Either condition suggests that large operational IT staffs will continue to shrink. One major implication of this is that those that remain will have increasing responsibility to understand the business.

The second major force affecting the IT staff makeup and size is reflected by ASP or web services. The sourcing of IT services will continue to evolve. We do not believe a firm will outsource all of their IT capabilities. Rather, the firm will define IT activities with increasing granularity. Sourcing will be used for those modules for which there are little advantage gained by replicating an equivalent service in the market. While each firm will vary as to which services they retain, the trend toward sourcing will exert a down pressure on staff size. It will also give rise to develop new competency in those remaining staff, e.g., relationship management skills. These trends will demand that the CIO innovate in both the structure of the IT organization and the mix of skills reflected by this organization.
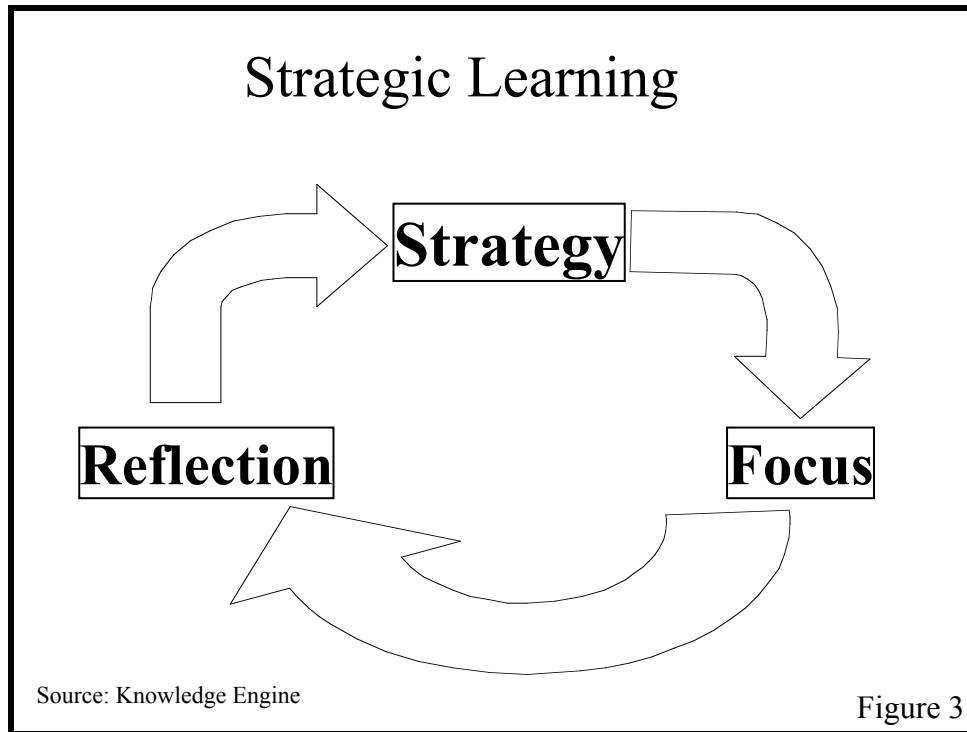
13. Strategic Learning

Given the uncertainty described above for these emerging platforms, the question becomes "what actions should the firm take? Our conclusion is that the firm should develop a **Strategic Learning** process and use this approach to develop an understanding of how and where to exploit this platform. Strategic learning is an experimental approach to strategy development. Modeled after concepts of product development, this approach calls for an interaction between concept development and field based experimental testing. A key to strategic learning is the process and choices made to define the intent and the design of these experiments. A product development methodology is used to evaluate the functionality of the product and its acceptance and use by the potential customers. A strategic learning

process must meet this condition plus provide an explicit means to evaluate elements of the firm's strategy with respect to this product or self. For example, often field tests were used to establish the technical feasibility and user acceptance for a new e-commerce solution. However, very few of these field experiments were designed to evaluate how best the capture the value created by these tools. Naive or simplistic assumptions about the willingness to pay, e.g., advertisers, were allowed to remain untested for too long a time. In many cases, only after massive investments, did the flaws in these underlying assumptions begin to surface.

Such learning is not easy. Often the link to the strategic involves a major process transformation and / or the existence of new relationships in a market (Arthur 2002). Careful thought has to be given both to the nature of these key strategic elements and how the field-testing can provide insight into their viability.   Often, the learning is sequential, requiring interaction between formulation and assessment with these "real-time" lessons quickly incorporated into the new product or service concept.

Baird and Henderson (2001)and Thomas, Sussman and Henderson (2001) discuss this concept of strategic learning. They position this capability as a key role of leadership with respect to building the firm's knowledge assets. The Baird and Henderson (2001) model has three basic elements for strategic learning (see Figure 3). An initial statement of strategy is used to provide the **focus** for the field experiment. This focus creates both the learning objectives for the experiment and identifies who must participate. Note that the focus does not create the details of the product functionality or the specific design of the experiment. These tasks are left to the domain experts and relevant stakeholders that are identified as part of the Focus process. It's also important to notice that the Focus processes develop explicit performance measures so that the field trials are directed toward value creation.

Strategic Learning

Source: Knowledge Engine

Figure 3

The Focus-Strategy link involves the first two elements of the strategic learning process. The third element is **Reflection**. Reflection, a key leadership activity, involves the assessment of the field trial and the interpretation of the results from a strategic perspective. It is very important to establish a priori who will be involved in this reflective process. Participants in the reflective process must both interpret the outcome of experiments and have the ability to adapt future strategy based on this learning. In addition, since the learning process will likely involve a series of field experiments, the leaders that are charged with the reflection task must sustain commitment. As Baird and Henderson (2001) argue, the failure to structure a meaningful reflective process is a major reason why the knowledge sharing and learning process of the firm do not accumulate over time.

14. Impact of Platform Scope

A second dimension of the strategic learning process is captured by the different types of platforms. A technology platform primarily affects internal processes and stakeholders. In this circumstance, the strategic learning agenda may be modest. It can focus on process efficiencies and internal competencies. However, for a capability platform, the scope of involvement extends beyond the organizational boundaries. The stakes are much higher and the complexity of organizational relationships much more sensitive. The design of the field experiments must reflect this complexity.

Finally if the concept involves a potential business platform, the impact on the current business model may be very dramatic. Issues of intellectual property become critical as does the timing of any activity that signals intention to the market. Great care must be exerted in both the design and sequencing of field experiments. While the complexity is high, the potential payoff more than justifies the effort.

15. Economics of Platforms

The third major implication for the CIO is the need to develop a robust methodology for understanding the value of a platform. For example, Option values are a reflection of the value of flexibility to the firm. A well-designed platform enables the firm to change course, acquire or divest capabilities or business units and quickly exploit opportunities by investing in new systems or processes. The more uncertainty facing the firm, the more value a platform provides. Each of the platforms discussed in this paper have the potential to create "real options" for the firm. However, while this seems clear at a conceptual level, there is no practical way at this time to evaluate the magnitude of this value.

These platforms also create network effects. The network effects arise from either complementary services enabled by the platform or from the value of connecting a community of users. Past literature has suggested that there should be tremendous potential network effects enabled by communication and coordination technologies supported by anecdotal evidence (Malone and Yates 1987; Shapiro and Varian 1999). The challenge for the CIO is to extend this line of reasoning for emerging platforms that leverage this core communications network. However, the magnitude of these network effects is unclear. Will the platform remain a technical platform and therefore impact only the community of users found in the firm? Or will these three technology platforms evolve into a capability business platform? If they do, the scope of the network effects could give rise to enormous value creation. It will fall on the shoulders of the CIO to help the organization understand this point. It is a leadership responsibility that may well determine the future of the CIO role within the firm.

Figure 4
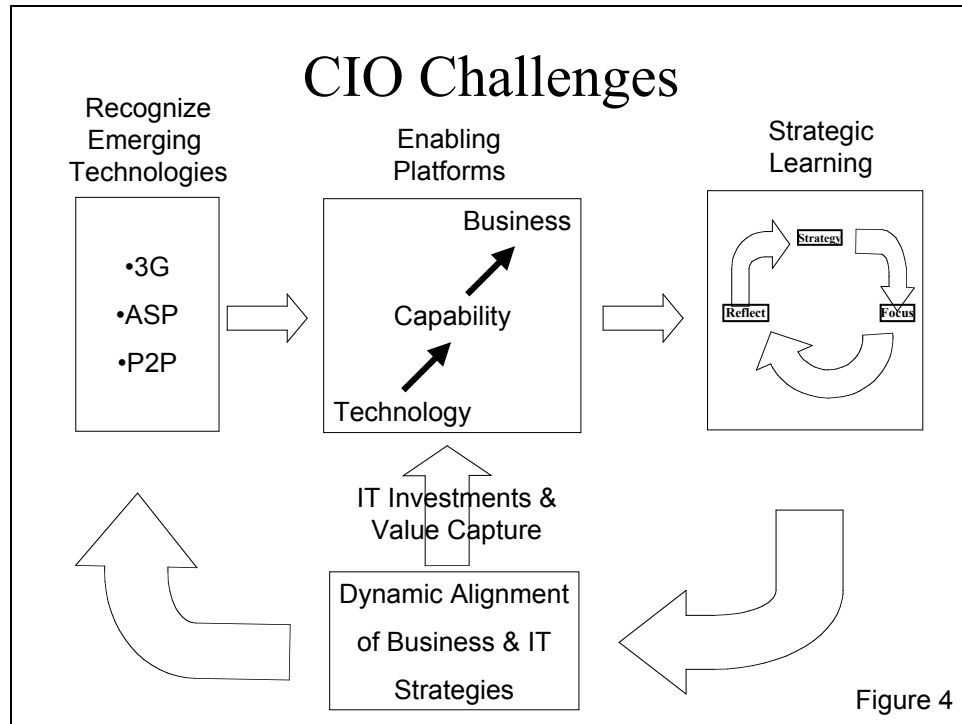
16. Conclusions

In summary, we see three key implications for the CIO. These implications arise from our exploration of three emerging technologies: (1) 3G mobile Internet, (2) ASP or Web Services and (3) Peer to Peer (P2P). The challenge facing the CIO is captured in figure 4.

The first implication is to recognize that these innovations are potential platforms that leverage a core network capability i.e., the Internet. An important consequence is that while these may be technical platforms today, they have the potential to evolve into capability or even business platforms. With that potential arises the possibility of disruptive change.

The second implication is to recognize the level of uncertainty for both the magnitude of value that could be created and the uncertainty as to how to capture this value. We argue these uncertainties are too high and the potential solutions too complex to pre plan. Therefore, a key leadership responsibility for the CIO will be to initiate a Strategic Learning process that helps guide the investments of the firm over time. An important aspect of this learning process is that it must use the firm's strategy to create a learning focus and incorporate a reflective process that adapts their strategy over time. Finally, we conclude that the traditional methodologies for valuing IT investments and managing the value realization process over time are inadequate. In order to carry out the leadership role

implied by the first two results, we believe the CIO must create a new value management process. While this new process may not be used for every systems investment decision, it will become the cornerstone of understanding both the network effects and option value created by an emerging platform. The process will also provide the discipline for the investment decision. This will not be an easy task. It will require the application of the sophisticated economic analysis currently applied in the fields such as mergers and acquisition and in R&D. However, creating this new capability to identify, understand and learn how to exploit new network centric technology may well be the most important role of the CIO in the 21st Century organization.

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