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## Developments in Practice VI: Riding the Wave: Discovering the Value of P2P Technologies

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**DEVELOPMENTS IN PRACTICE VI:  
RIDING THE WAVE: DISCOVERING THE VALUE OF P2P  
TECHNOLOGIES**

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**ABSTRACT**

Peer-to-peer (P2P) gurus suggest that inexpensive computing power, bandwidth, and storage will enable radically new enterprise forms that are driven by the distribution of interactive computing power more or less equally through the enterprise. Based on the capabilities of the Internet (as opposed to the web), which forms a vast network of computers that can be linked in many different ways, P2P has been called "a third age in Internet time" and "the next logical evolution of the Internet". While such predictions may be somewhat hyper-optimistic, the speed with which this technology already has spread from underground to mainstream is remarkable. Whether they like it or not, companies will soon need to determine how they are going to deal with P2P, just as they did with other major technology shifts (e.g., PCs, e-commerce). This paper is designed to help researchers and managers understand the challenges P2P technology poses for CIOs and organizations. It first gives an overview of these technologies, including their current status, probable applications and the opportunities and challenges involved in using them. Then, it discusses the strategic potential of P2P for organizations and explores some of the areas in which P2P could have a significant impact on how business and IT functions work. It concludes with some advice to CIOs about how to begin integrating P2P into their organization and some suggestions for researching the impacts of this technology on business.

**KEYWORDS:** Peer-to-peer computing, P2P, IT strategy, IT architecture, IT management.

## I. INTRODUCTION

Imagine a company that looks like a spider's web instead of a pyramid. The spider (head office) can be anywhere on the web as needed. The bigger the web, the more effective it is. If part or even all of it gets destroyed, the spider simply rebuilds it in the same or in a different place. All parts of the web can catch and hold new business and that intelligence is conveyed back to the spider on an as-needed basis. This organizational vision is held by the proponents of peer-to-peer (P2P) technologies. This new type of enterprise is driven by the distribution of interactive computing power more or less equally throughout it.

Already, the hype about P2P is beginning to build. Gartner Group predicts that "P2P will radically change business models" and Andy Grove of Intel anticipates that it will be "a revolution that will change computing as we know it." [Rutherford, 2002]. P2P gurus suggest that inexpensive computing power, bandwidth, and storage will enable radically new forms of work that will increase productivity while lowering costs. Based on the capabilities of the Internet (as opposed to the web), which forms a vast network of computers that can be linked in many different ways, P2P has been called "a third age in Internet time" and "the next logical evolution of the Internet" [Burgelman and Meza, 2000; McGarvey, 2002].

While CIOs can be excused if they take these hyper-optimistic predictions with a very large grain of salt, the fact remains that there is something new on the horizon. The Napster-MP3 phenomenon was the first "killer app" of P2P. As such, it represents a window on the possibilities and perils inherent in these new patterns of communication. In less than a year it redefined every relationship in the music business. The speed with which this technology spread from underground to mainstream is remarkable and thus, it cannot be ignored. Whether they like it or not, companies will soon have to determine how they are going to deal with P2P, just as they did other major technology shifts (e.g., PCs, e-commerce). At present, we are all very early on the learning curve for these technologies and movement is slowed by an anemic economy. Nevertheless, it is highly unlikely that P2P will go away. And as the next generation of consumers, conditioned by file sharing and instant messaging, grows up they will simply demand it. Thus, the only question for CIOs at present is how quickly, not whether, P2P will take off.

To help CIOs understand these challenges better, the SIM Advanced Practices Council invited two industry experts to discuss P2P technologies and their potential with a group of CIOs from a variety of industries. This paper is the outcome of that discussion. It first gives an overview of these technologies, including their current status, probable applications, and the opportunities and challenges involved in using them (Section II). Then, it discusses the strategic potential of P2P for organizations (Section III). Next, it explores some of the areas in which P2P could have a significant impact on how business and IT functions work (Section IV). Finally, it concludes with some advice to CIOs about how to begin to explore integrating P2P technology and principles into their organizations (Section V).

## II. P2P: AN OVERVIEW

P2P is the term given to a group of technologies that enable computer users to communicate directly with one another without going through a server. They take advantage of the capabilities of the Internet to enable users to share information, files, computing power and storage. Unlike the web, which imposes a discipline over how people connect with each other and what they share, P2P is considerably more free-wheeling and flexible and can be implemented in a number of ways. For example, Napster was based on a star-like framework (Figure 1), where a central server is used as a directory of where songs are located. Once a song is located on a client computer, the two clients connect directly and transfer the song between them. Other applications can be based on vine-like or web-like connections with every user acting as a client, a server, or both (Figure 2). In short, P2P is a networking architecture that facilitates a wide variety of possible connections between computers.

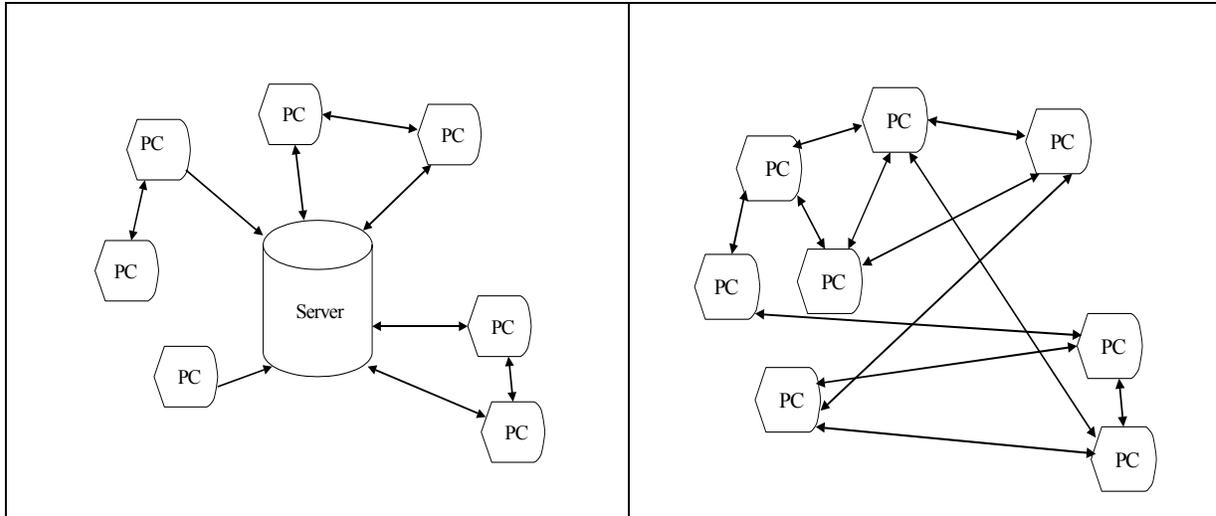


Figure 1. A Star-like P2P Configuration

Figure 2. A Web-like P2P Configuration

In the traditional client-server world, networking is hierarchical and controlled by centralized computers that limit where and how communication takes place.

Interaction is essentially one-way – from the server to the client. In the P2P world, all computers are considered peers and can serve as clients or servers for one another. This way of thinking about networking is based on the principle of reciprocity, i.e., two-way interaction. P2P technologies aim to connect computers intelligently to each other in a dynamic fashion, creating a virtual computing environment for the Internet. As the technology develops, it will enable organizations to create applications that make use of the whole Internet not just the web [Anderson et. al., 2002]. As a result, it will change the way organizations think about such things as:

- serving customers,
- sharing information,
- distributing computing power,
- developing applications,
- gathering business intelligence, and
- designing infrastructure.

However while promising, P2P technologies and concepts are not yet fully developed. In fact, there is general agreement that these technologies are still several years away from maturity [McGarvey, 2002]. Many ambiguities remain in the definition of the core technologies involved and their path of evolution [Ayer and Griffith, 2001]. P2P companies face a “catch-22” in that until a wider user base exists, only a limited number of applications will be feasible and as long as the applications base remains small, the user base will not grow [Anderson et. al., 2002]. As a result, very few organizations are actually using P2P as yet for real work (see box for a list of possible types of P2P applications). However, with companies such as MicroSoft, Intel, Sun and IBM, as well as a host of start-ups, investing heavily in developing more standardized ways to implement P2P networks, CIOs can expect to see rapid growth in these technologies in the near term.

### SOME APPLICATIONS OF P2P TECHNOLOGIES

#### **Managing and Sharing Information.**

P2P can give individuals access to their own and other people's documents anywhere, anyplace, any time, thereby making individuals and teams more productive. Staff at Ginsberg Development, a condominium builder, now use P2P to share documents and spreadsheets since they spend so much time away from the office [Overfelt, 2001]

**Collaboration.** These technologies enable dispersed teams to work together directly both in real time and offline. Lawyers at Martins and Demotes, in Peabody, Mass. are using P2P software to work on legal briefs simultaneously online [Overfelt, 2001].

**Grid Computing.** P2P can take advantage of unused processing, bandwidth and storage to solve problems cost-efficiently that require large amount of these resources. By tapping unused resources across the network, grid computing can reduce the load on servers and the need to grow infrastructure. This arrangement could enable improved video streaming and more computing-intensive applications. Wachovia Bank in North Carolina uses P2P so intermittently idle and underutilized PCs can perform portfolio analytics, thereby eliminating the need for additional servers [Coffey, 2002].

**Sensory Networks.** These technologies can enable extensive machine-to-machine communication thus facilitating the development of more responsive organizations. The US Army is currently experimenting with creating an ubiquitous wireless network of devices on airborne drones and Humvees that will integrate their communications systems on hostile territory [Caulfield, 2002].

**Edge Services.** P2P can help deliver services efficiently and effectively to the edges of the organization – whether it be to geographically dispersed communities or across firewalls to customers and suppliers. [Gill, 2001; Ziegler, 2001; Anonymous, 2002] Verisign is now using P2P to deliver content to its partners, employees and customers and also to train employees – wherever they are located -- on the company's products and services [Torres, 2002].

**Electronic Payment.** P2P can be used to send e-mail money transfers. Certapay, a Canadian e-payment company is working with five Canadian banks to enable anyone who banks online to transfer money electronically to anyone with an email address and an account at any financial institution in Canada. This will be the largest and most mainstream P2P application in the world [Marlin, 2002].

### OBSTACLES

Although movement towards P2P appears to be inevitable, a significant number of obstacles still stand in the way of the practical use of these technologies. These obstacles include:

- **Authentication.** At present, there is no infrastructure for the authentication of individuals or machines using a network. Authentication is an essential mechanism to support intra and inter-organizational policies and practices.
- **Security.** While most P2P companies emphasize the security of their technology, many organizations remain skeptical about it and are not yet comfortable with its robustness [Coffey, 2002].

- **Legal matters.** Litigation can potentially restrain the growth of this technology. In addition to the well-known cases of copyright infringement, there will likely be other collisions between the disciplines of business and the principle of sharing as P2P develops.
- **Privacy.** The significant privacy implications of this technology need to be understood better for it to be used effectively.
- **Lack of Standards.** Until general standards are agreed to, adoption and diffusion of P2P technologies will be limited [Vasudevan, 2001].
- **P2P's Image.** The legal problems that Napster and others faced frighten many copyright holders away from these technologies [Ayer and Griffith, 2001]. Trust, accountability, and reputation are all lacking at present [Vrana, 2001].
- **Technology Limitations.** By their very nature, P2P networks rely on a heterogeneous resource pool with many weak links. These links can affect scalability and performance [Vrana, 2001].
- **Control.** In the move to a shared architecture across many individuals and organizations, companies ask legitimate questions about who will control its development and use [Hagel and Brown, 2001].

In deciding when to adopt P2P, CIOs must balance the opportunities these technologies represent for their organizations against their immaturity and the significant obstacles still to be addressed.

#### A P2P STORY

Sam goes to the emergency department at midnight with chest pains. While he is getting hooked up to the EKG and IV, he gives consent to have his medical information shared with the doctor. The doctor signs on to his hospital's P2P network which links to Sam's doctor's computer where this information is stored. Soon, the ER doctor knows that Sam is taking prescription medication for anxiety and high blood pressure, has an allergy to penicillin and learns the results of his cholesterol test last month (normal). He is able to treat the chest pains appropriately and continue Sam on his regular medications without ordering additional, expensive tests. His family doctor is informed automatically about his condition and can access his hospital records to find out what treatment he is receiving. When Sam leaves, the hospital sends him home with a heart monitor which is directly linked to a monitoring center which can alert paramedics or Sam's doctor if problems arise. Information is also sent directly to a visiting nurse who makes sure that Sam takes all his medication and charts his progress. A homemaker and Meals-on-Wheels are also informed electronically. Sam's family doctor can monitor Sam's convalescence and order adjustments in his medications or treatment electronically.

### III. THE STRATEGIC POTENTIAL OF P2P

P2P technologies are expected to profoundly change how companies view themselves. These changes are not straightforward or easy to conceptualize. Nevertheless, as the world has seen with Napster, P2P can have important strategic implications for both an organization and an industry. The speed with which these technologies could spread and their potential to disrupt

mean that it is important for CIOs to think about how they can communicate their strategic potential to management. This job will be difficult as there are, at present, very few real life examples of P2P at work in business. Storytelling (see sidebar) is a key way to help executives understand what these technologies can do for their organization – both the opportunities and the challenges they represent [Denning, 2001]. Of all the dimensions of networking -- technical, social, narrative, organizational, and doctrinal (i.e., strategy and tactics) - that must be explored, good stories are most critical in the beginning since they help people visualize the possibilities [Stewart, 2001].

## STRATEGIC OPPORTUNITIES

These possibilities will only be realized if companies begin to think differently about their work than they do today. For example, today most business processes are based on a “markets model” that aims for high quality service and meeting contractual obligations. In contrast, P2P technologies are based on a “best efforts” model such as the one currently operating in the less formal parts of a business such as sales. Companies should consider whether there may be other parts of a business that could take advantage of this approach. Three possible areas are: improving products and services, building community-based interfaces and the collaborative learning cycle.

A key area of strategic opportunity is using P2P to build a more flexible and responsive organization. The traditional command and control approach of hierarchical organizations institutionalizes rigidity. As the events of September 11 taught us, “no hierarchy can keep up with a well-functioning network” [Stewart, 2001]. Such networks can offset a host of organizational disadvantages in size and technology. With few formal procedures and little physical infrastructure, they are hard to target. Instead, teams direct themselves based on the values of the organization and their leaders’ intent, reading a given situation and responding accordingly. P2P can be used to build multi-directional communication, develop trust between co-workers, share command, and respond quickly to changing needs. Thus, it is a mechanism for empowering individuals and moving decision-making out to the edges of an organization.

### P2P OPPORTUNITIES

- New forms of interaction and collaboration
- Increased flexibility and responsiveness
- Improved feedback
- Increased use of computing and storage-intensive applications

P2P is also a powerful technology for closing the feedback loop in many areas of a company’s work. It enables a business to consult its customers about information, products, and services they would like to see. For example, eBay improved its effectiveness by asking people what categories of information they would like to see and then growing its structures organically. Internally, too, feedback mechanisms can be used to stimulate

desired forms of organizational behavior and to enable individuals to self-correct. Ideally, feedback mechanisms should be passive, i.e., built into the technology, so they do not require extra effort to produce. The Pentagon already envisions an extension of this concept to a “mesh architecture” composed of sensors, emitters, and micro-bots which will work in concert with each other to produce a comprehensive picture of a war zone [Libicki, 1997]. Similar technology could be employed in an enterprise, connecting sensory devices and computers to other machines to evaluate and filter a wide variety of information, highlighting areas and anomalies to which the organization should pay attention.

Finally, P2P gives organizations new opportunities in scaling. It can help them build a robust service grid to accelerate and broaden the impact of their online products and services. For example, by speeding up and delivering rich media files efficiently, P2P could enable a whole host of new types of applications [Coffey, 2002; McGarvey, 2002]. The ability to parcel out applications across a network of computers could also lead to new forms of data mining, better

simulations and more varied products and services that can be delivered across a range of device types. P2P technologies will eventually include a variety of shared computing utilities to help organizations extend the scope of what they can do. Computing and storage-intensive applications for example, such as those used in pharmaceutical and financial organizations, could become more practical and cost effective. In short, P2P potentially increases the bounds of the possible for an organization significantly [Anderson et. al., 2002].

## STRATEGIC CHALLENGES

P2P also represents a number of strategic challenges to organizations. First and foremost, it is still not clear how and whether companies will be able to appropriate value with these technologies [Burgelman and Meza, 2000].

### P2P CHALLENGES

- Identifying and appropriating value streams
- Loss of control
- Disruption and disintermediation.

Simply creating a network does not necessarily mean that an investor will benefit from his investment. Many companies are questioning how they will be able to generate value from activity in a decentralized system. There is also a great deal of uncertainty about the exact “pain points” in an organization that P2P can help eliminate [Vasudevan, 2001]. Even where

revenue streams can be identified, significant technological obstacles remain to tracking usage and collecting micro-payments. Value issues are further confused by the characteristics of information, in that it can be given away yet still retained by its owner and can be recombined into many different forms. These issues underline and reinforce the need for organizations to begin to think clearly and strategically about how to translate P2P capabilities into a profitable business model.

The business world is used to having a high level of control over what it does. P2P computing challenges many of the assumptions on which this world has been built. For example, the principle of reciprocity – of sharing and receiving content – involves significant ramifications for an organization’s rights and asset management, and how it classifies, categorizes, publishes and syndicates information, as well as for activity management and web services. In fact, the discipline of defining the rights and authorities of participants in a network is likely a bigger task than implementing the technology itself. Furthermore, as the participants in this session noted, if a company only focuses on the assets it owns, it could miss opportunities to extend its assets of influence. Branding is another area of concern. Many companies believe that building a brand requires consistency and control to present a strong picture to the public. Nevertheless, if they are to take full advantage of P2P’s strategic opportunities, organizations will need to find a way to loosen their external control mechanisms in a number of these areas, i.e., information exchange, rights and asset management, and branding.

Finally, P2P could be significantly disruptive to industries and existing revenue streams. One CIO pointed out that while sharing is always a part of her industry, it is done on a limited basis. The scale and scope of the sharing capabilities offered by P2P could seriously undermine her organization’s intellectual capital. In the future, companies will need to be more careful in how they provide access to their information. Furthermore, where industries were developed to exploit an asymmetry in talent (e.g., the arts or science) P2P makes it possible to simply bypass them entirely. While the music industry is a familiar example, bypassing is also beginning to occur in the news media. “Blogging” involves publishing directly online and it is increasingly being done by serious news commentators. While this phenomenon is currently web-based, it clearly fits the P2P architecture -- building in a multiplicity of links, engaging in constant communication with readers, creating a network of sources and displaying an in-depth understanding of the peer communities they serve [Ellis, 2002]. While most blogs do not make money at present, they significantly threaten this industry’s existence because they are beginning to eat into the news media’s value-added proposition. The mainstream media is “amazed” at how quickly bloggers

established themselves. This phenomenon clearly illustrates the impact of the “network effects” of P2P at work on an industry.

As P2P technologies develop, the strategic options available to businesses will also become clearer. CIOs will need to work with other executives to think about what these options could be and to strategize ways to appropriate value from the networks that they develop. Given the current state of technology, this discussion will likely be an extended and ongoing conversation. However, it is an exploration that should start at once, given the speed with which the technology potentially disrupts.

#### IV. P2P'S IMPACT ON BUSINESS

Internally, P2P is also likely to be disruptive and could impact a number of business areas such as:

- Coordination and control
- Management and metrics
- Information management
- Applications development
- IT architecture and
- Organizational design.

##### COORDINATION AND CONTROL

Centralized coordination and control mechanisms will need to be loosened as decision-making responsibilities migrate outward in the ranks of the organization. As this trend proceeds, executives will need to learn to manage by establishing guiding principles of operation (e.g., the company must respond within a certain period of time if a customer engages with the company) rather than through traditional means. Social protocols will need to be established to build and protect the company's trustworthiness and reputation. And controls in every part of the organization will need to be evaluated to determine how much is truly needed in a particular area. For example, while some controls may still be necessary, they may need to be established between peers or in the sharing process itself, rather than between a manager and subordinates.

##### P2P RESEARCH OPPORTUNITIES

Among the many different opportunities for researchers to help business understand the P2P phenomenon better are:

- Exploring the impact of automated feedback measures on how people work (experiment).
- Understanding the role and importance of social network nodes in driving effectiveness and efficiency (network traffic analysis).
- Identifying key social and information sharing protocols in building P2P networks internally and externally (ethnography).
- Learning how P2P changes business models and organizational designs (longitudinal analysis).
- Discovering the types of information needs of virtual workers (survey).

##### MANAGEMENT AND METRICS

P2P technologies also make informal networks within an organization more visible. They can highlight the roles people play in the organization, for example:

- connectors,
- knowledge mavens,
- those over-burdened by demands and
- those who do not live up to their commitments.

Companies will need to develop protocols around what is requested, committed and done so that people can see themselves and improve their behavior. Metrics are particularly important for driving activity in the desired direction. Feedback metrics can highlight problem areas directly to an individual and encourage self-correction without the need for management intervention.

Incentives can also be built in to reward collaboration and reciprocity and to build social capital. Organizations will need to experiment to develop the most effective measures for the behavior they wish to engender. As networks become more prevalent, managers will find their roles changing in other ways as well. They will have to develop skills in social and organizational network analysis, learn to understand and manage the linkages between nodes (i.e., persons or places), and oversee how the network as a whole is working [Stewart, 2001].

### **INFORMATION MANAGEMENT**

An in-depth understanding of network patterns will also be needed to help organizations manage and make use of the huge amounts of information involved in P2P applications. Information filtering, analysis and distribution will become more critical [Libicki, 1997]. Today, most organizations' data is still managed centrally although increasingly it is shared with partners and others outside their boundaries. Many companies are also finding that supporting their own mobile and telecommuting workers with information is becoming more important [Zeigler, 2001]. As these needs increase, CIOs will likely become knowledge brokers building "ecosystems" for sharing beyond the firm. They will need to develop a broad and detailed understanding of where information comes from and where it goes, and determine how information assets and rights will be managed. Information will have to be indexed or given a structure that will enable it to be searched [Coffey, 2002]. In addition, while technical standards, such as XML, will make it relatively easy for data to be shared back and forth, companies will wrestle with such intra-organizational matters as developing shared meaning and resolving conflicting information cultures [Stewart, 2001; Hagel and Brown, 2001].

### **APPLICATIONS DEVELOPMENT**

Although some organizations have used P2P computing for many years, it represents a significant change for most in how applications are designed and implemented. These technologies enable applications to be broken up into hundreds or thousands of smaller jobs and distributed throughout a network. This type of computing is considerably more difficult for programmers to conceptualize, build, and test [Burgelman and Meza, 2000]. Developers will need retraining to help them move away from specific technologies and move towards methods of development that take into consideration such P2P issues as real-time collaboration, distributed computing, storage and data, and synchronization of processing and information. The current lack of developer tools, common utilities (e.g., for registries or session management), and shrink-wrapped software is inhibiting application development for P2P in businesses.

### **IT ARCHITECTURE**

Information management and applications for P2P will be built on a new IT architecture designed for interactive networking. Three conceptual layers will be needed to build and implement Internet-scale applications.

- The first layer includes software standards and communications protocols to simplify and streamline information management.
- The second layer establishes a service grid to provide shared utilities. These utilities will not only help users and providers connect with one another but will also create a reliable environment wherein mission-critical business can be carried out.
- The third layer includes a variety of web services such as shared authentication, authorization and accounting utilities, knowledge management utilities, and other services to help manage the network [Hagel and Brown, 2001].

Initially, a network architecture will probably coexist and complement the client-server, web, and mainframe architectures currently in place in most organizations [Vasudevan, 2001; Ziegler, 2001]. Coexistence will allow companies to evolve their architectures gradually over time.

While many experts suggest that the primary benefit of this new architecture will be to facilitate the distribution of computing resources over the web thus making them more cost effective, others feel that the ability it will provide to connect partners with each other easily and cheaply will be extremely valuable. Current architectures usually require fixed connections with others (e.g., customers, suppliers) that are difficult to manage and often require technology not available to smaller partners. A network architecture enables looser coupling thereby making it easier for companies to connect and disconnect with one another. In other words, it facilitates the use of applications at the edges of an organization (e.g., sales, service, event management) and addresses the areas of a business that are most likely to suffer difficulties with existing proprietary systems and less flexible architectures [Hagel and Brown, 2001]. The ability to deliver information and services across many device types will open up a whole new class of applications to organizations in areas such as procurement, inventory management, and supply chain management, by enabling them to exchange information with many different companies and their disparate systems. It could also make it much easier and cheaper to support and communicate with remote branches and staff.

## ORGANIZATIONAL DESIGN

In the longer term, networks will begin to affect the nature and structure of an enterprise. Today, IT does not play a role lay in organization design. However, as we learn more about how P2P technologies can be used effectively to create a largely decentralized organization, it can be expected that CIOs will begin to be involved in this aspect of organizational transformation. The evolution of the centralized, hierarchical firm into a networked organization composed of small teams of semi-autonomous individuals will likely be highly disruptive. CIOs can expect to see clashes of formal and informal ways of working and a shattering of the massive processes that now support the enterprise. Accepted business roles and relationships will also be affected [Vasudevan, 2001]. Core functions may move around dynamically as needed and excellent communication and information management will be essential. This transformation will not happen all at once. Tipping points will occur at different times and in different areas but will be recognizable only in retrospect [Libicki, 1997]. Thus, it is important for CIOs to begin to obtain a feel for these technologies, to learn how they could be exploited, and to then help prepare their companies for how they might affect strategies and structures.

## V. ADVICE FOR CIOs

Clearly, given its current immaturity, P2P technology is not ready for mission-critical, strategic applications. With very few examples of practical use in implementation today, in the short term CIOs have some time to accumulate insights into how P2P might be used and how it could affect their industry. Nevertheless, they should not be complacent. The risk in not being prepared to exercise P2P's potential is enormous. The massive growth in networking (e.g., Napster) and near-networking applications (e.g., email, instant messaging) demonstrates how quickly these technologies can take off. CIOs should therefore begin to lead the development of understanding about P2P in their organizations in a number of ways. Work to be done includes:

1. **Evaluation of potential.** A preliminary assessment of where P2P might be useful should begin at the edges of the organization and anywhere a firm is finding it difficult to communicate with staff, branch offices, customers, suppliers and partners. In doing so, managers should look at what different types of individual users *could* do rather than looking at how work is done now [Ziegler, 2001]. This type of analysis could uncover applications and information that might be moved off a central server and distributed more widely.
2. **Building internal networks.** With so many unresolved concerns about security and intellectual property rights, it is natural for organizations to remain skeptical about networking beyond the company's borders. However, these issues are not as important if P2P technologies are used within a company. As one expert noted, "business uses within firewalls should not be tarred with the same brush as uncontrolled file sharing" [Ayer and

Griffith, 2001]. For this reason, companies would be wise to begin with P2P by tailoring the technologies to fit internal groups of individuals.

3. **Experimentation.** IT departments face the dilemma of trying to identify the right time to introduce this technology into their organizations. They have a lot to learn – both about the technology itself and about the decisions that must be made around it. Small scale, low risk experiments are the best way to help companies answer such questions as:
  - What components of P2P are relevant to our current and emerging markets?
  - How should authentication be managed (not only for people but for machines)?
  - How should the infrastructure be adapted to incorporate networks?
  - What information is involved?
 Experiments can also help business executives begin to see the potential of the technologies. If they are designed so they can evolve over time as everyone learns, experiments can teach organizations a great deal about how to build effective P2P applications.
4. **Evolving architecture.** As noted above, it is possible for a network architecture to coexist with other architectures within an organization. Nevertheless, it is expected that older, less flexible platforms will become increasingly irrelevant, particularly in certain types of applications and industries such as manufacturing. Thus, it is wise to begin to identify the evolutionary path an architecture might take towards networking and to ensure that key capabilities are in place if an organization needs to move quickly to respond to a rapid shift towards P2P in their particular industry.
5. **Tracking start-ups.** Numerous companies are becoming involved in P2P<sup>1</sup>. CIOs should begin to monitor what these firms are doing and how their software is being used. Tracking will help them decide when is the best time to become involved.

## VI. CONCLUSION

The potential and the power of P2P technologies to change the current ways of working and existing business models is not in question. The Napster phenomenon and other interactive sharing applications show that millions of people are willing to share information and computing power. P2P already makes a significant impact on everyday life. While the marketplace does not yet fully recognize what is taking place, there is no question that these technologies are developing rapidly and that they will change many things about how organizations work. The challenge for CIOs is to understand the timing of when these impacts will occur in their industry and in different areas of their business. CIOs should begin to learn as much as they can about P2P during the present “lull in the storm” so that they will be well-prepared to respond when the timing is right.

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- Risk management in information systems (Vol. 7 Article 13)
- Enterprise application integration (Vol. 8, Article 31).
- Riding the Wave: Extracting Value from Mobile Technology (Vol. 8, Article 32)
- Managing the Technology Portfolio (Vol. 9, Article 5)
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<sup>1</sup> See [http://www.wired.com/wired/archive/8.10/p2p\\_pages.html?pg=3](http://www.wired.com/wired/archive/8.10/p2p_pages.html?pg=3) for a preliminary list

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