December 2003

Business Models for Peer to Peer Initiatives

Junseok Hwang
Center for Science and Technology, School of Information Studies, Syracuse University

Ian MacInnes
Center for Business and Government, Kennedy School of Government, Harvard University

Follow this and additional works at: http://aisel.aisnet.org/bled2003

Business Models for Peer to Peer Initiatives

Ian MacInnes

Center for Business and Government, Kennedy School of Government, Harvard University, United States
Ian_Macinnes@Harvard.edu

Junseok Hwang

Center for Science and Technology, School of Information Studies, Syracuse University, United States
JSHwang@Syr.edu

Abstract

This paper examines recent peer to peer initiatives in the context of the business models literature. There are three types of studies on business models: focused studies on success factors, multifactor studies of success and failure, and studies identifying the components of business models. The most common factors used to analyze business models are: revenue sources, potential benefits to actors, enabling technologies, security, and behavioural changes. Of the four cases analyzed the collaborative model of Groove and the distribution and caching model of Kontiki appear to have greater commercial promise than the file sharing model of KaZaA and the distributed processing model of SETI@Home.

1.   Introduction

The explosion of optimism generated by the initial use of the Internet as a commercial platform, led to many innovative business initiatives. The original euphoria led many companies, entrepreneurs, and venture capitalists to develop plans in enterprises that, due to weak business plans, among other factors, eventually ended in failure. In spite of this, innovative initiatives based on peer to peer (P2P) technologies have generated new optimism.

What are peer to peer technologies? According to Camp (2002) peers in a P2P network are multipurpose machines that can share computing resources such as processing power and storage, as well as files. These peers have equal stature and are autonomous but can collaborate with one another in order to obtain services or to complete large computing jobs (Triantafillou, et. al. 2003). This differs from the client server paradigm in that it

overcomes one of the greatest weaknesses of that topology, the existence of central points of failure and performance bottlenecks. In a P2P system the challenge is the coordination of the peer machines with the objective of enlarging the pool of resources available to those participating in the network.

There are three types of peer to peer systems: (1) pure: uniform control among nodes; (2) mediated: server controlled peer to peer resource exchange; (3) hybrid: peers depend on resources from several ultra peer managing servers. This differs from client server technologies in that servers and clients have a priori differentiation of roles. The servers receive requests for content and resources while the clients are mainly receivers of information and resources.

The rapid growth of a number of peer to peer systems, particularly those enabling file sharing, has shown that many users perceive value. If these systems are modified to support transactions some of this value could be converted into revenue for a P2P service provider. Analyzing the advantages that electronic markets bring to buyers and sellers can help illustrate the potential of these technologies. Bakos (1991), for example, identified that adequately implemented electronic markets can lead to great efficiencies that result from the reduction in search costs. P2P systems such as Gnutella have searching capabilities that allow users to rapidly find information. Dai and Kauffman (2002) also point out that electronic markets bring benefits to participants because they facilitate aggregation of players, matching, the closing of transactions. By matching they mean that they allow participants to find products and discover prices. Because P2P technologies are still under development, the systems are not yet able to offer these benefits. Resolving this seems to be a matter of time. P2P technologies have the advantages that have been attributed to successful commercial web activities but they are also likely to suffer from the costs of learning and experimentation. Napster's rapid rise and fall is an example.

The purpose of this paper is to analyze, using business models literature, current peer to peer network initiatives to evaluate their business potential. Analysis of scholarly work on business models will help identify the factors that are necessary for an enterprise to be successful. These factors will then be used to analyze peer to peer initiatives to determine if their current structures can eventually result in successful businesses. Based on this analysis it will also be possible to determine the weaknesses and strengths of these initiatives as viable electronic marketplaces.

2.   Framework of Analysis

In order to determine the business potential of peer to peer initiatives, it is necessary to examine the factors that other scholars have identified as key for the success of a business models. The literature on business models has surged in the last decade. This could be attributed to the numerous innovative initiatives enabled by the Internet. It could also be argued that the failure of many e-commerce initiatives has generated interest about the factors that make an enterprise successful. This section presents the work that other scholars have done on business models for electronic commerce and markets.

The literature on business models can be classified into four categories: (1) studies that focus on only one aspect that can affect success; (2) general studies that identify multiple factors for success; (3) studies that identify different types of business models; and (4) studies that have identified the components of a business model. The literature in each of these four areas is now examined separately.

(a) Focused studies of success factors

There have been several studies identifying factors that can affect the profitability of electronic businesses. Studies that focus on only one aspect of electronic transactions are intended to provide greater depth on the issue rather than trying to determine if it is or is not the most important aspect. These studies have looked at technological, management and personal factors. Barua, Koana, Whinston and Yin (2001), for example, focus on the technological aspects. For them using technology to gather operational information such as the percentage of goods purchased online from suppliers and the percentage of customer-service requests can have significant improvements in revenue streams, profits, and return on investments. The researchers that have focused on management aspects have emphasized the use of strategies that increase switching costs as a way of maintaining customer loyalty (Wathne and Heide, 2001), or look at a way of creating and maintaining communities within the context of the business as a way of supporting and enhancing the economic activity from a website. Doyle and Melanson (2001) pay attention to the personal relations that exist among companies and the way electronic markets are unable to replicate these networks and eventually lead to the failure of such markets. With respect to personal relations, Wathe also argues that it is switching costs that matter and not personal relations, if these are compared with the lower prices and cost efficiencies that can be attained in an electronic market.

Table 1: *Focused Studies of Electronic Commerce Factors Affecting Success*

Author	Factors
Doyle and Melanson, 2001	Personal relationships
Wathne and Heide, 2001	Switching costs
Barua, Konana, Whinston and Yin, 2001	Operational measures
Williams and Cothrel, 2000	Member development, asset management, and community

(b) Multifactor studies on success and failure of electronic commerce and marketplaces

What have been termed multifactor studies are works that do not necessarily look at business models and the elements these have to include to succeed. Instead these studies generally look for factors that affect the profitability of an electronic commerce or market initiative. These works are important for this research because, although the authors have not identified their paper as a business model paper, some of the factors that they analyze are crucial to the electronic commerce success.

Vasilopoulou, Pouloudi, Patronidou, and Poulymenakou (2002) is the most ambitious of the multifactor studies in the sense that it uses four broad categories. The authors are correct in pointing out that all of these have impact on the success of an electronic business enterprise. Although the broad categories are identified, the authors were not precise in the identification of more specific factors that underlie each category. Similarly it is necessary to prepare some type of ranking to determine which ones are crucial and which are secondary.

Schroder and Yin, (2000) determined through an extensive study the factors that companies considered most problematic in the transition of a traditional company to one centered on electronic commerce. Among the many factors that they included in their survey, the majority of companies considered lack of security, organizational, and legal issues to be the most difficult to overcome. This study has some limitations in terms of its

applicability to a peer to peer environment because it surveyed only companies that already had bricks and mortar businesses. The questions were aimed at identifying the factors helping or hindering the transition towards electronic transactions. At this point it is unclear if P2P technologies will be used by traditional businesses or if they will be limited to experimenting entrepreneurs. Under current market conditions it is unlikely that many established businesses would venture into risky initiatives.

A similar study by Amit and Zott (2001) was aimed at determining the factors that lead to the creation of value in a virtual enterprise. The authors, who also investigated multiple companies, concluded that electronic enterprises are able to create value by making transactions more efficient, thus reducing their costs. They also identified novelty as another source of value. This is interpreted to include new transaction structures, content, and participants. Like Wathne and Heide (2001), they also identified lock-in and the subsequent switching costs associated with it as another element that leads to value. This is because the company is able to retain its customers. The last element that they included in their framework was the possibility of developing complementary products, technologies, and their traditional revenues. The factors that these authors identify are indeed important for a company that is trying to enhance its business but, because the aim of the study was not sustainability or survivability, the application of the factors to a peer to peer environment may not be as relevant for a company

On a more technical level, Duh, Jamal, and Sunder (2001) focus on factors that can affect an electronic marketplace. They focus on three issues: integrity, privacy and security. Based on a case study the authors argue that a market can work only if the buyers do not have to be worried about fraud. They identify problems that can be dealt with by having strong security and policies.

Two other studies look specifically at consumers' preferences when making purchases or exploring electronic stores or portals. Yang and Jun (2002) use interviews and surveys to determine that Internet purchasers consider reliability, access, ease of use, personalization, security, and credibility as the most important factors that make them rate a site favorably. In a more theoretical piece, Dholakia, Dholakia, and Chiang (2002) point out the difficulty of changing a person's behaviour to feel comfortable engaging in electronic transactions.

Table 2: *Multifactor Studies of Electronic Commerce Factors Affecting Success*

Author	Factors
Vasilopoulou, Pouloudi, Patronidou and Poulymenakou, 2002	Organizational, societal, individual, technical
Schroder and Yin, 2000	Security, organizational and legal issues
Amit and Zott, 2001	Efficiency, complementarities, lock-in, and novelty
Duh, Jamal, and Sunder, 2001	Privacy, security, and the integrity of the marketplace
Yang and Jun, 2002	Reliability, access, ease of use, personalization, security, and credibility
Dholakia, Dholakia, and Chiang, 2000	Changes in consumer behaviour

(c) Business models research

Business model studies can be classified into two categories. The first corresponds to the works of people that focus their research on determining the different types of business models that have been implemented within the context of the Internet. In this realm, Timmers (1998) was one of the early contributors to this field. Bartlet (2001) and Rappa (2003) are more recent contributions to this type of research. Although these works are important to our understanding of the way industries adopt web technologies for their commercial transactions, they do not tell us much about the factors that contributed to the success or failure of any given model or of companies using the same business model. Another set of work has thus attempted to identify the components of a business model. The assumption made in these works is that these are the parts necessary for a business to be viable.

Timmers identified components of a business model when he defined the concept. It is possible to separate the different elements he included which are: (1) the architecture for the flow of products, information, and services; (2) a description of the potential benefits for the various business actors; and (3) a description of the sources of revenue. Timmers was by no means the first person that tried to identify the components of business model. The concept has existed and has been taught in universities for several decades.

A typical example of the way business models components are understood in a traditional sense is from Afhua and Tucci (2001), whose chapter on business models makes a nice comparison between the traditional components of a business model and the way these have to be thought of in an electronic environment. Generally the way business models components are described to people engaged in their designs is in the form of questions, which is the way these authors present the components.

Authors that have analyzed business models exclusively for electronic commerce have expanded on the elements that Timmers identified. Klueber (2002), for example, includes two other elements in addition to Timmers' original three. These are the IS architecture which is to support the business by adding standards and computability. The other components that Klueber includes are rules, which he defines as business logic, and the assumptions that the entrepreneur makes about the way the business is going to work. It is important to mention that his analysis of business components also includes a dynamic element in which he presents the way that all of these elements are interrelated and how they affect each other.

Osterwalder and Pigneur (2002) provide a more detailed analysis of components for an e-business. Each of their main four components of product innovation, customer relationship, infrastructure management and financials is further broken up into subcomponents to create a more complete picture. Bagchi (2002), who also focuses on electronic commerce, emphasizes information technology factors in a business model. One could argue that the components he identifies in the paper are ways to use technology to enhance the capabilities of a company.

There are other studies that have focused more on the dynamics of electronic commerce. Two papers that have done this are McGann and Lyytinen (2002) and Gordijn and Akkermans (2001). The first is a combination of static and dynamic components while the other is mostly dynamic. The main feature that characterizes these studies is that they do not see a business in isolation. The other conceives of business models as interactions and, for this reason, points of contact, which they call value ports, and interfaces that are used to communicate between the different parties, which they call value interfaces, form an important component of the business. Table 3 presents the components that each of the authors listed in this section.

Table 3: *Business Model Components*

Author	Business models elements
Timmers (1998)	Architecture
	Potential benefits to actors
	Sources of revenue
Bagchi (2002)	Online information exchange
	Electronic execution and delivery of services
	Customized (or personalized) services
	Resource pooling
	Business intelligence
	Online collaboration
	Offering aggregation
Osterwalder (2001)	Product innovation
	Customer relationship
	Infrastructure management
	Financials
Afhua (2001)	Profit
	Customer value
	Scope price
	Revenue sources
	Connected activities
	Implementation
	Capabilities
	Sustainability
	Cost structure
Gordijn and Akkermans (2001)	Actor
	Value object
	Value port
	Value interface
	Value exchange
	Market segment
	Composite actor
	Value activity
Klueber (2002)	Business architecture
	Rules
	IS architecture
	Potential benefit
	Sources of revenue
McGann and Lyytinen (2002)	Trading mechanisms
	Trading protocols
	Integration points
	Enabling technologies
	Supporting infrastructure

3.   Factor Selection

As Shapiro and Varian (1998) suggested, managers often are lost in the "trees" of e-commerce models and miss the "forest" of core economic principles. Because analysis of academic work yields numerous factors, the purpose of this section is to select those that are considered key in the development of a business model for peer to peer applications.

To make the selection of factors it was first necessary to identify those that, although having a different name were essentially the same attribute. For example "revenue source" for Timmers (1998) is the same as "financials" for Osterwalder and Pigneur (2001). "IS architecture" for Klueber (2002) is similar to "enabling technologies" in McGann and Lyytinen (2002). Once these factors were identified, it was then necessary to create a table to determine which of the factors were mentioned most by each of the authors. The assumption was that the more one factor was mentioned the more important it was. This, of course, has the drawback that there will be additional studies in the future that may emphasize factors that for now have only been mentioned once, so there is indeed the problem that we may not include factors that are relevant. In the analysis of the factors that other scholars have identified there were some that could have been included in broader categories. For example, factors such as "ease of use," "easy access" could be included within the larger category of benefits to actors. Table 4 includes the factors used for the analysis of peer to peer initiatives and the explanation for each of them.

Table 4: Business Models Factor Selection

Factor	Explanation
Revenue source	This refers to the way the company will be able to obtain income to maintain its operations.
Potential benefits to actors	These include the qualitative as well as the quantitative benefits that the actors can obtain from the peer to peer business.
Enabling technologies	These include both basic as well as supporting technologies that foster interaction among actors and a smooth flow of information, services, and payments.
Security	This is a multifaceted concept that includes the protection of data and infrastructure to assure that communication with sites is reliable and protected from unauthorized access.
Behavioural changes	This refers to the type of personal changes in behaviour required to feel comfortable with the technology. These include the set of skills that are necessary to work with the technology as well as the social networks that they are abandoning for the technology.

4.   Peer to Peer (P2P) Initiatives

Until recently peer to peer initiatives have been developed on a voluntary basis. In spite of using similar technological capabilities, their objectives vary significantly. Some have commercial intentions while others pursue social or scientific aims. It is not yet clear which of these diverse initiatives will become viable commercial enterprises. Because

many of these pursuits are voluntary non-profit projects, it would be unfair to analyze them solely for their potential for financial gain. In fact the survival of some of these may depend precisely on the fact that there is no profit motive. A better approach is to determine their potential for success based on many factors. There are many P2P initiatives. Their goals include file sharing (Napster, Morpheus, KaZaA), distribution and caching (Kontiki, Radio Free Virgin), computer resource sharing (SETI@Home), and collaboration (Groove).

Most current peer-to-peer technologies focus on resource sharing and management services rather than controls and coordination between peers, however constraints associated with the sophisticated control mechanisms between peers may limit the broad application and use of P2P services.

The control of P2P networks can be implemented in various ways. Basically, there are two different models for P2P connection control: "brokered" and "purist" P2P models. The traditional control model deploys a centralized brokered server to control manage the P2P connection. This is also called a "hybrid" model since the control path keeps the client-server model but the data path is on the P2P networks. One of the examples is the Napster file-sharing network. Generic control functions such as search and indexing are performed in the brokered server located in the center of the P2P networks. Groove Networks is another example employing a mediation server (so called relay server) for collaborative editing services. The status and any changes of the user activities are kept and relayed through the networks centralized servers. Other P2P networks such as Kazaa and Blubster fall in to this server control model.

The control of P2P networks also can be deployed in the "Purist" P2P manner which allow open architecture of the P2P networks. In this pure P2P control, each peer node should have control over its self-organization, routing and other control functions for managing the P2P networks. Gnutella is one of the popular examples to deploy the control functions in this way. In the Gnutella Network, each node manages the membership and conduct search to form P2P networks. There is no central server to coordinate or relay these functions. Unlike the "brokered' approach, the peer nodes send and receive the query and responses among them to control the P2P network. That is, Gnutella peers build an overlay network by forging mesh connections with a set of neighboring peers. The initiation starts with the flooding of the queries to it neighbors. Such purist P2P networks include Gnutella, Morpheus, Limewire, Freenet, and Publius.

These technical control models will affect the ways that the different P2P service providers will interconnect and transact each of the peer users from the different networks. Those business models should be equipped with interoperable service discovery, transparent motivation mechanisms, resource rights management, and security mechanisms to keep the sustainability of their own business models.

(a) Peer to peer for file sharing

Napster and KaZaA

Napster was a predecessor to KaZaA. The primary initial purpose of both initiatives was the sharing of music files. KaZaA has been able to overcome some of the weaknesses that Napster had for commercialization. Napster was the first widely known peer to peer system. Shawn Fanning developed it in 1999 with the objective of facilitating the sharing of music files encoded in MP3. This was a mediated P2P network. The application used a centralized dedicated server to find MP3 files. Once these files were identified, peers could download them directly from other peers.

Napster was not initially developed with a method of earning *revenue.* The application did not have a payment mechanism to allow for the commercial transaction of these music files. In fact, its great success was precisely because it allowed access free of

charge. Napster is now defunct. The objective of Bertelsmann entertainment, which owned it, was to have subscriptions or advertising as a way of receiving income. It would have been difficult to achieve this due to competition from other file sharing systems. KaZaA, which was always intended as a commercial enterprise, has developed revenue sources based on advertising. Although advertising has proved to be successful for some business models, it is unclear if this is sustainable given the saturation of that model for other forms of Internet content.

The *potential benefit to users* is great in the presence of free files. While a paid system can also be valuable for people who like music, the perceived benefit, considering viable substitutes, would have to exceed the price. The advertising model also reduces user benefits, as they have to listen to commercials as well. Alternatively the benefits of this application could be derived from ease of use and a simple way of locating these types of files. Artists who allow their music to be shared can benefit from exposure but sales of music have been a primary source of revenue that they would not receive.

The *technologies* necessary for this initiative to become commercially viable would have to include payment mechanisms as well as a way of monitoring for the quality of the files and the connection. If music is to be sold, the indexing should include all of the reference information about the file such as album and artist. Because KaZaA uses advertising for revenue, the application includes a server for this as well as software for handling graphics (Camp 2002).

For this type of application to be viable, it would be necessary to have strong *security*. This would eliminate the possibility of downloading without payment. Because this is an environment where anybody with the application can share files, it would be necessary to have security in place to prevent the spread of viruses, for example. Similarly the peers would need to have security mechanisms to prevent strangers from accessing files or resources that they do not want to share.

The *behavioural changes* of the actors involved are closely related to the issue of revenue source. Artists, for example, would need to find a way of getting paid within the context of P2P applications. The entire industry would have to find a way of taking advantage of these technologies. Until recently the reaction has been to fight it. There are however some signs of change. RealNetworks, BMG Entertainment, Warner Music Group and EMI Recorded Music have created MusicNet, which uses a subscription model to allow users to stream and download music. This initiative, nonetheless, does not use P2P technology.

Existing users appear to be comfortable with and appreciate the value provided by P2P applications. It is, however, not clear if this would apply to the mass market. Trust and free rider problems remain an issue. In the case of KaZaA, the company is able to reduce the free rider problem by forcing slower downloads for those that do not allow downloading as much as they make themselves. In general terms KaZaA and other file sharing initiatives have potential as business applications but revenue sources and behavioural issues remain in question.

(b) Peer to peer for distribution and caching

Some P2P initiatives have the objective of using the peer for distribution and caching, meaning that those machines that have caching available are used to temporarily store some content to be later distributed to other peers. This type of peer distribution is aimed at making streaming more efficient and consequently faster. The way this works is by having the peers locate other peers that are closer to the one requesting the media stream. Once the closest peers are found these are used to cache content, which is then redistributed to nearby peers. This ensures an even load distribution among peer nodes (Triantafillou, 2003).

Kontiki

Kontiki began operations in 2001, as a media distribution company. It uses peers to distribute high bandwidth content. These media files are loaded on multiple PCs connected to the Internet. When a user requests a particular file, the system will retrieve it from the nearby peers. Kontiki targets large corporations that want to deliver media rich content across multiple facilities. This could include, for example, multimedia training materials, service or product promotions, and videoconferencing across sites.

The *revenue sources* for Kontiki rely on having companies buy their technology to support communication with other offices, partners, or clients. Some companies are using it to deliver advertising to customers while media organizations use it for streaming videos and game publishers use it for online games.

There are great *benefits to actors* from this technology specifically related to the speed of content delivery. This technology allows corporations to develop rich content that can be downloaded or streamed at high quality. Users also benefit from reduced waits for multimedia files.

The *technologies used* by Kontiki consist of a set of applications that enable the protection and management of digital content, the delivery distribution piece that includes prioritization capabilities, and the delivery application that has built-in security to protect content while being delivered through the Internet. Kontiki thus takes full advantage of peers to deliver content at a much faster speed. Because these technologies are not for conducting transactions, the company does not yet have to worry about including payment mechanisms although it could benefit from these because companies adopting Kontiki solutions could begin to charge for content.

The *security* built into the application allows for secure delivery of multimedia material over the public Internet. It is not clear how the company handles problems with viruses. Infected files from one peer could potentially spread to others. The risk of this at the corporate level is lower because companies typically protect themselves better against viruses than consumers do.

The *behavioural changes* necessary for this project to work vary depending on the market segment where they are aimed. At the corporate level, potential clients may prefer to have personal meetings rather than see a video on their PCs. Similarly employees may be more comfortable with in-person rather than computer-based training. For some users that are simply downloading content, the need for an initial download of an application to view content may discourage them from using the service. It is also unclear whether the users know that their machines could potentially become peers.

In general terms, Kontiki has a strong technology that brings benefits to its users. There is a clear revenue base that could potentially be expanded to include payments from customers downloading multimedia content. The technology is robust, which fosters a certain level of security. The behavioural aspects for acceptance are not as easy to determine.

(c) Peer to peer for distributed processing

The main purpose of initiatives that share processing power is to gain access to resources when working on tasks that require substantial computing power. There are millions of personal computers connected to the Internet around the world. Relatively few of these are used at all the time, which gives others the opportunity of using processing capabilities when they are idle.

SETI@Home

Search for Extraterrestrial Intelligence (SETI) at Home is an initiative by the Space Sciences Laboratory of the University of California, Berkeley. The search for intelligent signals sent from other worlds requires extensive processing power. Processing power is necessary to help determine unknown parameters, such as the frequency that signals are transmitted, the bandwidth, whether they are pulsed and at what time intervals, and whether or not they are coming from space or echoes from earth (Korpela, et. al., 2003). The data is collected from the Arecibo telescope and is then sent to Berkeley where it is broken down into small pieces that can be sent to the volunteers that agreed to allow their computers to be used for processing tasks. Volunteers download software from the Berkeley center where the computer is registered. Data is thus sent and the processing take place at a time when computers are idle. As of January 20, 2003 there were 4.2 million volunteers whose computers were being used to process data gathered for the SETI project. SETI@Home is the largest computational project in existence (Korpela, et.al., 2003).

The purpose of this initiative is entirely scientific and thus there is no *revenue* generation for those that have developed this technology. The users also do not receive any credit except for their name on a list of co-discoverers when an unusual radio signal is detected. In real terms volunteers are doing this for curiosity or simply to help. It is important to note, however, that the SETI scientists are buyers rather than sellers. They are obtaining valuable processing power without having to pay for it. If this reduces costs or enables a valuable activity to happen that would not otherwise occur then it is having a positive financial effect. Furthermore, it is creating value from a resource that would otherwise be wasted.

The *benefit* from the use of these technologies is for the most part to the scientists that are working on the project, as they are able to expand their computing resources at a low price. To buy the processing power that they are receiving from volunteers would be extremely expensive and perhaps even impossible. The user benefits from learning about the technology used at the project website. People nonetheless could learn this without becoming volunteers.

The *technology* used has effectively expanded the processing capabilities of the researchers in this project. S*ecurity* remains an issue, as is shown by people, perhaps seeking fame, who have hacked the software to fake a signal. In an effort to eliminate this problem, the researchers send the same data to two different computers and then verify the information themselves. This process, although ultimately eliminating the problem of false signals, is done manually because of the limited security built into the application. The participation of networks of volunteers is thus based primarily on trust.

The *behavioural changes* are primarily related to peoples' willingness to share their computers with the SETI@Home project. While there are millions of volunteers, there are also many more millions of non-volunteers. The reward system is too limited to attract more people.

Although the SETI@Home project is purely scientific, it is not difficult to think that P2P networks for sharing computing power can have beneficial and possibly successful commercial applications. For example, the pharmaceutical industry is faced with complex tests that need to be done before a new drug is released in the market. Having greater processing power available could potentially reduce the time of their research. Commercial applications of P2P distributed processing may soon come.

(d) Peer to peer for collaboration

Peer to peer networks can be used for people to collaborate on projects that require a number of participants. The traditional approach is to use a single computer that stores all data and participants make modifications directly on this central server. Although this is a workable solution it suffers from the time lag resulting from sending information back and forth from the server to the participants. Similarly the processing necessary to handle these requests can make the application unstable. P2P networks can eliminate these problems by having the processing and the data spread among all the participants. Groove Networks is one of these initiatives.

Groove Networks

Ray Ozzie, the creator of Lotus Notes, founded Groove Networks in 1997. The company has developed an application that allows people to collaborate online by using its software. The Groove application is a managed peer to peer network as there is need for servers to have some level of control to foster data integrity and security.

The *revenue source* for the company comes from the sale of different types of applications to corporate clients. These include applications for scalability of the software, training, and infrastructure to manage collaborative projects. The company can also generate revenue from offering hosting services.

The *benefits* that users have identified are inherent in the benefits associated with P2P applications and these include more efficient use of corporate networks as well as greater stability of servers that do not need to handle the processing power as it is being distributed among peers. For users, the benefits are primarily in the ability to easily set up meetings without having IT departments involved in complex connectivity.

The *technology* has several modules: the main collaborative application, training, license distribution, identities, usage monitoring, and integration, which has the function of security. As a support technology it has not been set up to make payments. This is therefore an application that is not intended to support electronic commerce initiatives. It falls within the category of productivity software.

The *security* embedded in the system allows for participants to share files that are automatically encrypted. These files can simply be dropped onto the Groove workspace. As in other initiatives, the *behavioural changes* may be the greatest obstacle to the use of this technology. Extent of online collaboration will depend, in part, on the culture of the organization. Previous experience with computer-mediated collaboration would be a factor that would encourage acceptance of these technologies. Person to person communications is a powerful barrier as well as people's comfort with existing technologies. E-mail, although an imperfect substitute, is a pervasive tool that, for its simplicity, is the default for electronic collaboration.

Groove has a promising product in terms of technology, the benefits, and the revenue base. The greatest challenge will be the users themselves, who are accustomed to prior practices and may not be willing to adopt unfamiliar methods.

5.   Conclusion

Table 5 is a summary of the analysis from the previous sections. It helps the reader understand at a glance the business potential of these peer to peer initiatives. Darker circles indicate relatively lower probability of commercial success of a particular P2P model.

Business models research has provided tools to help analyze the commercial feasibility of new technological approaches. Peer to peer technologies available over the Internet have commercial potential and in the coming years there will be many initiatives attempting to take advantage of distributed computing. This paper reviewed some of these initiatives in four categories of peer to peer uses. Some of these showed more business potential than others. Specifically, it is clear that scientific pursuits such as SETI@Home will not evolve into commercial projects because this is not their purpose. Kontiki and KaZaA, on the other hand, have evolved with profit as a goal, but their current weaknesses could lead to failure if they are not resolved. The summary table indicates that Groove and Kontiki have the greatest potential for commercial success, but both of these face challenging behavioural barriers. In the next stage of this research it is necessary to provide empirical support for the framework.

Table 5: *Summary Analysis of P2P Commercial Promise*

Example	Napster / KaZaA	Kontiki	SETI@Home	Groove
Type of P2P system	File sharing	Distribution and caching	Distributed processing	Collaboration
Revenue source	◐	○	●	○
Potential benefits to actors	◐	○	◐	○
Enabling technologies	○	○	◐	○
Security	◐	◐	●	○
Behavioural changes	◐	◐	◐	◐

Legend: ● *Relatively low probability of success* ◐ *Relatively average probability of success* ○ *Relatively high probability of success*

References

Amit, R. and Zott Ch. "Value Creation in E-business," *Strategic Management Journal*, Vol. 22, No. 6-7, June-July 2001, p. 493-520.

Bagchi, S. and Tulskie B. "E-business Models: Integrating Learning from Strategy, Development Experiences and Empirical Research," *20th Annual International Conference of the Strategic Management Society*, Vancouver, October 15-18, 2000.

Bakos, Y. "A Strategic Analysis of Electronic Marketplaces," *MIS Quarterly*, Vol. 15, No. 3, September 1991, pp. 295-310.
http://pages.stern.nyu.edu/~bakos/stratemkts.pdf. Accessed January 26, 2003.

Barua, A. Konana P. Whinston A. and Yin F. "Driving E-Business Excellence," *Sloan Management Review,* Vol. 43, No.1, Fall 2001, pp. 36-44.

Camp, J. "Peer to Peer Systems," *The Internet Encyclopedia,* Hossein Bidgoli,(ed.) John Wiley & Sons: Hoboken, New Jersey, Spring 2003.

Dai, Q. and Kauffman, R. "Business Models for Internet-Based B2B Electronic Markets," *International Journal of Electronic Commerce*, Vol. 6, No.4, Summer 2002, p. 41-72.

Dholakia, N., Dholakia, R. and Chiang K. Behavioral Assumptions Underlying Business Models of Retail E-Commerce Ventures," *Americas Conference on Information Systems* Long Beach, California 10-13 August, 2000. http://aisel.isworld.org/article.asp?Subject_ID=17&Publication_ID=1 Accessed January 26, 2003.

Doyle T. and Melanson J. "B2B Web Exchanges: Easier Hyped Than Done," *Journal of Business Strategy*, Vol. 22, No. 3, May 2001, p. 10.

Duh R., Jamal K., and Sunder S. "Control and Assurance in E-Commerce: Privacy, Integrity and Security at eBay," *Sloan Management Review,* Vol. 43, No. 1, Fall 2001, p. 17.

Gordijn, J. and Akkermans, H. "Designing and Evaluating E-Business Models." IEEE Intelligent Systems, July-August 2001, pp. 11-17.

Groove Networks. http://www.groove.net. Accessed January 26, 2003.

Kontiki. www.kontiki.com, Accessed January 26, 2003.

Korpela, E., Werthimer D., Anderson D., Cobb J., and Lebofsky M. SETI@Home: Massively Distributed Computing for SETI, *IEEE Computer Society*, http://www.computer.org/cise/articles/seti.htm. Accessed January 26, 2003.

McGann, S. and Lyytinen, K. "Capuring the Dynamics of eBusiness Models: The eBusiness Analysis Framework and the Electronic Trading Infrastructure." 15th Annual Bled Electronic Commerce Conference, Bled, Slovenia, June 17-19, 2002.

Oram, A. (ed.) "Peer-to-peer: Harnessing the Benefits of a Disruptive Technology," Cambridge, MA: O'Reilly, 2001 First, ed.

Osterwalder, A and Pigneur Y. "An eBusiness Model Ontology for Modeling eBusiness," 15th Bled Electronic Commerce Conference, Bled, Slovenia, June 17-19, 2002.

Rappa, M. "Managing the Digital Enterprise." http://digitalenterprise.org/models/models.html. Accessed January 26, 2003.

Schroder D. and Yin P. "Building Firm Trust Online," *Communications of the ACM*, Vol. 43, No. 12, Dec. 2000, p. 73.

Shapiro, C. and Varian, H. Information Rules: A Strategic Guide the Network Economy. Harvard Business School Press, Boston, 1998.

Timmers, P. "Business Models for Electronic Markets," *Electronic Markets*, Vol. 8, No. 2, July 1998.

Triantafillou, P., Xiruhaki Ch., Koubarakis M., Ntarmos N. "Towards High Performance Peer-to-Peer Content and Resource Sharing Systems," *Proceedings of the 1st Biennial Conference on Innovation Data Research*, Asilomar California, January 5-8, 2003.

Vasilopoulou, K., Pouloudi, N., Patronidou S. and Poulymenakou, A. "Business models: A Proposed Framework," *Proceedings of the e-Business and e-Work Annual Conference*, Prague, Czech Republic 16-18 October 2002, p. 1003-1009. http://www.eltrun.aueb.gr/papers/Efactors-Ework.pdf. Accessed January 26, 2003.

Wathne, K. and Heide J. "Choice of Supplier in Embedded Markets: Relationship and Marketing Program Effect," *Journal of Marketing,* Vol. 65, No. 2, April 2001. p. 36-51.

Williams, R.and Cothrel J. "Four Smart Ways To Run Online Communities," *Sloan Management Review*, Vol. 41, No. 4, Summer 2000, pp. 81-91.

Yang Z. and Jun M. "Consumer perception of e-service quality: from Internet purchaser and non-purchaser perspectives." *Journal of Business Strategies*, Vol. 19, No. 1, Spring 2002, p. 19.