THE IMPACT OF CO-OPERATION POLICIES ON PARTICIPATION IN ONLINE LEARNING OBJECT EXCHANGE: A PRELIMINARY INVESTIGATION

by

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AUTHOR'S DECLARATION FOR ELECTRONIC SUBMISSION OF A THESIS

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

ABSTRACT

THE IMPACT OF CO-OPERATION POLICIES ON PARTICIPATION IN ONLINE LEARNING OBJECT EXCHANGE: A PRELIMINARY INVESTIGATION

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This research investigates the impact of cooperation policies on participation in, and benefits from, online learning object exchanges.

First, an in-depth study of issues encountered in other online contexts (peer-to-peer systems, discussion group with lurkers, reputation systems) provided evidence that explicit cooperation policies and motivation techniques could bring benefits to online object exchanges. A case study is presented based on the comparison between two peer-to-peer systems, Mojo Nation and Gnutella, to show how cooperative policies could add value to online communities. This case study highlights several issues, such as the algorithm of pricing/exchange mechanism. Successfully solving these issues will be the key to identifying the benefits of an e-marketplace based online object exchange.

An outline of an experimental exchange mechanism is presented, along with a prototype interface for users. To investigate further issues for users, an online scenario-based questionnaire was set up to measure potential users' attitudes towards cooperation policies. The detailed analysis on questionnaire results shows that cooperation policies hold promise to make the online object exchange more efficient. The results also illustrated how a transaction-based community could achieve the following benefits:

- increase of ROI
- object value discovery
- faster repository expansion
- better motivation through reputation recognition

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THE IMPACT OF CO-OPERATION POLICIES ON PARTICIPATION IN ONLINE LEARNING OBJECT EXCHANGE: A PRELIMINARY INVESTIGATION

1. Introduction

Online community thrives on various Internet platforms. It's an important entity of today's Internet. Online communities provide us with a new way of communication. One important subcategory of online community is an online object exchange group. There are two kinds of online object exchange groups: multifunction groups and pure object exchange groups. Multifunction groups provide a combination of services: group news, chat, message board and file sharing. Any of these services may be equally important to such groups. A good example for a multifunction group will be Yahoo! Groups[1] and Smiling E-Groups[2]. Pure object exchange provides a marketplace or mechanism for members to exchange objects. Most of them are only about object exchange. Some of them (under peer-to-peer environment) integrate instant messaging into the entire platform for user convenience.

Successful communities are built on co-operation and trust. In practice, however, behavior that seems reasonable to one person, and gets their needs met, may damage the group and diminish trust. (Preece, 2000, p.188) For example, most online communities protect user's anonymity, so a user can leave the community after retrieval of information without any contribution. These users are normally called lurkers, leechers or free riders. The existences of these users may be more or less destructive to the online object exchange.

An online community always has implicit rules for members' behaviors; object exchange communities may also have explicit policies which encourage co-operation and/or reduce free riding behaviors. The research presented within these pages is a small step toward our understanding of the impact of co-operation policies on the extent of participation in online learning object exchanges.

In the following chapters, we will first give a brief introduction about online learning and learning objects. Then we will present a case study based on the comparison between two online object exchange systems from outside the realm of learning object: Gnutella[3] and Mojo Nation[4]. This case study is presented to show how cooperative policies could add value to online communities. For each system, we will provide an in-depth overview of background, mechanism, and structure to present their respective strengths and weaknesses. The first approach (exemplified by Gnutella) is to provide users freedom to enter and exit an online object exchange by using a protocol. This approach is adopted by most online object exchanges. The second approach (exemplified by Mojo Nation) forces users to co-operate by adding a micropayment system.

Certain specific issues raised in the case study will then be explored further in an online learnware object exchange context. We will present our approach exemplified by CLOE[5] (Co-operative Learnware Object Exchange). It uses an adaptation of reputation systems (reputation system will be introduced in 4.3) based on a

pricing/exchange mechanism to enforce co-operation in an online learning object exchange.

Finally, we will collect survey data from participants in MERLOT[6] and CLOE to evaluate their attitudes towards co-operation policies. These two online object exchanges are both within the domain of learning objects exchange for ease of comparability. We will use the data collected from MERLOT users and potential CLOE users to reflect on issues arising in the emerging CLOE project.

2. Example of Online Learning Object Exchanges

As many related computing and networking technologies have matured, online learning as an application and an industry becomes more and more promising.

As proposed by the TeleLearning Research Network (TLRN), the definition of online learning/telelearning is: “the use of multimedia learning environments based on powerful desktop computers linked by the Information Highway. It is a fundamentally important technological and social innovation at all levels in a knowledge based society.” (TLRN, 1996) Another definition of online learning used by the LT3 Center at the University of Waterloo is “connecting people and learning resources through interactive technologies”. (T.T.Carey, personal communication, office screen saver)

Telelearning has many different models. Some examples are:

Web-based Training Model: Courses are delivered via web. Mostly the course materials are located in a central server; a registered student can use client machine to request retrieval of courses. Most web-based training models involve certain multimedia files. So a high-speed Internet connection will be required of students. Recent developments, such as Authorware by Macromedia, can make course files smaller. Web-based training is a viable model of telelearning. It’s adopted by many big companies to deliver training sessions to employees. There are several advantages of WBT: 1) Trainees can discuss a

particular problem with a trainer via email or chat room; 2) Peer trainees in a training session can help each other in a course bulletin board system. Characteristics like these help trainees feel as if they are in an interactive classroom setting. This makes WBT different from other TeleLearning models.

Computer-based Training Model: Courses are delivered via computer-based storage media, mostly CD-ROMs. Telelearning companies or training departments package course materials in CD-ROMs and distribute them to customers. It's not required to have an Internet connection in CBT scenarios. Many IT companies, such as Oracle and SAP, sell CBT CD-ROMs to partners or targeted students. CBT becomes a secondary source of profit for these companies. There are also many pure CBT players in the market, such as SmartForce, NetG, Transcender, etc. This indicates that the CBT industry is seen to be quite promising.

Online Learnware Repository Model: Learnware is developed by instructors to help deliver a course. However students can easily use it to conduct self-paced study. Individual units of learnware are also called learning objects and are collected in repositories. There are two different scenarios based on a learnware repository's major purpose and objective: for learners and for instructors. In one scenario, instructors select objects for use by their students. Alternately, the repository may be used by learners to get learnware information to enhance learning experience.

Learnware can be in various formats; it can be course slides, HTML files, applets, etc. To facilitate course development and delivery in an efficient way, effective learnware reuse has become a major topic. If an instructor can reuse a learnware object developed by somebody else for the same course or a different one, he can save valuable time. By sharing resources, learnware development efforts can be minimized to boost total community efficiency. An online learnware repository is an important component in this. People can check the website-based repository to get the appropriate learnware. There are a growing number of online learnware repositories, such as MERLOT and CLOE.

There are some other online learning models. For the purpose of this research we are interested in online learnware object model as it relates to the co-operation in an online object exchange. We will first introduce two online learning object exchanges. They are MERLOT and CLOE. They use different policies to regulate community users.

2.1 MERLOT

MERLOT is an acronym for Multimedia Educational Resource for Learning and Online Teaching. It was developed by California State University Center for Distributed Learning (CSU-CDL[7]). MERLOT has over 2,000 members and a collection of metadata for over 3,700 web-based learning materials. MERLOT is modeled after the NSF funded project, "Authoring Tools and An Educational Object Economy" (EOE[8]) by Dr. James Spohre, other industry, university, and government collaborators, and hosted by Apple Computer. The major objective of EOE is to develop and provide tools to enable

formation of online communities, which are engaged in providing shared knowledge base of learning materials.

MERLOT had developed and is implementing a peer review process in 13 Discipline Communities: Biology, Business, Chemistry, Engineering, Health Science, History, Information Technology, Mathematics, Music, Physics, Psychology, Teacher Education, and World Languages. (MERLOT's Brochure, n.d.)

MERLOT is an open system, which means anyone can retrieve information without membership status. However, only members can contribute learnware resources to the online repository. When a member contributes a learning object, there are several fields required, such as learnware URL, author, publisher, discipline, learnware description, images, etc. There are also some optional metadata fields to describe a learnware object. Below is a screenshot of MERLOT's "Browse Materials" section.

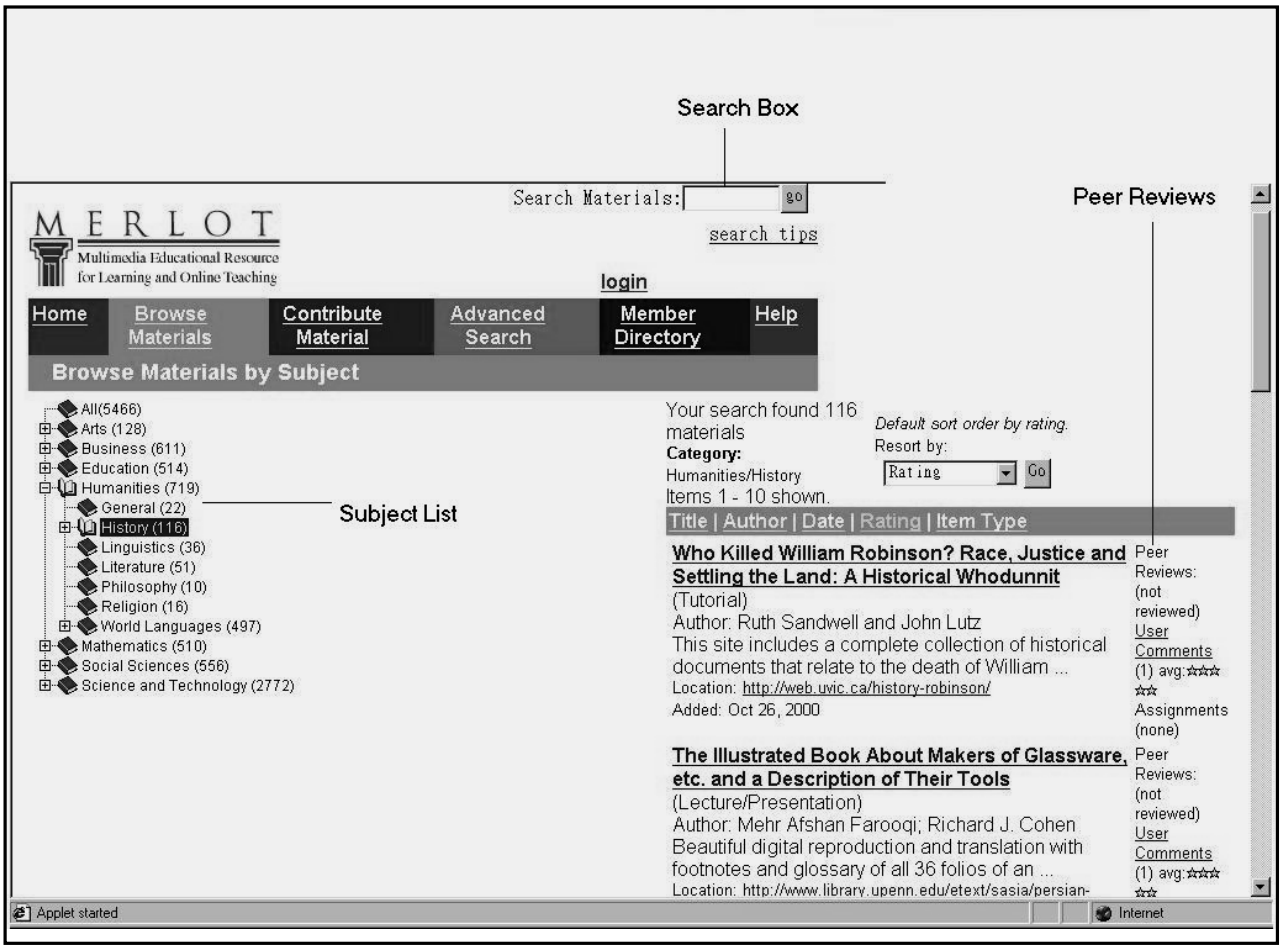

Figure 1: Screenshot of MERLOT Browse Materials Section

MERLOT is also an online educational community. It allows you to search for learnware, reviews, assignments and people. When a member contributes something, other members may have a sense of his role and subject interests in education. MERLOT provides a peer review process, a framework of evaluation standards and a rating system for instructional technology. These three tools help members get the best from the index of metadata about learnware; they also help MERLOT learn, improve and scale.

MERLOT has the following advantages and disadvantages:

Advantages:

1. A powerful search engine. MERLOT has a very powerful search engine. You can either specify different fields to search or search full-text. It's mainly because of fine-tuning of metadata. People can easily find the relevant learning objects by using its search engine.
2. A good review system. The review system resembles Amazon's book review system. The review system can help people to select better learning objects. As a result, benefits of reuse are maximized.
3. Good user interface design. MERLOT has developed a quite good user interface. On the left hand side of the page, there's a frame (developed using Java applet), in which all the subjects are listed. When you click any link on the left hand side, the portion of the right hand side will show the appropriate contents. For each learnware object, the listed attributes are informative.
4. Easy information retrieval. When a member finds relevant learnware, its URL is listed just below as one of the learning object's attributes. To reach this learnware object, it's only one click away. This information retrieval process is very effective.

Disadvantages:

1. Some member actions involve lengthy process. The registration process to become a member is quite long; this is not a major concern since many fields are

optional. Only last name and e-mail are actually required. More problematic is the learnware contribution process. The contribution process is pretty long. Many fields are required. For the metadata section, it's not very easy for a member to learn which information is required for different metadata fields. It may involve a not short learning cycle to understand all the metadata entries. A good online help system could alleviate this problem.

2. The community policy to make MERLOT a real cooperative system is weak. Though the contribution process is long, the information retrieval process is very short. People can retrieve information whether a member or not. Therefore it's reasonable to think about the existence and implications of free-riding behavior. This is neither fair to diligent contributors nor beneficial to whole community growth. A good co-operative policy may help at this point.
3. MERLOT assumes no responsibility for availability of objects. MERLOT is a repository of metadata of online learning objects. It doesn't store objects itself.

MERLOT is currently the biggest online learning object exchange. Its concept, system structure, metadata exemplification etc. as a whole serves as a good example for the followers in the same domain.

2.2 **CLOE**

CLOE is an acronym for Co-operative Learnware Object Exchange. Tom Carey, William Oldfield and Peter Goldsworthy from LT3 Center in University of Waterloo formed its proposal and concept.

Like MERLOT, CLOE's objective is to enhance the effectiveness of teaching and learning by expanding the quantity and quality of online learning materials in an online object exchange platform. Unlike MERLOT, CLOE has explicit collaboration policies to encourage the development of learnware objects with a strong commitment to re-usability.

The key innovation of CLOE is its exchange mechanism base on a virtual market economy. Each institution will contribute educational multimedia to the co-operative exchange and use resources developed by the other institutions in return. There are credits attached to each exchange. The credits each institution can get in one transaction are calculated in equations, which include basic elements of learnware use as variables. So there is a mandatory co-operation policy built into CLOE[9].

CLOE's long-term objective is to become a university-based electronic marketplace for the exchange of learning objects. Different from MERLOT, CLOE is a closed system for online learnware object exchange. Membership is required to access online learnware repository in CLOE. The CLOE project team has a different idea about how to make an online cooperative community. The result is that CLOE uses an explicit set of co-operation policies on participation in an online object exchange.

CLOE is a closed system. To register, an applicant from a member institution should go through the registration process. On the registration screen, there are ten fields, from

which four field are required. The required fields are: First Name, Last Name, University and Email. There is stricter rule on email entry: User should input a unique email, which is not in CLOE's registration database. System will use this email to send user registration information. After registration finishes, the system will automatically send an email with applicant's information to the webmaster. After reviewing this information, webmaster will send user the login name and password.

After login, a member will see the CLOE learnware repository. There are three functional modules working in the repository: add, update and search. We will illustrate this with screens from the CLOE prototype.

Add: Members can use it to contribute learnware to the repository. There are some required fields and many optional metadata attributes needed to be filled in. There are help files powered by JavaScript on every field. In CLOE, contributors must be the authors of an object, or an institutional representative with appropriate authorizations. In MERLOT, anyone can contribute. Then administration team manages to contact the authors to confirm their willingness to have the object indexed in MERLOT.

Update: Members can use this function to update the major information and metadata about the learnware contributed before. When a member clicks on update, he will see all the learnware he has inputted before.

Search: Members can use search to find a specific learnware. Search range can be customized to user's need: all fields, title, subject, creator, university and audience level. Users can use search range combined with search criteria: 'match all words', 'match any

words' and 'match exact phrase'. Figure 2 shows the screenshot of CLOE's main screen and member screen.

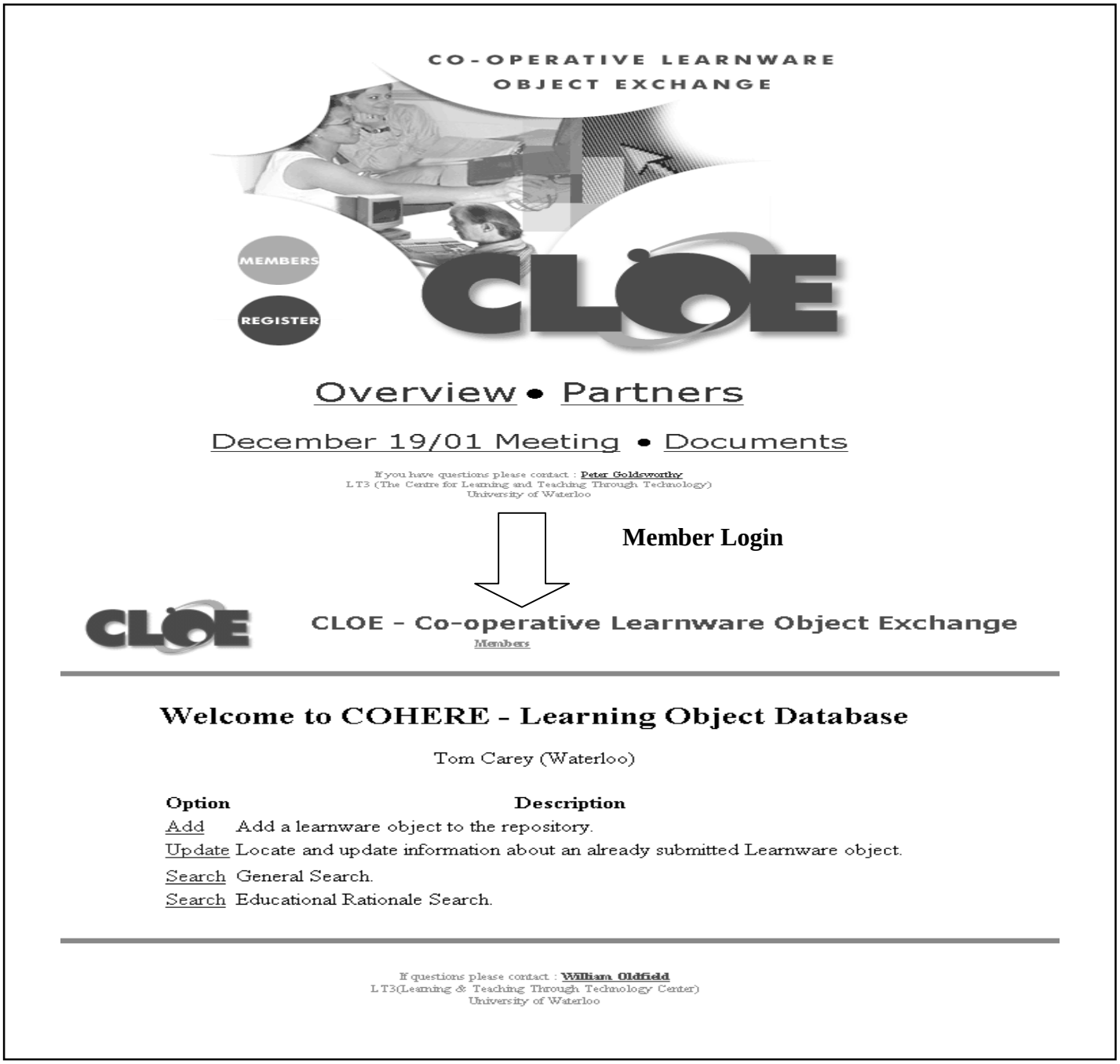

Figure 2: Main Screen and Member Screen of CLOE

Initially, we can observe the obvious difference between Figure 2 (MERLOT main screen) and Figure 3 (CLOE main screen): When you go to MERLOT's website, everything about learnware is already there; For CLOE, you cannot see any information about learnware on the main screen. It's a closed system for members only. However, when you successfully log into CLOE, you will not notice any major difference from MERLOT's main screen (though there is layout reorientation). In both systems, for example, there is categorization of learnware according to its discipline. And you can easily find every learnware object by using the search engine. The only difference on screen is that a checkout process is added.

As we will show later, the learnware exchange mechanism in CLOE is based on a market economy. The exchange mechanism can also be seen as rules of a reputation system. Briefly, the exchange mechanism works in this way: When a faculty member from an institution selects a learning object for use with students, the institution's account is debited. The account of the contributing institutions is credited an appropriate amount. The price to utilize a learning object from the exchange will be a specific amount for each object. Both qualitative and quantitative variables must be considered to set the price for a learnware. For example, usage duration, creation time and learning hours of a learnware are all variables counted into the calculation of pricing mechanism. The details of a sample pricing/exchange mechanism will be presented in Chapter 4. The exchange mechanism is one of the core technologies CLOE uses. This mechanism is set up to help CLOE become a truly co-operative online learning community.

We will briefly go through the advantages and disadvantages of CLOE as follows:

Advantages:

1. Good user interface design. The interface of CLOE is very clear to operate with. All the functions are easy to find.
2. Good search engine. Connecting Zope (open source web publishing software) at front end to MySQL (open source database software) at back end makes the search engine effective and efficient.
3. Good help file system. Help files are in JavaScript format. User can find help files for each fields in the add learnware process. Help file will be in another pop window, which will not interfere with original open window.
4. The core technology---pricing/exchange mechanism can help alleviate free-riding behaviors.

Disadvantages:

1. The add learnware process is long. But metadata is essential to build a powerful search engine. Here, the excellent help files system can solve this problem.
2. No review system. It's not easy for members to choose the right learnware from search results, although there are links to MERLOT reviews.

Both systems have advantages and disadvantages. However, the major difference between these two is that CLOE is a closed market-economy based object exchange. Also CLOE is both a repository and an index. It employs pricing/exchange mechanism. How

will this feature influence the community operation and performance? One way to anticipate how the community will respond to the co-operation policies is to examine parallel developments in other online object exchange. To do this, we will present a case study of two peer-to-peer systems in Chapter 3. These systems have different co-operation policies, which will illustrate the potential impacts of the differences between MERLOT and CLOE.

3. Case Study: Two Peer-to-peer Systems

The commercialization of the Internet just five or six years ago greatly improved the connection between information technology and normal people life. Now the Internet has an impact on almost everything in the modern world. But it's still true to say that we've only discovered 2% of Internet's potential, if we have a chance to look back at Internet 50 years from now.

Recent renaissance of peer-to-peer (P2P) technology is a good example of the unpredictability of Internet development. The Internet was conceived as a peer-to-peer system in its earliest stage. The first few hosts on the ARPANET---UCLA, UCSB, SRI and the University of Utah connected to each other with equal status. They were peers in ARPANET. As the Internet evolved, a client/server model began to dominate the Internet, especially since its commercialization. It was 2 years ago that peer-to-peer [P2P] technology came back to complement the mainstream client/server model.

The popularity of P2P technology is so surprising given its inconsistency with the dominant client/server architecture of the Internet. But its success proves the compatibility of the Internet with P2P approaches and shows the possibility of future development. Peer-to-peer technology is very important in our research as it revolutionizes the way people contribute in an online object exchange. As a result, the

number of online object exchanges built on peer-to-peer system has greatly increased over the past two years.

In the first part of this case study, we will give background information about these systems. This information will highlight what drives or facilitates people to lurk in online communities. We will show how the factors and features in those P2P systems can illustrate the issues of co-operation in a closed market economy-based online object exchange.

3.1 Peer-to-peer Systems

Why do we choose peer-to-peer systems as the scenario of this case study? First, almost all the P2P systems are used to exchange objects between users. Second, it helps to limit the differences between the systems in the case study. Finally, P2P is being considered as a possible structure for online learning object exchanges. (Shepherd, 2001)

Interestingly, there's still no widely accepted definition of peer-to-peer. Initially, this word was widely used by journalists to describe the popularity phenomena of Napster. The term peer-to-peer can get many people confused: a personal interview is peer-to-peer; fax and telephone are also peer-to-peer. Meanwhile Napster[10] is not strictly peer-to-peer. It still has a centralized server, which stores its user's information.

In the computer and internetworking domains, the widest meaning of 'peer-to-peer' is to conduct distributed computing or share computing resources in a network of equal status

members. Each peer in the network can communicate directly every other peer. The peer will be a computing device such as PC, UNIX workstation, Palm, printer and smart phone, etc. The network can be LAN, WAN or Internet. In most popular usage, peer-to-peer means to provide an application to help computers connect to each other directly in an easy way. According to this definition, Napster can fit into peer-to-peer computing because it's mostly about an application to help computers communicate directly.

People know peer-to-peer because of Napster. Napster was born in late1999. But peer-to-peer ancestors are as old as the Internet. The Internet as originally conceived in the late 1960s was a peer-to-peer system. (Minar & Hedlund, 2001) At that time, ARPARNET tried to integrate all the hosts on it----UCLA, SRI, UCSB, and the University of Utah. They were eventually connected together as computing peers. There was no server or client in the early Internet; every computer had equal status as the others. On the Internet, any two computers could send packets to each other until the late 1980s. Since the introduction of FTP and Telnet, Internet became organized more and more as client/server. The client/server model has many advantages, e.g. scalability and central manageability. It was these advantages that brought the first wave of Internet commercialization. In the midst of commercialization process, there are still some peer-to-peer systems in use, e.g. Usenet and DNS.

Napster is very important in terms of leading the revival of peer-to-peer systems. Though there are many other projects (e.g. SETI@home[11], Popular Power[12]), which started earlier than Napster, their user base is much smaller. With Napster, people can use the Internet

on their desktop in roles other than browsing, downloading or trading e-mail. This upgrades the role of desktop PCs from client to server. In contrast to the client/server model, peer-to-peer technology makes users producers as well as consumers.

Peer-to-peer technology helps place a files owner and computer with his files in the same geographical location. In a client/server model, the files a user shares are mostly in a remote web server in a data center, which is not at the same place the owner works. In a client/server model, users are able to produce some information, but it's not very convenient. For example, one user can produce some web pages on his desktop. But he cannot publish it on his machine. He should upload it to a server, and then other users can access it. By doing this, he should accept many restrictions applied to the publishing process. It's also true for FTP in terms of file sharing in the client/server model. In modern Internet, there is no fixed IP address for many client machines. Thus it is especially difficult to maintain a personal FTP site. It is nearly impossible to promote a client machine into a server machine.

But for a peer-to-peer system, a user can control or publish his files right on his machine. Peer-to-peer technology actually increases the normal user's capability on the Internet in terms of broadening the range of reach and sharing files. In other words, by borrowing terms from client/server model, one node in a peer-to-peer system can be client and sever at the same time. In short, they are all peers. Figure 3 compares these two models in terms of information flow.

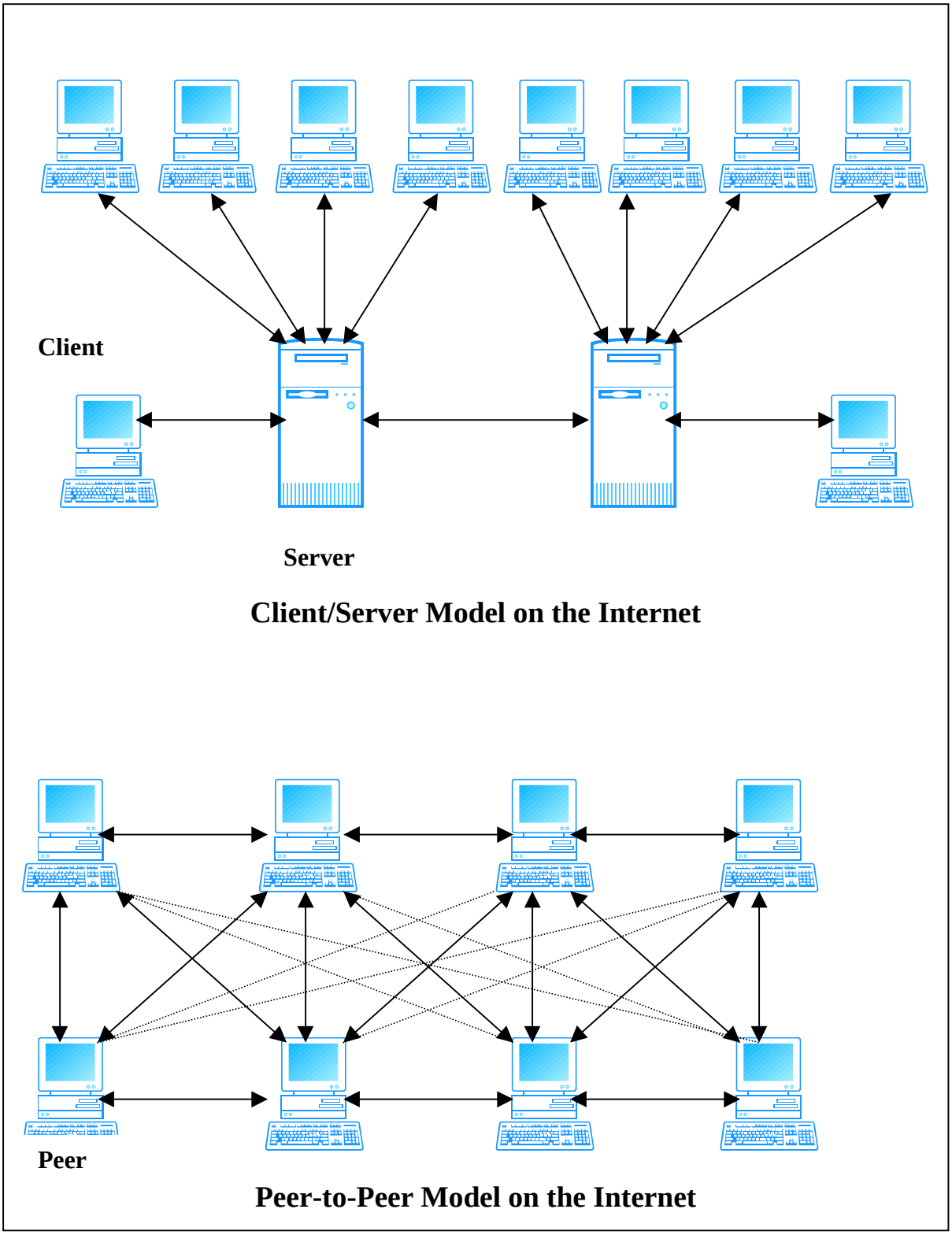

Figure 3: Client/Server Model and Peer-to-Peer Model

3.2 Napster

Shawn Fanning, a college dropout, developed a software tool to facilitate MP3 file sharing among his friends. (Greenfeld, 2000) After receiving help from his uncle on commercialization, Shawn Fanning founded Napster in May 1999. It achieved 60 million registered users in 9 months. It is estimated by Webnoize Research that 57% of all USA college students sign onto Napster once per week. (King, 2000) This is unprecedented in terms of accumulating registered users in such a short time. Its huge success started the renaissance of peer-to-peer technology.

Napster has several important characteristics to make it so popular:

1. Music files (in MP3 format) are not stored on the central server. Files are in each user's machine. So Napster doesn't distribute MP3 files itself. It only has a central server to keep track of every user's sharing directory content.

   This approach, which was later described as peer-to-peer, gives users a much wider selection of songs to choose from.
2. Unlike a pure peer-to-peer system, Napster still has a central server. This central server makes searching songs much faster compared to pure distributed search. If the central server is shut down, the service will no longer work.
3. Users can swap files directly. Once a user finds a song, his machine can bypass Napster's central servers to directly connect to another machine to finish the song

swapping process. The computing tasks related to song swapping are passed on to numerous PCs.

4. Napster has set many options for users to customize their searches. For example, you can choose a high-speed connection from all the search results.
5. Napster has integrated many useful components into its software, such as chat, audio player and instant messaging. Instant messaging is another important peer-to-peer application. It can be easily integrated into a peer-to-peer system by using the same protocol.

Napster has encountered lots of troubles since its launch. It's worthwhile to have a look at these difficulties. First, most universities banned Napster because heavy usage by students made their campus networks seriously congested. At first look, this can be thought of as the result of overuse of Napster by college students. But also another important reason is peer-to-peer technology's inconsistency with the underlying Internet infrastructure. Modern Internet favors downloading instead of uploading of information. For example, ADSL as a technology is structured to take advantage of client/server model. The peer-to-peer model makes a network more symmetric while client/server model takes network in an asymmetric way. So when symmetric Napster runs on asymmetric network infrastructure, heavy congestion appears.

Second, many recording companies and artists together with Recording Industry Association of America (RIAA) sued Napster because of copyright issues. Napster has a central server to keep track of songs stored on individual users' hard drives. The central

server make searching a file on Napster fast. But it is this centralized server that has gotten Napster into trouble. One user can easily download a song that he doesn't own from another user's machine by searching this central server. Once downloaded, there is at least one more illegal copy available on the Napster network. And this illegal copy can be tracked on the central server. In fact, the copyright issues about song swapping are very complicated. Napster has been deemed to provide public access to pirate songs. That's why Gnutella and its followers use distributed search instead of a central server.

In July 2000 Judge Marilyn Hall Patel ordered Napster to shut down its server until it can develop a plan to protect copyrighted songs. (Cave & Quistgaard, 2000) Recently, Napster has been publicly testing its subscription service. Portion of the subscription fees will be used to pay royalties.

3.3 Gnutella

Nullsoft's Justin Frankel and Tom Pepper started Gnutella primarily to share recipes. (Kan et al., 2001)When they abandoned this idea when it was version 0.56, it became an open source project. It is the first successful, fully decentralized, peer-to-peer system.

Gnutella is a protocol rather than an application. Gnutella software such as Gnotella, Furi and Toadnode, were developed using this protocol to help users to connect to each other directly. Unlike Napster, Gnutella is completely decentralized. To connect to the Gnutella network, all you need to do is to connect one arbitrary host. It has several important features:

- No Fixed Entry Point: There is no fixed entry point in the Gnutella network. A user can connect to the Gnutella network at different point each time. Even the Gnutella network itself is totally dynamic.
- Broadcasting Request and Routing Reply: When the user types something in the search box in the Gnutella software, that message will be assigned a Unique Universal Identifier (UUID, 128-bit unique identifier). Then this message will be sent to all the hosts this host can see. This is called broadcast. If some of the other hosts have the answer, they will reply. Otherwise they will broadcast this message further to all the hosts they know excluding the originating host. The message is broadcast in the period of its TTL (time to live). All the replies will be routed, not broadcasted, to the requesting host.
- User Anonymity: Gnutella uses several rules to protect user anonymity. First, unlike Napster, Gnutella users don't need to sign up at a central server before using it. Second, the messages from node to node don't involve any information about a user. Most messages do not contain an IP address, so they are not useful in identifying users. Third, the routing system in the Gnutella network is stored on numerous nodes for a very short time and it's not accessible outside the system.

Gnutella is the first fully decentralized peer-to-peer system. While a lot of users still use it to swap files, its potential attracts many peer-to-peer software projects (e.g. JXTA search[13]) to experiment on the Gnutella network.

3.4 Mojo Nation

Mojo Nation is another fully decentralized peer-to-peer system developed by Jim McCoy. ("O'Reilly Bioinformatics," n.d.) But what makes it different form Gnutella is its integrated micropayment system.

As we will discuss later, there are too many free-riding behaviors in an online object exchange. It's especially obvious in a peer-to-peer system. To eliminate free-riding behaviors, one effective solution is to use a reputation system to enforce users to contribute if they want to use other people's resources.

Micropayment system is a derivative reputation system. It tracks user's reputation in the form of digital currency---Mojo. It's also the core technology of Mojo Nation. For a detailed description of reputation system, please refer to 4.3.2.

Mojo Nation uses Mojo, an artificial currency, to calculate the resources each peer contributes. One peer can get Mojo by contributing processing time, disk space and bandwidth. And one peer cannot get any services from other peers without paying Mojo. Mojo is also related to quality of service in the network. By offering a higher price, one peer can always move up or have a higher priority in a long queue.

Paralleling to the peer-to-peer networking structure, the micropayment system itself is a distributed system. A broker automatically runs on each peer as a background process. There is a central broker server to update every peer's balance. This central broker server

is independent of the peer-to-peer service Mojo Nation provides. It communicates with every broker residing on every peer. The messages involved are all encrypted to protect user's identity.

To conclude this section, we note the similarity of co-operation structure between Mojo Nation and CLOE, though they are based on different computing platforms and different audiences. Some aspects are quite comparable between Mojo Nation and CLOE as shown in Table 1.

	MOJO NATION	**CLOE**
Co-operation Policy	Yes	Yes
Pricing Base	Computing Cycles, Disk Space, Bandwidth	Usage Duration, Creation Time, Learning Hours
Computing Platform	Peer-to-peer, Purely Distributed	Centralized Website-based for faculty, distributed for students

Table 1: Comparison between Mojo Nation and CLOE

3.5 Comparison between Mojo Nation and Gnutella

In order to compare Mojo Nation with Gnutella, Table 2 summarizes three key characteristics in the following table.

	MOJO NATION	**GNUTELLA**
Resource Usage	Contribution Based	Free

Co-operation Policy	Yes (Micropayment System)	No
Computing Platform	Peer-to-peer, Pure Distributed	Peer-to-peer, Pure Distributed

Table 2: Comparison between Mojo Nation and Gnutella

From this table, we can tell the only difference between Gnutella and Mojo Nation is the micropayment system. This difference makes resource usage in Mojo Nation contribution-based while it is free in Gnutella.

While making Gnutella much more popular, free access to resources does bring troubles to Gnutella. It suffers from a tragedy of the digital commons. (Shirky, 2000) Eytan and Bernado from Xerox's PARC (Palo Alto Research Center) analyzed user traffic on Gnutella and discovered "a significant amount of free riding in the system." (Adar & Huberman, 2000) Nearly half the files shared came from just 1 percent of hosts -- which suggests something closer to a traditional client-server model, rather than a peer-to-peer system. As it becomes more and more like a client-server model, major contributors are also going to face potential copyright related lawsuits.

Gnutella is designed to protect its user's anonymity. This is a nice advantage over Napster. However, with so many people lurking in it, this advantage will evaporate. Major contributors' computers will become server-only machines, so that their identities are much easier to recognize.

Other than legal concerns, as lurkers drive Gnutella to client-server model, some other advantages of peer-to-peer model disappear. For example, when a user in Napster downloads an MP3 file from another machine, there will be one more copy available in the whole community. If the file is popular, it will wind up in numerous copies available to the whole community. Overall resources are expanded. But this goal becomes less possible for Gnutella to achieve due to heavy lurking behavior. Users tend to download from major contributors' machines and they will relocate files in non-sharing folders after disconnection. When they reconnect to Gnutella next time, the total copies of this file won't increase, as they should in an ideal peer-to-peer scenario. To make resources more abundant and accessible is a peer-to-peer systems' major goal, but many of them fail at this point. At the same time, these systems also fail to achieve other goals such as distribution of computing resources.

Now let's look at Mojo Nation. By using micropayment system, Mojo Nation can prevent its peer-to-peer network from migrating to a client-server network, which happens to some other peer-to-peer network because of free-riding behavior. Controlled by micropayment system, users have to contribute files in order to retrieve files from other machines. As a result, swarm distribution becomes possible in the Mojo Nation network. Swarm distribution is the situation in which every peer contributes as much as it can to the collaborative effort. Even low-bandwidth, dial-up users can provide a small portion of requested resources.

3.6 Summary

Peer-to-peer systems' advantages are based on co-operation among community members. By using a set of co-operation policies in the form of a micropayment system, Mojo Nation delivers what the peer-to-peer model has promised. Co-operation might not be appropriate for every community, but it's essential to a collaboration-based community. Co-operation policy has benefited Mojo Nation: more computing resources are available to every individual user. If it's not for the micropayment system, there will be less computing resources available from a small group of contributing users.

The lesson from this case study indicates that co-operation policies might also make online learnware object exchanges perform better since the quantity and quality of resources available in a learnware object exchange is a major concern. However, learnware object exchanges are different from popular file exchanges. They are in the academic domain. In a different community scenario, things might turn out to be different. So we need to study co-operation policies in a learnware exchange scenario.

There are many different community scenarios, so co-operation policies can be in various forms. Analysis of various issues about co-operation policies is important to determine the proper co-operation policies to be used in an online learning object exchange.

4. Analysis of Lurking Behaviors and Co-operation Policies

For an online object exchange, it's inevitable that there might be more lurkers compared to diligent contributors. As illustrated in the previous chapter, communities may need policies to enforce participants to contribute. Here we will review the concept of lurker and co-operation. For the purpose of this research, we will focus on an analysis of effectiveness of a reputation system to reinforce co-operation between participants.

The analysis starts from issues around lurkers since a major function of co-operation policies is to get rid of lurking or free-riding behaviors.

4.1 Lurkers in Online Community

Little research has been done on lurking, but it is known to be a common behavior in online communities. Generally, 1:100 is quoted as the 'ballpark' ratio between posters and lurkers. (Preece, 2000) This ratio is surprising: the actual figure may be lower or higher. In the WELL, a community famous for high interaction, about 80 percent of its total 6,600 members didn't post during a one-month period. (Sproull & Faraj, 1997)

Jenny Preece categorized a lurker as one defined role in an online community. (Preece, 2000) Lurker is the term used to describe a community participant who observes what's going on but remains silent most of the time. (Preece, 2000, p.87) This definition will

work on all discussion groups. She pointed out that in the vernacular, lurker has pejorative connotations. (Preece, 2000, p.87) “Many think of a lurker as someone who hangs around, often with sinister or, at best, annoying (to us) motives, or as a free-loader, someone who wants something for nothing.” She explained this general view by noting that a community’s success is based on member’s active participation and ongoing contribution. Lurkers don’t meet these requirements. They act as if they want to get something for nothing.

Both Jenny Preece and Blair Nonnecke (Nonnecke, 2000) define lurkers as silent observers in an online community. This definition won’t work for the subject of this research --- online object exchange. Some lurkers in online object exchange will keep silent and observe what is going on. This is consistent with that definition. But these lurkers are not typical. Most lurkers in online object exchange will actively participate in a set of activities, such as downloading files, consuming bandwidth, borrowing computing cycles from other community participants; they themselves seldom or never contribute these resources. This phenomenon is also described as leeching. It’s an essential trait of a lurker in online object exchange. For this purpose, it’s necessary for us to broaden the definition of lurker.

We therefore propose an extended definition of lurker: The term lurker can be used to describe anyone who 1)never posts or posts infrequently in a discussion type online community; and/or 2)actively retrieves resources from an online repository or other nodes without contributing anything in an online object exchange community.

Common sense suggests that lurking behavior may not be good to the well being of a community. However, this might not hold for some special situation. For example, R.B.Nonnecke's research shows that lurking can be a self-controlled behavior to aid the community, thus helping to bring down the traffic rate of a discussion list during its peak time. (Nonnecke, 2000) To learn more about lurking behaviors' implications for online object exchange, we did a detailed analysis of research by Nonnecke and Preece.

In a study conducted by Nonnecke and Preece (Nonnecke & Preece, 1999), ten lurkers were interviewed at length to find out the reasons behind their lurking. The ten lurkers were member of 41 communities, of which 25 are listservs, 7 are BBS, 5 are newsgroups, 3 are chat rooms, and 1 is a MOO (Multiple user dimension, Object Oriented). The ten lurkers never posted or rarely posted in these communities. Reasons given by interviewees for lurking include (Preece, 2000, p. 89):

"

- They didn't understand the community (e.g., they didn't know the audience, comfort level, topic area, individuals)
- Personal factors (e.g., culture of origin, motivation)
- Posting takes time
- No personal or practical need (e.g., able to gather without posting, just reading, no reason to respond)
- No community requirement (e.g., no expectation or requirement)

- Structure of community (e.g., posting not possible, part of community is non-posting: FAQ, moderation)
- Information seeking (e.g., more interested in information than interaction, reading with a specific goal in mind)
- Privacy (e.g., sensitivity of employer, fear of archiving, fear of spamming)
- Safety (e.g., can't offend if don't post, curiosity without exposure)
- Involvement (e.g., maintain emotional detachment, makes leaving easier, shy)
- Community responsiveness (e.g., delay between posting and response, non-response to posts)
- Value of posting (e.g., no response required, nothing to offer, unable to add value)
- Interaction mechanisms (e.g., volume of posting, user interface, anonymity)
- Efficiency (e.g., not posting takes less time, others will respond, value without cost) "

For an online object exchange, which is a subset of online community, some of these points might not hold. I will discuss the 14 points briefly and summarize the reasons for lurking in online object exchange in Table 3 below.

1) They didn't understand the community:

In an online object exchange, the main focus is how to effectively share resources among members. It's different from those discussion communities, whose objective is to broadcast information. Lurkers always actively retrieve resources from a repository or other nodes in an online object exchange. This mostly happens when they already know

what the community is about; then they can lurk to take advantage of it. So this point will not apply for an online object exchange.

2) Personal factors:

This is true since participants might not be sufficiently motivated.

3) Posting takes time:

This is true. For a web site based online repository, posting or uploading of resources takes time. But this point needs to be extended since some posting behaviors in certain online object exchanges (e.g. peer-to-peer) make a contributor pay for added value for his contribution. The added value of contribution is mostly represented in computing resources, such as bandwidth, disk space and computing cycle.

Another important aspect is that there are different levels of contribution in an online learnware object exchange. As the complexity of contribution increases, so does the posting time. For example, authoring new learnware takes more time than doing reviews. We need to keep this in mind in the study presented in Chapter 5.

4) No personal or practical need:

This point is suitable for an online object exchange. Lurkers can get resources from others without any contribution.

5) No community requirement:

This point is also true for an online object exchange. There are no efficient regulation rules to guide user's behavior.

6) Structure of community:

The structure of most online object exchanges is built to encourage or facilitate users to contribute. So this point is not true here.

7) Information seeking:

In an online object exchange, lurker might have a good idea about the object he's looking for. He treats the community as an index. So this point is true here.

8) Privacy:

This is one of the major concerns for some users in certain online object exchanges. Some exchanges are illegally used to swap pirate software. In an online object exchange, a user will worry that his identity might be exposed or related to a specific object. So he might choose to lurk. In other legal exchanges, keeping privacy is still a main consideration for users.

9) Safety:

For this specific situation, this point might be incorporated into point 8.

10) Involvement:

This point is highly related to posting. This will hold for discussion type communities. It's mostly not true for an online object exchange.

11) Community responsiveness:

This point is highly related to posting. This will only hold for discussion type communities. It's not true for an online object exchange.

12) Value of posting:

Different from posts in a discussion community, every object in an online object exchange is regarded to have certain value. Actually, "contribution will make me lose some value" is one of the major concerns of lurkers. This point is not true here.

13) Interaction mechanisms:

This is true here. Too much required action to post or share resources may drive a potential contributor to become a lurker in the end.

14) Efficiency:

This is true here. The most efficient way to get resources is to lurk. Doing that, a user can get objects without offering anything.

According to the brief analysis above, there will be 8 points left as potential reasons for lurking in an online object exchange, summarized in Table 3.

REASONS FOR LURKING	EXPLANATION
Personal factors	Participants are not effectively motivated, or lack the background for sharing
Contribution takes expense	Expenses are in the forms of time, bandwidth, computing cycle and storage
No personal or practical need	Users are able to get resources without contributing
No community requirement	No efficient regulation rules to require user to contribute
Information seeking	Users treat the online object exchange as an index
Privacy and Safety	Users want to make sure that they are safe and their privacy won't be exposed
Interaction mechanisms	Some communities need many require actions to contribute
Efficiency	Lurking is the most efficient way to get resources in an exchange

Table 3: Potential reasons for lurking in online object exchange

4.2 Co-operation as a Social Dilemma

Successful communities are built on co-operation between participants. (Preece, 2000, p.187) Sometimes, users will try to act in some way to maximize personal benefits. Behaviors under this situation may be destructive to the whole community. The destructive force reflects a social dilemma. As pointed out by Kollock (Preece, 2000, p.187), social dilemma is the tension between what is best for the group and what is the best for the individual. In this case, the group is an online community.

Three of the conditions that Peter Kollock found maximize co-operation in Axelrod's two-prisoner dilemma (Axelrod, 1984) might be relevant to online communities. (Kollock, 1998)

The first condition is that the chance of two individuals meeting again in the future must be high; otherwise people may take whatever they want from the community since there is no future implication. (Walther, 1994) This suggests that the ongoing relationship is important for an online community. To bond with an individual, a starting point is to require him be registered. Thus, a relationship is set up between this individual and the community. Though registration doesn't guarantee ongoing relationship between a community and an individual, there is an initial social bond. The bonding may not be able to make individuals to offer commitments, but it can help prevent some devastating things from happening. For example, people will have an insecure feeling about their online privacy, they are afraid that their real identities might be exposed if doing something destructive.

The second condition is that people must be able to identify each other. This condition's implication in an online community is similar to the first one. People can identify each other by registered names to tell who is responsible for a certain message or comment. But most communities will hide user's real identity for privacy reasons. So this is only useful to some extent.

The third condition is that there is a record to reference for a certain user's past behavior. People can predict that user's future behaviors based on the record. From records in the community, people can easily separate users who co-operate from users who do not. On the other hand, past records have strong regulation effect on people. Anticipation of future meetings is a powerful incentive to make people behave properly. (Walther, 1994) From this point, maintaining a system of past records will be of great help to make people co-operate in an online community.

In the context of co-operation issues, we should note that co-operation is not important for every online community. The definition of acceptable behavior in a certain community is based on its purpose. (Preece, 2000, p.190) Thus people who never co-operate might be acceptable or even good for some communities.

4.3 Reputation Systems

The integration of a reputation system into an online community is a somewhat new idea. Why do we need a reputation system in an online community? It's because of the heavy lurking behaviors, especially in an online object exchange.

Before going in details about what is a reputation system, it's a good idea to have a look at eBay's feedback system[14]. This system might be the most successful one in the world.

4.3.1 EBay Feedback System

EBay is famous for integrating a reputation system (it's known as a feedback system) into its e-commerce practices. Customers can refer to trading partner's feedback value in considering a potential transaction. According to Stephen S. Standifird, it's very important to engage reputation in e-commerce (Standifird, 2000). Standifird did a data set analysis on closing prices of 3COM Palm Vs auctioned on EBay between January 3 and January 16, 2000. In this statistical analysis, the dependent variable is closing price and the independent variable is feedback value of the seller. By also considering a set of control variables, such as number of bids, days open, opening bid and reserve price, new or changed ID and weekend closing, Standifird found out that the results clearly demonstrated an important role for the reputation of a seller in facilitating electronic exchange. The further analysis showed that in the environment of eBay auctions, having a negative reputation has a much greater impact than having a positive reputation. "The results do not necessarily justify significant area in the area of building a positive reputation. However the cost associated with even one negative comment may well justify the expense associated with making sure customer expectations are always exceeded."

Obviously eBay is built on trust. If everyone is interested in cheating or doing fraud, the bond between members will be weakened. People will become reluctant to buy or sell on eBay. The whole community will be weakened or destroyed. A feedback system helps foster a better cooperative environment. The implication for an online object exchange is that if everyone is interested in free riding, then nothing is contributed to the community as a public good, and the community will not live.

4.3.2 Reputation Systems

A reputation system is a set of systematic approaches to record and summarize behaviors from past transaction. For every specifically designed reputation system, if people behave properly in the group's interests, they will get positive reputation; otherwise, a negative reputation will be recorded. In real life we use it to set our expectations when we consider future transactions. (Lethin, 2001) In the last chapter, we mentioned there should be a record to reference a certain user's past behavior. Reputation systems actually hold these records.

A reputation system helps people co-operate. People will consider other's reputation before a transaction. A buyer will try to reference a seller's reputation before placing an order. Likewise, a seller will find out a buyer's reputation before accepting the order in case there will be credit card charge back. This can be generalized to more complex transactions: A student will consider a university's reputation before applying; the university will check this student's reputation before admitting him. (Lethin, 2001) After both parties have a good idea about each other's past records, they can co-operate much better in the transaction processing. The transaction will turn out to be smoother. The understanding of each other comes from the reputation system.

While supporting successful e-marketplace operations, a reputation system can be deployed as a major mechanism to deliver trust management in other types of online communities. Most online communities are usually either goal or interest-oriented. Other

than this shared interest, there is rarely any other kind of bond or real-life relationship among the members of communities before the members meet each other online. The lack of information about other members causes a lot of mistrust in the community (Zacharia & Maes, 2000). An online repository of reputations will enable people to know each other much more quickly within an online community. It will help dispel some mistrust elements, which are deemed as a major entry barrier when a member joins a community. If the community is able to incorporate a reputation tracking system, trust will develop through the community's background process. That is, even if members don't know each other, trust can still be achieved if they show respect in the tracking system. This might be achieved by automating the operations of the object exchange.

4.3.3 Reputation System's Impact on Online Community

The possible credits of reputation an individual will get will also influence people to behave properly. In a business environment, if there is a related reputation system, a new seller with zero reputation will still be forced to deliver good service to buyers. If not handled properly, a potential negative feedback from a buyer will leave this seller with a negative reputation, which will decrease the possibility of a seller's future transaction. This example shows that people will try to behave properly in order to get their reputation enhanced or preserved.

Let's revisit eBay's feedback system to see how a reputation system can impact a community. EBay would not have become an e-commerce giant and have such a good

performance if without the feedback system. I will briefly discuss this case here to show the strength of a reputation system. First, people normally worry about the safety of online payment when it comes to e-commerce. EBay doesn't sell things itself. And payment can be arranged by seller and buyer either online or offline. Since eBay itself doesn't offer payment service, it reduces worries about online payment as long as the participants are willing to use money order and cheque.

The second potential worry is specifically caused by eBay. On eBay, people are required to register before trading. But it's still hard to identify any member, say, from a member name. To send a money order to a seller you do not know is a huge risk. To handle this problem, eBay built and introduced its feedback system. Now people can make a decision based on text description of other's past behaviors. Other users left the text description as feedback on past transactions. When people leave positive feedback, a numeric value of 1 will be added to the feedback sum; 0 is for neutral feedback; and –1 for negative feedback. This feature greatly decreases people's worries about this issue. In addition, eBay does have its safeharbour program to protect both parties in a transaction. Safeharbour is eBay's full service customer support and educational resource to ensure safe online trading at eBay. Safeharbour and feedback system have provided a good solution to make people co-operate at business level. But it's safe to say eBay is run on its feedback system since it announced several times that the safeharbour feature is not used very often.

4.3.4 Appropriate Algorithm for a Reputation System

A reputation system has many forms. Generally, it's very easy to identify eBay's feedback system as a reputation system as it records text description of member's behavior and attached numeric value. But there are some reputation systems in other forms. For example, a police office will keep every resident's criminal history. This is also a reputation system. The difference is this: if there is record, it's always bad. And some other systems will automatically use certain algorithms to calculate reputation value for parties in a transaction. Both examples are different from eBay's feedback system.

But a reputation system still has some problems. One big problem is how to attach numeric value to certain behavior, which is considered as qualitative. A default value is a simple and straight solution. (e.g. eBay) but it's not the best solution. For example: on eBay, if a seller wants to cheat, he can back out after cashing payment N times every M transactions, in which M is greater than N. If this is true, and we suppose this seller gets feedback on every transaction, then his feedback will still increase indefinitely in the positive direction. If there is this kind of seller on eBay, then how can a buyer tell which seller is honest just from the feedback sum value? Unless he takes time to peruse all the text description type feedback of that seller. So there are some faults here. Maybe we may use –2 or –3 as attached numeric values for dummy variable negative feedback. But why don't we choose –1.5 or –2.577 here? So a perfect algorithm behind a reputation system is not very easy to work out. Fortunately, most people still check text description type feedback after seeing the feedback sum value. So it's not a big problem for eBay.

But for an automatic reputation system, a good algorithm is especially important since numeric value type reputation is the only thing people can refer.

4.3.5 An Example of a Pricing/Exchange Mechanism

In previous section we have discussed the reputation system and its underlying algorithm. An appropriate algorithm is difficult, if not impossible, to derive. To develop a good algorithm, both qualitative and quantitative variables must be considered. The pricing/exchange mechanism is a good example. CLOE project team member Graham Carey developed one sample mechanism based on other co-operative exchanges (e.g. MERLOT). The following description of a potential pricing/exchange mechanism is adapted from his project report.[15]

In CLOE, the "price" to utilize a learning object from the exchange will be a specific amount for each element. Both qualitative and quantitative variables must be considered when evaluating said "price". We will use Figure 4 as a means of following the breakdown of the pricing for each element:

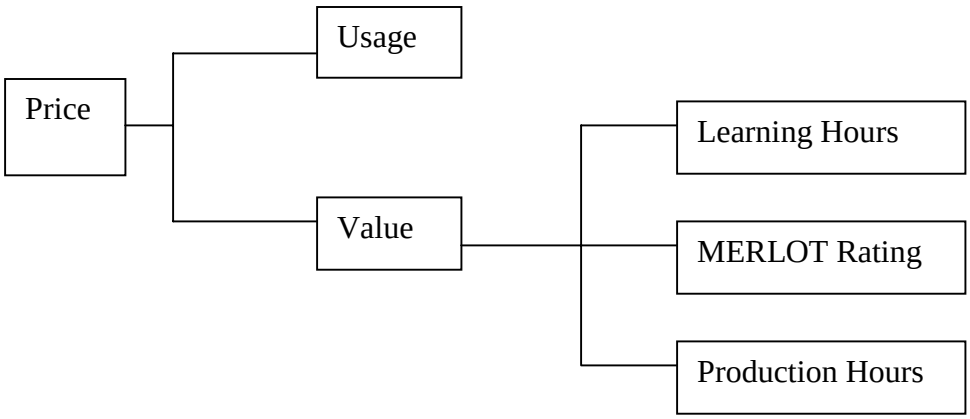

Figure 4: Pricing breakdown for each learnware element

Since each learnware element differs, a set value will be given to each object. This can be looked at as the base value of the element. This value is determined from the following three variables: typical learning hours required for the element, production hours to create the element, and the MERLOT rating.

Learning Hours:

Learning hours recognizes the number of hours associated with use of the material. This variable distinguishes (to a certain degree) the size of the element. The larger the element, the greater the value. Consequently, an entire online course (requiring 36 learning hours) will be worth more than a tutorial (requiring only one learning hour).

Production Hours:

Instead of looking at an element as an end product, we shift our point of view towards production. Using software reuse models as a starting point, we look at production as developmental cost/benefit. The question required is “How much effort goes into the initial development of the element?” This gives us a good idea of the effort that went into production. More effort implies that the element is more complex; therefore, “worth” more than another element requiring less effort during production. Complexity is an important factor to consider, since a simple one-hour tutorial could be incredibly interactive (or have some other complex features, like complex animation, that required

additional effort to produce) and deserve additional worth for this added complexity. So Production Hours is another estimate of size, measuring the complexity of an element.

There are some problems with this method, in that efficiency levels fluctuate between universities. Some institutions will be on the lower end of the learning curve, causing them to produce at less efficient levels. However, the overall difference is assumed to be negligible.

MERLOT Rating:

While quality discrimination should be (mostly) left up to the CLOE members, it still needs to be factored in to the value of an element (if only minimally). This gives a small advantage to those who produce higher quality learnware and also helps to balance out any variance created by the production hours. As a major learnware index, MERLOT can provide CLOE help on rating. Normally, the MERLOT Rating is between one and five stars, but since that would have too great an impact on the value of an element, the rating is mathematically skewed to minimize the effect. This is done by taking 2^{logM} (where M is the MERLOT rating), which diminishes the impact to a value between 1 and approximately 1.62.

These three variables give you the value equation:

$V=L*P*2^{logM}$

Where:

Value Variables	Description	Units

V	Value	CLOEs
L	Learning hours required for the element	Hours
P	Production hours to create the element	Hours
M	MERLOT Rating	Integer (star rating – 1 to 5)

Table 4: Description of Value Equation

Once the value of an element is determined, the only remaining variable to consider for the price of a specific transaction is usage. Each institution wishing to use an element will have a set number of students for their use of the element. So for each withdrawal, a specific number of credits will be required. Where the question before was "How large and complex is the element?" here we ask, "How many students will use the element?" This is similar to licensing an item for a certain amount of time. However, in our case, we "license" the element for use with a certain number of students. This usage factor is the second price determinant.

In order to moderate usage; so, as the number of students increase, the relative price decreases, the variable was adjusted mathematically. First, the logarithmic function is used, so that as the number of students increase, there is a drastic reduction in price per student (i.e.: log (# of students) =>log(10) = 1, log(100) = 2, log(1000) = 3, log(10000) = 4). This encourages the use of learnware elements not only for larger class sizes, but also over a greater period of time. The number of students does not correspond to one academic term, but to as many as are needed to fulfill the number of students "licensed".

The usage factor is further manipulated (in order to minimize its effect), by taking the square root of the logarithmic function. So, when the number of students increases

(10=>100=>1000=>10000) the usage factor is reduced to minimize its effect (instead of 1=>2=>3=>4, we use the following approximate values, 1=>1.41=>1.73=>2).

The final usage equation is as follows:

$U=\sqrt{\log(S)}$

Where:

Usage Variables	Description	Units
U	Usage	Real
S	Number of students	Integer

Table 5: Description of Final Usage Equation

When everything is combined, the pricing equation, where Price = P, is:

$P=U*V$

When a transaction occurs, the price value is debited from the user's account and credited to the contributor's account. This implies that the exchange will work, somewhat, on a system of mutual credit (where during a transaction, no new funds are created, just shifted between users).

4.3.6 Issues concerning the Pricing/exchange Mechanism

This sample pricing/exchange mechanism is not based on a market economy. The price of a learning object is based on qualitative values and quantitative values of this item. As the core of CLOE's co-operative policies, such a pricing/exchange mechanism can bring several benefits to an online learning object exchange:

1) Object Value versus Price

Pricing/exchange mechanism is intended to approximate a specific learning object's value based on quantitative variables and qualitative variables. The mechanism can calculate the price (P=U*V) based on values of those variables for a specific object. A market mechanism, on the other hand, would rely on usage to determine price.

2) Increase of Return on Investment (ROI)

Since every object in the exchange has its own price, we can decide which one is valuable, and which one is not. It can help both normal user and learning technology funding administrator easily identify appropriate object for them. Normal user can save time in finding correct object to use. Funding administrator will find it easier to increase financial input to potential projects. Successful commercialization becomes possible because of precise identification of potential commercial value in the early stage. These will bring high efficiency in usage of both time and money to the learning technology community. Thus, for the whole community, ROI will increase.

3) Better Motivation

Better motivation can be achieved through co-operation policies. The pricing/exchange mechanism includes "cashflow". Institutions have to contribute in order to get enough credits to use resources continuously. This should help target resources more effectively. In the next chapter, we will explore how such mechanism might affect individual motivation.

4) Faster Repository Expansion

The learning object repository can be expanded much faster. This is related to previous benefit. Because members are better motivated, more resources can be added to the repository during the same period. The online repository is expanded faster.

These benefits are achieved by using pricing/exchange mechanism, which is a set of co-operation policies for CLOE. Because CLOE is still in prototype stage, the impact of the co-operation policies is untested. To obtain data on the impact of the co-operation policies on user behaviors, we developed a questionnaire. In the next chapter, we will discuss the scenario-based questionnaire design and its result.

5. Design for a Scenario-based Questionnaire

In order to know potential CLOE users' opinions about how co-operative policies would impact them, we considered a set of possible measurement methods. Amongst those methods, we have chosen to use a scenario-based questionnaire. This chapter is about the steps of design for a scenario-based questionnaire.

5.1 Methodologies Review

To study online communities, a number of research methodologies might be used. Instead of using single methods at a time, multiple methodologies can be used towards a single problem at the same time. Generally, there are six popular methodologies in studying online communities: (Nonnecke, 2000)

- Logging
- Questionnaire
- Interview
- Observation
- Demographic survey
- Content & discourse analyses

Except for interviews and logging, all the other research methodologies have already been used or will be used in this thesis.

For the purpose of this research, a scenario-based questionnaire will be used to measure user's attitude. It will also contain a demographic survey as its second part. Before stating my reasoning behind scenario-based questionnaire, it would be useful to review related concepts on the use of scenarios first.

5.1.1 Scenarios

Scenarios are a common technique generally employed in information systems analysis and design and human computer interaction (HCI). It helps designers understand the situation and human needs better; as a result, a better system can be designed or correct modifications can be added to the system.

Scenarios are stories --- stories about people and their activities. (Carroll, 2000, p.46) In information systems analysis and design, a scenario is description of a specific use case. For example, in certain situation of computer usage, when a PC user wants to switch from an active window to an inactive window, there are several ways:

- Use "Alt" + "Tab" composite keys;
- Minimize the current window and activate another window;
- Click the icon of inactive window on task bar directly.

A detailed description of these possible situations, including what choices users would make and why, is a scenario. It can give HCI designers a clear view of possible options a user might choose, their motivations and the results.

Scenarios have characteristic elements to situate the story (Propp, 1958). All those elements will help construct a setting. For the “switching window” scenario, the setting could be an office with a user sitting in front of a desktop PC. The setting might also include description of computer interface layout.

Scenarios include agents or actors. In the previous example, the actor is the PC user. There is only one actor in this scenario. However, it’s normal for one scenario to have multiple actors. Each actor has his own goal. So if several actors coexist in one scenario, there will be more than one goal. A goal can also be broken up into sub goals sequentially. Achievement of sub goals will lead to fulfillment of goal.

Scenarios have a plot. Actors in scenarios have actions and feelings. Actions can lead to fulfillment of their goals. In the previous example, all three different actions can lead the actor to final goal successfully. In the meantime, actors have feelings during the sequence of actions. The different description of actor’s feeling in the same scenario can lead to different follow-up analyses.

To summarize, a scenario is a short story to help designers to do analysis and make decisions. The essential elements of a scenario include setting, actor, actions and goal. Feeling as an element might also be included.

5.1.2 Scenario-based Questionnaire

To research our hypothesis that an explicit co-operation policy will improve a learning object exchange community, the major problem we currently have is how to compare a community like MERLOT with the proposed CLOE. We could try to make a questionnaire to measure user's attitude on both platforms. Doing this would require that people have previous experience on both platforms. This is not true since CLOE is not launched yet. Thus, we are not able to deliver such a questionnaire to people until CLOE has been available for a while.

Gathering the necessary information thus requires a method such as a scenario-based questionnaire. That is, we can summarize the most important functions of CLOE into several sentences. Generally people can set up the scenario in their mind easily by reading the story.

To make the questionnaire more effective, we've created several scenarios to which participants can react. This can help us address other issues related to the main questions about co-operation policies in CLOE. Finally, the last part of our questionnaire becomes a survey to record demographic data about respondents --- placing questions at the end was expected to lead to more reliable data, because participants will have been engaged by the scenarios, and thus will be motivated to provide the demographic data.

The scenarios we designed have several characteristics:

1. They are short. When people take the questionnaire, they are contributing their free time. We should make sure that they feel comfortable with the length of the questionnaire.
2. They are original. These stories are not reworded from other stories. We create them. Why this is important? Most people dislike taking surveys. So attracting people to complete the questionnaire and keeping them interested are very important.
3. They are generally written based on our hypotheses in this research. So they have a very important role in terms of the outcome of this research.
4. Some scenarios are interdependent, which means it looks like "real world". Real world has many conflicting goals. It can help us measure reader's opinions toward those conflicting goals in these scenarios.

5.2 Scenario-based Questionnaire Design

I have reviewed the research methods used in this study in the previous section. In this section, I will describe several points in questionnaire design: potential users, structure of our questionnaire, testing process, and finalization.

5.2.1 Potential Users

The scenario-based questionnaire is designed to assess the reactions of experienced MERLOT users and future CLOE users. Most of them should already know some jargon in instructional technology such as "learnware objects". They are aware of the learnware development process as well as the learnware categories. Some of them might have

previous experience in allocating or procuring funding related to learnware technology. This knowledge is not required, but if present it will allow users to quickly go through the questionnaire and provide their meaningful thoughts.

5.2.2 Scenario design

Since the questionnaire is scenario-based, scenario design becomes the most important element in the whole design process. We designed three scenarios. A copy of the full scenarios and accompanying questions is appended in Appendix A.

Scenario I is about learnware development. In scenario I, three actors are described within three comparable learnware development settings. The learnware object under development in each setting varies in terms of several independent variables. The independent variables we considered are: development time, learnware object complexity, learnware object size and potential commercialization. This is used to measure user's attitude towards MERLOT collection and potential commercialization of learnware. This scenario is also referenced by scenario II and scenario III, which make them interdependent.

Scenario II is about learnware object technology funding allocation. Users are asked to take the perspective of a learnware technology funds administrator. Basically, two issues are raised for responses. First, should a funds administrator consider potential commercialization amongst the factors in allocating and replenishing funds? Second,

Should a funds administrator consider potential reuse elsewhere amongst the factors in allocating and replenishing funds?

Scenario III first briefly describes key proposed features of CLOE. Then several questions are raised. Issues measured here are: people's opinion on CLOE's potential collection of learnware; CLOE's capability of making natural selection on learnware; CLOE's potential to increase learnware community's return on investment. These questions can be contrasted with questions in previous scenarios, which are basically related to MERLOT. By doing this, we hope we can use these answers to compare potential users' reactions to the underlying structures of these two platforms.

5.2.3 Demographic Survey Design

The second part of the questionnaire is a demographic survey. Through this demographic study, we try to get some information about survey takers' MERLOT usage. Typical questions are: "How long have you been using MERLOT?"; "How frequently do you access MERLOT from the following places?"; "Have you ever contributed to MERLOT?"

The demographic survey has a very important role in this study. It helps us know more about how the participants' experience and context may be shaping their responses. Thus, a better understanding (or decoding) of their personal thoughts on those scenarios can be achieved. In addition, since most questions in the demographic survey are multiple-choice based, a statistical analysis based on survey result will be possible.

5.2.4 Pilot Testing

A pilot testing of the scenario-based questionnaire was conducted. Four faculty members from University of Waterloo joined the 2-day testing sessions. We spent about one and half hours with each faculty member. They all have MERLOT experience. One of them is MERLOT discipline team member. Faculty members are from different disciplines: chemistry, accounting, health science and biology. So it was possible to get diversified opinions.

I uploaded the whole questionnaire to a website. All the testing materials are available online. We did the testing in Flex Lab in LT3 Centre. All the testing participants accessed the scenario-based questionnaire from an IBM laptop.

The procedure for the pilot testing was:

1) Inform participants of the purpose and format of testing session
2) Open the browser (Netscape Navigator) for testing participants at the URL of scenario-based questionnaire
3) Each participant goes through the questionnaire freely
4) Each participant gives me opinions at the same time
5) After questionnaire is done, each participant is asked for final opinions and advice

The results of this testing were quite positive. Every participant had no difficulty in understanding the whole questionnaire. But they did provide some advice on potential improvements:

1) The wording in scenario design should be succinct. Use shorter description to get the same idea across.
2) Clarify the interdependencies across scenarios. Cross-referencing at this point would be better. For example, I added references in parentheses beside those items which originally appeared in another scenario.
3) Provide means to go back and review easily. For example, I can make those cross-references could be hyperlinks.

The questionnaire was revised as suggested. One exception is suggestion 3. Since I used a third party survey builder, the technological constraints didn't allow me to make those cross-references as hyperlinks.

In a final stage, two expert reviewers (Tom Carey and Peter Goldsworthy of the LT3 Centre) provided valuable suggestions on wording and proper order of questions. The questionnaire was finalized by incorporating their suggested modifications.

5.2.5 Questionnaire Delivery

The questionnaire is posted online at http://www.eng.uwaterloo.ca/~ljin. The questionnaire delivery was separated into two phases. In the first phase (2 weeks), the questionnaire was only open to potential CLOE users. In the second phase (2 weeks), the

questionnaire was open to MERLOT users. There was one-week idle time between these two phases to make the respondents separable. This arrangement made the comparative analysis of these two groups easier.

We used a mailing list to let people from CLOE and MERLOT know that there is a questionnaire in which they might be interested. After invitations, we have received 30 responses in total during the 5-week period. Sixteen respondents were MERLOT users. The remaining fourteen respondents were potential CLOE users.

6. Questionnaire Results Analysis

This chapter gives an overview of the data we collected through the scenario-based questionnaire. After the overview, we will describe a quantitative study and a qualitative study of the questionnaire results. In addition to this data analysis, we will review the conceptual framework for this study. Several questions will be raised to give direction for future research.

There are twenty questions in total. The questionnaire is composed of two parts: the first one is a scenario-based; the second one is a demographic survey. However, for each part there are questions that require personal thoughts in the form of free text. This means that there will be both qualitative study and quantitative study for both parts. To make the analysis easier to read, I do the study in the order of the questions. For different types of questions, different methods might be used.

Some replies will be quoted to:

1) Support quantitative study
2) Trace respondents' consistency throughout the questionnaire

6.1 Questionnaire---Part I

Part I is composed of three scenarios. There are questions following each scenario. In the following analysis, S is for Scenario; and Q is for Question. N is the total number of people sampled. *n* is the number of people choosing that choice. For example, S1Q2 is for Scenario 1 Question 2. For complete questionnaire or individual questions, please see appendix 1.

***S1Q1:* What should MERLOT contain and review?**

***S1Q2:* Why do you choose that answer?**

CHOICE	**ALL**		**CLOE**		**MERLOT**	
	n/N	**%**	**n/N**	**%**	**n/N**	**%**
1. Only Freeware	1/28	3	0/13	0	1/15	7
2. Only Freeware and Supported	9/28	32	**5/13**	**38**	4/15	27
3. Freeware, Supported and Commercial	**10/28**	**36**	4/13	31	**6/15**	**40**
4. Freeware plus others have a mini version available to all	6/28	21	2/13	15	4/15	27
5. Freeware plus others with a version available to MERLOT member institutions	2/28	7	2/13	15	0/15	0

Table 6: S1Q1 Results

As shown in above table, 36 % (10/28%: numerator is number of respondents who chose this answer; denominator is number of total actual respondents from this group) of the respondents chose the third option. Respondents from MERLOT confirmed this answer

with the highest percentage: 40%. 38% of CLOE members chose the second option, leaving the third option 31%. The highest percentage is highlighted for each group in Table 6.

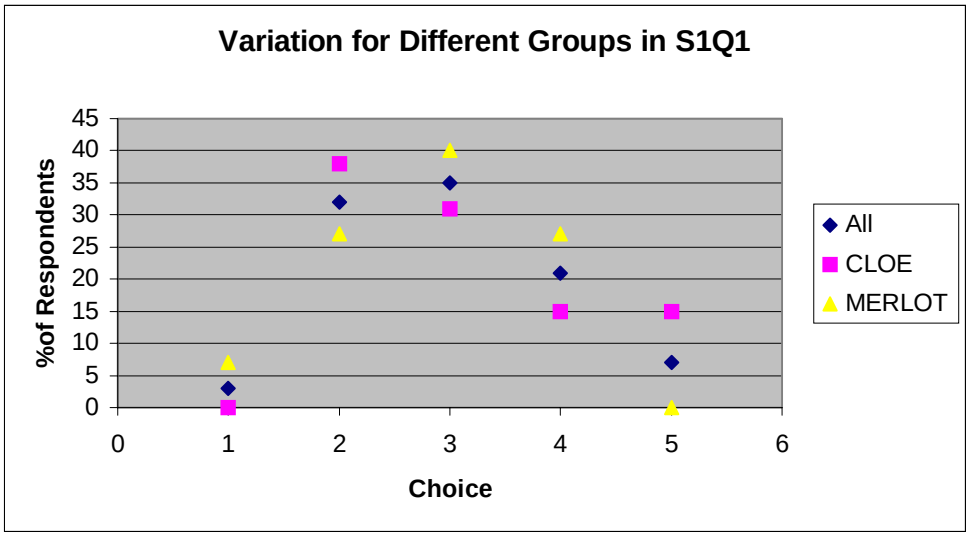

Figure 5: Variation for Different Groups in S1Q1

The scatter chart in Figure 5 compares pairs of values in the three groups. To understand why most respondents chose option 3, we can look at answers for S1Q2. It asks respondents to give reason for choosing that answer in S1Q1.

The reason why people think MERLOT should contain Freeware, Supported and Commercial is based on the notion that MERLOT should strive to have the most comprehensive resource that it can. As one respondent answered: “MERLOT should point users to excellent material of all sorts and let the user make the choice of commercial/non-commercial, etc.” It appears that the group of people from CLOE doesn’t like commercial learning objects as one respondent put: “avoid commercial interests”.

However, one thing should be noticed: option 4 and option 5 implicitly contain positive attitude towards commercial software. By considering this, 63% of all the respondents agreed that MERLOT should contain all three types of learning objects.

S2Q3: **Should Gary consider potential commercialization (scenario 1-Commercial) amongst the factors in allocating and replenishing funds for Sam?**

ANSWER	**ALL**		**CLOE**		**MERLOT**	
	n/N	**%**	**n/N**	**%**	**n/N**	**%**
Yes	11/28	37	**5/13**	**38**	6/15	40
No	**12/28**	**40**	**5/13**	**38**	**7/15**	**47**
Neutral	5/28	23	3/13	23	2/15	13

Table 7: S2Q3 Results

In the scenario, “Gary” is responsible for allocating university funds to support learning technology development. “Sam” is a faculty member requesting such funds.

Clearly, this is a hard question for people to answer. In the above table, there is a split between “Yes” and “No” from CLOE respondents. The dominant data pattern for this question is “No” followed closely by “Yes” for all three groups. As discussed in S1Q1, people hold different attitudes towards commercial learning objects. One respondent answered: “No. I've seen great stuff on MERLOT that probably couldn't go commercial

due to its specialized nature and resulting small potential audience." On the other hand, reasons given by respondents who supported this idea are also strong. One CLOE respondent said: "Yes, commercialization of learnware artifacts should be one of the options and a means of recouping the university investment as well as a source of funding for updates and enhancements of these projects on a go forward basis."

The results of this question are consistent with previous ones. This shows that "commercialization of learning objects" is still a controversial topic. Some neutral answers we collected also confirm this point: "Yes and No!! If the project aligns with the strategic aims and functional requirements of the University then it shouldn't have to have commercial potential. If it is really a niche interest of Sam, then all additional support is both necessary and should be a consideration of funding." However, most respondents with neutral opinions implicitly confirmed that potential could be one of the factors in allocating funds. By considering this, majority of the respondents still think potential commercialization is an important factor.

S2Q4: **Should Gary consider potential reuse elsewhere amongst the factors in allocating and replenishing funds?**

ANSWER	**ALL**		**CLOE**		**MERLOT**	
	n/N	**%**	**n/N**	**%**	**n/N**	**%**
Yes	**25/25**	**100**	**11/11**	**100**	**14/14**	**100**

No	0/0	0	0/0	0	0/0	0

Table 8: S2Q4 Results

As shown in Table 8, all of the respondents think potential reuse of learning objects is very important. Only 3 respondents skipped this question.

Many people think this should be closely followed in learnware area: "YES: This is a very powerful feature of learnware development." Some people also compared it with potential commercialization: "Reuse and distribution to largest possible sites is most important factor. Use by one person and one class is bad investment (low ROI). Commercialization is so dependent on marketing and probably will fail." It is apparent that potential reuse is a much more important factor than potential commercialization according to these respondents.

S3Q5: **In your opinion, which kind of learnware will CLOE possibly get? Freeware, Supported, Commercial (in Scenario I), which one would CLOE encourage or discourage?**

This is a free-text question similar to S2Q4. Respondents are likely to choose from freeware, supported and commercial first before providing explanations.

ANSWER	ALL		CLOE		MERLOT	
	n/N	**%**	**n/N**	**%**	**n/N**	**%**
Freeware	18/21	86	9/11	82	**9/10**	**90**
Supported	**19/21**	**90**	**10/11**	**91**	**9/10**	**90**
Commercial	4/21	19	2/11	18	2/10	20

Table 9: S3Q5 Results

As shown in Table 9, most of the respondents chose freeware and supported. Commercial is the least chosen one. Most people chose freeware and supported at the same time.

Needless to say, this question involves commercial aspects again, which people from academic area tend to hold different attitudes. But this is only one issue. One respondent raised an interesting issue in his/her explanation: “CLOE will get a lot of freeware, some supported and less commercial ONLY because that's the relative frequency of generation of these kinds of information. People will want to get as many credits as they can by whatever vehicle.” This statement indicates a problem in CLOE structure: how to improve its accounting system to avoid multiple submissions of less useful learning objects under the intention of accumulating credits? And there’s definitely far more freeware and supported than commercial out there. Other than that, people think CLOE is still in the academic area: “It will likely get freeware and supported while the commercial will remain in the competitive environment.” Size of commercial software is another concern: “CLOE will possibly get freeware and supported. It might wish to get commercial if only to provide a more complete repository.”

Results of this question suggest that a few constraints such as learning object size and accounting system will make CLOE get much more freeware and supported than commercial.

S3Q6: **How would you be encouraged or discouraged by this exchange platform?**

Many respondents didn't reply to the question directly. There are sixteen respondents who explicitly stated "encouraged" or "discouraged". The results are in the following table.

ANSWER	**ALL**		**CLOE**		**MERLOT**	
	n/N	**%**	**n/N**	**%**	**n/N**	**%**
Encouraged	**12/16**	**75**	**7/8**	**87.5**	**5/8**	**62.5**
Discouraged	4/16	25	1/8	12.5	3/8	37.5

Table 10: S3Q6 Results

The dominant data pattern in the above table shows that people will be encouraged. CLOE potential users are more encouraged than MERLOT users. Because this is a free text question, people who don't reply directly can be somewhat off topic and difficult to interpret.

However for those who reply directly, some respondents gave additional comments after saying they would be encouraged: “This is, perhaps, a bigger incentive to share. I would worry a little that this might cause a little too much emphasis on "Marketable" (to the coop) material rather than projects aimed at a smaller audience. (Specialized classes)” This still shows people’s concerns about potential commercialization in the academic area.

S3Q7: **In your opinion, would a scenario like CLOE support Gary to make the decision in Scenario 2?**

Similar to the previous question, the results are very consistent for all three groups as indicated in Table 11. Most respondents think CLOE would support Gary to make the funding decision.

ANSWER	**ALL**		**CLOE**		**MERLOT**	
	n/N	**%**	**n/N**	**%**	**n/N**	**%**
Yes	**17/21**	**81**	**8/10**	**80**	**9/11**	**82**
No	4/21	19	2/10	20	2/11	18

Table 11: S3Q7 Results

From the text responses we have collected, CLOE potential users are far more positive than MERLOT users: “Most definitely, once again due to potential multiplication of benefit. Gary, however, needs assurances that others are investing equally generous

amounts." Some MERLOT users think it a beneficial move but will not change the scene overall: "It would help but might not be enough to do it totally."

S3Q8: **In your opinion, would an exchange platform like CLOE encourage state and other funding sources to support Learnware Technology?**

ANSWER	**ALL**		**CLOE**		**MERLOT**	
	n/N	**%**	**n/N**	**%**	**n/N**	**%**
Yes	**21/26**	**81**	**11/13**	**85**	**10/13**	**77**
No	1/26	4	0/13	0	1/13	8
Neutral	4/26	15	2/13	15	2/13	15

Table 12: S3Q8 Results

For this question, almost all the respondents answered "yes". Only one respondent from MERLOT thought that CLOE added more bureaucracy: "No. My state is too big, too geographically diverse, and the needs are so great that I am personally seeing CLOE as an additional layer of bureaucracy. I don't want that, if my aim is to teach my students and share my experience with likely colleagues."

According to many respondents, many characteristics of CLOE would encourage their state to add more funding to learnware technology. These include the economic model of CLOE, potential reuse, and effective use.

S3Q9: **In your opinion, could a co-operative economy for learnware objects become a springboard for more learnware to become commercialized?**

This question is still quite controversial. But over the course of completing this questionnaire, there appears to be a shift to a more positive attitude about the commercialization scenario.

ANSWER	**ALL**		**CLOE**		**MERLOT**	
	n/N	**%**	**n/N**	**%**	**n/N**	**%**
Yes	**15/23**	**65**	**9/11**	**82**	**6/12**	**50**
No	8/23	35	2/11	18	**6/12**	**50**

Table 13: S3Q9 Results

In the earlier questions, such as S2Q3 and S3Q5, only a few MERLOT respondents agree on commercialization issues. Now there's a 50-50 split in the MERLOT group for this question. For many CLOE users, this becomes a sure prospect: "YES, as sales and commercial development get underway and the reputation of the CLOE products and services become known throughout the academic marketplace, the price mechanism will be critical to developing new offerings and creating enterprise." People from MERLOT are more conservative on this: "This seems like a likely possibility, although there are problems. Who owns the software? The person who developed it using school funds, or the school?"

On the other hand, many people still have a negative attitude on this scenario: “No. Learning and teaching will fail/are failing when rendered as commercial enterprises”.

6.2 Questionnaire---Part II

Part II is mainly about demographic questions.

Q10: **How long have you been involved in using or developing learning objects?**

CHOICE	**ALL**		**CLOE**		**MERLOT**	
	n/N	**%**	**n/N**	**%**	**n/N**	**%**
1. 5 years or more	**18/28**	**64**	**10/13**	**77**	**8/15**	**53**
2. 4 years	4/28	14	0/13	0	4/15	27
3. 3 years	2/28	7	1/13	8	1/15	7
4. 1-2 years	4/28	14	2/13	15	2/15	13
5. Less than one year	0/28	0	0/13	0	0/15	0

Table 14: Q10 Results

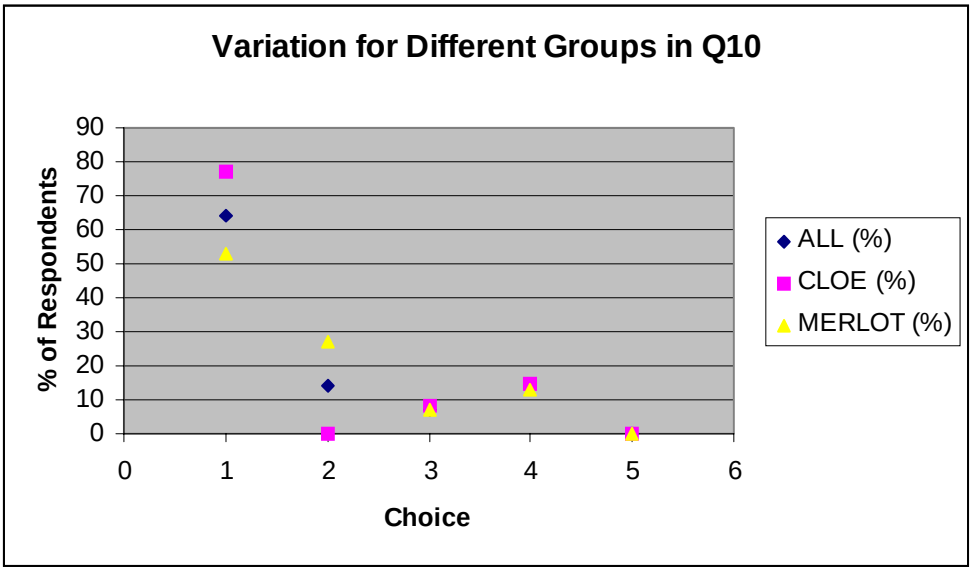

Figure 6: Variation for Different Groups in Q10

Table 14 shows that most respondents have 5 years or more experience in learning objects. And this is same for all three groups. No respondent has less than one year experience in learning objects. Figure 6 is the scatter chart for variation of different groups in Q10. This indicates that all respondents are experienced users.

***Q11:* How frequently do you access MERLOT?**

CHOICE	**ALL**		**CLOE**		**MERLOT**	
	n/N	**%**	**n/N**	**%**	**n/N**	**%**
1. Daily	5/28	18	1/13	8	4/15	27
2. Weekly	6/28	21	2/13	15	4/15	27
3. Monthly	5/28	18	0/13	0	**5/15**	**33**

4. Less than once a month	**8/28**	**29**	**6/13**	**46**	2/15	13
5. Never	4/28	14	4/13	31	0/15	0

Table 15: Q11 Results

As shown in Table 15, the usage of MERLOT is moderate for most respondents. 29 % of all the respondents access MERLOT less than once a month.

46% of the CLOE respondents access MERLOT less than once a month. In addition to that, 31% of CLOE respondents chose “Never”.

For MERLOT respondents, they access MERLOT more regularly: “Monthly” is the choice with the highest percentage, there’s a split between “Daily” and “Weekly” at the second place. Only 13% of respondents from this group access MERLOT less than once a month. And no one chose “Never”.

This question’s results tell us, not surprisingly, that MERLOT respondents have more usage of MERLOT than CLOE respondents.

Q12: **Which role are you in? (Check all that apply)**

Choice	CLOE		MERLOT		ALL	
	n/N	%	n/N	%	n/N	%
1. Instructor/Faculty	**7/14**	**50**	**12/16**	**75**	**19/30**	**63**
2. Learning Object Author	6/14	43	8/16	50	14/30	46
3. Learning Object User	5/14	36	**12/16**	**75**	17/30	56
4. Reviewer	1/14	7	10/16	63	11/30	36
5. Discipline Committee Member	0/14	0	8/16	50	8/30	26
6. Discipline Committee Co-leader	0/14	0	6/16	38	6/30	20
7. Instructional Designer	5/14	36	4/16	25	9/30	30
8. Faculty Development Staff	6/14	43	3/16	19	9/30	30
9. MERLOT Project Director	1/14	7	2/16	13	3/30	10
10. MERLOT Admin Team	1/14	7	0/16	0	1/30	3
11. None of the above	0/14	0	1/16	6	1/30	3

Table 16: Q12 Results

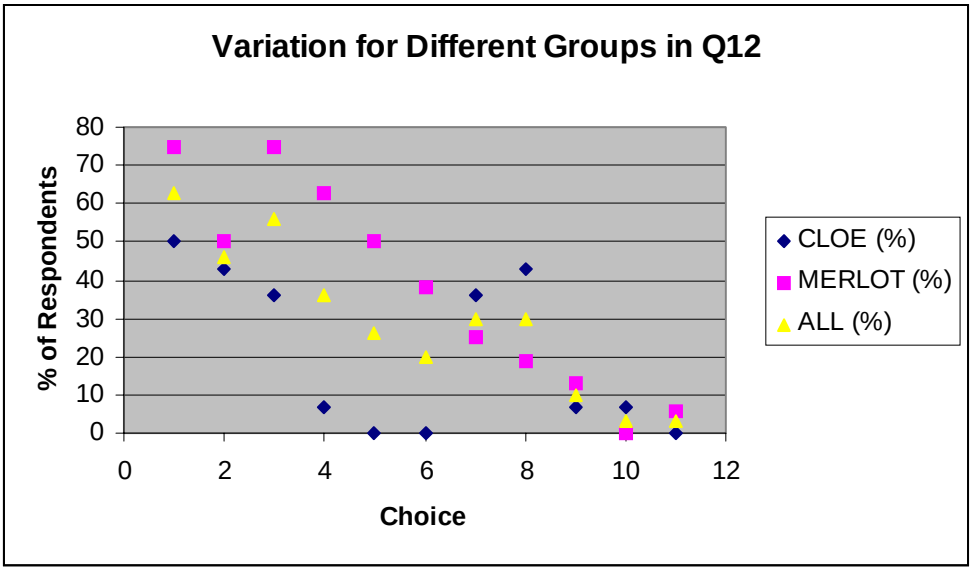

Figure 7: Variation for Different Groups in Q12

From Table 16 we can see most respondents are in the role of instructor/faculty for all three groups. Learning object author, learning object user, instructional designer and faculty development staff are other popular choices. Many respondents from MERLOT are discipline committee members and discipline committee co-leaders while no one from CLOE is in any of these two roles. One respondent from MERLOT chose the choice "none of the above" and replied his role is "Administration" in Q13.

86% of the respondents who chose "learning object author" also chose "learning object user". This shows that consuming and supply go together for all the respondents.

Q14: **How often do you make a contribution to MERLOT?**

CHOICE	**ALL**		**CLOE**		**MERLOT**	
	n/N	**%**	**n/N**	**%**	**n/N**	**%**
1. Daily	0/27	0	0/12	0	0/15	0
2. Weekly	1/27	3	0/12	0	1/15	7
3. Monthly	3/27	11	0/12	0	3/15	20
4. Occasionally	9/27	33	2/12	17	**7/15**	**47**
5. Rarely	1/27	3	0	0	1/15	7
6. Never	**13/27**	**48**	**10/12**	**83**	3/15	20

Table 17: Q14 Results

The contribution frequency is very low according to Table 17. The dominant data pattern shows that 48% of all the respondents never contribute to MERLOT. This is partly due to

the fact that 83% of CLOE respondents never contribute to MERLOT. While only 20% of MERLOT respondents never contribute, 47% of them contribute occasionally. However, MERLOT respondents did better in contribution. 7% of them contribute weekly. And 20% of them contribute monthly.

It's reasonable that no one chose "daily", because it's nearly impossible for people to contribute different learnware each day.

When asked why he/she chose "never" in Q14, they provided different categories of reasons as shown in Table 18:

CATEGORY	**COMMENTS**
No Intention	"I have not considered submitting any of my work-- At my institution this is not recognized as acceptable academic work." "Best intentions not realized..... yet..."
No Learning Object	"At this time, I have nothing I think would be worth contributing." "do not create online objects"
Role Mismatch	"See "Role" above." "Encourage others to do so... not my focus for now"
No Time	"No time to develop appropriate modules." "Time constraints and unfamiliarity."
Not a Member	"I am not a member and I do not create LOs."
Newbie	"just getting involved" "Only became exposed to MERLOT last month."
Incompatibility	"Also, my work is usually for a publisher (commercial interest) who currently sees little value in paying for development and then making the developed results public. I hope to remedy these factors this year."

Table 18: Non-contribution Reasons

***Q16:* So far, are you satisfied with MERLOT?**

CHOICE	ALL		CLOE		MERLOT	
	n/N	**%**	**n/N**	**%**	**n/N**	**%**
1. Very Satisfied	7/26	27	2/11	18	5/15	33
2. Somewhat Satisfied	**11/26**	**42**	3/11	27	**8/15**	**53**
3. Somewhat Unsatisfied	1/26	4	0/11	0	1/15	7
4. Unsatisfied	1/26	4	1/11	9	0/15	0
5. No Idea	6/26	23	**5/11**	**45**	1/15	7

Table 19: Q16 Results

42% of all the respondents chose “somewhat satisfied”. Possibly due to unfamiliarity with MERLOT, 45% of CLOE respondents chose “no idea”. There are total of 86% of MERLOT respondents chose “very satisfied” and “somewhat satisfied”. This indicates people are still satisfied with MERLOT.

People were asked why they chose “somewhat unsatisfied” and “unsatisfied” in Q17. Most people skipped this question. And four answers seemed to be off topic. Only three comments are on the point: “The reviews are tedious. I feel it would be valuable to list more sites, with shorter reviews. Also, there are few actual "learning objects" in my subject area.” “Many technical/design bugs to work out.” “It needs more reviews and

needs to be more populated." These comments are related to MERLOT's review section and technical problems.

Q18: **Some online communities have "free riding" problems. For example, in Napster, most users download MP3 files without any contribution to the community. Some people object to a perceived inequity in this situation. Do you think this is a significant issue for the MERLOT community?**

CHOICE	**ALL**		**CLOE**		**MERLOT**	
	n/N	**%**	**n/N**	**%**	**n/N**	**%**
1. Not likely to be a problem	11/28	39	3/13	23	**8/15**	**53**
2. Could become a problem as MERLOT grows	**13/28**	**46**	**8/13**	**53**	5/15	33
3. Already a problem for some people	4/28	14	2/13	13	2/15	13

Table 20: Q18 Results

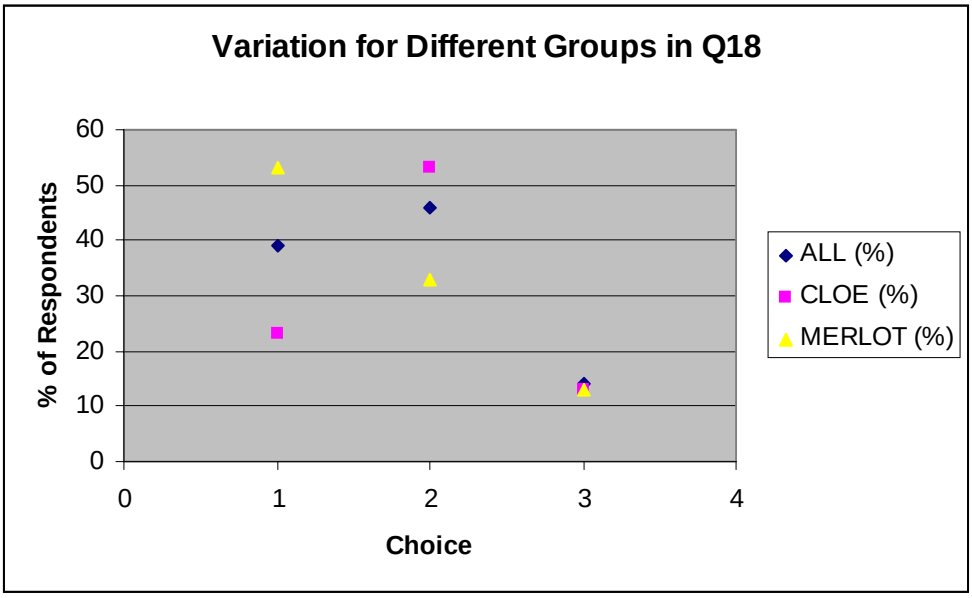

Figure 8: Variation for Different Groups in Q18

The result varies based on different groups. Most MERLOT respondents didn't think that this would be a problem. Most CLOE respondents believed that this could become a problem as MERLOT grows. The percentage is the same 53% for these two groups. Plus, 33% of MERLOT respondents also agreed this would be a problem in the future. This contributes to the overall percentage of Choice 2: 46%. The percentage of choice 3 is 14%, which is quite consistent across all the three groups.

The results suggest that most people think "free riding" problems will become significant in learnware object exchange. However, there's a clear difference between MERLOT users and CLOE users. As we can see from results of Q14, MERLOT respondents did better in contribution. They might think "free riding" less problematic based on their personal behavior. On the contrary, CLOE respondents confirmed its possibility based on their own "free riding" behavior.

Q19: **Suppose access to some MERLOT resources were to be restricted to members who contribute [objects, submissions, reviews, assignments, ...], which of the following restrictions would be acceptable to you?**

CHOICE (EVERYONE, WITH OR WOTHOUT A CONTRIBUTION, CAN ACCESS)	**ALL**		**CLOE**		**MERLOT**	
	n/N	**%**	**n/N**	**%**	**n/N**	**%**
1. Review summary	5/26	19	4/13	31	1/13	8
2. Full review	1/26	4	1/13	8	0/13	0
3. Full review and other existing info [assignments, member comments, etc.]	5/26	19	1/13	8	4/13	31
4. All information that might be in MERLOT [e.g. existing information plus extra design rationale, history, lessons learned, etc.]	**15/26**	**58**	**7/13**	**54**	**8/13**	**62**

Table 21: Q19 Results

This question suggests a scenario of setting up access restriction. As shown in Table 21, choice 4 was chosen the most times for all the three groups. This indicates that people don't like access restriction in a learnware object exchange. Any member should be able to access all information.

However, 31% of CLOE respondents chose choice 1. This makes "restriction to review summary" the second highest chosen option for CLOE group.

People gave their reasons for their choices in Q20.

For choice 1 (review summary):

"If you want to benefit, you need to contribute." (A CLOE respondent)

"MERLOT will most likely have to limit the access to a pay for use as it grows in order to survive and provide distinct value for 'members.'" (A CLOE respondent)

"MERLOT is costly. Non member states need to pay for the development and maintenance of MERLOT." (A MERLOT respondent)

For choice 4 (all information):

"What could be the harm in providing all info apart from the object itself? It is certainly of no benefit to someone who can't use the object." (A CLOE respondent)

"By using MERLOT as an open access medium, the original goals of the WWW are realized and in the long run the contributions will grow rather than diminish. It should not become a club or an exclusive medium." (A CLOE respondent)

"Maximum utility can only be derived from maximizing available information." (A CLOE respondent)

"MERLOT was created in part because not everybody has time or talent to create their own material. We should no more restrict access to MERLOT than we do to libraries." (A MERLOT respondent)

"I believe the main value in MERLOT is the search engine and the virtual guarantee that anything on the site is good. Once that is established, the review may not help that much." (A MERLOT respondent)

"Why restrict access to information about the LO. The more info you give, the more people will want to use the LO." (A MERLOT respondent)

From above comments, access restriction might not be a good solution. But as one respondent stated, MERLOT is costly. Thus, a maintenance mechanism can be set up to make state members contribute. We can conclude: while it's better to provide full access to individual members, we can set up access restriction to institutional members as well as state members.

In this chapter, we did a detailed analysis of questionnaire results. We will present a conclusion of this analysis in Chapter 7.

7. Conclusions, Conceptual Frameworks and Future Research

In previous chapter, we did a detailed analysis of questionnaire results. In this chapter, we will conclude this analysis first. Then conceptual frameworks of comparable areas as well as direction of future research will be discussed.

7.1 Conclusions from the Scenario-based Questionnaire

MERLOT or CLOE respondents would represent different subgroups within the larger population. The two groups may differ in roles or other factors (a larger sample would be required to determine this, but the differences in Table 15 suggest this would be the case). We highlight the different responses from these two groups as follows:

MERLOT respondents:

- Don't like the idea of "restricting access"
- MERLOT should include everything: freeware, commercial and supported
- Have negative attitudes towards commercialization
- Most of them contribute
- Believe that "free riding" would not be a problem

CLOE respondents:

- Some of them support restriction
- MERLOT should include freeware and supported
- Potential commercialization should be considered
- Most of them lurk
- Believe that "free riding" could become a problem as MERLOT grows

Other than differences between the two groups, CLOE's potential impacts on online learning object exchange is also judged to be significant. According to the questionnaire, the co-operation policies will make CLOE attract contribution of freeware and supported. Based on the pricing/exchange mechanism, CLOE will be helpful for a funding administrator to make decisions on which learnware technology project should be funded. And respondents feel that CLOE will likely encourage state and other funding sources to support Learnware Technology. These are the impacts that co-operation policies are perceived to bring to learnware object exchange.

Due to the fact that many respondents have negative attitudes towards the commercialization scenario, we are not able to measure CLOE's impact to potential commercialization of learning objects.

7.2 Further work: Conceptual Frameworks for the Study of Online Object Exchange

In this thesis we have applied results from two areas of work related to online learning object exchanges: lurking behavior in online discussion and in online media exchanges.

There are other areas which we have applied, which offer promising conceptual frameworks, for addressing the issues outlined in section 7.1. Two of these areas are summarizes below, to suggest directions for future research:

--- open source software communities

--- knowledge management communities

In order to make the literature review of these areas clear, they will be discussed in the following order: discussion group, media exchange, open source movement and organizational knowledge management.

Finally, all of these areas of exchange are examples of the broader theme of social capital, and the contrast between the 'gift economy' characteristic of academics and the 'market economy' characteristic of commercial endeavors. We will summarize some of these perspectives. They may contribute to future research on online learning object exchanges.

7.2.1 Discussion Group

A discussion group can be either a bulletin board system or a mailing list.

In a research conducted by Blair Nonnecke, the scope of study is focused on lurking behavior in discussion lists (DL). (Nonnecke, 2000) Three primary questions were addressed in the research. They are: why do lurkers lurk, what do lurkers do, and how many lurkers are there? Two studies were carried out in order to answer these three questions. The first study employed semi-structured interviews with ten DL members.

These ten lurkers described 117 reasons for lurking, six major lurking activities and five lurking strategies. The conclusions for this study were innovative in several aspects. First, Nonnecke recognized that lurking is a strategic activity that involves more than just passive reading. Second, he formulated three models of lurking to account for lurkers' processes, needs and circumstances. The three models are filter, gratification, and persistence. These models consider the reasons behind lurking in a context both inside and outside an online group.

The second study in the same research carried out a log-based demographic study over a three-month period to examine the number of lurkers in discussion lists. (Nonnecke, 2000) In this period, he logged 147,946 messages from 60,000 members in 109 discussion lists. The lurking level is different under different definitions. The lurking level was 55% when specifying lurkers as people who never post. The lurking level was significantly higher (81%) when lurking was defined as three or fewer posts in three months.

These two studies answered the three questions. However, there are two more key findings in this research. The first one is that lurking activities turned out to be heavier in some groups than other groups. Health-support discussion lists have lower lurking levels compared to software-support discussion lists. (Nonnecke, 2000) The second key finding is that smaller DLs or DLs with shorter messages have fewer lurkers.

This research is very thorough based on two in-depth studies. Though it's only situated in discussion lists, the underlying rationale for lurking behavior can help us pinpoint similar problems in other online communities.

7.2.2 Media Exchange

Media exchange is referred to as a peer-to-peer system, or distributed information-sharing system in this context. They maximize a user's capability to swap multimedia-rich files in a distributed computing environment. Emergence of Gnutella, Freenet[18] and Mojo Nation, which are inspired by peer-to-peer model pioneer Napster, promises to help users exchange in a fully distributed system (pure peer-to-peer system).

Any user in such a system can produce as well as consume. But as the system becomes larger, a user may stop producing, which will endanger many benefits a peer-to-peer system has brought to us. For example, it will expose the identity of a small number of super users, who provide most content in the system. These users may face lawsuits if they are involved in copyright issues. In addition, they might face denial of service attacks. This might not be a big problem in the context of the possible collapse of such systems as suggested by Adar and Huberman. (Adar & Huberman, 2000) They argued that free riding in such system would lead to degradation of the system performance and add vulnerability to the system.

In a general social dilemma, a group of people attempts to utilize the common good in the absence of central authority. In the case of Gnutella, common good is the provision of a

large library of files or bandwidth. The dilemma for each user is either to contribute to the common good, or to shrink it and free ride on the contribution of others. (Adar & Huberman, 2000) Since the files in such system are available to all the users, individuals can download files without contributing. This means increased load for everyone else: it makes everyone in this network worse off. Collapse of the system is possible if this situation doesn't change.

Eytan and Bernado did an experiment to sample messages on Gnutella network over a 24-hour period to analyze user traffic. They found out that there is a significant amount of free riding in the system. Specifically, they found that nearly 70% of Gnutella users share no files, and nearly 50% of all responses are returned by the top 1% of sharing hosts. Additionally, they found that free riding is distributed evenly between domains, so that no one group contributes significantly more than others, and that peers that volunteer to share files are not necessarily those who have desirable ones. (Adar & Huberman, 2000) These findings imply that these must be a large amount of voluntary co-operation for pure peer-to-peer systems to succeed.

Fortunately, variants of Gnutella such as Freenet and Mojo Nation can hold every user accountable. Freenet deals with free riders by simply ignoring them. If a node never contributes any files, no other nodes will gain references it. It is deemed as non-existent. (Hong, 2001) Mojo Nation deals with this problem by integrating a distributed micropayment system into the whole system.

7.2.3 Open Source Movement

The open source movement, as typified by Linux development, has become a major alternative to traditional software engineering. Success of Linux has many reasons. A major reason for its huge success is the co-operation of thousands of contributors and co-developers. The whole system for open source movement performs very well in terms of motivating people to contribute.

In his FetchMail project, Eric Raymond did an experiment to use the same development method employed by Linus Torvalds. (Raymond, 2001) The success of the FetchMail project validated his understanding of the key part in “bazaar style” software development: importance of individual contribution.

As suggested by Eric Raymond, Linus Torvalds is more a software engineering manager than a genius developer. (Raymond, 2001) By opening the source code of Linux operating system, Linus was keeping his hacker/users constantly stimulated and rewarded. Every participant is highly motivated by the prospect that he has an ego-satisfying piece of the action. They are rewarded by seeing there is constant (even daily) improvement in their work. (Raymond, 2001, p.30)

In bazaar style software development, every contributor will use different tools to debug different bugs, which are discovered from different usages or aspects. This is dubbed by Eric Raymond as Linus ‘s Law: “Given a large enough beta-tester and co-developer base,

almost every problem will be characterized quickly and the fix obvious to some one." (Raymond, 2001, p.30) Linus will generally risk instability of code to accept every suggestion from user/contributor. Linux version is updated daily or every several hours to incorporate peer contribution. User/contributor can see clearly see his contribution in a new version of Linux if he checks the updates very often. He is generally satisfied by seeing his own piece appearing in the software. As a result, user/contributor or co-developer is more motivated than in other software projects, even though they are not paid.

Participants who join the Linux development gain reputation in software development or related areas. This is quite valuable for most participants. On the other hand, reputation in open source software development can also ensure quality control and an entry barrier, which is especially important for an operating system level software development project. As proposed by Eric Raymond: "The open source community's internal market in reputation exerts subtle pressure on people not to launch development efforts they are not competent to follow through on." (Raymond, 2001, p.48)

7.2.4 Knowledge Management

To make people co-operate in a knowledge sharing community, there are generally two ways to accomplish this: intrinsic rewards and extrinsic rewards. An example of intrinsic rewards will be achievement of status and reputation within community. Tangible returns such as promotions, raises and bonuses are good examples of extrinsic rewards. Both

forms of rewards can be effectively used to motivate people to contribute in an online object exchange.

Besides extrinsic rewards and intrinsic rewards, there is one additional way easily ignored: make sharing knowledge become a responsibility and obligation of community participants. Citibank demonstrated that assigning specific responsibilities to particular individuals is more likely to encourage knowledge sharing than simply expecting people to contribute spontaneously. It was not until Citibank assigned employees the responsibility of entering content into a database that the knowledge base began to grow. (McDermott & O'Dell, 2001)

Knowledge sharing in knowledge management involves social as well as technical aspects. Many companies have already set up procedures or a professional information system for knowledge sharing. Participation in these systems is often less than expected by their designers. "It is important not only to have good systems and procedures for sharing knowledge, but also to encourage participation and to demonstrate the benefits to participants." (Fraser et al., 2000, p.40)

In recent years, companies have attempted to capture their employees' expertise in computerized knowledge management system. These systems are also called electronic knowledge bases, electronic communities of practice (Wasko & Faraj, 2000) and knowledge markets (Eschenfelder et al., 1998). They actually fail most anticipation that users would be able to fulfill tasks better and much more easily.

There are two reasons behind the electronic knowledge bases' failure according to Sukowski and Eppler. (Sukowski & Eppler, 2001) First, it's very difficult, if not impossible, to codify implicit knowledge and input it into the database. According to Nonaka, it's generally required to use other means such as body language to deliver implicit knowledge. (Nonaka & Konno, 1998) Printed text might not work for implicit knowledge dissemination. Second, individuals are not inclined to contribute their knowledge in an anonymous database voluntarily because of insufficient motivation.

Sukowski and Eppler are innovative in that they introduced neoinstitutional economics theory to help analyze the reluctance of employees to share their knowledge. They used transaction cost theory and property rights theory to get implications on knowledge transfer. The implication offered by transaction cost theory on this matter is that cost related to knowledge transaction should be reduced. The application of new interactive, online and just-in-time media can help reduce transaction cost. Thus, the application of new media can help improve the process of knowledge transfer in organizations. The property rights theory implies that individuals tend not to share their knowledge voluntarily without additional compensation. Most employees are paid for knowledge acquisition. And generally they are not rewarded for sharing it.

As a term in economics, dead weight loss is the difference between actual social surplus and the maximum social surplus. Generally, in economics, when loss occurs to an entity,

another entity will get profit to make the whole system balanced. When dead weight loss happens, everyone in the system is worse off.

According to Sukowski and Eppler, there is dead weight loss when the property rights are disseminated to more than one party. (Sukowski & Eppler, 2001, p.606) The dilution of the property rights structure of a good is referred to as external effects, which will result in dead weight loss. It is possible to reduce external effects by internalizing them. By implementing this, the originator of knowledge should be able to get profits from usage of his piece of knowledge by others. This will require that authors retain the rights associated with a piece of knowledge. If knowledge is considered a private good (as opposed to common good in next section) and traded in an organization, it is possible to encourage active knowledge sharing. “This is only possible by accepting additional cost (transaction cost) e.g. for excluding others from using the knowledge, for sanctioning free riders, for calculation of author’s compensations, for keeping track of user accounts, etc.” This will prevent members in an organization to use the knowledge for free. (Sukowski & Eppler, 2001, p.609) When external effects are minimized in this way, dead weight loss is reduced accordingly. This situation is shown in figure 9.

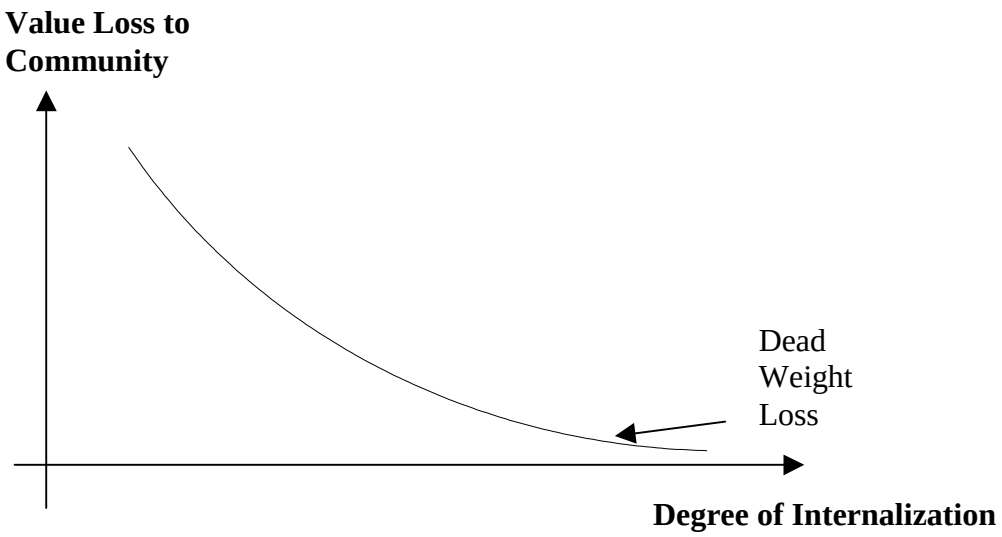

Figure 9: Internalization of external effects reduces dead weight loss[16]

But there's a still side effect for internalizing all external effects. To effectively associate property rights to each owner will significantly increase transaction cost. In some circumstances, it will become prohibitively huge. The example Sukowski and Eppler gave is pollution produced by cars to the environment. Driving a car is one of the reasons for pollution of the environment. However, the cost for environment protection is not charged to every driver but to society, because it is virtually impossible to calculate the specific share of each driver's damage. (Sukowski & Eppler, 2001, p.606) When the degree of internalization improves, transaction cost increases accordingly. As a result, overall effect, which is the sum of dead weight loss and transaction costs, will increase again after reaching optimal point N. This phenomenon is shown in Figure 10.

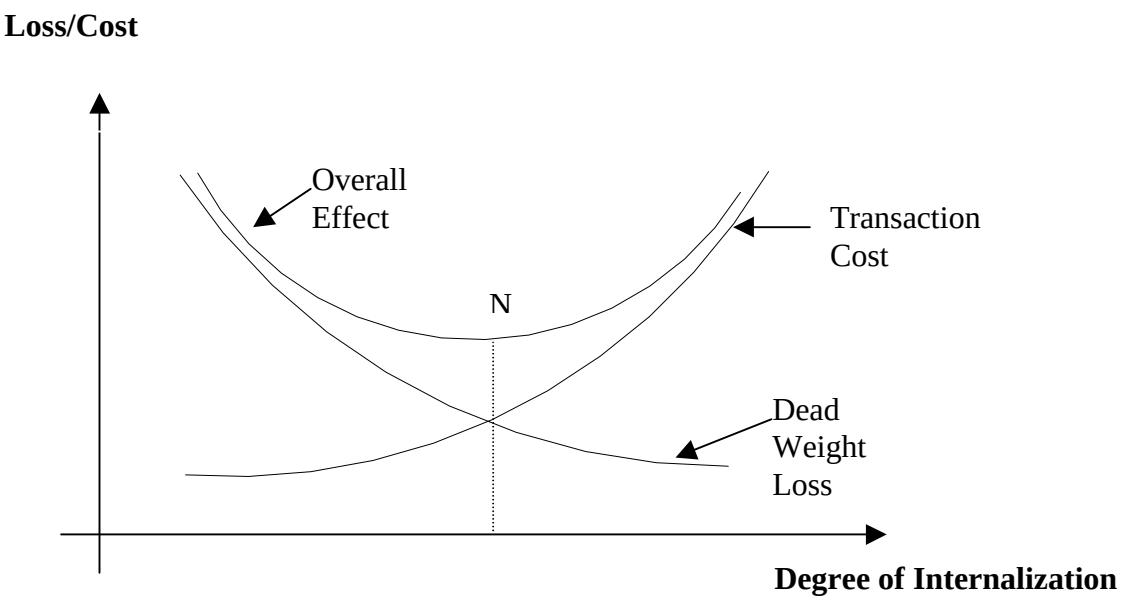

Figure 10: Internalization of external effects, transaction costs, and dead weight loss[17]

To make this figure easily comprehensible for a learning object exchange scenario, we change the measurement unit of horizontal axis from “degree of internalization” to “individual’s owner’s control”. For a certain community, the overall effect is fixed as the sum of transaction cost and dead weight loss, both of which are function of characteristics of this community. But a solution will be to find a lower optimal point on the overall effect curve. According to the curve shape in figure 10, one practical solution to lower the optimal point of overall effect curve is to move transaction cost curve to the right. One could also seek to move dead weight loss curve to the left. The resulting overall effect curve will be lower than the original one. Value of new optimal point N’ will be smaller than that of N. This approach is shown in Figure 11.

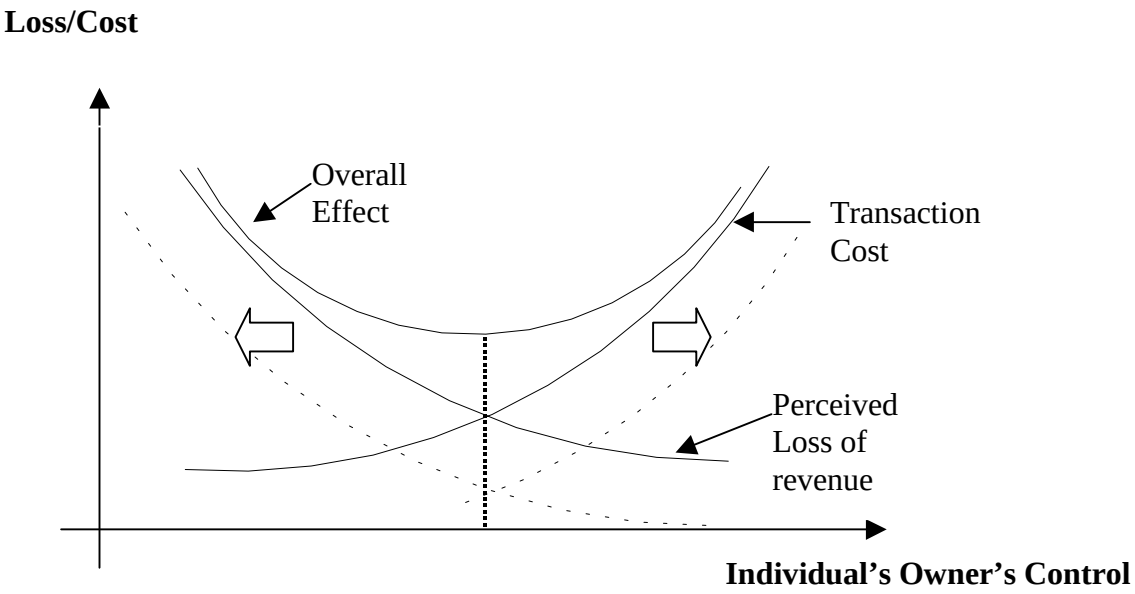

Figure 11: One solution to lower optimal point

Another practical solution is to make transaction cost curve less steep than before. This can be achieved by trying to lower transaction cost as presented in the highlighted area in Figure 12. (As the degree of internalization improves, transaction cost and dead weight loss are fixed for a certain community. But from a member's perspective, transaction cost may not be charged to him if the organization's administration team will pay the transaction cost. As a result, the transaction cost an individual member faces will be smaller. A much smoother individual transaction cost curve will be achieved. This is an attractive goal to work towards.)

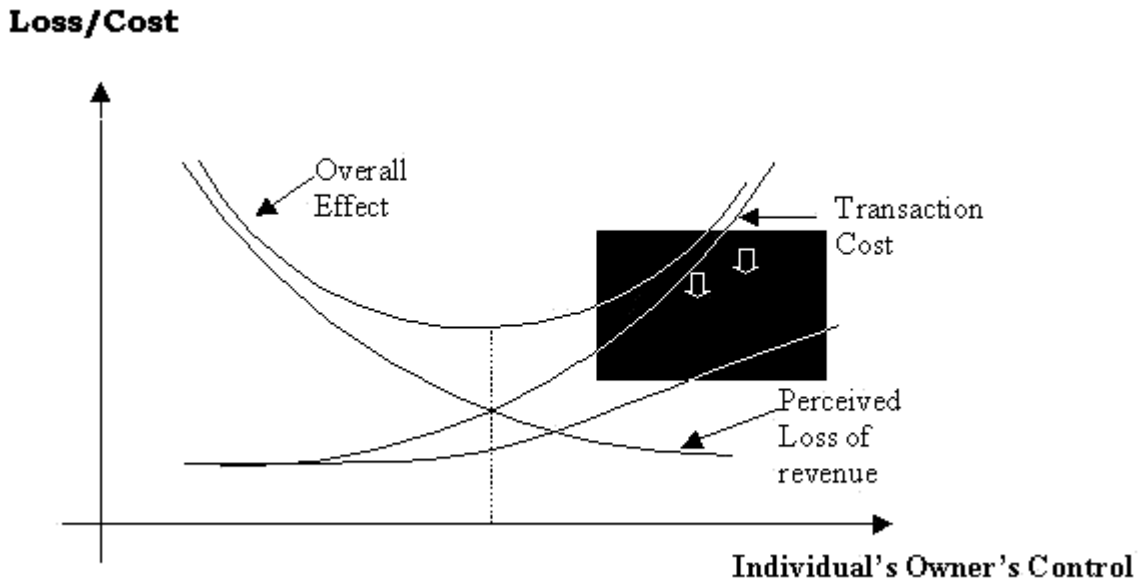

Figure 12: Another solution to lower optimal point

The possible practical way to make knowledge management successful in a company is to integrate a set of policies, which can relate people's contribution in knowledge base to their compensation or bonus. In other words "build sharing knowledge into routine performance appraisal." (McDermott & O'Dell, 2001) This is an extrinsic benefit, which is not a part of the transaction cost.

In another research study to identify the reason why people participate and help others in electronic communities of practice, authors suggest that KMS (Knowledge Management System) could be designed in three ways based on perspectives on knowledge: knowledge as object; knowledge embedded in people; knowledge embedded in a community. (Wasko & Faraj, 2000) The first two view knowledge as a private good while the last one views knowledge as a public good. Traditionally, knowledge management systems being developed are based on the assumption that knowledge is a private good that is exchanged in the expectation of a return. Authors of this research

suggested that organizations should also consider developing electronic communities to manage knowledge as a public good. They found out that in a successful community, members act out of community interest rather than self-interest. Self-interest will denigrate the value of the community. Many of the comments (Wasko & Faraj, 2000, p.169) received in the study reflect that people do not expect to receive future help from the same individual. But they do expect generalized reciprocity, which comes from someone else. This finding supports the work of Kollock (Kollock, 1999), who noted that when people help others due to the possibility of future reciprocation, they most want to make sure that interaction will be available in the future. Thus, electronic communities need to build an embedded system to keep track of interactions, archive discussions in a searchable format, and display the identities of group members.

7.2.5 Social Capital

From 7.2.1 to section 7.2.4 I have reviewed related research on communities in discussion group, media exchange, open source movement and knowledge management. We can conclude that there are heavy lurking activities in discussion group and media exchange. Open source movement's success can be attributed to the fact that every participant can find his ego-satisfying piece in the project community. This has important implications for other similar situations. For example, we can use extrinsic credits to motivate employees in a company to co-operate in knowledge management scenarios. We can use a reputation system as a possible solution to help cut off the free riding behaviors in a fully distributed system.

While we discovered such lurking phenomenon in online communities, it's not an independent event. It has connection to current social background.

Robert Putnam demonstrated that respect for public life has been waning in recent years. Most social groups' member base has become smaller and smaller at an astounding speed. And many of them have to be closed. In recent years social scientists have concerns about the changing character of American society in terms of the concept of "social capital". Social capital refers to social connections among individuals. According to Robert Putnam, social networks have value. Just like physical capital (e.g. screwdriver) and human capital (e.g. education), social capital can also increase individual and collective productivity (Putnam, 2001). Increased amounts of social capital can improve people's understanding of reciprocity. Generally people can benefit from reciprocity. But in the first place, people need to invest time and energy to do something for other people to acquire social capital. This has important implications to this research as we can look to enhance social capital in appropriate forms through online communities.

One important point raised by Robert Putnam is this: "A society characterized by generalized reciprocity is more efficient than a distrustful society, for the same reason that money is more efficient than barter." (Putnam, 2001) This has two connections to similar problems in online communities. First, users in an online community do benefit for their co-operation in the form of reciprocity. Second, a reputation system used to record user's contribution will make the whole exchange system more efficient. Another

important point raised by Putnam is: “Dense social ties facilitate gossip and other valuable ways of cultivating reputation – an essential foundation for trust in a complex society.” (Putnam, 2001) This implies that a reputation system, which can be in various forms to deliver the same function of gossip in society, is essential for an online community, which desires to practice trust and co-operation.

7.2.6 Gift Economy and Market Economy

Besides connection to social capital, the problem of lurking is a product of people’s confusion between gift economy and market economy. This is also why the Weissmann case became an “uncommon controversy” (McSherry, 2001)

In a gift economy, social relationships are marked by exchange of gifts that involves more or less complexity. Market economy is a mechanism for allocating labor and capital toward commodity production. (Gibbons et al., 1994) Normal social activities are based on gift economy. Gift exchange is based on people’s individual perception of value of gifts received or sent. Mismatch in perceptions of values in one transaction will cause dissatisfaction for both parties. And if one party fails to obligate to return a certain amount of gifts, relationship is probably at verge of break-up. The whole community will be ruined if this happens to everyone.

The modern academy is based on a gift economy, which has caused many problems. However, I don’t think it’s appropriate to bring market economy to every part of the learning and teaching community. Gift economy works well for many of them. How to

build a mechanism to include advantages of both economies is what this research all about. And it is still a great challenge in the future.

7.3 Other Research Topics

From this research it is evident that co-operation policies do have impact on online learnware object exchange. This conclusion is based on analysis of previous research, a case study and a scenario-based questionnaire. However, we need to conduct a further study using a real cooperative exchange. We can conduct this experiment by publicly launching CLOE. After that we can monitor its parameters: growth rate, member population, supply, demand and learning objects categories, etc on an ongoing basis. We can sample some learning objects in the repository to measure their quality as well as their ongoing development. This can be used towards measurement of influence of co-operation policies on ROI. The duration of this study should be at least 1 year. This period allows researchers to compare the different pattern it shows with respect to other learnware object exchanges. As a result, the impact of co-operation policies can be measured and recorded.

We talked about object discovery in 4.3.5 (pricing exchange mechanism). However, this algorithm is still quite static. In a real learnware object marketplace, we need a dynamic quoting system. Behind the quoting system, the algorithm should consider variables that are going to change from time to time. Examples of such variables are supply and demand of a specific learning object. In an ideal situation, the mechanism can

dynamically name the price of that object based on an object's supply and demand. I believe this mechanism can help discover an object's value in real time.

In this research, our empirical analysis mainly focused on lurking behaviors in online communities. We think that motivations of contributors should also be considered. Further research on this area would be required to provide a complete solution for online object exchange.

Another issue raised by this study is that academics seem to hold negative attitudes towards commercialism. To make a learnware object exchange become an e-marketplace is a real offence to many of them. How to alleviate their concerns or present the e-marketplace differently will be a real challenge. We need to consider these aspects in further research.

Notes

1. Yahoo! Groups home page: http://groups.yahoo.com
2. Smiling E-Groups home page: http://www.smiling.com.cn
3. The Gnutella home page: http://gnutella.wego.com
4. Mojo Nation home page: http://www.mojonation.net
5. CLOE home page: http://LT3.uwaterloo.ca/CLOE
6. MERLOT home page: http://www.MERLOT.org
7. CSU-CDL home page: http://www.cdl.edu
8. EOE home page: http://www.eoe.org
9. The originals of CLOE actually hope that sufficient co-operation will develop to make the explicit mechanism redundant. See Personal Communication (Feb3, 2002).
10. Napster home page: http://www.napster.com
11. SETI@home home page: http://setiathome.ssl.berkeley.edu
12. Popular Power home page: http://www.popularpower.com
13. For more information about JXTA search, please see http://search.jxta.org
14. EBay home page: http://www.ebay.com
15. The original report titled “CLEO: Co-operative Learnware Exchange for Ontario” is written by Graham Carey. We include extensive quotes rather than refer the reader to the original because the report is not publicly available. Amongst all papers referenced by Graham Carey, the most important one is:

Aalst, J.V. (2001). Knowledge Management in Courseware Development. Delft, The Netherlands: Delft University Press.

16. In original paper, the vertical axis of above figure is measured in “dead weight loss”. This is inappropriate since the value of the function curve is measured in the same unit. We change it to “value loss to community”.
17. In original paper, the vertical axis of above figure is measured in “overall effect/ transaction cost”. This is inappropriate since the value of the function curve is measured in the same unit. We change it to “loss/cost”.
18. Freenet project home page: http://freenetproject.org

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Appendix A: Scenario-based Questionnaire on Participation and Motivation Issues in MERLOT

Guidelines

This questionnaire is composed of two parts. The first part of this questionnaire is based on scenarios. The second part is stand-alone.

Some questions will allow more than one response. Some questions will require input of personal thoughts. Please read through the scenarios carefully before writing down your opinions or choosing certain choices. When you have completed the questionnaire, please click the "Submit Answers" button to send us your answers. Thank you for your help.

Scenario I

Freeware. Fred builds several topic pages in physics. These pages have limited interaction. He uses his own time to do this. These pages will not take much time. One reason is that they are easy to build. The other reason is that Fred already has previous experiences with web page builders (e.g. FrontPage, Dreamweaver) and HTML.[Freeware]

Supported. Sam develops an interactive simulation on a few sociology topics. This learning object is based on HTML with embedded animations. The whole simulation can be delivered using a web browser and general animation plug-ins. The animations simulate some social situations. Sam receives a 10K grant from University allocation of Learnware Technology funds. And this project will take four months for him to finish.[Supported]

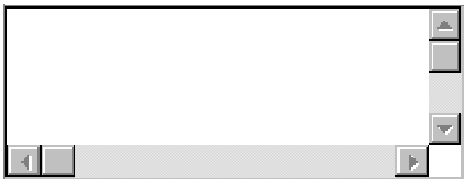
Commercial. Carla and her team make a commercial courseware CD-ROM. It includes many video segments about World War I. These video segments are from commercial videos. In addition to designing customized multimedia tools which will be integrated with those video segments, Carla and her team should pay a large amount of money for royalties on those commercial videos. This project will take six months for the team to finish. This CD-ROM will be bundled with a history textbook, which will be available in many university bookstores.[Commercial]

Tip:
Fred 'Freeware' , Sam 'Supported' , Carla 'Commercial'

1) What should MERLOT contain and review?

- Only Freeware
- Only Freeware and Supported
- Freeware, Supported and Commercial
- Freeware plus others that have a mini version available to all
- Freeware plus others with a version available to MERLOT member institutions

2) For Question 1, Why do you choose that answer?



Scenario II

Gary  administers the local university allocation of Learnware Technology funds. Sam  (Scenario I-Supported) tries to get funding from Gary. Before allocating funding, Gary has to convince higher level (local or state) by showing promising return on investment (ROI).

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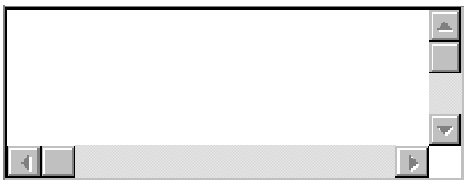
3) Should Gary  consider potential commercialization (scenario I-Commercial) amongst the factors in allocating and replenishing funds for Sam  ?

Please give your answer and reason.



4) Should Gary  consider potential reuse elsewhere amongst the factors in allocating and replenishing funds? (e.g. in convincing the state to renew its funding for Learnware Technology because it's valuable to make certain learnware usable across the state)

Please give your answer and reason.

Scenario III

Some state or provincial systems have proposed a co-operative exchange for re-use of learnware objects. It's going to have an automatic accounting system working in the background. When other institution members use your learnware, you will get credits. In the meantime, you will have to debit your account when you use other member institution's learnware. Such a mechanism could provide incentives for building learnware modules of wide interest and high quality, e.g. by providing more funding to institutions with the most credits or by limiting how far 'out of balance' the credit and debit accounts can get. (One example is the CLOE prototype under development in Ontario.)

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5) In your opinion, which kind of learnware will CLOE possibly get? Freeware, Supported, Commercial (in Scenario I), which one would CLOE encourage or discourage?

Please give your answer and reason.

6) How would you be encouraged or discouraged by this exchange platform?

7) In your opinion, would a scenario like CLOE support Gary  to make the decision in Scenario II?

Please give your answer and reason.

8) In your opinion, would an exchange platform like CLOE encourage state and other funding sources to support Learnware Technology?

Please give your answer and reason.

9) In your opinion, could a co-operative economy for learnware objects become a springboard for more learnware to become commercialized? (e.g.?more enhancements could be added to a piece of learnware if CLOE indicates high demand in a particular area or on particular learnware)

Please give your answer and reason.

The Following are stand-alone questions which are not related to the above

scenarios.

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10) How long have you been involved in using or developing learning objects?

- ○ 5 years or more
- ○ 4 years
- ○ 3 years
- ○ 1-2 years
- ○ Less than one year

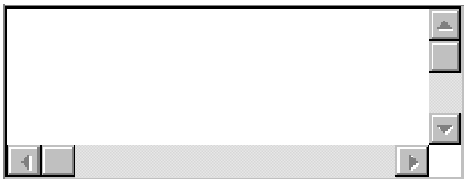
11) How frequently do you access MERLOT?

- ○ Daily
- ○ Weekly
- ○ Monthly
- ○ Less than once a month
- ○ Never

12) Which role are you in? (Check all that apply)

- ☐ Instructor/Faculty
- ☐ Learning Object Author
- ☐ Learning Object User [provide for your classes]
- ☐ Reviewer
- ☐ Discipline Committee member
- ☐ Discipline Committee Co-leader
- ☐ Instructional designer
- ☐ Faculty development staff
- ☐ MERLOT Project Director
- ☐ MERLOT Admin Team
- ☐ None of the above

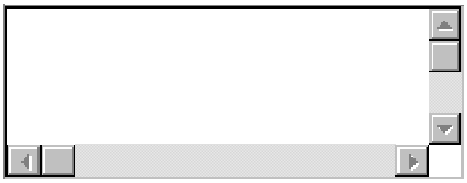
13) If you chose "none of the above" in previous question, please specify your role.



14) How often do you make a contribution to MERLOT?

- Daily
- Weekly
- Monthly
- Occasionally
- Rarely
- Never

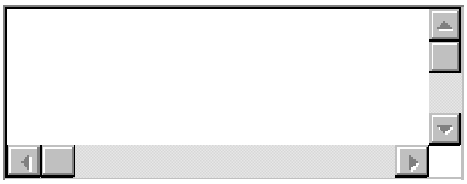
15) If you chose "Never" in previous question, please state the reason



16) So far, are you satisfied with MERLOT?

- Very Satisfied
- Somewhat Satisfied
- Somewhat Unsatisfied
- Unsatisfied
- No Idea

17) If you chose "Somewhat Unsatisfied" or "Unsatisfied" in previous question, please state the reason



18) Some online communities have "free riding" problems. For example, in Napster, most users download mp3 files without any contribution to the community. Some people object to a perceived inequity in this situation. Do you think this is a significant issue for the MERLOT community?

- Not likely to be a problem
- Could become a problem as MERLOT grows
- Already a problem for some people

19) Suppose access to some MERLOT resources were to be restricted to members who contribute [objects, submissions, reviews, assignments, ...], which of the following restrictions would be acceptable to you??
[note: there are no current plans to move MERLOT in that direction]

Everyone (with or without a contribution) can access:

- Review summary
- Full review
- Full review and other existing info [assignments, member comments, etc.]
- All information that might be in MERLOT [e.g. existing information plus extra design rationale, history, lessons learned, etc.]

20) Please tell us the reasons for your answer to the previous question.