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VIRTUAL COMMUNITY INFORMATICS: A REVIEW AND RESEARCH AGENDA

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ABSTRACT

Divergent opinions exist on the basic understanding of the concept, virtual community. This study offers a working definition by examining different definitions, and proposes adoption of virtual community classifications. It also includes a summary of research conducted in the field. The research categorizes the different stages in virtual community growth to show the transition of research in this area. The results illustrate a paucity of technology development studies. We also investigate the extent of the adoption of informatics in these communities using a survey 200 virtual communities. The results indicate that discussion forum is the most popular tool adopted in virtual communities. The integration of the research review and tool adoption survey contributes to the generation of an agenda to direct future virtual community research.

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INTRODUCTION

With the exponential growth of the virtual community, more and more studies have been conducted on how virtual communities affect living standards by providing functions for relationship building and knowledge sharing (Baranski 1997; Bieber et al. 2002; Blasé 2000; Brown 2000; Siwolop 1997). Nevertheless, little consensus has been reached on basic concepts such as definitions and classifications of the virtual community. Without such underlying concepts, researchers use a variety of meanings for the same terms. The various classifications proposed by different researchers prevent the adoption of a standard terminology. Also, the existing literature shows that virtual community research is lacking and is being ignored in the most prestigious journals. This implies that virtual community research has not yet reached a mature stage and opens opportunities for future study.

From a practical point of view, a virtual community provides access for engaging in common activities, sharing feelings, or discussing ideas with others. The current practice is to build web sites and allow people to register as members who can then share information or feelings virtually. However, the tools that virtual community web sites are using to assist in relationship building and knowledge sharing are of dubious value. As the virtual community becomes more popular, researchers need to be aware of what is happening in the theoretical aspects as well as practical developments and consideration of research opportunities that exist.

We develop four research questions based on the problems mentioned above:

1. What is our proposed working definition of the virtual community?
2. What are the classifications of virtual community and how can they be adopted in different situations?
3. What are the tools currently adopted in virtual communities and expectations for their functionalities?
4. What suggestions can we make about future research about virtual communities?

In this paper, we compare different virtual community definitions and develop a working definition. We then describe different classifications of virtual community and suggest selective adoption based on different situations. We identify existing research on virtual community, and demonstrate the lack of technology development studies. Next, we examine virtual community from a practical point of view to reflect on what is actually happening in this area. On the practical side, we conduct a survey on internet tools used in 200 virtual community web sites, and provide suggestions for how these tools can provide

CONTRIBUTION

This study provides an overview of various aspects of virtual community research to reflect the basic knowledge in this area. It proposes a working definition of the virtual community to contribute to a consensus on standard terminology. In addition it proposes classification schemes for virtual communities and suggests the adoption of appropriate classifications in different situations.

Another contribution of this study is the summary of existing research on virtual community. It reflects the immaturity of research in this area and exposes the lack of research on technology development for supporting virtual community.

This paper also includes a survey on tools used in virtual communities. The results contribute to our knowledge on the most popular tools adopted in virtual communities, i.e. discussion forum.

We propose future research topics, including knowledge management in virtual community and the impact of discussion forums on information exchange and emotional support.

The paper can help novices gain a basic understanding of virtual community research. Researchers may find this paper useful to help select new research areas. Virtual community administrators can become aware of the popular types of technological tools used in virtual communities for community development.

support. The results of the survey indicate that discussion forum is the most popular virtual community tool. Finally, integration of research summary and survey findings contributes to a research agenda for directing future virtual community research with the technology development focus.

This is a review and a research agenda paper about the virtual community. We first propose a working definition of virtual community and suggest circumstances where different virtual community classifications could be applied. We also provide a summary of research conducted on virtual community that could be useful for future studies. We conduct a survey to help us understand the practical issues in virtual community, in which we focus on tools adopted in virtual community. Incorporating the research summary with the survey results could be helpful in preparing an agenda for indicating direction for future research. Some suggested future research directions include:

- Impact of discussion forums on information sharing and emotional support;
- Requirements of tools to support communication in the virtual community;
- Knowledge management in the virtual community; and
- Design of virtual communities to generate profit.

DEFINITION OF A VIRTUAL COMMUNITY

Traditionally, the word "community," has been considered to be a closed system. It has been seen to have a relatively clear boundary, relatively stable membership, and show little linkage to other communities (Anderson 1999). But with the advanced development of information and communication technology, predominance of geography as a force of a shaping community is reduced. The communication network is enhanced and thus the virtual community arises. However, the basic question remains: what is a virtual community?

A generally agreed upon definition of a virtual community, a definition understood by most people, would be a good starting point. What we need is a working definition, a consensus found in the major stream of literature. To achieve this goal, definitions of virtual community proposed by various authors are compared in Table 1. Similar items found in definitions are then extracted in order to build up a working definition. These definitions are presented in order of popularity. Howard's (1993) definition is the most popular cited reference, followed by Hagel and Armstrong's (1997).

Table 1: Definitions of virtual communities proposed by various authors

Author	Definition
Carver (1999)	Virtual Communities are about aggregating people. People are drawn to virtual communities because they provide an engaging environment in which to connect with other people – sometimes only once, but more often in an ongoing series of interactions that create an atmosphere of trust and real insight.
Craig and Zimring (2000)	A sense of community, that is, it is not guaranteed by opportunities for interaction but, rather, must grow out of interaction itself.
Erickson (1997)	Long term, computer-mediated conversations amongst large groups.
Hagel and Armstrong (1997)	Virtual communities are computer-mediated spaces where there is a potential for an integration of content and communication with an emphasis on member-generated content.
Hesse (1995)	A community that spins time and geography, a community that supplements buildings and streets with personal computers and information superhighways.
Ho, Schraefel, and Chignell (2000)	Technologically mediated, persistent, environment which supports: multiple interaction styles, capability for real-time interaction, and multi-user engagement.
Howard (1993)	Social aggregations that emerge from the Net when enough people carry on public discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace.
Jones and Rafaeli (2000)	Virtual Publics are symbolically delineated computer-mediated spaces, whose existence is relatively transparent and open, that allow groups of individuals to attend and contribute to a similar set of computer-mediated interpersonal interactions.
Romm and Clarke (1995)	Groups of people who communicate with each other via electronic media, rather than face to face.

In his definition of a virtual community, Howard (1993), the primary early advocator of virtual community and often quoted in the literature (Kozinets 1999), includes factors that describe what a virtual community is: 1) *the Net / cyberspace* refers to activities carried out in cyberspace, to differentiate them from real community activities; 2) *public discussion* suggests that participants have discussions with one another, whether to share opinions, knowledge, feelings, or common topics of interest. There is the implication that topics are generated by participants rather than web site coordinators; 3) *personal relationship* indicates that with sufficient time, participants develop a self-sustaining relationship amongst themselves.

Hagel and Armstrong (1997) focus on the content and communication aspects with special emphasis on member-generated content. From Table 1, the definition proposed by them is: virtual communities are computer-mediated spaces where there is a potential for an integration of content and communication with an emphasis on member-generated content. Key points from their definition are: 1) *computer-mediated spaces* has a similar meaning to cyberspace and internet space when being accessed by technology; 2) *member-generated content* obviously refers to the data, information, discussion, expression, and feelings generated in discussions led by members. This helps to distinguish the virtual community from online information services.

The third definition is from Jones and Rafaeli (2000) who use the term 'virtual public' instead of virtual community. To repeat their definition: 'Virtual Publics are symbolically delineated computer-mediated spaces whose existence is relatively transparent and open, that allow groups of individuals to attend and contribute to a similar set of computer-mediated interpersonal interactions.' Based on this definition, virtual publics are: 1) in the *computer mediated spaces*, that is, the cyberspace arbitrated by technology; 2) *groups of individuals attending and contributing to a similar set of computer-mediated interpersonal interactions*, stressing the participants' contributions to the interactions in cyberspace.

Romm and Clarke's (1995) definition points out only the aspect of communication, that is, via electronic media. This broader definition may not sufficiently distinguish the virtual community from other web sites. However, there is still some similarity with the definitions of the others. This similarity includes 1) *groups of people who communicate* indicating that participants interact with each other to share or discuss; 2) *electronic media* referring to the support of communication by technology.

In his definition of a virtual community, Hesse (1995) defines it 'as a community that spins time and geography, a community that supplements buildings and streets with personal computers and information superhighways.' His definition focuses on the virtual community enabled by technologies designed to move *information* rather than goods and people. He appears to view the virtual community from a technical rather than social point of view.

The other definitions in Table 1 share some similar points with Howard, and Hagel and Armstrong. Craig and Zimring (2000) focus on the outcome of virtual community and an important element to achieve the outcome, i.e., interaction. Erickson (1997) points out that the conversion should be mediated by computer technology in order to qualify as a virtual community. Lastly, both Carver (1999), and Ho et al. (2000) emphasize the purposes of and interaction in virtual community.

There are distinct differences in the definitions mentioned above. For example, Craig and Zimring place emphasis on the outcome of virtual community, while Romm and Clarke look at the definition from the communication pattern of virtual community. Sometimes there are mismatches. Take Erickson's definition as an example. He proposes virtual community as long-term, computer-mediated conversations for large groups. But, in reality, some virtual communities have only a small number of members and they can still survive.

Even though discrepancies occur among some existing virtual community definitions, almost all definitions share some similar points, but none of them address all

ideas. The similarities will contribute to the construction of a working definition. The first similar point is **cyberspace**. All of the definitions state that virtual community should be on the net, use computer-mediated spaces, or cyberspace. This point differentiates the virtual community from a physical community. Unlike the traditional definition of "community" that implies the existence of a geographical boundary and its communication bounded by the physical location (Moffitt 1999), virtual community does not have borders since it locates in a place where no boundary can be found.

The second aspect in common is the usage of **computer-based information technology** to support the activities in virtual community. The different definitions directly or indirectly emphasize that access to virtual community is through the computer or electronic media, i.e., computer-based information technology. In virtual community, the commonly used computer-based information technological tools are e-mail, discussion forums, and message boards. One of the objectives of this study is to provide a review of technological tools adopted in virtual community. The details of the review will be shown as a survey result in the latter part of this paper.

The third similar aspect is that **communication and interaction are the main focus, and content or topics of virtual community are driven by the participants**. The participant-driven community, not the web site coordinators, clearly distinguishes the virtual community from online information services. And the contents in the community are formed when members communicate with each other. Among members, recurring interaction generates further messages and makes the communication non-stop for a sustained community.

The final shared aspect is the successful virtual community **relationship** culminating after a certain time period of communicating together.

Using the common elements mentioned above, a working definition of virtual community could be: a cyberspace supported by computer-based information technology, centered upon communication and interaction of participants to generate member-driven contents, resulting in a relationship being built up. This working definition encompasses the elements that constitute a virtual community.

CLASSIFICATION AND ADOPTION OF VIRTUAL COMMUNITIES

The classification of virtual communities shows divergent opinions. Authors classify virtual communities into different categories according to their underlying principals or focuses. Several popular classifications are listed in Table 2. Hagel and Armstrong's (1997) classification is most popularly referenced.

Table 2: Classifications of types of virtual community

Author	Classified by	Types of virtual community
Hagel and Armstrong (1997)	Basic needs of human	- Interest, Relationship, Fantasy, and Transaction
Carver (1999)	*Not mentioned*	- Interest, Relationship, Entertainment, and Commerce
Jones and Rafaeli (2000)	Use	- Transaction, interest, relationship, and fantasy
	Social Structure	- Examples: Virtual settlements, cyber-inns, virtual airport bar, virtual voluntary associations, other forms of social structures
	Technology Base	- Web-BBS, Web Avatar meeting place, Usenet group, Email list, 3-D world, Text generated space, Internet relay chat, and other CMC-Technologies

Hagel and Armstrong's (1997) classification of types of virtual communities is commonly referred to in the literature (Kozinets 1999). In their opinion, interactions in virtual community are based on people's desire to meet four basic needs: interest, relationship, fantasy, and transaction. Under this classification, the *interest* need is targeted in the virtual community by aggregating a dispersed group of people who share an interest and expertise in a specific topic. The *relationship* need gives people with similar experiences the opportunity to come together and form meaningful personal relationships.

The *fantasy* need provides an opportunity for people to come together and explore new worlds of fantasy and entertainment, while the *transaction* need is met online through the trading of information between participants. Hagel and Armstrong's classification is similar to Carver's (1999), albeit with different wording for similar meaning.

Jones and Rafaeli (2000) have developed Hagel and Armstrong's classification by providing further classifications according to different focuses. As shown in Table 2, these different classifications focus on "use", "social structure", and "technology." "Use" is one of the classifications by Jones and Rafaeli. They adopted Hagel and Armstrong's proposal to provide a scheme for classifying virtual communities by use. This classification categorizes virtual communities by the way they help meet one of four basic needs: interest, relationships, fantasy or transactions. The transactions based communities can be sub-classified into business-to-business virtual communities and customer-focused virtual communities. Business-to-business focused communities consist of various types including vertical industry, geographic publics, functional publics, and business type publics. Customer-focused virtual communities can be sub-divided into geographic, demographic or topical types.

Another classification by Jones and Rafaeli is by "social structure." This classification requires an analysis of the social networks that are formed by users that are more specific to some particular virtual communities. Examples of this categorization include Cyber-Inns by Coate (1992) and Virtual Airport Bar by Doheny-Farina (1996).

The third classification by Jones and Rafaeli is a more straightforward one. It classifies virtual communities according to their technological base that encompasses Web-BBS, web avatar meeting place, usenet group, email list, 3-D world, text generated space, internet relay chat, and other computer mediated communication technologies.

Each of these classifications represents a specific understanding under different situations. We can therefore suggest that different classifications are appropriate in specific studies based on the perspective taken.

Taking the different focuses of research into consideration, various classifications could be adopted for different occasions. For example, as presented in Table 2, Hagel and Armstrong propose a classification in a sociological perspective and classify virtual community in view of social interpretation. They focus on how people feel about each other and the satisfying of their needs. This classification is appropriate when studying social influences on virtual communities, for example how members behave and what factors affect participation in a virtual community. On the other hand, this classification is general and can be applied to most studies. Hagel and Armstrong's classification is similar to Carver's categorization on virtual community since both of them look at the issue from a similar perspective.

One of Jones and Rafaeli's classifications is "use" concerning human basic needs. Similar to Hagel and Armstrong's proposal, this classification can be applied when studying social and psychological issues in virtual community. But the classification by "social structure" is unclear. The community type is quite specific and may only fit in one situation but not in others. Their third type of classification by technological base can be applied when studying the functions and features provided in virtual community.

In summary, none of the classifications of virtual community covers every aspect, or fits under every circumstance. Each categorization scheme fits better in certain situations than in others. For example, when describing something relating to technology, Jones and Rafaeli's classification by technology would be more suitable. However, categorizations of Hagel and Armstrong or Carver are more generic and relate more to social issues. They could be applied in behavioral studies where participation is voluntary and the outcomes are uncertain.

CURRENT RESEARCH CONDUCTED ON VIRTUAL COMMUNITY

As more and more virtual communities can be found in the internet, virtual community research becomes important. However, there is a paucity of reviews about existing research on the virtual community. To address this problem, we list and categorize prior research to show the progress made in virtual community research.

We examined the meta-analyses by Claver, Gonzalez, and Llopis (2000) and Li (1997) to classify research on the virtual community. To accomplish this we modified the method used in an earlier study by Lai and Mahapatra (1997), a meta-analysis of prior research about information technology implementation, supporting the classification of studies by phases of virtual community growth. Lai and Mahapatra divided IT implementation into seven phases: basic research, technology development, diffusion of information, adoption, implementation, outcome assessment, and institutionalization. In the diffusion of information stage, several research topics are not relevant to virtual community, such as market analysis, marketing strategy, change agent analysis, etc., so we excluded this stage from our classification of virtual community research. We combined the implementation phase and outcome assessment phase because most researchers address both stages in the same study.

To clarify virtual community research growth, we suggested five stages, based on an adaptation of Lai and Mahapatra's (1997) phases. The first stage is to get a **fundamental understanding** about the virtual community. It includes the derivation of underlying concepts, principals, definitions and models, etc. After having an idea of what the virtual community is, it is important to know how to develop the fundamental understanding. Thus, in the second stage the emphasis is on **technology development** for supporting growth. This stage includes studies on the tools used in the virtual communities and technological potential for developing them. After building up the virtual community, it is also necessary to understand the **functions derived and proposed adoptions** of them. This is the main focus in the third stage. The studies encompassed in this stage are the potential applications of virtual community, relationship building and knowledge sharing in virtual community - points to be aware of when developing a virtual community.

The fourth stage combines the conceptual ideas and technology available into reality. This means that **implementations and outcome assessments** need to be worked out to gain experience of virtual community building and to evaluate the results. In the final stage, with sufficient understanding of virtual community, research can link up the knowledge of virtual community with other research areas or disciplines to enlarge the potential benefits. This is a step of **institutionalization,** including studies on the impact of virtual community on e-commerce. The work in these five stages may not happen in sequence, and on a practical level, it is very likely that they are conducted in parallel.

We reviewed IS journals to examine the existing research conducted on the virtual community. We include journals suggested by previous literature, such as *MIS Quarterly*, *Information Systems Research*, *Management Science*, and *Journal of Management Systems* (Claver et al. 2000; Hardgrave and Walstrom 1997; Nord and Nord 1995). We also include references from *the Proceedings of the Hawaii International Conference on System Science's* mini-track on online communities, and short studies of *Communications of the ACM*.

A look at the list of articles in Table 3 shows that the numbers of studies have increased in recent years. This indicates that virtual community study is the subject of increasing attention. However, the number of studies in this area is still low. Many existing studies focus on defining the basic concepts of virtual community and the attempts to adopt or implement virtual community.

In addition, as shown in Table 3, the number of studies conducted in the technology development stage is especially low. It reflects that there is a lack of studies on technology development for supporting virtual community. It is surprising that although we regard virtual community as a computer-

Table 3: Research conducted on the virtual Community

Research Stage	Author	Research Topic
Fundamental understanding	(Andrews 2002)	Audience-specific online community design
	(Burnett 2000)	Information exchange in virtual communities: a typology
	(Cummings, Butler, and Kraut 2002)	The quality of online social relationships
	(Ho, Schraefel, and Chignell 2000)	Towards an Evaluation Methodology for the Development of Research-Oriented Virtual Communities
	(Igbaria 1999)	The Driving Forces in the Virtual Society
	(Jones 1997)	Virtual-Communities, Virtual Settlements & Cyber-Archaeology: A Theoretical Outline
	(Jones and Rafaeli 2000)	Time to Split, Virtually: 'Discourse Architecture' and 'Community Building' as means to Creating Vibrant Virtual Metropolises
	(O'Neil 2002)	Assessing community informatics: a review of methodological approaches for evaluating community networks and community technology centers
	(Romm, Pliskin, and Clarke 1997)	Virtual Communities and Society: Toward an Integrative Three Phase Model
	(Romm and Clarke 1995)	Virtual Community Research Themes: A Preliminary Draft for A Comprehensive Model
Technology development	(Bieber *et al.* 2002)	Virtual Community Knowledge Evolution
	(Goodman and Darr 1998)	Computer-Aided Systems and Communities: Mechanisms for Organizational Learning in Distributed Environments
	(Hattori, Ohguro, and Yokoo 1999)	Socialware: Multiagent Systems for Supporting Network Communities
Functions derived and adoption	(Berghel 2001)	A Cyber publishing Manifesto
	(Cowan, Mayfield, Tompa, and Gasparini 1998)	New Role for Community Networks
	(Erickson 1997)	Social Interaction on the Net: Virtual Community as Participatory Genre
	(Faucheux 1997)	How Virtual Organizing is Transforming Management Science
	(Marlino, Summer, Fulker, Manduca, and Mogk 2001)	The Digital Library for Earth System Education: Building Community, Building The Library
	(Pliskin and Romm 1997)	The impact of e-mail on the evolution of a virtual community during a strike
	(Stanoevska-Slabeva and Schmid 2001)	A Typology of Online Communities and Community Supporting Platforms
	(Swan 2001)	Knowledge Management in Action: Integrating Knowledge Across Communities
	(Wachter, Gupta, and Quaddus 2000)	IT takes a village: Virtual communities in supporting of education
Implementation and outcome assessment	(Chellappa, Barua, and Whinston 1997)	An Electronic Infrastructure for A Virtual University
	(Emmen 1999)	Establishing a Virtual Medical World Community
	(Hardwick and Bolton 1997)	The Industrial Virtual Enterprise
	(Hesse 1995)	Curb Cuts in the Virtual Community: Telework and Persons with Disabilities
	(Hiltz and Wellman 1997)	Asynchronous Learning Networks as a Virtual Classroom
	(Majchrzak, Rice, Malhotra, King, and Ba 2000)	Technology Adaptation: The Case of a Computer-Supported Inter-organizational Virtual Team
	(Pearson 1999)	Electronic networking in initial teacher education: is a virtual faculty of education possible?
	(Piccoli, Ahmad, and Ives 2001)	Web-Based Virtual Learning Environments: A Research Framework and a Preliminary Assessment of Effectiveness in Basic IT Skills Training
	(Rao 1998)	India Network – the first case study of a virtual community
	(Singh, Yu, and Venkatraman 2001)	Community-based Service Location
Institutional-ization	(Bruckman 2002)	The future of e-learning communities
	(DeSanctis, Wright, and Jiang 2001)	Building A Global Learning Community
	(Jin 2002)	Design of a virtual community based interactive learning environment
	(Kozinets 1999)	E-Tribalized Marketing?: The Strategic Implications of Virtual Communities of Consumption
	(McWilliam 2000)	Building Stronger Brands through Online Communities
	(Rothaermela and Sugiyamab 2001)	Virtual internet communities and commercial success: individual and community-level theory grounded in the atypical case of TimeZone.com
	(Wang, Yu, and Fesenmaier 2002)	Defining the virtual tourist community: implications for tourism marketing

mediated community, we have found few studies proposing how technology can enhance its development.

Another point shown in Table 3 is the trend of virtual community research to integrate with other research areas. We find that virtual community received more attention, especially in the years 2001 and 2002. During this time the amount of virtual community research increased dramatically. Some of the research was conducted from the viewpoints of other disciplines. This indicates the extensive growth of virtual community research.

SURVEY ON ADOPTING INFORMATICS IN VIRTUAL COMMUNITY WEB SITES

We should address the practical and technological development of virtual community so that novices can gain an understanding of the basic idea and comprehend how technology can help support the development of virtual community. Since virtual communities are located in cyberspace that uses technology to operate, there is a need to study the adoption of different tools by virtual communities.

We believe the concept of community informatics (CI) is useful in guiding the development of virtual community because CI addresses the question of how communities, community affairs, and "civil society" in general are interpenetrated, enhanced, and enabled through the use of Information and Communication Technologies (ICT) (Gurstein 2000). CI can also be viewed as a promising strategy for taking advantage of ICT to further the goals of community development (Pitkin 2001). Informatics can refer to a large variety of tools. They range from e-mail and forums to decentralized computing linked together and networks of Telecentres that support the communications. In this study, we conduct a survey examining the adoption of different CI tools by existing virtual communities.

In order to understand how informatics can help virtual community grow, we first examine how it supports virtual community in the current situation. In this section, the results of a survey conducted on existing virtual community web sites indicate which tools are used to support these web sites. The results contribute to our understanding of the current situation, which in turn will assist researchers in proposing what can be done to improve virtual community development.

The virtual community web sites selected in this survey include those searched from the dominant search engines, Yahoo.com and Google.com. We recognize that this limited use could indicate an incomplete sample of virtual communities. It may also show geographical bias that may create a potential problem, such as no Chinese virtual community being included in the survey. However, we believe it is not deterministic, and we at least cover enough communities to reflect the phenomenon.

We conducted a search under the key words "virtual community" and "online community." It is surprising that when searching Yahoo.com and Google.com, the numbers of web sites under these key words are 492 and 2,210,000, respectively, for "virtual community" and 3,036 and 4,830,000, respectively, for "online community." Although both are very popular search engines, the number of virtual community web sites linked to them show a great difference. The reason may be due to population differences of search engine visitors. Since Google.com is a more referential search engine in the academic and professional field, most academics and professionals prefer to link their web sites to Google.com as a way of sharing their interests with others. Also, many universities connect their communities with Google.com to establish communication links with their alumni. Another possible reason for the difference in number is the different web site classification systems that are executed in the two search engines.

In Table 4, we use Hagel and Armstrong's categorization (see Table 2) to classify the examined web sites. The samples include 100 web sites from each of Yahoo.com and Google.com that sum up to 200 identical web sites. Again, these web sites are searched using the key words "virtual community" or "online community."

Table 4: Types of virtual communities in virtual community web sites

Search Engine	Types of virtual community			
	Interest	Relation-ship	Fantasy	Trans-action
Yahoo.com	39	41	11	9
Google.com	36	45	13	6
Total	**75 (38%)**	**86 (43%)**	**24 (12%)**	**15 (7%)**

Table 5: Tools used in the sample virtual community web sites

Search Engine	**Tools**				
	E-mail	Forum/ Discuss-ion Board	Message Board / Bulletin Board	Chat-room	News-letter
Yahoo.com	28	41	27	30	31
Google.com	24	54	39	34	27
Total	**52**	**95**	**66**	**64**	**58**

When conducting the survey, we found that most web sites provide tools to support participant communication. Of the sites that call themselves "virtual communities," not all provide tools or functionality to support communication among participants. Many, such as Danville Virtual Community (http://danvillevirtual.com/), are just online information service web sites that provide only services for internet web site building. Most of the named virtual library web sites, such as Virtual Reference Library (http://vrl.tpl.toronto.on.ca/), Cleveland Digital Library (http://web.ulib.csuohio.edu/SpecColl/cdl/), Michigan Virtual Learning Collaborative (http://www.siweb.com/) provide linkages to search information for the participants, but they do not facilitate communication between the participants. These kinds of web sites usually provide contact means to the web site builder only, but do very little for participants' communication. Hence, these kinds of web sites are not included in the survey list of this study.

To understand which tools are used in virtual communities, Table 5 shows the frequency of tools used in the sample web sites. The tools listed in the figure include the most popular types of tools: e-mail, forum, message board / bulletin board, chatroom and newsletter. These are some primitive tools that support sharing and message delivery among participants to some extent. Among these tools, discussion forum gains the highest percentage on adoption, followed by message board / bulletin board, chatroom, newsletter, and e-mail.

Taking a closer look at these most commonly adopted tools, White (2001) suggests that e-mail can be individualized or sent to a larger list of recipients. This is always the easiest tool to consider. However, it is also very easy to abuse, creating useless junk email or "spam" which can alienate the audience (White 2001). In a forum, people come together online for discussion of a common interest topic or topics. Forums are designed to support a debate that goes on for an extended period of time, not to give a quick hint of popular opinion (Gurstein 2000). Bulletin boards are comprised of dial-in electronic space, which can store transmitted electronic messages. Individuals can dial into the board to retrieve the range of messages placed there, including those that might have been specifically left for them (Gurstein 2000). Chatrooms have interactions usually with small groups for a very low cost. However, a time needs to be chosen that works for the target audience, which becomes increasingly difficult as we expand to global audiences and groups (White 2001). Newsletters are popularly used as a way to distribute a community's information. Apart from these popular tools, internet broadcast that allows a one-to-many presentation via the web and the traditional methods that include telephone conferencing and video conferencing are some less frequently used examples to support communication in virtual communities.

Although the use of these simple tools to support communication in virtual community is frequently used today, there is a question of their ability to support knowledge transfer among the participants. It is also doubtful whether these tools can help the participants to share in depth and whether the interaction supported by these tools will result in building up relationships.

DIRECTION FOR FUTURE RESEARCH ON THE VIRTUAL COMMUNITY

After reviewing the definition and classification of virtual communities, the recent literature, and the technical tools adopted in existing virtual communities, we now propose topics for future studies that could make valuable contributions to research. These topics are presented in the context of the five virtual community research phases suggested previously.

Fundamental understanding

Virtual community research is still immature. Consequently, there is still a need for studies to provide better definitions and classifications for components and tools supporting virtual communities. For example, there is a need to differentiate virtual communities from online information service providers. Conceptual papers suggesting theoretical frameworks could also be useful in guiding empirical investigation in this area.

Technology development

Our literature review indicates a lack of research in the technology development phase. The following areas are worthy of investigation.

Researchers can start by gaining a better understanding of virtual community participants' requirements and needs. For example, we might study the requirements for tools that support communication in virtual community. The survey approach can be used to collect community members' requirements for these types of tools.

It is also important to develop a wider variety of tools that can be put at the disposal of participants. Researchers might also develop concepts of good user interface design to attract more participants to join these communities.

Functions derived and adoption

In this stage, we might study knowledge transfer in virtual community. As we pointed out above, learning is a popular issue in this field; researchers want to use the virtual community to achieve active learning. Hence, knowledge transfer or knowledge management during the learning process in virtual community is suggested for investigation. The case study method might be used to study how knowledge is exchanged in a virtual community that is created specifically for learning purposes.

Implementation and outcome assessment

Research regarding the implementation and outcome assessment phase might be fruitful; for example, studying the impact of different virtual community tools on important process and outcome variables, such as level of participation, satisfaction, information exchange, and emotional support, might be worthwhile. A specific study might examine how a discussion forum contributes to information sharing and emotional support. As Table 5 shows, the discussion forum is the most popular tool used in virtual communities. It would be interesting to examine how this tool supports the two important purposes of virtual community participation, information sharing and emotional support. Such a study could be carried out by conducting interviews with virtual communities members to examine how they perceive these two purposes when they are participating in discussion boards.

Institutionalization

Future institutionalization research could develop ways to integrate the virtual community with other profit-making electronic commerce and customer relationship management applications. A study to examine how and whether online businesses can improve profitability through the use of online communities could be done using the case study method. Such studies could lead to the understanding of success and failure factors for virtual community institutionalization.

CONCLUSION

The results of this study help build a consensus on a virtual community definition: a cyberspace supported by computer-based information technology, centered upon communication and interaction of participants to generate member-driven contents, resulting in a relationship being built.

We have presented several classification schemes for virtual communities, the existence of which suggests that researchers could adopt a particular classification scheme depending on their research focus. General and behavioral studies about the virtual community could use Hagel and Armstrong or Carver's classification. Technologically related research questions might use Jones and Rafaeli's technologically based classification.

This summary on virtual community research could help researchers gain a clearer vision of the deficiency of existing research, especially in the technology development area, and the potential of future studies. For example, although our survey on tools for supporting virtual community web sites, reported here, concludes that the discussion forum is the most popular tool used in virtual communities, many opportunities remain for tool application. Based on the summary of existing studies and survey on tools adoption, research topics are proposed to show the potential research areas in virtual community.

In conclusion, this study points out that research in virtual community is immature with many areas left for researchers to investigate. To support the growth of virtual community, community informatics could be a powerful tool to facilitate the functions of relationship building and knowledge sharing. Based on the growing number of virtual communities, we can predict that virtual community will become an important research area in the information systems discipline.

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