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Knowledge Sharing through Interactive Social Technologies: Development of Social Structures in Internet-based Systems over time

Isa Jahnke

Email: isa.jahnke@tu-dortmund.de
Web http://www.isa-jahnke.de

Keywords: Socio-Technical Design, Knowledge Sharing, Knowledge Management, Online Behavior, Online Community, Online Relationships, Social Capital, Social Networks, Socio-Technical Paradigm, Virtual Community, Virtual Community Building, Virtual Community, Trust, Virtual Organization, Organizational Learning, Organizational Structure, Virtual Organizations, Organizational Change, Organizational Dynamics**,** Socio-Technical Systems, Web-Based Applications, Action Research, Case Study, Ethnographic Study, Qualitative Research

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Abstract: How do the Internet and new interactive web-based tools, for example wikis and discussion boards, affect people and their behavior in organizations? This chapter will show the emergence of social structures in Internet-based systems over time. Based on results of an empirical investigation of an internet-based knowledge sharing system, the author demonstrates the change of roles, expectations and activities in online communities. Finally, the author sketches some essential process criteria for introducing online communities, which are extended part of organizations (e.g. companies and institutions), characterized by a large size and supplemented the formal company.

INTRODUCTION

New buzzwords have become part of our daily lexicon: Web 2.0, Social Software and Social Web often used as synonyms. These concepts focus on new or existing software systems which are influenced by human communication and collaboration. Web 2.0 is heavily reliant on social interaction, so, social web-based applications generate a human-centered design approach. Web 2.0 is – as O'Reilly (2005) said – a "*second generation of internet-based services*". The common idea is to enable people to collaborate and share information online in new ways, such as in wikis, communication tools, social networking sites, and for example in Folksonomies. Folksonomy consists of 'folk' and 'taxonomy'[1]. Folksonomy is a 21st century practice of collaboration and taxonomy. People categorize content such as Web pages, online photographs or Web links. However, they do not do it on their own as a lonesome rider - they generate 'tags' (labels) in collaboration with others. This social process is known as social or collaborative tagging. The underlying idea is that many Internet users find more suitable classifications and keywords than a computer or a limited number of people at a company can.

To describe such new concepts and new forms of internet-based applications it is appropriate to compare Web 1.0 and the newer Web 2.0. When we do so, we see for example, that 'personal websites' disappear and blogging becomes the favored interaction of Internet users. Individual publishing has evolved in the direction of participation. Wikis replace pure 'content management systems'. Whereas Web 1.0 was focused more on the downloading of prepared information, Web 2.0 transfers the process into communication about the information (for example Weblogs). The behavior of users is changing from being readers and consumers (Web 1.0) to authors and producers (Web 2.0). Figure 1 (on the next page) displays both concepts.

In this paper, we will focus on web based groups and communities that are a part of Web 2.0. Many empirical studies and practical projects give insights into the initiation, support or cultivation of communities (in particular Preece 2000 and Wenger et al. 2002). Our analysis focuses on communities which predominantly depend upon computer-supported communication, and ask if and how people build forms of social structures (e.g. how the community members collaborate). Our analysis is particularly concerned with social structures, for example: how do they interact and will they build roles (formal/informal roles)? What relevance do computer-mediated social relations

have on trust and social capital for online groups in Web 2.0? Does the technical system help to create social proximity? Our in-depth case study of the online community "InPUD" gives indicators about such social structures of virtual groups. These indicators are based on an empirical investigation of the mentioned case.

Web 1.0 (mainly 1992-2002)	**Web 2.0 (shift since 2003)**
Encylopedia Britannica Online / German Brockhaus etc.	Wikipedia.com
Personal Websites	Blogging (e.g., IBM developerWorks Blogs[2])
Publishing	Participation (e.g., pepysdiary.com[3] and many discussion boards)
Content Management Systems	Wikis
Directories (Creating a taxonomy top-down)	Social tagging (Folksonomy': bottom-up), social bookmarking (e.g., del.icio.us[4])
Telephone	Instant Messaging (e.g., ICQ), VoIP (e.g., Skype)
GPS non internet-based	New location-based services (mobile devices, e.g., Dodgeball[5])
Newsgroups	Social networking (e.g., facebook.com and xing.com[6]) / online communities
Download of information (download of prepared content): one-to-many users	Communication & collaboration about the information, creating new knowledge: many-to-many users

Figure 1: Shift from of Web 1.0 to Web 2.0 (similar to O´Reilly, 2005)

We will first define the concept of online communities as socio-technical systems, define what an online community is and highlight the social structures of online communities. An essential indicator of social structures is the development of roles (section 2). In section 3 we describe the case study of the empirical investigation of the InPUD-Community – as an example of Web 2.0 applications – and describe what InPUD actually is. In Section 3 we describe also the research method. Section 4 derives empirical results from the case and shows aspects of social structures which have been developed, based on interactive social technologies (such as Web 2.0). Section 5 sketches some essential process criteria for introducing online communities supplemented to formal organizations. Section 6 offers a conclusion and section 7 looks forward to possible future areas of study.

INTERNET-BASED COMMUNITIES AND SOCIAL STRUCTURES

Online communities are good examples of typical socio-technical systems (cf. Coakes 2002): On the one side, such Internet-based communities consist of actors who use technical systems to communicate and share knowledge. On the other side, the technical system influences the communication of the community members. An online community owes its existence to the fact that the technical system exists. People who participate and interact in internet-based communities share knowledge and communicate 'through' the technical systems (for example discussion boards, instant messaging or networking tools). Such socio-technical phenomena were investigated especially by Preece (2000), Kim (2000), Williams & Cothrel (2000) and, Wenger et al. (2002) who give design criteria for cultivating pure online communities as well as communities of practice (as internal part of business companies).

Definitions of online communities

Our contribution follows the definition of "*communities of practice*" created by Lave & Wenger (1991, p. 98) and Wenger et al. (2002, p. 4). Web-based communities are generated through social relationships among individuals "*who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis*". Similar to Preece et al. (2004), we use the term "*online communities*" to describe all online groups which have some kind of online presence, but these groups differ in the following four areas:

- The size (small groups with just 25 people (members); big groups with hundreds or thousands of people (members).
- The primary content (e.g. discussion boards about specific books or movies; discussions about sports like marathon training; communication about stock exchanges; information sharing about classes at universities).
- The lifespan (several years or just for one topic).
- The type of communication: "W*hether the community exists only virtually, or has a physical presence, or exists primarily through physical connections, e.g. a networked neighborhood*" (Preece et al., 2004, p. 3).

Value of participation in online communities

In contrast to companies and organizations – where the members are rather formally bound (e.g., by work contracts) – online communities consist of informal connections between members, however, with strong ties (Granovetter, 1973). "*Communities are defined as collections of individuals bound by informal relationships*" says Snyder (1997, in Lesser & Prusak, 1999). Koch (2002) reported online communities as a set of people who are willing to help each other in order to accomplish their own goals. Wenger et al. (2002) add that the members form a "*joint enterprise and the community continually renegotiates itself through its members*". The members act in good faith, they trust each other, although they may not normally act in such a way: *I will help you, even if you do not help me immediately because I know you, or another community member, will assist me when I need support* (cf. Putnam, 1995). This underlying idea of altruism[7] affects active participation and mutual support as well as collaborative knowledge sharing. Mutual support is given for example through feedback, annotations and comments, sharing ideas, answering questions, mutual reviews etc.

However, this view on computer-mediated social interaction neglects the role of the "lurker": just a few community members – in relation to the whole group – answer questions of the others, while the majority of the community members only read the information and does not actively participate. The description of such members who "*observe what is going on but remain silent*" is "*lurker*" (cf. Preece, 2000, p. 87). Further investigations about roles in online settings such as elders, leaders, regulars, novices and visitors did particularly Kim (2000) and Preece et al. (2004). These kinds of denotations (of the term 'role') are focused on the number of postings of the community members and the date of registration. It neglects the difference between formal and informal roles, how the members interact with others and the dynamic change of roles and social structures.

Social structures and roles

Mackinnon (2006) reviewed the literature on the concept of social structures. He comes to the conclusion that different definitions emphasize "*social structures as a set of*

elements in mutual relation to each other" – also known as social networks. Instead of just mutual relations, Jary & Jary (1991, p. 465) describe the term 'social structures' as a "*relatively enduring pattern or interrelationship of social elements*" i.e., expectations, social interaction and relationships within social systems. This notion of social structures, as relationships between different members of groups or as enduring and relatively stable patterns of relationships, emphasizes the idea that social and socio-technical systems for example online communities are grouped into sets of patterns – often defined as roles with different functions, meanings or purposes. Lave & Wenger (1991) give similar results from their analysis of "*legitimate peripheral participation*". Hence, the analysis of social systems as well as online communities needs – besides the analysis of social networks – especially the analysis of social roles. The emergence and change of social roles in virtual communities are essential observable aspects that influences and forms the social structure of communities and vice versa.

Social roles are often defined as sets of expected activities performed by individuals. According to Dahrendorf (1958), a role is the sum of all behavior expectations of a social system (all different members) towards a concrete role actor. From this viewpoint, a role is a set of descriptions defining the expected behavior of a position (Biddle & Thomas, 1966).

Instead of roles in social systems, roles in socio-technical systems (e.g., online communities) depend primarily on technically mediated communication. Therefore, the development of roles in online communities can be particularly observed through the written communications of community members. Then, a role is a perceivable interaction pattern created through the repetition of social interaction[8]. Such repeated and anticipated behavior leads to expectations which characterize a role.

A role consists of the following aspects with four observable factors (cf. especially our prior publication which includes a full description of roles for designing community systems: Herrmann, Jahnke, & Loser, 2004):

- **a)** Position: Members' position in the online community in relation to the others (also known as network position): How many and what social/communicative contacts has a member to others?
- **b)** Tasks/Activities: what primary activity is conducted by the member? (e.g., moderating, lurking, contributing)
- **c)** Expectations: How do community members communicate to others the expectations they have about behavior in online discussions (rules of online behavior)? Do members communicate just factual information (aspect of content) and/or could we observe indices of information about their relationships to the others (aspect of relationship)?
- **d)** Online interactions (Role-playing): A role is built and changed by individuals by way of their communication and social interaction. Roles are gradually developed in online communities by perceiving the repetition of social interaction patterns. Such repeated and anticipated behavior leads to expectations which characterize a role. These patterns can metaphorically be described as *role-mechanisms*. Role mechanisms describe how people take a role or assign someone a role. The role-mechanisms are, for example, role-assignment, role-taking, to allow someone's role-taking, role-changing, role-making, role-(re)defining (Herrmann et al., 2004, p.169). Herrmann et al. (2004) explain the role mechanisms and describe empirically how to find and support such role mechanisms in Internet-based community systems.

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CASE STUDY: THE INPUD-COMMUNITY – AN EXAMPLE OF WEB2.0

What was the problem?

In 2001, the Department of Computer Science at the University of Dortmund in Germany had about 2,000 students. However in the years between 1996 and 2001, problems occurred. A lot of students did not achieve the degree of computer science (statistic report from 2001). This report made clear that many students ended their computer science courses after three or four semesters without degree[9] or even moved to another the university; others did not take the written examinations. But we did not know exactly why the students were failing and so, we wanted to find out why the students were dropping their computer science studies. Our assumption was based on the 'organizational problem'. We assumed that the problem was not just related to the content of the courses but with the study management. So, the primary question for our research was: How do German students organize their studies at a university? Do they have enough information about how to organize their studies successfully?[10]
Additionally, the university has a wide diversity of roles: students who are beginners, who are experts, there are tutors for course guidance, study management advisors, lecturers, an examinations office, a registry office, and so on. To conclude, there are many people in different roles who support student's activities. Each of them has a lot of information and knowledge about study management. However, the problem seems to be their joint collaboration. Do they really cooperate and share knowledge as well as they could in order to help and promote students?

What exactly is the InPUD-Community?

The InPUD-community[11] can be described as an 'online knowledge sharing community' for computer science students at the University of Dortmund, Germany. The InPUD-community differs from other communities which are built in spare time and which are not a part of a company.
According to the characteristics from Preece et al. (2004, see also section 2), the InPUD-community is characterized by a large size (more than 1,500 people) and is an extended part of the Department of the mentioned university supplemented to the formal organization. The primary content of InPUD is knowledge (and its collaborative creation) about the study of computer science, its courses and study management. The students get information about how to study successfully, and the opportunities to discuss study management, content and exercises of lectures as well as seminars. Thus, InPUD helps to share information to improve the practice. The community exists primarily online, but has also a physical presence through physical connections, e.g., networked students in different courses. InPUD was launched in 2002.
In detail, the InPUD-Community includes an overview of all classes and lectures which are offered during the course of a semester. The way that the information is structured is the same for each lecture or seminar. The information about the lectures, including any tutorials which are being held (and when they are being held), course materials, notices for examinations, lecturer contact information and often a free discussion forum are included as well as news and search functions.
The information and content about the study management domain were integrated with online discussion boards. These enabled the potential members to build active social interactions. The discussion boards exist for each lecture as well as for study management. They are embedded into an information website which includes facts

about course guidance as well as graphical maps of how to study which course at which time.[12] The discussion boards include discussions about selected lectures. (At the time of writing, 30 boards are on-line, each with their own moderator.) It is possible to discuss exercises and their solutions on the discussion boards. Furthermore, there is information, and discussion boards, which have been initiated by study management advisors, course guidance or counseling services. The discussion boards include questions and answers referring to course guidance, for example "*how to study successfully*", "*how and where to register for written examinations*", "*where to find the university calendar (timetable)*", "*what are the contents of computer science courses*", "*which semester is best suited for studying abroad*" etc. Figure 2 shows a screenshot of InPUD.

Many members participated. The community members are primarily people (in particular students) from the Department of Computer Science at the University of Dortmund, Germany, but also people who are interested in studying at the department study (e.g. high school students). The community members are also made up of advisors from counseling services, course guidance, and the examinations office. The initiated and empirically investigated community InPUD currently has more than 1,300 members.

The InPUD community consists of students who could theoretically meet at lectures. However, this face-to-face communication is in fact unlikely due to the fact that the courses are oversubscribed; sometimes there are as many as 600 students in a single course - direct social interaction with each person seems to be not realistic.

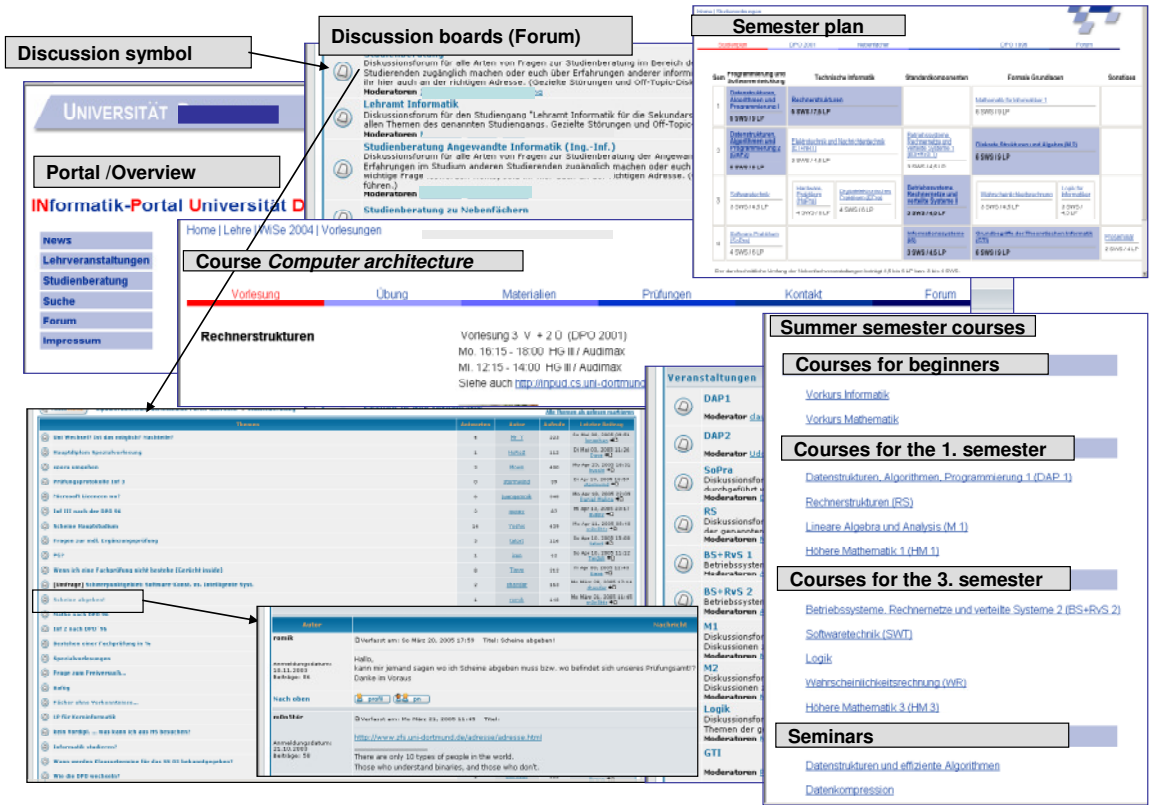

Figure 2: Screenshot of InPUD (in more detail: http://www.inpud.de)

Stages of development of the InPUD-Community

The InPUD community is continuously increasing. Since the launch in May 2002, more than 1,330 registered participants have written more than 24,000 contributions. Registration and login is only necessary when actively contributing. Observation and reading is possible without registration and without logging in; each user has access to all information. InPUD is used by more than 60 percent of students within the Department of Computer Science at the University of Dortmund.
The number of requests has grown consistently and the access rate usually peaks at the beginning of a new semester. In October 2002 there were only 171,408 requests. A year later, in October 2003, there were 292,155 requests and in October 2004 this had increased to 491,330 requests. To this today requests are continually increasing (see Figure 3).

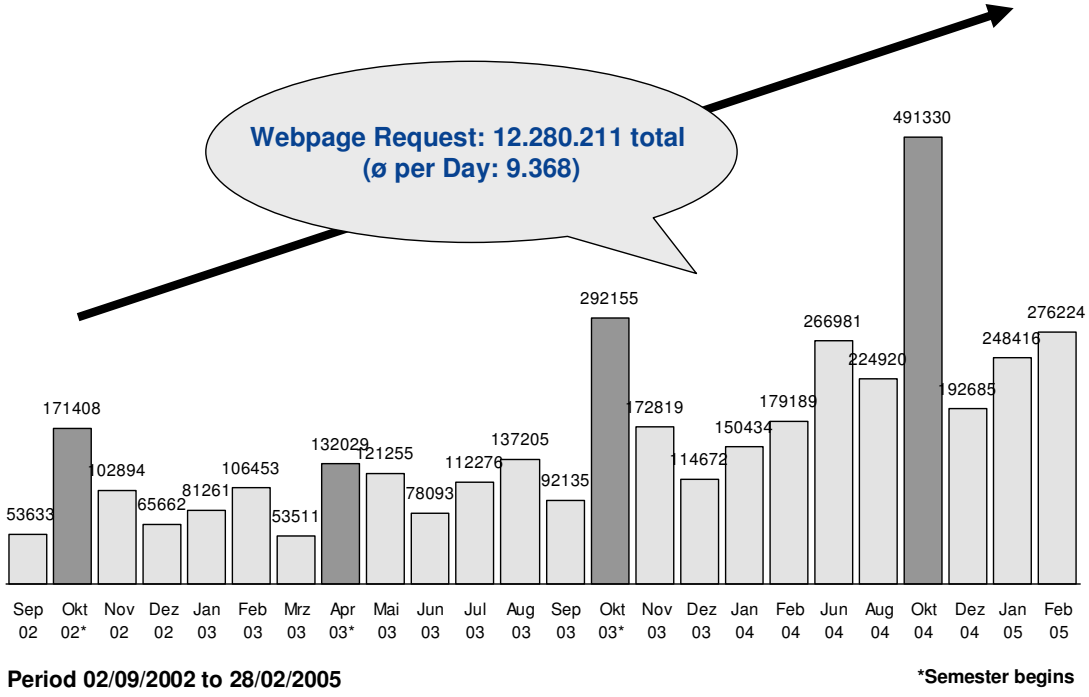

Figure 3: Continuous flow to more usage (dark bars show beginning of new semesters)

Figure 4 shows the analysis of the communication structure: About 2,000 students (100 percent) are enrolled at the Department of Computer Science at the German University of Dortmund. More than 1,330 (66.5 percent) are registered in September 2006. About 670 students (33.5 percent) are not registered at the InPUD-community. We do not know if these 'not registered persons' are lurkers or if they do not use the information portal.
About 868 members (of 1,330 registered members) contribute actively. The other 462 members are registered but did not posting. We assume that these registered InPUD-lurkers (23.1 percent of 2,000 students) want to show their interest in the community although they did not actively participate. It gives different reasons why they do not posting (e.g. motivation, no personal need, curiosity without exposure; see section 2; cf. Preece, 2000). Maybe they are waiting for "the right" moment for posting.

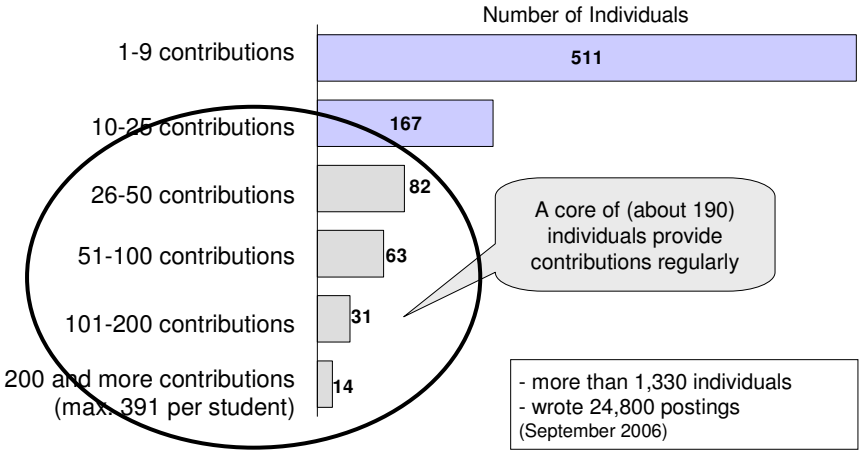

Figure 4: InPUD Discussion Board - Number of Contributions per Individual

A core (of about 190) individuals regularly provide contributions: ranging from 26 to 391 postings (questions/answers) per individual. That is a significant number. The core members are the elders, leaders and partly the regulars (cf. Kim, 2000). The other 678 active members (167 and 511) make postings in the range from 1 to 25. These members can be described as regulars, too, but include also novices and visitors (cf. Kim, 2000). The InPUD discussion board provides an awareness tool (provides information about activities of the users, formal roles and current status), which shows who and how many users are online at a given time.[13] The large number of participants indicates that a significant number of students appreciate this form of knowledge sharing. They discuss, ask questions, answer the questions of others, come up with new ideas and help each other.

As already stated, the community also includes lecturers and tutors as well as study management advisors. So, it is possible to say that the success of the InPUD-Community can be measured by the significant number of students who actively participate. More than 60 percent computer science students participate and use the community contents.

How we analyzed the problem: the action research process (an exploratory research method)

Starting from the problem of the organization of the study management, we started the WIS-project[14] in 2001. The aim was both first to find out, on the one hand, what the barriers to studying were, on the other hand, to establish which factors lead to success for students of computer science and second to give the results back to the students in order to initiate a discussion about these issues. To summarize, the purpose of the empirical procedure was to help students build their online community about study management. Besides the practical purposes, we used the project in order to study people's behavior as well as emerging changes of social structure and social roles in that online community.

Thus, the project was based on an empirical exploratory research method including ethnographic observations and qualitative interviews and questionnaires as well as action research processes. The exploratory method was essential since we did not have sufficient theses in order to explain why the students dropped their studies. Action research is an iterative process which enables us to understand a social or sociotechnical

phenomenon or to improve its quality. It consists of several phases of analysis (reflection) and action (interventions) which are alternate and interwoven. Avison et al. (1999) calls it a cycle of activities: "*Action research involving researchers and practitioners acting together on a particular cycle of activities, including problem diagnosis, action intervention, and reflective learning (…) in real situations, gain feedback from this experience, modify the theory as a result of this feedback, and try it again*" (Avison et al.,1999, pp. 94-95). Our empirical procedure included the following phases of action research:

Part 1: Main steps of implementation process

a) Identifying the problem(s): Based on semi-structured interviews, we found out the student's main problems with study management. The interviews, held between 2001 and 2002 with an open-ended interview guide, included 14 people face-to-face (8 students and 6 professors/lecturers). The diversity of how students manage their studies was summarized in the following nine areas (main problems):

- **a.** Students know the importance of attending lectures and learning groups, though they do not attend courses.[15]
- **b.** Informal learning groups: students know how helpful a learning group is, but a lot of them do not create or participate.
- **c.** The city of residence of the students is often not the same as the place where they study (many students travel to university each day by car or bus).
- **d.** The majority of students take on jobs to fund their studies; consequently they have less time to attend courses.
- **e.** New students at German universities need a high degree of self-organization but they have not learnt (and it have not been taught) to organize themselves prior to attending university.
- **f.** There is a significant amount of information available about computer science courses; however there is no single portal which organizes this information. As a result, students are forced to search through a jungle of information to find a suitable course.
- **g.** A large number of students they that say become disoriented during the regular nine semesters (4-5 years), becoming unsure of when to attend which lectures and seminars / when to register for which examinations.
- **h.** New students have a false impression of what a course in computer science really entails.
- **i.** The university experience is not just about studying, many students want to find out about themselves and develop their own personalities.

Based on the empirical-based main problems, a standardized questionnaire was sent out to the computer science students at the University of Dortmund. 384 completed questionnaires were returned. This represented a total of about 20 percent of all computer science students enrolled in the bachelor courses. The results confirmed the thesis: The majority of students know theoretically how to organize themselves for a successful computer science course, but they did not practice it.

In addition, the interviews and the questionnaire should also find answers about 'how to' spread the main problems into the students' groups in order to create awareness and to encourage discussions about possible solutions. Hence, we decided to use Internet-based tools for two reasons: (a) due to the large number of students that would be

involved and (b) to document the process for the next generation of students. Thus, the way to an Internet-based information portal was built.

b) Creating an information portal: The interview results gave the idea to create an Internet-based information portal which would offer an overview of each lecture, seminar and course per semester, a graphical plan of the first four semesters (according to a bachelor degree). Second, the portal would enable information from the study management advisors and other university roles. In May 2002, the first prototype of the community-system called "InPUD" (Informatic Portal University of Dortmund: www.inpud.de) was launched.

c) Support ways of active communication and collaboration: Based on empirical insights into the InPUD prototype, we added a discussion board about study management, the nine areas (see above) and selected courses in September 2002. The aim was to improve the transparency of the study management factors which are critical for success. Information about study management and seminar content was interwoven with online discussion boards. Thus, a computer-mediated knowledge sharing system was created. The knowledge sharing process was based upon voluntary participation. As we will describe later, that was the beginning of an online community.

d) Continuous improvement: From 2002 to 2006, the project team enhanced the technical system and changed some things, for example, to improve the performance of the technical system. Meanwhile, a lot of new discussion boards were added, likewise more information about study management was included. The InPUD community grew.

Part 2: Analyzing the implementation process in order to study emerging social structures

Especially from 2002 to 2006, we analyzed the InPUD community and its emerging social structures based on following research methods.

First in 2003-2004, interviews with 8 experts were held face-to-face. The experts came from the area of study management, had experiences of 'university management' and knew Web based IT-Systems very well. We asked what the crucial factors for successful study management were in order to compare the experts' statements with InPUD's development. Based on the empirical results of the interviews with the experts we supported the InPUD-Community with new ideas, for example; giving members with formal roles a role name and making roles visible, for instance, the study management advisors were labeled explicitly. Furthermore, we conducted participant observation of the online discussions in InPUD from 2002-2006. Moreover, the analysis also regarded user statistics, communication structures as well as qualitative content analysis which focus on social relationships to understand the social interactions.

As a result, in this exploratory action research process we identified empirically based theses about the emergence of social structures through social interactive technologies. The results can be found in the next section, number 4.

SOCIAL STRUCTURES OF THE INPUD-COMMUNITY

Our empirical analysis focuses on social structures, and in particular the development and dynamic of (existing and new) roles in internet-based communities which depend

on technically mediated communication. In the above mentioned InPUD-case we have analyzed how people build social structures in online communities. We subdivided social structures with the four criteria: network position, task/activities, expectations and role-playing (cf. section 2). From our exploratory case study about the online community InPUD (from 2001 to 2006) we can derive the following results. These results – empirical-based theses – were derived from our exploratory study. Hence, the results are not representative but can spark off new ideas and innovative new theses about further visions of social structures of Internet-based knowledge sharing systems and online communities.

(1) The member's position in the online community and changing of position

(1.1) Members of online communities build different qualities of social relationships – just in time when needed

We observed that the members of the InPUD-community, particularly students, develop social relationships online. Some people even build social ties, for example, the same people met habitually at the same discussion board at the same time. Wenger et al. 2002 call these members "*the core of the community*", what Kim (2000) differentiates as elders, leaders und regular members. (Novices and visitors are outside of the core; rather on the edge; cf. Kim, 2000). The emergences of social ties were affected by following aspects:

First, the analysis shows that it was not necessary to create a face-to-face communication among students before the online community was created. The students did not take advantage of the opportunity to build social relationships at face-to-face meetings (e.g. seminars, lectures) because of the fact that there can be more than several hundreds students at lectures. Although the interviewed experts said it would be important to promote face-to-face communication before cultivating a web-based community, we know today that this is not correct for every online setting: we explain these differences with homogenous and heterogeneous groups.

Homogenous groups: The students of InPUD build homogenous interests and therefore a face-to-face workshop is unnecessary. The underlying idea is that homogenous groups have same (or similar) interests and therefore the members act truthful and rely on the others (in more detail, see point 3.1).

Heterogeneous groups include people who work in hierarchical dependences, for example, in the investigated case people work in different formal roles, for instance, they are advisors, part of the counseling services, at the examination office, at the registry office, and they are lecturers and so on. Such people – in different formal roles – do not have the same goals (although they may have many similar interests in the context of student support).[16] Consequently, it might be better to create a trust-building face-to-face workshop before you support their knowledge sharing with IT. For example, the 'central office for study management at the university' creates a face-to-face workshop for advisors at each department.

Second, the analysis of InPUD shows that the online communication – through the medium of the technical system – gives the community members the opportunity to find people with the same topic, problem or passion. A person can find people with the same interests within a large rather anonymous group. From the individual's viewpoint, a community helps her/him to become "*someone with a (new) name*": a person who needs information from others but also has information for other people.

Third, the InPUD-members could foster their collaborative knowledge sharing under the condition of a minimum of formal regulations and limited university control. For instance, without registration every person – also external people – can read all of the InPUD-content. Registration is just required when anyone wants to give answers or pose questions. Additionally, the registration needs just a username and an email address.
Finally, InPUD is open 24 hours a day and people were able to connect to others. Some students really answered questions and helped other students at night. Instead of one-to-many users' communication, InPUD is able to support the communication from many-to-many users, and promote the "*wisdom of the crowds*" (Surowiecki, 2004).[17]
In summary, these settings enable the InPUD-community and its members to build different qualities of social relationships online – right at the moment when people need knowledge. So, the InPUD-members combine their knowledge and may develop their own understanding in a collaborative effort.

As mentioned in section 2, each community includes also the role of lurkers: the majority of the community members just read the information and does not actively participate. We could observe this phenomenon also in the investigated InPUD-community during the community stages of development – start (in 2002), phase of initial growth (2002-2004) and phase of sustainable development (2005-2006). The InPUD-lurkers did not give an active input. These people gain knowledge from other active members without sharing. The high number of lurkers seems to be a problem. However, that is not a problem, since they have the essential function of spreading information about the existence of the community into other groups. The specific relationship which is developed between active members and lurkers decides if the knowledge sharing system works successfully.
Furthermore, in contrast to usual lurkers, some of the InPUD-lurkers did not post but they were registered. We explain this phenomenon as follows. These registered lurkers want to show they are part of the community and they want to support the community – but there are many individual reasons why they do not post. Based on Preece's (2000, p. 89) research, this can include, for example, personal factors, desire for privacy, interaction mechanisms (fear of embarrassing oneself), and the time for posting. She lists further reasons, based on empirical analysis, given by lurkers for not posting. It might be that such registered lurkers become active users later.

(1.2) The visible value of benefit – providing immediate support and building more social capital
Meeting on a virtual community platform has not the same quality as participating in a "*bowling team*" (Putnam, 1995). Nevertheless, for people who are unable to find other people with the same interests in face-to-face situations, meeting in an online community is better than not meeting at all. That is one essential and easy-to-know benefit.
The Internet-based InPUD-community gives its members easy access to many people and their knowledge – this is called 'social capital' of a group. *"Social capital is the sum of the resources, actual or virtual, that accrue to an individual or a group by virtue of possessing a durable network of more or less institutionalised relationships of mutual acquaintance and recognition"* (Bourdieu, & Wacquant, 1992, p. 119). In other words, social capital is the access to people, their knowledge and possibly immediate support.

A person knows someone, or someone of someone, who can help. Such immediate help, for instance, a person's problem can be solved immediately through other people, is one of the added values of an online community. To conclude, the access to a large social group is the potential for cultivating more social capital and knowledge sharing.
Nahapiet & Goshal (1998) distinguish the concept of social capital into three dimensions: The structural dimension identifies the "*patterns of connections between actors - that is who you reach and how you reach them*" (p. 244). Second, the relational dimension describes the form of "*personal relationship people have developed with each other*". In the InPUD-community the relationships are built through computer-supported communication over a period of time. Trust plays an important role. Fukuyama says that social capital is the social capability which develops when trust in a social system exits (Fukuyama, 1995, p. 26). Finally, the cognitive dimension identifies the "*shared representations*", norms and "*systems of meaning*".
In summary, the more members actively participate – with personal relationships as well as similar social values and meanings – the more social capital will be created. According to Wellman et al. (2001), who demonstrated that the Internet is increasing interpersonal connectivity and organizational involvement, the empirical analysis show that InPUD leads also to an increase in social capital.
The building of social capital depends also on the quality of social ties. But the "*development of weak ties is better than not meeting at all*" (Preece, 2000, p.24). The analysis gave some hints about the core members of InPUD who built rather strong ties. The members do not share just pure information but they also wrote some emotional sentences to create social relationships (cf. point 1.1 as well as point 1.3 about online presence and social proximity). For example, the members "*wish good luck for the exams*" and said "*thank you*" when other people helped them.

(1.3) Online presence and social proximity through technical systems
Based on the InPUD-analysis, some members are better visible than others because of their numbers or quality of contributions to online discussions (similar to Kim, 2000: elders, leaders and regulars versus novices and visitors). The degree of online presence affects the perception of the people, their expectations, and finally their behavior. For instance, such students who made postings more frequently and gave regularly answers than others (e.g., who are just one time contributors) are more and better visible within the Web based community (cf. section 3, statistic analysis: several members post contributions every day).
The people's motivation behind this social interaction – degree of online presence by written contributions – is similar to aspect 1.1 (see above): to build social ties. Furthermore, interviews with students showed that some of them wanted to "*break out*" from the anonymous mass (from the large student's group of about 2,000 members). The online community gives the students the chance to keep in touch with people with same problems. A second argument is the 'self-profiling' (self-expression) of those people. Third, other members respect members more when they are more present in InPUD. In other words, in the minds of the users the more regular online presence is connected with a higher degree of competency which can result in a higher status – assigned by others to such 'leaders'. To conclude, some interviewees assume a connection between the frequency and quality of contributions on the one hand and a higher social status and acceptance in the community on the other hand. Moreover, such a higher online status also has impacts on their lives outside of InPUD. These people

might feel more confident in their face-to-face communication as a result of their increased online social status. For instance, interviews with some students at the Department of Computer Science showed that some students also know the strong members personally – behind their usernames – and when they want they could meet them face-to-face.
The online presence also influences kinds of 'online social proximity' through the technical system (what we describe as computer-mediated social proximity). Indicators for such online proximity are emotional interaction patterns, for example, they say 'thank you' or wish 'good luck' with exams and further hints. In summary, some contributions drift from the main topic – just pure information – to questions about personal interests, for example, "*where do you live*?" which have positive influences on the building of social proximity.

(2) Tasks/Activities in online communities
The InPUD-community has many participating members; hundreds of people who give ideas or share their knowledge online. The differences between communities and organizations, such as companies and institutions, are the established formal processes, work roles and tasks. The InPUD-community is successful due to the fact that it has less formal roles. That means for organizations with knowledge sharing problems that they are not so successful since their processes are more formalized. They might need the support of more informal communication, e.g. computer-supported communities or communities of practice.

a) During the initial stages (in 2002) the majority of the InPUD-community's members occupied the same position. Tasks were transparent for each new member. At the outset of InPUD, the main tasks were following:

- Posting/contributing (function: provides information for the community or asks questions)
- Only reading (function: takes the information and spreads it to the outside world)
- Formal facilitating by academic staff (function: gives rules, checks conventions)

b) In the initial growth phase (from 2002-2004), we observed that the members began to employ new forms to communicate. We define these new forms as 'informal posting activities'. For example, some core members took the part of the informal moderator. They did not have the formal role of a moderator but guided the other members with words. The following points illustrate the differentiation of those informal posting activities (in more detail see Herrmann, Jahnke, & Loser, 2004):

- Author: contributes information, communicates own ideas by writing short statements. InPUD-members add own contributions and ideas, for example: "*It would be nice, if the Department had a central website with all information about the computer science courses. Inpud is a good idea. Unfortunately some people in the department do not work sufficiently with Inpud*."
- Scaffolding: person who gives structure to the discussion, for example: "*Please*, *look at the thread of study management, before you ask the same questions like the others before*"; "*This question was already answered in thread 19*".

- Reading as visitor (cf. Kim 2000): reads contributions of other users; visitor: only interested in getting an orientation without making own contributions (gets inspiration), for example, one member wrote: "*I am not a member of this university*".
- Conflict-mediator: acts as mediator in emotional conflicts (e.g. when two people or more have a dispute); intervention in emotional discussions (to enable the discussion to continue), for example: "*I understand your problem, and it is good that you want to change something, but this thread is not the right way to solve your problem. Would you mind talking with the professor face-to-face?*"
- Technical-supporting: solves technical problems (e.g., a person has problems with the discussion board since it is offline at the weekend; the technical-supporter helps and explains the use of the technical system), for example: "*Why is the board so often offline at the weekend*?" The answer of a different user in the informal role of technical-helper was: "*I just asked the technical project team and they said they had upgraded the software. The new version should work in two weeks. Hopefully they are right.*"
- Conclusion-Making: adds comments to the process of communication; has an essential influence on the content discussion, for example: "*From my point of view, it looks like ...*" or "*Summarized…*".
- Promoter of the procedure: makes the current procedure more transparent; supports task completion; positively promotes the discussion or activities; motivates to participate, for example: "*Yes, I could explain the seven answers of the exam after the exam – when there are enough students who will participate. I suggest Wednesday, 14 February, 10am in room E28. I will not do this if there are just 3 or 4 people, so, come on, and all come to the meeting.*"
- Organizational-supporter: helps to give another view of the activities (meta-level: communication about the communication), support to think about organizational conventions (e.g. how to communicate), for example: "*Why have you written this posting three times*? *Please, wait a moment before you write it again"* or "*You say that someone says the script would be online, but where is it and who said this?*"
- Decision-initiator: combines diverging contributions by relating them to a summarizing statement; if the discussion diverges, the person calls for an informal vote to reach consensus, for example: "*Do we share this view of the problem?*"

To conclude, during the growth phase the InPUD-community was able to build new informal roles. These developments are continuing.

c) In the phases of sustainable development of InPUD (from 2005-2006) the analysis showed particularly a lot of new members who were in formal roles, for example, moderating tasks by lecturers, academic staff and professors). These new formal members started a lot of new topics on the discussion boards (e.g. studying abroad, women in computer science, discussions about new courses of bachelor and master). Nevertheless, the students – and not the formal members – were the driving force behind InPUD. Because of their high number as well as good practice, they pushed the academic staff and other students to become involved in this online collaboration and communication.

(3) Expectations affecting the behavior of other members

(3.1) Trust (implicit expectation)

All online communities build their potential on the basis of trust. Shneiderman (2000, p.58) says that trust is "*the positive expectation a person has for another person, organization, tool, or process that is based on past performance and truthful future guarantees made by a responsible person or organization*". The process of trust-building in the Internet-based InPUD-community is computer-mediated and based only on online communication with little face-to-face contact. Hence, the InPUD-members who communicate with other InPUD users do not generally know them outside of this virtual space. Furthermore, anonymity can also be maintained, if desired, by the use of a discreet username. Similar to Schmidt (2000), we distinguish between four areas of trust. These are design criteria for facilitating trust:

1. Trust in the identity of the others: who is the person behind the name that I see on my computer screen?
2. Trust in the interests and motives of others: Which interests/motives does she/he follow/have? Why does she/he communicate with me? Is the person acting faithfully and giving honest statements?
3. Trust in the expertise of others: Does she/he know enough about these things to help me?
4. Trust in others' played roles: which role does she/he play?

Internet-based communities (like the InPUD-community) need particularly *pre*-trust in the beginning. Betrayal of trust can have a significant negative impact on the online community and can limit or dissolve collaborative learning. "*When there is trust among people, relationships flourish; without it, they wither*" (Preece, 2000, p. 191). Therefore, the question is how to encourage trust in computer-mediated communities?
Similar to Shneiderman's model (2000) to facilitate trust, we *clarified the context*, for example, we made transparent that InPUD is part of the Department of Computer Science. Second, it was important to "*make clear commitments*", for instance, each board has a description about possible content and the announcement that "*off topic discussions will be deleted*". And finally, the trust–building was supported by ensuring that each discussion board had one or more formal moderators, a task that is obligatory taken by academic personnel. The static information in InPUD is also checked by the academic personnel, in particular by the administrators. So, the formal moderators – although they act as facilitator moderately and not often – also gave the InPUD-community the context for facilitating trust.

(3.2) How online role naming affects expectations
In the case of the InPUD-community the formal role of the moderator and others with responsibilities such as study management advisors, counseling services or people offering course guidance, are integrated into the community by an 'online role presence', for example, "*Mr. Miller, Advisor of Study Management*" or "*Mrs. Smith, Lecturer for Computer Science Study: Human-Computer-Interaction*". To summarize, the formal roles were visible when people communicated online.
This formal role presence also helps new community members who can easier assess the quality of information through the member's role (e.g. formal moderator and advisors). The members, in particular students, ascribe more expertise and knowledge to those members who have formal roles. So, the empirical investigation shows that online role presence is essential when checking the quality of the given information. In conclusion, the visible presence of role names improves the ability to assess the quality

of the information given, and this may improve the frequency and quality of requests that finally encourage the members and affects the evolution of a community (cf. trust, in point 3.1).

(4) Role-playing: the emergence of online interaction patterns (roles)
The InPUD-analysis illustrated the development of roles over a period of time, for example the interaction pattern of active people, the promoter, the conclusion-maker, the decision-initiator and the conflict mediator (cf. point 2: differentiations of informal activities). These perceivable interaction patterns provided a structure for a joint online communication. We describe this by following examples:

- Our analysis of the InPUD-Community provides indices for the importance of a moderator (cf. point 3.2) and a promoter: a person who feels responsible for the growth of the community. During the first stage of InPUD's development of a common culture (in 2002) the formal role of a moderator as well as a promoter was essential. However, the frequency of their comments is less important than the fact that the other (or new) members know that a moderator exists and she/he can delete contributions or comment on false contributions. If there is a moderator's role, it is also essential to make the rules and (off)topic contents visible. The moderators "*must learn to achieve a balance*", (Preece, 2002, p. 291). In the InPUD case, "balance" means that the moderator should act in a moderate way, for example, delete off-topic remarks, comment on factually incorrect answers, clarify which content may be discussed, which topics are not required, and make them visible. To summarize, the InPUD-moderators have a very moderate position, they only provide answers when other students had no idea or provided incorrect answers.
- Other members - often students – also took part in informal moderation activities. In InPUD the formal moderator role is often supported by students as informal moderator. These informal moderators help other members and tell them "*how to ask questions*" or tell them that "*this question has already been answered on board 6*" (cf. in particular point 2, the beginning of the development of tasks).

Besides these positive aspects of roles, community members can however also restrict the joint enterprise of knowledge sharing. The behavior of the community members, especially the moderators, affects the development of the community: either the community will grow better, or the roles have a negative influence on the community and cause problems. For example, some people communicate in a negative way when they act carelessly with their choice of words. In such cases, the members prevent the cultivation of a common culture and even more they can destroy trust. In some of such cases in InPUD, other members either did comment the behavior as "not okay" or they ignore such behavior, they did not answers or opened new discussion threads. It is important to be aware of these problems. In the case of 'danger' – e.g., too much negative influence – it is important to intervene, for example as formal moderator, in order to support the 'good' community members.

ATTRACTIVENESS OF ONLINE COMMUNITIES – DESIGN CRITERIA

The success of online communities depends upon the interplay of social structures and technical systems: the attractiveness of the socio-technical system promotes the online communication. A socio-technical system such as the InPUD-community needs to be given the opportunity to develop itself, and give people the opportunity to share their

information. The members should be able to organize context, create online spaces for discussions and be able to cultivate a common culture of knowledge sharing.
Resulting from our observations of the InPUD-community (cf. section 4), in this section we draw some general aspects for the attractiveness and designing of online communities. This conclusion might be applied to communities which are characterized by a large size and supplemented to the formal company. However, we also suggest these ideas for firm's internal communities.

1. **Identify the group and their problems**

According to most designers and researchers we have no doubt that it is essential to understand the group for whom you are designing a community. Hence, the possible community members should be consulted and involved in the design process from the start (cf. Preece et al., 2004, p. 4).
The first 'To Do' is to identify the group. Furthermore, it is necessary to answer at least following questions: What problem is the group faced with? Why do they have insufficient contact, communication and/or collaboration? Second, if the group and the problems are clearer you can ask what technical system(s), for example Web2.0 applications, are appropriate to support the 'new way' of communication, cooperation or the social networking. From our empirical analysis we suggest to ask some people who could be participants at the new community. Finally, it is necessary to make your personal goals as well as your role clear and to compare it with the community's need.

2. **Integration of Web 2.0 applications and critical mass**

If it is clear what kind of technical systems the group needs, Web 2.0 applications (or new forms of them) should be integrated to the group as quickly as possible in order to support the interests and formal tasks of the users at their organizations or companies. From the InPUD-case we know that it is important to support many-to-many communication, and the possibility that users can discuss about information when they want. Hence, information and communication must be combined to enable questions and answers. Thus, the creation of new knowledge is possible.
Second, it is essential to have a critical mass in the beginning. This is the number of people at online communities who use the technical system in order to communicate with each other. It attracts other people to invest time at the same community. This phenomenon is also discussed as the "*cold start problem*". Markus & Connolly (1990) showed that in cooperative settings the use of the technical system increases with the number of users, while the cost for an individuals use stays stable and individual benefit increases. If there are not enough users, the cost/benefit balance is negative. An indicator for a well-designed community-system is the growth without external marketing. For example, the InPUD-community grew without marketing or any external advertising. Although we did not made external marketing, we already had a lot of participants in the beginning.
In addition, the project team should ensure just a minimum of formal regulations. That means low level of control by project team and company leaders. A knowledge sharing process – which is based on the willingness of individual users and participation is not obligatory – might be work better than other communities. Furthermore, a success factor is also the support of rather less formal roles but more members in informal roles (in more detail see section 4). This factor is closely linked with the next aspect which is called as 'facilitate the social dynamic' (see point 3).

3. Interviewing the people, support communication about the community

Whilst the whole process of cultivating of an online community, conduct interviews with possible community members about 'what is good' and 'what could be better'. Such a continuous evaluation leads to a better understanding of the community and gives ideas for redesigning – not only in the case or problems.

Similar to the success factor 'minimum of formal regulations', also the aspect 'facilitate the social dynamic' includes the support of interactions and communication. Following questions might help: Could participants constantly read *new* documents, annotations etc.? Do members reply relative immediately to questions from others? How can actors and new members react to contributions of other actors? Is the interaction between new user and actors – or among actors in general – rather complicated, emotional or just okay? To conclude, the support of social dynamic also means to give people the possibility to create relationships and the opportunity for social networking to enable collaboration and knowledge sharing.

Furthermore, ensure a 'sufficient quality of content'. Following questions might be helpful to achieve that goal: What information is presented? Do the members comment on wrong information? Which different roles have been created over time and who takes part? Once again, are content and discussion about it integrated in order to promote active interactions? A further aspect is to facilitate the assessment of the quality of the given information. One success factor is to give participants – who take formal roles, for example, staff of the organization – role names. To conclude, make the less formal roles present in order to show what posting comes from what role. Such explicit role names (which should comprehensible and not too artificial) might help to assess the given information. This also affects trust and reliability for the community members.

4. Ensure sustainable development by enabling possible changes

From our InPUD-analysis we suggest to support social integration, for example: Are the members able to exchange their knowledge amongst different communities and does the technical system of the community offers the building of diverse networks? This is important also with regard to Davenport (2005, p.162f.). His research confirmed that knowledge workers which are high performers have larger, "*stronger and more diverse networks to which they can turn for information*" than lower performers. To summarize, it seems to be essential to support diverse networks as well as possible changes at the community: Are the members able to influence the structure of the community in accordance with their needs? Does a person have the opportunity to develop personally, for example to get more prestige, and have the community members the possibility to create new social networks?

Finally, from our five year research about the InPUD-case we also recommend an action research process with iterative learning cycles. For this, Preece (2000, p. 291) provides further design criteria: a checklist with eight heuristics (usability and sociability concerns) for guiding the development process and planning evaluations.

CONCLUSION

Knowledge management studies reveal that online communities or communities of practice (Wenger, 1998) positively promote knowledge sharing in organizations. They

initiate and enhance information exchange among many people in different departments (e.g., Lesser, & Prusak, 1999; Wenger, McDermott, & Snyder, 2002). Our empirical study mentioned in this publication also confirmed this thesis. However, our viewpoint focused on the dynamic development of social structures in the computer-mediated communications of a big group.

Although the InPUD community is different from a community created in a firm or from a large international community, we assume that the results (section 4) as well as the design criteria (section 5) may be applied for resembling communities with similar attributes, i.e., rather large communities, lifespan of several years or more, especially online communication than face-to-face.

Section 4 confirms that members of an online community develop new social structures although the InPUD-community was only supported by a minimum of formal regulations (e.g. few formal roles, easy log in).

Furthermore, the explanation of the ongoing quantitative development of InPUD users refers to the continuing evolution of social relationships and ties between its users, which is mirrored in their interactions and written contributions. A clear willingness to be helpful to others has been observed. The students developed an interest in the careers of others although they often only knew them through InPUD. Due to the activities of its users, InPUD has become a continuously growing and helpful database for successfully organizing and answering questions about the study of computer science.

Moreover, the analysis of the InPUD-case showed the evolution of social structures. Active social interactions and communication about information led to new 'behavior settings', rules and conventions. In the stages of growth, the online community InPUD formed new social structures which depend on computer-mediated communication, and led to technically mediated regulation. For example, the InPUD-community is beginning to create new social conventions, e.g., new activities and new informal roles could be observed (cf. section 4). However, as mentioned in section 4, these social mechanisms can also lead to more social control. These results are in accordance with Giddens' (1984) theory of the "*duality of structures*": on the one side the structures are composed by those who interact, and simultaneously, on the other side, the rules, values and social relationships are produced and reproduced during social interaction. Both sides influence each other.

Additionally, we have observed that on the one hand; computer-mediated communication can lead to new social structures (e.g. new informal activities), and on the other hand the initially established structures do affect the online communication. The members built social structures through the use of the technical system.

Nevertheless, the emergence of social structures in online settings leads to a similar differentiation as in 'physical' societies. The observed roles affect social distinctions. Therefore the line of thought that 'all people are the same' when they communicate in online communities must be rejected. The dynamic of social structures in online communities does make a difference. However, the difference between online and face-to-face settings is following: People who have had bad experiences in online settings, for instance, unexpected behavior in contrast to the self-description of the online community, are able to participate again by using another nick name – that is not (so easily) possible in the 'real' world.

Summarized, the empirical aspects (of section 4) – emergence of informal roles; visible formal roles, providing immediate support and building social capital online; enabling social presence, building social proximity and trust "through" the technical system – are

characteristics of the *developed results of the social structure over time* at the InPUD-community.
Although the InPUD case did not include all technical features as discussed with respect to Web 2.0 (cf. section 1), the success of this community was evidently driven by the spirit underlying of Web 2.0: The evolution of reliable, social relationships and the development of a valuable basis of content and communication 'through' user-generated content are highly interweaved. This process was based on a minimum of formal regulations and control and on only a very moderate intervention by moderators. We strongly believe that these ingredients are the fundamentals upon fundaments on which the further emergence of Web 2.0 – a socio-technical phenomenon – is based.

FURTHER RESEARCH DIRECTIONS

In further research we will deeper evaluate the quantitative network of the InPUD-members, e.g. analyzing who persons communicate with whom and how often. Furthermore, the question of how strong the InPUD's relationships really are should be investigated in further research.
Moreover, further research should focus also on the question of community boundaries in relation to online networks and their affects on the Internet-based society. Do online communities build new social boundaries or will they build a free-open network where everybody is able to participate without boundaries? Will system boundaries be dissolved or will they emerge on a higher level?
In addition, further research should also investigate if and how the development of social structures in online communities leads to new social boundaries (e.g. new members could be excluded; closed vs. open system) or if and how the social dynamic leads to new forms of sociotechnical phenomena and the potential for business companies.
To summarize, we want to find answers to these research questions to enable us to learn more about the Web 2.0 phenomenon and the next generation (e.g., Web 3.0) when we move from a social to a socio-technical society.

ACKNOWLEDGEMENT

I would like to thank Thomas Herrmann for giving me the opportunity to work and carry out research in the field of socio-technical systems and roles. I gratefully acknowledge and thank him for his supervision, help and advice not only throughout my work on the InPUD-project but also in developing my own role. I also would like to thank Volker Mattick who I worked together with on this project and to everyone who made my research studies such a fulfilling experience.

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Preece, J. (2000*): Online Communities. Designing Usability, Supporting Sociability*. Chichester: Wiley & Sons, Ltd.
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A good book for designing communities of practice: in particular persons and groups in business companies. It builds the bridge between communities and knowledge management.

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1 Taxonomy is the practice and science of classification of data, photos, pictures and so on.

2 Retrieved September 9th, 2007, from http://www.ibm.com/developerworks/blogs/

3 Pepysdiary.com site "*is a presentation of the diaries of Samuel Pepys, the renowned 17th century diarist who lived in London, England. A new entry written by Pepys will be published each day over the course of several years; 1 January 1660 was published on 1 January 2003*." (Retrieved September 9th, 2007, from http://www.pepysdiary.com/). People discuss Pepys' life and his diary entries by posting own annotations.

4 Del.icio.us is a social bookmarking site. By using tags, people can organize their own bookmarks and see what other people with similar tags have. This supports the idea to find information from the Internet easier. "*Tags are one-word descriptors that you can assign to your bookmarks on del.icio.us to help you organize and remember them. Tags are a little bit like keywords, but they're chosen by you, and they do not form a hierarchy. You can assign as many tags to a bookmark as you like and rename or delete the tags later. So, tagging can be a lot easier and more flexible than fitting your information into preconceived categories or folders."* Retrieved September 9th, 2007, from http://del.icio.us/help/tags

5 Dodgeball site helps to find friends when people are at different places: "*Tell us where you are and we'll send messages to all your friends letting them know, so you can meet up. (…) we'll locate friends of friends within 10 blocks (…) find venue locations and broadcast messages to all your friends*." Retrieved September 9th, 2007, from http://www.dodgeball.com/

6 "*Facebook is a social utility that connects you with the people around you*." Retrieved September 9th, 2007, from http://www.facebook.com/ Similar to Facebook (especially in USA), Xing.com is popular in Europe.

7 Altruism usually means helping another person without expecting material reward from that person, although it may include the intrinsic motivated benefit of a "good feeling" (as sense of satisfaction).

8 We got inspirations of the "*interaction process analysis*" of Bales (1950). He developed a method for the study of small groups in face-to-face situations.

9 The standard length of an undergraduate computer science degree in Germany is nine semesters (4-5 years). The majority of students take 12-14 semesters to complete their course (6-7 years).

10 German students have often a high degree of freedom: the decision of when to attend lectures or seminars (in which semester) or even when to take examinations (in which semester) is left to the discretion of each student.

11 InPUD is an acronym for Informatics Portal University of Dortmund (Germany) and can be found at http://inpud.cs.uni-dortmund.de

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[12] German universities offer multitudes of lectures and students have to create their own semester plan for lectures; meaning they can choose which lectures they attend and when to attend them.

[13] The community grew without marketing or any external advertising.

[14] WIS is an abbreviation for the project 'Development the Computer Science' at the University of Dortmund (Prof. Dr. Thomas Herrmann). It was promoted by the state of North Rhine Westphalia (Germany) from 2001-2004.

[15] It is not obligatory for German computer science students to attend lectures in order to take the examinations.

[16] People have not the same goals since the role 'study management advisors' is perceived as "*just an add-on job*" which must be conducted by the academic staff from the Department of Computer Science. This job is an add-on job besides research activities, lectures and doctoral thesis. Hence, from the viewpoint of such people, the job 'study management' is not their priority.

[17] Surowiecki argues that the aggregation of information in groups, resulting in decisions, is often better than by any single member of the group.