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Satisfaction and Coordination in Virtual Communities

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ABSTRACT

The concept of virtual communities and organizations has received much attention in recent times as a new organizational form which increases the independence and flexibility of individuals. However, these communities present challenges with regards to management, social interaction and structure which could affect the overall satisfaction levels of participants within these communities. The goal of this study is to identify some factors related to member satisfaction in open source projects. We investigate the relationship between intrinsic and extrinsic motivational factors, project coordination, project characteristics and group trust, on the intrinsic and extrinsic levels of satisfaction of members in the community. A pilot study was conducted in which members of open source software communities were surveyed via a questionnaire. The results offer some insights into the attitudes and behaviors of members of the communities. Practical implications, limitations and future research are provided.

Keywords

Virtual communities, management of information technology, attitudes.

INTRODUCTION

The concept of virtual communities embodies two basic areas, that of virtual teams which consists of human beings, in remote locations working towards some common goal and the computer networks that link these teams together and facilitates this cooperative work. Researchers have identified these computer networks as social networks (Wellman, Salaff, Dimitrova, Garton, Guila and Haythornthwaite, 1996). However, virtual communities also have challenges associated with their function. These include issues of low social interaction and the need for coordination. The research literature indicates that virtual teams are typically separated by space and time, and sometimes by culture and language. This absence of face-to-face and real-time interaction creates opportunities for group dysfunctions to occur. Examples include social loafing and lower commitment to the group (Jarvenpaa and Leidner, 1999). At lower levels of personal interaction and accountability, inequities in effort can occur. Furthermore, as members limit their interaction to the advancement of the project, there may be little done outside of the work environment to foster feelings of belonging, identification, and involvement in the group. Consequently, member commitment to the group, which could be vital in voluntary organizations, may be low (Clary, Snyder, Ridge, Copeland, Stukas, Haugen and Miene, 1998).

The purpose of the paper is to present some preliminary findings from a pilot study on open source virtual communities. Since membership is voluntary, the problem of attracting and maintaining members over time is a central one (cf., Hertel, Niedner and Herrmann, 2003). At the onset of the project, participation is voluntary; therefore no one knows whether the software will be of a high quality. The quality or effectiveness of the software may also be affected by the skill levels of the volunteers on each project. One way potential members might be drawn to participate is if they believe they will find the project to be satisfying (Clary et al., 1998). The extant literature in the area of social sciences and information technology forms the basis for the establishment of the theoretical foundation. The paper identifies a set of hypotheses that relate intrinsic and extrinsic motivation, project characteristics, coordination and group trust to member satisfaction that has practical implications for organizations.

OPEN SOURCE COMMUNITY

The Open Source Software (OSS) development community has become one of the largest virtual communities in existence today. This community spans several different geographical boundaries and cultures. Some of the more prevalent open source software includes Linux which is operating system software, as well as Apache which is web server software. Open source software is essentially software that is provided "free of cost" to the general public; individuals can then use, modify

and redistribute the software under special licenses (Mustonen, 2003). The software can usually be obtained by individuals downloading it over the Internet.

The OSS development process encourages the formation of various virtual teams to handle the development, debugging and continued maintenance of software projects. These virtual teams which are joined together by the common interest of utilizing and/or developing the software then form a community around the OSS project (Ye and Kishida, 2003). The roles played by members within the community are neither pre-determined nor pre-assigned. Each individual decides on the type of participation as well as the extent of that participation.

THEORETICAL FOUNDATION

Hackman and Oldham's Job Characteristics model (1976), states that jobs with high levels of autonomy, feedback, skill variety, task identity, and task significance are thought to be more motivating than jobs without these features. For the purpose of clarity, a job is defined as a collection of tasks; we can therefore refer to the tasks performed on an OSS project as a job. Autonomy refers to the discretion that one has in doing the job. Feedback is the opportunity to know how one is performing on the job. This feedback could come from external sources, such as peers, or a supervisor. It could also come from the task itself, for example, did the program execute or not? Skill variety refers to the range of skills one needs to do the job. Task identity focuses on the degree to which one is responsible for the overall identifiable work output. Task significance is the impact of one's work on others. Depending on how the tasks are divided and how the work is coordinated, members of OSS project teams can have high levels of all of these job characteristics. At a minimum, the level of autonomy with the voluntary nature of the participation establishes a baseline motivating potential for the OSS project. The Job Characteristics Model is therefore very appropriate for understanding OSS project groups.

Since one feature of virtual communities is a relatively high sense of member autonomy, members can decide when and if to participate, and how much time to devote to the project. In this sense, the virtual group approximates an autonomous workgroup. According to Wall, Kemp, Jackson, and Clegg (1986), members of an autonomous workgroup have a high degree of control over the division of labor, the pace of work, and the socialization of new members. The Hackman and Oldham's (1976) model indicates that jobs with high levels of autonomy are thought to be more motivating than jobs with less independence. Autonomy is a quality of the job and is therefore an intrinsic motivator (Ryan and Deci, 2000).

Intrinsic and Extrinsic Motivation

Intrinsic motivation is the performer's motivation to complete a task because of the inherent interest he/she has in the task. Extrinsic motivation is the performer's motivation to complete the task because of the consequences for completion, for example a reward or the removal of a threat (Ryan and Deci, 2000). Previous research has shown a relationship between motivational job characteristics and job satisfaction (Wong, Hui and Law, 1998). Overall job satisfaction is the extent to which people like their jobs. Since jobs can have multiple facets, it is possible to be satisfied with some facets and not others. For example, someone could be satisfied with the nature of the work but not with the supervision. The intrinsic aspects of the job involve the nature of the tasks, and the extrinsic involve the work situation, such as, the supervisor, the pay, and the co-workers.

Intrinsic job satisfaction is derived from the aspects of the job related to challenge, achievement, and helping others. Extrinsic job satisfaction is the feeling associated with company policies, working conditions, supervision, and the like. These distinctions are important because extrinsic rewards have been found to undermine intrinsic motivation (Ryan and Deci, 2000). If a member is working on a project with the intent to make money from it, the level of intrinsic motivation will be low while the level of extrinsic motivation will be high (Ryan and Deci, 2000).

Raymond (1998), indicates that "to solve an interesting problem, start by finding a problem that is interesting to you (1998, p. 13)." The people who become involved in an open source project usually do so because they have some personal interest in the project. Other researchers (Hars and Ou, 2000; Sawyer, 2000) have put forward reasons of "egoism". Most of the more popular open source sites such as Apache and Linux post the names of the contributors to the project on their web site. Autonomy of the OSS project groups is also an attraction. It would therefore be expected that the intrinsic motivating factors of the OSS project would contribute to members of the community experiencing intrinsic satisfaction. Thus, the following hypothesis is indicated.

- H1: There is a positive relationship between intrinsic motivation and satisfaction with intrinsic aspects of the OSS project.

There are also several ways that individuals can make money from the open source movement. Highly skilled programmers can provide their services to third-party companies who are involved in the development and maintenance of these products,

modifying the software to run on different platforms, developing additional applications, providing support and the like. The potential to enjoy rewards is a component of extrinsic motivation. Thus, a second hypothesis is proposed.

- H2: There is a positive relationship between extrinsic motivation and satisfaction with the extrinsic aspects of the OSS project.

Given the previous discussion regarding the relationship between intrinsic and extrinsic motivation, it is expected that intrinsic motivation will be independent of extrinsic satisfaction, and that extrinsic motivation will be independent of intrinsic satisfaction.

Project Characteristics

According to Ye and Kishida (2003), one of the main reasons for involvement in OSS projects is to learn and develop new skills. The Stanford Institute for Economic Policy Research conducted an on-line survey of OSS developers (FLOSS) and found that in addition to technical skills (TECH), most programmers were also interested in the community, collaboration and cooperation aspects, classified as instrumentality (INSTRUM). Participants in that study were also interested in the ideological characteristics of the project, such as the ability of the software to solve a problem that could not be solved by proprietary software (IDE), (Ghosh, Glott, Krieger and Robles, 2002). Project characteristics are therefore categorized as extrinsic as it relates to facilitating the development of technical skills and collaboration, and intrinsic as it relates to how important ideology was in the decision to participate in the project. In any single project the number of contributors can range from a few individuals, to a larger group of several hundred, with individual contribution levels varying within each group (Dempsey, Weiss, Jones and Greenberg, 1999). The characteristics cover both extrinsic and intrinsic motives. Thus, the next hypotheses are proposed.

- H3: There is a positive relationship between intrinsic project characteristics and satisfaction with the intrinsic aspects of the OSS project.
- H4: There is a positive relationship between extrinsic project characteristics and satisfaction with the extrinsic aspects of the OSS project

Project Coordination

Another important aspect of virtual communities is the need for coordination of the efforts of the members. This paper focuses on the effect that the project coordinating mechanisms have on job satisfaction. In employment situations, there can be control over the composition of work groups. On OSS projects, members self-select to be a part of the project, and information on skills and experience are self-reported by the individuals. There is not much independent information that is known about these members. If the project has the potential of being intrinsically and extrinsically satisfying, and the potential members feel that the project will be well coordinated, then they may be more likely to participate. It is therefore important to understand how projects are coordinated, and the effect of the types of coordinating mechanisms on satisfaction as this has practical implications.

Research indicates that the open source style of development seems to be very effective in identifying and fixing problems. Raymond (1998) suggests however that this development style is not ideally suited for the initiation and organization of new projects. Participants in the development process need some base from which to work. They can more easily participate in fixing, modifying and enhancing existing code than in coming up with the original design and development. The process therefore seems to require an individual or a core group of individuals to initiate the project. Once this is done then other users can become involved in the continued development and debugging. The Linux project, initiated by Linus Torvalds and the Apache project initiated by a small group of about eight individuals are successful examples of this process in action.

As indicated by Van de Ven, Delbecq and Koenig (1976), modes of coordinating mechanisms may be classified as impersonal, personal or group. For OSS projects, impersonal modes include rules and plans, common goals, and technology. Personal modes refer to individuals or liaisons that coordinate the work. Group modes entail standing committees and ad hoc groups who work together to coordinate the work. The level of coordination increases from impersonal to group. Given the relatively high need for coordination in virtual OSS project groups, members may feel more satisfied generally with the higher levels of coordination from the group modes. Project members may want to know that their efforts are being coordinated effectively and efficiently; otherwise they may become dissatisfied and withdraw their participation. The following hypotheses are presented.

- H5: Satisfaction with the intrinsic aspects of the project will be greater when group mode coordination is used for OSS projects.

- H6: Satisfaction with the extrinsic aspects of the project will be greater when group mode coordination is used for OSS projects.

Group Trust

The research literature indicates that trust has a direct impact on group processes such as cooperation (Dirks, 1999). That is, the higher/lower the level of trust, the higher/lower the level of cooperation among group members. As a result of the separation between the members of an OSS project, trust is likely to be an important component in the stability of the group. Trust can develop as a result of shared norms about such things as the goals of the project. For example, if the members believe that the project idea is good and they agree that devoting effort to the project advances the open source idea and their own interests, then there can be trust within the group. This is an intrinsic quality of the project because it is based on the members' perception of the project being good. Trust can also grow over time when members can observe each others contributions and share common experiences, in particular, positive experiences (cf. Jarvenpaa and Leidner, 1999). As the project progresses with the addition of lines of code and the exchange of feedback, members can see that others are committed to the project. This is an extrinsic quality of the project since the member's satisfaction derives from the efforts of the contributors and not from the project itself. Thus it can be seen that group trust may be related to both intrinsic and extrinsic satisfaction.

- H7: There is a positive relationship between high levels of group trust and satisfaction with the intrinsic aspects of the OSS projects.
- H8: There is a positive relationship between high levels of group trust and satisfaction with the extrinsic aspects of the OSS projects.

RESEARCH METHODOLOGY

Measures

The intrinsic and extrinsic motivation measure is based on the 25-item Work Preference Inventory (WPI) developed by Amabile, Hill, Hennessey and Tighe (1994). An example of an intrinsic motivation item is, "The more difficult the problem, the more I enjoy trying to solve it". An example of an extrinsic motivation item is, "I am keenly aware of the income goals I have for myself". The project characteristics measure was adapted from the FLOSS study highlighting the importance of project characteristics. A total of 15 items were used. Respondents indicated how important the characteristic was in their decision to work on the project. A sample characteristic is, "The project seemed technically interesting". The 6-item group trust measure was adapted from a scale used by Jarvenpaa and Leidner (1999). Respondents indicated their agreement with statements such as, "I can rely on those I work with in this group". Satisfaction with the intrinsic and extrinsic aspects of the project (e.g., the freedom to use my own judgment; the recognition I get for doing a good job) was measured using nine items from the short form versions of the Minnesota Satisfaction Questionnaire (MSQ; Weiss, Dawis, England and Lofquist, 1967). The research on the psychometric properties of the WPI, group trust measure, and MSQ especially is extensive (cf. Amabile et al., 1994; Jarvenpaa and Leidner, 1999; Law and Wong, 1999). Other data collected for this study included sex, age in years, education, and group size. The hypothesized relationships are summarized in the following model, as shown in Figure 1.

Data Collection

The data was collected from 50 members of the open source software community, using a questionnaire administered in a class room setting at the monthly meeting of two open source support groups. Eight questionnaires were discarded as unusable. The individuals who participated in the study interacted with the larger open source community and had either previously been involved in or were currently involved in an open source software development project, although not necessarily the same projects.

RESULTS

The items in the scales were analyzed using principal components analysis on SPSS 11.5 for Windows. For the WPI, there are supposed to be two subscales. The number of components was set to two and the solution converged with the items loading roughly according to the intrinsic/extrinsic subscales, with the exception of three items. Reliability analysis was then conducted on the subscales. A 6-item scale was indicated for the extrinsic motivation (EM) WPI subscale, with an alpha reliability of .78. The 13-item intrinsic motivation (IM) subscale had an alpha of .88. There were two extrinsic satisfaction

items (ES-1 and ES-2) but they failed to load on the same component. Therefore, the items were not combined into a single scale. The Intrinsic Satisfaction (IS) subscale had five items with an alpha of .92.

The perceived project characteristics items were taken from the FLOSS study and modified. After Principal Components analysis specifying three components was conducted, the items clustered according to Technical Skills, Instrumentality, and Ideology. The Technical Skills (TECH) items pertained to the project as an opportunity to develop technical skills. For example, “A chance to learn and develop new skills.” The Instrumentality (INST) items concerned the opportunities the project presented as a way to increase earnings or social status. An item from this dimension is, “The project was important and visible”. The Ideology (IDE) items focused on an anti-proprietary stance. A sample item is, “Solve a problem that could not be solved by proprietary software”. The 7-item technical skills (TECH) scale had an alpha of .85, the 3-item Instrumentality (INST) scale had an alpha of .80, and the 3-item Ideology (IDE) scale had an alpha of .79 - a high score on a project characteristic means that the characteristic is salient to the respondent.

All of the items on the TRUST scale loaded on a single factor. The first item did not contribute to the reliability of the scale and was therefore dropped. The surviving items formed a 5-item scale with an alpha of .91. Table 1 presents the means and standard deviations of the study variables. The sample sizes vary due to missing data. Thirty-nine (39) of the respondents were male and one (1) was female; three gave no response. Twelve (12) respondents had some college education and twenty (20) had at least a college degree.

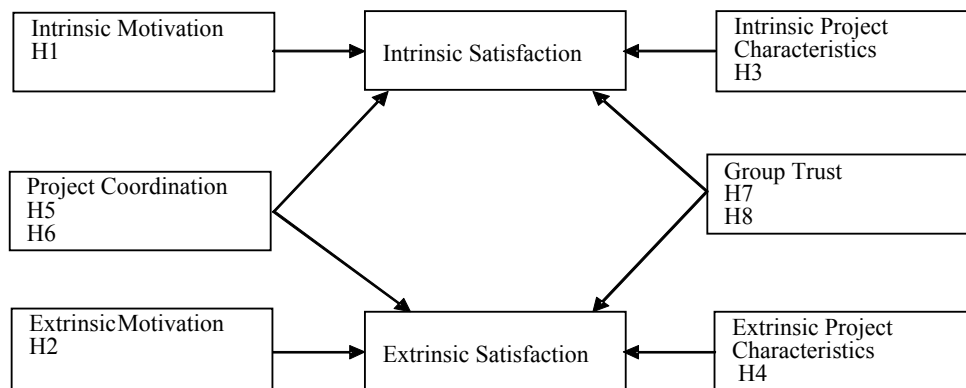


Figure 1. Summary of Hypothesized relationships of Job satisfaction to other variables.

Variable	Mean	Standard Deviation	N
Age	38.85	14.0	39
# people on OSS project	65.55	215.9	22
Extrinsic Motivation (EM)	2.74	.68	32
Intrinsic Motivation (IM)	3.29	.50	32
Intrinsic Satisfaction (IS)	4.04	.78	27
TRUST	4.02	.77	24
Extrinsic Satisfaction-1 (ES-1)	3.50	.88	28
Extrinsic Satisfaction-2 (ES-2)	3.86	.85	28
Technical Skills (TECH)	3.31	.89	31
Instrumentality (INST)	4.15	.82	33
Ideology(IDE)	3.24	1.18	33

Table 1. Descriptive Statistics

Table 2 presents the inter-correlation matrix for the main study variables. The findings indicated support for Hypothesis 1 as Intrinsic Motivation (IM) was highly correlated with Intrinsic Satisfaction (IS) ($p < .01$). Hypotheses 2 and 3 were not supported. Extrinsic Motivation (EM) did not correlate with Extrinsic Satisfaction (ES), and the intrinsic project characteristic (IDE) did not correlate with Intrinsic Satisfaction (IS). It should be noted here that Intrinsic Motivation (IM) did not correlate with Extrinsic Motivation (EM), but Intrinsic Satisfaction (IS) did correlate with Extrinsic Satisfaction-2 (ES-2) ($p < .05$). Hypothesis 4 was partially supported. Technical Skills (TECH) and Instrumentality (INST) did not correlate with Extrinsic Satisfaction-2 (ES-2), but Technical Skills (TECH) did correlate with Extrinsic Satisfaction-1 (ES-1). It should be noted that Technical Skills (TECH) did not correlate with the ability to increase earnings or social status, the Instrumentality (INST) variable, suggesting that these measures of the extrinsic project characteristics are independent of each other. Hypothesis 7 was supported as TRUST was related to Intrinsic Satisfaction (IS). Hypothesis 8 had partial support with TRUST correlating with Extrinsic Satisfaction-2 (ES-2) but not Extrinsic Satisfaction-1 (ES-1).

Table 3 reports the mean satisfaction levels associated with the highest level of project coordination. If a respondent reported that the project was coordinated using rules and a person, the highest level of coordination was coded as Personal. Hypotheses 5 and 6 were not supported. The mode of coordinating mechanism had no statistically significant effect on the measures of extrinsic or intrinsic satisfaction.

		# people on project	EM	IM	IS	TRUST	ES-1	TECH	INST	IDE	ES-2
# people on project	Pearson Correlation	1	.200	-.394	-.164	-.353	-.153	-.036	-.129	-.146	-.262
	N	22	22	20	20	17	21	21	22	22	21
EM	Pearson Correlation	.200	1	.055	.459*	.097	.245	.546**	.067	.050	.050
	N	22	32	29	26	23	27	28	29	29	27
IM	Pearson Correlation	-.394	.055	1	.812**	.380	.013	.215	.699**	.113	.117
	N	20	29	32	24	21	25	27	29	29	25
IS	Pearson Correlation	-.164	.459*	.812**	1	.463*	.155	.466*	.745**	.182	.436*
	N	20	26	24	27	24	27	26	27	27	27
TRUST	Pearson Correlation	-.353	.097	.380	.463*	1	-.238	.115	.266	.159	.467*
	N	17	23	21	24	24	24	24	24	24	24
ES-1	Pearson Correlation	-.153	.245	.013	.155	-.238	1	.473*	.159	.253	.198
	N	21	27	25	27	24	28	27	28	28	28
ES-2	Pearson Correlation	-.262	.050	.117	.436*	.467*	.198	.342	.317	.341	1
	N	21	27	25	27	24	28	27	28	28	28
TECH	Pearson Correlation	-.036	.546**	.215	.466*	.115	.473*	1	.327	.290	.342
	N	21	28	27	26	24	27	31	31	31	27
INST	Pearson Correlation	-.129	.067	.699**	.745**	.266	.159	.327	1	.118	.317
	N	22	29	29	27	24	28	31	33	33	28
IDE	Pearson Correlation	-.146	.050	.113	.182	.159	.253	.290	.118	1	.341
	N	22	29	29	27	24	28	31	33	33	28

Table 2. Inter-correlation matrix for the main study variables

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Coordinating mechanism		ES-2	ES-1	IS
Impersonal	Mean	3.78	3.56	4.07
	N	9	9	9
	Standard. Deviation	.97	.88	.77
Personal	Mean	3.80	2.60	3.88
	N	5	5	5
	Standard. Deviation	.45	.89	1.4
Group	Mean	3.89	3.67	4.09
	N	9	9	9
	Standard. Deviation	.60	.71	.47

Table 3. Mean satisfaction scores by highest coordinating mechanism

DISCUSSION AND CONCLUSION

The objective of this study was to test the strength of the relationship between satisfaction and intrinsic and extrinsic motivation, salient project characteristics, project coordination mechanisms and group trust. The small sample size precluded more sophisticated analyses to determine moderating and mediating effects. This study contributes to the literature on OSS by including variables such as intrinsic and extrinsic satisfaction and motivation which were not previously investigated in the same study. The results indicated support for 2 of the 8 hypothesized relationships and partial support for two others. Intrinsic motivation and group trust were positively related to intrinsic satisfaction. Aspects of the project that allowed for the development of technical skills, intrinsic and extrinsic motivation factors, and trust all correlated with Intrinsic Satisfaction. We also found that group trust and the opportunity to enhance technical skills were related to a single-item measure of extrinsic satisfaction. Single-item measures were utilized because the items failed to correlate. The unreliability of single-item measures could have contributed to the lack of support for the hypotheses pertaining to extrinsic satisfaction. This will serve to improve the measure of extrinsic satisfaction utilized in future studies.

The initial assumption was made that OSS projects required complex levels of coordination. The rationale was that because these were virtual communities, simple mechanisms such as rules and procedures would be inadequate to coordinate member contributions. It was therefore expected that coordination using groups as opposed to impersonal or personal means would be associated with member satisfaction. This was in fact not the case; the participants were more satisfied with impersonal mechanisms such as rules and common goals than any of the other methods of coordination. One possible explanation could be that the members of OSS projects view impersonal coordinating mechanisms more positively than members of other types of groups or perhaps not all virtual community OSS projects require high levels of coordination. These results will serve to improve future research on project coordination to include questions and measures on the complexity of the coordination of the project. Although the means were not statistically different, one can see from the results reported in Table 3, that the lowest levels of satisfaction are for the Personal coordinating mechanisms. As already noted, one of the limitations of the study was the small sample size. As this was a pilot study, it is expected that in a follow-up study a larger sample will be used to more fully test the strength of relationships.

These findings indicate that virtual community coordinators will need to emphasize the intrinsic and extrinsic motivational factors such as opportunities to develop technical skills and to increase earnings or social status, as well as group trust factors

in order to attract and sustain participants over time. Understanding the factors that affect member satisfaction in virtual communities will play a significant role in understanding the future of these communities and the ability to maintain these communities over time. For future research, it would be useful to do a comparative analysis of members of different virtual communities to see if there are differences in members preferred coordinating mechanisms. An interesting avenue for research would also be to examine in what ways members in virtual communities, such as OSS project members, differ from members working outside of virtual communities.

REFERENCES

1. Amabile T. M., Hill, K. G., Hennessey, B. A. and Tighe, E. M (1994). The Work Preference Inventory - Assessing Intrinsic and Extrinsic Motivational Orientations, *Journal of Personality and Social Psychology*, 66, 5, 950-967.
2. Clary, E. G., Snyder, M., Ridge, R. D., Copeland, J., Stukas, A., Haugen, J. and Miene, P. (1998) Understanding and assessing the motivations of volunteers: A functional approach. *Journal of Personality and Social Psychology*, 74, 6, 156-1530.
3. Dempsey, B. J., Weiss, D., Jones, P. and Greenberg, J. A. (1999). Quantitative Profile of a Community of Open Source Linux Developers. Unpublished Working Paper, School of Information and Library Science, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, October 6, 1999. Source: <http://metalab.unc.edu/orst/develop.html> (03/14/2000).
4. Dirks, K. T. (1999). The Effects of Interpersonal Trust on Work Group Performance. *Journal of Applied Psychology*, 84, 3, 445-455.
5. Ghosh, R.A., Glott, R., Krieger B. and Robles, G. (2002). Free/Libre and Open Source Software: Survey and Study (FLOSS). Source: <http://www.stanford.edu/group/floss-us/report/FLOSS-US-Report.pdf>. (09/2003).
6. Hackman, J. and Oldham, G. (1976). Motivation through the design of work: Test of a theory. *Organizational Behavior and Human Performance*, 15, 250-279.
7. Hars, A. and Ou, S. (2000). Why Is Open Source Software Viable? – A Study of Intrinsic Motivation, Personal Needs, and Future Returns, *Americas Conference on Information Systems, Conference Proceedings*, Long Beach, California, 486-490.
8. Hertel, G., Niedner, S. and Herrmann, S. (2003). Motivation of software developers in Open Source projects: An internet-based survey of contributors to the Linux kernel. *Research Policy*, 32, 1159-1177.
9. Jarvenpaa, S. and Leidner, D. (1999). Communication and trust in global virtual teams. *Organization Science*, 10, 6, 791-815.
10. Law, K. S. and Wong, C. (1999). Multidimensional constructs in structural equation analysis: An illustration using the job perception and job satisfaction constructs. *Journal of Management*, 25, 2, 143 – 153.
11. Mustonen, M. (2003). Copyleft – The Economics of Linux and other open Source Software. *Information Economics and Policy*, 15, 1, 99-121.
12. Raymond, E. S. (1998). The Cathedral and the Bazaar. Open Source White Paper. Source: <http://www.fsf.org> (11/17/1998).
13. Ryan, R. and Deci, E. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology*, 25, 54-67.
14. Sawyer, S. (2000). A Social Analysis of Software Development Teams: Three Models and their Differences, *Americas Conference on Information Systems, Conference Proceedings*, Long Beach, California, 1645-1649.
15. Van de Ven, A., Delbecq, A. and Koenig, R. (1976). Determinants of coordination modes within organizations. *American Sociological Review*, 41, 2, 322-338.
16. Wall, T, Kemp, N., Jackson, P. and Clegg, C. (1986). Outcomes of autonomous workgroups: A long-term field experiment. *Academy of Management Journal*, 29, 2, 280-304.
17. Weiss, D., Dawis, R., England, G. and Lofquist, H. (1967). Manual for the Minnesota Satisfaction Questionnaire: Minnesota Studies in Vocational Rehabilitation. Minneapolis: Industrial Relations Center, University of Minnesota.
18. Wellman, B., Salaff, J., Dimitrova, D., Garton, L., Guila, M. and Haythornthwaite, C. (1996). Computer Networks as Social Networks: Collaborative Work, Telework, and Virtual Community. *Annual Review of Sociology*, 22, 213-238.
19. Wong, C., Hui, C. and Law, K. (1998). A longitudinal study of the job perception-job satisfaction relationship: A test of the three alternative specifications. *Journal of Occupational and Organizational Psychology*, 71, 127-146.
20. Ye, Y. and Kishida, K. (2003). Toward an understanding of the motivation of Open Source Software developers. *Proceedings of the 25th International Conference on Software Engineering*.