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LEADERSHIP BEHAVIOR IN VIRTUAL COMMUNITIES

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Abstract

The success of open source software like Apache or Linux not only attracts practitioners of IS to look more thoroughly on the development processes of these communities but also attracts researchers to take a closer look on how these communities work. At first glance open source software development is seemingly chaotic and anarchistic (Kuwabara, 2000). However, successful open source software communities like Apache or Linux do have strong leadership, management, and governance structures (apache.org, 2003; Bretthauer, 2002; Fielding, 1999). In these communities single individuals or a group of participants exercise leadership functions and are in charge of the project direction and survival. Currently, a strong focus of the open source software (OSS) literature is especially on the motivation of participants who spend a lot of time and effort without getting a direct monetary compensation. So far, only little is known about how these communities are organized, managed, and governed. This paper will concentrate on successful practices of effective leadership in OSS communities as an example of virtual communities. Specifically, we will look how leadership behaviors influence project performance. A conceptual model of how leadership behaviors influences project performance considering several contingencies will be developed, presented and propositions as well as testable hypotheses will be derived.

Keywords: Virtual Communities, Leadership, Open Source Movement, Open Source Software Communities

Introduction

The success of open source software like Apache or Linux not only attracts practitioners of IS to look more thoroughly on the development process of these communities but also attracts researchers to take a closer look on how these communities work. OSS communities are excellent examples of virtual communities. A virtual community is a community of people who have common interests and share them over the Internet or other network technology. In open source software communities geographically dispersed developers are working together to develop free software¹ (Cook, 2001; Feller & Fitzgerald, 2000). A strong focus of the current OSS literature is in particular on the motivation of the participants who usually spend a lot of time and effort without getting a direct monetary compensation (Bonaccorsia & Rossia, 2003; Butler, Sproul, Kiesler, & Kraut, 2002; Markus, Manville, & Agres, 2000). However, this is only one perspective on why and how these virtual

¹ The term “Free Software” does not mean that the software does not cost money but that it may be copied, modified, and distributed. This right is protected by different license models that fall under the Open Source Definition (see Open Source Initiative (www.opensource.org)).

communities work. Another salient question is how these communities are organized, managed, and directed. This paper will concentrate on successful practices of effective leadership in OSS communities as an example of virtual communities. Specifically, we will look how leadership behaviors influence project performance.

The paper is composed as follows. First, we discuss the importance of research in leadership within the OSS community. Second, the model and testable hypotheses for effective leadership behaviors in OSS communities will be developed. Finally, we present a methodology for a survey to test our hypotheses.

The Importance of Leadership in OSS communities

At first glance open source software development is seemingly chaotic and anarchistic (Kuwabara, 2000). The communities are considered to be self-organizing entities that develop around the software development process (Stewart and Gosain, 2001). Volunteers worldwide can make contributions to the software code. However, projects plans or explicit software design usually do not exist. Developer can chose what, how, and for how long they want to contribute. "Keeping a team of developer, support staff, moderators, etc. organized and working toward a common goal is probably our biggest challenge." (James Atkinson, formal leader of the project phpBB (<http://sourceforge.net/potm/potm-2004-01.php>))

Looking at successful open source communities like Apache or Linux, it is apparent that they have strong leadership, management, and governance structures (apache.org, 2003; Bretthauer, 2002; Fielding, 1999). In traditional organizations, executives, and managers are providing direction, mission, and vision to shape the organization. In open source communities single individuals or a group of participants exercise leadership functions and are in charge of the project direction and survival. Especially the virtual character of OSS communities makes strong leading, managing, and organizing practices necessary in order to avoid loosing direction. This is not only true for large and complex communities like Linux and Apache but also for smaller projects like those registered on SourceForge (www.sourceforge.com). SourceForge is the largest online repositories of OSS projects with more than 70,000 projects.

Each of projects on SourceForge has an appointed project leader and usually a core of main developers. Typically, the leader is also the founder of the project. He or she often started the project in need of a customized or new application. The project leader decides the direction of the software, oversees the daily work, and coordinates communication among the developers. Over time the project may attract new developers and contributors. Individuals who want to participate on a regular basis can become part of the official development team. As a project grows in size the community structure also evolves and can become more and more formalized. Apache for example has defined different roles such as developers, committers, and officers with different task assigned to them (apache.org, 2003). The project management committee for example is responsible for the direction of one single project. The committee again is supervised by the Board of Directors that is responsible for the management of the Apache Software Foundation.

The importance of leadership in OSS communities is also attested in the current literature (Fielding, 1999; Raymond, 1998a) but only little rigorous academic research has been conducted (Feller & Fitzgerald, 2000). The current OSS literature mostly concentrates on influential leaders like Linus Torvald, looks on the role of the project leader and administrator, or describes leadership in terms of decision-making authority. However, leadership can be studied from a variety of perspectives including leader traits, behaviors, influence and power processes, contingencies, or multiple level of analysis. Thus, there are significant gaps in the scholarly study of leadership within the OSS community and only little is known about how general leadership practices are adopted to OSS communities. This paper examines how leadership behaviors influence project performance considering several OSS specific contingencies.

Theoretical Foundations

Leadership in Open Source Software Communities

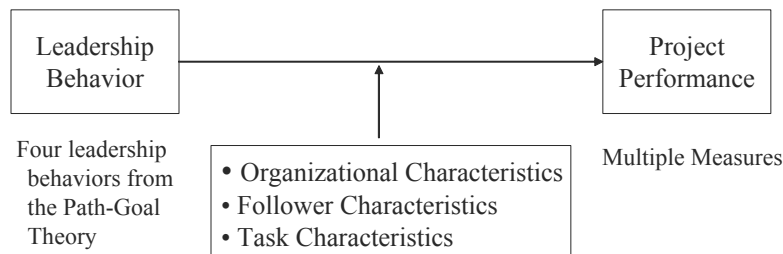
Leadership is still a controversially discussed concept with as many definitions as authors and with overlapping borders to management (Stogdill, 1974; Yukl, 2002). Current OSS literature mostly concentrates on influential leaders like Linus Torvald (Raymond, 1998a), looks on the role of the project leader and administrator (Butler et al., 2002; Gallivan, 2001), or describes leadership in terms of decision-making authority (apache.org, 2003; Fielding, 1999). General leadership studies have considered leader traits, skills, behaviors, power, and contingencies. In addition, these studies cover different levels of analysis and focus not only on the leader but also on followers or the relationship between follower and leader (Yukl, 2002). Definitions depend on the objective of the study; however, they all encompass influence processes to direct a group of people

towards an objective (Yukl, 2002). This very broad definition of leadership overlaps to an extent with management. Following Kotter this study will distinguish between management and leadership in that management deals with the complexity of the work in an organization with the objective to “produce a degree of predictability and order” (Kotter, 1990a, 1990b) while leadership focuses on a longer time frame, on strategy and on change. Leadership is the direction-setting, and management the implementation of leadership (Kotter, 1990a). Kotter defines three sub-processes of leadership (1) establishing direction by developing a vision and a strategy to realize the necessary changes, (2) aligning people by communicating the direction, and (3) motivating and inspiring people to align them to objectives by appealing to their norms, values, and beliefs. This general definition of the term leadership can be used to examine leadership in OSS communities. The distinct characteristics of OSS communities will challenge traditional leadership practices and may change how effective leadership is exercised but does not necessarily change the leadership definition. This paper defines leadership as the inspiring and influencing act in order to direct, align, and motivate people towards a common goal.

Developing the Conceptual Model – Effective Leadership in OSS projects

Different perspectives and approaches to leadership in organizations exist. Each of these approaches provides an important component to the study of leadership. The main approaches are (1) the trait approach – studying the traits and skills of leaders, (2) behavior approach – examining the leader behaviors, (3) power & influence – evaluating power and influence tactics of leaders, and (4) situational approach – considering the impacts of contingencies (Yukl, 2002). The article will concentrate on aspects of the second and fourth approach. The basic tenet of the research is that effective leadership behaviors in an OSS project will depend on specific contingencies which are identified below. Figure 1 presents the conceptual model for the study. The following section will give a short overview of the theoretical bases of the concepts that will be used in the research model.

Figure 1: The Conceptual Model



Proposition: Leadership behaviors will have an impact on project performance. This relationship will be moderated by organizational, follower, and task characteristics.

Leadership Behaviors

The study will examine four leadership behaviors as defined in the Path-Goal-Theory (R.J. House & Mitchell, 1974): (1) Participative leadership – the leader encourages participation, consults with the followers, and considers their suggestions and opinions, (2) directive leadership – the leader provides structure, sets objectives, expectations, and schedules, (3) supportive leadership – the leader supports subordinates’ satisfaction, acts in a friendly and supportive manner, and is concern about the followers needs, and (4) achievement-oriented leadership – the leader encourages excellent performance, sets challenging goals and expects a high performance from the followers.

House extended the Path-Goal-Theory by 6 further leadership behaviors: work facilitation, interaction facilitation, group oriented decision process, representation and networking, values based leader behavior, and shared leadership (Robert J. House, 1996). While some of the new behaviors such as shared leadership behavior seem to be different to the previous four leadership behaviors others such as work facilitation seem to overlap and thus, may not lead to a parsimonious model. We

will examine in our study the present leadership behavior in order to judge whether these 6 leadership behaviors should extend our model.

Leadership Outcome

The dependent variable of the conceptual model is project performance. Leadership behaviors that enhance project performance are considered to be more effective than practices that lead to lower project performance. Project performance is difficult to measure and no single measure can fulfill this task sufficiently. Thus, multiple measures will be included i.e. market share, number of users, lines of code, number of people staying/leaving, meeting objectives (if any set), and community attitude (motivation, climate).

Contingencies

Contingencies theories take diverse situational variables into account that have an influence on the effectiveness of leadership practices. According to the leadership substitute theory, developed by Kerr and Jermier (1978), situational variables can not only mediate the effect of leadership practices but also act as substitutes for them. Substitutes will make the leader behavior redundant and therefore ineffective (Kerr & Jermier, 1978). Three classes of variables emerged as significant leadership contingencies: task characteristics, follower characteristics, and environmental characteristics (e.g., organizational context) (Kerr & Jermier, 1978; Yukl, 2002). These situational variables may influence the relationship between leadership behavior and the outcome of the leadership behaviors. Based on these three classes of contingencies, six situational variables of interest in the context of OSS communities are identified: (a) three organizational characteristics (license model, virtual work, culture), (b) one task characteristic (task interdependency), and (c) two member characteristics (motivation, hacker-mentality). Variations in all variables are expected across different OSS projects. Below these six situational contingencies are explained. The following section describes how these six situational contingencies moderate the relationship between leader behavior and project performance.

Organizational Characteristics: Open source software can be licensed under different OSS license models. The common denominator however, is that the source code is free to copy, modify, and distribute without discrimination (Open Source Definition <http://www.opensource.org/>). These forms of licenses are also called copyleft to contrast them to copyright where the right to copy, modify, and distribute is owned by a commercial organization (Fink, 2003).

OSS communities can be considered as an excellent example for virtual communities. Since the ownership of code belongs to the community instead to a particular organization, everyone without discrimination can use it (www.opensource.org). Thus, OSS projects typically consist of people that are not geographically bound to one organization or location. The software development process is consequently geographically distributed and communication as well as collaboration is rather media based than face-to-face (Cook, 2001; Fielding, 1999; Zigurs, 2003). Another consequence is, that the OSS projects are not limited to a hired set of developers but have access to an unlimited source of potential developers. In addition, membership is usually not bound to a contract and developers can leave or join the community on a temporary basis (Markus et al., 2000). Technology is the enabler and basis of the worldwide collaboration and can be seen as one dimension of virtuality. It might mediate or even substitute some functions of leadership (Zigurs, 2003).

The OSS culture can be described according to Schein (Schein, 1984) on the three levels of artifacts, values, and basic assumptions. Although cultures can differ slightly between sub-communities of the overall OSS community common characteristics can be found (Raymond, 1998b). The important artifacts for OSS communities are the collaboration over Internet Technology, copyleft, and the multicultural community (Sharma, Sugumaran, & Rajagopalan, 2002). Basic OSS values include peer recognition (developer is identified as “hacker” by other developers), reputation based on contributions, free code & information, code competition, and shared ownership (Feller & Fitzgerald, 2000; Sharma et al., 2002). Trust, loyalty, and shared norms (such as giving credit to work) can be considered to belong to the basic assumptions of the OSS community (Feller & Fitzgerald, 2000; Sharma et al., 2002).

Follower Characteristics: The OSS participants are usually experts and professional developers, “hackers” identified by other developers (peer recognition), and highly motivated (Feller & Fitzgerald, 2000; Hars & Ou, 2002; Markus et al., 2000; Sharma et al., 2002). Their values greatly influenced the OSS culture described above.

The question why people are participating in OSS communities although they receive typically no direct monetary rewards have interested researcher since the beginning of the OSS movement (Hars & Ou, 2002; Hertel, Niedner, & Herrmann, 2003; Lakhani & Wolf, 2003; Raymond, 1998a). Benkler distinguishes between three categories for motivation – extrinsic rewards (i.e. monetary, expand own knowledge by programming of new and complex software), intrinsic rewards (i.e. task pleasure,

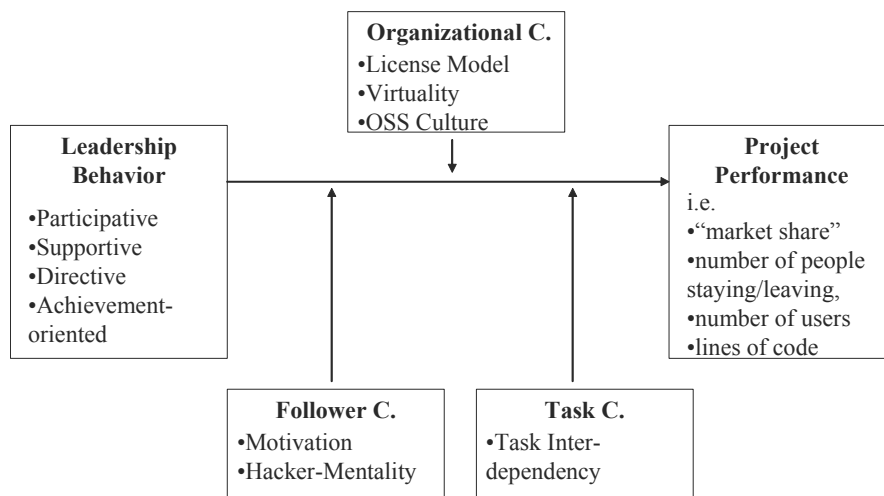
personal enjoyment), and social-psychological rewards (Benkler, 2002). Which of these factors are more relevant than another depends on the individual. Indeed, the study of Hars and Ou (2002) showed that paid OSS developers were more motivated by monetary rewards than non-paid programmers.

Task Characteristics: As mentioned earlier, a large OSS project can have different sub-projects. A challenge for better coordination arises when the OSS project is highly modularized and the different modules or sub-projects respectively are highly interdependent (Bonaccorsia & Rossia, 2003). Thus, low or high interdependence of sub-projects may have different implications for leadership.

Effective Leadership Behavior in OSS communities

The next figure gives a short overview how the situational variables may affect the effectiveness of leadership behaviors. Below some (but not all) of these relationships are discussed.

Figure 2: Impact of Organizational, Follower, and Task Characteristics on the success of Leadership Behaviors



Hypothesis 1: The effect of achievement-oriented LS behavior on project performance is moderated by license model and hacker-mentality as such that no higher project performance is expected.

Hypothesis 2: The effect of supportive LS behavior on project performance is moderated by hacker-mentality as such that no higher project performance is expected.

The license for open source software guarantees the freedom to copy, modify, and distribute the source code of the software. However, the authority to change the official source code of the software lies typically in one hand. An individual – typically the founder or a subsequent maintainer– or a group of developer decides what code comes into the official source code and what code not (Gallivan, 2001). Among different solutions the source code with the best quality will be chosen. Only a high quality source code will therefore survive the competition (Cook, 2001). It can be argued that this makes an achievement-oriented leadership style unnecessary because the underlying license model supports a competitive selection process among the best code solutions. The assumption of this hypothesis is that contributions to the code from non-official members have the same chance of becoming part of the source code as those from official members. In OSS communities code sharing, improving one’s own skills, and striving to solve software problems are highly valued norms (Lakhani & Wolf, 2003; Sharma et al., 2002). Typically, developers in an OSS project are experts and highly motivated to code the best solution possible, to advance their own skills (Feller & Fitzgerald, 2000; Hars & Ou, 2002), and, thus, do not need explicit support from an appointed leader. A supportive leadership style can thus be considered as ineffective.

Hypothesis 3: The effect of participative LS behavior on project performance is moderated by follower motivation as such that higher project performance results in cases of intrinsic and social-psychological motivation.

Hypothesis 4: The effect of directive LS behavior on project performance is moderated by follower motivation as such that lower project performance results in cases of intrinsic and social-psychological motivation.

OSS participants may have different motivations to participate in an OSS project. For participants who are motivated by social-psychological factors like recognition by others or forming close relationships to others it might be more important than for extrinsically motivated members to engage in the community and influence important decisions and directions. A participate leadership may therefore lead to higher performance whereas a directive leadership can have a negative effect on project performance. A participation in the decision and direction setting processes is also probably more important for participants who are intrinsically motivated and engage because of personal enjoyment or task pleasure. They may want to choose the module they enjoy most, that are challenging, or best suit their skills most (Lerner & Tirole, 2000; Sharma et al., 2002). A directive leadership style could limit their choice and may decrease their commitment and therefore decrease project performance.

The underlying rationale is that commitment of the individual project member is influenced by leadership practices. A high commitment means that the member is highly motivated to accomplish the work and tends to put even extra effort in the work (Yukl, 2002). A high commitment therefore positively affects performance. Since OSS communities rely typically on voluntary work and participants that are highly-motivated (Bonaccorsia & Rossia, 2003; Feller & Fitzgerald, 2000), active participant can be considered as committed to the community. If a participant does not agree with the leadership style of the appointed leader and the dispute continues and does not resolve, the commitment will probably decrease until the participant does not see a need to stay in the community any more and leaves.

The last section describes the methodology for a survey to test our hypotheses.

Methodology

The study will have three main steps. First, we will examine the scope of leadership behaviors. Second, the survey will be constructed and pre-tested. Finally, the survey will be conducted with a web-based questionnaire and with a randomly selected sample from the SourceForge repository.

Interviews: Before conducting the survey an investigation of the scope of leadership behaviors in OSS projects will be undertaken. The objective is to create a categorization or typology of present leadership behaviors in OSS projects. Primarily, we will conduct interviews with leaders from the Open Source movement. In addition, we will analyze and classify the guidelines, discussion boards, and communication patterns between the formal leader and the active participants of randomly selected projects in SourceForge.

Survey: The questionnaire will consist of items in four different categories. First, the questionnaire will contain items to measure the four leadership behaviors (or more if indicated through the qualitative analysis). There is discussion about the items to use for measuring the leadership behaviors (Robert J. House, 1996; Villa, Howell, Dorfman, & Daniel, 2003). Therefore the previously used items (i.e. Ohio State Leader Behavior Description Questionnaire (LBDQ)) have to be thoroughly evaluated if they mirror our described constructs. We will therefore evaluate the items and if necessary add or modify them. Second, the moderating variables are measured. Our 4 hypotheses only incorporate the motivations of the followers. Measurements from previous studies will be used (Hars & Ou, 2002; Hertel et al., 2003; Lakhani & Wolf, 2003) and adapted if necessary. The organizational, task, and project characteristics will be measured as control variables along with some other control variables like follower characteristics, age, nationality, and professional status. The third category will measure project performance. A short evaluation of the key factors for project performance will be conducted based on selected interviews with OSS project leaders from SourceForge projects. The project performance measures could include such items as market share, number of users, lines of code, number of people staying/leaving, meeting objectives (if any set), and community attitude (motivation, climate). In the last part of the questionnaire the respondent has the opportunity to add further comments.

The questionnaire will be tested in a pre-test with selected projects from SourceForge. The survey and research question can be explained in an announcement i.e. a separate web page and we hope to get feedback and further ideas about how to modify the instruments.

Sample: The unit of analysis is an OSS project. A single project has the objective to develop a single piece of software. In contrast, the OSS community is the collectivity of individuals who work on OSS projects (Fink, 2003). The sample will be

selected randomly from SourceForge which has more than 70,000 projects listed from small to large, from successful to unsuccessful projects. Although SourceForge has a broad repertoire of OSS projects it does not reflect the full scope of OSS projects. OSS projects that do limit membership of participation for example are not registered in SourceForge. However, the available range of OSS projects seems to fulfill the requirements for the characteristics of our model and this limitation is therefore considered to be less significant for the results of the study. A web-based questionnaire will be developed and sent to the formal appointed leader and the official developers of the selected OSS projects.

Conclusion

A research model for examining leadership behavior in OSS projects using a contingency approach has been developed, along with testable hypotheses. The study will contribute to the study of leadership and the study of virtual communities. It will give further insight into how these communities are directed and will identify effective leadership practices and patterns in OSS projects. It will help leaders of OSS projects to understand and reflect upon the impact of their leadership behavior on the performance of their project and may help them to act more effectively.

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