Leadership in a Non-Traditional Setting: Self-Managing Virtual IS Development Teams

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LEADERSHIP IN A NON-TRADITIONAL SETTING: SELF-MANAGING VIRTUAL IS DEVELOPMENT TEAMS

Research-in-Progress

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Abstract

Despite its abundance, traditional leadership research cannot be claimed to transfer directly to the leadership context of self-managing virtual (SMV) Information Systems Development teams. Unique conditions of these novel team environments require focused studies of leadership in virtual team settings. Although there are some studies of virtual team leadership that make important contributions to the literature, these studies typically use short term, ad-hoc teams of students. This study ultimately aims at filling the gap in the literature by investigating how leadership manifests in real-life SMV IS teams over time. In this paper, the overall study is introduced and the initial findings based on the content analysis schema development effort are reported.

Keywords: Leadership, self-managing teams, virtual teams, IS development, content analysis
Introduction

This paper investigates how team members’ leadership shapes information systems (IS) development in self-managing virtual (SMV) teams, a novel and increasingly ubiquitous form of organization. In this study, leadership behaviors that contribute to both social relations and the development tasks are investigated. This section provides the justification for the study of leadership in SMV IS development teams, introduces the research questions and the context for the study.

With increased globalization and competition, companies increasingly depend on virtual teams for software development. Often times these team members make their own decisions about how they will collaborate for software development, and thus can be categorized as self-managing virtual teams. Self-managing teams are those with a high degree of decision-making autonomy and behavioral control at the work-group level... (where) a much greater emphasis is placed on control from within the group (e.g., Manz et al. 1980). Furthermore, in an effort to become more innovative and competitive in the global markets, companies started using open source software development strategies. They do so either by open sourcing their existing software, by collaborating with existing Open Source Software (OSS) development teams, or initiating new OSS projects. OSS is a software whose source code is available under an open source software license that permits others to view, change and redistribute it. OSS developers studied here are SMV teams of (mostly) volunteers, who communicate and coordinate their work using information and communication technologies.

Although SMV IS development teams enable companies to take advantage of experts who might be distributed around the world. Yet, they are difficult to lead and manage due to challenges such as incongruent temporal rhythms (Hinds et al. 2003), cultural and organizational differences, lack of non-verbal cues (Sproull and Kiesler, 1986), time zone differences (Maznevski et al. 2000), time delays in receiving feedback (Yoo et al. 2004), language barriers, differences in understanding and lack of shared frame of reference (Cramton, 2001). Organizational behavior and small group researchers suggest that leadership is one of the most important variables that contribute to the development of effective teams (Kozlowski, Gully, McHugh, Salas, & Cannon-Bowers, 1996). Kayworth and Leidner’s (2001) review of existing studies of virtual teams suggests that team leadership is also vital for virtual teams. Given the increasing ubiquity of SMV IS development teams, it is crucial to understand how leadership manifests in these teams, and how leaders contribute to software development.

Despite its abundance, traditional leadership research cannot be claimed to transfer directly to the leadership context of self-managing virtual (SMV) teams (Carte et al. 2006; Hooijberg et al. 1997). Yoo and Alavi (2004) suggest that unique conditions of these novel team environments require focused studies of leadership in virtual team settings. Although there are some studies of virtual team leadership that make important contributions to literature (see Misiolek 2006), these studies typically use short term, ad-hoc teams (Misiolek 2006) made up of students (Powell et al. 2004). The use of short-term, ad-hoc student teams limits the understanding of long-term team leadership dynamics within real virtual teams and perhaps causes a rather static view of leadership to prevail. The ultimate goal of this research is to fill this literature gap and answer the following research questions: (1) How does the leadership of the leaders and other team members contribute to software development and social relations in SMV IS development teams? (2) How do leadership behaviors in SMV IS development teams evolve over time? and (3) Which leadership behaviors contribute to leadership perceptions in SMV IS development teams?

To answer these questions, longitudinal case studies of two OSS teams (Apache Lucene Java and Apache Directory) will be conducted. While the third research question deals with the perceptions of the individuals, the first two research questions deal with the actual behaviors that are observed in the team. The perceptions of the team members will be captured using interviews, and the individuals’ behaviors will be captured by analyzing the archival data related to communication, work, and coordination. In order to analyze the archival data, first, a content analysis schema is developed. Coding schema development required building on the existing literature to capture the leadership behaviors that apply to the SMV setting. At the same time it was also necessary to ground the study in the data in order to identify the leadership behaviors that may be unique to SMV settings. Thus, independent inductive analyses of sample archival data and exploratory interviews are conducted. The findings are then organized within the framework provided by the literature. This paper describes the initial observations that result from the data analysis that is conducted as part of the content analysis schema development effort. These observations are relevant to first and third research questions. This paper describes the overall study and specifically reports on the initial findings based on the two analysis. The behaviors that result from two analysis will then be combined into a single coding schema and its reliability will be established before using the schema to analyze two case studies.
Literature Review

Recent studies show evidence that leadership in virtual teams can be emergent in nature (e.g., Carte et al. 2006; Crowston et al. 2007a; Misiolek et al. 2005; Tyran et al. 2003; Yoo et al. 2004). Similarly, virtual teams may also exhibit shared leadership (Balthazard et al. 2004; Fielding 1999). For this study of SMV teams, it is most appropriate to use the behavioral leadership approach, since the archival data shows most of the communication, coordination and work behaviors exhibited and observed by team members. The remainder of the literature review section will summarize the behavioral leadership studies. Due to space limitations, for a more comprehensive review of different leadership approaches and theories, please refer to Northouse (2003).

Behavioral leadership studies emerged out of three groups of researchers: Bales and his associates at Harvard, the Ohio State Leadership Center (in the late 1940s), and the Institute for Social Research at the University of Michigan (Bass 1990; House et al. 1997). Most recently, Yukl and colleagues distinguished between task- and relationship-oriented behaviors in his book on leadership in organizations and provided the following definitions (Yukl 2002): Task-oriented behaviors are those that move the team forward in the accomplishment of its task, such as planning and scheduling work, and coordinating subordinate activities (Yukl et al. 2002). Relationship-oriented behaviors are those that allow the team to maintain a positive social environment—for example by showing trust and confidence, acting friendly and considerate, keeping subordinates informed, and providing recognition for subordinates’ accomplishments” (Yukl et al. 2002). The four types of leadership behaviors below are identified based on Crowston, Heckman and Misiolek’s (2007a) categorization of the leadership behaviors in the behavioral leadership literature. According to this, leaders can help advance the group’s work by either making substantial work-related or by coordinating the work of others. Leaders also contribute to the team environment by helping maintain the group together (group maintenance) and connecting the team to the outside (boundary spanning).

Task-Oriented Leadership Behavior: Substantive Task Contribution

Since the earliest leadership literature typically focused on analyzing managers’ leadership, substantive task contribution (i.e., actual work behavior) was not a consideration. However, in self-managing teams, there is no formally established managerial person (or role) tasked solely with team oversight and task coordination. Instead, everybody is expected to contribute to the work. Misiolek and Heckman (2005) call these kind of task-oriented leader behaviors substantive behaviors based on their study of virtual self-managing student teams. Based on interviews with Free/Libre Open Source Software development team members Scozzi, Crowston, Eseryel and Li (2008) suggested that leadership seems to be correlated with sustained contribution in these teams.

Task-Oriented Leadership Behavior: Task Coordination

Yoo and Alavi (2004) concluded that emergent virtual team leaders sent more task-oriented email messages, particularly ones related to coordination. Task coordination is also identified as a leadership behavior in other SMV’s such as free/libre open source software development teams (Crowston et al. 2007a; Crowston et al. 2007b). The task coordination leadership behaviors include: planning (Yukl et al. 2002) and organizing work (Stogdill 1974), determining goals (Stogdill 1974), providing necessary tools, technical infrastructure and technical assistance (Yukl et al. 2002), integrating the teams’ contributions (Morse et al. 1978; Yoo et al. 2004), task assignment (Crowston et al. 2007c; Morse et al. 1978; Yukl et al. 2002) and defining timeline (Kayworth et al. 2000; Stogdill 1974).

Relationship-Oriented Leadership Behavior: Group Maintenance

Group maintenance behaviors keep interpersonal relations pleasant, resolve disputes, provide encouragement, stimulate self-direction and increase interdependence among members (Cartwright et al. 1960). Based on the literature review, the leaders’ group maintenance behaviors include; encouraging contribution (Bales 1950; Scialdone et al. 2007; Yukl et al. 2002), showing trust and confidence (Yukl et al. 2002), acting friendly, considerate and kind (Cartwright et al. 1960; Kayworth et al. 2001; Scialdone et al. 2007; Yukl et al. 2002), helping to develop others / act as mentors (Kayworth et al. 2001; Yukl et al. 2002), keeping others informed (Yukl et al. 2002),
resolving conflicts/releasing tension (Bales 1950; Bass 1990; Cartwright et al. 1960; Morse et al. 1978) and give or ask for opinion (Bales 1950; Cartwright et al. 1960).

**Relationship-Oriented Leadership Behavior: Boundary Spanning**

The relationship-oriented functions of leaders are not limited only to relationships within the team. Ancona and Caldwell (1988) observed that there are leadership functions of maintaining relations with individuals and groups outside the team, called boundary-spanning. Boundary (spanning) roles can be defined as links between the teams and their environment (Aldrich et al. 1977). Druskat and Wheeler (2003) found that the effective external leaders of self-managing teams acted as an interface between the team and its organizational environment (in Yoo et al. 2004).

**Research Methods**

This research employs a comparative, longitudinal multi-method case study of two Apache OSS teams. The case studies will provide rich descriptions of the team members’ and identified leaders’ leadership at two points in time. In this section, case site selection, data sampling and analysis will be described for the ultimate study and for the initial study conducted for content analysis development purposes.

**Case Site Selection**

The ultimate study involves a case study of two Apache SMV IS development teams. The access to case sites were possible through existing long-term connections with key ASF members. Apache OSS teams are self-managing virtual teams that exhibit both shared (Fielding 1999) and emergent leadership (Heckman et al. 2006). Apache OSS teams are formed under an umbrella organization called Apache Software Foundation (ASF), which legally protects the OSS team members. ASF does not manage or control any of the teams, instead provides norms and best practices. Apache OSS teams are interesting contexts for investigation because they are similar to the SMV teams that are formed within companies and other organizations: They have an umbrella organization, team rules, roles and norms inherited from this organization. These similarities may allow opportunities to generalize this research’s findings to other organizational SMV contexts. As in many companies, although rules, roles and norms influence how Apache OSS teams function, they don’t eliminate the self-managing team structure, because each team still determines how it functions.

As mentioned earlier, Apache teams exhibit shared leadership, yet all shared leadership teams are not the same. Team leadership distribution in shared leadership teams can be conceptualized as a continuum ranging from ‘relatively centralized leadership’, where the majority of the leadership behaviors are exhibited by a small number of leaders, to ‘relatively decentralized leadership’, where the leadership is equally shared by all team members. Thus, understanding leadership in SMV IS development teams requires investigating teams that are close to different ends of this continuum. Thus, for this study, Directory team (relatively centralized shared leadership) and Lucene Java team (decentralized shared leadership) are identified based on preliminary interviews with ASF members.

For the development of the content analysis schema that can be applied more generally, I conducted an initial (exploratory) study with key ASF leaders, who have experience with several OSS teams. I used a snowballing approach to identify these leaders at an Apache Conference. These key informants acted as leaders in some teams, and also observed and mentored various teams, where other individuals provided leadership.

**Description of Data, Data Sampling and Analysis**

Multiple sources of data were used to obtain both theoretical and perceptual view of the team leadership. The researcher first conducted exploratory interviews with key informants from eight Apache OSS teams based on snowball sampling. Then, in order to observe leadership behaviors, various archival data on team members’ communication (developer’s email lists, and users’ email lists), task coordination (issue trackers), and contribution to software development work (software version control tools) are collected. Since the OSS teams interact mainly through the information and communication technologies, this archival data shows their exact behaviors as observed by the other team members. The researcher also conducted two rounds of semi-structured interviews with the key
informants from the Directory and Lucene Java teams in order to find out the perceived leaders and analyze the perceived leadership behaviors. Table 1 shows the data sources and how the data is used at different phases of research.

Sampling of the archival data is important in order to compare the interviewee perceptions with the findings from the archival data. Based on the exploratory interviews with key informants, the researcher identified that (1) individuals’ most recent contributions to the project, and (2) individuals’ contribution to significant events affect the leadership perceptions.

### Table 1. Research Phases

<table>
<thead>
<tr>
<th>Phase</th>
<th>Analysis</th>
<th>Data</th>
<th>Outputs</th>
<th>Phase Completed?</th>
</tr>
</thead>
</table>
| **Step 1 Data Reduction** | - Interview transcription  
- Collection and sorting of archival data  
- Import data into Atlas-Ti. | - Interview Data  
- Archival Data | - Data is ready to be analyzed with Atlas Ti. | Yes |
| **Phase 1 Develop Content Analysis Schema** | - Leadership literature review  
- Inductive coding of sample archival data  
- Inductive coding of exploratory interviews  
- Establishing content analysis reliability with sample data | - Leadership literature  
- Sample archival data  
- Exploratory interviews | - Content analysis schema | Yes |
| **Phase 2 Content Analyze Archival Data** | - Content analysis of all archival data | - Archival Data  
- Developers’ email lists  
- Users’ email lists  
- Issue trackers (JIRA)  
- Software version control tool (SVN) | - Leadership behavior counts of all team members are identified | No |
| **Phase 3 Identify & Profile Perceived Leaders and Team Leadership** | - Calculate perceived leadership index (PLI)  
- Within-case analyses  
- Cross-case analyses | Questions for Interviews  
- “Do you have one, more than one, or no leaders? Who are they?”  
- “Why do you think of them to have been a leader?”  
- “How do you define leadership?”  
- “Who contributes significantly to [4 leadership behavior categories]?” | - Perceived leaders are identified and their PLIs are calculated  
- Leader profiles  
- Team profiles  
- Discussion of interesting findings from within- and cross-case studies | No |
| **Step 2 Data Display and Analysis** | - Comparison of results from phases 2 & 3.  
- Appropriate tactics of conclusion drawing identified by Miles and Huberman (1994) | Triangulation with Team Members  
- Interview findings  
- Findings from archival data analysis  
- Conversation with team members. | - Potential conclusions are drawn.  
- Findings are confirmed / rejected  
- Potential discrepancies between actual behaviors and perceptions are explained. | No |

The leadership behaviors will be analyzed at two points in time that are at least six months apart from each other. Team interviews and archival data collection are repeated to reflect the team dynamics at two points. A total of 244 threads of communication and collaboration (1193 individual messages) were collected for Lucene and 304 threads.
(1015 individual messages) for Directory project using the following approach. For each of the two rounds of interviews, eighty threads were collected that precede the interview date in order to account for individuals’ recent contributions. These threads were divided equally among four different sources of data. By studying the archival data, the researcher determined that team members are disciplined about organizing their discussions within different archival data with “threads” that use the same subject line. Typically issues were resolved within the same thread with the same subject line. Thus, threads enable the researcher to understand the full context as experienced by the team members and evaluate and identify leadership behaviors. The researcher also identified threads on significant events for each time period by using issue trackers and team member inputs.

In all rounds of interviews, subjects were asked whether the team had one leader, more than one leader or no leaders. If they believed the team had leader(s), then they were asked to name them and to describe, for each identified leader, why the respondent thought of that person as a leader. Perceived leaders are identified by calculating Perceived Leadership Indices (PLI) for each of the two rounds of interviews following a procedure developed by Sarker, Grewal and Sarker (2002), and used by Heckman and Misiolek (2005). PLI is calculated by dividing the number of times an individual is identified as a leader by the number of interviews conducted. For each of the perceived leaders, the researcher will create a leader profile that includes comparative findings on leader’s behaviors versus perceptions of the leader, along with rich descriptions.

**Initial Findings**

In this section, I will report on the initial findings based on the archival data analysis and the analysis of the exploratory interviews done with key ASF leaders. Two coders independently inductively analyzed sample archival data based on leadership definition and then discussed each code until they reached full agreement. In both the interviews and archival data, the most frequently observed leadership behavior was substantive task contribution, followed by group maintenance behavior. The importance of boundary spanning behavior was evident from the interviews. Yet boundary spanning was not observable in archival data, since it happened outside of the team communication.

Tables 2 and 3 show the findings of both inductive interview and archival data analysis. These analyses are done separately and independent of each other. The archival data analysis shows that most frequently observed form of leadership in OSS is substantive task contribution. Individuals contribute to task by developing software (20%) and by making suggestions to other developers and users and explaining the reasons behind their suggestions. Second most often observed leadership behaviors are group maintenance behaviors of motivating others and also keeping a positive group environment by encouraging, and guiding others. Very interestingly, task coordination in the archival data involves very minimal task coordination and management of other team members. Instead, individuals take charge of their own contributions and communicate what they will be doing to the others to avoid effort duplication. Lastly very few instances of boundary spanning are observed, which is perhaps somewhat surprising.

The interviews also suggested that substantive task contribution is the most frequently identified behavior of the perceived leaders. Interestingly also behaviors such as doing procedural tasks, and documentation work also were as reasons for why respondents perceived a person as a leader. The interviewees also identified a number of leadership behaviors that can be categorized under group maintenance: For example, some people can be a role model for others by providing substantive task contribution, which, it is hoped, will cause the others to also contribute to the software development, rather than just providing ideas and expecting others to contribute the relevant code. Another interesting observation is how little task coordination is identified as reason for the leadership perception, which is quite opposite to the findings in traditional leadership literature.

Interview analysis resulted in an additional leadership behavior category called “strategy/vision”. This category includes behaviors related to creating and communicating a shared vision, and defining or changing the project direction in line with a vision. For example one interviewee suggested:

“You show that you have that vision, that idea, to demonstrate that it works through code and through discussion on the mailing lists. By this, one of these guys automatically becomes the leader because he demonstrates that he understands the technology.”

At the outset, not all findings from the exploratory interviews fit neatly into the categories of leadership behaviors. In addition to leadership behaviors, interviewees identified leadership traits and skills as reasons for leadership attribution. These are mainly: being trusted by the team, having tenure, and having skills, knowledge, and
experience related to the specific software that the team is developing. These categories are not added to the content analysis schema as they are, but rather included in the interview protocol.

<table>
<thead>
<tr>
<th>Table 2. Findings Based on Inductive Analysis of Archival Data</th>
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<tbody>
<tr>
<td>Indicator</td>
</tr>
<tr>
<td>Substantive Task Contribution</td>
</tr>
<tr>
<td>Reporting Work Done</td>
</tr>
<tr>
<td>Suggestions / Ideas</td>
</tr>
<tr>
<td>Explaining Reasons</td>
</tr>
<tr>
<td>Task Coordination</td>
</tr>
<tr>
<td>Reporting One’s Future Tasks</td>
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<tr>
<td>Involving Others</td>
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<tr>
<td>Group Maintenance</td>
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<tr>
<td>Apologies And Appreciation</td>
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<tr>
<td>Mentorship / Guidance</td>
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<tr>
<td>Boundary Spanning</td>
</tr>
<tr>
<td>Bringing New Team Members</td>
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<tr>
<td>Total</td>
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</tbody>
</table>

<table>
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<tr>
<th>Table 3. Findings Based on Inductive Analysis of Exploratory Interviews</th>
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<tbody>
<tr>
<td>Indicator</td>
</tr>
<tr>
<td>Substantive Task Contribution</td>
</tr>
<tr>
<td>Doing Organizational And Procedural Tasks And Duties</td>
</tr>
<tr>
<td>Doing Technical, Process Or Documentation Work.</td>
</tr>
<tr>
<td>Contributing To Decision-Making.</td>
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<tr>
<td>Task Coordination</td>
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<tr>
<td>Assigning Tasks To Other Members</td>
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<tr>
<td>Group Maintenance</td>
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<tr>
<td>Involving Others In Tasks</td>
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<tr>
<td>Involving Others By Stepping Down</td>
</tr>
<tr>
<td>Being A Role Model</td>
</tr>
<tr>
<td>Creating A Friendly Environment</td>
</tr>
<tr>
<td>Protect The Project (Socially Or Legally)</td>
</tr>
<tr>
<td>Training / Mentoring</td>
</tr>
<tr>
<td>Boundary Spanning</td>
</tr>
<tr>
<td>Representing The Project To Others</td>
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<tr>
<td>Bringing New Team Members</td>
</tr>
<tr>
<td>Other Leadership Factors</td>
</tr>
<tr>
<td>Vision (Create and communicate a vision. Define or change project direction in line with the vision)</td>
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<tr>
<td>Tenure (Working on the project for a long time), Skills, Knowledge, Experience</td>
</tr>
<tr>
<td>Gain trust and respect of others</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

The leadership principle that interviewees unanimously described was one that they called “meritocracy”, which means that individuals who contribute more to the teams work over time are expected to emerge as leaders. This finding supports the anecdotal evidence provided in (Raymond 1998) and also supports the importance of substantive task contribution for leadership.
Discussion

This study reports the findings based on exploratory interviews and pilot study with archival data. The identified leadership behavior categories and indicators will be merged with those from the literature to develop a content analysis schema to be used for the archival data analysis of the two case studies.

Among various leadership behaviors, substantive task contribution, specifically technical contribution to work seems like the most important determinant of leadership perception. This is indeed different than the emphasis by most traditional leadership on giving direction and coordination. It is difficult to tell whether this finding is due to the technical nature of the teams’ work, or whether this finding would apply to all SMV teams, but this area is definitely worth studying more. Another interesting finding, that confirms our previous work (Crowston et al. 2005) is that both leaders and members focus their task coordination efforts on communicating their own work. This, I expect is due to the self-managing and voluntary nature of these teams. In other words, no one formally has authority to ask another person to do something. Thus, individuals choose to contribute to task substantively and strive at influencing others by becoming a role model. The lack of formal authority, might also explain why group maintenance behaviors are so important to these teams. Individuals mentor and encourage others so that team members keep contributing to the team. Thus, treating each other kindly and building trust over time matter.

Another finding of this study is about the leadership approach that seems to be relevant to OSS teams. There are a number of leadership theories, which take a behavioral, skill-based or trait-based approach to leadership (if not a combination of these approaches). During the exploratory interviews, the interviewees mentioned a number of skills and traits, when answering the questions “Who are the leaders in your team? Why do you consider them to have been a leader?” Yet, when the interviewees were prompted to explain, they were able to clearly link traits and skills to behaviors that they observed in others as explained below.

Leadership trait of “Being visionary” is explained with the behaviors of “identifying vision, communicating vision, and showing others that his vision is viable by demonstrating it with code and with supporting documentation”. Similarly, the trait of “being trustworthy” was linked to gaining trust of others by showing the following behaviors; making well-intentioned and well-thought out comments in the developers’ email listservs, and/or making high-quality contributions to the software code. Similar to these examples of vision, and trust, the other factors identified, namely; knowledge, skills and experience, are the factors that are translated by the individuals into behaviors and observed by the team members. Team members observe that skilled and knowledgeable individuals are able to solve problems, and/or suggest alternatives by discussing these in email listservs, drafting solutions, or writing and submitting the software code. Thus, these interview findings show how trait-approaches to leadership are in fact behavioral in terms of how the leaders exhibit them and how followers perceive the leaders.

Contributions

The observations that are discussed here are used in order to analyze the data at two points in time, and understand how leadership changes over time. Do perceived leaders change? What do the team members do, that enables them to be perceived as a leader and followed by others? This study will highlight the dynamic nature of leadership by going beyond the emergent leadership literature, which typically focuses on how leaders emerge.

The ultimate study is expected to contribute to virtual team leadership literature by identifying which of the organizational team leadership literature applies to the SMV team settings. Moreover leadership behaviors that are unique to the SMV team settings may also be identified. In addition, the study is useful for practitioners, especially OSS developers, since it identifies specific behaviors that one might want to use, if they want to influence and lead these communities. The researcher expects the leadership behaviors to be relevant to other SMV teams, with tasks and settings that are similar to those of OSS teams.

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