Emergence of Leaders in Virtual Teams: What Matters?

Saonee Sarker
Washington State University, Pullman, WA 99164
E-mail: ssarker@wsu.edu
Rajdeep Grewal
Penn State University, University Park, PA 16802
E-mail: rug2@psu.edu
Suprateek Sarker
Washington State University, Pullman, WA 99164
E-mail: sarkers@wsu.edu

Abstract

Leadership is currently viewed as a key though relatively unexplored variable influencing the effectiveness of virtual teams. This paper identifies and empirically examines potential factors explaining the emergence of leaders in cross-cultural ISD virtual teams. Results of the study indicate that factors such as performance, culture, cultural ability, trust, ISD ability, communication ability, and co-location with client explain the emergence of leaders in the initial stages of a project, while performance, culture, and ISD ability explain the emergence of a leader in later stages. Interestingly, in both initial and later stages, technical ability of an individual was found to have a negative effect on leader emergence. Also, the extent of communication was found to have no effect in both stages, thereby falsifying the “babble hypothesis.”

1. Introduction

In recent times, virtual teams have become an increasingly attractive option for organizing work, especially in the arena of information systems development (ISD), where members no longer need to be physically co-present in order to communicate and collaborate [13]. Much of prior research on teamwork has focused on traditional face-to-face teams, thus, not much is known about virtual teams. Virtual teams and factors that lead to their effectiveness have remained for the most part, unexplored. While leadership has been identified as a key issue in traditional as well as other computer-mediated groups [3], it has not been adequately examined in the context of virtual teams. This paper seeks to fill this void in the literature by empirically examining the factors that lead to the emergence of a leader in a virtual team context. Specifically, the research question for the study reported in this paper is: What are the factors that lead to the emergence of leaders in virtual teams?

The rest of the paper is organized as follows: First, a brief discussion on virtual teams and leadership is provided. The next section presents the theory. This is followed by a description of the research methods. Finally, results, limitations, and contributions of the study are highlighted.

2. Background

2.1 Virtual teams

Virtual teams can be defined as a collection of geographically and/or organizationally dispersed coworkers who are assembled using a combination of telecommunications and information technologies to accomplish a specific task or project [22]. Given the availability of specialized skills around the world, the competitive pressures driving companies to seek skilled personnel at the lowest possible costs, and the increasing reach, range, and responsiveness of telecommunications, virtual teams are increasingly crossing national boundaries and drawing members from different cultures. This multinational nature of virtual teams presents a need

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1 All three authors contributed equally to the paper.
for examining virtual team leader emergence in a cross-cultural context as well.

2.2 Leadership

Leaders are defined as those individuals who direct the activities of a group toward a shared goal [9]. In other words, leaders are those individuals who perform certain actions that “help the group achieve its preferred outcomes” [4]. Most of the existing theories of leadership discuss the emergence of leaders and the factors leading to their emergence in a traditional face-to-face setting. It has been argued that in a virtual team environment traditional theories may not be directly applicable [17]. This study hence develops a new theoretical model surrounding the emergence of a leader by synthesizing diverse literature on leadership, computer-mediated communication, culture, and groups. In addition, since the study focuses on ISD, the literature on systems analysis and design has also been drawn upon.

3. Theoretical model

Our theoretical model proposes that emergence of leaders in virtual teams involved in ISD is dependent on the ability of the individual (in terms of the cultural ability, technical ability, communication ability, and ISD ability), the national culture to which the individual belongs, the extent of communication by the individual, the performance of the individual, the extent to which the individual is trusted by other members, and the location of the client for which the systems development project is being undertaken.

Previous research on virtual teams has examined the interaction processes in two different stages (initial phase and a later phase) [13]. In this study a similar approach is adopted. Moreover, it has been has argued that in different stages of a virtual team development, individuals with different sets of skills may become the leader [17]. Hence, in this study, a different combination of factors (discussed above) is hypothesized to be of relevance in explaining the emergence of a leader at two stages of the project. Before proceeding, it is also important to state that, consistent with the recent literature, emergence of a leader is examined based on the perceptions of other members of the team [23, 15]. Next, the formulation of the research hypotheses is presented:

**Culture and Leadership:** In an intercultural encounter, intercultural ability or competence is important for its success [10]. This intercultural cultural ability consists of the awareness that there are different cultures in the world, and that people of different cultures have different values, social systems, etc [10]. Further, cultural ability consists of some specific knowledge and skills regarding cultures, and is enhanced through experience in dealing with individuals from other cultures. Some individuals are generally more gifted than others in this respect [10]. Extending this concept to the virtual team context, it can be argued that some members may have higher intercultural competence than others when the virtual team is being initiated. In the initial stage of the virtual team, the group norms are being set and the team is being formed. One of the inhibitors of norm formation in a virtual team is the cultural barrier that exists between members [17]. Thus, members with a high cultural ability will be more successful in bridging the cultural barriers that may exist in a cross-cultural team, and hence move the team towards a positive direction. Since, moving the group towards its goal achievement and positive direction is one of the characteristics of a leader, it can be concluded that members a high level of cultural ability will emerge as the leader of a virtual team in the initial stages of the virtual team project (H1a). However, as the virtual team project or "production" continues, and the team transitions to later stages, where social structures have been solidified and members have developed a shared frame of reference, the focus on the task increases, causing social maintenance to become a background process [18]. Further, cultural ability can increase with practice and experience [10]. Hence, over time, cultural ability no longer remains a distinguishing feature among different team members. In other words, in the later stage of the virtual team, leader emergence will not depend on the cultural ability of the individuals (H1b).

**Hypothesis 1a:** In the initial stage of virtual team projects, individuals with high cultural ability will emerge as the leader of virtual teams.

**Hypothesis 1b:** In the later stage of virtual team projects, cultural ability of the individuals will not affect leader emergence.

In a cross-cultural virtual team, one of the primary factors that will affect the group dynamics and the emergence of the leader is the culture itself. Culture is defined as the "collective programming of the mind that distinguishes the members of one group or category of people from another", and is usually manifested in the values, behaviors, and actions of an individual [10]. Members of some cultures are more comfortable with an authority figure and a hierarchical structure than others, who may prefer more equality. The variable of power...
distance explains such a difference between cultures [10]. Cultures that have a higher power distance index believe that there should be a large proportion of supervisory personnel in work organizations, and are comfortable with autocratic leaders [10]. On the other hand, individuals who belong to lower power distance cultures prefer flat organizational pyramids, small proportion of supervisory personnel, and expect to be consulted than be told what to do. Thus, the traits and actions of what is traditionally viewed as “leadership” are not valued or emphasized in this culture. A study involving multiple cultures concluded that individuals from cultures with lower power distance index had less authoritarian attitudes than individuals from cultures with higher power distance index [10]. Hence, individuals from cultures with higher power distance will be more likely to take up leadership responsibilities and emerge as a leader. Moreover, culture is often seen as being similar to a personality trait [10]. This similarity with personality traits suggests that just like personality, culture too is a relatively constant attribute of an individual, and its influence on the individual in terms of the behaviors, values, etc. will not change over the lifetime of a project. Thus culture is expected to remain an important factor affecting leader emergence in a virtual team, irrespective of the stage of the team development, and individuals from cultures with higher power distance will emerge as the leader in both stages.

Hypothesis 2a: In the initial stage of virtual team projects, individuals from cultures with higher power distance will emerge as the leader.

Hypothesis 2b: In the later stage of virtual team projects, individuals from cultures with higher power distance will emerge as the leader.

Communication and Leadership: In small groups, the amount of communication initiated by an individual is an important determinant of leader emergence. There is compelling evidence in leadership research in support of the “babble Hypothesis,” which argues that people who “talk” (i.e. communicate) the most in a group emerge as the leader [23]. Scholars associated with the emergent approach to leadership also believe that communication is the most important determinant of leadership, especially in a context where there is no formally-assigned leader [15]. Researchers from the emergent perspective argue that what is important in the emergence of a leader is not the substantiveness of the communication, but merely the communication of “just more of the same thing” [15]. In a virtual team environment, this verbal proficiency may be enacted in the form of increased participation in chat sessions, and communication in the online bulletin boards, etc. Communication in a virtual team can be expected to be very important irrespective of whether the focus of the team is in maintaining social solidarity and establishing norms (as in the initial stages) or whether in communicating information relating specifically to the task (as in the later stages). Thus, it can be argued that extent of communication will remain an important factor affecting leader emergence in both stages of the team.

Hypothesis 3a: In the initial stage of virtual team projects, individuals who have a high extent of communication will emerge as the leader.

Hypothesis 3b: In the later stage of virtual team projects, individuals who have a high extent of communication will emerge as the leader.

Communication competence is an important factor in any communication-related interaction [12], and is defined as the “ability to demonstrate appropriate communication in a given context” [20]. Communication competence is reflected in two types of behaviors: altercentricism (demonstration of empathy, and ability to relate to others to develop mutual understanding) and interaction management [12]. In a cross-cultural virtual team environment, in the early stages when the team is being formed and norms are being set, the development of the mutual understanding is extremely important, since it helps in hurdling over the differences in frames of reference of the individual team members [18]. In such a situation, the individual who has the ability to demonstrate altercentricism and communicate a shared meaning to which all the other members can relate, will emerge as the leader [19]. Thus, in a virtual team, in the initial stages, the individual with high communication competence will emerge as the leader (H4a). However, as argued earlier, in the later stage of the virtual team project, norms and behavioral expectations are well established, and the focus of the team is primarily on “production” aspects. As a result, altercentrism and interaction management ability is likely to be less valued and hence will no longer be an important factor in the leader emergence (H4b).

Hypothesis 4a: In the initial stage of virtual team projects, individuals who have a high communication ability will emerge as the leader.

Hypothesis 4b: In the later stage of virtual team projects, communication ability will not affect the emergence of leaders.

Technical/ISD Ability and leadership: In the initial stages, when the focus of the team members is on building the team’s infrastructure [17], primarily in the form of mutual trust as well as norms of communication...
and collaboration [18], members with high technical ability will not be viewed to be of any particular value to the team. Thus, having more or less technical ability would not contribute to the individual emerging as the leader (H5a). In the later stage, when the team is engaged in technical activities and facing a lot of uncertainty due to technical unknowns associated with the project, the traditional power influence approach to leadership is applicable. Among the many different types of power identified by this approach, is expert power, which refers to the expertise and knowledge of an individual that receives significant regard and acknowledgement from others [8]. Expert power tends to cause a significant social influence on an individual’s cognitive structure [23]. In an informal group setting where there are no formally-assigned leaders, the individuals who have “the expertise that is highly valued by the group” will emerge as the leader [23]. In a virtual team involved in ISD (without a formally-assigned leader), the expert power regarding the technical aspects is very important, since the success or failure of the project depends on the success of the information system being built. Hence, an individual who possesses high technical ability will gain the confidence and recognition of his/her team members and will emerge as a leader.

Hypothesis 5a: In the initial stages of virtual team projects, technical ability will not have a significant effect on leader emergence.

Hypothesis 5b: In the later stages of virtual team projects, individuals possessing high technical ability will emerge as the leader.

For a virtual team involved in ISD, the knowledge of the ISD process will be extremely important. An information systems project not only requires the knowledge of the technology (the topic of hypotheses 5a and 5b), but also of the methods to be followed in the development and the "heuristics" (also referred to as project management practices) [14]. In the context of our study, these methods could be expected to contribute to the process of systems development that may include an understanding of the waterfall model, prototyping, data and process diagrams, managing client relationships, project management techniques, among others. It is argued that utilizing these skills and knowledge to guide and motivate the ISD group is central to the role of an individual being seen as the leader. Further, it can be argued that in a virtual team involved in ISD, the knowledge and competence in aspects of systems development will remain critical to the team from the initiation of the project to the final implementation. Hence, in a virtual team, an individual who has the requisite skills and ability regarding the ISD project should emerge as the leader of the team in the initial as well as the later stages of the project.

Hypothesis 6a: In the initial stage of virtual team projects, individuals who have the necessary ISD ability will emerge as the leader.

Hypothesis 6b: In the later stage of virtual team projects, individuals who have the necessary ISD ability will emerge as the leader.

Trust and Leadership: Trust has always been considered to be an important aspect of leadership. The behavioral approach to leadership suggests that the exhibition of consideration behavior and initiating structure by the leader manifests in the emergence of leaders.

Hypothesis 7a: In the initial stage of virtual team projects, individuals who are trusted the most will emerge as the leader.

Hypothesis 7b: In the later stage of virtual team projects, individuals who are trusted the most will emerge as the leader.

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Performance and Leadership: Performance can also be considered as an important prerequisite for leadership. Group members attribute credits to each other, which is usually based on the amount of positive regard in which
he or she is held [11]. Poor performance of an individual reduces these credits, while positive and high performance increases these credits [23]. They conclude that "only a member who reaches a certain threshold of credits attains a leadership role". Since virtual teams are usually gathered for a specific purpose, the focus of virtual teams is primarily on production or the task performance [17]. In such a context, performance of the individuals will remain the key factor in the team in all stages of the team development, even though performance in different area may be required in different stages.

Hypothesis 8a: In the initial stage of virtual team projects, individuals with a high level of performance will emerge as the leader.

Hypothesis 8b: In the later stage of virtual team projects, individuals with a high level of performance will emerge as the leader.

Gender and Leadership: Gender is also believed to make a difference in leader emergence. Females are believed to lack in motivation to "attain higher-level posts" or leadership roles due to factors such as lack of socialization, self-confidence, assertiveness, and self-esteem [2]. In mixed-gender groups, women were not consistently judged as the group leader, while men were usually judged as group leader [16]. In a virtual team with mixed-gender members, a similar phenomenon may be noticed. It is worth noting that even though several personal characteristics such as height and weight of a team member may not be readily available to virtual collaborators, gender information in a formal group setting is often readily available from the name, team-member profile, as well as from preliminary round of introductions (H9a). However, these differences in leadership due to gender may be transitory in nature [2]. Leadership behaviors of women may increase over time due to "their greater recognition and response to the need of others" [2]. Also, as the team focuses on "production," characteristics of remote team members that are not prominently visible (e.g., gender), become irrelevant to deciding who is the leader.

Hypothesis 9a: In the initial stage of virtual team projects, male individuals will more often emerge as the leader.

Hypothesis 9b: In the later stages of virtual team projects, gender will not have a significant effect on leader emergence.

Location of the Client and Leadership: Individuals who control the flow of information are most likely to emerge as the leader [2]. The suggestions of such individuals would also be accepted more frequently, and they would be seen as contributing more to the group than anyone else. Such individuals can hence be considered to be the leader of the group. In a virtual team involved in an ISD project for a particular client, the information advantage would belong to those individuals who are co-located with the client. The co-location will involve closer interactions with the client, and hence the collection of more information regarding the task, which will later have to be conveyed to the other members. This co-location with the client will be even more critical in the initial stages of the project, when the focus is on building a relationship with the client and collecting the appropriate user requirements necessary to build the system. Hence, an individual who is co-located with the client in a virtual team is more likely to emerge as the leader in the initial stages (H10a). However, in the later stages, the focus of the group will be on developing the information systems, thus requiring less client interaction and information. In addition, the client would also become familiar with the specialized roles of each team member irrespective of his/her location, and communicate (electronically, if necessary) with team members who seek clarifications on the project scope and requirements. Hence, in the later stages of the virtual team development, client location will no longer have a significant effect on leader emergence (H10b).

Hypothesis 10a: In the initial stage of virtual team projects, individuals who are co-located with the client will emerge as the leader.

Hypothesis 10b: In the later stage of virtual team projects, the location of the client will not have a significant effect on leader emergence.

4. Research methods

The purpose of the empirical design was to test the model of leader emergence proposed above.

Sample: The sample consisted of virtual teams comprising of 4-5 students enrolled in a systems analysis and design course in a large US university who were teamed up with 4-5 students enrolled in a similar course in a Norwegian university. There were a total of eight teams with an approximate sample size of seventy-five students (given the individual level of analysis). Team-members from the US university were randomly matched with team-members from the Norwegian university.

Design: Half of the teams (four) were required to develop application systems to solve a certain business problem for "real" organizations located in the home state of the US university, while the other four teams were required...
to develop application systems for organizations located in the home city of the Norwegian university. The team members in both locations were required to function both as analysts and the developers.

The communication between the US and the Norwegian team-members occurred primarily through the use of an electronic communication tool (WebCT), which allowed online chats, document sharing, and threaded discussion, and email.

Data Collection: Data for this study was drawn from questionnaires administered to the virtual team members at three different stages of the project-- before the start of the project (when ability was measured), during the initial stage, and towards the end of the project (when the development of the information system was in full-swing). A course credit of 10% was given to all students who completed all the questionnaires.

Measures: For the purpose of this study, leader emergence was measured by calculating a leadership index for each person. The leadership index was calculated by dividing the number of times an individual was named as the leader of the team by the total number of individuals in the team who had voted. According to the believers of the attribution approach, leadership is a perception of the follower and hence, more than the actions of the leader, the perceptions of the follower determines who will be the leader. It is argued that "a group member is a leader if other group members judge her or him as one" [15]. Given these arguments, measuring the leadership emergence as the perception of other group members seems most appropriate. Culture was measured by an item that tracked the location of the individual (whether US or Norway). This information was coded as 1 or 0 depending on the location.

Cultural ability, communication ability, technical ability, and ISD ability were measured by a self-reported pre-questionnaire that was administered before the start of the project. Subjects were asked to rate their ability on a scale of 1 to 7 anchored at Not at all and To a Great Extent. The questionnaire was later factor analyzed and the reported reliabilities of all the factors were greater than .80. Gender was measured by coding each individual with a 1 or 0 depending on whether a certain individual was a male or a female. Client location was measured by coding each individual with a 1 or 0 depending on whether the client was co-located with the concerned team member or not co-located with the concerned individual.

Finally, performance, extent of communication, and trust were measured in the initial stage of the project as well as in the later stage of the project. Each individual was asked to rate each of his/her team members (local and remote) on these three aspects.

Analysis: Leadership index, our dependent measure, has certain characteristics that motivate the choice of our analysis/estimation procedure. Since the maximum value of the leadership index is 1 and the minimum is 0, we could not use regression (ordinary least squares), where the normal distribution is assumed to range from $-\infty$ to $+\infty$. Thus, the bounds of our dependent variable [0,1] are not recognized, leading to biased and inefficient estimates [1]. Congruently, we estimated the censored regression model, popularly known as the Tobit model, to test our hypotheses [21]. We observed the value of leadership index (LI) that is based on the latent (unobserved) leadership index (LI*) with the following specification:

$$LI = 0 \quad \text{if} \quad LI* \leq 0 \quad (1)$$
$$LI = LI* \quad \text{if} \quad 0 < LI* < 1 \quad (2)$$
$$LI = 1 \quad \text{if} \quad LI* \geq 1 \quad (3)$$

We can specify the latent leadership index (LI*) in the standard linear model format as:

$$LI_i* = \beta'X_i + \epsilon_i \quad (4)$$

Maximizing the likelihood function is the recommended approach for estimating the above-mentioned model [1]. The log-likelihood function can be specified as a collation of three parts, as shown in Equation 5 (see Exhibit 1).

Results: In Table 1 we report the results obtained by maximizing Equation 5. Hypotheses 1 (a & b) stated that individuals with high cultural ability would emerge as the leader in the initial stages of the project, while cultural ability would not affect the leadership emergence in the later stages. Results indicated that cultural ability seems to matter only during the initial stages of the virtual team project where, individuals with cultural ability emerged as the leader (H1a: b = .090, p < .01), while it did not matter in the later stages of the project (H1b: b = -.16, p > .75). Hence, we find support for the first hypothesis.

Hypotheses 2 (a & b) stated that team members from cultures with higher power distance would be identified as the leader in the initial and the later stages of the project. Culture had a significant effect on leadership emergence. Team members from higher power distance cultures (US) were more likely to become leaders at the initial (H2a: b = -.134, p < .10) and the later (H2b: b = -.244, p < .05) stages of the virtual team project. Thus hypotheses 2 a and b were supported.

Hypotheses 3 (a & b) suggested that the extent of communication would have a significant effect on the
leader emergence, and individuals with a high extent of communication would be identified as the leader in the initial and the later stages of the project. We did not find support for the third hypothesis at either stage (H3a: b = .023, p > .38; H3b: b = .106, p > .16).

Hypothese 4 (a & b) suggested that individuals with high communication ability would emerge as the leader in the initial stages, while communication ability would not affect the leader emergence in the later stages of the project. Results supported the hypotheses in both stages of the project (H4a: b = .152, p < .01; H4b: b = .102, p > .37).

Hypothesis 5a stated that technical ability would not have a significant effect on leadership emergence in the initial stage of the project. Interestingly, the results were significant (H5a: b = -.217, p < .01) indicating that technical ability did have a significant negative effect on leader emergence. Hypothesis 5b stated that in the later stages of the virtual team project, individuals with a high technical ability would be identified as the leader. While the results were significant (H5b: b = -.189, p < .05), technical ability had a negative correlation with leadership emergence in this stage of the virtual team project.

Hypotheses 6 (a & b) stated that individuals with higher ISD ability would emerge as the leader in both stages of the virtual team project. Results indicated that ISD ability indeed has a marginal positive effect on leader emergence in both stages of the virtual team project (H6a: b = .086, p < .10; H6b: b = .138, p < .10).

Hypotheses 7 (a & b) stated that the individual who is trusted the most would emerge as the leader in the initial and later stages of the project. Results indicated that there was a significant main effect of trust in the initial stages of the project (H7a: b = .506, p < .01). However, results failed to show a significant effect of trust on leader emergence in the later stages of the project (H7b: b = -.371, p > .76).

Hypotheses 8 (a & b) suggested that individuals with higher performance would emerge as the leader in both stages of the virtual team project. Results supported these hypotheses (H8a: b = .250, p < .01; H8b: b = .291, p < .05).

Hypothesis 9a stated that male individuals would emerge as the leader in the initial stages of the virtual team project. This was supported (H9a: b = -.190, p < .05). However, hypothesis 9b argued that gender would not significantly affect leader emergence in the later stages of the project. This hypothesis was also supported (H9b: b = -.244, p = .36).

Finally, hypothesis 10a stated that an individual who is co-located with a client would be more likely to be identified as the leader in the initial stages of the virtual team project, while hypothesis 10b stated that location of the client would have no effect on leadership emergence in the later stages of the project. Results supported these hypotheses (H10a: b = .166, p < .05; H10b: b = .044, p > .36).

5. Discussion of results

Initial Stage: The empirical testing of the model indicates that different factors lead to the emergence of a leader in a virtual team in different stages of virtual team development (the initial stage and the later stage). An individual is likely to be viewed as a leader of a virtual team in the initial stages of the project, if s/he:

- Is from a culture with a relatively higher power distance
- Has high cultural, communication, and ISD ability
- Is highly trusted by other team members
- Is perceived by team members to have a high level of performance
- Is a male
- Is co-located with the client

Interestingly, the amount of communication did not determine the leader of a virtual team in the initial stage of the project. This result contradicts the "babble hypothesis" which contends that the individuals who "talk" the most emerge as the leader. In some sense, the results seem to support the work of a small group of researchers who argue that the content of the communication, rather than the amount of the communication is an important determinant in leadership emergence [15].

The results also indicate that while technical ability did have a significant effect on leader emergence, it was not in the predicted direction. In contrast to the hypotheses on this issue, it was seen that individuals with high technical ability were less likely to emerge as the leader. This was an interesting finding, given the fact that the virtual team project involved the development of an information systems application, where technical skills are critical to the success of the project. Researchers have argued that while the production in a virtual team is extremely important, such teams heavily depend on "member-support and group well-being functions to cement the team relationships," especially in the initial stages of the project [17]. Such a dependence on
member-support may require a leader who is primarily socially adept, rather than one who views himself/herself as having very strong technical skills. A technocentric individual is likely to be "blind to people, seeing only computers, thinking only computers, and so on" [6]. On the other hand, those individuals reporting lower technical skills are likely to view themselves as socially-oriented, and thus act in a manner that contributes to "member-support" and "group well-being." This line of reasoning could explain the negative relationship between technical ability and leader emergence.

Later Stage: In the later stage of the virtual team project, a different set of factors was found to be important in determining who emerged as a leader. As predicted by the literature, in this stage, the culture of the individual, the performance of the individual, and the ISD ability of the individual determined whether or not he/she was viewed as the leader of the virtual team.

As the virtual team project moves into the later stages, the focus of the team shifts to task performance, i.e., to the development of the information systems application. In such a context, the performance of team members becomes critical to the success of the project. Thus, the individual with the highest amount of performance becomes the most critical contributor to the team's success. The higher performance enables the team-member to gather more "credits" from other team members, and this in turn helps them to emerge as the leader [23]. Similarly, in an ISD project, the ISD skills continue to be critical to the success of the project. Hence, an individual with higher ISD skills is able to manage the project better, keep it on time, and manage customer expectations, thereby taking up a more central role in the team and emerging as the leader. Finally, given that the effect of culture remains constant through the life of the project, individuals from the higher power distance culture tend to emerge as the leader in the later stage as well.

Interestingly, in this stage (as in the initial stage), the extent of communication was not found to be a significant determinant of leader emergence. This again suggests that it is not the extent (quantity) but perhaps the content (quality) of communication that is relevant. More research is needed to investigate this issue.

Finally, the technical ability continued to have a significant negative correlation with leader emergence. In other words, individuals with low technical ability tended to emerge as the leader even in the later stage of the project. This is an unexpected finding, since the latter stage of an ISD project is usually the phase where technology takes the most prominent role. However, the following views of prominent systems theorist Weinberg might help make sense of this apparent anomaly [6]:

...systems developers naturally tend to view the world from a computer perspective. When they get promoted from programming to management, they must use the knowledge they have in solving the problems they face. People are then seen as modules or program components and are treated by the very techniques used in the design of computer systems. The competence that served the systems developers so well when they were constructing systems, and that was the reason for their promotion, now becomes a burden rather than their efforts to deal with people.

The key point that may be inferred is that having too strong a technical skill might correlate negatively with the ability to deal with people, and hence work against being perceived as the leader. Finally, trust did not seem to matter during the final stages of the project. It appears that "softer" issues, such as trust matter during the initial stages, and efficiency-related issues, such as performance and ability, become critical in determining leadership emergence during the later stages.

Overall, this study provides a well-defined model for the emergence of leaders in virtual teams. However, this study is not without its limitations. Below is a discussion of the limitations of this study.

6. Limitations

The primary limitation of this study is the fact that it involved only particular (i.e. dyadic) configuration of virtual teams. In other words, not all members were situated in different locations, but members were distributed between two locations. Hence, for the results of the study to be generalizable, similar studies need to be conducted using different virtual team configurations.

Another limitation of this study is the fact that it involves the use of student subjects. However, it is argued that student subjects represent a variety of backgrounds and goals, similar to organizational members, and usually reflect a typical working professional [7].

7. Conclusion

The concept of virtual teams is relatively new, and hence, little empirical research has been undertaken to help identify the factors that lead to virtual team effectiveness. Researchers have proposed that leadership
is an important factor in virtual team effectiveness. This paper provides an exploration of the issue of leadership in virtual teams, whereby a model involving factors that lead to leader emergence in a virtual team is developed and empirically tested. In this manner it makes a significant contribution to the literature on leadership in virtual teams. Future research will involve validating this model in different configurations of virtual teams consisting of members from different cultures.

8. References


Exhibit 1: Equation 5

\[ \ln(LI) = \sum_{L=0}^{L} (\ln[1 - \Phi(\frac{\beta X}{\sigma})]) + \sum_{0 < L < 1} \frac{1}{2} \ln(2\pi) + \ln \sigma^2 + \frac{(LI_1 - \beta X_i)^2}{\sigma^2}\] + \sum_{LI=1} (\ln[\Phi(\frac{\beta X_i}{\sigma})]) \]

- \(\Phi(.)\) depicts the normal cumulative distribution function
- \(X_i\) denotes the explanatory variables.
- \(\beta\) represents the impact of explanatory variables.
- \(\sigma\) stands for the standard deviation.
- The first term (LI=0) is for virtual team members who do not get any votes.
- The second term is for virtual team members who get a fraction of votes.
- The third term (LI=1) is for virtual team members who get all votes.

Table 1: Tobit Model Results

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Leadership Index - Initial</th>
<th>Leadership Index - Later</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-4.196 **</td>
<td>-1.914 ***</td>
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<td></td>
<td>(.733)</td>
<td>(.626)</td>
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<tr>
<td>Cultural Ability</td>
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<td>-.016</td>
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<tr>
<td></td>
<td>(.037)</td>
<td>(.052)</td>
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<tr>
<td>Culture b</td>
<td>-.134 *</td>
<td>-.244 **</td>
</tr>
<tr>
<td></td>
<td>(.083)</td>
<td>(.119)</td>
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<tr>
<td>Extent of Communication</td>
<td>.023</td>
<td>.106</td>
</tr>
<tr>
<td></td>
<td>(.077)</td>
<td>(.108)</td>
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<tr>
<td>Communication Ability</td>
<td>.152 ***</td>
<td>.102</td>
</tr>
<tr>
<td></td>
<td>(.053)</td>
<td>(.086)</td>
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<tr>
<td>Technical Ability</td>
<td>-.217 ***</td>
<td>-.189 **</td>
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<td></td>
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<td>(.083)</td>
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<tr>
<td>ISD Ability</td>
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<td>.138 *</td>
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<tr>
<td></td>
<td>(.067)</td>
<td>(.092)</td>
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<tr>
<td>Trust</td>
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<td></td>
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<td>(.123)</td>
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<tr>
<td>Performance</td>
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<td>.291 **</td>
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<td>(.150)</td>
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<tr>
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<td>-.117</td>
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<tr>
<td></td>
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<td>(.130)</td>
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<tr>
<td>Client Location d</td>
<td>.166 **</td>
<td>.044</td>
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<tr>
<td></td>
<td>(.072)</td>
<td>(.123)</td>
</tr>
</tbody>
</table>

* Standard error in parentheses (one-tail test for hypothesized effects).
  ** Coded as 1 for Norway and 0 for USA.
  *** Coded as 1 for female and 0 for male.
  **** Coded as 1 for local and 0 for remote.
  p<.10
  p<.05
  p<.01