Group Interaction Constructs for Hands-On LAN Projects:
An Initial Investigation

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Abstract

Group work has long been an effective approach to solving organizational problems and making high quality management decisions. This has been particularly true for information systems projects. This research effort attempts to define the constructs for group interaction as it pertains to small groups (i.e. 3-7 members). The subjects were students who were placed into groups and then assigned a short technology-intensive LAN building project. Five constructs were identified as comprising group interaction for IT projects, including: 1) group cohesion; 2) group communication problems; 3) group conflict; 4) member encouragement; and 5) group leadership. These factors were then contrasted with previous research on group interaction where the groups faced an intellectual (decision making) task, not a short technology-intensive task. The factors comprising the constructs from the two studies were different.

Group Interaction Constructs and Information Technology Projects:
An Initial Investigation

Introduction

Groups have become a main stay of many organizations over the past decade [23]. Group structures allow organizations to rapidly respond and
adapt to dynamic business environments [16]. One reason for the popularity is that groups can access large and diverse amounts of information thereby providing a higher potential for task performance. This increased productivity is extremely vital to many IS departments because systems development projects are growing more and more complex. For this reason, IS managers often turn to groups to get development work completed [11]. Schuler [21] explains that the use of groups is the best way to design and implement systems that meet society’s needs.

Although groups are vital to today’s organizations, most research has been focused on group outcomes [9, 10, 13]. The problem is that the group interaction process is central to a group [12]. Many researchers believe that this group interaction process has been inadequately studied [9, 10, 13]. Another major component, task type, has been found to significantly affect group interaction processes [17] and group outcomes [4, 19]. Task is an important variable in group dynamics and often moderates group outcomes [2, 20]. This research directly focuses on the group interaction process within the context of IS (information systems) project tasks. Our goal is to identify group interaction constructs for those completing technical IS tasks.

Benefits of Groups

Groups allow individual members to use their own specific knowledge, tools, tasks, colleagues, organizational memory and history to assist the group effort. However, the use of groups in organizations only improves the organizational response to dynamic environments if quick, responsive, and accurate judgments and behaviors exist within the group [23]. Hill [7] noted that the benefits of pooling knowledge, skills, and abilities in a group consisted primarily of the enlarged knowledge base and error correction capabilities to gain better performance. He concluded that group performance was superior to individual performance for particular tasks. With IS projects, the challenges include selecting groups with the right mix of people, skill sets, and personalities [22, 11].

IS group projects are unique because they require the collaboration of three groups of stakeholders: IS staff, end users, and management [3]. Without satisfactory interaction among project stakeholders, delays and even cancellations may occur, particularly for large scale IS projects [3]. IS projects include technical group activities that are exposed to all the potential pitfalls of group dynamics, interactions, coordination, and communication [3]. These pitfalls and risks associated with IS projects are difficult to assess with any degree of reliability prior to the start of the projects. However, we do know that the risks may include: project size, project domain complexity, limited expertise technology, unstable information requirements, and system integration problems [3]. Many of these risks may be avoided and addressed through pooling IS group members’ skills and abilities. Only through successful group interaction can such pooling occur. Another outcome of the successful pooling of human resources and group interaction is an increased creative output that occurs when the initial individual brainstorming ideas are combined.

Groups vs. Individuals

Many researchers [6, 15] have found that "the most competent group member represents the upper limit of what a group might expect to achieve". These findings are in direct contrast to current management practices that assume that groups will significantly outperform individuals. On the other hand, Michaelsen, Watson and Black [14] did find in their study that project groups consistently outperformed their most proficient member. Hackman and Morris [5] argued that the reason why groups sometimes performed poorly is the artificial and simplistic tasks that were employed in many of the research studies and the temporary (i.e. short time duration) nature of the groups (i.e. less than one hour). In support of that observation, the Michaelsen, et. al. [5] study used a relevant task (i.e. management case) and an extensive time frame, 32 hours of effort as part of an MBA Organization Behavior course. We believe that the differences between this study and previous studies that found no positive effects for groups provide a plausible explanation for the different conclusions. The contrived nature of groups [8] in some previous empirical studies can account for the lack of group effectiveness. Too often in experiments, the group is thrown together and immediately called upon to make a series of decisions. This collection of people is not necessarily a cohesive group characterized by a common goal, such as a basketball team or a system development team.

Purpose of Study
If previous research shows a positive effect of groups over individuals on realistic tasks, what accounts for and amplifies these effects? In particular, what are the ways that group members interact with one another to produce these positive effects? In this study, we attempt to identify constructs of effective interaction among small groups involved in a technical IS project. Some existing research speaks to this issue with non-IS tasks. For example, Watson and Michaelsen [24] used a Varclus cluster analysis procedure to identify underlying components of group interaction among undergraduate and graduate organizational behavior students. The students were performing an intellective task, which Michaelsen and Watson [24] describe as a group problem or decision for which there is a correct solution within a conceptual system. These types of tests were presented to the student groups in their study.

Watson and Michaelsen [24] collected data at two different time intervals. The results of their first cluster analysis showed that there seemed to be five underlying variables: expectation/integration, power struggle, organization, non-involvement, and communication/participation. These results are shown in Table 1. The results for the second time period produced a somewhat different set of interaction variables: expectation/integration, fight or flight, leadership, and cohesiveness. These results are shown in Table 2. Interestingly, even with the same groups, the results were significantly different for the two time periods. The variables from time period 1 included expectation/integration, power struggle, organization, non-involvement, and communication/participation. The variables from time period 2 included expectation/integration, fight or flight, leadership, and cohesiveness.

Time Period 1

Component 1: Expectation/Integration
We share high performance expectations.
There is group concern over quality performance.
Our individual styles are compatible.
There is a relaxed atmosphere.

Component 2: Power Struggle
Arguments carry on too long.
Some members interrupt when another is speaking.
There is conflict and hostility among members.
Some act like they "know it all."
One or two members tend to dominate the discussion.
One or two members are stubborn in their viewpoints.

Component 3: Organization
We delegate our group work.
We organize our time well.
We’re willing to meet on our own time.
We identify the functions necessary for successful completion of group projects.

Component 4: Non-Involvement
Some members respond only when asked.
In our discussions, we drift off the point.
Some take our group work too lightly.
Some members appear to withhold questions.
Sometimes people with good ideas don’t seem to speak up.
One or two members pretend to be prepared when they’re really not.
Some members of the group don’t disagree for fear of what the others might think.

Component 5: Communication/Participation
Everyone participates.
Everyone has a chance to express their opinion.
We listen to each individual’s input.
Members feel free to make positive and negative comments.
Even though we don’t have total agreement, we do reach a kind of consensus that we all accept.
We are comfortable with the roles that we play in the group.

Table 2
Michaelsen-Watson Varclus Clusters
Time Period 2

Component 1: Expectation/Integration
Everyone participates.
We share high performance expectations.
There is group concern for quality performance.
We organize our time well.
Diversity of backgrounds aid group problem solving.
We show a high level of support for teamwork.

Component 2: Fight or Flight
Some members respond only when asked.
In our discussions, we drift off the point.
Some take our group work too lightly.
Some members appear to withhold questions.
Some members interrupt when another is speaking.
There are conflicts and hostility among members.
Some act like they “know it all.”
Sometimes people with good ideas don’t speak up.
One or two members pretend to be prepared when they are really not.
Some members of the group would not disagree for fear of what the others might think.
One or two members tend to dominate the discussion.
One or two members are stubborn in their viewpoint.

Component 3: Leadership
A definite leader has emerged in our group.
A leader has emerged who was effective at helping us work together as a group.

Component 4: Cohesiveness
Everyone has a chance to express their opinion.
We listen to each individual’s input.
Members feel free to make positive and negative comments.
Even though we don’t have total agreement, we do reach a kind of consensus that we all accept.
Our individual styles seem compatible.
There is a relaxed atmosphere.
An atmosphere of trust exists in our group. We maintain a high exchange of ideas. Encouragement is given to reticent members to express their opinions. We are comfortable with the roles we play in the group.

Given the importance of this topic and the fact that little research exists in the group interaction process with IS groups, we felt this was worthy of further research. The technical nature of the task and task environment could play an important and accentuating role in the IS group process. In particular, defining group interaction constructs can help IS managers and project group leaders better understand the IS work environment. Knowledge in this area could facilitate greater productivity from software development groups, network development and operation groups, and many other IS groups. Using the same instrument, we performed an exploratory factor analysis procedure on group reactions to a task that has a finite completion operation. One important difference is that our study focused on the IS technical environment. This investigation constituted a theory-building exploratory study to identify key areas of group style for building a LAN. Our goal is to see if the Watson-Michaelsen group style [24] constructs hold up in the technical environment. If so these constructs can be used to explain group behavior across many environments and not just for intellectual discussion groups.

The first research question was:

**R1: What are the areas of group interaction for project groups involved in a technologically intensive project (LAN Building)?**

The answer to this research question is found in identifying the areas of group interaction. In a review of the items that comprise each of the Watson and Michaelsen [24] five factors for time period 1 and the four factors for time period 2, the researchers derived names for each factor that encompassed what was the underlying dimension expressed in those items. These names appear as the component names in Tables 1. A review of the items that load on each factor should confirm that they have been assigned appropriate names that explicitly signify the underlying dimension expressed in those items.

A second research question was:

**R2: Are the group interaction areas associated with the technologically intensive project (LAN Building) different than the group clusters found in Watson-Michaelsen’s study of groups involved in an intellective task?**

The answer to this research question is found in comparing the group clusters of the two studies. The researchers will discuss the similarities and differences between the two group clusters.

**Methodology**

The data collected to use in identifying implementation factors was obtained through the use of a survey instrument. The survey was conducted among students belonging to project groups who were building LANs. The questionnaire used for the study was the Watson Michaelsen [24] group style instrument. The instrument presented 40 group style items that were anchored by a 5-point Likert scale. The survey instrument anchors ranged from 1 (strongly disagree) to 5 (strongly agree). A total of 113 students belonging to 18 project groups completed the questionnaire. All students were senior MIS majors at a large southeastern university. Project groups were assigned randomly so as to not bias the population. Every student in the course sections participated in the survey thus the entire population of MIS students in the course was used. All students were required to respond to the questionnaire as part of the LAN development project.

**The LAN Project**

The LAN project required the project group to install, configure, troubleshoot, and operate a network comprised of an NT Server, NT Workstation and Windows 95 clients. The LAN project was an intense project that lasted for 10 days for each project group. The goal of the LAN project was to offer students some valuable experience that covered many of the topics in four of the core Microsoft Certified Systems Engineer (MCSE) Exams [Networking Essentials (Exam 70-058), Windows NT Workstation 4.0 (Exam 70-073), Windows NT Server 4.0 (Exam 70-067), and Windows NT Server in the Enterprise (Exam 70-068)].
Upon completion of the installation and configuration of the Windows NT LAN, the laboratory assistant and researchers created a number of common problems on the network. The student groups were then asked to troubleshoot the network and to restore the network to normal working order. All software and hardware components needed for this project were provided to the student groups. Each project started and finished with the same tasks. The projects were completely identical for every project group. The deliverable for the LAN project was a working LAN prototype. This course was the students’ first exposure in their MIS degree program to LANs.

Factor Analysis

A factor analysis was used to identify the underlying dimensions regarding items of importance to group interaction. Factor analysis was chosen for this research to reduce the 40 items of the Watson and Michaelsen [24] group style instrument down to a more manageable set. An exploratory factor analysis was chosen because of the limited amount of available knowledge regarding group interaction with technical MIS group tasks and the exploratory nature of the research project in general.

A number of different criteria have been used to justify the use of factor analysis to analyze research data. In reviewing the literature on the criteria that have been used, it became obvious that no single criteria can be universally applied. The following discussion identifies many of these criteria and shows how these research ratios compare with those existing criteria.

The study used two criteria to evaluate the importance of factor loadings: significance of item loadings and simplicity of factor structure. Using the first criterion, only items with factor loadings of at least .50 were retained which is a much higher criterion than the .35 suggested by Nunnally [18]. The second criterion, simplicity, calls for eliminating items that exhibit factor loadings of .30 on two or more factors (cross-loaded), or items that exhibit no factor loadings greater than .50. We used this criterion in the study.

Cronbach's coefficient alphas were used to test internal reliability of the factors. Nunnally [18] stated that in most cases coefficient alpha was a good estimate of reliability. Before conducting the study, the researchers established the criteria that Cronbach alphas of at least .70 would be used to estimate reliability for each factor [18]. Each factor eventually identified by the analysis was above the stated minimum level for the alpha coefficient, and thus exhibited strong internal reliability.

Identifying Factors

An exploratory factor analysis procedure using a varimax factor rotation was performed on the responses to the 40 items on the Watson-Michaelsen [24] questionnaire. No factors were a-priori specified for the initial factor analysis, resulting in a possible 23-factor solution. A minimum value of 1.0 for eigenvalues was used to indicate cut-off criteria for identifying possible factors [1]. An analysis of the scree plots showed a drop in the eigenvalue levels from 1.196 to less than 1.0 after the fifth factor. Overall, the analysis indicated a possible 5-factor solution.

A subsequent factor analysis was performed forcing a 5-factor solution and factor loadings of at least .50. The forced analysis was performed to eliminate possible factors that did not have at least 1.0 eigenvalue. This procedure is very effective in eliminating items that do not load on particular factors or clusters. This procedure converged after eight iterations to reveal five factors with eigenvalues of at least 1.1 with each factor explaining at least 4.6 percent of the explained variance. Eleven of the 40 possible items failed to meet the .50 factor loading requirement and were subsequently eliminated from the analysis. Three additional items crossloaded and were also dropped from the analysis. In total, the five factors explained 57.1 percent of the systematic covariance among the remaining 26 items. Tables 3 – 7 present the factors, list the items that comprise them, and other resulting statistics.

Factor Interpretation and Discussion

The first factor consisted of 12 items that directly related to group cohesion. The latent variable name assigned to this factor was **Group Cohesion**. This factor addresses such issues as the group organization, the desire for quality and the creation of an atmosphere of trust. As noted in Table 3, this factor appears to comprise items dealing with positive attitudes toward group members, trust, and the compatibility of styles. A large portion of this factor deals with communication and a high exchange of ideas among group members. Another component of the
factor is the group’s ability to organize its efforts both for communication, roles being played, and delegation of subtasks. Group cohesion and organization are integral to the group interaction process. The Cronbach alpha for this factor was .89 which indicates a high reliability for this factor. The factor mean of 3.5 indicates that respondents gave positive responses for their group’s cohesion.

Table 3: Factor 1 - Group Cohesion

<table>
<thead>
<tr>
<th>Cronbach's Alpha</th>
<th>Factor Mean</th>
<th>Variance Explained</th>
<th>Eigenvalue</th>
</tr>
</thead>
<tbody>
<tr>
<td>.89</td>
<td>3.5</td>
<td>26.1%</td>
<td>5.527</td>
</tr>
</tbody>
</table>

Factor Items | Loading |
--- | ---|
There is group concern for quality performance. | .722 |
Members feel free to make positive and negative comments. | .591 |
We delegate our group work. | .538 |
We organize our time well. | .514 |
We show positive attitudes toward group work. | .781 |
Our individual styles seem compatible. | .624 |
An atmosphere of trust exists in our group. | .617 |
We organize our communication according to available time. | .637 |
We maintain a high exchange of ideas. | .648 |
We identify the functions necessary for successful completion of group projects. | .770 |
We are comfortable with the roles we play in the group. | .781 |
We show a high level of support for teamwork. | .546 |

The second factor included 4 items associated with group communication. The latent variable name assigned to this factor was Non-Involvement. This factor encompassed the problems that may exist in getting members to communicate within the group during the project. Clearly, Table 4 shows that the items reflected the reluctance to speak up and the fear of what others might say or think. Group members’ lack of preparation is also a part of this factor. This factor definitely contributes to group communication problems. The Cronbach alpha for this factor was .73. The factor mean for this factor was 3.4. Evidently, groups did have members that failed to become part of the group process even though in many cases their contribution could have been considerable. Involvement is a major problem for the group interaction process for all groups.

Table 4: Factor 2 - Non-Involvement

<table>
<thead>
<tr>
<th>Cronbach's Alpha</th>
<th>Factor Mean</th>
<th>Variance Explained</th>
<th>Eigenvalue</th>
</tr>
</thead>
<tbody>
<tr>
<td>.73</td>
<td>3.4</td>
<td>12.3%</td>
<td>3.192</td>
</tr>
</tbody>
</table>

Factor Items | Loading |
--- | ---|
Some members appear to withhold questions. | .612 |
Sometimes people with good ideas don’t seem to speak up. | .656 |
One or two members pretend to be prepared when they’re really not. | .788 |
Some members of the group don’t disagree for fear of what others might think. | .759 |

Factor 3 contained 4 items related to group conflict. The latent variable name given to this factor was the Group Conflict. These items reflect the argumentative and combative nature of group discussion, as well as other possible inhibitors of a smooth group process. Table 5 presents the items that relate to group conflict. Group domination by a few group members is a problem that many of the LAN project groups encountered. “Know it all” attitudes and stubborn behavior were present in many of the project groups. These behaviors did cause arguments to occur for many project groups. The factor mean was 3.5, which indicates that group members did have these problems on their project groups. These types of problems are typical for the group interaction process. The Cronbach alpha was .74.

Table 5: Factor 3 - Group Conflict

<table>
<thead>
<tr>
<th>Cronbach's Alpha</th>
<th>Factor Mean</th>
<th>Variance Explained</th>
<th>Eigenvalue</th>
</tr>
</thead>
<tbody>
<tr>
<td>.74</td>
<td>3.5</td>
<td>7.5%</td>
<td>1.946</td>
</tr>
</tbody>
</table>

Factor Items | Loading |
--- | ---|
Arguments carry on too long. | .582 |
Some act like they “know it all.” | .663 |
One or two members tend to dominate the discussion. | .614 |
One or two members are stubborn in their viewpoints. | .809 |

Factor 4 consisted of the 3 items associated with the encouragement of less assertive members to communicate and get involved. The latent variable name given to this factor was Member Encouragement. These items in Table 6 are suggest facilitating effect of interaction on group performance. The Cronbach alpha for this factor was .73. However, the factor mean present a different picture. Although these items clustered together, the factor mean was 3.1. These results indicate indifference among group members with regard to the importance of getting all group members to participate.

Table 6: Factor 4 - Member Encouragement

<table>
<thead>
<tr>
<th>Cronbach's Alpha</th>
<th>Factor Mean</th>
<th>Variance Explained</th>
<th>Eigenvalue</th>
</tr>
</thead>
<tbody>
<tr>
<td>.73</td>
<td>3.1</td>
<td>6.6%</td>
<td>1.721</td>
</tr>
</tbody>
</table>

Factor Items | Loading |
--- | ---|
Someone always makes sure that quieter group members get a chance to express their ideas. | .828 |
One of our members is very good at getting less assertive members to voice their opinions. | .759 |
Encouragement is given to reticent members to express their opinions. | .686 |

Factor 5 included 3 items related to the group leadership. The latent variable name assigned to this factor was Group Leadership. As shown in Table 7, these items represent leader directed drivers of the group process. The factor mean was 3.4. This result shows that groups did have an emergence of leadership.
This factor indicates that either an individual leader emerged or a collective group leadership was adopted. In either case, leadership was an important aspect of the group interaction process.

Table 7: Factor 5 - Group Leadership
Cronbach's Alpha = .71 Factor Mean = 3.4
Variance Explained = 4.6% Eigenvalue = 1.196

<table>
<thead>
<tr>
<th>Factor Item</th>
<th>Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>A definite leader has emerged in our group.</td>
<td>.840</td>
</tr>
<tr>
<td>We exercise leadership skills as a group and don’t really have a “leader” per se.</td>
<td>.695</td>
</tr>
<tr>
<td>A leader has emerged who was effective at helping us work together as a group.</td>
<td>.785</td>
</tr>
</tbody>
</table>

These results show the LAN project groups to have 3 positive and 2 negative group interaction constructs. These are extremely important for project managers and IS managers in dealing with project groups to gain the performance advantages that groups are supposed to provide organizations. The only way that pooling resources will provide performance gains will be with smooth group interaction. The three positive constructs are group cohesion, member encouragement, and leadership. These three constructs are closely tied to each other. An obvious positive construct is group cohesion. The communication and organization of member ideas are central to gaining the potential benefits of pooling. Leadership can provide the structure for gaining this pooling effect. Finally, member encouragement is vital to attaining the pooling effect by bringing out the ideas of every group member. The two negative constructs were group conflict and non-involvement. Both of these constructs can destroy the group interaction process. Again, non-involvement has reticent group members withholding ideas that could be helpful to the group’s efforts. Group conflict has overbearing group members inflicting their will on the project group. Either way, the potential outcomes of the group process are compromised.

Comparison of Factors with the Watson-Michaelsen Group Clusters

A comparison of our constructs to the first Watson-Michaelsen [24] group clusters presents several differences. The group cohesion factor from our analysis combines items from Watson-Michaelsen clusters expectation/integration, communication/participation, and organization. Two factors from our analysis, group leadership and member encouragement, are not included in the Watson-Michaelsen [24] time period 1 analysis at all. Finally, non-involvement and group conflict factors align closely with the power struggle and non-involvement factors from the Watson-Michaelsen study [24].

A comparison of our analysis to the Watson-Michaelsen [24] time period 2 analysis reveals a close relationship between our group cohesion factor and a combination of their expectation/integration and group cohesion factors. Both negative oriented factors from our analysis, non-involvement and group conflict, align closely with the Watson-Michaelsen fight or flight factor [24]. Additionally, the leadership variables from both analysis are closely related. Again, our member encouragement factor does not appear in their analysis.

These results indicate strong support for the overall group cohesion factor found in our study. This factor encompasses the expectation/integration, organization, communication/participation from time period 1 and the expectation/integration and group cohesion factors from time period 2. Without question, group organization, freedom of communication, concern for performance, and group trust are essential to all project groups regardless of task or nature. Our two negative factors non-involvement and group conflict align closely with power struggle and non-involvement from time period 1 and fight or flight from time period 2. Again, these negative factors are reality for groups regardless of task. Another factor, group leadership, is closely related to the leadership variable from time period 2. Leadership emergence is another vital factor for all project groups. Finally, our analysis broke out a new factor, member encouragement. We believe that this new factor is vital to gaining the pooling effect of the group process. This member encouragement factor is even more important with many of the cross-functional groups that comprise MIS projects (ie. users, programmers, consultants and general management).

Conclusion

This study has identified several basic constructs for group interaction for project groups working in a technical IT environment. The member encouragement factor is a major finding for organizations that are using cross functional groups and even for those involved in non-IT projects. We believe that the overlap of factors between our study and the two Watson-Michaelsen [24] studies is significant. Our
study confirms many of the Watson-Michaelsen findings [24] in a technical environment. These findings extrapolate the group constructs into a totally new environment and significantly add to the base group literature. The differences between the two studies produce yet another significant result with a totally new construct being found. We acknowledge that the use of only one IT task with student projects in this study is a limitation for this study. However, this research study provides an initial assessment of project groups working on technical IT projects and identifies the group interaction constructs involved. We believe this is a major contribution to the management of IT project groups. Again, we have been surprised by the lack of research focused on the group interaction and the number research projects focused only on the communication modes (media richness, communication channels, and group support systems (GSS)) and outcome effects of group projects.

Directions for Future Research

We believe this study needs to be replicated in actual business operations in industrial project groups that are working on technical IT projects to confirm that the factors that have been identified actually compose the group interaction constructs. A wide variety of IT type projects should be used to confirm the factors such as system development projects, new technology implementation projects, IT training projects, database application development projects, and more network projects. Consequently, as Huang and Wei [9] call for a great effort needs to be made isolating and studying the group interaction process in the IT arena. Linkages between the group interaction process and both user satisfaction and performance outcomes should be explored.

References


