CAN PEERS BE USED EFFECTIVELY TO ASSESS TEAMS: TASK/TEAM FUNCTION OBSERVATIONS DURING TEAM BUILDING EXERCISES

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Abstract – *This presentation describes a model used to illustrate functions that team members assume during teambuilding exercises. The Design (EPICS) program introduces teams of engineering students to design, technical communications and teamwork processes through an open-ended, client-based project. Teams conduct a series of exercises in which half perform the exercise and the other half observe teamwork based on an observations technique developed by Eberhardt. During the forming phase of the project, teams emphasize task (75%) functions but learned the value of team (25%) functions. By the end of the semester, team performance relies on a balance of task (52%) and team (48%) skills. Essentially all observations collected for each function are statistically similar over six semesters of data collection.*

Following the Second World War, the National Training Laboratory for Behavioral Studies developed a method for describing team performance based on a balance of task and team functions. Task functions, critical to producing a quality product, focused on activities aimed at the project goal. Team functions, critical to maintaining team unity, focused on behaviors and a team-centered approach to solving problems. These functions initially developed by Benne and Sheats[1] were refined over the years by Schein[2] and Eberhardt[3] as training instruments.

Eberhardt identified two sets of functions necessary to operate optimally as a team. Her instrument consisted of ten categories evenly divided between task and team functions, summarized in Table III. As observed by Applbaum[4] and Jones and Bearley[5], the synthesis of these functions led to successful problems solving.

TABLE III
Team Function during Decision-Making Processes

Function	*Description*	*Function*	*Description*
Task Functions		**Team Functions**	
Initiating	Proposing goals or actions	**Harmonizing**	Reconciling disagreements
Information Seeking	Asking for factual clarification	**Gate Keeping**	Keeping channels open
Information Giving	Offering facts	**Encouraging**	Being friendly and responsive
Clarifying	Interpreting ideas or suggestions	**Compromising**	Offering alternatives in conflicts
Summarizing	Pulling together related ideas	**Standard Setting**	Expressing standards for the team

Hanna and Wilson[6] noted that an instrument for measuring team operations should adequately cover four components central to team performance:

1. Task functions (approach to goals and decision-making processes)
2. Team functions (cohesiveness or general liking and attraction to team)
3. Outcomes (solution quality to open-ended problems)
4. Satisfaction (feelings about participation in the team)

Satisfaction correlated closely to productivity (ability to accomplish goals) and cohesiveness (the team's pride, commitment and attraction to each other). According to Hanna & Wilson, too much cohesiveness lowered productivity but too little created barriers to producing high quality outcomes.

Studies evaluating roles of team members have been mainly conducted in laboratory settings. As an example, the Interaction Process Analysis (Anderson and Blanchard[7]) is confined to laboratory settings because it requires coding each verbal utterance in discussions. The method is time consuming and expensive, requiring trained observers. The use of outside observers creates an expensive and complex process that precludes using the tool on a routine basis.

> The hypothesis of this paper is that class peers can effectively use the training tool created by Eberhardt to observe the distribution of task and team functions for teams during team building exercises. Using students to observe their peers during the exercise creates a visual picture of team operations at various phases of the project and reinforces the importance of a balance between task and team functions to the performance of the team.

The Design (EPICS) program introduces multidisciplinary teams of first and second year students to design, technical communications and teamwork processes through an open-ended, client-based project.

Teams conduct a series of teamwork exercises at various phases of the project, reinforcing the impact of task and team functions to the performance of the team. During these exercises, half of the teams perform the exercise, and the other half observe the functions of performing team members using an observation sheet based on functions proposed by Eberhardt. Observations are compiled for each team member and then summarized for each team.

Teamwork Exercises

The Rope Geometry exercise, conducted in week 4 (team forming phase), creates a situation in which students rely heavily on their ability to operate as a team. Team members form an understanding of the client's needs, the project goals and the team make up. In the context of the project, teams have been defined but have not formed the bonds that help to unify the team. Eliminating their sense of sight drives members to verbally exchange information. They must also keep track of each other to make sure all members are participating.

ROPE GEOMETRY EXERCISE		
The objective of this exercise is to create as a team a specified geometry using the rope as the boundary. Each team member gets inside the rope, puts on the blindfold and faces the rope. The team brings the rope to waist level, keeping both hands on the rope and in contact with their waste. The mentor requests the team to create a geometric figure (The figure must have one less angle than the number of team members.		
Materials	Rope Blindfolds	25ft tied at the ends. One for each member.
Guidelines	No contact with other members. Hands must remain on the rope. Hands must remain on waist. 10 minute time limit.	
Reflection	What team and task functions stood out in the exercise? What is the significance to your team at this stage of the project? What is the importance of this exercise to your career?	

The exercise reveals to the students a traditional engineering emphasis on task functions but then conveys the importance of team support. The goal of the exercise promotes initiating and communicating to successful build the geometry. Clarifying and summarizing keep members in touch with the team's progress. Participants, however, rely on their ability to work as a team in order to produce an accurate representation of the geometry. Team functions; such as compromising, encouraging, and gate keeping; assure participation and interaction from all members. Harmonizing and standard setting also keep the team progressing toward the goal. Team satisfaction and production of a quality product depend on a balance of both task and team functions.

On average, teams early in the project performed as expected. Based on 6 semesters observing 181 students (2165 observations), nearly 75 percent of the observations, shown in Figure 1, were attributed to task functions with an emphasis on initiating, followed by an exchange of information. While only 25 percent of the observations represented team functions, emphasis was on compromising. First-year men tended to initiate, and women to seek and give information. Both behaved equally well at processing the information. First-year women compromised frequently, whereas men set the standards during the exercise. The exercise demonstrated that the traditional engineering focus on task functions needed to be enhanced with an equal attention to the team's cohesion. The exercise provided a tool early in the semester to discuss with students the importance of team functions during the design process.

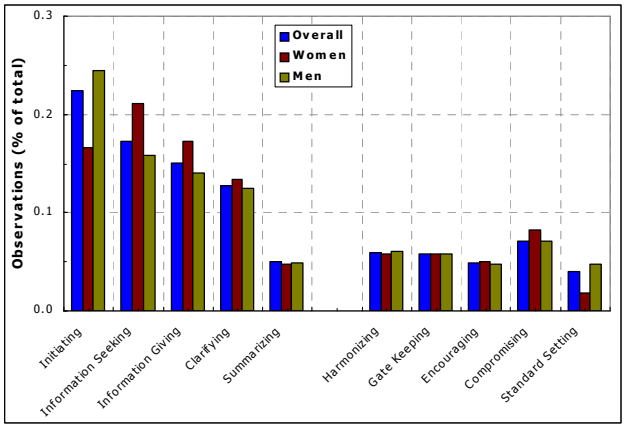

***Figure 1**: Distribution of Task and Team Functions during the Rope Geometry Exercise*

The Atomic Popcorn exercise is conducted between week 7 and week 10 (team norming phase) when the team members begin their individual research. Team have defined the project plan and set the guidelines for how the team intends to operate. Timing also coincides with the start of the implementation phase of the project. The exercise reinforces values of integrating individual skills into the team's design strategy. An exercise, that requires each team member to operate individually but as an integral part of the team, demonstrates the consequences of each member's contribution to the outcome. This exercise requires team planning, which entails an

ATOMIC POPCORN		
The objective of the Atomic Popcorn exercise is to remove the pot of toxic popcorn from the confined area without spilling a single kernel. No part of any team member may enter the area or the person is disabled and removed from the exercise. The team can only use the materials available to extract the popcorn.		
Materials	Popcorn Containers Rope Elastic	 Medium flower pots 5 x 7.5 ft pieces Bicycle inner-tube
Guidelines	No body parts may cross boundary No member may sacrifice self May only use materials provided Unsafe container can only move 1.0 ft from center of area	
Reflection	What team and task functions stood out in the exercise? What is the significance to your team at this stage of the project? What is the importance of this exercise to your career?	

understanding of the individual strengths. The team not only plans but also implements their specific skills to achieve the goal of the exercise.

The team develops and implements a strategy for removing the popcorn, which requires cooperation among all team members. Task functions set the stage for operational completion of the exercise with an emphasis on information exchange. The exercise, however, requires a great deal of harmony and gate keeping within the team to work the ropes and elastic band necessary to capture the container. Once the process is underway, clarifying and encouraging play key roles in the team's actions. The exercise emphasizes integration of both team and task functions for the team to perform well and to save the community.

Teams demonstrated a greater emphasis on team functions, typical of their ability to establish norms. Observing 71 students (792 observations), 65 percent of the observations, schematically depicted in Figure 2, were attributed to task functions with an emphasis on initiating. Information exchange governed the processes once the team attempted to pick up the container. Team functions played a greater role, increasing to 35 percent of the total observations. Since the team needed to work as a unit to remove the toxic popcorn, encouraging and harmonizing increased throughout this exercise. Standard setting may have occurred during the planning phase and was subsequently taken for granted during the exercise. Gate keeping may not have been as dominate because everyone was already involved in the exercise. Men continued to initiate the process whereas women more frequently provided the encouragement to complete the exercise. Other differences seemed to diminish as both men and women actively participated in the exercise.

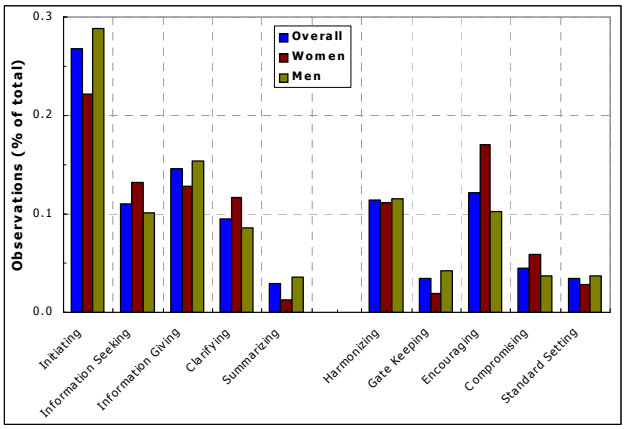

Figure 2: *Distribution of Task and Team Functions during the Atomic Popcorn Exercise*

Teams end the semester playing Jenga against other teams (team performing phase). By the end of the project, teams perform at their capacity with little guidance from the mentors. This exercise confirms the impact of both sets of functions to the team's operations, an excellent ending to the semester. The goal, to construct the tallest structure within the time constraint, requires attention to the task with emphasis on clarifying and summarizing. Team functions play

Jenga		
The objective of the Jenga exercise is to construct the largest tower within the time constraint. All Jenga rules apply, except how you replace a piece at the top of the tower. Pieces may be repositioned in any fashion that a team decides.		
Materials	Game	Jenga
Guidelines	If tower collapses, team must start over from the beginning. Only one member may touch the tower at a time. 10 minute time limit.	
Reflection	What team and task functions stood out in the exercise? What is the significance to your team at this stage of the project? What is the importance of this exercise to your career?	

an equal role as teams compete with each other. Each member must respond to the exercise quickly and efficiently to assure timely decision and smooth movements.

Team performance requires a plan and support of each team member for the plan. Initiating plays a much lesser role to the other task functions, except on an individual basis when each player must decide on which piece to move. Most students comment during the reflection session that initiating takes place frequently throughout the game on an individual basis, which may not be perceived by the observers. Encouraging is recognized as a dominate team function, although standard setting and compromising lead to team unity. Gate keeping and harmonizing contribute to the cooperation among members as they confirm decisions. Summarizing the strategy constantly clarifies the direction the team is headed, reinforcing individual decisions.

Teams on average exhibited a balanced allocation of task and team functions. Observing 44 students (918 observations), team members definitely encouraged each other as they built their towers, confirmed in Figure 3. 52 percent of observations were task functions with emphasis on information seeking. Other task functions were equally distributed. 48 percent of total observations were team functions, which were balanced between all but the encouraging function. Encouragement definitely dominated the team functions as frequently observed when teams are in the performing phase. First-year women encouraged and harmonized considerable more often then men during the exercise. Men set standards and summarized more frequently. Both exhibited a good balance of other functions during the exercise.

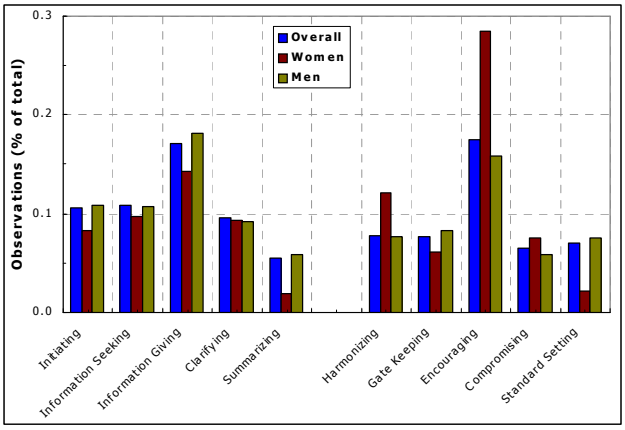

Figure 3: *Distribution of Task and Team Functions during the Jenga Exercise.*

The three exercises complemented the content of the course and helped students to visualize the value of balance between task and team functions. The distribution of functions for each exercise, illustrated in Figure 4, demonstrated the progression toward a balance of team and task functions. The rope geometry introduced teams to the value of assuring that all members were participating in the process. It set the stage for team members to participate in the project and to identify methods required keeping members involved. As the team divided the work into individual pieces, the atomic popcorn exercise reinforced the importance of initiating action and exchanging information but with greater emphasis on supporting and encouraging each other. At

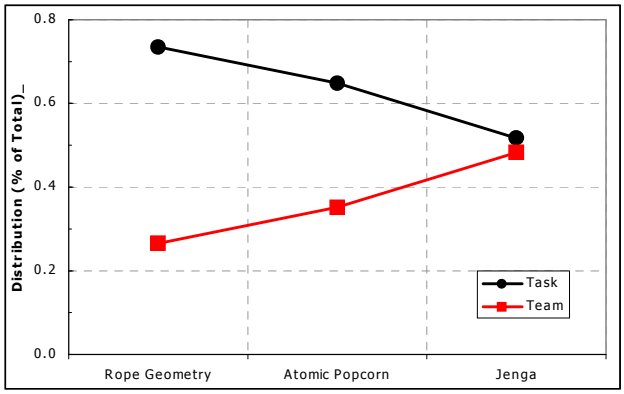

Figure 4: *Change in Task and Team Distribution during Teamwork Exercises throughout the Semester*

this stage of the project, team members developed norms, conducting their individual research and integrating the results into a quality product. Members continued to support and to encourage each other to develop this quality, ensuring satisfaction. By the end of the semester, team performance relied on a balance of task and team skills, reinforced by their performance during the Jenga exercise. The series of exercises reinforced the balance of task and team functions and documented the progression throughout the semester.

Using one team to observe another team created the ability to collect data concerning team behavior in an effective and reliable manner. The numbers of observations collected for each function were statistically evaluated using a student-t test. The only data that were significantly different occurred for the rope geometry exercise. Information seeking during the first two semesters was significantly lower ($\alpha = 0.05$, $P < 0.001$). In the fall of 2002, encouraging was significantly lower ($\alpha = 0.05$, $P < 0.001$) and in the fall of 2003, harmonizing was significantly lower ($\alpha = 0.05$, $P < 0.001$). Although these differences may be attributed to the method of collection, they most probably were attributed to differences in the individual classes. As an example, the fall of 2003 class was characterized as a group of very individualistic students who enjoyed teasing each other. Harmony was not an issue to the performance of their teams.

This study confirms an "easy to implement" method for demonstrating to first-year engineering students the balance that develops between task and team functions as the project evolves. These findings only scratched the surface on using this tool to help students observe the relationships between behavioral roles and team performance. Where do we go from here? Several factors may influence the observations that could be important to the application of this technique as a tool for enhancing student learning. The sequence of exercises may contribute to the growth in balance as the semester continues. Follow-up studies should examine a reversal in the sequence or the inclusion of other exercises to assess the impact of the exercise on the observations. In addition, an independent observer should gather data to confirm that students' familiarity with the rubric does not bias the findings. Ultimately, a relationship should be explored between team balance and performance to reinforce the value of effective teamwork. These issues should become the focus of several proposals, as well as future studies, to improve upon this simple but effective tool for exploring team roles

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Biographical Information

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Robert Knecht's 23 years of experience in the industry focuses on technical and management support for minerals, energy and waste projects. He currently directs an engineering design program based on a curriculum that focuses on projects from industry. His projects require students to implement a design methodology in teams to resolve open-ended problems and to communicate both in written and verbal forms the results of their work.