
AC 2011-836: SMARTER TEAMWORK: SYSTEM FOR MANAGEMENT, ASSESSMENT, RESEARCH, TRAINING, EDUCATION, AND REMEDIATION FOR TEAMWORK

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Matthew W. Ohland is Associate Professor of Engineering Education at Purdue University. He has degrees from Swarthmore College, Rensselaer Polytechnic Institute, and the University of Florida. His research on the longitudinal study of engineering students, team assignment, peer evaluation, and active and collaborative teaching methods has been supported by over \$11.4 million from the National Science Foundation and the Sloan Foundation and his team received the William Elgin Wickenden Award for the Best Paper in the Journal of Engineering Education in 2008 and multiple conference Best Paper awards. Dr. Ohland is Chair of ASEE's Educational Research and Methods division and an At-Large member the Administrative Committee of the IEEE Education Society. He was the 20022006 President of Tau Beta Pi.

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Daniel M. Ferguson is a graduate student in the Engineering Education Program at Purdue University. Prior to coming to Purdue he was Assistant Professor of Entrepreneurship at Ohio Northern University. Before assuming that position he was Associate Director of the Inter-professional Studies Program and Senior Lecturer at Illinois Institute of Technology and involved in research in service learning, assessment processes and interventions aimed at improving learning objective attainment. Prior to his University assignments he was the Founder and CEO of The EDI Group, Ltd. and The EDI Group Canada, Ltd, independent professional services companies specializing in B2B electronic commerce and electronic data interchange. The EDI Group companies conducted market research, offered educational seminars and conferences and published The Journal of Electronic Commerce. He was also a Vice President at the First National Bank of Chicago, where he founded and managed the bank's market leading professional Cash Management Consulting Group, initiated the bank's non credit service product management organization and profit center profitability programs and was instrumental in the EDI/EFT payment system implemented by General Motors.

Misty L. Loughry, Georgia Southern University

Dr. Loughry earned a Ph.D. in management from University of Florida in 2001. She also has an M.B.A. from Loyola College in Maryland and a B.A. from Towson State University. Before joining Georgia Southern University, she was a member of the faculty at Clemson University. Her research specialties are control in organizations, especially peer influences and other social controls, and teamwork, especially self and peer evaluation of teamwork. Prior to beginning her academic career, Dr. Loughry worked for ten years in the banking field, holding positions including credit analyst, branch manager and Assistant Vice President of Small Business Lending. Her research has been published in journals such as Organization Science, Educational & Psychological Measurement, Journal of Managerial Issues, Information and Management, Journal of Information Technology Management, Journal of Engineering Education, and Business Horizons.

David J Woehr, University of Tennessee

David J. Woehr is a Professor in the Department of Management at the University of Tennessee, Knoxville. He received his Ph.D. in Industrial/Organizational Psychology from Georgia Institute of Technology in 1989. Dr. Woehr's research focuses on the measurement and evaluation of individual job performance, managerial assessment centers, and applied measurement. Dr. Woehr currently serves as an associate editor for Human Performance and is an elected fellow of the Society for Industrial/Organizational Psychology (SIOP), the American Psychological Association (APA), and the Association for Psychological Science (APS).

Hal R Pomeranz, Deer Run Associates

Hal Pomeranz is the lead developer of the SMARTER Teamwork tools. He is a Faculty Fellow of the SANS Institute and a nationally recognized expert in computer security and information systems management.

SMARTER Teamwork: System for Management, Assessment, Research, Training, Education, and Remediation for Teamwork

Abstract

The rapid adoption of Team-Maker and the Comprehensive Assessment of Team Member Effectiveness (CATME), tools for team formation and peer evaluation, make it possible to extend their success to have a significant impact on the development of team skills in higher education. The web-based systems are used by over 700 faculty at over 200 institutions internationally.

This paper and its accompanying poster will describe strategies for broadening the scope of those tools into a complete system for the management of teamwork in undergraduate education. The *System for the Management, Assessment, Research, Training, Education, and Remediation of Teamwork* (SMARTER Teamwork) has three specific goals: 1) to equip students to work in teams by providing them with training and feedback, 2) to equip faculty to manage student teams by providing them with information and tools to facilitate best practices, and 3) to equip researchers to understand teams by broadening the system's capabilities to collect additional types of data so that a wider range of research questions can be studied through a secure researcher interface. The three goals of the project support each other in hierarchical fashion: research informs faculty practice, faculty determine the students' experience, which, if well managed based on research findings, equips students to work in teams. Our strategies for achieving these goals are based on a well-accepted training model that has five elements: information, demonstration, practice, feedback, and remediation.

Different outcomes are expected for each group of people. For the students, both individual outcomes, such as student learning, and team outcomes, such as the development of shared mental models, are expected. For the faculty, individual outcomes such as faculty learning and faculty satisfaction are expected. The outcomes for researchers will be community outcomes, that is, benefits for stakeholders outside the research team, such as generating new knowledge for teaming theory and disseminating best practices. Measuring these outcomes is the basis for the project's evaluation plan.

Research Overview. The broad and deep scope of the proposed SMARTER Teamwork research is summarized in Figure 1. The figure addresses the project's three broad research goals, people impacted, strategies for achieving the goals, and measureable outcomes.

Goals. The proposed work has three goals: 1), equip students to work in teams; 2), equip faculty to manage teams; and 3), equip this research team to understand student teams. These goals support each other in hierarchical fashion: research informs faculty practice, faculty determine the students' experience, which, if well managed based on research findings, should equip students to work in teams.

People. People are the groups that will use the proposed system: students, faculty, and researchers. The hierarchy of people reflects the hierarchy of goals: the work of the research team supports the work of faculty, which in turn supports the work of students and their teams.

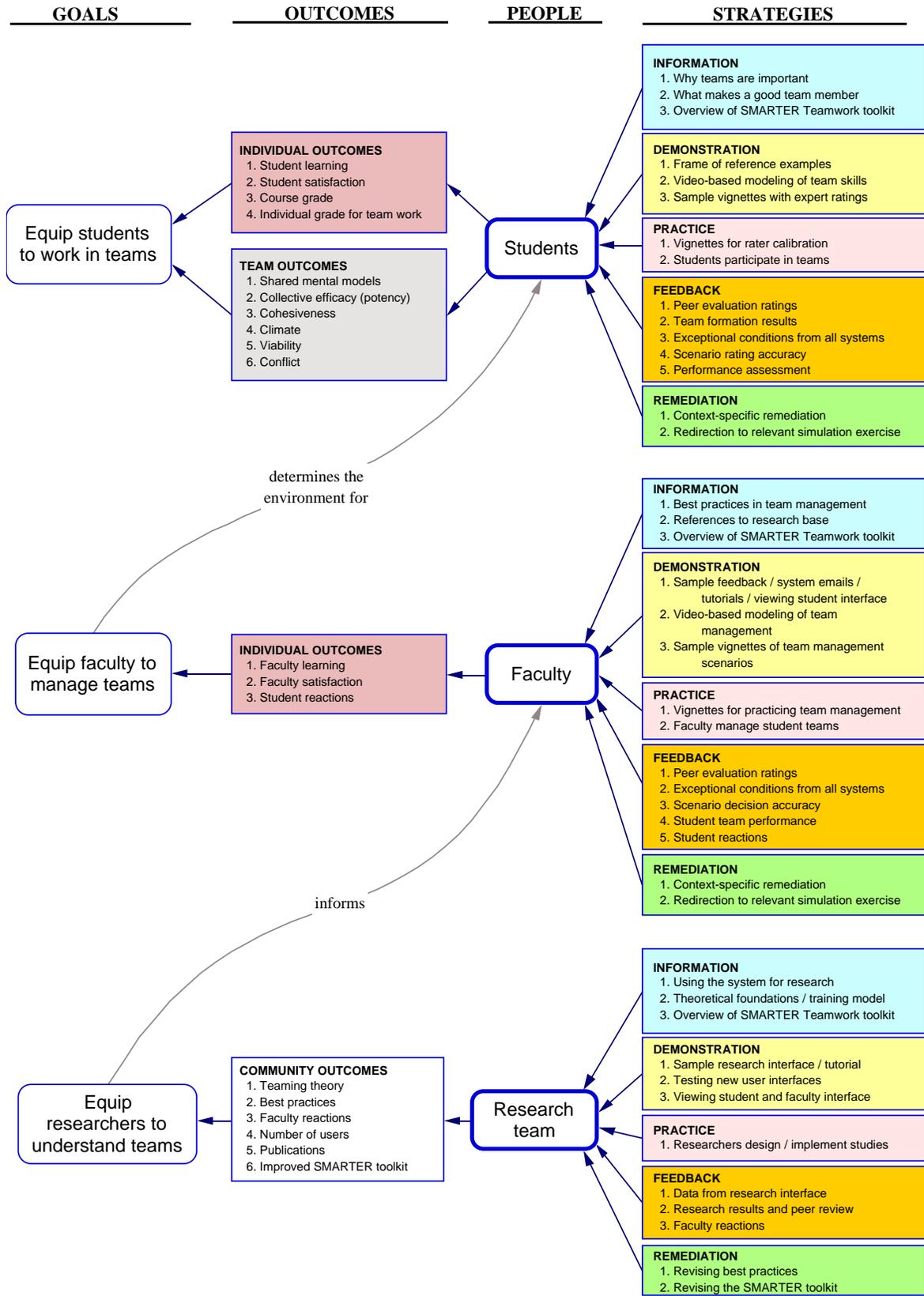


Figure 1. System for the Management, Assessment, Research, Training, Education, and Remediation for Teamwork

Strategies. For each group of people — students, faculty, and researchers — we developed strategies for achieving our goals based on a well-accepted training model that has five elements: information, demonstration, practice, feedback, and remediation. By following this model, we will enable the people affected by the system to become proficient in teamwork (all users), managing teamwork (faculty and researchers) and creating new knowledge about teamwork (researchers).

Outcomes. Different outcomes are expected for each group of people. For the students, both individual outcomes, such as student learning, and team outcomes, such as shared mental models, are expected. For the faculty, individual outcomes such as faculty learning and faculty satisfaction are expected. The outcomes for the research team will be community outcomes, that is, benefits for stakeholders outside the research team, such as generating new knowledge for teaming theory and disseminating best practices. Measuring these outcomes is the basis for the project’s evaluation plan.

HIGHLIGHTS OF THE PAST YEAR

- Continued growth of the CATME and Team-Maker user base;
- System improvements, including repairs addressing usability concerns;
- Progress toward development of the SMARTER system;
- Development of material for training vignettes, including selection of video clips for training using video-based modeling and video vignettes, permissions for using the video clips has been granted;
- Further progress on databases of literature on team formation and (separately) peer evaluation;
- Multiple workshops promoting the system were conducted, with more scheduled.

CONTINUED GROWTH OF THE CATME AND TEAM-MAKER SYSTEMS

The growth in users of CATME and Team-Maker system has been substantial. Since October 2005, 1144 instructors have registered to use the system at 321 different institutions to collect ratings from 51,895 unique student users. As shown, system use has grown dramatically.

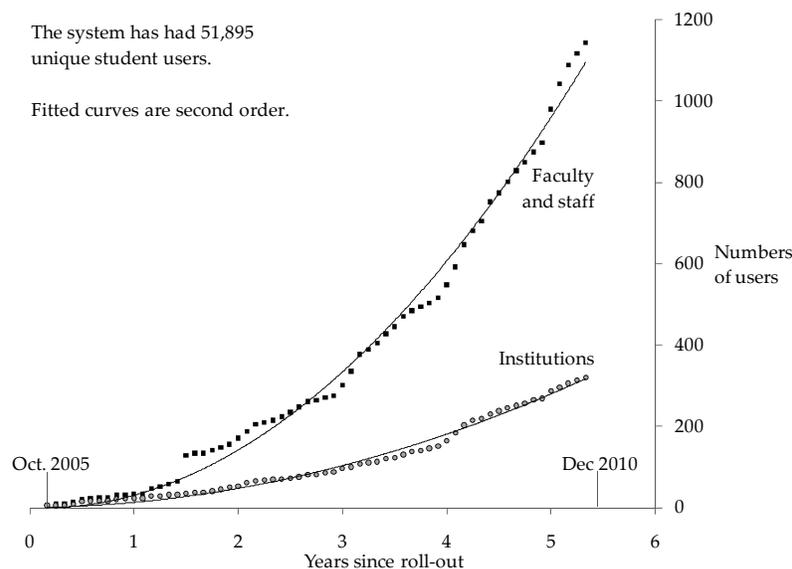


Figure 2. Growth in the Number of Faculty and Institutions using CATME Team Tools.

The most recent growth in system use has introduced an interesting complication—as the user base expands, it extends beyond “early adopters,” who are comfortable manipulating the interface with little guidance. Rather, the most recent users are more likely to seek help getting started, which can be quite time-consuming. Rather than divert resources to technical support, a usability study of the interface (scheduled as part of this project) has revealed opportunities to make the interface more accessible to a broader audience.

DEVELOPMENT OF MATERIAL FOR TRAINING VIGNETTES

The use of critical incident analysis

The development of training vignettes is a central strategy for this project. Our plan was to use a critical incident methodology to identify a wide variety of team behavior to include in the vignettes. Originally developed by Flanagan,¹ the critical incident technique gathers specific, behaviorally focused descriptions of work or other activities. Bownas & Bernardin² assert that “a good critical incident has four characteristics: it is specific, focuses on observable behaviors exhibited on the job, describes the context in which the behavior occurred, and indicates the consequences of the behavior.” Thus, a good critical incident describes behaviors, rather than traits or judgmental inferences. Normally, critical incident data are collected by asking subject matter experts to describe particularly effective or ineffective behaviors from their experience, a content analysis identifies underlying dimensions of performance, and the critical incidents are rewritten to highlight the underlying dimensions that were found. In this work, a critical incident was used to develop the behaviorally anchored rating scale for the CATME instrument as well as the sample vignette developed earlier. In this stage of the research, it is important to develop additional vignettes, but subject matter experts close to this work were struggling to identify enough critical incidents to support the development of a large pool of behaviors aligned with the dimensions of the CATME instrument.

Identifying behavioral descriptions from student comments

The research team has identified another source of behavioral descriptions that can be used for vignettes—from student comments about their teammates. Large numbers of peer evaluations have been conducted, and the research team has access to a large volume of comments students have made about their teammates. These comments are a rich source of behavioral descriptions. A large volume of student comments has been processed by two undergraduate researchers to distill those comments down to essential behaviors. This task is ongoing and has been taken over by a graduate assistant at Purdue. This process requires:

- Deleting non-behavioral comments (e.g., “Nice guy!” and “nothing to say, really.”);
- Eliminating redundant phrasing to isolate a superset of unique behavioral descriptions;
- Reducing all comments to the most basic elements representing a single behavior; and
- Removing all names and pronouns.

Building vignettes from individual behavioral comments

As the comments are processed, graduate students at the University of Central Florida will convert those behavioral elements into phrases that remain gender neutral, but are complete

sentences. Calibration ratings for each behavioral phrase will be determined by subject matter experts. Where there is significant disagreement about the category to which a behavior is assigned or the rating level, behaviors will be deleted as ambiguous. In preliminary work, the software developer has designed a system that will piece together a collection of behavioral phrases into a comprehensive vignette that spans all the behavioral dimensions measured by CATME.

PROGRESS ON DATABASES OF LITERATURE

Databases of literature on both team formation and peer evaluation are being developed. While these resources are being developed, these are for internal use only. As they near completion, they will be released and faculty who use the database will have the opportunity to propose additions. The team has concerns that such a literature database will quickly grow stale, as new work emerges that must be added. The team discussed the ideal solution to this problem would be an automated system that is trained to perform certain search tasks regularly to dynamically update the database. The development of such a system would be well beyond the scope of this grant, so the team will look for opportunities to leverage this work.

PUBLICATIONS (Journal and Conference)

- Ohland, Matthew W., Richard A. Layton, Misty L Loughry, Hal R. Pomeranz, Eduardo Salas, David J Woehr, "SMARTER Teamwork: System for Management, Assessment, Research, Training, Education, and Remediation for Teamwork," *American Society for Engineering Education 2010 Annual Conference*.
- Ohland, Matthew W., Lisa G. Bullard, Richard M. Felder, Cynthia J. Finelli, Richard A. Layton, Misty L. Loughry, Hal R. Pomeranz, Douglas G. Schmucker, David J. Woehr, "The Comprehensive Assessment of Team Member Effectiveness: Development of a Behaviorally Anchored Rating Scale for Self and Peer Evaluation," Academy of Management 2010 Annual Meeting.
- Ohland, M.W., M.L. Loughry, D.J. Woehr, C.J. Finelli, L.G. Bullard, R.M. Felder, R.A. Layton, H.R. Pomeranz, and D.G. Schmucker, "The Comprehensive Assessment of Team Member Effectiveness: Development of a Behaviorally Anchored Rating Scale for Self and Peer Evaluation." In review, *Academy of Management: Learning & Education*, Manuscript ID: AMLE-RR-2010-0056.
- Layton, R.A., M.L. Loughry, M.W. Ohland, and G.D. Ricco, "Design and Validation of a Web-Based System for Assigning Members to Teams Using Instructor-Specified Criteria," *Advances in Engineering Education*, 2(1), Spring 2010, pp. 1-28.
- Zhang, B., and M.W. Ohland, "How to Assign Individualized Scores on a Group Project: an Empirical Evaluation," *Applied Measurement in Education*, 22(3), 2009.
- Layton, R.A., M.L. Loughry, and M.W. Ohland, "Design and Validation of a Web-Based System for Assigning Members to Teams Using Instructor-Specified Criteria," accepted with revisions to *Advances in Engineering Education*, September 10, 2008, MS AAE-09-078.
- Meyers, K., S. Silliman, M. Ohland, "Comparison of Two Peer Evaluation Instruments for Project Teams," *Proceedings of the American Society of Engineering Education Annual Conference*, Pittsburgh, PA, June 2008.

PRESENTATIONS

- Ohland, M., “Managing Teams,” Project-Centered Learning Symposium, Cambridge -MIT Institute, <http://web.mit.edu/cmi/ue/workshop2008/>, March 18, 2008.
- Layton, R.A., M.L. Loughry, M.W. Ohland, and H.R. Pomeranz, *Assigning Students to Teams: Scholarship, Practice, and the Team-Maker Software System*, ASEE/IEEE Frontiers in Education Saratoga, NY, October 22, 2008.
- Pomeranz, H.R., *Managing Student Teams Scholarship, Practice, and the Team-Maker/CATME Applications*, Faculty Brown Bag Lunch Series, Oregon State University, February 20, 2009.
- Layton, R.A., M.L. Loughry, M.W. Ohland, H.R. Pomeranz, “Resources for Student Teams: The Team-Maker and CATME systems (and why they work),” Academy of Process Educators Conference, Gaston College, July 9, 2009.
- Ohland, M.W., “Tools for Teams,” invited workshop, Wichita State University, October 30, 2009.
- Ohland, M.W., “Teams: creating a community of learning through peer accountability,” invited talk, November 20, 2009, Clemson University Environmental Engineering and Environmental Science.
- Layton, R.A., M.L. Loughry, M.W. Ohland, “The Effective Management of Student Teams Using the CATME/Team-Maker System: Practice Informed by Research,” invited to Capstone Design Conference 2010, June 7-9, 2010: Boulder, CO.
- Layton, R.A., M.L. Loughry, M.W. Ohland, “Research into Practice: Tools for Effective Management of Student Teams,” workshop at *American Society for Engineering Education 2010 Annual Conference*.
- Ohland, Matthew W., Richard A. Layton, Misty L Loughry, Hal R. Pomeranz, Eduardo Salas, David J Woehr, “SMARTER Teamwork: System for Management, Assessment, Research, Training, Education, and Remediation for Teamwork,” *American Society for Engineering Education 2010 Annual Conference*.
- Layton, R.A., M.L. Loughry, M.W. Ohland, H.R. Pomeranz, “Workshop on the Effective Management of Student Teams Using the CATME/Team-Maker System,” submitted to INGRoup (Interdisciplinary Network for Group Research) Conference, Arlington, VA, July 22-24, 2010.
- Ohland, Matthew W., Lisa G. Bullard, Richard M. Felder, Cynthia J. Finelli, Richard A. Layton, Misty L. Loughry, Hal R. Pomeranz, Douglas G. Schmucker, David J. Woehr, “The Comprehensive Assessment of Team Member Effectiveness: Development of a Behaviorally Anchored Rating Scale for Self and Peer Evaluation,” Academy of Management 2010 Annual Meeting, paper #13912, Cross Divisional Paper Session, “Research Methods: Construct and Scale Development in Organizational Behavior and Networks,” August 9, 2010, 1:15-2:45 pm.
- Ohland, Matthew W., Alessio Gaspar, and Cen Li, “Building Teams and Learning Communities,” Workshop W55, Pedagogy Track, 2011 CCLI PI Conference, Session B, January 27, 2011, 3:30-4:45 p.m.
- Loughry, Misty L., Ohland, Matthew W., and Pomeranz, Hal R., “The Effective Management of Student Teams: Practice Informed by Research and Facilitated Using the CATME/Team-Maker System,” Preconference workshop at The SoTL Commons: A Conference for the Scholarship of Teaching & Learning, Statesboro, GA, March 8, 2011.

- Lyons, Rebecca, and Piccolo, Ron, “Applying Science to Improve the Teaching of Teamwork in Classrooms,” Society for Industrial and Organizational Psychology (SIOP) Symposium, Chicago, IL, April 10-12, 2011.
 - Ohland, Matthew W., “Team Formation: Alternative Methods for Assigning Students to Teams.”
 - Loughry, Misty L., and Woehr, David J., “Self/Peer Evaluations of Member Contributions: Benefits, Risks, and Unresolved Issues.”
 - Lyons, Rebecca, Bedwell, Wendy L., Salas, Eduardo, and Heyne, Kyle, “Teamwork in the Movies: Applying Science to Instructional Design.”
- Ohland, Matthew W., Daniel M. Ferguson, Richard A. Layton, Misty L Loughry, Hal R. Pomeranz, Eduardo Salas, David J Woehr, “SMARTER Teamwork: System for Management, Assessment, Research, Training, Education, and Remediation for Teamwork,” in review, *American Society for Engineering Education 2011 Annual Conference*.
- Team-Based Learning and Peer Evaluation in Management Education: Issues, Challenges, and Solutions, Symposium at Academy of Management Annual Conference, San Antonio, TX, August 12-16, 2011.
 - Loughry, Misty L., “The Compelling Need to Do Team-Based Learning Well and Why It Is Challenging.”
 - Ohland, Matthew W., “Assigning Students to Teams.”
 - Woehr, David J., “Self and Peer Evaluation of Team-Member Contributions.”
 - Lamm, Eric, and Petkova, Antoaneta, “Teaching and Assessing Team Member Skills.”
 - Madden, Timothy, and Collins, Mark, “Peer Evaluation in Management and Marketing Classes at University of Tennessee.”

OTHER DISSEMINATION

- Team-Maker / CATME flyers distributed at Mudd Design Workshop, May 2009, Claremont, CA, and the INGRoup Interdisciplinary Network for Group Research conference in Colorado Springs, CO, in July 2009.
- Richard Layton will champion the development of presentation resources so that other members of the team can effectively promote the use of the system. Further, our “power users” – those who use the system frequently and who are very excited about using it – might be able to give presentations on behalf of the team (particularly to smaller groups of faculty at their own institution).
- Hal Pomeranz will investigate the possibility of user group conference at San Francisco State University. Depending on the success of such an event, there are active user communities at University of Southern Maine, Rose-Hulman Institute of Technology, Georgia Southern, and other sites. A multi-site EPICS conference might be possible. Matt Ohland will visit San Francisco State during June 2011 to explore this possibility.

REFERENCES

1. Flanagan, J.C. (1954). The Critical Incident Technique. *Psychological Bulletin*, 51, 4, 327-358.
2. Bownas, D. & Bernardin, H. (1988). Critical Incident Technique. In Gael, S. (Hg.). *The job analysis handbook for business, industry and government*, 2. New York: Wiley, 1120-1137.