TEAMWORK FROM TEAM TRAINING: NEW DIRECTIONS

Eduardo Salas
Arthur R. Blaiwes
Richard E. Reynolds

Human Factors Division
Naval Training Systems Center
Orlando, FL

and

Albert S. Glickman
Ben B. Morgan, Jr.
Old Dominion University
Norfolk, VA

ABSTRACT

The Human Factors Division of the Naval Training Systems Center has initiated a systematic R&D effort to address three prevailing problems in the areas of team training and team performance. These are the lack of: (1) conceptualization and integration of team research studies; (2) a sound team performance measurement system; and (3) research dealing with team processes. Specifically, this paper describes two unique and innovative projects aimed at solving the above problems and at providing the much needed guidelines for training operational military teams. Discussion as to whether existing team training programs teach teamwork (i.e., are we there yet?) is provided.

Introduction

Over the past forty years, team performance research has been of recurrent interest to scientists, engineers, military personnel and managers. Task forces, quality circles, autonomous work groups, project teams and training of teams have become more prevalent in organizations as a way to enhance organizational effectiveness. Many fields like psychology (military, organizational and engineering), sociology, instructional systems development and engineering have devoted considerable effort and resources to the study of team performance (Dyer, 1984[6]; Hackman, 1976[13]). Early experimental research made significant advances in conceptual approaches to team training and performance requirements of teams (Glaser & Klaus, 1963[7]; Horrocks, Heermenn, Krug, 1961[16]; Briggs & Naylor, 1965[3]). Nevertheless, many theoretical and practical problems beset research related to teams, and important gaps remain in the research available in support of training and performance of teams, especially operational military teams.

In light of this, the purpose of this paper is twofold: (1) to outline and briefly discuss some of the problems related to the study of team performance and the implication of these problems to military team training; and (2) to describe and highlight the important contributions of a research program designed to address some of the noted problems. Critical concluding remarks to the Fleet and other R&D practitioners are also given.

Team Research: Problems for Team Training

Recent literature reviews by Denson (1981)[5], Dyer (1984)[6], Nieva, Fleishman & Reich (1978)[20], have outlined many problems associated with efforts to study and improve team performance. The scope of this paper limits discussion on all problems in the area. For more extensive discussion on team issues, the reader is referred to Denson, 1981[5]; Dyer, 1984[6] and Hall & Rizzo, 1975[15].

Three problems are emphasized in the current review because of their apparent relevance and impact on the derivation of team training guidelines for military applications. First, there is a large body of research in both military and industrial settings without sound conceptualization, methodology or conclusive results. There have been literally thousands of research studies on team performance. Most of the research describes what occurs within a team or provides empirical association among variables such as group size or leader qualities that characterize a team and its performance context (Hackman, Brousseau & Weiss, 1976[12]; Hackman, 1976[13]). However, much of this research has not been designed and conceived to generate knowledge that can be used to develop, train or manage teams. This problem is exacerbated by constraints or variables in the team performance domain that have not been operationally defined consistently in different "schools of thought," thereby hindering the accumulation of research and knowledge.

Conceptualization and cumulation of findings related to team performance is difficult also, because of an over-emphasis on laboratory research. Although this type of research has its merits (Hackman, 1983[11]), its generalizability to operational environments is questionable, especially to military teams. Dyer (1984)[6] discusses 11 characteristics that distinguish military teams research from small-group research, which is the primary focus of laboratory studies. These differences may seem irrelevant or trivial but do present a challenge to field researchers and to those trying to draw from laboratory research to impact the environment of operational teams. In sum, these shortcomings - lack of conclusive results and the non-representativeness of laboratory research - are the biggest detriments to the derivation of guidelines that can help in the design of programs for improving team performance.

A serious deficiency resulting from the conceptual and methodological problem for the training community is perhaps the lack of suitable techniques for measuring team performance. This is an area that has been more talked about than acted upon and is the second major problem to be considered. Researchers offer team performance measurement systems for use in different task contexts, but the systems often do not promote team training objectives. As Denson (1981)[5] notes, the various techniques reflect differences in team definition and functions, which currently limit their usefulness. For the most part, traditional measures or criteria refer to the number of exercises completed per unit time or other summary outcome measures (e.g., hit or miss). They say little about the level of skill attainment, the quality of performance or the effectiveness of component team processes, and hence, provide little information about what is specifically learned during training (Hall & Rizzo, 1975[15]). There are, as stated before, several methodologies that could be useful for quantifying team performance and processes (Denson, 1981[5]), but their applications to specific training needs have not yet been adequately demonstrated.

Finally, and perhaps most importantly, the third problem of concern for team training is a lack of understanding about how various patterns of member interaction and relationships develop, change and affect team effectiveness during the life cycle of the team. That is, very little systematic, empirical research has addressed the process of team performance to show what facilitates or hinders the acquisition of team skills and the development of effective teams. Hackman and Morris (1975)[14] state "...something important happens in group interaction which can affect performance outcomes." (p. 49). Similarly, Hall & Rizzo (1975)[15] argue that everyone can recognize a good team, but not one can tell you why. Furthermore, earlier investigations (Bass, 1982[1]; Dyer, 1984[6]) have largely failed to account for the facts that: (1) through common experiences across a span of time, teams evolve strategies, styles and patterns of interaction which determine differences between teams in behavior and effectiveness; and (2) teams learn to operate in an open systems context where performance is influenced by many exogenous variables in addition to internal structures, processes, goals and tasks.

Collins (1977[4]) lists several issues which could be the "something" and the "why" -- the processes -- as well as demonstrating the degree of interaction existing between team performance and team training. First, improving the performance of teams requires understanding of the interactions of the team. This understanding can only be achieved through a task analysis which is comprehensive enough to include group tasks/skills, ability and knowledge requirements for group tasks as well as for individual tasks. Second, team tasks vary along several formal and informal dimensions of technical and social requirements. It is necessary to acknowledge the existence of these tasks and to prepare for the real-world inevitability of their existence and impact. Third, there exists a large number of input, process, performance variables and evaluation strategies. Fourth, it is important to recognize the difference in, and existence of, individual and group goals. The degree to which these are congruent will impact heavily upon the success or failure of any team effort. Fifth, it is necessary to foster the development of commitment to the group over and above the needs of the individual. Sixth, it is imperative that individual contributions - in terms of task performance - be acknowledged as part of the overall effectiveness of the group and as such, become an integral part of total team performance. It is necessary for team performance criteria to encompass the totality of the situation. This includes not only training criteria, but the dynamics of change brought about by variables such as crew turnover, change in rank and tasks during actual operations.

In summary, the three problems discussed above present challenges to the military team training community. As stated before, the military places high priority on team skills and invests significant resources in training systems to develop team skills. However, with a lack of team training guidelines or performance measurement systems, these training programs typically provide students with opportunities to practice individual skills in a team context, rather than teach skills specific to team interaction. They fail to address interactive processes basic to teamwork in, for example, a multi-threat environment of at-sea exercises. As a consequence, the instruction of team skills that does occur tends to be unsystematic and inconsistent.

The following section describes a systematic research program on team training and performance that focuses on answers to the above problems and training issues.

Current R&D on Team Training and Performance

The Human Factors Division of the Naval Training Systems Center has initiated a systematic R&D program on team training and performance which includes efforts that range from basic research through engineering development. Two programs will be outlined here: (1) a meta-analysis of the team performance literature; and (2) the Team Evolution and Maturation (TEAM) project.

Meta-Analysis of Team Training and Performance. Because the large number of studies in the team performance literature is not well integrated and has not generated principles useful for team training (i.e., no cumulative knowledge), a better integration of findings is needed.

The recent emergence of innovative approaches to research integration, called meta-analysis, makes this solution feasible. Glass (1976)[8] proposed the term meta-analysis to refer to the "statistical analysis of a large collection of analyses results from individual studies for the purpose of integrating the findings" (p. 3). It is not only a collection of quantitative studies, but rather a systematic approach to the problem of integrating a common research domain. Briefly, Glass, McGaw and Smith (1981)[9] and Hunter, Schmidt and Jackson (1982)[17], described this analytical procedure as: (a) the gathering of published and unpublished literature; (b) extracting information from the studies (with the aid of a carefully

developed code sheet and book); (c) cumulating findings by generating a common metric to represent the size of effects obtained in individual studies (i.e., Pearson r, mean difference); and (d) correcting the distribution generated for several statistical artifacts (see Glass et al, 1981[9]; Hunter et al, 1982[17] for further details).

Efforts on this project have produced a meta-model that depicts the variables that influence team performance. This working theoretical model has been used to focus the meta-analysis research and to identify the domain to be included (i.e., variables in literature impacting team training and performance). Also, an exhaustive search was undertaken to locate research studies that test the components of the model. This search identified over 2,200 studies that are currently being evaluated by several researchers for reliability purposes based on several criteria (e.g., focus on team, empirical in nature, military relevance and some indicator(s) of performance) to determine whether or not they are relevant to the meta-analysis. Next, the code sheet and book will be developed for extracting the characteristics and data from each study. Multiple readers (coders) will be involved in this process to assess reliability and ensure consensus on definitions and conceptualizations of variables involved. Finally, data analyses will be performed and conclusions drawn based on the magnitude of various associations (e.g., team size and performance).

Contributions of Meta-Analysis to Team Training. This technique provides a more rigorous, and more accurate, alternative to typical qualitative and subjective narrative discussions that attempt to integrate related research studies. Moreover, meta-analysis has significant payoffs and implications for team performance research. First, by integrating and summarizing the team performance literature (by aggregating relationships among set variables), it will (a) provide empirical links for theory development; (b) provide recommendations for applications; and (c) establish critical points of departure for hypotheses for future R&D. Secondly, the empirical integration will enable scientists to draw sound conclusions from the research and will support team system design and procurement. Finally, results from this effort will provide avenues for R&D in surface warfare areas that could be implemented and tested with a research vehicle such as the Surface Warfare Advanced Training Technology (SWATT) testbed (Williams, Reynolds, & Salas, 1984)[21] and the project described below.

Team Evolution and Maturation (TEAM). Team training can be improved by teaching individual skills in individual contexts and focusing instruction on team skills in team contexts. However, training specialists can offer little help in defining "team skills," in measuring their quality, or in designing training programs that foster their development.

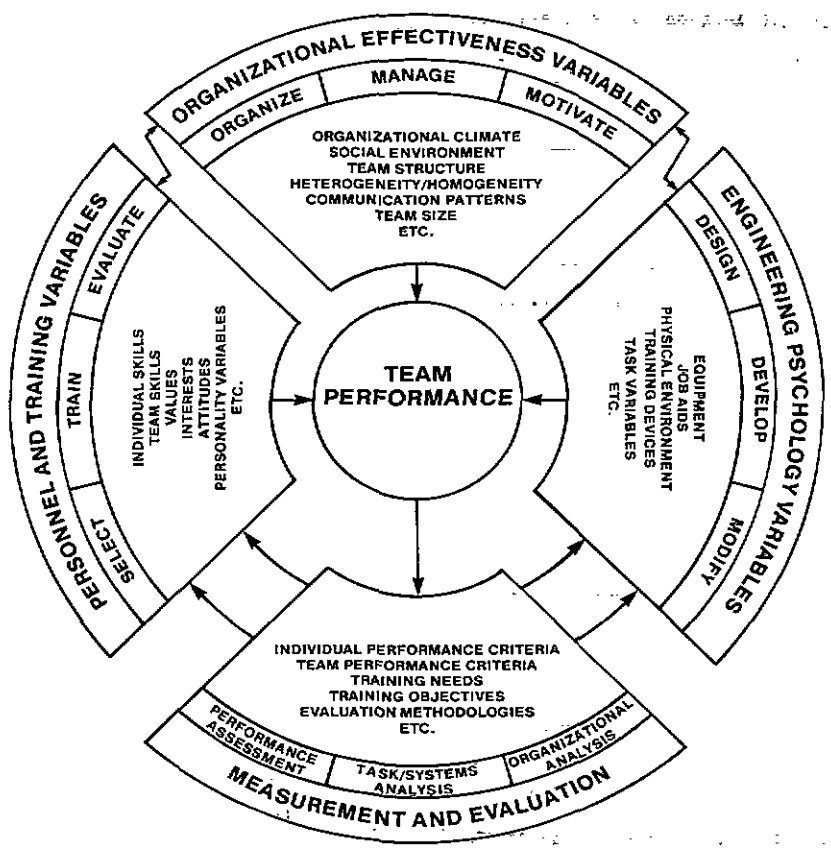

Figure 1. Classes of Variables Interacting to Influence Team Performance

A definition of "team" is presented below to guide the development of a conceptual model of team performance, the identification of variables to be studied, and the selection of research methodologies. Extracting from earlier sources (Bass, 1982[1]; Baum et al, 1981[2]; Denson, 1981[5]; Dyer, 1984[6]; Hall & Rizzo, 1975[15]; Knerr et al, 1980[18]; Morgan, Coates, Kirby, Alluisi, 1984[19]; Nieva et al, 1978[20]), this project defines a team as a relatively stable collection of interdependent individuals performing coordinated tasks directed toward the achievement of both specific task and team maintenance goals. The processes by which the team achieves these goals is a function of the interactions over time between: (1) the initial mix of individuals, in terms of their levels of skills, training, values, interests and motivation; (2) the physical and task environment, which incorporates job requirements, equipment and the physical environment; and (3) the organizational social environment, which includes such variables as team size and structure, motivational and communication networks, and interdependencies with other units and levels of the systems.

Figure 1 depicts, in cross-section, these three classes of variables which interact to influence team performance. However, we believe that a still broader conceptual scope is needed to complete the picture of team performance in the military environment.

Research Thrust. Traditionally, teamwork is taught by giving learners opportunities to practice individual skills in a team context, rather than in terms of specific team skills. This training is inefficient because individual skills are learned better in individual contexts, and team skills are learned better where instruction focuses on such skills (rather than expecting their development to occur as an incidental product of general task practice).

To focus instruction on team skills, training designers need first to identify tasks that are learned best in team contexts and then, to define and measure behaviors essential to the performance of those tasks. The design of instruction for teaching team skills is based on products from these initial analyses. Techniques for performing these analyses and design processes for team training are available, but very little information is available regarding their use and value for developing team training programs. These techniques should provide a conceptual model or framework for identifying and classifying team performance variables. Without such framework, piecemeal research will continue to dominate the literature, lacking focus and relevance.

A basic need is for a standardized, objective and relevant team performance measurement technology to be used in training and on the job. Current criteria or team performance provide mainly summary outcome measures such as reaction time or accuracy which say little about acquisition of component team processes.

A special issue concerns the need to train military teams (especially tactical ones) and to measure their performance in terms of particular conditions of performance. For example, research should include training implications from an individual member's expectations of other team members' requirements, capabilities and limitations.

In efforts to address teams processes as well as implications from Collins (1977)[4], we draw from Denson (1981)[5] examples of the kinds of questions which need to be asked:

- What kind of individual behavior can be expected at various stages of combat team development?
- How can instructors recognize these stages and evaluate performance relative to the stage of development? What processes can be used to bring about positive changes in team behavior?
- How can understanding of these stages of team development and their associated behaviors improve team performance?
- What factors can improve the rate and level of development of the team?
- How can team training efficiency be improved in situations where all team members are not at the same stage of development?

In addition, Dyer (1984)[6] calls for comparisons of the effectiveness of different training programs. By comparing different programs with different samples of teams under different environmental conditions, it will be possible to develop training criteria and standards for success unique to teams. As Dyer states, this is a time and resource consuming task which should only be conducted after the type of thorough initial investigation outlined here.

Only a longitudinal *in situ* investigation will identify the unique developmental patterns of coordination and adaptation in military teams and the resultant activity patterns and skills which are manifested in effective performance.

Our preliminary model of the TEAM process is based on an open systems framework of organizational effectiveness adopted from Glickman, Goodstadt, Kavanagh, and Bass (1977)[10]. As depicted in Figure 2, team performance (and skill acquisition) is viewed as a dynamic activity of process-outcome linkages occurring within an environmental envelope of organizational and other exogenous forces. Our research program is guided by several assumptions upon which this conceptualization is founded: (1) we are dealing with processes that are continuing or changing over time; (2) these processes embrace continual process-outcome-process-outcome sequences (intermediate outcomes serving as inputs for continuing processes); (3) as a result of experience within the team, team members learn team-oriented aspects of team tasks that demand from them adaptive, interdependent actions; and (4) the experience and learning acquired by the team over time will result in changing behavior patterns.

Contributions of TEAM to Team Training. The general focus of the program of research described above is the evolution and maturation of military teams. The proposed research aims

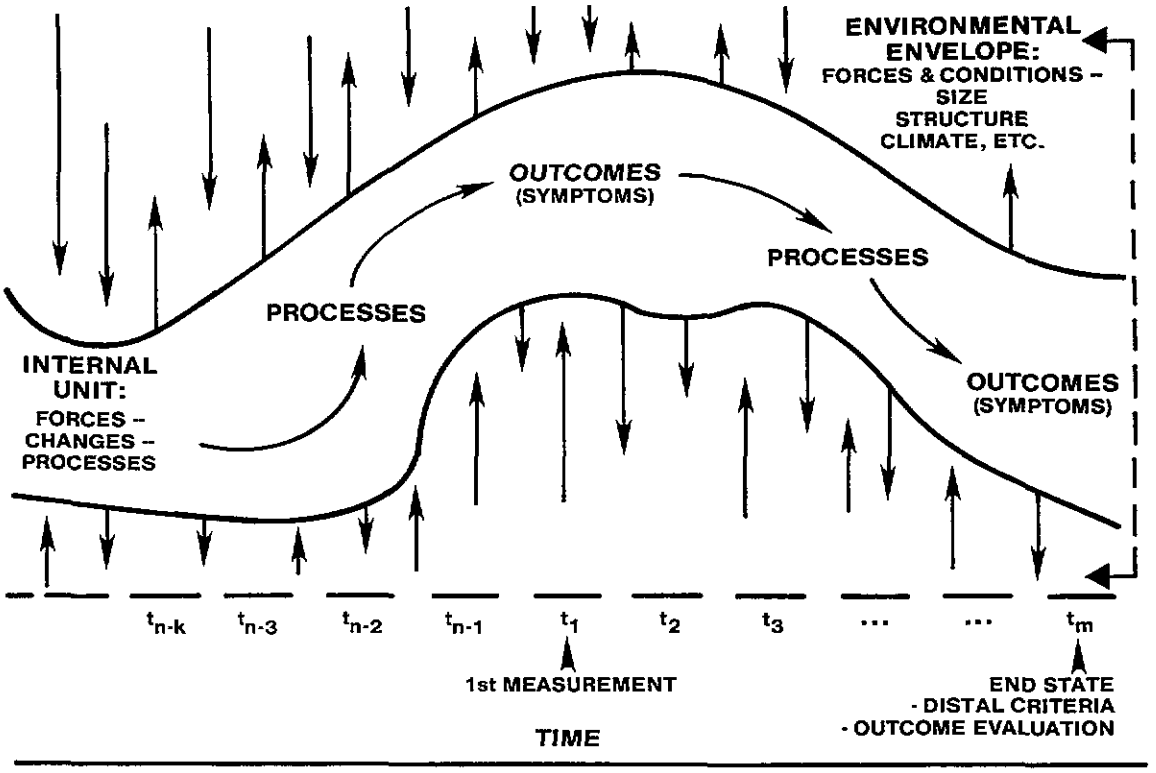

Figure 2. Dynamic Organizational Change Model

to identify team skills and processes that result in effective team performance and team training procedures that contribute most to the efficient development of those skills and processes. The primary effort in this project is being devoted to: (a) developing a model of team evolution and maturation; (b) developing techniques and evaluating schemes capable of measuring the development of team processes and skills related to successful task accomplishment; and (c) validating the measurement system with a variety of types of teams. These models and techniques will be applied in a team training framework, in order to provide measures of team skill levels along several dimensions during different phases of training and specific guidance for training interventions to correct deficiencies and enhance performance. To make the results most applicable to the military, operational teams in training will be used as the testbed of study.

Team training is costly, because of the large number of components involved. This project can reduce these costs by eliminating unnecessary training practices that drive costs up but do not contribute to the learning of team skills. It can also reduce costs of poor team performance in operational environments resulting from inadequate training of team skills. These costs tend to be especially high, since the performance effectiveness of individuals depends on the quality of teamwork.

In sum, the current project is an effort to improve team training in the military by developing techniques for identifying tasks that are learned best in team situations, and for defining and measuring team behaviors via an in situ longitudinal framework essential to the performance of those tasks. These analyses will provide the basis for designing instruction (e.g., practice, cuing, feedback, reinforcement) and instructor aids (e.g., training guides, behavioral checklists) for teaching team skills. Emphasis is being placed on the development of standardized, objective, and relevant measures of specific team skills to supplement summary outcome measures which say little about acquisition of the component team processes.

Conclusions

The problems associated with team training identified in this paper suggest that we need to reach out and point to a new and better basis for team training and evolve to improve methods of teaching teamwork. The paper criticizes team training technology for lacking an acceptable model or definition of what good team training actually is, as well as methods for assessing how well team training is working in specific situations. Without such definitions and methods, we -- the Fleet, sponsors, users, designers, and R&D practitioners -- will not know what we are after; how to best achieve it; nor how to measure progress toward achieving it. If we are not sure what we are trying to achieve nor what we have already achieved, how can we ever know whether we are there yet? In other words, we cannot yet precisely evaluate how well existing team training programs are teaching teamwork.

From experience with instruction of individual skills, we know that systematic instructional design based on suitable instructional objectives is the essence of instructional program development. Good instruction does not occur by chance. Because current systems for teaching teamwork are developed and used without such systematic approaches, they do not provide the basics needed. Teamwork apparently does develop from existing training programs, but the instructional process appears to be inefficient and ineffective by modern instructional standards.

We are not there yet, but the prognosis is good. In spite of the previously noted problems with team research, many of the elements for elevating team training to more modern standards do exist and need only to be refined and combined. Definitions of team performance and methods for developing team processes, albeit piecemeal, abound in the literature. This information will be integrated and conceptualized (through the meta-analysis process), and the conceptualizations will be refined and evaluated through operational demonstrations (in the TEAM project).

Efforts such as undertaken here are far from being small or easy. There are no easy solutions. In order to progress, we must understand, at least philosophically, that we are part of both the problem and the solution. We must work as a team, collaborate and exchange information (among all services); otherwise, ten years from now we will still be addressing the same issues. Furthermore, the training community has talked about the importance of teamwork and has spent major resources for developing teamwork without supportable bases for long enough. It is way past time for finding out exactly what we are talking about and whether we are achieving anything. We now need to know what teamwork is; what the extent of its involvement is in military tasks; how important it is to mission success; and how to assess and improve it. The team performance model discussed earlier and the project TEAM effort described above provide the impetus for many analytical based team development principles and teaching methodologies.

With such knowledge, the Department of Defense, for the first time, will be able to introduce team trainers that really are team trainers and not merely simulations that allow collective practice with the faith that team skills will develop "naturally" from the practice. These new designs could represent fundamental changes to team training approaches. The benefits would appear to be large, and the outcome could, in fact, point the way to a new order of magnitude in measurable, effective teamwork training and team development. In any event better defin- itions and methods will allow the military to assess its conceptions and practices related to teamwork and to redirect its team development program to more closely correspond with its goals.

References

1. Bass, B. (1982). Individual capability, team performance, and team productivity. Human Performance and Productivity, 1, 179-132.

2. Baum, D.R., Modrick, J.A., & Hollingsworth, S.R. (1982). Team Training for Command and Control Systems Executive Summary (Report No. AFHRL-TP-82-11). Minneapolis, MN: Honeywell Systems and Research Center.

3. Briggs, G.E. & Naylor, J.C. (1965). Team versus individual training, training task fidelity and task organization effects on transfer performed by three-man team. Journal of Applied Psychology, 49, 387-392.

4. Collins, J.J. (1977). A Study of Potential Contributions of Small Group Behavior Research to Team Training Technology Development. Alexandria, VA: Essex Corporation.

5. Denson, R.W. (1981). Team Training: Literature Review and Annotated Bibliography (Report No. AFHRL-TR-80-40). Wright-Patterson Air Force Base, OH: Logistics and Technical Training Division.

6. Dyer, J.C. (1984). Team research and team training: A state-of-the-art review. Human Factors Review, Chapter 8, Santa Monica, CA: Human Factors Society, Inc.

7. Glaser, R. & Klaus, D.J. (1963). Proficiency measurement: Assessing lunar performance. In R. Gagne (Ed.), Psychological Principles in Systems Development, pp. 419-476. New York: Holt, Rinehart & Winston.

8. Glass, G.V. (1976). Primary, secondary, and meta-analysis of research. Educational Researcher, 5, 3-8.

9. Glass, G. V., McGaw, B., & Smith, M. C. (1981). Meta-Analysis in Social Research. Beverly Hills, CA: Sage.

10. Glickman, A.S., Goodstadt, B.E., Kavanagh, M.S., and Bass, B.M. (1977). Support of ARI Research Program in Organiza- tional Effectiveness. Washington, DC: Advanced Research Resources Organiza- tion, 1977.

11. Hackman, J.R. (1983). A Normative Model of Work Team Effectiveness (Report No. 2). New Haven, CT: Yale School of Organization and Management.

12. Hackman, J. R., Brousseau, K. R., & Weiss, J.A. (1976). The interaction of task design and group performance strategies in determining group effectiveness. Organizational Behavior and Human Performance, 16, 350-365.

13. Hackman, J.R. (1976). Group Influences on Individuals. In M. Dunnette (Ed.), Handbook of Industrial and Organizational Psychology. Chicago, IL: Rand McNally.

14. Hackman, J.R. & Morris, C.G. (1975). Group tasks, group interaction process and group performance effectiveness. In L. Berkowitz (Ed.), Advances in Experimental Social Psychology, Vol. 8, pp. 45-49. New York: Academic Press.

15. Hall, E.R. & Rizzo, W.A. (1975). An Assessment of U.S. Navy Tactical Team Train- ing (Report No. TAEG 18). Orlando, FL: Training Analysis and Evaluation Group.

16. Horrocks, J.E., Heermann, E.F., & Krug, E. (1961). Team Training: III. An approach to optimum methods and proce- dures (NAVTRAEQUIPCEN 198-3). Port Washington, NY: U.S. Naval Training Device Center.

17. Hunter, J.E., Schmidt, F.L., & Jackson, G.B. (1982). Meta-Analysis: Cumulating Research Findings Across Studies. Beverly Hills, CA: Sage.

18. Knerr, C.M., Nadler, L., & Berger, L. (1980) Toward a Naval Team Taxonomy (Report No. AD-A097 945). Arlington, VA: Litton Mellonics.

19. Morgan, B.B., Jr., Coates, G.D., Kirby, R.H. & Alluisi, E.A. (1984). Individual and group performances as functions of the team-training load. Human Factors, 26(2), 127-142.

20. Nieva, V.F., Fleishman, E.A., & Rieck, A. (1978). Team Dimensions: Their Identity, Their Measurement and Their Relationships (Report No. DAHC 19-78-C-0001). Washington, DC: Response Analysis Corporation, Advanced Research Resources Organization.

21. Williams, K.E., Reynolds, R.E. & Salas, E. (1984). The application of advanced technology to surface warfare train- ing. Proceeding of the 6th Interservice/Industry Training Equipment Conference and Exhibition, 1, 243-248.

ABOUT THE AUTHORS

DR. EDUARDO SALAS is a Research Psychologist with the Human Factors Division, Naval Training Systems Center in Orlando, Florida. He has done research on training evaluation, human performance assessment, skill acquisition, and personnel psychology. He holds a Ph.D in Industrial/Organizational Psychology.

DR. ARTHUR S. BLAIWES is a Research Psychologist in the Human Factors Division at the Naval Training Systems Center. He received the Ph.D degree in 1967 in Experimental Psychology from the University of Kentucky. He has directed and engaged in research and development programs dealing with training system design and has consulted in the development of operational training programs. His current research emphasizes measurement and evaluation of human performance, computer-assisted instruction, cognitive processes, team training and pilot training. Dr. Blaiwes is a frequent contributor to the training literature.

DR. RICHARD E. REYNOLDS is an Experimental Psychologist with the Human Factors Division, Naval Training Systems Center. He has directed programs in maintenance training, surface and subsurface warfare training and aircrew training. He holds a Ph.D degree in Experimental Psychology from Miami University.

DR. ALBERT S. GLICKMAN, is Eminent Professor of Psychology and Head, Organizational Effectiveness Laboratory at Old Dominion University. His past positions include Vice President, Advanced Research Resources Organization, Washington, D.C.; Deputy Director, American Institute for Research, Silver Spring, Maryland; Chief, Personnel Research Staff, Department of Agriculture; and Director, Psychological Research Department, U.S. Naval Personnel Research Activity. His current areas of research interest are organization and management, and the effects of the changing composition of the work force.

DR. BEN B. MORGAN, JR., is a Professor of Psychology and Director of the Center of Applied Psychological Studies, Department of Psychology, Old Dominion University. He received his Ph.D (1968) in Experimental Psychology from the University of Louisville. His major research interests are human information processing, the effects of various stresses on human performance, the recovery of performance from decrements caused by those stresses, and the variables that influence the acquisition of skill in complex work situations.