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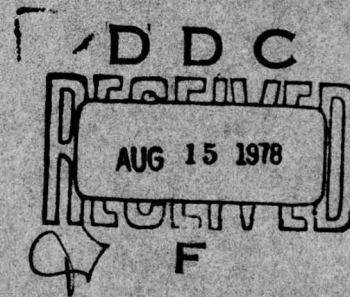
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MANAGEMENT LEADERSHIP IN SYSTEM
MEASUREMENT BEDS REVISITED

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U. S. Army
Research Institute for the Behavioral and Social Sciences

February 1978

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) More than 30 years of research by the Army on managerial leadership behavior confirms that the effectiveness of a unit or group depends critically on its leader or manager. The many variables which interact in effective leadership may be analyzed as parts of several different, interwoven systems. One of the most basic systems distinguishes between noncognitive and cognitive aspects of human performance. (The noncognitive deals with values and emotionally colored value judgments, and styles of action; the cognitive		

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deals with logic and facts that are demonstrably right or wrong). Another system distinguishes authoritarian and participative styles of management. A third focuses on types of selection, training, and job environment to produce effective worker performance.

Noncognitive aspects dominate in selection rating and ranking judgments, situational training, and organizational variables at the workplace. Cognitive aspects dominate in selection and school tests, school training, and human factors engineering at the workplace--all readily measurable. Army officer leadership research has developed realistic assessment processes for measuring noncognitive aspects of leader behavior in a "test bed" in which situational demands are defined and which yields constructs interrelating leader characteristics, leader behaviors, and situational requirements--the system measurement bed.

Research utilizing the system measurement bed has divided Army officer positions generally into the combat and the technical/managerial domains. Qualifications for these can be differentiated to give eight general personal leadership characteristics. The first six are dominantly noncognitive in nature: in the combat domain are (1) combat leadership, (2) team leadership, and (3) command of men; in the technical/managerial domain are (4) technical/managerial leadership and (5) executive direction; and cutting across both domains is (6) mission persistence. The last two personal characteristics are dominantly cognitive in nature: (7) tactical staff skills, in the combat domain; and (8) technical staff skills, in the technical/managerial domain.

Analysis of performance records of officers in a 3-day situational Officer Evaluation Center program indicated specifically that noncognitive motivational variables were better predictors of performance in combat situations, as cognitive factors were better predictors in technical/managerial situations. Further analysis showed that decisiveness of leader behavior is the most important factor in combat situations, whereas knowledge of military technology or of tactics is the most important factor in administrative or technical situations.

The system measurement test bed, then, can be used to study selected interactions of utilitarian variables to produce specific usable findings--in this case for the Army's leadership management program.

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TECHNICAL REPORT S-5

**MANAGEMENT LEADERSHIP IN SYSTEM
MEASUREMENT BEDS REVISITED**

J. E. UHLANER

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Office, Deputy Chief of Staff for Personnel
Department of the Army

February 1978

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MANAGEMENT LEADERSHIP IN SYSTEM MEASUREMENT BEDS REVISITED

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MANAGEMENT LEADERSHIP IN SYSTEM MEASUREMENT BEDS REVISITED

Over a long period of time, the US Army has made a very substantial investment in research dealing with the measurement, understanding, prediction, and development of management leadership behavior in a great variety of combat and technical/managerial environments.

The cumulative findings of three decades of leadership research amply justify the investment. Most impressive are the empirical results of a 1952 research effort by Havron¹ dealing with the effectiveness of squads and taking into account a huge number of variables, too numerous to detail here but in gross terms reflecting squad leadership, inter-squad communication, intra-squad relationships, motivation, and role perceptions. The dramatic conclusion was that the major portion of the explained variance of squad effectiveness was due to the performance of the squad leader. Since that early effort, other research has confirmed the important and critical contribution made by the management leader, whether in a combat or in a technical/managerial situation, with respect to execution of the overall mission by the entire team or unit.

Over the years, the classes of significant variables in the management leadership situation have emerged as almost overwhelmingly numerous and complex--much more complex than in most problems facing the Army. Minimally, concern with the management leader is in relation to the group or team he heads: the functions of the group, the cognitive and noncognitive characteristics of its members, the style the leader has developed or the style that may be imposed by the system in which he and his team are embedded. Other variables of critical importance in the leader management situation are the pattern of prevailing supervisory behavior, the characteristics of the tasks and the jobs to be performed, the characteristics of the employees, the job environment (stressful or nonstressful), the organizational climate (authoritative, permissive, or mixed), the missions to be accomplished (specific and short term or broad and ambiguous), and the methods used to enhance group morale. Figure 1 displays these variables in the context of type of management situation.

These and many more variables make for a rich research base, which has not only caught the attention of dozens of research psychologists but has also led to a number of substantial research programs, including some in industry, in which relevant questions relating to management leadership have been examined.

¹ Havron, M. Dean, Greer, F. L., and Galanter, E. H. An Interview Study of Human Relationships in Effective Infantry Rifle Squads. Army Research Institute Research Report 983, December 1952.

Pattern of Supervisory Behavior or Style	Characteristics of Tasks & Jobs To Be Performed	Employee Characteristics	Job Environment	Situational Organizational Climate	Goals	Enhancement of Group Morale
BENIGN AUTHORITARIAN ¹						
Job-centered	Tasks and jobs highly structured	Relatively unskilled	Stressful	Authoritarian	Specific and definite	Rewards given as "goodies"
High initiating structure	Routinized and amenable to automation	Relatively uneducated	Rapid response required	Acceptance of authoritarianism as way of efficient production	Short term	Fairly concrete rewards and punishment; group progress highlighted (lower end of need hierarchy)
Firm but fair instructions and discipline	"Human engineering" tends to be applicable	Relatively rigid and compulsive	Monotonous	Often many layers and "boxes"	Group goals common	Organization provides supervisors high in initiating structure
Consistent behavior	Jobs tend to be frozen	Anxious and insecure	"High initiating structure"	Emphasis on initiating structure for efficiency	Deadlines and production measures important	Group cohesion through extra-curricular activities
	Short training requirements	Good followers	Physical and psychological fatigue more common			Unambiguous instructions and objectives
						Fringe benefits
DEMOCRATIC, PARTICIPATIVE, OR EMPLOYEE-CENTERED ²						
High consideration for employee	Structure of tasks looser	Creative, highly versatile, educated	Non-stressful	Democratic	Broad, even ambiguous	Emphasis on intrinsic motivation
	Problems defined by employee	Independent broad thinkers; want to help set goals	Liberal time requirements	Employees resist being fitted into a mold	Long term	Reward & punishment at upper end of need hierarchy; individual progress recognized through status and prestige
	Opportunity for ego-involvement, self-actualization		Can be exciting and interesting	Few layers	Goals usually acceptable to followers	Tolerance of individual values
	Intrinsic motivation		Low level of fatigue	Emphasis on effective interpersonal relations	Group goals and individual values may conflict	Employee participation in setting of general goals
	Extensive training requirements					Group cohesion by specialty of work

"High" leaders ³ use appropriate behavior style and content, and initiate structure effectively, taking into account the characteristics of the tasks, of those led, and of the situation--applying the correct amount and type of consideration. ⁴

¹ Tyrannical authoritarian leadership can be considered a sick form, or it could be looked at as the extreme of no consideration.

² Laissez faire leadership is no leadership at all.

³ High from a Systems Psychology point of view--neither authoritarian nor democratic is better in a vacuum; rather, the job, the situations, and the employees must be considered against a criterion fashioned to "predict" specified outcomes, such as high productivity, high morale, minimum turnover, minimum grievances. Even within a given situation, different styles of behavior may be equally effective.

⁴ Supervisor's role with respect to consideration affects the outcome like a moderator variable.

Figure 1. Classes of variables significant in management leader situations

There has, in fact, been considerable professional coordination between the research carried out in the US Army environment and research carried out under the auspices of industry, particularly as related to assessment techniques and measurement methods. In industry, what comes to mind are the long-term AT&T works by Bray, Campbell, and Grant,² and the work at Ohio State University, including that by a former ARI associate, Dr. Edward A. Fleishman.³

Considering the complexity of the topic, I will discuss only selected major findings from Army efforts. I find it not only helpful but necessary to consider several models in order to present these findings in proper perspective. These models are as follows:

1. Conceptualizations of interactions of human factor system variables as related to human performance effectiveness (see Figure 2).

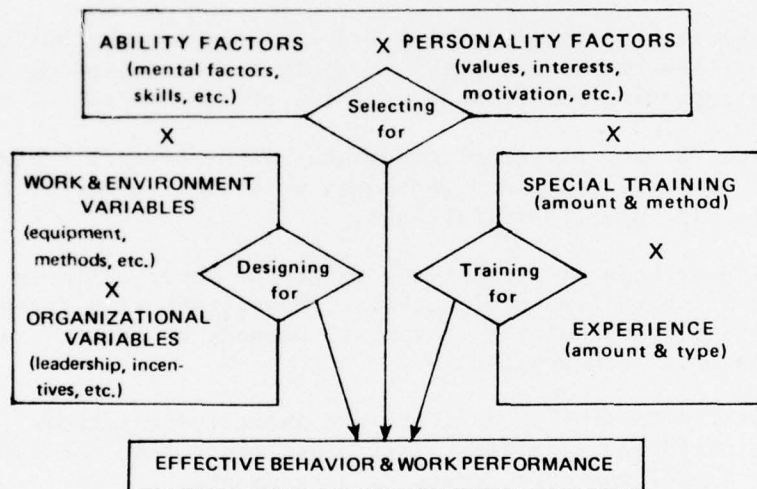


Figure 2. Conceptualization of interactions of human factor system variables as related to human performance effectiveness.

²Bray, Douglas W., Campbell, Richard J., and Grant, Donald L. Formative years in business: Longterm AT&T study of managerial lives, N.Y.: John Wiley & Sons, 1974.

³Fleishman, E. A., Harris, E. F., and Burt, H. E. Leadership and supervision in Industry. Research Monograph, No. 33. Columbus, Ohio: Bureau of Education, 1955.

Fleishman, E. A., and Harris, E. F. Patterns of leadership related to employee grievances and turnover. Personnel Psychology, 1962, 15, 43-56.

2. My own conceptualization of cognitive and noncognitive aspects of jobs, particularly as they relate to high noncognitive job demands of a management leader.

As a working definition, the cognitive content of a job consists of right or wrong responses, objectively or logically determined, such as the correct solution to a mathematical problem; the noncognitive content consists of styles of behavior and value judgments, often subjectively determined or colored by emotion and often bipolar in concept, which objectively are neither right or wrong.

3. The differential classification model, which the Army Research Institute has developed over many years. This evolving model has assumed, not a general monolithic factor of leadership behavior, but differential talents of individuals and differential job requirements.

ARI LEADERSHIP RESEARCH

The Army research program in this area in recent years has provided the Army with research-based results to apply to the following major objectives in improving effectiveness of the officer personnel system:

1. Provide US Army personnel management with scientific measurement procedures to identify young men and women with high potential for management leadership in military settings.

2. Develop methods of identifying cadets or young officers with potential for military leadership careers, consistent with recent Army Research findings, particularly in combat commands as contrasted with technical/managerial commands.

3. Assist the US Army in devising and quantifying methods for evaluating officer performance in first tour assignments, and for estimating potential for higher and more demanding assignments.

4. Develop techniques to assess motivation for a military leadership career and to enhance career motivation through appropriate early assignments.

Quite early in our research program, it was fairly evident--as indeed it has been to other investigators--that management ability factors we were dealing with were of at least two kinds. First, they indeed had to deal with the cognitive aspects previously defined in this paper, as these cognitive aspects were related to job content. That is, the military officer must know the technical side of the work, whether it is technical/managerial or combat activity, and whether it is work that he personally performs or that his subordinates do. The second type of management ability factor was probably largely noncognitive, but even here considerable cognitive interaction was obvious. More specifically, a management leader has additional requirements for effective face-to-face interaction for motivating his team or group, for effectively communicating, evaluating his men, and rewarding and punishing. As

indicated in Figure 1, effective leaders must use appropriate behavior style and content and must initiate structure effectively, taking into account characteristics of the tasks, of those led, and of the situation --applying the correct amount and type of consideration.

Our earliest findings, indeed, indicated predictive validity for cognitive measures. We repeatedly found predictive validity for higher level intelligence tests against Officer Candidate School (OCS) class standing or grades, or for likelihood of graduating from ROTC--that is, for achieving skill in cognitive functioning. However, as early as the fifties, we began to get predictive validity for Army performance through use of peer ratings which far exceeded the validity of specially designed cognitive intelligence tests. The usefulness of peer ratings is well known now, but the point I want to emphasize is that the kind of predictors which finally yielded useful validity, at least in the management leadership situation, obviously have a large noncognitive component. It became evident that, on a measurement basis, it was the noncognitive domain that needed research attention.

Let us return to the earlier model, represented in Figure 2. This figure points out the highly interactive nature of the variables that need to be considered in the evaluation of the leadership situation. A few of these interactions, with emphasis on style of leadership, have been abstracted in Figure 1. Regardless of the specific situational model, evidently management leadership research must find a way to pinpoint significant variables (as in Figure 1) and deal with selected interactions, while relating to reality as much as possible considering the fact that the order of interactions can indeed be huge.

My colleague, Professor Lee J. Cronbach of Stanford University, has stated: "In attempting to generalize from the literature, Snow and I have been thwarted by the inconsistent findings coming from roughly similar inquiries. Successive studies employing the same treatment variable find different outcome-on-aptitude slopes. Some fraction of this inconsistency arises from statistical sampling error, but the remainder is evidence of unidentified interactions."⁴ Quoting further from his distinguished address, "In the personality field [and in the management leadership area we are certainly concerned with personality], it is neglect of interactions that has kept alive the battle between the 'situationists' and the trait theorists."

THE SYSTEM MEASUREMENT BED

The resolve to maximize interaction effects in exploiting the various concepts discussed above has greatly influenced the Army's research. ARI obtained experimental measures on a large sample of officers immediately after their entry on active duty. At subsequent points in the officers' careers, performance evaluations were obtained. From one to two years after entry, measures were obtained on performance in a synthesized

⁴Cronbach, Lee J. Beyond the two disciplines of scientific psychology. Distinguished Scientific Contribution Award address presented at the meeting of the American Psychological Association, New Orleans, September 1974.

situational test bed which we developed in the form of special problem situations, hypothesizing differential measurement, and which we designed to achieve differential prediction of the various domains of management leadership. The tests were administered to large samples of officers--one sample of 6,500 in 1958-59 and another of about 4,000 in 1961-62. From the sample of 4,000, 900 officers were selected as representative of various branches of service to take part in an ARI experimentally-controlled 3-day exercise at the US Army Officer Evaluation Center (OEC). Figure 3 presents the problem situation activities at the OEC. The problem situations allowed reasonably objective data to be recorded on specific details of each officer's performance, as well as judgmental evaluations of his style of behavior and effectiveness in aspects of each task and in each situation, all of which was consistent with the Cronbach philosophy of taking account of interactions. Our situations were appropriately realistic; they had content validity; and they were carefully sampled from the three broad domains--management leadership in combat situations, management leadership in technical/managerial situations, and technical/managerial leadership in administrative situations. The third eventually collapsed into the other two.

In addition to the evaluations at the OEC--sometimes referred to as the Assessment Center--ratings of all officers who had taken the Differential Officer Battery (DOB) were obtained in their work assignments. The first evaluation ratings were made by superiors and associates after the officers had been in their duty assignments for 12 to 18 months. In 1967-68, various evaluations of performance were obtained for officers of the original sample on duty in Vietnam, Europe, Korea, and within the continental United States. These evaluations were used in interpreting the results and measures employed at the OEC.

When we correlated rated performance in combat, administrative, and technical duties on first duty assignment with performance in combat, administrative, and technical exercises of the OEC, we found that combat command exercises correlated an average of .26 with combat duty performance, .05 with administrative duty performance, and .02 with technical performance. On the other hand, technical/managerial exercises correlated .21 with technical/managerial duty performance, -.01 with administrative duty performance, and .17 with combat duty performance. Administrative exercises in the OEC correlated .13 with administrative duty performance, .14 with technical/managerial duty performance, and .06 with combat performance. Clearly, there was a technical/managerial combination which emphasized the combat support aspects of the technical exercises and the technical/managerial aspects of the administrative exercises. One task which involved combat staff operations (Day 3) confirmed this interpretation, correlating .31 with technical duty performance, .21 with combat duty performance, and .08 with administrative duty performance. The factor analysis of the OEC which identified combat leadership and technical/managerial leadership as the principal components of military leadership was thus confirmed. This finding is especially useful as it is based on actual duty positions in the field.

OFFICER EVALUATION CENTER SITUATIONAL TESTS
DAY ONE: MAAG Office-Peacetime

TIME

0730 Inspect 3 MAAG vehicles for combat readiness; recommended or take actions to correct deficiencies
(T)

1030 Correct poor supply records of Host Nation Army unit; explain errors to unit's antagonistic CO
(A)

1330 Check for bugs in communication network display for visit of Host Nation VIP; recommend or make corrections
(T)

1630 Supper

1745 Evaluate report on personnel office of Host Nation Army unit; recommend changes in organization and work flow
(A)

1945 Study production records of Host Nation ordnance platoon; reschedule work assignments of repairmen
(A)

2230 To BOQ

HOST NATION INVADED WITH NUCLEAR STRIKES
DAY TWO: MAAG Office-Wartime

0300 By radio, direct 4 jeep mounted survey teams on Host Nation terrain reporting road damage, radiation levels, and
(T) other conditions

1200 Evaluate captured foreign weapon brought back by one of survey teams
(T)

1330 Study Host Nation map to select new depot sites; defend selections of depot sites made by MAAG CO
(A)

1630 On map, select new highway net to carry materiel from chosen depot sites to forward supply points
(A)

1900 Evaluate potential hasty airstrip sites and compute runway length
(T)

2000 To BOQ

SITUATION DETERIORATES
DAY THREE: Guerrilla Operations

0030 Evacuate MAAG Hq Office; trucked to woods; 5 mile night-march through woods to MAAG Field CP
(C)

0330 In bunker, prepare Company March Order to move friendly guerrilla unit
(C)

0700 Prepare roadblock, first instructing NCOs in placing demolitions on trees to form abatis
(C)

0900 With NCOs (one is unmanageable), recon Helicopter LZ and plan deployment of platoon in its defense
(C)

1000 From prepared Observation Post, report enemy activities and potential targets
(C)

1100 Lunch

1130 Lead route recon patrol in jeep; captured, interrogated, released, and returned to US control
(C)

1430 CEASEFIRE: FOREIGN NATIONALS LEAVE HOST NATION

Figure 3. Three days' activities in Officer Evaluation Center (OEC). (T = Technical/Managerial, A = Administrative, C = Combat)

What follows are the definitions of the various factors constituting management leadership as found in officer behaviors by ARI.

MAJOR FACTORS IN OFFICER LEADERSHIP

Eight general factors are clearly delineated. Their structure reveals differentiation of the combat and technical/managerial domains of officer leadership. The first six factors are dominated by noncognitive aspects, while the last two are cognitive in nature.

FACTOR I -- TECHNICAL/MANAGERIAL LEADERSHIP. The first factor is definitely one of technical/managerial leadership, emphasizing effective problem solving in support of combat operations. Behavior is characterized by well-organized planning, reporting and follow-through under varying degrees of stress. A generally competent manner also appears which transcends the technical/managerial versus combat differentiation.

FACTOR II -- COMBAT LEADERSHIP. The second factor clearly reflects effective conduct of combat missions with the utilization of men and material appropriate to the given situation. Key behaviors are decisive response to emergencies, clear direction, and active example. The central combat effectiveness aspect of this factor is associated with forcefulness and assurance of manner coupled with consideration for men. The successful combat officer also relies on his knowledge of tactical matters and his skill in performing specific activities.

FACTOR III-- TEAM LEADERSHIP AS OPPOSED TO PERSONAL RESOURCEFULNESS. The third factor has a two-fold aspect. Teamwork-oriented behavior implies accepting personal responsibility for carrying out command missions, training and utilizing men, providing on-site security, understanding the mission, keeping cool, and reporting effectively to superiors. The other end of this bipolar factor is marked by self-reliance; the individual displays courage, endurance, and personal commitment-willingness to drive on alone in difficult and even dangerous situations. In other words, this factor represents a continuum from reliance on oneself to reliance on the team to accomplish the objective. At best, reliance on oneself is leadership by example only; reliance on the team involves effective deployment and utilization of men.

FACTOR IV -- COMMAND OF MEN. This aspect of combat leadership suggests a commander effectively employing men as contrasted to one who functions as a technical specialist, as in individual staff work. Components of the command aspect are direct command and control in a field operation, timely decision making, face-to-face leadership of men in combat and motivating men to accomplish the mission. Technical jobs in several different areas--automotive inspection, assessing a captured weapon, computing radiation levels, selecting depot sites--are components of the technical specialist end of the factor.

FACTOR V -- MISSION PERSISTENCE. A most intriguing dimension that emerges from these research data is mission persistence--behaviors representing dogged persistence in carrying out orders and willingness to devote effort and to risk personal safety to achieve the goal. The officer accepts his role as an instrument in pursuing missions goals, and this attitude runs through diverse behaviors in different situations--establishing a roadblock, keeping combat reconnaissance team going, resisting enemy interrogation. This leadership style is also characterized by bearing and assurance and consideration of men, including discipline as required to protect the health and safety of the unit. Effective assignment of men also underscores commitment to mission goals through careful preparation for action. This factor did not belong predominantly in either the technical/managerial domain or the combat domain but generalized across tasks in both domains. The point is that if one were to look for a single dimension that seems to cut across managerial leadership--combat leadership, individual contribution, or contribution through accomplishing the mission objective through others--then this dimension, mission persistence, is the one. Further, this dimension was not clearly measured by the paper-and-pencil test of the experimental battery that had been designed for differential prediction of these broad domains of leadership behavior.

FACTOR VI -- EXECUTIVE DIRECTION. On the one hand, this factor suggests a picture of the military leader operating in a variety of situations--combat security mission, selection of depot sites, assessing damage from enemy action, and the like--all tasks requiring decisive and timely action as well as organizing ability, endurance, and maintenance of technical competence under stress. Where face-to-face contact is of prime importance, effectiveness seems to depend on perseverance and oral communication in a generally favorable impression on subordinates, peers, and superiors. At the other end of this continuum is individual technical tenacity in which the officer applies decisiveness, organizing ability, and special knowledge in solving technical/managerial problems on his own rather than through the organizational structure.

On the basis of previous research, it has been hypothesized--and the hypothesis was borne out--that the performance of the combat leader could be influenced in large part by the noncognitive aspects of his behavior--forcefulness, risk-taking, decisiveness, and the like. What the present analysis demonstrates is the extent that specialized cognitive abilities also enter into officer performance in both combat and noncombat situations. The combat officer relies on his knowledge of tactical matters and his skill in performing specific activities in carrying out his mission. How he applies his knowledge and skills is influenced by his general mode of action, his system of values, and his attitude toward subordinates and peers and toward the mission objective--all this as brought to bear in a particular environment. To the officer in a technical/managerial activity, his technical skills--the cognitive element--are basic to

performance. Beyond these abilities, his success in his assignment is a function of his skill and perseverance in directing the work of his command, his poise under emergency demands, and--in common with the combat leader--his persistence in completing his mission.

Thus, the seventh and eighth factors emerging from the analysis demonstrate the differential requirements of combat and technical/managerial duties and at the same time point to the common requirement for cognitive abilities--different in knowledge content though these may be.

FACTOR VII -- TACTICAL STAFF SKILLS. This factor in the effectiveness of the combat leader depends on the effective application of specialized knowledge and skills in combat operations--how to deploy troops, use or set up networks of facilities, use or set up combat zone communications.

FACTOR VIII -- TECHNICAL STAFF SKILLS. A major aspect of technical/managerial performance involves use of specific knowledge and skills in logistic and technical services in support of combat activities. This factor is characterized by practical application of knowledge of material in a setting requiring effective staff relations.

Figure 4 shows how these leadership factors are interrelated. The factors connected by the arrows are of particular interest. One way to conceptualize such factors is to recognize that when a leader is working individually and solving his own technical problem with technical tenacity, or using personal resourcefulness on an individual basis, he is not likely at the same time to expend his energy to direct others or command others in the execution of that particular task. These factors could be looked at as competitive behaviors in the individual or in the individual management leader. A leader may have great skill or lack such skill; or he may be able to balance the relative allocation between individual task performance and supervision of tasks and persons for particular situations. Here again, we have a good example of aptitude/treatment interaction, perhaps meaningful and explainable only in a systems measurement framework.

PREDICTION OF DIFFERENTIAL BEHAVIOR

As we look at the next phase of results, which tested the initial hypothesis of differential prediction by finding the extent to which the Differential Officer Battery scores were associated with differential performance in the measurement test bed (OEC exercise) and with success in combat and technical/managerial assignments, we may have come to somewhat controversial conclusions. The officer leadership factors derived from the paper-and-pencil predictors of leadership performance and those derived from specific OEC performance success in situations yielded correlation coefficients from the higher teens to the lower twenties. A very critical question that has to be asked is whether all the questions in the DOB can be effectively substituted for the OEC type of assessment; also, if this is to be done, which specific measures of

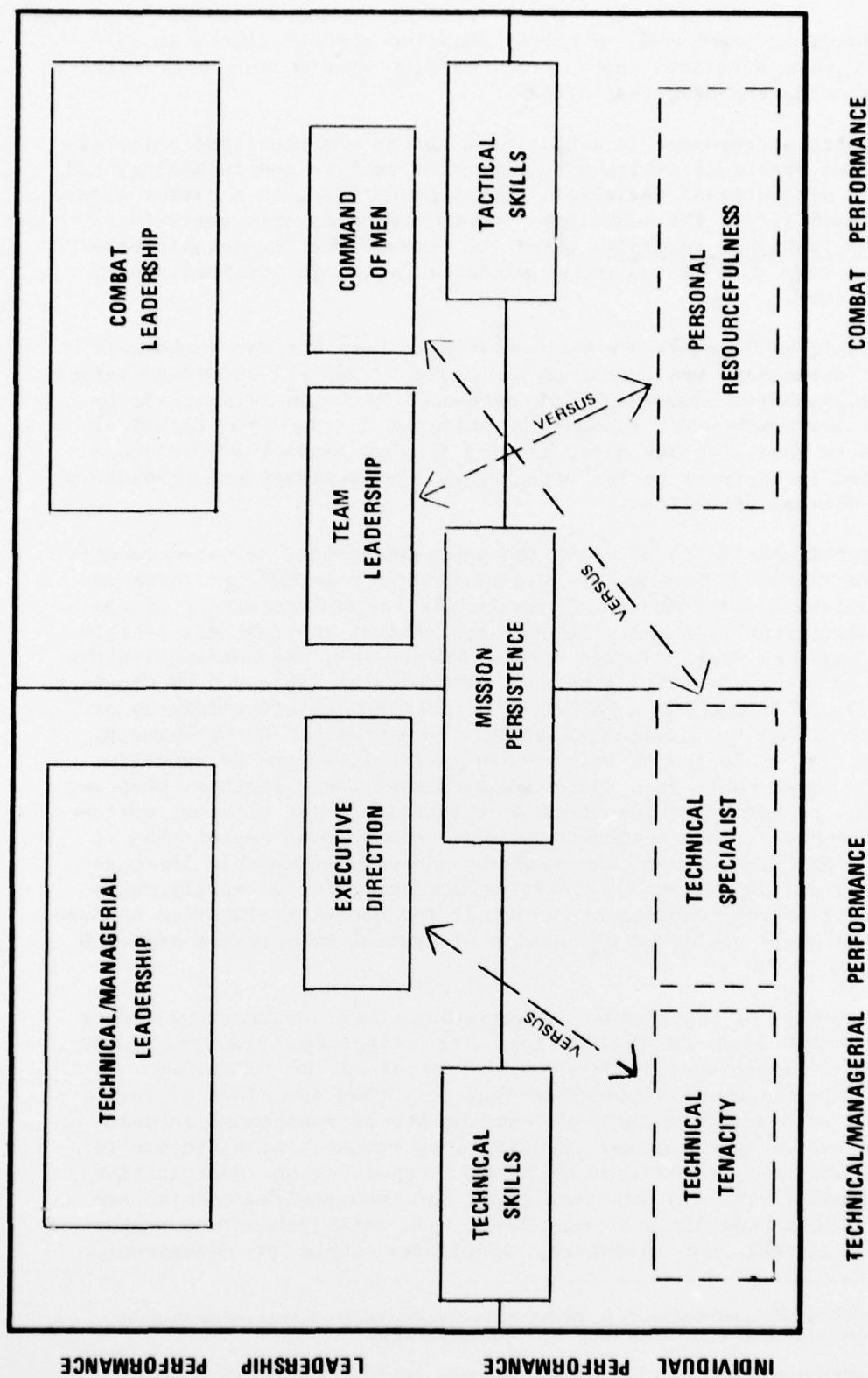


Figure 4. General factors of officer performance evaluated in simulated combat situation

the DOB should be employed. A fairly detailed report⁵ issued in 1974 dealt with this question, and I will concern myself here only with selected conclusions from that effort.

Leadership performance in combat simulations was predicted primarily by combat and practical military knowledge of tactics and technology and by a set of motivational variables, but in my opinion, to a rather modest degree of usability. The most significant finding in this analysis is that the motivational variables predicted these combat leadership behaviors better than did the cognitive measures, although admittedly only slightly better.

Leadership performance in the measurement test bed for technical/managerial situations was predicted primarily by general-knowledge/verbal-information measures characterizing personnel staff activities and by scientific and technical information measures in the more technical activities in general. The major finding is that cognitive predictors predominated in contrast to the stronger role of motivational predictors in combat command situations.

My general conclusion was that the paper-and-pencil measures identified in the research program are useful, but not nearly as useful as the evaluations under conditions provided by the OEC exercises of the systems measurement test bed. Taking into account the findings of this series of studies, with emphasis on the OEC studies, and considering the importance of the interactions between variables as discussed by Cronback, the more fruitful applications toward organizational effectiveness or toward cost-effective accomplishment of missions will, in my opinion, derive from methodologies in which these interactions can be specified and studied, preferably in a systems measurement bed. Further, when we approach the research problems from a utilitarian point of view, delimiting the number of interaction to be addressed becomes easier than it is for the basic researcher, who tends to address innumerable interactions in any particular study. A framework which for me neatly pulls together many of the requirements critical for useful application derives from my previously published discussion of systems measurement research methodology.⁶

As an example of two classes of variables where interactions, after research, would lead to implications for selection, training, and development of management leadership, let me offer the following: It is clear, from the studies discussed thus far, that one class of variables deals with measured aptitude and ability of management leaders. In fact, a set of measures was identified by research as effective in predicting combat-type performance in both cognitive and noncognitive domains; similarly, a set was identified for technical/managerial activities. The second class of variables, well established in a number of studies at ARI and elsewhere, identifies style of management.

⁵Helme, W. H., Willemin, L. P., and Grafton, F. C. Prediction of officer behavior in simulated combat situation. ARI Technical Research Report 1182. March 1974. (NTIS No. AD 779 445).

⁶Uhlaner, J. E. Management Leadership in System Measurement Beds. ARI Technical Report S3. August 1975. (NTIS No. AD A021 888).

Of interest is the design of an experiment which examines differential effectiveness of management leaders as a function of aptitude/treatment interactions (style of management transactions). That design becomes significant in terms of its application for selection, development of leadership and differential assignment.

INFLUENCE OF LEADERSHIP STYLE

Carrying further our theoretical probing in this direction, we performed an additional analysis on data obtained from the officer prediction research. Let me discuss details of the procedures and our results that are directly applicable--and utilizable--in such leadership management problems as I have been discussing.

The principal hypotheses investigated were (1) that both high military knowledge and leader behavior characterized by a high degree of directiveness/decisiveness would be related to superior performance, and (2) that high directiveness would be more important in combat situations and high relevant knowledge more important in administrative and technical situations.

From the comprehensive data of the officer prediction study, measures of knowledge, skills, behaviors, and leader effectiveness had been derived through factor and logical analyses. Findings from wide-ranging analyses of these measures have been reported in other publications,⁷ and some of the salient findings have been discussed in the preceding paragraphs. The special data analysis reported here was concerned with the relationship of leader knowledge, behavioral style, and mission accomplishment in situations falling in the three categories: administrative, technical, and combat.

To test our hypotheses, a sample of over 600 lieutenants was divided into groups of high and low military knowledge on the basis of the tests administered to the officers at entry on active duty. This division was carried out twice, first on the basis of knowledge of military tactics and second on the basis of knowledge of military technology operations. The members of each group were evaluated on directiveness of behavior, separately in different situational contexts. Finally, each officer was evaluated on mission accomplishment in each of the 15 situations of the officer prediction exercise, 5 in each of the three categories of assignment. Criterion data of mission accomplishment were also dichotomized.

The results were tabulated separately for each situation in which directiveness/decisiveness was observed, and separately for each situation in which performance of the task or mission was evaluated. Table 1 lists the specific observations used to estimate decisiveness in the 15 situations on which total performance scores were obtained.

⁷ Helme, W. H., Willemin, L. P., and Grafton, F. C. Dimensions of leadership in a simulated combat situation. ARI Research Report 1172. July 1971. (NTIS No. AD 730 315).

Helme, W. H., Willemin, L. P., and Day, R. W. Psychological Factors Measured in the Differential Officer Battery. ARI Research Report 1173. July 1971. (NTIS No. AD 737 685).

Helme, W. H., Willemin, L. P., and Grafton, F. C. Prediction of Officer Behavior in a Simulated Combat Situation. ARI Research Report 1182. March 1974. (NTIS No. AD 779 445).

Table J

OBSERVATIONS OF DECISIVENESS AND THE 15 TASK-SITUATIONS
USED TO EVALUATE PERFORMANCE

Decisiveness Observations	Administrative Task-Situations
None	Office Management
None	Production Analysis
Bearing and assurance (Interaction with allied officer)	Supply Records
Bearing and assurance (Response to turbulence and time pressure stress)	Site Selection
Bearing and assurance (Response to time pressure under stress)	Highway Traffic
	<u>Technical Task-Situations</u>
Bearing and assurance (Technical presentation to superiors)	Communications Exhibit
Bearing and assurance (Direction of men)	Automotive Inspection
None	Weapons Assessment
None	Airfield Layout
Bearing and assurance (Response in actual combat environment)	March Order
	<u>Combat Task-Situations</u>
Command of Men Decisiveness	Road Damage and Radiation Survey
Command of Men Decisiveness	Security Mission
Command of Men Decisiveness	Roadblock
Command of Men Decisiveness	Reconnaissance Patrol
Bearing and assurance (Response in actual combat environment)	Observation Post

The results consisted of mean performance scores for each of four groups: high knowledge, high decisiveness; high knowledge, low decisiveness; low knowledge, high decisiveness; low knowledge, low decisiveness. Analyses of variance yielded F-ratios which proved highly significant for the main effects of knowledge and decisiveness, but in only a few instances (though well above chance incidence) in interaction variance. Technical knowledge accounted for significant variance in performance in 62% of the effects analyzed, decisiveness in 80%, and interaction in 22% (Table 2). Tactical knowledge accounted for significant variance in 85% of the effects analyzed, decisiveness in 81%, and interaction in 20% (Table 3).

Given these findings of substantial significance, the next step was to estimate the percent of variance accounted for by each effect. The mean variance explained by technical knowledge was 4.0%; by decisiveness, 6.4%; and by interaction, 0.8% (Table 4). The mean variance explained by tactical knowledge was 3.7%; by decisiveness, 6.5%; and by interaction, 0.7% (Table 5). These results show clearly that across all situations, decisiveness accounted for a substantial majority of the performance variance.

Table 2

NUMBER OF SIGNIFICANT F-RATIOS FOR EFFECTS ON PERFORMANCE OF
TECHNICAL KNOWLEDGE, DECISIVENESS, AND INTERACTION

Number of F-tests ^a		Technical Knowledge	Deci- siveness	Inter- action
15	Office Management	10	9	3
15	Production Analysis	10	11	1
14	Supply Records	8	13	5
14	Site Selection	9	6	1
14	Highway Traffic	9	9	2
14	Communications Exhibit	6	13	3
14	Automotive Inspection	7	12	5
15	Weapons Assessment	8	15	7
15	Airfield Layout	10	8	2
14	March Order	9	9	0
13	Road Damage & Radiation Survey	8	13	4
13	Security Mission	8	12	3
13	Roadblock	11	12	4
13	Reconnaissance Patrol	8	13	3
14	Observation Post	9	12	3
Total		130	167	46
Percent		62%	80%	22%

Note. Significant at the .01 level.

^aNo F-test made in situation where decisiveness measure was obtained.

Table 3

NUMBER OF SIGNIFICANT F-RATIOS FOR EFFECTS ON PERFORMANCE OF
TACTICAL KNOWLEDGE, DECISIVENESS, AND INTERACTION

Number of F-Tests ^a	Situation	Tactical Knowledge	Deci- siveness	Inter- action
15	Office Management	13	11	2
15	Production Analysis	12	12	2
14	Supply Records	12	14	3
14	Site Selection	13	6	5
14	Highway Traffic	13	9	1
14	Communications Exhibit	11	14	3
14	Automotive Inspection	12	13	3
15	Weapons Assessment	12	15	4
15	Airfield Layout	13	8	4
14	March Order	12	9	1
13	Road Damage & Radiation Survey	11	13	2
13	Security Mission	10	11	4
13	Roadblock	13	11	3
13	Reconnaissance Patrol	9	13	3
14	Observation Post	12	12	2
Total		178	171	42
Percent		85%	81%	20%

Note. Significant at the .01 level.

^aNo F-test made in situation where decisiveness measure was obtained.

Table 4

PERCENT OF VARIANCE IN PERFORMANCE OF 15 SITUATIONAL TASKS
 ATTIBUTABLE TO TECHNICAL KNOWLEDGE, DECISIVENESS, AND INTERACTION

Situational Task	Knowledge (K)	Decisiveness (D)	K x D
Office Management	4.83	2.50	0.63
Production Analysis	4.37	3.03	0.57
Supply Records	3.50	6.36	0.93
Site Selection	4.36	2.36	0.57
Highway Traffic	4.14	1.50	1.00
Communications Exhibit	2.43	7.64	0.93
Automotive Inspection	3.50	6.57	1.21
Weapons Assessment	3.04	7.43	1.23
Airfield Layout	4.77	1.83	0.63
March Order	4.07	3.93	0.50
Road Damage & Radiation Survey	2.42	16.04	0.73
Security Mission	4.42	10.42	0.73
Roadblock	4.88	9.12	1.65
Reconnaissance Patrol	4.27	9.65	0.73
Observation Post	5.07	7.43	0.71
Mean	4.00	6.39	0.85

Table 5

PERCENT OF VARIANCE IN PERFORMANCE OF 15 SITUATIONAL TASKS
ATTRIBUTABLE TO TACTICAL KNOWLEDGE, DECISIVENESS, AND INTERACTION

Situational Task	Knowledge (K)	Decisiveness (D)	K x D
Office Management	4.37	2.57	0.63
Production Analysis	3.70	3.10	0.77
Supply Records	3.93	7.36	0.71
Site Selection	4.57	3.50	0.71
Highway Traffic	4.29	2.14	0.64
Communications Exhibit	2.93	7.07	0.79
Automotive Inspection	3.86	6.50	0.79
Weapons Assessment	3.17	8.17	0.97
Airfield Layout	4.17	1.90	0.70
March Order	3.71	4.21	0.64
Road Damage & Radiation Survey	2.58	15.42	0.73
Security Mission	2.73	9.81	0.79
Roadblock	4.73	9.27	0.79
Reconnaissance Patrol	2.65	9.27	0.88
Observation Post	3.71	7.71	0.57
Mean	3.67	6.53	0.74

Note, however, that in the administrative and technical tasks requiring no interaction with subordinates or colleagues, performance variance attributable to knowledge exceeded variance attributable to decisiveness except in one highly complex task (Communications Exhibit). Strikingly, the reverse was found for the combat command tasks, especially in the Road Damage and Radiation Survey, a command-and-control task lasting 8 hours in which the pressures of emergency decision and input overload were extreme.

When category of situation was considered, the mean percentages of variance attributable to each source were as follows:

	Technical Knowledge	Decisiveness	Interaction
Administrative	4.24	3.15	0.74
Technical	3.56	5.48	0.90
Combat	4.21	10.53	0.91
	Tactical Knowledge	Decisiveness	Interaction
Administrative	4.17	3.73	0.69
Technical	3.57	5.57	0.80
Combat	3.28	10.30	0.75

Here again, knowledge was slightly more important in administrative task situations and decisiveness in technical situations. Decisiveness was markedly more important in combat task situations.

To determine the relation of the situation in which decisiveness was observed to the percent of variance attributed to each source, the six observations of decisiveness (bearing and assurance) in administrative and technical situations were averaged and compared with the nine observations in combat situations. Technical knowledge was found to contribute more than decisiveness to performance variance in technical staff tasks (Table 6) but the reverse was found for decisiveness observed in combat command tasks. Tactical knowledge, however, contributed less to performance in all tasks than did decisiveness when observed in technical staff situations. The difference when decisiveness was observed in combat situations was even greater. Apparently, decisiveness itself may also be responsive to situational demands and to the officer's particular expertise.

Results clearly confirmed our first hypothesis that the leader's military knowledge and decisiveness of behavior are highly related to effectiveness of performance in a wide range of situations within the context of a combat emergency. There was also clear evidence that decisiveness is more important in combat situations, whereas a high degree of relevant knowledge is more important in administrative and technical situations.

Table 6

DIFFERENTIAL EFFECTS OF KNOWLEDGE AND DECISIVENESS ON TASK PERFORMANCE
AS A FUNCTION OF SITUATIONS IN WHICH DECISIVENESS
AND PERFORMANCE WERE OBSERVED

Percent of Variance Attributable to <u>Technical</u> Knowledge				
<u>Situation-Category</u> <u>of Decisiveness</u>	<u>Situation-Category of Performance</u>			
	<u>Administrative</u>	<u>Technical</u>	<u>Combat</u>	<u>All</u>
Technical Staff	6.88	6.04	6.40	6.44
Combat Command	2.72	2.08	2.42	2.41
All	4.39	3.66	4.01	4.02

Percent of Variance Attributable to Decisiveness				
	<u>Administrative</u>	<u>Technical</u>	<u>Combat</u>	<u>All</u>
Technical Staff	3.57	3.86	7.08	4.84
Combat Command	2.94	6.37	13.94	7.75
All	3.19	5.40	11.20	6.59

Percent of Variance Attributable to <u>Tactical</u> Knowledge				
	<u>Administrative</u>	<u>Technical</u>	<u>Combat</u>	<u>All</u>
Technical Staff	3.52	2.97	3.27	3.25
Combat Command	4.53	3.97	3.31	3.97
All	4.19	3.57	3.29	3.68

Percent of Variance Attributable to Decisiveness				
	<u>Administrative</u>	<u>Technical</u>	<u>Combat</u>	<u>All</u>
Technical Staff	4.42	4.91	6.77	5.38
Combat Command	3.44	5.90	13.11	7.49
All	3.83	5.50	10.57	6.64

Aside from providing practical applied products, which have been responsive to the four goals of the Army research program listed earlier in this paper, this research effort made it possible to get better insight into the important dimensions of management leadership behavior in an aptitude/treatment mode or in a systems measurement bed framework by emphasizing analysis of the realistic, content-valid, specific actions recorded, observed and evaluated during the officer evaluation center simulation.

Let us go back to Figure 4, which represents the definition of this Army management leadership behavior as delineated by eight general factors. The factor structure reveals fairly good differentiation between the combat and technical/managerial domains. In Figure 4, we can readily identify four quadrants of the model. The quadrants to the right deal with dimensions related to management leadership in combat. The quadrants to the left tend to deal with management leadership related to technical/managerial performance. The two upper quadrants deal with dimensions in which the individual management leader accomplishes his objectives through his team or through other men and women. Dimensions in the quadrants on the lower part of the figure, although important for exercising effective operational leadership, represent individual behaviors which may depend on personal knowledge, capability, and resourcefulness to achieve the mission.

CONCLUSION

The more recent of our analyses of selected interactions, then, using data from ARI's comprehensive system measurement bed research, have provided empirical findings on the optimum mix of leadership style and type of military assignment designed to achieve the highest performance in an organizational element. Leadership characterized by high directiveness is more important in the combat commands. A style with a high degree of military knowledge is more important in the technical/administrative area. Some areas of command require greater flexibility, now dominated by directiveness, now making more use of expertise. A further implication of these impressive results is for further research on organizational effectiveness (OE), in which I have consistently felt a need for a more clearly discernible underpinning for the theories--and procedures--that are evolving concerning leadership in organizations. Taking advantage of the relationships established here, OE now has available a solid basis for action.

For the applied setting, then, it is my repeated contention that for maximum usefulness the research scientist must depart from preoccupation with co-variance of abstract measures or painstaking experimental study of variables in the independent/dependent mode. Abstract, theoretical research, though often intellectually rewarding, often yields little in the way of practical knowledge for application. The systems measurement bed discussed in this paper, with emphasis on criterion inputting by the user expert and with a methodological emphasis on study of selected interactions of utilitarian variables, will provide a particular segment of society, in this case the military, with usable findings. The psychometric heritage of measurement techniques has provided such

concepts as construct validity and predictive validation. The experimental heritage has provided a better conceptualization of dependent/independent variables. It is time to take advantage of interactions between these two disciplines, embedding the work in a systems measurement bed in which the variables can be studied in relation to desired, specified outcomes, and thus applying a more reality-based methodology to the study of management leadership and human performance in systems situations.