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Fighting Vehicles --

Final Report, 30 June 1962

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Research Study 62-2

6) FIGHTING VEHICLES--STATUS REPORT, 30 JUNE 1962,

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BRIEF

FIGHTING VEHICLES—STATUS REPORT, 30 JUNE 1962

ABSTRACT

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REQUIREMENT:

In October 1958, USCOMARC generated a requirement for coordinated effort on human factors research to determine how to effect better utilization of armor personnel through improving quality of personnel assigned to armor and work methods and procedures of those assigned.

PROCEDURE:

A research program containing the following subtasks was initiated in July 1960:

1. Identification of Psychological Factors and Personal Characteristics Associated with Effective Fighting Vehicles Personnel (subtask a);
2. Development of Criteria of Effective Performance in Fighting Vehicles (subtask b);
3. Construction and Validation of an Experimental Prediction Battery for Fighting Vehicles Personnel (subtask c);
4. Evaluation of the Relation between Characteristics of Group Composition or Interpersonal Relations and Successful Performance in Fighting Vehicle Units (subtask d); *and*
5. Improvement of Communications Techniques for Armored Platoons (subtask e).

ABSTRACT

ACCOMPLISHMENTS TO DATE:

Accomplishments have been limited because of the difficulties encountered in carrying out the research as planned. Essentially they are restricted to the following:

1. Subtask a. Research areas and their potential payoff to the military were outlined in detail, including problems and difficulties in use of psychometric techniques, simulator techniques, and tactical field situations.
2. Subtask c. The Armor Systems Selection Battery was developed as a basis for testing hypotheses regarding relationships of certain cognitive and noncognitive functions to performance in current and projected armor systems.

3. Subtask e. Tape recordings of typical communications traffic during simulated combat maneuvers of an armored cavalry platoon and troop were collected and analysis of such factors as voice communications discipline and the role of radio communications in tactical decision making was initiated.

UTILIZATION OF FINDINGS:

The difficulties of obtaining needed facilities and support for research in the armor area have necessitated a recommendation to the Chief of Research and Development that the effort as a full-scale task be discontinued, with work under subtask c transferred to another task within USAPRO.

FIGHTING VEHICLES TASK--STATUS REPORT, 30 June 1962

ESTABLISHMENT OF THE FIGHTING VEHICLES TASK

Armor has played, and will continue to play, a prominent role in the successful accomplishment of tactical missions. Successive advances in the technology of warfare have dictated and continue to dictate the development of increasingly complex systems, from the Holt gas-electric tank of 1918 and the Mark VIII of the twenties to the M60 of the sixties and the Main Battle Tank of the seventies. Without exception, each of the plans calling for the reorganization of the Army's combat forces places greater emphasis on the role of armored vehicles such as tanks and personnel carriers.

Although developments in guidance systems, automatic weapons, and homing devices can be expected to play an increasingly larger role in armored vehicle operation, ultimately success or failure depends upon the human element in the system. In many cases, the operation and maintenance of these new systems and subsystems may make even greater demands than before upon the human operator in terms of skills, abilities, aptitudes, and tolerances to various conditions because of changes in doctrine and materiel.

In October 1958, USCONARC generated a requirement for a coordinated effort on human factors research to bring about more effective performance of the human element in fighting vehicles. In response to this requirement, an Army Human Factors Engineering Committee working group on Human Capabilities in Fighting Vehicles was formed to recommend development of coordinated solutions to the problems cited by USCONARC with respect to human factors in the design and tactical operation of armored personnel carriers and tanks. Inasmuch as USCONARC's requirement cut across the fields of interest of a number of agencies, the Working Group was established with representation from OCRD, HumRRO, TSG, HEL, and USAPRO (then with TAG).

As a direct outcome of the resulting recommendations, a research program was initiated for the purpose of determining: 1) psychological and physiological limitations and capabilities of individuals and crews operating in tanks and armored personnel carriers; 2) consequences of the above limitations and capabilities for the design of combat vehicles; 3) methods of measuring the aptitudes and tolerances of individuals for purposes of selecting and assigning personnel adapted to the stated condition; and 4) training necessary to increase the ability of individuals and crews to operate in tanks and armored personnel carriers for sustained periods of time under battlefield conditions.

Within this framework, the Fighting Vehicles Task was established by USAPRO in July 1960 to investigate two broad basic problem areas:

- 1) how might the quality of personnel assigned to armor be improved? and
- 2) how might work methods and procedures be improved to effect better utilization of personnel?

The approach taken--a systems oriented approach--included a consideration of the equipment, personnel skills and aptitudes, and techniques for accomplishing specified functions of an Army mission within the operational environment and associated conditions for that mission. Furthermore, this approach in the light of materiel and doctrinal change would permit the projection of future manpower requirements and the establishment of technical data and research findings which would contribute to the optimal utilization of personnel in the projected armor system.

On the basis of this requirement and the interest of the Army, major emphasis was directed toward those human factors considerations relevant to mid-range and long-range planning. Through a program of orientation and familiarization with respect to the armor field in general, including participation in a special orientation course at the Armor School and numerous trips to field and training installations, task personnel identified certain areas wherein research appeared necessary, feasible, and within the mission of USAPRO. In addition, these areas were selected as being directly related to the changing needs of the Army in the light of anticipated developments in the art of warfare. Tacticians and equipment designers were consulted at Combat Developments agencies, contract organizations, and related Army agencies. It was found, for instance, that increased dispersion on the battlefield of the future, also change in design and capabilities of vehicles for sustaining nuclear attack, would introduce new demands upon the operators of the vehicles. Reevaluation of traditional selection and utilization procedures would be necessary to maintain or improve performance of the vehicle system.

THE RESEARCH PROGRAM

The Fighting Vehicles Task was initiated in July 1960 and five subtasks were established with the objective of manipulating human resources to optimize the performance of armored vehicle crewmen as an approach to maximizing the output of the vehicle system. In the studies as undertaken, there were indications that several of the areas proposed did not prove researchable or were too expensive or lengthy to conduct. Brief descriptions of each subtask and accomplishments to date follow.

Subtask a: Identification of Psychological Factors and Personal Characteristics Associated with Effective Fighting Vehicles Personnel. A report in preparation summarizes the orientation of task personnel to the armor area and the subsequent development of research areas and their potential pay-off to the military. Information was gathered by means of numerous field trips to training centers, operating field units, and other research agencies. In addition, interviews were conducted with armor officers and enlisted personnel, combat developments planners, and weapons developers. The report reviews the development of armor, the need for research as a consequence of this development, and the role of the Fighting Vehicles Task within the on-going program of research in this area. Particular emphasis is given to the effects of current and future developments

upon classical human factors problems and upon problems peculiar to materiel and tactical planning. A selected bibliography of some 160 reports bearing on the research area is included.

Subtask b: Development of Criterion of Effective Performance in Fighting Vehicles. There existed within the research design the need for instruments permitting the quantitative and qualitative evaluation of crews and crew members under a wide variety of conditions and situations. A number of these instruments would serve as the bases for the validation of experimental prediction instruments, specifically for administration to an experimental sample at the end of AIT and six months later on the job. Other techniques would afford the researchers conditions under which to evaluate the effects of experimental variables on performance. In addition, inasmuch as tactical planning requires information as to the availability and state of preparedness of troop and equipment resources, there existed within the military a need for a realistic scorable performance measure which would differentially predict or gauge combat behavior without the expense and time of running a large tactical exercise such as BRISTLE CONE, MESQUITE DUNE, etc.

Three types of criteria relevant to the task effort were explored: psychometric techniques (including paper-and-pencil achievement measures and performance evaluation measures) simulator techniques, and tactical field criteria. Preliminary review revealed that such specific field criteria as had been developed by HUMPRO require a great deal of equipment, support, and terrain in which to conduct maneuvers. The criteria developed by HEL are highly specific to engineering studies and necessitate facilities unavailable to this Office.

Simulator techniques and tactical field criteria were investigated through contact with the Armor School, the US Navy Training Devices Center, OTAC, and civilian contract agencies such as Otis Elevator Company and Lockheed Aviation Company. In addition, task personnel observed and participated in Army Training Tests, Army exercises, and other similar tactical maneuvers used to evaluate the combat readiness of operating units.

The field maneuvers, while offering realistic conditions for the conduct of research, were not characteristically amenable to the necessary controls and measurements in experimentation. The staggering logistical problems and expense made them highly unlikely as research tools. However, the adaptation of such limited "whole-system" performance measures as the tank drivers' qualification course, for instance, appeared to be a possibility as to how to accomplish the necessary control of variables and complexity of logistical support. However, the obtaining of troops, vehicles, logistical and administrative support loomed as major obstacles.

Simulation techniques investigated range from pure computer simulation and war gaming to the mock-up of the tank turret. While hardware simulators are generally utilized for training purposes, it is felt that they could in some instances well be adapted to the purpose of the task under such areas as improving work methods and procedures (utilization) of personnel within the vehicle system or subsystem. The main problem in utilizing these devices, however, is the

coordination necessary to obtain time on them. They are currently in use for training purposes and research use by USAFRO and would be strictly on a "we'll-work-you-in-if-we-have-time" basis. A more abstracted simulation technique, i.e., a laboratory-type approach, was suggested for the communications subtask which is, by its nature, more amenable to small-scale simulation of communications equipment. The use of pure computer simulation was regarded as inappropriate to the task because of the complexity of factors involved and because of the present state of the knowledge of these factors and their interactions.

Subtask c: Construction and Validation of an Experimental Prediction Battery for Fighting Vehicles Personnel. Primary emphasis in the Fighting Vehicles Task was directed toward the consideration of human factors in the mid-range and long-range time frames. Although it was anticipated that new equipment design and modification could be expected to necessitate modifications in training, task personnel reviewing vehicles projected for future combat found no indication that selectors developed to predict performance in current vehicles would not be valid also for vehicles in the foreseeable future.

The absence of a systematic procedure for the assignment for personnel to the armor area, however, suggested a requirement that current selection procedures be improved and that the present MOS classification system within this area be evaluated. The Armor System Selection Battery was developed to fill this need on the basis of hypotheses regarding the relationships of certain cognitive and noncognitive functions to performance in current and projected armor systems. These hypotheses were generated by task personnel attending a special orientation course at the Armor School, through observation of a number of armor maneuvers, exercises, and training tests, and through interviews and discussions with knowledgeable armor personnel. Consideration was also given previous studies conducted by USAFRO personnel on such groups as Special Forces and Ranger troops.

In the above manner, a number of cognitive and noncognitive factors were selected as relevant and a number of specific tests, to supplement those of the Army Classification Battery, were selected for inclusion in the experimental battery. "Can-do" factors selected include: psychomotor coordination, visual perception, attention to detail, memory, precision, numerical facility, mechanical know-how, spatial orientation, adaptability, multiple reaction facility, and reasoning. Noncognitive, "will-do" factors were hypothesized to be more important for the selection of future armor crewmen as it was anticipated that future systems would place more stringent demands upon personnel required to perform dependably in isolated work locations with a minimum of supervision, and to perform under uncomfortable environmental conditions for lengthy periods of confinement. The noncognitive factors selected included: attitudes, interests, personal adjustment, social adjustment, and combat adjustment.

It was planned to administer these tests to a sample of armor crewmen (MOS 131.0) at the completion of AIT-A scheduled for assignment to USAREUR.

The sample would be drawn over a six-month period beginning in May 1962. Supplementary data would be collected at the time of testing. Analysis of the data would involve the evaluation of the test battery as a predictor of success in assignment to the armor area in general and in assignment to specific vehicle or to specific crew position within armored vehicle systems.

Research in this area was intended to yield a set or sets of selection measures which could be used, singly or in combination, 1) to select enlisted personnel for initial assignment to armor training, and 2) to assist the unit commander in making the most advantageous assignment of individuals to vehicle and crew position. The use of these measures could be expected to improve both the quality of personnel assigned to these jobs and the assignment of personnel within armor units, and in so doing, to result in an improvement in armored vehicle system performance.

In June 1962 the Armor System Selection Battery was ready for administration to a six-month sample of armor trainees, for validation purposes.

Subtask d: Evaluation of the Relation Between Characteristics of Group Composition or Interpersonal Relations and Successful Performance in Fighting Vehicles. This subtask was planned for FY 1963. Initial consideration of the problem in the light of the experience of tank personnel suggested, however, that the role and contribution of the tank commander or alternate tank commander (gunner) within the crew would be likely to have greatest immediate military pay-off. The notion of the tank commander's unique role in determining the proficiency of the crew, for instance, while generally held by tank commanders, needed some verification. Also, the impact of the personal characteristics of the tank commander upon the functioning of the crew offered a profitable area of research. The primary contribution of this area of research, then, would probably be the provision of information on the position and role of the tank commander in the effective crew. Such information could be expected to have implications for the selection and training of tank commanders as well as for training and discipline of tank crews.

Supplementary areas to be examined included those of crew composition and interpersonal factors within the crew and the relation of these interpersonal factors to other (manipulable) variables. But difficulties were anticipated not only in obtaining large enough samples for the conduct of crew interpersonal relations studies, but also in controlling the multiplicity of relevant and irrelevant variables.

Subtask e: Analysis of Voice Radio Communication Procedures for Armor Platoons. The communications link within and among the highly mobile elements of the armor platoon has been found to be absolutely essential to the success of mounted warfare. Where the presence or absence of effective coordination means success or failure, particularly on the dispersed battlefields of the mid-range and long-range time frames, there exists a critical need for an adequate, flexible, and adaptable means to effect this coordination. The voice radio set appears to fulfill this need. This subtask was aimed at improving procedures and discipline in the use of the radio network in order to optimize its effectiveness as a communications medium.

A first step in the conduct of this research involved the collection of tape recordings of typical communications traffic during simulated combat maneuvers of an armored cavalry platoon and troop. An initial attempt to collect these data at Camp Pickett, Virginia during an Army Troop Test was unsuccessful due to inadequacy of equipment. A second trip, to Operation BRISTLE CONE, Fort Irwin, California, on which task personnel were supported by recording experts, succeeded in obtaining tactical voice radio traffic on the platoon and troop nets during approximately fifty hours of the exercise. In addition, task personnel collected reports of terrain, tactics and movements of units or elements during the exercise in order to facilitate further the analysis of the data obtained. This attempt, though more successful than the first, was again hampered by breakdown of equipment and logistical difficulties as the highly-mobile elements traversed well over 600 miles of desert terrain.

Schema for the analysis of the data collected at Exercise BRISTLE CONE were developed, and detailed transcription and classification of the messages by type, source, destination, and other pertinent characteristics of the messages were accomplished by armor subject-matter experts. These data would provide task personnel the opportunity to make several subsequent analyses, including the analysis of voice communications discipline, and an analysis of the role of radio communications in tactical decision makings. Under the former study, factors hypothesized or demonstrated to be essential to optimal utilization of the platoon communication network would be evaluated against a measure of adequacy of communication. It was hypothesized that, for a given period of time, optimal utilization of the net is related to the amount of relevant information transmitted and to the amount of time spent on the net. The interaction of time and information factors suggest the relevance of communications discipline in achieving more adequate utilization of this communication facility.

Plans for the latter study called for analysis of the nature of messages utilized by the platoon leaders in making tactical decisions. This analysis would include a consideration of amount, type, source-destination and other pertinent characteristics of information and message flow either utilized or ignored during tactical problems. It was planned that the experimental study of communications discipline and decision-making be conducted in the laboratory situation employing equipment which, while simulating some of the complexities of the operating situation, would also permit the exercise of experimental controls and the assurance of collecting complete data.

It was felt that pursuance of this subtask would have a high probability of yielding concrete recommendations for the improved utilization of armor voice radio communications through the implementation of more controlled (disciplined) procedures governing the use of the platoon network and through the more efficient processing of information relevant to tactical decision making. This improvement could, thereby, play a significant role in improving the coordination capabilities of armor units in the present and future time frames.

Since armor is generally utilized as a part of a combat team, the problems of communication thus extend well beyond the particular armor unit, suggesting that the utilization of communications facilities should be investigated within a more global framework.

FUTURE PLANS

The Fighting Vehicles Task, while possessing the necessary personnel capabilities, suffered from a lack of the support necessary for the successful conduct of research in this area. This lack of support is evidenced by the absence of a specific USCONARC sponsor to give guidance to the research, the unavailability of vehicles and equipment for the conduct of research, and the lack of attached military subject-matter experts which might have been available had the task been located at a military installation. While these difficulties do not preclude the conduct of research, they impose definite restrictions upon the nature of the investigations. For example, since vehicles were unavailable for studies testing certain hypotheses generated in the research effort, it was necessary for researchers to develop other techniques such as simulation for the conduct of research. The development of such techniques whereby meaningful results might be obtained has been extremely difficult.

As a consequence, a recommendation was made 9 May 62 to the Chief of Research and Development through the Army Human Factors Research Advisory Committee that effort as a full-scale task be discontinued.

It is anticipated that research on the experimental armor selection battery will be transferred to another task within USAPRO.