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REPORT OF THE ARMY SCIENCE BOARD

INDEPENDENT REVIEW

OF

THE U.S. ARMY HUMAN ENGINEERING LABORATORY

DECEMBER 1987

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A. EXECUTIVE SUMMARY

The Human Engineering Laboratory (HEL) is the Army's lead laboratory for human factors engineering. It studies human factors in order to increase the soldier's effectiveness in the use of equipment, to simplify the operations and maintenance of equipment, reduce training time for soldiers, and reduce the workload required to perform tasks. The work at HEL cuts across all mission areas and is organized by directorates which include aviation and air defense; fire support; behavioral research; combat service support; and individual soldier and battlefield environments. A Special Projects Office takes on areas of activity that are high priority, involve high technology, or are exploratory in nature.

Before summarizing the findings, which are presented in more detail later in this report, it is important to state an overall general conclusion about HEL. The panel believes that this is a unique and very effective operation and ranks high in its performance among all government laboratories. The technical staff is excellent, the technical work is of high quality, morale is high and overall HEL is providing significant technology and technical support to crucial Army programs. Our findings, some of which are critical, should be viewed as areas that we think are worthy of improvement and should be viewed in the overall context of the high quality of this organization.

In this summary, the overall conclusion is that there is clearly a unique mission role for HEL in conducting research and development completely relevant to Army needs. There are elements of this research that are crucial and would not be picked up by industry. The panel hopes that the findings and discussions justifying the findings are of sufficient clarity to enable the Army at all levels, DA, AMC, DCSPER, LABCOR, and HEL to make further improvements in this fine organization.

1. Does the Human Engineering Laboratory (HEL) have a quality staff, facility and technical program?

- 1a. Office and laboratory facilities are good.
- 1b. Test bed and simulation facilities are good, but engineering support is lacking.
- 1c. Automatic Data Processing (ADP) initiatives at HEL are mixed.
- 1d. Current staff quality and staff morale are good but there is concern for the future.
- 1e. Personnel survey indicating severe understrength at HEL is receiving no action from AMC.
- 1f. Technical program quality is good.

2. How productive is the Human Engineering Laboratory in accomplishing its mission?

- 2a. The HEL is productive in its area of focus, but a clear, well understood mission statement does not exist against which to measure overall productivity.
- 2b. The HEL is not fulfilling all of its MANPRINT responsibilities.
- 2c. There is no evidence of significant technical program overlap with that of the Army Research Institute (ARI).
- 2d. The current mechanism for the management of HEL's program and funding is inefficient, awkward and managerially frustrating; however, it may be the best viable alternative to ensure proper emphasis on the human factors and personnel dimensions of Army systems.
- 2e. Supported agencies give HEL good marks overall, but better transferring of technology by HEL could have substantial payoff.
- 2f. The HEL detachments/field offices are doing good work, however the concept needs to be reevaluated.
- 2g. Human Factors Engineering needs a stronger proponent within AMC.

3. How relevant is the Human Engineering Laboratory work program to important Army problems?

- 3a. High percentage of the tasks reviewed are relevant to top Army problems.
- 3b. Effective internal mechanism to establish and prioritize HEL technical program is lacking.

B. INTRODUCTION

1. Background --

Past studies of Federal laboratories have suggested the importance of independent effectiveness reviews as a means of assuring continued laboratory excellence. Consistent with the findings of these studies, and at the request of the Commander of the US Army Materiel Command (AMC), the Army Science Board (ASB) has initiated a series of reviews of the AMC Laboratories and Research, Development and Engineering Centers. The first of these reviews was conducted during the summer of 1984. To date twelve Laboratories/RD&E Centers have been reviewed (See Appendix D.1 for reference to past and ongoing ASB reviews). This document reports ASB findings based on a review of the US Army Laboratory Command (LABCOM), Human Engineering Laboratory (HEL).

2. Panel Composition -- The review panel consisted of the following members:

Ms. Naomi J. McAfee (Chair)
Manager, Engineering Operations Defense & Electronics Center
Westinghouse Electronic Corporation

LTG Robert J. Baer (USA Ret.)
Senior Vice President
XMCO Inc.

Dr. Dora Dougherty Strother
Manager
Human Factors Engineering & Cockpit Arrangement
Bell Helicopter Textron, Inc.

Dr. Robert C. Williges
Professor of Industrial Engineering Operations Research
Virginia Polytechnic Institute and State University

3. Panel Activities --

The ASB panel was asked to provide independent observations on the potential and actual performance of the laboratory with specific emphasis on the following issues:

- a. Quality of staff, facilities and technical program;
- b. Productivity of the laboratory in accomplishing its mission;
- c. Relevancy of the laboratory's work to important Army problems.

During the course of the review, the panel conducted on-site visits at the Human Engineering Laboratory to survey facilities and receive detailed organization and program briefings. The panel also met with HEL detachment/field office chiefs and primary users of the laboratory's product and services. Included were representatives from major Army program offices, TRADOC schools and AMC commodity commands. In addition, the panel chairman and HQDA staff assistant met with DA, AMC and LABCOM officials responsible for HEL management and funding.

4. Acknowledgments -- The Army Science Board Panel which conducted this review recognizes the Panel could not have completed its work without the assistance and cooperation of a number of Army organizations, and we wish to express our appreciation. The management and technical staff at the Human Engineering Laboratory (HEL) were completely open with their data to our inquiries and fully responsive to our requests for information. They were willing to let the data speak for itself, and for this they should be commended. Of course, the panel accepts full responsibility for the observations and findings expressed in this report.

The panel expressly wishes to thank Dr. Erwin M. Atzinger of the US Army Materiel Systems Analysis Activity (AMSAA) and Mrs. Glenna D. Tingle also of AMSAA, who were the DA staff assistants for this study. The panel also thanks Mr. Ronald A. Mlinarchik, Executive Director, Army Science Board for his assistance. They not only provided all the absolutely vital logistics and scheduling support, but also participated in the deliberations and findings and made significant contributions in both areas.

C. DISCUSSION OF OBSERVATIONS

1. Does the Human Engineering Laboratory have a quality staff, facility, and technical program?

1.a. Office and laboratory facilities are good.

Office facilities and laboratories at the HEL, Aberdeen, have recently undergone a major upgrade. The facilities are good and in fact better than would be found in most government laboratories. The physical plant and layout are conducive to quality work.

1.b. Test bed and simulation facilities are good, but engineering support is lacking.

The panel was impressed with the test beds and simulation facilities available at the Human Engineering Laboratory. Particularly noteworthy are the human factors Howitzer Test Bed, the Artillery Control Environment Facility, the Human Factors Cockpit Simulator Facility, the Eye Tracker Research Facility, and the Test Range Facility. These facilities represent significant capabilities and should be supported and promoted for maximum use both by HEL and other elements of the Army. Of some concern to the panel was an apparent lack of engineering support to those facilities that are highly computer intensive. It appears that there is too much of a dependence upon the scientist or researcher to support and maintain the equipment. Sophisticated equipment of this type requires dedicated, disciplined engineering support and maintenance in order to function to the degree of precision required. Of particular concern is the apparent lack of adequate engineering support for the Eye Tracker Facility, as expressed by TACOM.

1.c. Automatic Data Processing (ADP) initiatives at HEL are mixed.

It appears as though automatic data processing equipment (ADPE) at HEL is quite good. The HEL is in the process of a major upgrade to their ADPE capabilities through the design and implementation of the HEL Network (HELNET). This network is to provide integrated work stations tied to appropriate mini and main frame computers. While some new hardware has either just been received or is on order, the integrated system was not operational for the panel to observe. In any case, the HELNET initiative appears to be a reasonably well thought out step in the right direction.

Several areas of concern were identified by the panel. The first relates to frustrations expressed by HEL field elements concerning poor communication between their organization and the main laboratory. The field elements have the impression that HELNET will solve this problem; however, the panel is not sure that is the case. While during the

review the fundamental problems and causes were not examined in detail, the undertones indicating a problem exists were significant. The panel suggests that this area deserves attention by HEL management.

A second area of concern to the panel was the obvious lack of state-of-the-art, government furnished equipment (GFE) and commercially available design and analysis tools to aid in the conduct of human factors engineering analyses. Computer performance simulation and workload models seem to be lacking. While there was some talk at HEL of procuring a package, there seems to be no aggressive program in defining requirements and fulfilling them. The panel believes that continued management emphasis must be placed on maintaining state-of-the-art currency in the use of these tools. In addition to high quality work, significant time and cost savings and productivity increases will result.

1.d. Current staff quality and staff morale are good but there is concern for the future.

HEL customers interviewed indicated that the quality of the HEL staff is good and in most cases better than their counterparts in industry. Training of the staff appears in keeping with a research organization. HEL exceeds the normal Army training goal of 40 hours of training per employee per year. Motivation within the staff is excellent. One-on-one interviews with 16 members of the HEL staff indicated that the motivation and morale were very high. Interviewees were enthusiastic about what they were doing, felt that they were being treated like professionals and believe that they can count on excellent management support. Interviewees also spoke very positively about their training opportunities and career paths.

There is concern for the future both at the HEL main lab and its field elements. At the the main lab, the panel perceived that in a number of key mission areas the resident technical depth is very shallow. In particular, the continued success of excellent programs in the Individual Soldier and Battlefield Environment Directorate and the Fire Support and Target Acquisition Directorate appear to hinge on essentially one key individual with exceptional strength and experience in the area. In addition, the panel is concerned that while the chief of the Behavioral Research Directorate is moving out aggressively, the technical depth within that directorate may not be adequate to result in a successful program. This situation is critical since HEL can expect to lose many key people to retirement over the next 5 years. It was not evident to the panel that HEL management has recognized the criticality of the situation nor laid out steps to deal with it in a timely fashion. At the field elements the current work force is very stable with many people in the same detachment, even position, for more than ten years. The TACOM detachment is an example where this situation exists. While this has a beneficial effect, it can be a negative factor in a changing environment. We see MANPRINT and emphasis

on soldier-machine interface as absolutely essential to future actions that will enable success on the Air Land battlefield. This would indicate that not only a larger but perhaps a somewhat different workforce is required in the field.

In the light of this changing situation and faced with loss of senior people to retirement and the difficulty in attracting new graduates, we view this as a potentially serious situation in the future. Further, we saw no evidence that the Army is taking a relook at the distribution of current spaces to ensure a match of spaces with current or emerging changes in workload and/or Army priority. This relook should include an examination of the distribution of required disciplines, e.g., engineering, operations research, cognitive and experimental psychology and computer science, and consideration of greater rotation of personnel between detachments and HEL emphasizing professional growth and wider advancement opportunities to also aid in retention.

1.e. Personnel survey indicating severe understrength at HEL is receiving no action from AMC.

The HQAMC manpower survey of the Human Engineering Laboratory performed by the DCS for Resource Management Force Development Division, Apr-May 1986, identified a shortage of 110 spaces (most of these in the field.) This shortfall is due primarily to the increased workload associated with MANPRINT dealing with on the order of 50 major systems and more than 700 minor systems. Clearly, unless some personnel augmentation or major mission realignment does occur, there is no way HEL will be able to accomplish the MANPRINT mission envisioned by the panel. The panel recognizes that AMC is in an overstrength position and has been directed to reduce strength to align itself with DA personnel goals. Thus, wholesale allocation of spaces to HEL may not be realistic. On the other hand, it is clear that HEL is being asked to deal with a workload that seems seriously in excess of its capacity as indicated by the survey. The panel believes that, in all fairness to HEL and the Army, the recommendations from the management survey should be addressed in an expeditious manner. Discussions with DCSPER indicated that while they were cognizant of HEL's dilemma, they could take no action until AMC either validates or rejects the survey findings.

1.f. Technical program quality is good.

In the opinion of the panel, the quality of the current HEL technical program is good. Our consensus, and the views expressed by the users, can be generalized as: what HEL does, both in terms of research and engineering support, it does well. HEL has a long standing history and reputation in the scientific community for their basic research in acoustics and eye movement. This research is regularly reported in quality scientific journals. Notable human factors test

beds and feasibility studies include: the Howitzer test bed; the joint HEL and NATICK REDLEG demonstration of advanced life support concepts and combat vehicle crews in toxic environments; studies of soldier load and battlefield stress conducted in the HEL test range facility; and research support provided to AVRADA in connection with integrated controls and cockpit automation.

In addition, the various HEL detachments/field offices are providing quality human factors engineering support to the commodity commands. This support is in the form of Human Factors Engineering Analyses (HFEAs), participation on source selection boards, defining Human Factors Engineering (HFE) specifications and standards (e.g., MIL STD 1472), and participation in program design reviews and critical design reviews. The users of these HEL engineering support services, who we surveyed, were unanimous in supporting our overall evaluation of high quality.

2. How productive is the Human Engineering Laboratory in accomplishing its mission?

2.a. The HEL is productive in its area of focus, but a clear, well understood mission statement does not exist against which to measure overall productivity.

The mission statement reviewed by the panel is too general. It is permissive rather than directive and, in particular, fails to address how HEL is expected to deal with the Army outside of AMC, e.g., it fails to address the interaction that is necessary with other organizations to make MANPRINT work. The mission statement refers to "human factors engineering" with no indication of whether a narrow interpretation involving concentration on ergonomics is desired or if a broader interpretation addressing the interaction of the human intellect and human physiology with the machine is what is intended. If human factors engineering is being considered as directed at all soldier-machine interfaces, then the broader interpretation is most appropriate.

It is the panel's impression that a complete revision of the mission statement needs to be accomplished. This revision should take into consideration current and projected doctrine and concepts of operations to include the Army's mission of fighting the Air Land Battle 2000. In particular, consideration should be given to the world of hardware development expected over the next 15 to 20 years. Whenever possible the mission statement should be specific enough to allow evaluation of the organization's productivity.

2.b. The HEL is not fulfilling all of its MANPRINT responsibilities.

The Manpower and Personnel Integration (MANPRINT) initiative within the Army emphasizes the consideration of human factors engineering, manpower, personnel, training, system safety and health hazard assessment

throughout the entire materiel development process from pre-concept exploration to final product improvement. HEL has a critical role in representing MANPRINT issues between the user community and the engineering community.

In the opinion of the panel there are several factors which contribute to HEL not fulfilling all of its MANPRINT responsibilities. First, HEL has not received specific guidance as to its role in MANPRINT from higher headquarters. HEL's mission statement presented to the panel indicates that HEL is to "perform human factors engineering analysis (including MANPRINT issues) in support of AMC developed materiel systems." The guidance is not definitive and thus allows HEL to pursue MANPRINT in any way it sees fit. The panel feels that definition of responsibilities is essential to effective implementation of MANPRINT. In particular, precise working relationships among, for example, the Human Engineering Laboratory, the Army Research Institute, the Soldier Support Center and the AMC Integrated Logistics Support community must be defined.

A second contributor seems to be a "what else is new attitude" prevailing at the laboratory. HEL perceives it has been doing what is now called the human factors engineering part in MANPRINT ever since the lab's inception and that the rest of the Army is now catching up. They base this on the fact that the laboratory has for many years been the lead lab for all soldier-machine interface activity within the Army. In addition, HEL generated documents, MIL H-46855 and MIL STD 1472, are the standard documents for the MANPRINT initiative.

A third contributor is HEL's perception as based on the DCS survey, that they are totally understaffed to fulfill the MANPRINT mission and thus have assumed a status quo posture. In the opinion of the panel the impact of MANPRINT on the resources at HEL, both at the main lab and the field offices is not understood at either HEL or AMC. When the subject of MANPRINT was raised with the field detachments, the reaction was very mixed. The significant potential impact was recognized, but both customer and detachment personnel lack specifics on the full meaning and thus far seem little pressured by implementation actions. Where MANPRINT has been pushed, e.g., the Aviation Center, the HEL office has been heavily tasked and the impact on other functions has been significant. As MANPRINT has scarcely started its implementation at the "working level," there is real cause for major concern about capability to perform the crucial HEL systems integration service in the future. The field detachments don't really know what's coming, neither does HEL nor its customers.

The three factors identified above have contributed to HEL's reluctance to define a meaningful MANPRINT role or develop alternatives to accomplish that role.

2.c. There is no evidence of significant technical program overlap with that of the Army Research Institute (ARI).

Both HEL and the Army Research Institute (ARI) have research charters pertaining to soldier-related issues. Human factors engineering concerns are central to both HEL and the Systems Research Laboratory of ARI. Since HEL reports to AMC through LABCOM and ARI reports directly to the DCSPER in the chain of command there is the potential for program overlap.

During panel discussions with personnel from various organizations, when asked direct questions concerning program overlap, there was no strong evidence provided by the personnel interviewed that indicated there was a problem. From the panel's review of current research activities and program plans there does not appear to be significant duplication of effort within these two laboratories. In fact, there appears to be a concerted effort to coordinate research plans and activities across the two laboratories in order to maximize coverage of the Army's human factors research and engineering support requirements within the current budget constraints. Besides the close coordination between laboratory personnel, the Office of the DCSPER does provide organizational overview in terms of reviewing budgets and RDT&E plans for both ARI and HEL. Consequently, the potential for some program overlap exists, but does not appear to be a major issue.

2.d. The current mechanism for the management of HEL's program and funding is inefficient, awkward, and managerially frustrating; however, it may be the best viable alternative to ensure proper emphasis on the human factors and personnel dimensions of Army systems.

The panel had a difficult time trying to understand the existing process for the funding and technical program management of the Human Engineering Laboratory. It is a complicated arrangement involving DCSPER, DCSRDA and LABCOM. DCSPER is the Army's agent responsible for program oversight of the entire human factors engineering analysis area. As part of that responsibility, they are expected to provide high level oversight of the human factors engineering work programs of the Human Engineering Laboratory, the Army Research Institute and the Surgeon General.

DCSRDA has responsibility for work prioritization and funding for the entire 6.1, 6.2, 6.3A tech base programs, including work directed to human factors engineering analysis (HFEA). In accordance with this responsibility, DCSRDA prioritizes the work done by HEL, and they accomplish this through coordination with DCSPER. Based on the prioritized program, money for tech base work at HEL is channeled from DCSRDA to AMC, to LABCOM and subsequently to HEL.

LABCOM is responsible for work prioritization and funding for the tech base program within AMC.

Discussions concerning this management scheme revealed mixed opinions. AMC Headquarters/LABCOM feel that the current situation is awkward since they do not have effective control over the entire tech base program within AMC. While they have responsibility for personnel resource management at the HEL, they feel that they do not have any control over the funding that dictates the work program. There are no official external constraints concerning HEL funds, however, past experience indicates that LABCOM has been unsuccessful in reallocating HEL funds to any other AMC tech base requirement. In cases where LABCOM made such attempts they were overruled by DCSPER.

DCSPER feels that their control of HEL funding is necessary because if AMC Headquarters/LABCOM controlled HEL funds, in situations where cutbacks were required, the human factors requirements would in almost all cases lose out to hardware related tech base work. They feel that in the AMC Headquarters/LABCOM community hardware solutions enjoy a "favored status" and in that environment human factors related work will not be given equal consideration. DCSRDA expressed a concern that the current system was logically inconsistent. They felt it was not a good practice for money to be controlled by one organization and personnel resources by another. In addition, they felt that the human factors engineering analysis requirements of the Army could possibly be better served by combining the resources of HEL and ARI both of which they felt were inadequately staffed. Thus the suggestion was made to the panel to consider consolidation of HEL and ARI under one sponsor, either DCSPER or AMC. The thought was that such a solution would result in a more precise line of command and would provide the critical mass required for HFEA.

While on the surface consolidation of HEL and ARI under one sponsor would result in a cleaner, more precise line of command, there are operational considerations which make it less attractive. When examining the roles and missions of those two organizations, it becomes evident that HEL, in order to be effective, must be tied very closely to the development community which is resident within AMC. On the other hand, there are many personnel issues addressed by ARI which are not related to the development of systems and thus require a tie to the DCSPER and TRADOC community. On balance it appears to the panel that the current arrangement while somewhat cumbersome is effective in that it does provide the appropriate ties with DCSPER whose oversight responsibility does to some degree minimize program overlap and in the case of HEL provides a mentor who can better represent their interests in an environment predominately dominated by a hardware oriented emphasis within AMC.

2.e. Supported agencies give HEL good marks overall, but better transferring of technology by HEL could have substantial payoff.

The panel sampled numerous HEL customers including representatives from Project Management Offices, the TRADOC combat development community, AMC Laboratories and DA headquarters. HEL enjoys a very favorable reputation throughout the community surveyed. Comments to the panel universally noted a helpful, responsive attitude and a worthwhile contribution to the customer when tasked. In several cases users stated that they could not accomplish their mission without HEL. In any case, HEL management should be commended for its success in fostering a positive attitude to its customers.

While HEL enjoys a reputation of being responsive when asked, there were clear indications that improved transfer of technology by HEL could have positive benefits. It became apparent to the panel that certain of HEL's existing and potential users are somewhat confused as to just what HEL does and what it can do for them. They are not quite sure if and when to get HEL involved. They are not aware of some of HEL's existing work. Instances were surfaced where it appeared to the panel that current HEL involvement on a project resulted by accident rather than through any disciplined forethought and planning. This is good when it occurs, but it appears as though there could be many opportunities for HEL involvement with users that are being lost due to the lack of an aggressive attempt by HEL to identify targets of opportunity with high payoff. In essence, HEL needs to emphasize its "marketing" function to better promote its value to its customers.

2.f. The HEL detachments/field offices are doing good work, however the concept needs to be reevaluated.

The panel feels that the on-site reach out and touch, deployment of teams is extremely important in the eyes of supported agencies. The detachments/field offices are potentially, if not now, the principal means of influencing the attention given to soldier-machine interface in the Army materiel development process in terms of policy information; technical data; application procedures; tactics and techniques; and leadership.

The size and structure of the HEL detachments/field offices can be debated at length. The panel concluded that while numbers must be appropriate to the essential, continuous workload, it is quality that overrides quantity, and if quality is to be maintained a critical mass is essential in these locations.

The panel found that the need far exceeded detachment/field office capability in all cases. As a result the field elements are

not seeking more work but allow it to come to them. They then do some sorting and prioritizing, but most often try to cover as many bases as possible, giving time and effort most often in an order influenced by local pressures and perhaps some local politics. We found little evidence of local detachment initiative or desire to develop increased knowledge and acceptance of a more important role for HFE in supported agency policy and procedures or for the introduction or transfer of the results of human factors research from HEL or other sources. In sum, the conclusion reached is that the detachments see the situation as a reactive struggle to do the possible with no real thought that their role could be a proactive one.

Overall, the detachments/field offices have a very good relationship with supported agencies. These agencies are generally comfortable with the HEL people, viewing them as doing what they can and, in particular, getting along. The panel believes that the detachments/field offices need more direct involvement with the main HEL lab and require a dedicated management team rather than that management being assigned as one of the several responsibilities of the Associate Director. In making this statement the panel would emphasize that the current Associate Director is doing an outstanding job in that primary role. Further, it recognizes the desirability of some dual hatting in the light of overall personnel limitations.

While it is recognized that there does exist a legitimate field mission, in the era of declining resources and with the additional resource implications of MANPRINT, the detachment/field office concept must be examined to assure that the current implementation is the best utilization of HEL's limited resources. Additional alternatives to accomplishing the field mission which should be examined include:

- o Increase staffing at field elements to provide critical mass required.
- o Augment current field elements with additional contractor support.
- o Disestablish field elements and locate resources at HEL, Aberdeen. Use teams dispatched to field locations as required.
- o Disestablish field elements and use contractor support for specific tasks at field locations.
- o Decrease the number of field elements and redistribute assets in areas where they can have the most impact.
- o Greater rotation of personnel between field elements and HEL emphasizing professional growth and wider advancement opportunities to also aid in retention.

2.g. Human factors engineering needs a stronger proponent within AMC.

HEL's ability to influence the development community is not very high. Their advice on system issues often carries little weight at IPRs. HEL cited instances where their initial cautions and concerns had no impact on the decision making process. As a result, costly redesigns were required. The Anti-Armor Weapon System - Medium (AAWS-M) was cited as an example of this phenomenon. While MANPRINT has been designed to provide increased emphasis on human factors engineering, that initiative alone will not succeed without a substantial effort within AMC to change the current hardware oriented mind-set within the development community. The panel perceives that there exists a bias toward hardware solutions to problems that occur during development and there is a predominant attitude which says "let's build it and we'll fix it later." The panel feels that HEL needs a stronger advocate within AMC who understands the human factors need and who can articulate that need to Army decision makers. AMC must play a stronger role in motivating industry by putting a stop to developments which have not adequately addressed human factors issues and by insisting that human factors engineering be included as a major criteria in contractor selection. A similar level or degree of influence on development decisions as that currently enjoyed by the Surgeon General and the Safety Center on health and hazard issues is necessary. Human factors needs clout of a comparable nature.

3. How relevant is the Human Engineering Laboratory program to important Army problems.

3.a. High percentage of the tasks reviewed are relevant to top Army problems.

All of the HEL 6.1 and 6.2 R&D tasks appear to be focused on identified Mission Area Analysis (MAA) deficiencies and the DA specified thrusts addressing soldier/unit performance. The programmatic R&D work is of course controlled through the budget process and thus down the prescribed path. The lab does a significant amount of work on a task basis for PMs and other development agencies. Most of this is reimbursable, i.e., not budgeted by HEL, and again seems to be well focused on Army problems. Finally, there are certain in-house initiatives undertaken and these were recognized as "skunk works" endeavors by several interviewees. Some of these could be construed as not being an HEL responsibility. When objectively reviewed, however, there was a major HFE issue involved and there was a systems engineering requirement as a driver and there was an appropriate basis for HEL participation/lead. The panel did not find such actions to be outside the broad mission responsibilities of HEL and, in fact, agreed that such efforts were very much in the interest of the Army.

HEL's reputation for innovative thinking in developing or modifying hardware to address specific soldier-machine problems leads to most of this off-line tasking. Admittedly, tasking is sometimes the result of internal promotional efforts on an in-house "idea", but more often it has been externally initiated and supported by those who know what HEL can do. Rarely is there action taken without some "official" sanction. The panel found no evidence of cases where it is carried beyond initial concept stage without Army/AMC knowledge and support of some kind.

The panel received a DA comment to the effect that "if Army labs have any guilt for doing what they want to do, it is probably less at HEL than at other laboratories". This is consistent with the observations of the panel. The exceptional work in the Human Engineering Laboratory Battalion Artillery Test (HELBAT) series was cited by the Director of Combat Developments, Field Artillery Center as a significant contribution to that mission area. In fact, he noted that "we couldn't have done it without HEL." That work performed was heavily oriented to the soldier-machine interactions recognized as critical to the future requirements in the fire support mission area and thus the panel had no questions of relevancy of HEL involvement nor of the work performed. The exceptional pay off to the Army from HEL work in this case was primarily a function of the special qualifications and interest of their staff and in particular the leadership of the division chief responsible.

3.b. Effective internal mechanism to establish and prioritize HEL technical program is lacking.

The panel was briefed on the process to establish, prioritize and evaluate HEL's technical work program and the role of the MAMP in this process. However, when the panel asked penetrating questions concerning the criteria used by HEL to sort out whether or not to pursue individual tasks and how it establishes new areas of thrust, the response was very vague. While it is advertised that a process for determining workload exists, that process was not visible to the panel, nor does the panel believe that it is visible to the workers within the organization. The panel left with the impression that the internal mechanism to establish and prioritize the HEL technical program is quite weak. As a result, the panel feels that while most of what HEL is working on is relevant to Army problems, they are most likely involved in entirely too many tasks and are spread too thin on many of which they are working. In some cases tasks are being carried too long and aren't being transitioned to other organizations soon enough. Military Operation on Urban Terrain (MOUT) and HELBAT possibly fall into that category. An example where the panel believes HEL may be working beyond its mission area is in its assignment by AMC Headquarters as the lead lab for Robotics. While the

panel realizes that robotics encompasses human factors, they seriously question whether HEL is the appropriate organization to serve in a lead role capacity for the entire AMC. Clearly this function will compete with other human factors work.

The panel believes that in the current environment of constrained resources at HEL and what appears to be an evolving mission in human factors engineering, it becomes even more important that HEL be able to make those difficult decisions on project prioritization.

APPENDIX D.1

REFERENCES TO PAST AND ONGOING ARMY SCIENCE
BOARD REVIEWS OF LABORATORIES AND RESEARCH,
DEVELOPMENT AND ENGINEERING CENTERS

APPENDIX D.1

REFERENCES TO PAST AND ONGOING ARMY SCIENCE
BOARD REVIEWS OF LABORATORIES AND RESEARCH,
DEVELOPMENT AND ENGINEERING CENTERS

1. Report of the Army Science Board Independent Review of the Army Avionics Research & Development Activity, September 1984.
2. Report of the Army Science Board Independent Review of the US Army Tank-Automotive Command Research and Development Center, October 1984.
3. Report of Army Science Board Ad Hoc Subgroup on Atmospheric Sciences Laboratory Effectiveness Review, June 1985.
4. Army Science Board Panel Review of U.S. Army Signals Warfare Laboratory, June 1985.
5. Report of Army Science Board Ad Hoc Subgroup on Electronic Warfare Laboratory Effectiveness Review, June 1985.
6. Report of the Army Science Board Independent Review of the US Army Research and Technology Laboratories, June 1985.
7. Report of the Army Science Board Independent Review of the US Army Missile Command Research, Development and Engineering Center, September 1986.
8. Report of the Army Science Board Independent Review of the US Army Ballistic Research Laboratories, August 1986.
9. Report of the Army Science Board Independent Review of the Armament Research, Development and Engineering Center, projected completion Spring 1987.
10. Report of the Army Science Board Independent Review of the Human Engineering Laboratory, projected completion Spring 1987.
11. Report of the Army Science Board Independent Review of the Engineering Topographic Laboratory, projected completion Spring 1987.
12. Report of the Army Science Board Independent Review of the Army Research Institute, projected completion Spring 1987.

APPENDIX D.2
TASKING LETTER



DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, DC 20310-0103

7 AUG 1981

Dr. Irene C. Peden
Chair, Army Science Board
8752 Sand Point Way, NE
Seattle, Washington 98155

Dear Dr. Peden:

A number of recent studies of Federal Laboratories have pointed out the importance of external effectiveness reviews as a means of assuring their continuing excellence. Accordingly, I ask that you appoint an Army Science Board panel of four to seven members to conduct an effectiveness review of the U.S. Army Human Engineering Laboratory, Aberdeen Proving Ground, Maryland. The panel should provide independent observations on potential and actual performance of the laboratory, including professional judgment on the cause of deficiencies, if any. A proposed framework for the assessment is enclosed. Specifically, the panel should address the following five questions:

- a. What is the quality of staff, facility and technical program?
- b. How productive is the lab in accomplishing its mission?
- c. How relevant is the lab's work to important Army problems?
- d. How can we improve the assessment methodology and procedures?
- e. What are the lessons learned from conducting the review?

General Richard H. Thompson, Commander, U.S. Army Materiel Command is the sponsor. Mr. Ronald A. Mlinarchik, Executive Director, Army Science Board will serve as the OASA(RDA) Cognizant Deputy. Dr. Erwin M. Atzinger, U.S. Army Materiel Systems Analysis Activity will serve as the DA Staff Assistant.

It is not anticipated that your inquiry will go into any "particular matters" within the meaning of Section 208 of Title 18, United States Code.

The panel should begin immediately and complete its review by 31 January 1987.

Sincerely,



J. R. Sculley
Assistant Secretary of the Army
(Research, Development and Acquisition)

Enclosure

PROPOSED FRAMEWORK FOR ASSESSMENT

QUESTION 1. What is the quality of the staff, facility and technical program of the lab?

1. Balance of background - i.e., adequacy of the distribution and mix of degrees based on relevance to the lab's mission.
2. Currency of degrees and/or other technical training of technical and management staff.
3. Quality, scope and innovativeness of training programs.
4. Peer recognition of technical personnel within government and private sectors.
5. Initiatives to maintain staff technical competence in contract heavy operations, i.e., the ability to retain smart buyer posture.
6. Staff stability and effectivity of recruiting initiatives.
7. Adequacy of physical plant and other physical resources - plans and initiatives for upgrade.
8. Degree to which automation and other leading edge tools and techniques have been introduced into the workplace.
9. Assess technical program balance within context of mission responsibilities.
10. Degree to which technology program is forward looking, i.e., demonstrates willingness to assume technological risk to attain marked advances.
11. Relevance of technology base efforts to mission responsibilities.
12. Reputation of lab within Army, DOD and industrial complex.

QUESTION 2. How productive is the lab in accomplishing its mission?

1. Relevant patents granted (not just applied for).
2. Outside awards and other significant recognition accorded labs and/or personnel.
3. Relevant technical papers/reports published (subjected to independent peer review).

4. Responsiveness of lab, i.e., providing solutions to unanticipated problems in developmental or fielded systems and/or newly identified threats.

5. New concepts successfully transitioned to significant materiel development/improvement programs.

6. Integration of external technology capability to address lab responsibilities.

7. Manpower utilization/cost per professional manyear.

8. Army's present materiel/system/component capability in the laboratory's area of responsibility versus that of our adversaries.

QUESTION 3. How relevant is the lab's work to important Army problems?

1. Relationship of technology programs to MAA deficiencies and those identified in other materiel needs and requirements documents (Army 21, C² SPR, AC²MP, etc.).

2. Degree of interface with the field user.

3. Components/subsystems/systems fielded and supported (past five years)

4. Army/DOD customer programs (lab services or hardware provided).

5. Importance of maintaining an in-house capability (versus existing industry/university sources).

Participants List

Army Science Board Ad Hoc Subgroup
on
U.S. ARMY HUMAN ENGINEERING LABORATORY
EFFECTIVENESS REVIEW

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APPENDIX D.3
PROCEDURES AND LESSONS LEARNED

APPENDIX D.3

PROCEDURES AND LESSONS LEARNED

Reference is made to Appendix C, Report of the Army Science Board, Independent Review of the US Army Tank-Automotive Command, Research and Development Center, October 1984.

The panel supports the referenced Procedures and Lessons Learned with one modification. It is recommended that the laboratory/research, development and engineering center being reviewed not be required to provide a written response to the framework question. The experience of this panel indicates that requiring these data imposes a burden on the organization being reviewed with limited value of the data to the panel. It is recommended that the organization being reviewed be requested to supply the following:

- a. mission statement of the organization to be reviewed, its parent command and subordinate organizations of the command which provide direct support to that organization,
- b. funding and personnel data as reflected in charts found in this appendix,
- c. laboratory statement of its internal standing operating procedures for conducting review of R&D projects,
- d. lists of patents granted over the last 10 years,
- e. list of publications within the government and open literature over the last 10 years.

Civilian

Authorized

Actual*

Scientists and Engineers

Management, Administrators and Clerical

Technician

TOTAL

Military

Officer

Warrant Officer

Enlisted

TOTAL

*As of _____
Date

TOTAL

Electrical Engineers

Mechanical Engineers

Computer Scientists

Physicists/Mathematicians

Management

*Only most recent degree counted

TOTAL

Ph.D.

Masters

Bachelors

Electrical Engineers

Mechanical Engineers

Computer Scientists

Physicists/Mathematicians

Management

*Only most recent degree counted

TOTAL

Electrical Engineers

Other Engineers

Computer Scientists

Physicists/Mathematicians

Management

TABLE 4 - FUNDING PROFILE

TOTAL OBLIGATION AUTHORITY - INCLUDES PRIOR YEAR CARRYOVER

(Dollars in Thousands)

FY 84 FY 85 FY 86*

RDT&E-MISSION

- 6.1 (Basic Research)
- 6.2 (Exploratory Development)
- 6.3A (Adv. Dev. - Tech Base)
- 6.3B (Adv. Dev. - Requirements)
- 6.4 (Engineering Development)
- 6.5 (Management & Support)
- 6.7 (Operational Systems Development)

REIMBURSABLE

PAA

OMA

TOTAL

*Authorized Program as of _____
Date

TABLE 5 - IN-HOUSE/CONTRACT MIX

(Dollars in Thousands)

FY 84 FY 85 FY 86

RDT&E MISSION

In-house

Contract

Other Government

REIMBURSABLE

In-house

Contract

Other Government

PAA

In-house

Contract

Other Government

OMA

In-house

Contract

Other Government
