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Research Report 1553

Operator Performance Enhancement for the Guardrail/Common Sensor System 5

Mary Jo Hall
U.S. Army Research Institute

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The Communications and Electronics Command (CECOM) Center for Electronic Warfare/Reconnaissance, Surveillance, and Target Acquisition (EW/RISTA) requested the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) to identify Guardrail operator requirements and identify uses for advanced technology that would enhance operator performance. Analytical functions within the Integrated Ground Processing Facility were identified and workload assessments and observations of operator performance were made. It was found that, while workload demands were not excessively high, advanced technology is needed for functions requiring analytic and foreign language skills. Recommendations were made for job aid support to operators.

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Research Report 1553

Operator Performance Enhancement for the Guardrail/Common Sensor System 5

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Field Unit at Fort Huachuca, Arizona
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February 1990

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2Q263007A793	Operational Effectiveness

Advanced technology can tremendously improve operator productivity. However, if used improperly, it can be an ineffective and costly investment. To have its greatest benefit, advanced technology must be implemented where it can provide the greatest payoff.

This report describes a study of the Improved Guardrail V System operator function. The effort was undertaken at the request of the Communications and Electronic Command (CECOM) Center for Electronic Warfare/Reconnaissance, Surveillance, and Target Acquisition (EW/RISTA) as part of their program to determine where emerging technologies could be used to enhance operator performance in the Guardrail/Common Sensor System 5, the final planned version of the Guardrail/Common Sensor to be fielded. The results of this study were provided to RISTA for inclusion in their GR/CS System 5 studies.

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Technical Director

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OPERATOR PERFORMANCE ENHANCEMENT FOR THE GUARDRAIL/COMMON SENSOR
SYSTEM 5

EXECUTIVE SUMMARY

Requirement:

The Communications and Electronic Command (CECOM) Center for
Electronic Warfare/Reconnaissance, Surveillance, and Target Ac-
quisition (EW/RISTA) will employ new technologies in the devel-
opment of the Guardrail/Common Sensor (GR/CS) System 5. As a
result, the U.S. Army Research Institute for the Behavioral and
Social Sciences, Fort Huachuca Field Unit, was asked to identify
where advanced technology was needed to improve operator
performance.

Procedure:

Interviews with subject matter experts and reviews of per-
tinent documents were carried out to determine the analytical
functions of the Guardrail Ground Station. Operators were inter-
viewed and observed while performing their duties. Operator
workload in the current improved Guardrail system was assessed to
determine the extent of the job demands placed on operators.
Based on that data, it was determined where advanced technology
could be used to enhance operator performance.

Findings:

Results indicated that workload demands were not excessively
high for the operator activities, and that while full workstation
capability was not used, the greatest need for advanced technol-
ogy is for those functions requiring cognitive skills such as
analysis and foreign language interpretation.

Utilization of Findings:

The recommendations of this report are to be incorporated
into a RISTA report on hardware/software technology recommenda-
tions for the GR/CS System 5.

OPERATOR PERFORMANCE ENHANCEMENT FOR THE GUARDRAIL/COMMON SENSOR
SYSTEM 5

CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

OPERATOR PERFORMANCE ENHANCEMENT FOR THE
GUARDRAIL/COMMON SENSOR SYSTEM 5

Introduction

The Guardrail/Common Sensor (GR/CS) will be the next generation Army Airborne SIGINT collection and direction-finding system replacing Guardrail, Improved GR V, and Quicklook II. The Guardrail family of sensors was first fielded in the 1970's using technologies of the late 1960 vintage. During the evolution of the system, new processing capabilities were added and the number of computers and their technology were upgraded. Currently, CECOM Center for Electronic Warfare/Reconnaissance, Surveillance, and Target Acquisition (EW/RISTA) is (1) surveying existing tactical SIGINT systems to identify technical approaches, equipment, or system capabilities which could be used in the GR/CS and (2) identifying new emerging technologies and methods from SIGINT research and development activities. The objective is to determine what and how advanced technical capabilities can be employed in the development of the GR/CS System 5, the final planned version of GR/CS to be fielded.

While the Army is pushing to increase system productivity through the introduction of new materiel developments, it is simultaneously reducing manpower. As a result, ARI was asked by the US Army Intelligence Center and School to determine if the current four MOS (Military Occupation Specialties) assigned to Guardrail could be combined into a single generic Common Sensor Operator MOS for the future GR/CS. An analysis of the baseline Guardrail or Improved GR system was conducted by Hall and Mather (1987). They found that with the introduction of additional technology, the correct allocation of soldier/machine functions, and task automation, the number of MOS required to operate the GR/CS could be reduced. These findings indicate that while technology was used to upgrade the system hardware, there was not a corresponding advancement in the software and soldier-machine interfaces.

Objective

As a result of the 1987 ARI Study, CECOM EW/RISTA requested ARI to identify the operator requirements for the Guardrail mission and determine where technology could be used to enhance operator performance. The results of this study are to be contrasted with the hardware/software technology recommendations for GR/CS System 5.

1

Methodology

The GR/CS system is composed of two major platforms, the aircraft which houses the sensors and the Integrated Ground Processing Facility (IPF) where operators analyze the sensor data collected. To determine where technology could enhance operator performance, the following steps were performed:

1. Identify IPF operator functions during GR/CS mission.

2. Define the primary activities associated with each function.

3. Collect operator data via interviews and observations of IGRV operations.

4. Conduct operator workload analysis.

5. Derive where operator performance could be enhanced by new technology.

The results of each of these research steps are described in detail below.

Identify IPF Analytical Functions

For this step, an analytical function was defined as collection of activities or processes that occur over time without implying how they will be accomplished or what instrument or methods will be used to perform them. The IPF functions were derived using the IGRV Operator Manual, Program of Instruction (POI), interviews with SMEs at the US Army Intelligence Center and School, and the US Army Intelligence School-Ft. Devens, and a job analysis of IGRV done by ARI. From these data it was determined that the IGRV system requires seven unique analytical functions to be performed. These functions (shown in Figure 1) are accomplished in a sequential but iterative manner throughout the mission. A brief description of each function is provided in Table 1. Although the IPF has undergone major hardware/software changes since its initial development, these functions have not changed; thus, they are considered to be the generic analytical functions for the Guardrail mission.

Major Activities within the IPF

To understand the operator requirements for the Guardrail mission each of the seven analytical functions were categorized into the specific activities performed by the operators during a

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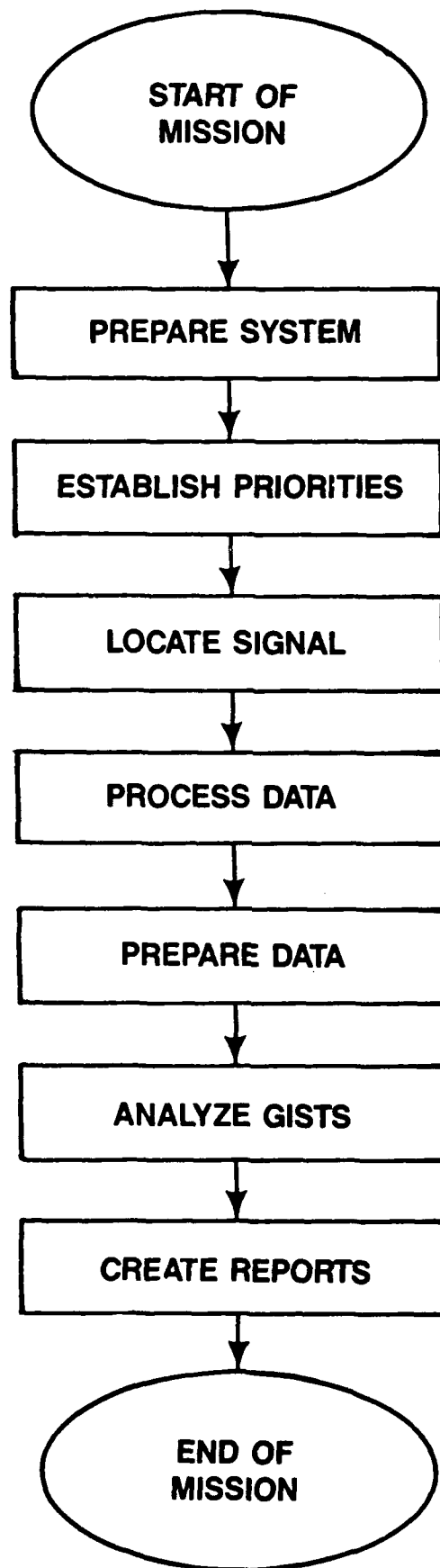
Figure 1. Analytical functions and flow for Guardrail ground station.

Table 1

Description of Analytical Functions for Guardrail Ground Station

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1. PREPARE SYSTEM - Set up equipment for collecting, analyzing, and disseminating SIGINT information.

2. ESTABLISH PRIORITIES - Organize the information that needs to be collected and order them by level of importance.

3. LOCATE SIGNAL - Find a radio frequency of interest which has voice transmission and data transmission within range of the system.

4. PROCESS DATA - Copy voice transmissions and obtain location of transmission site.

5. PREPARE GIST - Translate and record voice transmission.

6. ANALYZE GIST - Identify unit sending voice transmission.

7. CREATE REPORT - Transmit information.

---

mission. It was determined that the objectives of this project could best be met by looking at functional activities rather than system-specific tasks as traditionally done. Factors that made a task analysis inappropriate were: (1) the Standard Operating Procedures (SOP) between units differed considerably, and (2) future as well as currently proposed design changes alter operator procedures thus making task-based recommendations moot.

To identify the primary activities operators performed for each of the seven functions, IGRV operations were observed at 1st MI Battalion (AE), Wiesbaden, Germany, V Corps, and 2d MI Battalion (AE), Stuttgart, Germany, VII Corps. Primary activities were defined as the activities necessary to accomplish an analytical function without reference to the tasks involved. The eleven identified primary activities performed by operators are described in Table 2. As can be seen, some functions are represented by one major activity and others by several. Although different MOS are assigned, according to TOE (Table of Organization and Equipment), to perform specific functional activities, units in the field do not adhere to the MOS assignments. As a result, this study viewed functions and activities as generic and as being performed by a generic operator.

Collect Operator Data: Observations and Operator Critiques

To determine what requirements the system imposed on the operator, IGRV operations at V and VII Corps were observed and the IGRV operators were interviewed. Since performance is determined by job requirements, tools or equipment to perform the job, and an operator's ability to perform the job, these topic areas were used to organize and discuss the observational and interview data collected.

Job Requirements

Although this study focuses on generic functions, it is necessary to discuss this section within the context of specific MOS functions because that is how job requirements are structured. The system is currently configured where IPF tasks are allocated between four MOS, each handling specific unique functions. However, as mentioned above, the system is not utilized as designed. One unit did not use 05Ds (EW/SIGINT Emitter Locator/Identifier), another used 05Ds to collect data for national agencies instead of supporting the 98G. One unit had language trained 98Cs (EW/SIGINT Analysts) and reconfigured the tasks so that the 98C worked directly with the 98G (Voice Interceptor). In this case, the analyst "pre-screened" the voice communications and directed the voice intercept operator to the radio frequencies of interest.

Table 2

Description of Major Activities Performed by the Generic Operator

---

1. GET PRIORITIES

The operator gets a list of targets to collect on or a list of prioritized targets. From the list, the operator prioritizes the data he collects.

2. SEARCH & LOCATE SIGNAL

There are two search modes, directed and general.

General Search: An operator sequentially steps through the range of frequencies until a voice communication or data transmission is detected. If the transmission is not of interest the process is continued.

Directed Search: An operator spins the dial to specified frequencies until a voice communication or data transmission is detected.

3. LISTEN & HANDCOPY

When a voice communication is detected an operator with the required language skills copies the transmitted message.

4. TAKE LOB & GET FIX

For a voice communication of interest, an operator pushes a key to obtain Lines-of-Bearing (LOB) from the aircraft sensors. The key is continually pushed until enough data has been acquired for the system to automatically calculate a fix on the location of the communication source.

5. TRANSLATE & GIST

The handcopy message of voice traffic is translated. An abstract of the translated message is created on the system

6

word processor.

6. SEND GIST

The abstract is forwarded to the analysts using the system's electronic mail. The command to forward the mail is simply a key stroke.

7. SCREEN GIST

The gist is reviewed and a judgment is made as to whether it should be forwarded for further analysis and reporting. The judgments are based upon mission priorities and quality of information.

8. ID UNITS

The analyst uses the information in the gist to make an order of battle match to the information. He tries to explain as much about the unit as he can in terms of the who, what, when, where, and why.

9. CREATE KLEIGHT & TACREP

Using a standardized format, message is created reporting on the intercepted communication.

10,11. PREPARE REPORTS

Using standardized formats, end of mission reports are generated which cover all the activities which occurred during an eight hour shift.

When queries were made as to why the 05D was not used, it was stated that the current DF algorithms made it unnecessary to employ the 05Ds. It was also stated that the 98Cs and 98Gs could do their job effectively without the 05D. The unit which reconfigured the tasking, where 98C and 98Gs worked in a partnership relationship, believed that the new arrangement made them more effective since it reduced unnecessary collection of redundant information and provided a better focus for the decision effort. Whether these assumptions and changes optimize system performance or not is unknown. Performance comparisons of the different MOS configurations would need to be assessed in a controlled environment with quantitative measures and criteria.

Because Guardrail products are the results of a team effort, the exchange of information among team members was examined. Specific functions which required "handing-off" information included "get priorities" where the 98C gives the 98G the frequency priority list, "send gist" where the 98G forwards his translation to the 98C, and when an 05D is utilized in the system, edited fixes are put into the 98G database. While not observed, the 05D hand-off does not utilize unnecessary human resources. Files are pulled up, edited, and replaced in the 98G database. The hand-off of priorities was not critical since it occurred at the beginning of the shift. Dialogue occurred in explaining what was to be done during the shift (establish priorities), and was deemed necessary to convey mission objectives to a team.

The procedure for the hand-offs of gist information was straight forward (i.e., push a key to forward the abstract to the analyst). However, the time for operators to prepare the information for sending, as well as the time for the receiving operator to review the information, must be considered. For example, if 50 gists were completed in an hour and it took 2-3 minutes to record the translated voice communications, 1 1/2 to 2 hours per shift is used preparing information for another to review. If one minute is needed to review that information and to determine the merit as to whether to analyze that data, another hour is used. Thus, a total of 2 1/2 to 3 hours of an operator's time in an 8 hour shift could be dedicated to the hand-off process which under a heavy threat load might be undesirable and inefficient. This could be the reason one unit tried to restructure the task assignments between the 98C and 98G. It should be noted that the Air Force does not separate its personnel in the IGRV by 98C and 98G functions; one person is assigned to perform both.

Tools and Equipment

Within the IGRV system, there are workstations for each MOS. In general, the workstation provide 200 software functions for operators to use. Operators indicated that they could perform 40

8

of these functions and routinely use 10-12. When asked why they didn't learn the other functions, operators stated that they could do the job adequately without them. However, operators did complain about the parameters of the commands not being readily obvious and that the help command was of little value. It was apparent that the operators did not understand the architecture of the database. In addition, operators indicated that it took 3-6 months to become proficient with the workstation, and that all training occurred on-the-job. These may be the contributing factors, as to why only 20% of the workstation capability is being utilized. Quantitative data is required to determine whether the workstation capability is over-built, the software is improperly designed, or if better training programs are required.

Operators found obtaining lines-of-bearing (LOB) to get a fix frustrating. Frequently, when the key was pushed to acquire a LOB, they could not obtain one due to the position of the aircraft. As a result of not knowing what was occurring, operators tended to stick a pencil into the keyboard jamming the key until LOB information was obtained.

Operator Abilities

Specific skills and knowledge bases are required to conduct the Guardrail mission. They are: mastery of a foreign language (verbal communication), analytical skills, order of battle knowledge, and direction finding. All personnel observed in the IGRV system appeared to have the appropriate skills. However, it was noted that certain procedures in performing the activities were inefficient due to the requirement to find information in other external documents or sources. For example, linguists frequently needed to look up words for translation and analysts needed to consult other documents to identify a unit.

Conduct Workload Assessment

In the field, successful operator performance depends on obtaining and analyzing information about OPFOR threat elements. Without ground truth or an external criterion it is impossible to determine how well the operator has performed. In the absence of external criterion, workload analysis provides a method for determining factors which can effect operator performance. Typically, high workload levels result in poor performance. The level of operator performance, in general, is determined by such factors as (1) the perceived speed and accuracy with which the activity must be completed; (2) the kind of effort required, and (3) the required skills, procedures, and knowledge.

The NASA-Task Load Index (TLX) was selected for use since it could be easily administered in the field, has moderate to high

diagnosticity for pinpointing the factors involved in high workload and can discriminate between different levels of workload (Lysaght, et al., 1988). In a recent study by ARI, TLX has been shown to be a more valid subjective workload technique than others (Hill, et al. 1988). The NASA-TLX uses bipolar scales to assess task workload in six dimensions: mental demand, physical demand, temporal demand, performance, effort, and frustration. The TLX is administered by having operators rate each task performed on the six workload dimensions using a scale from low to high. The operator also rates the workload dimensions to determine the weight of each dimension relative to the other dimensions. The weightings and rating for each dimension are combined to produce the weighted workload rating for the task. The workload can vary between 0 and 100, the zero indicating low workload, the 100 high workload. Intermediate points on the scale are interpreted accordingly, i.e., 50 would be a medium workload, 25 relatively low, 75 relatively high. The combined aggregate response of multiple operators are compiled and weighted to provide a workload index. A sample rating sheet can be found in the Appendix. The definitions of the workload factors are provided in Table 3.

To assess workload of the Guardrail operators, 14 personnel (6-98Cs, and 8-98Gs) at the 1st and 2d MI Battalions, rated the functional activities. Figure 2 shows the workload assignment for each of the activities. As can be seen from this figure, when used with Table 2, the areas with the highest workload requirements were "listen and handcopy," "translate and gist," "identify unit," and "create STRUM." The first two tasks involved using language skills, the third required analytical skills and order of battle knowledge, and the later involves writing a report. Overall, none of the tasks were perceived as placing excessive or very low workload demands on the operators.

The weights of the factors which contributed to the total workload ratings are shown in Table 4. High scores indicate that all factors contributed to the overall workload index except for the performance factor. Low scores on the performance factor indicated operators perceive they are successful in accomplishing the activities. In general, the higher workload was primarily due to mental demands, temporal demands and frustration. Of the four highest workload tasks, these factors accounted for most of the workload (Figure 3). However, effort was a high weighted factor for the two language related activities (listen and handcopy, translate and gist). Three additional observations should be noted. First, operators perceived they were successful in accomplishing the goals of the activities. Second, create End of Mission Report, while requiring a heavy mental and temporal demand, had no frustration factor, and thus reduced the total workload index. Lastly, there was a high frustration weighting for the activity "take LOBs and get fix."

10

Table 3

NASA-TLX Rating Scale Definitions

| TITLE	ENDPOINTS	DESCRIPTIONS
MENTAL DEMAND	Low/High	How much mental and perceptual activity was required (e.g., thinking, deciding;, calculating, remembering, looking, searching, etc.)? Was the task easy or demanding, simple, or complex, exacting or forgiving?
PHYSICAL DEMAND	Low/High	How much physical activity was required (e.g., pushing, pulling, turning, controlling, activating, etc.)? Was the task easy or demanding, slow or brisk, slack or strenuous, restful or laborious?
TEMPORAL DEMAND	Low/High	How much time pressure did you feel due to the rate or pace at which the tasks or task elements occurred? Was the pace slow and leisurely or rapid and frantic?
PERFORMANCE	Low/High	How successful do you think you were in accomplishing the goals of the task set by the experimenter (or yourself)? How satisfied were you with your performance in accomplishing these goals?
EFFORT	Low/High	How hard did you have to work (mentally and physically) to accomplish your level of performance?
FRUSTRATION DEMAND	Low/High	How insecure, discouraged initiated, stressed and annoyed versus secure, gratified, content, relaxed and complacent did you feel during the task?
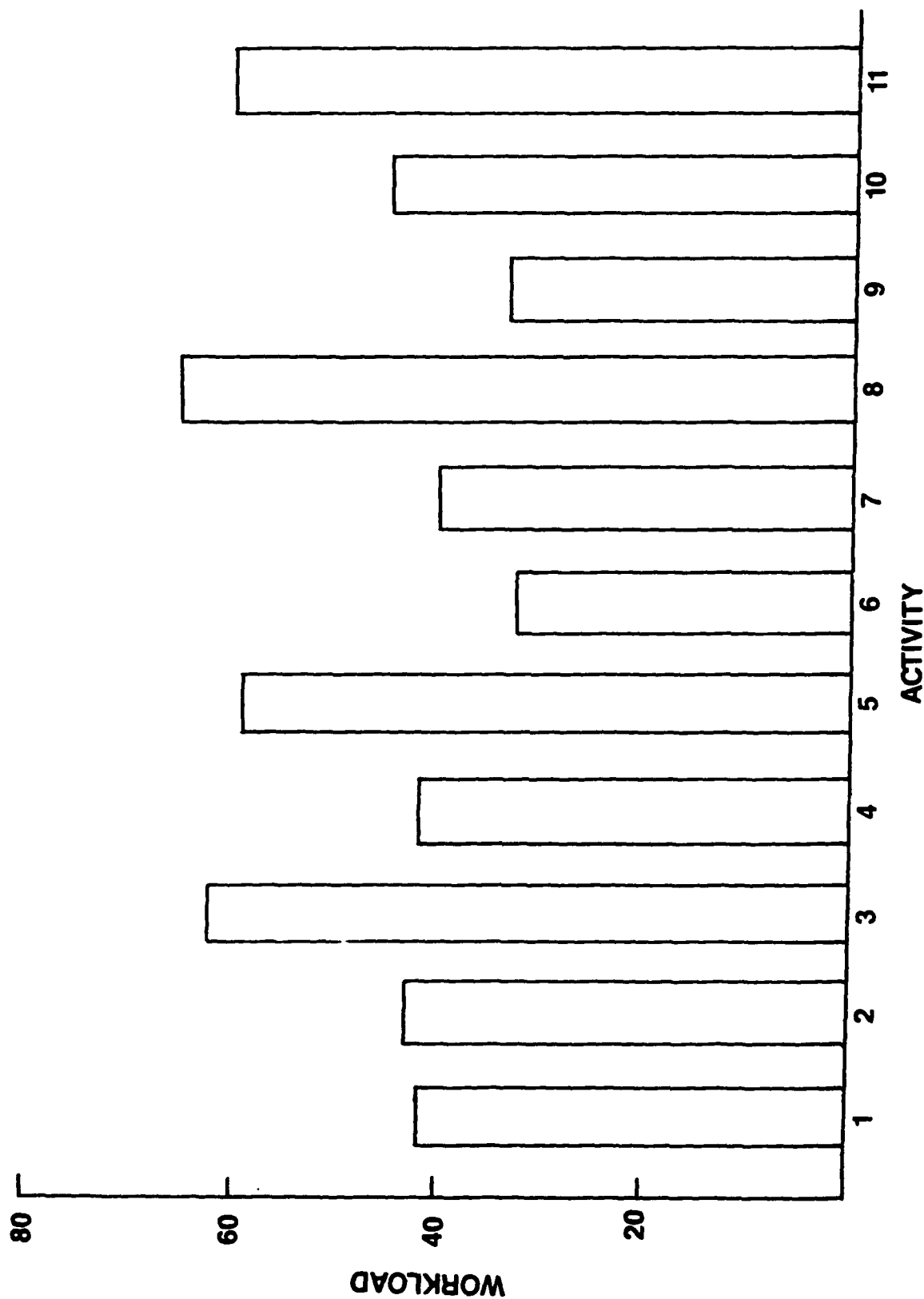
Figure 2. Workload requirements for the 11 IGRV activities as determined by the NASA TLX. The numbers on the abscissa refer to the activity identified in Table 2.

Table 4

Total workload and the contribution of the workload factors to the
total, for the 11 IGRV activities.

ACTIVITIES	TOTAL WORKLOAD	WORKLOAD FACTORS					
		MD	PD	TD	P	E	F
1. Get Priorities	41.7	6.1	0	9.1	9.1	8.9	8.5
2. Search & Locate Signals	42.8	9.0	0	9.0	6.8	9.9	8.1
3. Listen & Hand-copy	62.4	14.6	0	16.3	5.4	14.0	12.1
4. Take LOBs & Get Fix	45.7	6.9	0	10.1	6.8	9.4	12.5
5. Translate & Gist	58.7	14.5	0	15.9	4.3	11.7	12.3
6. Send Gist	32.4	4.4	0	11.1	4.0	8.0	4.9
7. Screen Gist	40.0	10.0	.2	8.0	9.9	7.9	6.3
8. ID Units	65.2	17.0	0	19.3	4.2	8.1	16.6
9. Create KL & TACREP	33.5	8.6	0	9.6	4.2	5.8	5.3
10. Create End of Mission Report	45.1	12.5	0	17.7	4.3	6.5	4.1
11. Create STRUM	60.6	16.9	0	17.0	2.7	8.7	15.3

MD = mental demand   PD = physical demand   TD = time demand
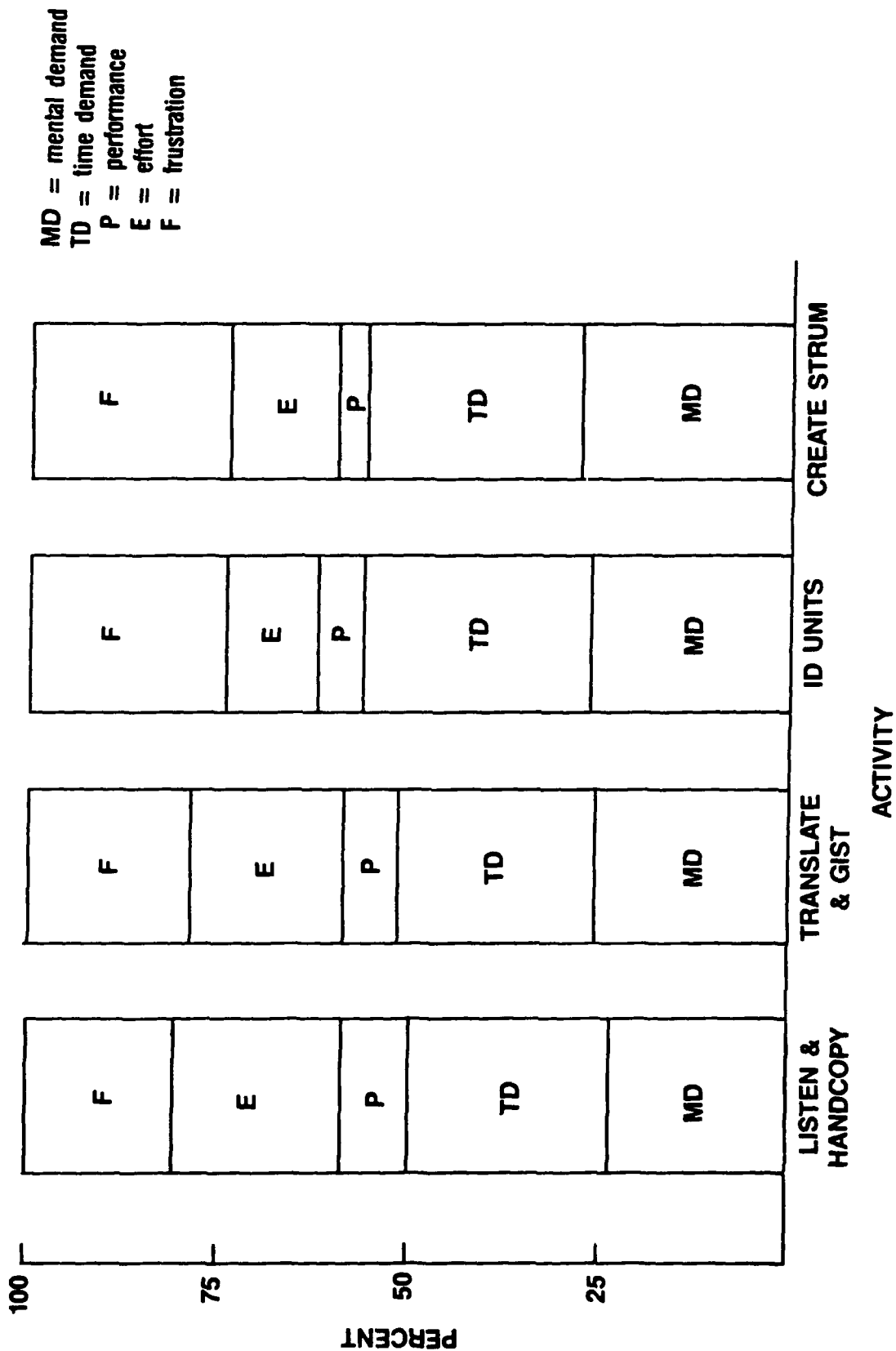P = performance   E = effort   F = frustration

Figure 3. Contribution of the workload factors to the four high workload activities.

MD = mental demand
TD = time demand
P = performance
E = effort
F = frustration

14

Analysis: Technology Implications

Gilbert's behavior engineering model (Gilbert, 1978) indicates that there are two ways to enhance performance. One is by providing environmental supports such as supervision, tools and materials, and motivation. The other is by manipulating the required behavior through training, task structure, or selection. When these behavioral techniques are matched to the workload dimensions, guidance is provided as to which remedies would work better for specific workload demands (see Table 5). This shows, for example, if high workload ratings are due to mental demands, job aids and training techniques should be examined for the source of remedy. For activities with high physical demands, job aids and selection techniques could improve performance.

Job aids can range from new types of databases to computer software and automation, including revised interface designs, help features, and tools which can be provided to operators. Supervision involves letting the operator know what is expected and guides him to meet those expectations. Motivation refers to appropriate reinforcement for performance. Training, either formal or informal, is used to increase skill level. Task structure involves the design and sequencing of procedures that the operator must perform in order to complete the task. Finally, selection refers to matching the operator to the job both physically and psychologically.

Although there are many behavioral engineering techniques which can enhance *operator performance*, only supporting the operator with job aids meets the technological enhancement criteria. Since the ratings of all the activities fell in the mid-workload range, and since job aids are the primary remedies for most workload factors, each activity will be discussed individually.

Get Priorities. Ratings on each of the factors were on the low end of the scale. Although operators indicated that they did not perform the task as well as others, performance was still high. Thus, the introduction of technology is unnecessary for this activity.

Search and Locate Signal. Again the ratings indicated no problem; however, this activity was ranked third in effort. Since job aids, as shown in Table 5, can be used to reduce effort workload, technological implications were explored. One major observation was noted. During general search mode, the sequential stepping through frequencies was detrimental. A potential solution would be to use a scanner which would automatically search for a frequency with a signal. Directed search did not have the same problems but a scanner could still be utilized if programmable.

15

Table 5

Behavioral Engineering Techniques Which Best Address the NASA
Workload Factors

| | TECHNIQUES FOR BEHAVIORAL ENGINEERING OF | |
FACTOR	ENVIRONMENT	BEHAVIORAL REPERTOIRE
Mental Demand	Job Aids	Training
Physical Demand	Job Aids	Selection
Temporal Demand	Job Aids	Task Structure
Performance	Supervision, Motivation	Training, Selection
Effort	Job Aids	Task Structure
Frustration	Supervision	Task Structure, Structure

Listen and Handcopy. This activity and "translate and gist" were combined because they involved the same cognitive skills. They also had the same workload demands, involved with language skills, and require concentration. Although research is being done to develop computerized language translators, the technology is not advanced enough to be considered for implementation. Thus the only support technology which could currently be provided the voice interceptor is in the form of a computerized dictionary. Such a dictionary would allow an operator to search out words and idioms for translation, military meanings, etc. Such support would reduce the time now taken to search other documents.

Take Lob and Get Fix. Only the frustration and effort factors contributed to the workload of this activity. The reason is due to the futile attempts to get LOBs as mentioned before. Some other mechanism should be used, perhaps software functions or some feedback mechanism, to avoid operators jamming the key in order to not push it continually.

Translate and Gist. See Listen and Handcopy.

Send Gist. This activity had the lowest workload rating of all the activities with time demand being the primary contributor to the rating. Since time constraints are inherent in the nature of the job and the workload is low, no new technology needs to be employed.

Screen Gist. While the activity had a low workload, it involves the hand-off process previously discussed. The review process can be made easier if within the preparation process key elements of the Gist can be automatically highlighted. Then, these key areas can be automatically related to the priorities, e.g., through an AI program. It should be possible to have the program prioritize Gists for analyses.

ID Units. As with the language activities, the analysis activity had a high workload index. Technology which is feasible in the near future would be an automated database for Order of Battle data. With search capabilities that allow for obtaining information, call sign, frequencies, activities, etc., the analytical function could be performed more efficiently. In the future, other technologies such as artificial intelligence or decision augmentation systems could be used to augment the operator.

Create Reports. The last three activities, create KL and TACREP, create End of Mission Report, and create STRUM all involve report writing. They differ in how much information and what information is required to go into the report. It should be possible to activate the report writing to the extent that as information is recorded and processed throughout the activity cycle, it could be automatically collated and categorized as it

is produced. If information doesn't get past an activity, e.g., a gist is screened as not to be analyzed, and that information is not needed for one of the final reports, i.e., is not relevant to any of the priorities, it could be automatically eliminated. An automated system to write the report would address the time demands and any frustration due to gathering and recollating information that had already been processed. In turn, the mental demand would change from a production activity (writing) to being an editing activity.

Conclusions

When advanced technologies are incorporated in existing or new Army systems, the effectiveness is accomplishing mission objectives and the efficiency in achieving those objectives should increase. For this study on Guardrail/Common Sensor 5, it was impossible to assess the effectiveness of implementing advanced technologies. However, inefficiencies were identified in terms of time, personnel, and materiel usages on the current Guardrail system. These inefficiencies could be improved to a limited degree by the introduction of new technologies. However, the data suggests that the current TOE may not be optimal and the workstation is either over-designed or personnel are not adequately trained. Changes made in the equipment which operators use must be done in parallel with a review of personnel and training requirements. This includes not only the operator functions examined in this study but also the maintainer functions. Problems already exist in maintaining the IGRV. As equipment becomes more sophisticated in assisting the operator, greater demands may be placed on the maintainers, the system for training the maintainers and operators, and the resource requirements necessary to field an effective work force increase accordingly. To determine the value of introducing new technology, trade-off analyses of time saved, personnel resources used, and materiel cost must be made.

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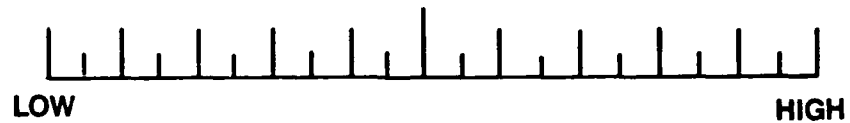
APPENDIX A

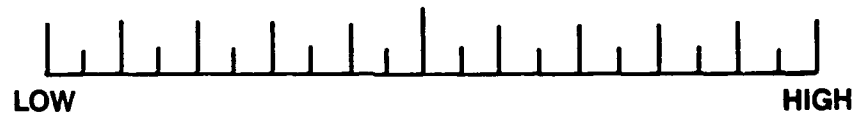### NASA TLX RATING SHEET

MOS_____
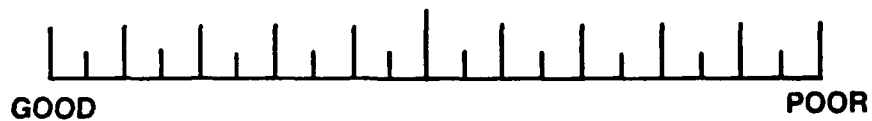
TASK_____

RATING SHEET

MENTAL DEMAND

LOW   HIGH

PHYSICAL DEMAND

LOW   HIGH

TEMPORAL DEMAND

LOW   HIGH

PERFORMANCE

GOOD   POOR

EFFORT

LOW   HIGH

FRUSTRATION

LOW   HIGH