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AN ASSESSMENT OF SELECTED ARMY TECHNICAL MANUALS

GERALD D. NIELSEN

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U. S. ARMY MATERIEL SYSTEMS ANALYSIS ACTIVITY
ABERDEEN PROVING GROUND, MARYLAND

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Five series of Army technical manuals were examined, and users of these books were interviewed in order to compare objective measurements with user attitudes. Soldiers at several installations expressed their satisfaction with the new Army manual format of proceduralized instructions in simple language accompanied by numerous line drawings. As demonstrated by the UH-60A manuals, technical manuals could be improved by reducing the extent of cross referencing between volumes. Further, it should also be possible to reduce page counts by including more information on each page. Verification of three major Army end items

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resulted in only approximately 20 percent of maintenance tasks being published without change being required. This shows the continuing need for 100 percent verification of technical manuals. More detailed guidance could improve the verification process. Poor durability of technical manuals is the most frequent user complaint, but this can be substantially improved without incurring unreasonable cost increases.

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AN ASSESSMENT OF SELECTED ARMY TECHNICAL MANUALS

1. INTRODUCTION

On 13 July 1981, General Guthrie, DARCOM Commander, tasked AMSAA to conduct an independent assessment of Skill Performance Aids (SPAS) associated with the Abrams Tank, to ascertain whether SPAS, in general, are achieving intended benefits for the user. The tasking letter is provided as Appendix A. This task was apparently motivated by complaints about the M1 manuals and by concern about the projected cost of future SPAS (approximately $0.4 billion between FY 82 and FY 87). The initial findings of that assessment were briefed to Major General Bergquist, DARCOM DCG for Resources and Management, on 31 July 1981 for possible inclusion in LOG Study 81. At that time, user acceptance of the M1 manuals was found to be poor, except for the operators' books. This was due in part to excessive errors, cross referencing between volumes and high page counts. However, the M1 had just undergone stage II of operational and developmental testing; and the associated manuals were still maturing. Further, due to maturity considerations and the restriction of the assessment to one system, the findings could not be presented as generally applicable or conclusive.

In response to the continuing need for an assessment of the SPAS concept, TRADOC, through the Training Support Center, proposed a study focused on the Advanced Attack Helicopter. This was felt to be the best representative of a SPAS program. However, the effort proposed would have required four to five years. AMSAA recommended an extension of the M1 assessment to include other Army systems as well as the M1. Although there is no system now fielded with Technical Manuals (TM's) representative of a fully implemented SPAS approach, sufficient experience appeared to be available

to warrant an inprocess review of Army technical documentation.

The extended assessment pursued three sources of data. The manuals themselves were subjected to a desk top analysis, which measured such parameters as number of words, illustrations, and cross-references per page. The soldiers who use these books were interviewed in the field, following a three page questionnaire. Discussions were held with publications and school personnel who were and are involved in the training applications, development, and testing of these manuals. Information from these sources was then compared and integrated as far as possible into a consistent set of findings and recommendations.

The primary series of technical manuals for each of the following five systems was assessed: M1, M60A1, M109A1, UH-60A, and M220A1. These were selected to provide a range of system complexity and commodity type as well as publications specification. There are three automotive systems, an aircraft, and a missile system with total parts counts ranging from about 4,000 (M220A1) to about 25,000 (UH-60A). These parts counts were determined by observing the total number of national stock numbers (NSN's) and part numbers in the -34 parts manuals for these systems. Parts count was used as the measure of complexity because it could be applied to each system in the same way.

Army specifications for technical manuals may be divided into three categories: traditional, Integrated Technical Documentation and Training (ITDT), and New Look (NL). The traditional format can be characterized as using fewer illustrations which are generally half-tone photographs, more technical language at a higher reading grade level, and less coverage of task details. MIL-M-38784B is the current specification which could be

termed traditional. The ITDT specifications, MIL-M-632XX, and MIL-M-633XX (troubleshooting) were developed originally by RCA to enable entry level mechanics to perform maintenance with a minimum of supervision. These specifications emphasized extensive front end analyses of equipment and tasks to produce highly proceduralized manuals with numerous illustrations, written at the fifth grade level. The New Look specifications, MIL-M-63036 (crew level) and MIL-M-63038B (organizational, direct support, and general support), differ from the ITDT specifications primarily in requiring a target audience description to be provided by the Training and Doctrine Command (TRADOC) and somewhat less proceduralization and detail. Appendix B describes the development of these specifications and describes them in greater length. Table 1 presents the series of technical manuals assessed in this effort and which of the above categories best describes the format of each series.

TABLE 1. Technical Manuals Selected for the Assessment.

SYSTEM	NO. PARTS	TECHNICAL MANUALS	SPECIFICATION	NO. VOLUMES	NO. PAGES
M1	19K	9-2350-255-10	NL	3	836
		9-2350-255-20	ITDT	12	10271
		9-2350-255-34	ITDT	5	3205
M60A1	13K	9-2350-215-10	NL	3	1037
		9-2350-215-20-1	NL	4	3380
		9-2350-215-20-2	ITDT	7	2846
		9-2350-215-34-1	NL	1	525
		9-2350-215-34-2	ITDT	6	2380
M109A1	13K	9-2350-217-10N	NL	1	298
		9-2350-217-20N	NL	1	540
		9-2350-217-34	TRAD	2	727
UH-60A	25K	55-1520-237-23	NL	9	4728
M220A1	4K	9-1425-472-12	NL	1	472
		9-1425-472-34	NL	2	2184

2. OBJECTIVES

The objectives of this assessment, as stated in the work unit summary dated 16 February 1982, were as follows:

Overall Objective: To determine what improvements could be made in Army technical documentation by examining a number of selected Army end item systems.

Specific Objectives:

a. Determine the effectiveness of the technical documentation for each selected end item system with regard to:

- Support of operation and maintenance of equipment.
- Use of the Technical Manual (TM) as the primary training resource.
- Support of on-the-job training by the Extension Training Material (ETM).

b. Examine the effectiveness of the publications development process:

- Identify the proper point in the development cycle for deciding whether a SPAS program should be implemented.

- o Examine the adequacy of contract preparation and administration.

- o Examine the adequacy of publications program management.

c. Examine the effects of DARCOM and TRADOC publications policy on the end item systems included in the assessment.

d. Recommend what changes should be made in product (TM and ETM) and in process to improve Army technical documentation.

Areas of Concentration: Certain topics within publications are of obvious importance; other areas emerged during the initial assessment of the M1 TM's. Particular emphasis in the extended assessment was planned for the following areas:

a. The usability and user acceptance of the TM's - for example, even though individual task procedures may be easily understood by the soldier-mechanic, the documentation considered as a whole may be less acceptable and usable due to extensive cross-referencing.

b. Troubleshooting concepts - this includes the relative reliance placed on automated test equipment, the TM format, and the type of logic used to isolate faults.

c. The acceptability of a TM as primary training reference source - how has this affected the primary function of the TM, to what extent have TM's been used as training source documents, what characterizes a TM which provides a good source?

d. The utility of Extension Training Materials - Intended to serve as a bridge between Advanced Individual Training (AIT) and the TM's, the ETM's have become progressively less extensive. How are ETM's actually used in the field? Can the TM stand alone? Should the use of ETM's vary with system type and/or complexity?

e. Front End Analysis (FEA) or Source Data Collection - What effects can be demonstrated by past or present publications programs? What elements of an FEA are crucial?

f. Target Audience Description - How precise are these descriptions? Could they be more closely matched to the subgroup of users who typically perform the documented functions?

g. Validation and Verification - How closely do the results of validation and verification resemble the user's perceptions of text accuracy and usability? Can initial verification accuracy be used as a measure of publications program performance? How do verifications differ from system to system and what effects on TM quality have these differences had?

Unfortunately, data for some of these areas were insufficient to permit meaningful analysis, particularly with respect to the impact of policy and program management. Others, such as ETM, FEA and SPAS decision point, have been overtaken by events.

3. TECHNICAL MANUALS ASSESSED

For each of the five systems studied, the most important series of technical manuals was selected. Within these series, the operation and maintenance books from the -10 to the -34 were included. These are as follows.

3.1 M109 Manuals.

The 217 series operator and organizational books for the M109 and M109A1 were the first to be written following the New Look concept of plentiful illustrations closely accompanied by simple text. Many of the features embodied in the -10N and -20N were subsequently codified in MIL-M-63036 and 63038. The -34 manual was written to MIL-M-63032 and could be termed an old style or traditional manual for the most part. None of these books had a formal front end analysis.

3.2 M1 Manuals.

The 255 series of manuals for the M1 used MIL-M-63036 for the operators manual and 632XX and 633XX for the -20 and -34 books. As the publications were developed, the latter specifications were modified by Chrysler, the primary contractor. The extent of the modifications is difficult to determine, since only Chrysler retained records of the modifications. Forty-eight ETM lessons were prepared. No formal front end analysis was done. However, since the decision to make the M1 an ITDT project was made at approximately the full-scale engineering development stage, some source data should have been available.

3.3 M60A1 Manuals.

The 215 series TM's for the M60A1, as studied, comprise 21 books with a total of 10168 pages. The operators manuals were prepared to the MIL-M-63036 specification. The -20-1 books and the -34-1 book used the 63038

specification and were among the first to do so as part of an ITDT or SPAS project. The -20-2 books and the -34-2 books used the ITDT specifications, 632XX and 633XX. Only the ITDT books had a formal front end analysis. There were also 69 ETM lessons prepared according to specification MIL-M-63040.

3.4 UH-60A Manuals.

The 237-23 series manuals for the UH-60A Blackhawk helicopter represent a departure from the typical pattern of TM acquisition. The two primary contractors competing for the UH-60A contract were requested to prepare innovative maintenance manuals which were then judged and compared as part of the entire system. The UH-60A PM and the Materiel Readiness Support Activity (MRSA) considered the Sikorsky books to be superior and selected them to be the system manuals. Although these manuals were not written to the 63038 specification, they do exhibit many of the New Look features. The tasks are quite proceduralized and highly illustrated. The organization of the nine volumes is by functional subsystem (Vol. 1 contains the wiring codes and was not analyzed). An LSA was part of the development process and fulfilled the function of a front end analysis.

3.5 M220A1 TOW Manuals.

The 472 series of manuals for the TOW missile was originally prepared using the ITDT specifications, MIL-M-632XX and 633XX. The 9-1425-472 TOW manuals are divided into one -12 book and two -34 books. These books were revised to conform with the New Look specifications, MIL-M63036 and 63038.

Five ETM lessons were prepared according to MIL-M-63040 to accompany the revised manuals. MIL-M-63035 was used for the front end analysis.

4. METHODS

As stated in Section 1, this assessment sought to bring together three distinct types of information concerning Army technical manuals in a fashion which has not been done before, to the knowledge of the author. Specifically, objective measures of TM attributes were analytically compared to user opinions and attitudes about those same TM's. Where appropriate, these results were then related to the development and testing of those TM's as described by the people directly involved.

4.1 Data Collection Procedures.

The information presented in this assessment was obtained in the following three ways:

4.1.1 Technical Manual Analysis. The technical manuals for the five end item systems studied were sampled to collect the following measures: the number of subtasks, sentences, words, syllables, illustrations, and cross-references per page. Reading grade level was derived from syllable and sentence counts as prescribed by the Flesch-Kincaid formula given in AR 310-3.

First, page counts were made and checked against counts furnished by MRSA. These counts were next used to randomly sample 50 pages from each maintenance level (-10, -20, -34) for each series of manuals. The M60A1

used different specifications for the turret and for the hull at both the -20 and -34 levels and therefore had two samples done at each of these echelons.

Each selected page was examined to ensure that it possessed at least one sentence or sentence fragment which either described or explained some assembly or subassembly of the system or its functioning, or how to operate or service the equipment. Pages which were simply tables or illustrations were not included. Next, the text on a page was partitioned into subtasks or task elements. For operating or servicing text, a subtask was defined as the text directly related to the performance of a single action (e.g., clean, adjust, remove, calibrate, tighten, oil, replace). Also, a conditional such as "if" may imply an action: "if the fitting leaks, replace it" is two actions. Titles, headings, labels, paragraph numbers, etc. were omitted. Explanatory text was partitioned by subject-verb construction, except where several subject-verb constructs had to be understood as a unit in order to be clear in meaning. Each subtask was then examined to determine how many sentences, words, syllables, and cross references it contained. A sentence was defined as a discrete statement separated from other text by a period or by spacing. The illustrations referred to by the text on a page were also counted. An illustration was considered to be a pictured group of parts which together constitute a larger assembly and which are all displayed together. This definition often resulted in a single panel being broken into several illustrations. For example, a locator illustration combined with an exploded view of a particular assembly would be considered two illustrations.

Two categories were used to tally cross-references. Within cross-references were those references which required the reader to find another location within the same book, while a between cross-reference required going to another book. The initial partitioning of the text into subtasks was done by the author; the counting of words, syllables, etc. was done by two AMSAA temporary employees, with the author checking their work by sampling. Appendix C contains the TM data collection form.

4.1.2 User Survey. User opinions and attitudes constitute the second source of information. Operators, mechanics and their direct supervisors were interviewed employing the user questionnaire shown in Appendix D as a guide. The questionnaire sought information on the soldier's rank, experience, training, usage of the manual, and on his opinion of the manual's availability, error rate, accessability, clarity, illustration quality and frequency, troubleshooting effectiveness, and its value as an aid to training. These interviews were conducted one-on-one, usually in the work environment of the user. Typically, an interview took 20 to 30 minutes, and discussions with supervisory personnel often occupied over an hour. By conducting the interviews in the user's work environment, the interviewee was more likely to be relaxed and communicative; he was less likely to forget information or limit his responses and comments to shorten the interview. Comments were recorded as close to verbatim as possible. These comments were edited for clarity, and this version was then usually repeated to the interviewee to ensure an accurate rendition of his opinion.

4.1.3 Discussions with Publications Personnel. The expertise and experience of the Army publications community was accessed, for the most part, through telephone discussions. Interview guides were also prepared for these discussions, but were not followed as closely as the user questionnaires. Unfortunately, there is little published information available on the technical manuals associated with specific systems.

4.2 Methods of Analysis.

The primary analytical tool used to compare the results of the TM analysis with the results of the user survey is the Pearson product moment correlation coefficient, r. Although the raw data from the user survey are category frequency counts, these were first averaged and the correlation was then calculated using the mean survey values as data points. In other words, the correlations calculated in this paper are based on data which are reasonably well behaved (i.e., distributed normally). More specifically, we have user survey data for 10 manuals (or series of manuals, as the case may be). When the mean values for a particular survey question are compared to the TM analysis results, this provides us with 10 points with which to calculate r.

It should be remembered that r is a measure of the linear relationship between two variables; r may range from -1 to +1 with those extremes representing perfect linear relationships, with negative or positive slope, respectively. Departures from linearity or restrictions on the sample range of either variable move the obtained value of r toward zero even though a real relationship may exist. The strength of the relationship may be expressed as the proportion of the variance accounted for by the linear formula which which can be esti-

mated by r^2. The statistical significance of the correlations reported in the results section may be judged by how likely they would be to occur by chance alone. That is, for a 5 percent probability of rejecting the null hypothesis of zero correlation when it is actually zero, the obtained r must be 0.55 or greater. For 10, 15, and 20 percent, the threshold value of r would be 0.44, 0.36, and 0.30 respectively. Given the noise inherent in survey data and the relatively small number of manuals for which we have data (ten distinct categories), it is not inappropriate to discuss r values as low as 0.30 provided the reader remains aware of the statistical limitations.

5. RESULTS

The results of the technical manual analysis are covered first, then the results of the user survey, and finally, the analysis of both sets of results considered jointly.

5.1 Results of the Technical Manual Analysis.

The data describing individual pages of manuals are presented in Appendix E. Note that the 9-2350-250-10 crew manual for the M901A1 Improved TOW Vehicle (ITV) was added to the books listed in Table 1. This addition was made after the interviews of TOW personnel at Ft Hood in November 1982. At that time it was discovered that these personnel were using the portion of 9-2350-250-10 referring to the M220A1 in place of the TOW reference 9-1425-472-12. In this case, only the pages of the ITV book covering the M220A1 were analyzed. In all, 547 pages were analyzed.

In order to make these results more directly comparable from one manual to another, only the data from the manual pages describing maintenance procedures were used in the analyses presented in this report (unless specifically stated otherwise). These data are summarized in Tables E-1 through E-6 which provide respectively the average number of subtasks per page, the average number of words per page, the average Reading Grade Level (RGL), the average number of illustrations, the average number of within cross-references, and between cross-references per page.

The first two measures, number of subtasks per page, and number of words per page, were highly correlated as would be expected ($r = 0.96$, slope of 10.0). These two measures will, therefore, be considered together. Both exhibited a wide range: 3.2 to 15 subtasks per page (Table E-1) and from 40 to 192 words per page (Table E-2). Words per page decreased slightly as echelon increased (a decrease of about ten words per echelon) as did subtasks per page (a decrease of one subtask per echelon).

Reading grade level ranged from 5.3 to 7.8 (Table E-3) indicating that the developers of this set of manuals did a good job in controlling readability. RGL was unaffected by echelon.

The number of illustrations per page varied from 0.5 to 3.0 (Table E-4). There were fewer illustrations per page as echelon increased: 1.9, 1.5, and 1.2 for -10, -20, and -34 respectively. Across the 10 sets of manuals, the number of illustrations was correlated only slightly with number of words per page ($r = -0.25$). The weakness of this negative relationship means there was little tradeoff between illustrations and words for space on a page.

The number of within cross-references did not vary greatly (from 0.4 to 1.6 per page, Table E-5). Maintenance level did not have a consistent effect. Specification had a small effect: ITDT books demonstrated a rate of 0.85 within cross-references compared to 0.54 per page for New Look books (-20 and -34 levels only).

The number of between cross-references did demonstrate one strong effect: For the -20 and -34 levels, ITDT books exhibited about four times as high a count as did the New Look manuals (Table E-6). The M1 manuals are primarily the cause; even the -10 M1 volumes prepared to MIL-M-63036 had a relatively high rate. An interesting comparison can be made between the -23 books for the UH-60A and the -20 books for the M1. Although these systems are of comparable complexity as measured by total parts count, the UH-60A manuals had 0.3 between cross-references per page while the M1 had 2.0. The low rate of between cross-references for the UH-60A is partially

attributable to the organization of the -23 volumes by functional subsystem and, in part, to the specific efforts of the contractor and PM to limit cross-referencing.

The other four measures showed little difference between ITDT and New Look manuals.

5.2 Results of the User Survey.

Table 2 lists the sites visited, the dates of the visits, and the number of soldiers interviewed at each site. Appendix F contains the individual questionnaire data. These data are summarized in Tables F-1 through F-10. In order to make these tables easier to interpret, the entries have been standardized to a scale of one to five with a value of one always representing the most favorable response. The user's responses to the open-ended questions are contained in Appendix G. The most frequent categories for these verbal responses are summarized in Tables G-1 through G-3.

TABLE 2. SITES AND NUMBERS OF SOLDIERS SURVEYED.

July 1981	Ft Hood (15)	Ft Knox (13)
November 1981	Ft Campbell (9)	
September 1982	Ft Sill (16)	Ft Knox (10)
November 1982	Ft Hood (82)	

The consistency of an individual's responses to the questionnaire can be partially evaluated by comparing the response to question 2 with the response to question 12. Both questions ask how often the interviewee uses the manual although each asks it in a different way. The responses to these two questions are reasonably consistent ($r = 0.62$) given the differences in wording and response scale of the two questions.

The average soldier interviewed for this study may be described as an E-4 who has been in the Army for 4.4 years and in his military occupational skill (MOS) for 2.1 years. The composition of the interviewees was fairly consistent across the manuals included in this study.

The ten manuals for which we have survey data may be compared through a composite measure, the sum of the averages for questions 6, 7, 9, 10, and 18 (Table F-10). These questions were selected as being most sensitive to the acceptability of the format and style of the manuals (eliminating, for example, questions concerning error rate, missing information, and troubleshooting effectiveness). This measure shows no appreciable effect of echelon or of specification (New Look or ITDT) used for the manuals. The range was only from 6.4 (best) to 8.9 (worst) with both specifications having examples at or near each end of this range. A perfect total for the composite measure would be 5, while the worst possible score would be 25. All of the assessed technical manuals demonstrated good acceptance by the user. This was also shown by the verbal responses to the open-ended questions as can be seen in Appendix G.

Question 23 asks the user what he likes best about his manual, and the responses are summarized in Table G-1. The response category "clarity" in that table refers to a comment regarding ease of understanding, clarity of expression, task proceduralization, or step-by-step instructions. It was readily apparent that the surveyed soldiers appreciated the ease of translating the information contained in these manuals to the system they were operating or maintaining. They were also very favorable toward the illustrations, particularly as an aid to understanding how a task should be done. These two categories, clarity and illustrations, probably overlap to some extent as some interviewees may have included illustrations in their concept of clarity or ease of understanding. The next four most frequent categories all received about the same number of responses. The user appreciates the ease of locating information in these books, in the sense of favorable comments concerning the index or table of contents or organization of the books. Troubleshooting, correct and complete information, and the Preventative Maintenance Checks and Services (PMCS) were also frequently cited as particular strong points.

Question 24 asks the user what he dislikes most about his manual, and these responses are summarized in Table G-2. The most frequent negative comment was the poor durability soldiers attribute to these books. This was often described as pages being lost from three ring binders, although at least one unit reported unsuccessfully trying a number of alternative binding methods for loose leaf manuals. PMCS received the next highest number of negative comments, followed by number of volumes (M1 and M60A1 -20 and -34 books). Five people (all at the -34 level, and four of these for the M1) felt the wording was too simple for them ("Low RGL" category). The same number of people complained of information access problems.

When asked what change they would like to see in these manuals (question 26, Table G-3), the largest number responded, "improve durability." Comments suggesting changes to the PMCS, index and wiring schematics were much lower in frequency.

A particularly interesting outcome of the user survey is the improvement in user attitudes toward the M1 manuals. Crews, mechanics and supervisory personnel for the M1 were interviewed at Ft Hood in July 1981 and in November 1982. Although different soldiers were interviewed in these two visits, a comparison of the results is not inappropriate. Since a slightly different questionnaire was used in the first visit, not all questions are directly comparable. However, questions 3, 6, 7, and 9 were virtually unchanged. User attitude toward the manuals improved in each of these categories (from 2.1, 2.1, 1.9 and 2.0 to 1.2, 1.2, 1.4, and 1.5, respectively), and the improvement was statistically significant. Some of this improvement can be explained by the fact that development of these manuals are now not as far behind the hardware development as they were in July 1981. Further, these soldiers have had more time to become familiar with both the books and the hardware. However, it is likely that a good part of this improvement in user attitude can be credited to the verification process which has resulted in numerous changes in these books.

5.3 Combined Results from User Survey and TM Analysis.

By considering the opinions of the users in concert with the objective measures of the manuals, we can learn much more than by examining either

source of information by itself. For example, number of subtasks and words per page have been shown to vary widely across this group of books. This result becomes more meaningful when it is seen that both of these measures correlate positively but weakly with a composite measure of user acceptance made up of questions 6, 7, 9, 10, 12, and 18 (subtasks per page, $r = 0.55$ and words per page, $r = 0.48$). That is, the more words or subtasks per page a manual had, the better the user tended to like it. These results suggest that the typical soldier has little difficulty dealing with more information on a page than he now often sees. By providing guidance to the manual developer in terms of a standard for words per page, shorter, more usable manuals should result.

The surveyed users also appeared to prefer the books with higher reading grade levels: RGL correlated at 0.39 with the composite measure, and at 0.48 with user acceptance as measured by question 9 ("Are the new style manuals easier to read and understand than the older traditional style manuals?" see Figure 1). RGL does not appear to be related to user opinion of clarity ($r = 0.09$). These results suggest that a seventh grade reading level (as measured by the Flesch-Kincaid formula) is appropriate for Army manuals aimed at a broad audience.

Finally, the results suggest that users are sensitive to the range of between cross-references per page found in the assessed manuals. This measure correlated at -0.325 with the composite measure; that is, the more between cross-references per page, the less the user liked the book. Similarly, the more between cross-references per page, the less often the book was used ($r = -0.31$, question 12).

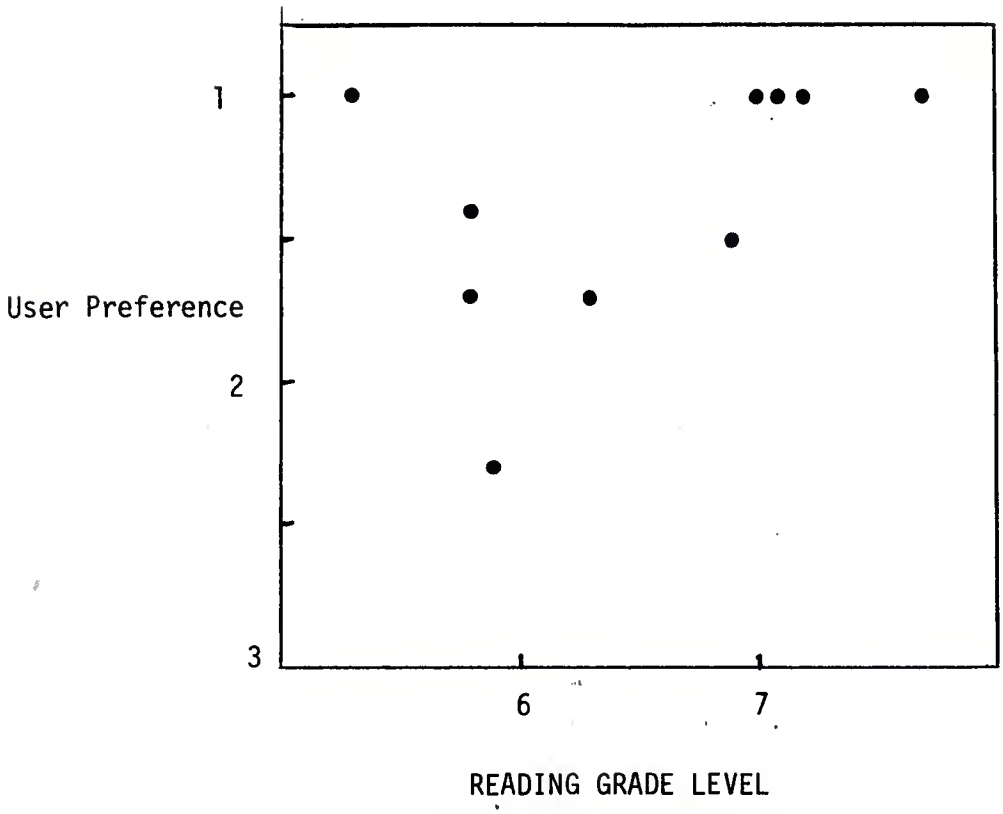

FIGURE 1. Reading Grade Level VS User Preference (Question 9: "Are the new style manuals easier to read and understand than the older traditional style manuals?")

6. DISCUSSION

6.1 User Acceptance.

Overall, the responses to this survey of user attitudes indicate good acceptance of this group of technical manuals. Indeed, this uniformity is itself troublesome, for it might be used to question the validity of the results. However, it should be noted that the methods used in this assessment were sufficiently sensitive to detect an improvement in user attitudes toward the M1 manuals. Further, as noted, the survey results are internally consistent for the most part, as shown by comparing multiple alternative results with verbal responses to open-ended questions. The typical soldier sees the new format (step-by-step instruction written to a target grade level and closely accompanied by numerous line drawings) as acceptable, easy to use, and, where he is familiar with old style or traditional books, superior to them.

6.2 Troubleshooting.

Fault diagnosis remains the most difficult area of technical documentation. It is obvious that although nearly all operational and regular maintenance tasks can be included in the books for a system, this is not possible for fault isolation. The ratio of faults which can be documented to the total number of possible faults presumably decreases as system complexity increases. The two most complex systems in this assessment (as measured by parts count), the M1 and the UH-60A, have demonstrated troubleshooting problems.

The M1 shortcomings are due in part to hardware difficulties: The mechanics for the M1 distinguished between troubleshooting success when using the alternate test procedures (ATP) and troubleshooting failure when using the special test equipment (STE/M1). Still, these mechanics appear to be hampered by their limited understanding of the M1. For example, M1 faults were characterized as being either fairly easy or impossible to isolate.

The troubleshooting volume for the UH-60A is undergoing a complete re-write. Although the Blackhawk PM does not feel the current format is a problem, it differs from the other assessed manuals in its use of a paragraph format instead of a diagrammed logic tree. Given the importance of fault isolation in maintaining operational availability, the Army should consider preparation of the UH-60A troubleshooting volume in both formats, and subsequently, a systematic comparison of the effectiveness of each.

6.3 TM as Training Resource.

The responses to questions 17 and 18 of the user survey demonstrate good user satisfaction with these manuals as an aid to training. The verbal comments could be summed up as, "These books are easy to learn from."

Discussions with TRADOC instructors and lesson plan developers generally expressed the opinion that the proceduralized format and associated line drawings were acceptable, and text and illustrations could either be translated into course materials, or used directly themselves. However, they did have some specific criticisms of the M1 manuals such as:

a. insufficient theory

b. too many cross-references between books impedes classroom use

c. too much detail on basic skills - too much redundancy

d. schematics lack needed test values

This difference of opinion between soldier and trainer can be at least partially resolved by examining their different objectives. The soldier in the field appreciates going to the books for most tasks and being able to successfully apply the instructions. The trainer is frustrated because he does not have sufficient course time to teach the theory he sees as necessary. The end result may be seen in the troubleshooting difficulties which the M1 is exhibiting. For complex major systems, it may be most effective to require a separate volume of theory specific to each end item, designed to augment the troubleshooting books.

6.4 Extension Training Materials.

The ETM specification, MIL-M-63040, has been canceled. In spite of this, some effort was made to assess user attitudes and experience with respect to ETM. Of the soldiers interviewed, very few claimed any knowledge of ETM, although a number of them reacted favorably to the concept. A cursory examination of usage patterns at a Ft Hood training center suggested that additional printed text would not be used to the extent audio-visual material would.

6.5 Target Audience Description (TAD).

Some of the shortcomings of the M1 manuals (extreme lack of theory, detail on simple tasks, volume and low RGL) may be attributed to the restrictive TAD which was provided initially for this system. Essentially, the prospective user was described as an Advanced Individual Training (AIT) graduate with a fifth grade reading ability. Considerable improvement can be seen in TAD's done subsequently to the M1. For example, more detail on skills has been provided along with an assessment of reading ability. A further improvement could be made by providing separate target audience descriptions for those particular volumes which would be used by a subset of the user population (troubleshooting books). Although the Army cannot train every mechanic to be a skilled diagnostician, it should make the necessary theory available to those mechanics who could make use of it.

6.6 Validation and Verification.

Validation is intended to serve as quality control for publications, a check of accuracy and completeness performed by the contractor. Verification performed by the government using target audience soldiers is a final test of usability. Unfortunately, these intentions have seldom been realized in practice. First, validation and verification are often combined because of scheduling pressures. Second, even when a separate validation has been done, there often remains considerable skepticism about the actual extent of the contractor effort. The most appropriate available performance measure is the percentage of tasks which are verified as acceptable with no changes (sometimes called the first pass go without change rate).

For the M2/3, the Bradley, which had a separate validation, 19 percent of tasks tested passed without change. The M1, which employed a combined validation and verification, has produced a 16 percent rate and the UH-60A, which also had a combined validation and verification, had a rate of about 25 to 30 percent (detailed records are no longer available). Among the reasons for this poor performance are: TM writers typically do not have access to developing hardware or up-to-date information on that hardware (manuals are written in response to hardware changes and therefore, will lag behind those changes), and validation is a contractor function over which government has exercised little control or monitoring.

These verification rates could be improved by providing writers with access to hardware or, at least, photographs or video tapes of the current configuration. In addition, automated configuration management could be extended to track the publications changes required by hardware changes. If contractors were required to keep good records of the validation process, this could also have a beneficial impact on the efficiency of verification as shown by the DRAGON program. In this instance, verification reportedly was much faster because of the quality of the validation. Further reductions in the cost and time taken by verification could be achieved by providing contractors with performance incentives linked to verification. An appropriate performance measure for this purpose would be the percentage of pages which are verified without change.

In order to provide monetary incentives for the contractor, several conditions must be met. First, new equipment contracts must be more specific with respect to publications costs. These must be stated

separately, and the services and products which are paid for by those funds must also be adequately described and reasonable standards and delivery schedules set forth. Second, an appropriate type of contract must be employed, such as a cost plus award fee contract. Under this type of contract, the amount of the award fee is not subject to dispute by the contractor. Third, the amount of the award fee should be set as some fraction of the cost the government avoids through an expeditious verification. Regulations state that this amount may not exceed 10 percent of the fixed portion of the publications contract cost. In other words, each draft TM page which is verified without requiring a technical change saves the government the expense of a subsequent rewrite and reverification. The performance measure would be the number of TM pages which are verified without requiring a technical change or one to enhance usability, and which meet all other contract requirements, divided by the total number of TM pages submitted for verification. A minimum acceptable level would be subtracted from this ratio. This difference, if greater than zero, would then be multiplied by the total number of tasks submitted for verification and by the estimated cost of verifying a task for the commodity area in question and by the fraction representing the percentage of avoided cost to be awarded.

For example, assume that manuals for a new truck have been verified. The contract specified 65 percent as a minimum acceptable level for the verification performance measure, $500 as the estimated avoided cost per task and 0.7 as the fraction of avoided cost to be awarded. There were 1450 tasks and 16,000 pages verified, and 15,000 pages did not require any technical or usability change. The amount of incentive fee to be awarded would be

$$\left(\frac{15,000}{16,000} - 0.65\right) \times 1450 \times \$500 \times 0.7 = \$145,906.25.$$

If we assume $350/page as the total publications contract fixed cost, then this example satisfies the Defense Acquisition Regulation requirement that the maximum incentive fee may not exceed 10 percent of the base portion or fixed contract price

$$(16{,}000 \text{ pages} \times \$350/\text{page} \times 0.1 > (1-.65) \times 1450 \times \$500 \times 0.7).$$

In order for such performance incentives to be set at valid levels, it will be necessary to keep better records of TM verifications and their costs. It should also be noted that the above estimate of $500 saved per task is for labor and overhead and does not attempt to provide a cost equivalent for the time saved through avoiding reverification.

There are also improvements which could be made in the verification process itself. This process is now described in AR 310-3 and in MIL-M-63038B in very limited detail. For example, these descriptions omit how long subjects can be used, what data will be retained and by whom, what procedure will be used to check for the inclusion of verification changes in the final publication and what rewrite procedures are to be used in a combined validation and verification. More detailed guidance for verification could result in a more efficient, more uniform process.

Unless validation can be better controlled, a combined validation/verification should receive routine consideration in those programs for which it would be appropriate. The verification of all tasks which are feasible to test ("100 percent hands-on verification") should be continued. It is necessary, as shown by the low percentage of tasks passing verification without change for our selected three major systems, and effective, as shown by the improvement in user attitude toward the M1 manuals.

6.7 Durability.

As noted in the discussion of the survey results, durability of technical manuals is a real problem for the user. There are several alternative materials with each having its own benefits and drawbacks. Thicker paper adds bulk and weight with little increase in strength or resistance to water and soiling. Tyvek is extremely strong but also very vulnerable to grease and oil which result in puckering. Chemdura may have availability restrictions and, like tyvek and latex impregnated paper, requires special handling by the printer. Latex impregnated paper gives good water and oil resistance but does not greatly increase resistance to tearing. Another possibility is an acetate reinforcement applied to the binding edge of the sheets.

The potential exists to improve field life and usage of the books, as well as user satisfaction, at about a 50 to 100 percent increase in material and printing costs. The additional material cost for 80 lb latex impregnated paper would be about $0.012 per page or about $172,000 added to the cost of 1000 copies of the 255 series books for the M1. Additional printing costs would be considerably higher due to the changes from normal printing procedures. These costs are more difficult to estimate, perhaps, because of lack of printer experience with large runs of paper substitutes. A very rough estimate would be about $1 million in additional printing costs for this example. At least some of this expense would be recovered through the longer life of the manuals. The above additional costs might be compared to the $28.6 million spent on developing these M1 manuals.

A field trial is now being conducted at Ft Hood by the M1 project manager which should provide data on these points for several alternative materials.

The field life of operator manuals could also be improved by making the PMCS available separately from the books themselves in a highly durable, perhaps plasticized, checklist form.

Manual durability is directly related to one of the more frequent supervisory (warrent officer, etc.) complaints: it takes too long to order technical manuals. They don't like the procedures for ordering TM's, and they particularly dislike the delays. This attitude could be summed up as, "We scrounge the books when we get tired of waiting for them." The Adjutant General's Office (TAGO), which is responsible for the printing and distribution of manuals,

has had several alternative distribution systems under study for a number of years.

6.8 Publications Cost..

The cost to the government of technical manuals is typically expressed only as a total publications contract cost for number of pages delivered. This allows calculation of a cost per page which should have some comparability from program to program. It must be kept in mind that these costs may include different elements for each program. For example, the Logistics Support Analysis Record (LSAR) is intended to provide data for publications development. However, in some programs, the publications effort has supported the LSAR, increasing publications cost. Also, a revision is presumably less expensive than the initial development of a manual. A similar problem is the question of how to account for the effect hardware configuration changes have on publication cost. In short, the quality of available publications cost data severely limits analysis.

Table 3 gives the cost per page and number of pages on those books for which data were available. The cost per page corrected to 1981 dollars (inflation factor of 1.05 per year) and the system total number of parts (index line count from -34 parts manuals) are also provided. Note that the costs for the M220A1 had a second correction applied, as some of the pages in these books were double size. The costs for the M1 books were divided by five to attempt to correct for the five configurations which this system has had.

TABLE 3. PAGE COSTS, PARTS COUNTS, PAGE COUNTS, AND WORDS PER PAGE.

System	Manual	$/Page	Corrected $/Page *	Parts	Page Count	Words/Page
M1	255-10	1984	397	19,000	836	158
M1	255-20	1974	395	19,000	10,271	77
M1	255-34	1984	397	19,000	3,205	103
M60A1	215-10	221	221	13,000	1,037	54
M60A1	215-20(NL)	275	275	13,000	3,381	65
M60A1	215-34(NL)	215	226	13,000	525	81
M109A1	217-10N	284	284	13,000	298	192
M109A1	217-20N	228	228	13,000	540	108
M109A1	217-34-1	175	382	13,000	322	89
M109A1	217-34-2	201	201	13,000	405	89
UH60-A	237-23	475	550	25,000	4,738	111
M220A1	472-12	360	269	4,000	472	40
M220A1	472-34	360	269	4,000	4,368	69
M915**	273-10	202	212	6,000	180	
M915	273-20	202	212	6,000	1,412	
M915	273-34	293	308	6,000	646	

* 1981 Dollars (inflation factor of 1.05 per year)
**Not an assessed system but one for which cost data were available

The adjusted cost per page was found to correlate at 0.50 with the number of pages delivered, with a slope of about $18 per 1000 pages. That is, the more pages delivered, the more each page tended to cost (although the effect is a small one). There was also a slight correlation found between cost per page and number of words per page (r = 0.28, slope of 0.7 dollars per word). In other words, there is a weak trend for more words per page to mean higher cost per page. Of more interest is the relationship between number of parts in a system and number of pages in the manuals for that system. This comparison was made separately for each echelon and demomstrated a tendency for more complex systems to require more pages as expected (r = 0.66, 0.78, and 0.50, slope of 51,665 and 91 pages per 1000 parts for -10, 20, and -34 respectively). However, these estimates are each based on only a few points.

One of the most interesting trends to emerge from these data is the dependence of corrected cost per page on system parts count (r = 0.73, slope of $11.7 per 1000 parts). This relationship is shown in Figure 2. The system parts count is a measure of system complexity and is simply the total number of national stock numbers (NSN's) and part numbers taken from a -34 parts manual. This measure of complexity was used because it could be applied consistently to each system. It appears that as a system becomes more complex (has more parts), the technical manuals for it cost more per page. This may be due to a ripple effect, namely, that hardware changes in more complex systems result in more extensive publications changes. This relationship could have predictive value for materiel developers in estimating publications costs.

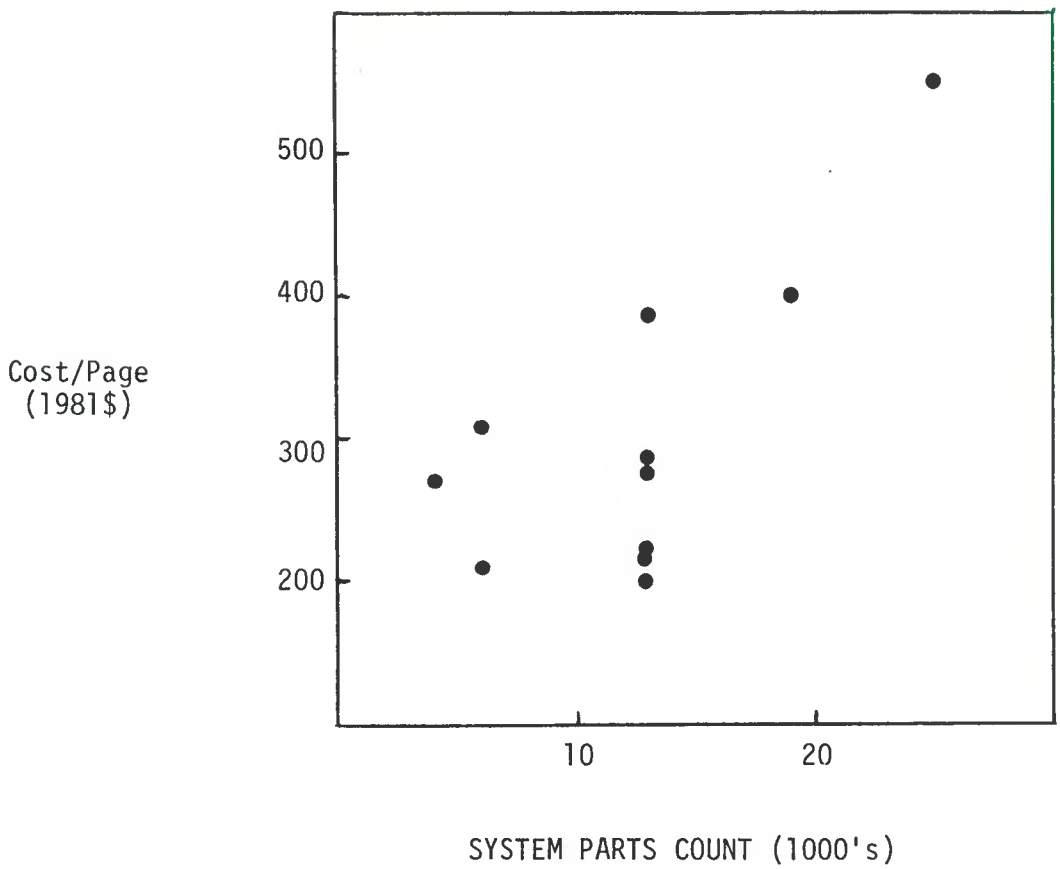

FIGURE 2. System Parts Count VS Cost/Page

7. CONCLUSIONS AND RECOMMENDATIONS

The primary conclusions and recommendations of this assessment are:

a. The surveyed soldiers demonstrated high acceptance of these new style manuals, particularly of the step-by-step instructions and numerous line drawings.

b. Troubleshooting remains a problem for highly complex Army end items. This may be due in part to the lack of theory in the manuals and in school courses. It may be more effective to target a different audience for the troubleshooting books, perhaps to the extent of providing a separate volume of theory to augment these books.

c. As shown by the UH-60A -23 books, it is possible to control the frequency of between cross-references, even for a very complex end item. By doing this, frequency of use of the manuals should be improved. Similarly, several manuals demonstrated the feasability of putting more words on each page of maintenance instruction. This should improve user acceptance and usage as well as reduce page counts.

d. For the UH-60A, the M1, and the M2/3, only about one fifth of the tested maintenance tasks were verified without change. Because of this, 100 percent hands-on verification should be continued for those tasks which it is feasible to test. The proportion of tasks which pass without change could be improved by providing cost incentives to the contractor.

e. The verification process itself needs better definition.

f. Durability of Army technical manuals should be improved, as this can be accomplished without excessive cost increases.

g. The distribution of technical manuals continues to irritate the soldier who needs them. There is no apparent solution under consideration at this time.

APPENDIX A

INITIAL TASKING LETTER

DEPARTMENT OF THE ARMY
HEADQUARTERS US ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND
5001 EISENHOWER AVENUE, ALEXANDRIA, VA. 22333

DRCPA

13 July 1981

SUBJECT: Independent Assessment of Skill Performance Aids

Director
US Army Materiel Systems Analysis Activity
Aberdeen Proving Ground, MD 21005

1. Skill Performance Aids were introduced as refinement of Integrated Technical Documentation and Training. With over $500 million in the Army's FY 83-87 Program devoted to Skill Performance Aids, it is appropriate to revisit this program. Based upon current experience, it appears that we may not be receiving a proper return on the investment. I have been hearing too many complaints as to complexity, volume of pages, lack of utility for fault isolation and out-of-date manuals.

2. As a matter of priority, I want AMSAA to conduct an independent assessment of Skill Performance Aids associated with the Abrams Tank. This should be a DARCOM only effort with a basic thrust to ascertain whether Skill Performance Aids are achieving intended benefits for the user.

3. Your assessment should be completed by 31 July 1981 so that the results can be briefed to LOG 81 Study Group. Point of Contact in the headquarters is LTC McLaughlin, DRCPA-S, AUTOVON 284-8037/8.

John R. Guthrie

JOHN R. GUTHRIE
General, USA
Commanding

APPENDIX B

EVOLUTION OF TECHNICAL MANUAL SPECIFICATIONS

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EVOLUTION OF TECHNICAL MANUAL SPECIFICATIONS

The M1 represents the first attempt by the Army to provide a major new system with manuals which can be used by inexperienced personnel. Other armed services pioneered this approach. The Air Force, in particular, has had considerable success in making use of relatively undertrained mechanics on very complex systems through the use of highly proceduralized technical manuals; however, contractor personnel are used for difficult tasks. This is feasible because of lower end item density and concentration of resources in areas distant from the FEBA. This success helped motivate several attempts to improve Army technical manuals. The Kinton Report, published in 1975, under the aegis of the US Army Human Engineering Laboratory, surveyed numerous studies and proposed methods for documenting technical information. It recommended concentration of effort upon a front end analysis which would identify needed tasks and specify in detail the way each task should be performed. The Kinton Report, also, recommended use of draft specification 632XX prepared by RCA. Some of the more important features of this specification are: a fifth grade reading level, very little theory, a separate frame for each significant task step, and government verification of all tasks. These elements come together in the Integrated Technical Documentation and Training (ITDT) program (see Table B-1). The primary benefits claimed for the ITDT approach are shown in Table B-2).

TABLE B-1. ELEMENTS OF INTEGRATED TECHNICAL DOCUMENTATION AND TRAINING.

- FRONT END ANALYSIS
  - Equipment Analysis
  - Functional Analysis
  - Task Analysis
  - Behavorial Task Analysis
- TROUBLE SHOOTING (MIL-M-633XX)
  - System/Subsystem Organization-Symptom and/or Test Equipment Organization-By Tests
  - Bi-level Text
  - o MANDATORY VALIDATION AND VERIFICATION
- TECHNICAL MANUALS (MIL-M-632XX)
  - 5th Grade Reading Level
  - Organized by Function
  - One Frame Per Cue-response Subtask
  - No Exploded Drawings
  - No Theory or Schematics
  - High Page Count
- EXTENSION TRAINING MATERIALS (MIL-M-63040)

TABLE B-2. BENEFITS INITIALLY CLAIMED BY ITDT.

- Reduce Additional Training Requirements
- Lower Spare Parts Consumption
- Reduce Technician-Induced Errors
- Increase Effectiveness of Job Training Systems
  - Reducing Downtime Due to Improved Malfunction Diagnosis
  - Reducing Mean Time to Repair
  - Increasing Utilization of Inexperienced Personnel

Meanwhile, other specifications for writing technical manuals were prepared by the Materiel Readiness Support Activity. These grew out of the ARRCOM M109 project and have come to be called the New Look specifications (MIL-M-63036 and MIL-M-63038). They do not attempt to include quite the level of detail sought by the ITDT specifications, and the resulting page counts are generally felt to be intermediate to old style manuals (i.e, prior to ITDT or New Look) and ITDT. Two key differences are that the New Look manuals are written to a target audience definition provided by TRADOC, and that MIL-M-63038 allows considerable latitude in selection of format, degree of detail and troubleshooting logic. The New Look specifications replaced the ITDT specifications, but the remainder of the program was retained, and the preparation of training materials was formalized by MRSA in MIL-M-63040. This combination was titled Skill Performance Aids or SPAS. Currently, the front end analysis (as described in the canceled MIL-M-63035) has been replaced by the Logistics Support Analysis or some substitute (see Table B-3).

The specification for the extension training materials (ETM), MIL-M-63040, has also been canceled. Very few, if any, of these documents were used in the field. The usual rationale for this non-use was that the proceduralized manuals fulfilled the role originally intended for the ETM. In sum, the term SPAS now has no meaning beyond implying the use of MIL-M-63036 or MIL-M-63038.

TABLE B-3. ELEMENTS OF SKILL PERFORMANCE AIDS.

o DEVELOPMENT OF SOURCE DATA	o TECHNICAL MANUALS ("New Look")
LSAR or substitute	MIL-M-63036 Operator
	MIL-M-63038 for Others
	TRADOC Target Audience Definition
	Bi-level Text (color)
	Exploded Drawings and Schematics
	Page Counts Greater Than Old Style, Less Than ITDT
	Content Format Selection Summary
o MANDATORY VALIDATION AND VERIFICATION	

APPENDIX C

TECHNICAL MANUAL DATA COLLECTION FORM

Next page is blank.

TM _____

PAGE _____ SCORER _____ DATE SCORED _____

SUBTASK	SENT.	WORDS	SYLL.	ILL.	wCR	bCR
1						
2						
3						
4						
5						
10						
15						
20						
25						
30						
35						

_____ subtasks on page
_____ sentenceson page
_____ words on page
_____ syllables on page
_____ words/sentence
_____ syllables/word
_____ Flesch-Kincaid RGL
_____ illustrations
_____ within TM cross references
_____ between TM cross references
_____ words/subtask
_____ std dev words/subtask

Check one:

_____ maintenance procedure

_____ troubleshooting

_____ PMCS

_____ other (e.g., explanatory)

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APPENDIX D

USER QUESTIONNAIRE

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TECHNICAL MANUAL SURVEY

This questionnaire is part of an effort aimed at improving Army Technical manuals. We need to know how often you use these TM's, what problems you have had with them, and how you would like to see them changed.

JOB TITLE _____ MOS _____ TIME IN MOS _____ LENGTH OF SERVICE ____

RANK _____ ARMY BACKGROUND _____

Were you school trained for your present job? Yes _____ No _____

What technical manual do you use most often to operate and maintain your equipment?

TM Number _____ Date on Cover _____ (Aim your comments at this TM).

1. Is this manual available when you need it? Yes ____ No ____ Sometimes ____

2. How often do you use this manual?

   Almost always ___ Most of the time ___ Sometimes ___ Almost never ___

3. On what percentage of your maintenance tasks was there an error in the TM?

   ___100-80% ___80-60% ___60-40% ___40-20% ___20-0%

4. What kinds of errors were most frequent? _____

   _____

5. How often was the information you needed not in the TM?

   ___100-80% ___80-60% ___60-40% ___40-20% ___20-5%

6. How often was it hard to find what you wanted in the TM (even when it was there)?

   ___100-80% ___80-60% ___60-40% ___40-20% ___20-0%

7. How often was the TM unclear to you?

   ___100-80% ___80-60% ___60-40% ___40-20% ___20-0%

8. How was it unclear? _____

   _____

9. Are the new style manuals easier to read and understand than the older traditional style manuals: Yes___ No___ About the same___

10. How good are the illustrations in this manual?

    Excellent___ Good___ Fair___ Poor___ Unacceptable___

11. How many illustrations should each area of this TM have?

Operating instructions	More___	Fewer___	No change___
PMCS	More___	Fewer___	No change___
Troubleshooting	More___	Fewer___	No change___
Maintenance procedures	More___	Fewer___	No change___

12. On what percentage of your maintenance tasks did you use the TM?

___100-80% ___80-60% ___60-40% ___40-20% ___20-0%

13. How often do you troubleshoot this system?

Daily___ Weekly___ Monthly___ Almost never___

14. How effective is the troubleshooting in this TM?

Excellent___ Good___ Fair___ Poor___ Unacceptable___

Any troubleshooting problems? _____

15. Should there be more or less theory of operation taught in training programs and included in this manual?

More___ About Right___ Less___ Why? _____

_____

16. Is this manual now used to support on-the-job training?

Most of the time___ Sometimes___ Never___

17. Could this manual be used to support OJT?

Yes___ No___ Explain _____

_____

_____

18. If this TM was used in a course you took, how good was it as an aid to training?

Excellent___ Good___ Fair___ Poor___ Unacceptable___

19. Do you know what extension training materials (ETM) are? Yes___ No___

20. Have you ever used ETM? Yes___ No___ Not sure___

21. If so, on what system have you used them most? _____

22. The ETM for that system were:

Very helpful___ Helpful___ Slightly helpful___ No help ___

23. Was there anything that you especially liked about this TM, anything which made it easier to use?

24. Was there anything that you especially disliked about this TM? Anything which made it harder to use?

25. What is your opinion of this TM? Especially as compared to TM's for similar systems?

26. How could this TM be better?

27. Please use the remaining space to expand any of your answers or to provide other comments on Army Technical Manuals. (If you are a supervisor, please describe any important problems your troops have had in using this manual.)

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APPENDIX E

TECHNICAL MANUAL DATA

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TECHNICAL MANUAL DATA

Column		
1	TM series:	1 = M1 (9-2350-255) 2 = M60A1 (9-2350-215) 3 = M109A1 (9-2350-217) 4 = M22-A1 (9-1425-472) 5 = UH-60 (55-1520-237) 6 = M901 (9-2350-259)
2	Page type:	M = maintenance T = troubleshooting P = PMCS E = explanatory
3	Echelon:	1 = -10 or -12 2 = -20 or -23 3 = -34
4	Specification:	N = New Look or similar I = ITDT 0 = Traditional
5-10	Number of subtasks	
11-16	Number of sentences	
17-22	Number of words	
23-28	Number of syllables	
29-34	Words per sentence	
35-40	Syllables per word	
41-46	Reading grade level	
47-52	Number of illustrations	
53-58	Number of within cross references	
59-64	Number of between cross references	
65-70	Words per subtask	

* Each line in the list describes one page selected at random from a technical manual.

1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
1E1N	20.0	20.0	262.0	410.0	13.1	1.6	8.0	2.0	0.0	0.0	13.1
1P1N	13.0	15.0	177.0	278.0	11.8	1.6	7.5	0.0	0.0	1.0	13.6
1P1N	6.0	9.0	112.0	165.0	12.4	1.5	6.6	1.0	1.0	1.0	18.7
1P1N	10.0	8.0	97.0	146.0	12.1	1.5	6.9	5.0	0.0	4.0	9.7
1M1N	13.0	10.0	150.0	243.0	15.0	1.6	9.4	3.0	3.0	1.0	11.5
1E1N	13.0	14.0	197.0	284.0	14.1	1.4	6.9	3.0	6.0	1.0	15.2
1E1N	11.0	10.0	144.0	200.0	14.4	1.4	6.4	6.0	6.0	0.0	13.1
1E1N	12.0	14.0	172.0	242.0	12.3	1.4	5.8	4.0	1.0	1.0	14.3
1E1N	16.0	17.0	132.0	176.0	7.8	1.3	3.2	5.0	2.0	0.0	8.3
1E1N	12.0	16.0	205.0	310.0	12.8	1.5	7.3	3.0	0.0	0.0	17.1
1T1N	26.0	19.0	160.0	275.0	8.4	1.7	8.0	0.0	1.0	1.0	6.2
1T1N	24.0	13.0	139.0	250.0	10.7	1.8	9.8	0.0	2.0	2.0	5.8
1T1N	20.0	16.0	152.0	234.0	9.5	1.5	6.3	0.0	0.0	2.0	7.6
1T1N	19.0	13.0	170.0	259.0	13.1	1.5	7.5	0.0	0.0	2.0	8.9
1T1N	21.0	17.0	178.0	267.0	10.5	1.5	6.2	0.0	0.0	3.0	8.5
1M1N	11.0	12.0	134.0	183.0	11.2	1.4	4.9	3.0	2.0	0.0	12.2
1M1N	11.0	12.0	136.0	207.0	11.3	1.5	6.8	3.0	2.0	3.0	12.4
1M1N	13.0	13.0	147.0	230.0	11.3	1.6	7.3	4.0	6.0	1.0	11.3
1M1N	11.0	6.0	134.0	195.0	22.3	1.5	10.3	2.0	0.0	4.0	12.2
1E1N	13.0	13.0	160.0	238.0	12.3	1.5	6.8	2.0	0.0	0.0	12.3
1M2I	9.0	8.0	110.0	136.0	13.8	1.2	4.4	4.0	0.0	0.0	12.2
1M2I	8.0	8.0	99.0	125.0	12.4	1.3	4.1	1.0	4.0	0.0	12.4
1M2I	9.0	11.0	93.0	136.0	8.5	1.4	4.2	2.0	1.0	0.0	10.3
1M2I	5.0	5.0	64.0	88.0	12.8	1.4	5.6	3.0	1.0	0.0	12.8
1M2I	14.0	15.0	100.0	126.0	6.7	1.3	1.9	5.0	1.0	0.0	7.1
1M2I	4.0	4.0	47.0	69.0	11.8	1.5	6.3	3.0	0.0	2.0	11.8
1M2I	5.0	4.0	45.0	75.0	11.3	1.7	8.5	0.0	0.0	4.0	9.0
1M2I	4.0	6.0	45.0	71.0	7.5	1.6	6.0	1.0	0.0	0.0	11.3
1M2I	13.0	12.0	117.0	198.0	9.8	1.7	8.2	0.0	2.0	10.0	9.0
1M2I	7.0	6.0	68.0	136.0	11.3	2.0	12.4	0.0	0.0	6.0	9.7
1M2I	7.0	8.0	111.0	156.0	13.9	1.4	6.4	3.0	6.0	0.0	15.9
1M2I	10.0	10.0	106.0	169.0	10.6	1.6	7.4	2.0	2.0	6.0	10.6
1M2I	1.0	1.0	7.0	10.0	7.0	1.4	4.0	0.0	1.0	0.0	7.0
1M2I	8.0	8.0	61.0	73.0	7.6	1.2	1.5	3.0	0.0	0.0	7.6
1T2I	9.0	16.0	134.0	197.0	8.4	1.5	5.0	1.0	0.0	4.0	14.9
1T2I	6.0	11.0	47.0	92.0	4.3	2.0	9.2	0.0	2.0	2.0	7.8
1T2I	8.0	13.0	102.0	146.0	7.8	1.4	4.4	0.0	4.0	1.0	12.8
1T2I	6.0	6.0	51.0	73.0	8.5	1.4	4.6	3.0	0.0	0.0	8.5
1T2I	15.0	19.0	149.0	251.0	7.8	1.7	7.3	0.0	1.0	2.0	9.9
1T2I	2.0	4.0	19.0	41.0	4.8	2.2	11.7	0.0	0.0	2.0	9.5
1T2I	9.0	13.0	100.0	162.0	7.7	1.6	6.5	0.0	0.0	3.0	11.1
1T2I	8.0	14.0	109.0	189.0	7.8	1.7	7.9	0.0	0.0	5.0	13.6
1T2I	14.0	22.0	173.0	329.0	7.9	1.9	9.9	0.0	1.0	9.0	12.4
1T2I	17.0	23.0	157.0	280.0	6.8	1.8	8.1	0.0	0.0	3.0	9.2
1T2I	6.0	8.0	45.0	74.0	5.6	1.6	6.0	3.0	1.0	1.0	7.5
1T2I	15.0	18.0	161.0	226.0	8.9	1.4	4.5	0.0	3.0	0.0	10.7
1T2I	12.0	17.0	116.0	169.0	6.8	1.5	4.3	1.0	0.0	2.0	9.7
1T2I	15.0	24.0	169.0	251.0	7.0	1.5	4.7	0.0	9.0	0.0	11.3
1M3I	11.0	21.0	109.0	182.0	5.2	1.7	6.1	0.0	0.0	4.0	9.9
1M3I	10.0	20.0	128.0	221.0	6.4	1.7	7.3	0.0	0.0	4.0	12.8
1M3I	12.0	18.0	118.0	202.0	6.6	1.7	7.2	0.0	0.0	4.0	9.8
1M3I	10.0	10.0	100.0	172.0	10.0	1.7	8.6	1.0	0.0	0.0	10.0
1M3I	3.0	3.0	32.0	51.0	10.7	1.6	7.4	1.0	0.0	0.0	10.7
1M3I	6.0	6.0	105.0	131.0	17.5	1.2	6.0	2.0	0.0	0.0	17.5
1M3I	11.0	16.0	175.0	225.0	10.9	1.3	3.8	1.0	0.0	0.0	15.9
1M3I	4.0	7.0	74.0	100.0	10.6	1.4	4.5	1.0	0.0	0.0	18.5
1M3I	6.0	6.0	85.0	109.0	14.2	1.3	5.1	1.0	1.0	0.0	14.2
1M3I	7.0	7.0	64.0	85.0	9.1	1.3	3.6	1.0	1.0	0.0	9.1
1M3I	2.0	2.0	38.0	45.0	19.0	1.2	5.8	3.0	0.0	0.0	19.0
1M3I	4.0	4.0	69.0	99.0	17.3	1.4	8.1	3.0	1.0	0.0	17.3
1M3I	8.0	9.0	116.0	175.0	12.9	1.5	7.2	1.0	3.0	1.0	14.5
1M3I	11.0	11.0	134.0	195.0	12.2	1.5	6.3	4.0	1.0	1.0	12.2

1M3I	10.0	10.0	104.0	152.0	10.4	1.5	5.7	5.0	2.0	1.0	10.4
1M3I	9.0	11.0	107.0	152.0	9.7	1.4	5.0	1.0	1.0	0.0	11.9
1M3I	9.0	13.0	140.0	169.0	10.8	1.2	2.8	1.0	0.0	0.0	15.6
1M3I	12.0	12.0	145.0	179.0	12.1	1.2	3.7	5.0	0.0	0.0	12.1
1M3I	5.0	7.0	95.0	123.0	13.6	1.3	5.0	2.0	0.0	0.0	19.0
1M3I	12.0	13.0	116.0	210.0	8.9	1.8	9.3	1.0	1.0	8.0	9.7
1M3I	7.0	11.0	114.0	166.0	10.4	1.5	5.6	1.0	0.0	0.0	16.3
1T3I	7.0	12.0	88.0	172.0	7.3	2.0	10.3	1.0	0.0	2.0	12.6
1T3I	8.0	10.0	89.0	140.0	8.9	1.6	6.4	1.0	0.0	2.0	11.1
1T3I	8.0	14.0	96.0	204.0	6.9	2.1	12.2	0.0	0.0	4.0	12.0
1T3I	4.0	8.0	44.0	88.0	5.5	2.0	10.2	0.0	0.0	4.0	11.0
1T3I	9.0	16.0	107.0	179.0	6.7	1.7	6.8	1.0	0.0	3.0	11.9
1T3I	13.0	20.0	145.0	277.0	7.3	1.9	9.8	0.0	0.0	5.0	11.2
1T3I	11.0	18.0	129.0	234.0	7.2	1.8	8.6	0.0	0.0	5.0	11.7
1T3I	11.0	16.0	132.0	231.0	8.3	1.8	8.3	1.0	1.0	2.0	12.0
1E3I	6.0	7.0	85.0	131.0	12.1	1.5	7.3	0.0	0.0	0.0	14.2
1E3I	18.0	21.0	253.0	367.0	12.0	1.5	6.2	0.0	0.0	2.0	14.1
1P3I	15.0	17.0	174.0	237.0	10.2	1.4	4.5	3.0	1.0	0.0	11.6
2P1N	5.0	4.0	71.0	113.0	17.8	1.6	10.1	2.0	0.0	0.0	14.2
2P1N	15.0	14.0	127.0	194.0	9.1	1.5	6.0	3.0	0.0	0.0	8.5
2E1N	10.0	13.0	123.0	182.0	9.5	1.5	5.6	1.0	1.0	0.0	12.3
2E1N	4.0	5.0	47.0	69.0	9.4	1.5	5.4	1.0	0.0	0.0	11.8
2E1N	3.0	3.0	28.0	41.0	9.3	1.5	5.3	2.0	1.0	0.0	9.3
2T1N	2.0	2.0	20.0	29.0	10.0	1.5	5.4	3.0	0.0	0.0	10.0
2T1N	10.0	11.0	119.0	203.0	10.8	1.7	8.8	1.0	0.0	0.0	11.9
2T1N	5.0	6.0	73.0	121.0	12.2	1.7	8.7	1.0	0.0	0.0	14.6
2T1N	10.0	13.0	118.0	187.0	9.1	1.6	6.6	0.0	0.0	0.0	11.8
2M1N	4.0	4.0	40.0	48.0	10.0	1.2	2.5	3.0	0.0	0.0	10.0
2M1N	5.0	6.0	74.0	102.0	12.3	1.4	5.5	3.0	0.0	0.0	14.8
2M1N	3.0	3.0	36.0	46.0	12.0	1.3	4.2	2.0	0.0	0.0	12.0
2M1N	2.0	3.0	19.0	29.0	6.3	1.5	4.9	3.0	0.0	0.0	9.5
2M1N	7.0	8.0	76.0	113.0	9.5	1.5	5.7	2.0	0.0	0.0	10.9
2M1N	4.0	5.0	58.0	84.0	11.6	1.4	6.0	3.0	0.0	0.0	14.5
2M1N	5.0	5.0	26.0	44.0	5.2	1.7	6.4	2.0	0.0	2.0	5.2
2M1N	7.0	9.0	82.0	141.0	9.1	1.7	8.3	4.0	0.0	0.0	11.7
2M1N	4.0	4.0	39.0	60.0	9.8	1.5	6.4	2.0	3.0	0.0	9.8
2M1N	2.0	2.0	27.0	39.0	13.5	1.4	6.7	2.0	0.0	0.0	13.5
2M1N	5.0	5.0	45.0	66.0	9.0	1.5	5.2	3.0	0.0	0.0	9.0
2M1N	6.0	6.0	45.0	67.0	7.5	1.5	4.9	2.0	0.0	0.0	7.5
2M1N	5.0	4.0	47.0	76.0	11.8	1.6	8.1	2.0	1.0	0.0	9.4
2M1N	8.0	8.0	66.0	97.0	8.3	1.5	5.0	2.0	5.0	0.0	8.3
2M1N	11.0	13.0	129.0	196.0	9.9	1.5	6.2	3.0	0.0	0.0	11.7
2M1N	5.0	5.0	31.0	40.0	6.2	1.3	2.1	3.0	0.0	0.0	6.2
2M1N	5.0	7.0	65.0	92.0	9.3	1.4	4.7	3.0	0.0	0.0	13.0
2M1N	12.0	12.0	104.0	153.0	8.7	1.5	5.1	1.0	0.0	3.0	8.7
2M1N	6.0	6.0	42.0	59.0	7.0	1.4	3.7	5.0	0.0	1.0	7.0
2M1N	5.0	6.0	47.0	64.0	7.8	1.4	3.5	5.0	0.0	2.0	9.4
2M1N	3.0	4.0	41.0	62.0	10.3	1.5	6.3	2.0	0.0	0.0	13.7
2M1N	6.0	6.0	42.0	63.0	7.0	1.5	4.8	5.0	0.0	3.0	7.0
2P2I	6.0	6.0	59.0	95.0	9.8	1.6	7.2	3.0	0.0	1.0	9.8
2P2I	7.0	9.0	47.0	77.0	5.2	1.6	5.8	2.0	0.0	0.0	6.7
2P2I	6.0	8.0	35.0	63.0	4.4	1.8	7.4	2.0	0.0	0.0	5.8
2E2I	2.0	2.0	19.0	39.0	9.5	2.1	12.3	0.0	0.0	1.0	9.5
2M2I	4.0	4.0	52.0	69.0	13.0	1.3	5.1	1.0	0.0	0.0	13.0
2M2I	12.0	10.0	144.0	215.0	14.4	1.5	7.6	1.0	0.0	1.0	12.0
2M2I	7.0	6.0	120.0	188.0	20.0	1.6	10.7	3.0	0.0	1.0	17.1
2M2I	3.0	3.0	51.0	72.0	17.0	1.4	7.7	0.0	0.0	0.0	17.0
2M2I	4.0	4.0	26.0	45.0	6.5	1.7	7.4	1.0	0.0	0.0	6.5
2M2I	4.0	4.0	46.0	79.0	11.5	1.7	9.2	1.0	0.0	0.0	11.5
2M2I	14.0	15.0	169.0	224.0	11.3	1.3	4.4	1.0	3.0	1.0	12.1
2M2I	4.0	3.0	28.0	42.0	9.3	1.5	5.8	1.0	1.0	0.0	7.0
2M2I	1.0	1.0	11.0	16.0	11.0	1.5	5.9	1.0	0.0	0.0	11.0
2M2I	8.0	9.0	112.0	165.0	12.4	1.5	6.6	0.0	3.0	0.0	14.0
2M2I	9.0	10.0	107.0	174.0	10.7	1.6	7.8	2.0	2.0	0.0	11.9

2M2I	10.0	10.0	88.0	135.0	8.8	1.5	5.9	0.0	1.0	0.0	8.8
2M2I	9.0	10.0	159.0	256.0	15.9	1.6	9.6	2.0	1.0	1.0	17.7
2M2I	9.0	9.0	109.0	193.0	12.1	1.8	10.0	2.0	2.0	0.0	12.1
2M2I	4.0	4.0	41.0	56.0	10.3	1.4	4.5	1.0	1.0	0.0	10.3
2M2I	3.0	3.0	36.0	54.0	12.0	1.5	6.8	1.0	0.0	0.0	12.0
2M2I	4.0	4.0	55.0	71.0	13.8	1.3	5.0	1.0	0.0	0.0	13.8
2M2I	14.0	15.0	159.0	261.0	10.6	1.6	7.9	3.0	0.0	4.0	11.4
2T2I	5.0	6.0	42.0	78.0	7.0	1.9	9.1	1.0	0.0	1.0	8.4
2T2I	7.0	8.0	58.0	91.0	7.3	1.6	5.8	1.0	0.0	0.0	8.3
2T2I	4.0	5.0	44.0	75.0	8.8	1.7	8.0	2.0	0.0	1.0	11.0
2T2I	6.0	7.0	51.0	84.0	7.3	1.6	6.7	3.0	0.0	0.0	8.5
2T2I	7.0	7.0	60.0	98.0	8.6	1.6	7.0	3.0	0.0	0.0	8.6
2T2I	4.0	4.0	37.0	46.0	9.3	1.2	2.7	1.0	0.0	2.0	9.3
2T2I	5.0	6.0	42.0	76.0	7.0	1.8	8.5	2.0	0.0	0.0	8.4
2T2I	6.0	10.0	101.0	167.0	10.1	1.7	7.9	2.0	0.0	0.0	16.8
2M2N	5.0	5.0	57.0	96.0	11.4	1.7	8.7	1.0	0.0	0.0	11.4
2M2N	8.0	8.0	90.0	150.0	11.3	1.7	8.5	2.0	0.0	0.0	11.3
2M2N	7.0	7.0	64.0	101.0	9.1	1.6	6.6	3.0	0.0	0.0	9.1
2M2N	3.0	4.0	44.0	61.0	14.7	1.4	5.1	1.0	0.0	0.0	14.7
2M2N	3.0	3.0	25.0	37.0	8.3	1.5	5.1	0.0	2.0	1.0	8.3
2M2N	8.0	8.0	92.0	119.0	11.5	1.3	4.2	3.0	0.0	0.0	11.5
2M2N	12.0	13.0	119.0	156.0	9.2	1.3	3.4	2.0	1.0	0.0	9.9
2M2N	6.0	6.0	65.0	89.0	10.8	1.4	4.8	2.0	0.0	3.0	10.8
2M2N	2.0	2.0	16.0	27.0	8.0	1.7	7.4	1.0	0.0	1.0	8.0
2M2N	5.0	5.0	42.0	54.0	8.4	1.3	2.9	2.0	0.0	0.0	8.4
2M2N	4.0	4.0	44.0	69.0	11.0	1.6	7.2	1.0	1.0	0.0	11.0
2M2N	1.0	1.0	21.0	26.0	21.0	1.2	7.2	1.0	0.0	0.0	21.0
2M2N	9.0	10.0	154.0	227.0	15.4	1.5	7.8	4.0	3.0	0.0	17.1
2M2N	2.0	2.0	15.0	21.0	7.5	1.4	3.9	1.0	0.0	0.0	7.5
2M2N	3.0	3.0	59.0	87.0	19.7	1.5	9.5	1.0	0.0	1.0	19.7
2M2N	14.0	14.0	126.0	176.0	9.0	1.4	4.4	3.0	0.0	0.0	9.0
2M2N	8.0	8.0	116.0	151.0	14.5	1.3	5.4	3.0	0.0	0.0	14.5
2M2N	4.0	4.0	47.0	57.0	11.8	1.2	3.3	1.0	0.0	0.0	11.8
2M2N	4.0	4.0	30.0	46.0	7.5	1.5	5.4	2.0	0.0	0.0	7.5
2E2N	5.0	5.0	107.0	187.0	21.4	1.7	13.4	6.0	0.0	0.0	21.4
2P2N	12.0	12.0	121.0	179.0	10.1	1.5	5.8	2.0	5.0	0.0	10.1
2P2N	9.0	8.0	87.0	125.0	10.9	1.4	5.6	3.0	0.0	0.0	9.7
2T2N	16.0	20.0	150.0	201.0	7.5	1.3	3.1	1.0	0.0	0.0	9.4
2T2N	6.0	8.0	78.0	119.0	9.8	1.5	6.2	1.0	0.0	0.0	13.0
2T2N	4.0	5.0	40.0	64.0	8.0	1.6	6.4	3.0	1.0	1.0	10.0
2T2N	8.0	9.0	96.0	174.0	10.7	1.8	10.0	3.0	2.0	1.0	12.0
2T2N	5.0	6.0	40.0	63.0	6.7	1.6	5.6	1.0	1.0	0.0	8.0
2T2N	8.0	9.0	88.0	165.0	9.8	1.9	10.3	2.0	3.0	0.0	11.0
2T2N	13.0	14.0	131.0	248.0	9.4	1.9	10.4	2.0	6.0	0.0	10.1
2M3I	10.0	10.0	154.0	231.0	15.4	1.5	8.1	0.0	0.0	3.0	15.4
2M3I	5.0	5.0	70.0	100.0	14.0	1.4	6.7	0.0	0.0	0.0	14.0
2M3I	15.0	15.0	172.0	266.0	11.5	1.5	7.1	0.0	0.0	0.0	11.5
2M3I	9.0	10.0	107.0	173.0	10.7	1.6	7.7	0.0	2.0	0.0	11.9
2M3I	5.0	5.0	58.0	81.0	11.6	1.4	5.4	3.0	0.0	0.0	11.6
2M3I	8.0	8.0	100.0	170.0	12.5	1.7	9.3	0.0	0.0	3.0	12.5
2M3I	9.0	12.0	127.0	209.0	10.6	1.6	8.0	0.0	0.0	3.0	14.1
2M3I	11.0	11.0	155.0	242.0	14.1	1.6	8.3	0.0	1.0	2.0	14.1
2M3I	7.0	8.0	105.0	156.0	13.1	1.5	7.1	0.0	1.0	0.0	15.0
2M3I	16.0	14.0	215.0	334.0	15.4	1.6	8.7	0.0	2.0	5.0	13.4
2M3I	12.0	12.0	164.0	279.0	13.7	1.7	9.8	0.0	0.0	0.0	13.7
2M3I	15.0	15.0	166.0	238.0	11.1	1.4	5.6	0.0	2.0	1.0	11.1
2M3I	7.0	7.0	86.0	129.0	12.3	1.5	6.9	2.0	0.0	2.0	12.3
2M3I	13.0	13.0	110.0	207.0	8.5	1.9	9.9	0.0	0.0	11.0	8.5
2M3I	9.0	11.0	112.0	182.0	10.2	1.6	7.6	3.0	0.0	0.0	12.4
2M3I	7.0	7.0	73.0	105.0	10.4	1.4	5.4	1.0	2.0	1.0	10.4
2M3I	4.0	4.0	26.0	39.0	6.5	1.5	4.6	1.0	0.0	3.0	6.5
2M3I	13.0	12.0	67.0	135.0	5.6	2.0	10.4	0.0	11.0	0.0	5.2
2M3I	10.0	11.0	116.0	164.0	10.5	1.4	5.2	0.0	0.0	0.0	11.6
2M3I	9.0	10.0	113.0	181.0	11.3	1.6	7.7	1.0	2.0	1.0	12.6

2M3I	13.0	14.0	207.0	267.0	14.8	1.3	5.4	0.0	0.0	5.0	15.9
2M3I	6.0	7.0	74.0	103.0	10.6	1.4	5.0	0.0	0.0	0.0	12.3
2M3I	11.0	12.0	128.0	176.0	10.7	1.4	4.8	0.0	0.0	2.0	11.6
2M3I	14.0	18.0	202.0	255.0	11.2	1.3	3.7	0.0	0.0	2.0	14.4
2M3I	9.0	10.0	123.0	162.0	12.3	1.3	4.7	0.0	0.0	0.0	13.7
2M3I	12.0	13.0	127.0	184.0	9.8	1.4	5.3	0.0	1.0	3.0	10.6
2M3I	7.0	5.0	69.0	100.0	13.8	1.4	6.9	1.0	0.0	0.0	9.9
2M3I	4.0	4.0	53.0	81.0	13.3	1.5	7.6	1.0	0.0	0.0	13.3
2M3I	4.0	5.0	85.0	130.0	17.0	1.5	9.1	2.0	0.0	0.0	21.3
2M3I	14.0	14.0	162.0	231.0	11.6	1.4	5.7	0.0	0.0	2.0	11.6
2M3I	9.0	9.0	77.0	116.0	8.6	1.5	5.5	1.0	0.0	4.0	8.6
2M3I	9.0	9.0	95.0	149.0	10.6	1.6	7.0	1.0	2.0	2.0	10.6
2P3I	7.0	8.0	88.0	119.0	11.0	1.4	4.7	2.0	0.0	2.0	12.6
2P3I	7.0	7.0	123.0	169.0	17.6	1.4	7.5	1.0	0.0	0.0	17.6
3P1N	7.0	5.0	54.0	95.0	10.8	1.8	9.4	1.0	0.0	0.0	7.7
3P1N	2.0	2.0	23.0	27.0	11.5	1.2	2.7	0.0	0.0	0.0	11.5
3P1N	1.0	1.0	14.0	21.0	14.0	1.5	7.6	1.0	0.0	0.0	14.0
3P1N	11.0	11.0	92.0	163.0	8.4	1.8	8.6	1.0	0.0	1.0	8.4
3M1A	9.0	9.0	126.0	199.0	14.0	1.6	8.5	0.0	0.0	0.0	14.0
3M1A	11.0	12.0	116.0	190.0	9.7	1.6	7.5	2.0	1.0	0.0	10.5
3M1A	10.0	11.0	106.0	164.0	9.6	1.5	6.4	1.0	0.0	0.0	10.6
3M1A	10.0	10.0	81.0	114.0	8.1	1.4	4.2	3.0	1.0	0.0	8.1
3M1A	8.0	7.0	51.0	62.0	7.3	1.2	1.6	3.0	0.0	0.0	6.4
3M1A	12.0	10.0	93.0	136.0	9.3	1.5	5.3	4.0	0.0	0.0	7.8
3M1A	8.0	10.0	146.0	233.0	14.6	1.6	8.9	1.0	0.0	0.0	18.3
3M1A	10.0	10.0	98.0	146.0	9.8	1.5	5.8	2.0	5.0	0.0	9.8
3M1A	10.0	12.0	206.0	333.0	17.2	1.6	10.2	1.0	0.0	0.0	20.6
3M1A	11.0	10.0	220.0	334.0	22.0	1.5	10.9	2.0	0.0	0.0	20.0
3M1A	11.0	8.0	161.0	239.0	20.1	1.5	9.8	2.0	0.0	0.0	14.6
3M1A	17.0	12.0	190.0	267.0	15.8	1.4	7.2	0.0	1.0	0.0	11.2
3M1A	9.0	9.0	106.0	160.0	11.8	1.5	6.8	3.0	1.0	0.0	11.8
3M1A	17.0	18.0	235.0	367.0	13.1	1.6	7.9	1.0	0.0	0.0	13.8
3M1A	26.0	29.0	448.0	677.0	15.4	1.5	8.3	0.0	1.0	0.0	17.2
3M1A	20.0	21.0	354.0	539.0	16.9	1.5	9.0	2.0	0.0	0.0	17.7
3M1A	23.0	21.0	310.0	488.0	14.8	1.6	8.7	1.0	0.0	0.0	13.5
3M1A	5.0	6.0	79.0	112.0	13.2	1.4	6.3	1.0	1.0	0.0	15.8
3M1A	9.0	11.0	198.0	299.0	18.0	1.5	9.2	1.0	0.0	0.0	22.0
3M1A	12.0	21.0	330.0	490.0	15.7	1.5	8.1	1.0	2.0	0.0	27.5
3M1A	18.0	21.0	356.0	530.0	17.0	1.5	8.6	1.0	2.0	0.0	19.8
3M1A	11.0	13.0	210.0	306.0	16.2	1.5	7.9	1.0	0.0	0.0	19.1
3E1A	6.0	9.0	180.0	335.0	20.0	1.9	14.2	0.0	0.0	1.0	30.0
3E1A	12.0	12.0	205.0	320.0	17.1	1.6	9.5	2.0	0.0	0.0	17.1
3T1A	17.0	18.0	92.0	147.0	5.1	1.6	5.3	0.0	1.0	0.0	5.4
3T1A	18.0	18.0	127.0	209.0	7.1	1.6	6.6	0.0	5.0	1.0	7.1
3P2A	8.0	8.0	120.0	153.0	15.0	1.3	5.3	2.0	0.0	0.0	15.0
3T2A	11.0	13.0	170.0	248.0	13.1	1.5	6.7	2.0	6.0	0.0	15.5
3T2A	11.0	10.0	63.0	103.0	6.3	1.6	6.2	0.0	4.0	0.0	5.7
3T2A	32.0	16.0	259.0	401.0	16.2	1.5	9.0	2.0	2.0	0.0	8.1
3T2A	16.0	13.0	144.0	212.0	11.1	1.5	6.1	4.0	4.0	0.0	9.0
3T2A	8.0	6.0	65.0	91.0	10.8	1.4	5.2	2.0	3.0	0.0	8.1
3T2A	15.0	12.0	117.0	149.0	9.8	1.3	3.2	3.0	3.0	0.0	7.8
3T2A	27.0	23.0	216.0	288.0	9.4	1.3	3.8	4.0	3.0	0.0	8.0
3M2A	7.0	6.0	43.0	66.0	7.2	1.5	5.3	0.0	5.0	0.0	6.1
3M2A	7.0	7.0	55.0	90.0	7.9	1.6	6.8	5.0	0.0	0.0	7.9
3M2A	9.0	9.0	66.0	107.0	7.3	1.6	6.4	2.0	2.0	0.0	7.3
3M2A	12.0	12.0	94.0	136.0	7.8	1.4	4.5	2.0	8.0	0.0	7.8
3M2A	10.0	10.0	63.0	96.0	6.3	1.5	4.8	2.0	0.0	0.0	6.3
3M2A	6.0	6.0	53.0	80.0	8.8	1.5	5.7	2.0	1.0	0.0	8.8
3M2A	6.0	6.0	46.0	68.0	7.7	1.5	4.8	2.0	0.0	0.0	7.7
3M2A	7.0	8.0	49.0	68.0	6.1	1.4	3.2	1.0	1.0	0.0	7.0
3M2A	7.0	7.0	42.0	69.0	6.0	1.6	6.1	3.0	0.0	0.0	6.0
3M2A	4.0	4.0	40.0	68.0	10.0	1.7	8.4	2.0	1.0	0.0	10.0
3M2A	3.0	3.0	17.0	26.0	5.7	1.5	4.7	1.0	0.0	0.0	5.7
3M2A	13.0	13.0	95.0	157.0	7.3	1.7	6.8	3.0	0.0	0.0	7.3

3M2A	5.0	7.0	109.0	164.0	15.6	1.5	8.2	3.0	1.0	0.0	21.8
3M2A	3.0	4.0	47.0	76.0	11.8	1.6	8.1	1.0	2.0	0.0	15.7
3M2A	17.0	16.0	224.0	390.0	14.0	1.7	10.4	1.0	0.0	0.0	13.2
3M2A	12.0	11.0	95.0	159.0	8.6	1.7	7.5	4.0	2.0	0.0	7.9
3M2A	11.0	11.0	137.0	214.0	12.5	1.6	7.7	5.0	0.0	0.0	12.5
3M2A	24.0	20.0	216.0	290.0	10.8	1.3	4.5	4.0	1.0	0.0	9.0
3M2A	9.0	9.0	75.0	101.0	8.3	1.3	3.6	3.0	1.0	0.0	8.3
3M2A	4.0	4.0	48.0	77.0	12.0	1.6	8.0	2.0	1.0	0.0	12.0
3M2A	22.0	21.0	186.0	266.0	8.9	1.4	4.7	1.0	0.0	0.0	8.5
3M3D	10.0	15.0	204.0	302.0	13.6	1.5	7.2	4.0	0.0	0.0	20.4
3M3D	4.0	6.0	67.0	102.0	11.2	1.5	6.7	4.0	0.0	0.0	16.8
3M3D	2.0	3.0	26.0	46.0	8.7	1.8	8.7	3.0	0.0	0.0	13.0
3M3D	4.0	5.0	28.0	48.0	5.6	1.7	6.8	4.0	0.0	0.0	7.0
3M3D	2.0	2.0	20.0	31.0	10.0	1.6	6.6	1.0	0.0	0.0	10.0
3M3D	4.0	5.0	24.0	40.0	4.8	1.7	5.9	4.0	0.0	0.0	6.0
3M3D	3.0	3.0	13.0	22.0	4.3	1.7	6.1	3.0	0.0	0.0	4.3
3M3D	5.0	6.0	40.0	75.0	6.7	1.9	9.1	5.0	0.0	0.0	8.0
3M3D	3.0	7.0	56.0	92.0	8.0	1.6	8.9	3.0	0.0	0.0	18.7
3M3D	3.0	3.0	35.0	51.0	11.7	1.5	6.2	1.0	0.0	0.0	11.7
3M3D	5.0	5.0	41.0	54.0	8.2	1.3	3.1	3.0	0.0	0.0	8.2
3M3D	3.0	4.0	45.0	79.0	11.3	1.8	9.5	1.0	0.0	0.0	15.0
3M3D	11.0	12.0	209.0	312.0	17.4	1.5	8.8	4.0	0.0	0.0	19.0
3M3D	3.0	6.0	98.0	148.0	16.3	1.5	8.6	0.0	0.0	1.0	32.7
3M3D	14.0	19.0	306.0	504.0	16.1	1.6	10.1	0.0	1.0	4.0	21.9
3M3D	9.0	6.0	94.0	147.0	15.7	1.6	9.0	4.0	0.0	0.0	10.4
3M3D	8.0	8.0	124.0	188.0	15.5	1.5	8.3	1.0	12.0	1.0	15.5
3M3D	6.0	6.0	62.0	77.0	10.3	1.2	3.1	1.0	0.0	0.0	10.3
3M3D	2.0	2.0	17.0	30.0	8.5	1.8	8.5	1.0	0.0	0.0	8.5
3M3D	2.0	3.0	32.0	54.0	16.7	1.7	8.5	1.0	0.0	0.0	16.0
3M3D	7.0	8.0	91.0	145.0	11.4	1.6	7.6	3.0	0.0	0.0	13.0
3M3D	15.0	15.0	168.0	217.0	11.2	1.3	4.0	0.0	0.0	0.0	11.2
3M3D	5.0	5.0	53.0	68.0	10.6	1.3	3.7	1.0	0.0	0.0	10.6
3M3D	3.0	4.0	44.0	67.0	11.0	1.5	6.7	3.0	0.0	0.0	14.7
3M3D	14.0	19.0	280.0	482.0	14.7	1.7	10.5	0.0	3.0	0.0	20.0
3M3D	10.0	11.0	85.0	110.0	7.7	1.3	2.7	3.0	0.0	0.0	8.5
3M3D	19.0	24.0	248.0	452.0	10.3	1.8	9.9	0.0	13.0	0.0	13.1
3M3D	5.0	6.0	55.0	80.0	9.2	1.5	5.1	1.0	0.0	0.0	11.0
3M3D	7.0	6.0	63.0	94.0	10.5	1.5	6.1	3.0	0.0	0.0	9.0
3M3D	4.0	4.0	39.0	60.0	9.8	1.5	6.4	2.0	0.0	0.0	9.8
4P1N	9.0	9.0	61.0	96.0	6.8	1.6	5.6	2.0	2.0	0.0	6.8
4T1N	7.0	8.0	91.0	141.0	11.4	1.5	7.1	2.0	0.0	0.0	13.0
4T1N	7.0	9.0	70.0	99.0	7.8	1.4	4.1	2.0	3.0	0.0	10.0
4T1N	9.0	11.0	112.0	179.0	10.2	1.6	7.2	1.0	2.0	0.0	12.4
4T1N	5.0	8.0	89.0	128.0	11.1	1.4	5.7	2.0	1.0	0.0	17.8
4T1N	5.0	5.0	39.0	61.0	7.8	1.6	5.9	1.0	2.0	0.0	7.8
4M1N	5.0	4.0	45.0	62.0	11.3	1.4	5.1	0.0	0.0	0.0	9.0
4M1N	3.0	3.0	40.0	61.0	13.3	1.5	7.6	1.0	0.0	0.0	13.3
4M1N	1.0	1.0	9.0	15.0	9.0	1.7	7.6	1.0	0.0	0.0	9.0
4M1N	5.0	5.0	74.0	103.0	14.8	1.4	6.6	0.0	2.0	0.0	14.8
4M1N	3.0	3.0	24.0	34.0	8.0	1.4	4.2	2.0	0.0	0.0	8.0
4M1N	3.0	3.0	33.0	51.0	11.0	1.5	6.9	3.0	0.0	0.0	11.0
4M1N	3.0	3.0	45.0	58.0	15.0	1.3	5.5	2.0	0.0	0.0	15.0
4M1N	3.0	3.0	38.0	52.0	10.0	1.7	8.8	2.0	0.0	0.0	10.0
4M1N	2.0	2.0	36.0	40.0	18.0	1.1	4.5	1.0	0.0	0.0	18.0
4M1N	2.0	2.0	41.0	62.0	20.5	1.5	10.2	1.0	0.0	0.0	20.5
4M1N	1.0	1.0	13.0	18.0	13.0	1.4	5.8	1.0	0.0	0.0	13.0
4M1N	2.0	3.0	23.0	35.0	7.7	1.5	5.4	1.0	0.0	0.0	11.5
4M1N	1.0	1.0	8.0	14.0	8.0	1.8	8.2	1.0	0.0	0.0	8.0
4M1N	4.0	4.0	48.0	59.0	12.0	1.2	3.6	3.0	1.0	0.0	12.0
4M1N	4.0	4.0	100.0	139.0	25.0	1.4	10.6	1.0	0.0	0.0	25.0
4M1N	5.0	5.0	57.0	80.0	11.4	1.4	5.4	2.0	2.0	0.0	11.4
4M1N	3.0	3.0	43.0	56.0	14.3	1.3	5.4	2.0	1.0	0.0	14.3
4M1N	2.0	2.0	20.0	27.0	10.0	1.4	4.2	1.0	0.0	0.0	10.0
4M1N	1.0	1.0	6.0	9.0	6.0	1.5	4.5	1.0	0.0	0.0	6.0

4M1N	3.0	3.0	32.0	54.0	10.7	1.7	8.5	2.0	0.0	0.0	10.7
4M1N	3.0	3.0	66.0	91.0	22.0	1.4	9.3	1.0	0.0	0.0	22.0
4M1N	5.0	5.0	56.0	70.0	11.2	1.3	3.5	1.0	1.0	0.0	11.2
4M1N	4.0	4.0	31.0	38.0	7.8	1.2	1.9	1.0	0.0	0.0	7.8
4M1N	9.0	9.0	77.0	110.0	8.6	1.4	4.6	1.0	0.0	0.0	8.6
4M3N	9.0	8.0	88.0	137.0	11.0	1.6	7.1	1.0	1.0	0.0	9.8
4M3N	6.0	6.0	55.0	75.0	9.2	1.4	4.1	1.0	0.0	0.0	9.2
4M3N	3.0	3.0	29.0	41.0	9.7	1.4	4.9	1.0	0.0	0.0	9.7
4M3N	6.0	6.0	78.0	110.0	13.0	1.4	6.1	1.0	0.0	0.0	13.0
4M3N	3.0	4.0	59.0	68.0	14.8	1.2	3.8	1.0	0.0	0.0	19.7
4M3N	6.0	6.0	73.0	93.0	12.2	1.3	4.2	1.0	0.0	0.0	12.2
4M3N	6.0	6.0	40.0	50.0	6.7	1.3	1.8	1.0	0.0	0.0	6.7
4M3N	10.0	10.0	208.0	344.0	20.8	1.7	12.0	0.0	0.0	2.0	20.8
4M3N	10.0	11.0	140.0	210.0	12.7	1.5	7.1	1.0	0.0	0.0	14.0
4M3N	6.0	6.0	46.0	69.0	7.7	1.5	5.1	0.0	0.0	0.0	7.7
4M3N	5.0	5.0	31.0	57.0	6.2	1.8	8.5	1.0	1.0	0.0	6.2
4M3N	2.0	2.0	24.0	33.0	12.0	1.4	5.3	1.0	0.0	0.0	12.0
4M3N	7.0	7.0	88.0	113.0	12.6	1.3	4.5	1.0	1.0	0.0	12.6
4M3N	5.0	5.0	72.0	89.0	14.4	1.2	4.6	0.0	0.0	1.0	14.4
4M3N	3.0	3.0	50.0	77.0	16.7	1.5	9.1	1.0	0.0	0.0	16.7
4M3N	5.0	5.0	54.0	72.0	10.8	1.3	4.4	1.0	0.0	1.0	10.8
4M3N	9.0	9.0	84.0	144.0	9.3	1.7	8.3	1.0	0.0	0.0	9.3
4M3N	3.0	3.0	58.0	78.0	19.3	1.3	7.8	1.0	0.0	0.0	19.3
4M3N	9.0	7.0	110.0	189.0	15.7	1.7	10.6	0.0	3.0	0.0	12.2
4M3N	4.0	4.0	20.0	38.0	5.0	1.9	8.8	0.0	1.0	0.0	5.0
4M3N	4.0	5.0	36.0	56.0	7.2	1.6	5.6	0.0	2.0	0.0	9.0
4T3N	10.0	10.0	84.0	122.0	8.4	1.5	4.8	1.0	0.0	1.0	8.4
4T3N	7.0	7.0	91.0	138.0	13.0	1.5	7.4	1.0	2.0	0.0	13.0
4T3N	9.0	10.0	94.0	132.0	9.4	1.4	4.6	1.0	5.0	0.0	10.4
4T3N	9.0	9.0	80.0	121.0	8.9	1.5	5.7	1.0	1.0	0.0	8.9
4T3N	10.0	10.0	106.0	158.0	10.6	1.5	6.1	0.0	1.0	1.0	10.6
4T3N	11.0	10.0	95.0	149.0	9.5	1.6	6.6	1.0	1.0	1.0	8.6
4T3N	8.0	8.0	76.0	104.0	9.5	1.4	4.3	1.0	0.0	0.0	9.5
4T3N	15.0	15.0	161.0	228.0	10.7	1.4	5.3	1.0	2.0	0.0	10.7
5T2N	8.0	10.0	94.0	153.0	9.4	1.6	7.3	0.0	0.0	0.0	11.8
5P2N	10.0	9.0	157.0	247.0	18.6	1.5	9.1	0.0	0.0	0.0	16.7
5E2N	38.0	36.0	746.0	1218.0	20.7	1.6	11.8	0.0	0.0	1.0	19.6
5E2N	11.0	9.0	183.0	268.0	20.3	1.5	9.6	1.0	0.0	0.0	16.6
5E2N	5.0	5.0	131.0	203.0	26.2	1.5	12.9	1.0	0.0	0.0	26.2
5E2N	34.0	32.0	734.0	1362.0	22.9	1.9	15.3	0.0	0.0	0.0	21.6
5E2N	8.0	6.0	208.0	280.0	34.7	1.3	13.8	1.0	0.0	0.0	26.0
5E2N	40.0	36.0	820.0	1252.0	22.8	1.5	11.3	0.0	0.0	0.0	20.5
5E2N	16.0	16.0	316.0	476.0	19.8	1.5	9.9	0.0	0.0	0.0	19.8
5E2N	5.0	5.0	77.0	124.0	15.4	1.6	9.4	0.0	0.0	0.0	15.4
5E2N	38.0	34.0	830.0	1350.0	24.4	1.6	13.1	0.0	0.0	0.0	21.8
5M2B	16.0	16.0	187.0	305.0	11.7	1.6	8.2	0.0	0.0	0.0	11.7
5M2B	7.0	8.0	56.0	99.0	7.0	1.8	8.0	1.0	0.0	0.0	8.0
5M2B	7.0	9.0	71.0	125.0	7.9	1.8	8.3	0.0	0.0	0.0	10.1
5M2B	11.0	15.0	177.0	277.0	11.8	1.6	7.5	0.0	0.0	0.0	16.1
5M2B	10.0	12.0	70.0	120.0	5.8	1.7	6.9	1.0	1.0	0.0	7.0
5M2B	9.0	9.0	63.0	118.0	7.0	1.9	9.2	1.0	0.0	0.0	7.0
5M2B	14.0	13.0	141.0	206.0	10.8	1.5	5.9	0.0	0.0	0.0	10.1
5M2B	25.0	25.0	184.0	294.0	7.4	1.6	6.1	0.0	0.0	0.0	7.4
5M2B	10.0	10.0	122.0	216.0	12.2	1.8	10.1	0.0	0.0	4.0	12.2
5M2B	9.0	10.0	76.0	145.0	7.6	1.9	9.9	1.0	0.0	0.0	8.4
5M2B	11.0	14.0	116.0	170.0	8.3	1.5	4.9	0.0	0.0	0.0	10.5
5M2B	8.0	8.0	94.0	129.0	11.8	1.4	5.2	1.0	0.0	0.0	11.8
5M2B	6.0	6.0	87.0	169.0	14.5	1.9	13.0	1.0	0.0	0.0	14.5
5M2B	11.0	11.0	97.0	143.0	8.8	1.5	5.2	0.0	2.0	0.0	8.8
5M2B	4.0	4.0	62.0	98.0	15.5	1.6	9.1	0.0	0.0	0.0	15.5
5M2B	12.0	11.0	82.0	153.0	7.5	1.9	9.3	1.0	1.0	0.0	6.8
5M2B	18.0	18.0	187.0	330.0	10.4	1.8	9.3	0.0	2.0	5.0	10.4
5M2B	9.0	11.0	96.0	140.0	8.7	1.5	5.0	1.0	0.0	0.0	10.7
5M2B	8.0	9.0	80.0	135.0	8.9	1.7	7.8	1.0	0.0	0.0	10.0

5M2B	7.0	7.0	55.0	68.0	7.9	1.2	2.1	0.0	0.0	0.0	7.9
5M2B	21.0	22.0	242.0	348.0	11.0	1.4	5.7	0.0	0.0	0.0	11.5
5M2B	16.0	19.0	150.0	256.0	7.9	1.7	7.6	0.0	0.0	0.0	9.4
5M2B	7.0	7.0	103.0	164.0	14.7	1.6	8.9	1.0	1.0	0.0	14.7
5M2B	4.0	5.0	67.0	97.0	13.4	1.4	6.7	1.0	1.0	0.0	16.8
5M2B	4.0	3.0	40.0	53.0	13.3	1.3	5.2	0.0	0.0	0.0	10.0
5M2B	11.0	12.0	139.0	194.0	11.6	1.4	5.4	1.0	0.0	0.0	12.6
5M2B	6.0	5.0	53.0	84.0	10.6	1.6	7.2	0.0	0.0	0.0	8.8
5M2B	22.0	26.0	202.0	308.0	7.8	1.5	5.4	0.0	2.0	0.0	9.2
5M2B	7.0	7.0	79.0	127.0	11.3	1.6	7.8	0.0	0.0	0.0	11.3
5M2B	17.0	19.0	172.0	272.0	9.1	1.6	6.6	0.0	2.0	0.0	10.1
5M2N	14.0	14.0	100.0	168.0	7.1	1.7	7.0	1.0	0.0	0.0	7.1
2M3N	6.0	7.0	123.0	174.0	17.6	1.4	8.0	4.0	2.0	0.0	20.5
2M3N	7.0	7.0	94.0	147.0	13.4	1.6	8.1	3.0	0.0	0.0	13.4
2M3N	10.0	10.0	110.0	165.0	11.0	1.5	6.4	1.0	0.0	0.0	11.0
2M3N	2.0	2.0	19.0	33.0	9.5	1.7	8.6	3.0	0.0	2.0	9.5
2M3N	3.0	5.0	103.0	135.0	20.6	1.3	7.9	3.0	0.0	0.0	34.3
2M3N	12.0	12.0	140.0	209.0	11.7	1.5	6.6	4.0	1.0	0.0	11.7
2M3N	4.0	5.0	68.0	87.0	13.6	1.3	4.8	3.0	0.0	0.0	17.0
2M3N	6.0	6.0	50.0	82.0	8.3	1.6	7.0	2.0	0.0	3.0	8.3
2M3N	13.0	15.0	163.0	266.0	10.9	1.6	7.9	2.0	0.0	0.0	12.5
2M3N	6.0	6.0	86.0	118.0	14.3	1.4	6.2	2.0	0.0	0.0	14.3
2M3N	12.0	12.0	111.0	162.0	9.3	1.5	5.2	2.0	3.0	0.0	9.3
2M3N	8.0	8.0	79.0	119.0	9.9	1.5	6.0	3.0	0.0	0.0	9.9
2M3N	10.0	10.0	112.0	176.0	11.2	1.6	7.3	2.0	1.0	3.0	11.2
2M3N	5.0	6.0	68.0	100.0	11.3	1.5	6.2	3.0	0.0	0.0	13.6
2M3N	10.0	9.0	81.0	140.0	9.0	1.7	8.3	2.0	0.0	0.0	8.1
2M3N	7.0	5.0	54.0	97.0	10.8	1.8	9.8	3.0	0.0	0.0	7.7
2M3N	14.0	14.0	92.0	131.0	6.6	1.4	3.8	1.0	0.0	2.0	6.6
2M3N	3.0	3.0	21.0	36.0	7.0	1.7	7.4	0.0	2.0	1.0	7.0
2M3N	5.0	6.0	70.0	96.0	11.7	1.4	5.1	2.0	0.0	0.0	14.0
2M3N	4.0	4.0	28.0	44.0	7.0	1.6	5.7	1.0	1.0	0.0	7.0
2M3N	7.0	7.0	58.0	88.0	8.3	1.5	5.5	1.0	0.0	1.0	8.3
2M3N	2.0	2.0	35.0	46.0	17.5	1.3	6.7	1.0	0.0	0.0	17.5
2M3N	4.0	4.0	50.0	75.0	12.5	1.5	7.0	1.0	1.0	1.0	12.5
2M3N	12.0	12.0	101.0	131.0	8.4	1.3	3.0	2.0	2.0	0.0	8.4
2T2N	4.0	4.0	60.0	104.0	15.0	1.7	10.7	1.0	1.0	0.0	15.0
2T2N	5.0	5.0	59.0	85.0	11.8	1.4	6.0	1.0	0.0	0.0	11.8
2T2N	9.0	10.0	138.0	222.0	13.8	1.6	8.8	1.0	2.0	0.0	15.3
2T2N	11.0	11.0	114.0	187.0	10.4	1.6	7.8	1.0	3.0	0.0	10.4
2T2N	10.0	10.0	88.0	151.0	8.8	1.7	8.1	1.0	1.0	0.0	8.8
2T2I	6.0	6.0	68.0	126.0	11.3	1.9	10.7	2.0	0.0	0.0	11.3
2T2I	5.0	6.0	47.0	77.0	7.8	1.6	6.8	3.0	0.0	1.0	9.4
2T2I	3.0	3.0	40.0	59.0	13.3	1.5	7.0	3.0	0.0	0.0	13.3
2T2I	4.0	5.0	44.0	57.0	8.8	1.3	3.1	1.0	0.0	1.0	11.0
2T2I	6.0	6.0	62.0	103.0	10.3	1.7	8.0	1.0	0.0	1.0	10.3
2T2I	5.0	6.0	50.0	88.0	8.3	1.8	8.4	2.0	0.0	1.0	10.0
2T2I	5.0	6.0	55.0	92.0	9.2	1.7	7.7	1.0	0.0	0.0	11.0
2T2I	6.0	6.0	55.0	108.0	9.2	2.0	11.2	2.0	0.0	1.0	9.2
2T2I	6.0	6.0	72.0	113.0	12.0	1.6	7.6	2.0	0.0	2.0	12.0
2T2I	5.0	6.0	66.0	98.0	11.0	1.5	6.2	2.0	0.0	1.0	13.2
2T2I	5.0	5.0	71.0	133.0	14.2	1.9	12.1	1.0	0.0	1.0	14.2
2T2I	5.0	6.0	36.0	59.0	6.0	1.6	6.1	3.0	0.0	0.0	7.2
2T2I	4.0	4.0	34.0	54.0	8.5	1.6	6.5	1.0	0.0	1.0	8.5
2T2I	5.0	5.0	54.0	106.0	10.8	2.0	11.8	1.0	0.0	1.0	10.8
2T2I	9.0	11.0	113.0	241.0	10.3	2.1	13.6	2.0	0.0	1.0	12.6
2T2I	6.0	7.0	69.0	126.0	9.9	1.8	9.8	2.0	0.0	0.0	11.5
2T2I	5.0	5.0	48.0	78.0	9.6	1.6	7.3	1.0	0.0	1.0	9.6
2T2I	13.0	15.0	131.0	190.0	8.7	1.5	4.9	2.0	0.0	1.0	10.1
2T2I	10.0	10.0	103.0	163.0	10.3	1.6	7.1	2.0	0.0	0.0	10.3
2M3N	13.0	13.0	115.0	201.0	8.8	1.7	8.5	3.0	0.0	6.0	8.8
2M3N	9.0	8.0	116.0	187.0	14.5	1.6	9.1	3.0	0.0	0.0	12.9
2M3N	7.0	8.0	134.0	220.0	16.8	1.6	10.3	2.0	0.0	0.0	19.1
2M3N	12.0	14.0	135.0	216.0	9.6	1.6	7.1	3.0	0.0	6.0	11.3

2M3N	2.0	2.0	24.0	35.0	12.0	1.5	6.3	2.0	0.0	0.0	12.0
2M3N	7.0	7.0	62.0	89.0	8.9	1.4	4.8	3.0	0.0	0.0	8.9
2M3N	5.0	5.0	70.0	110.0	14.0	1.6	8.4	2.0	0.0	0.0	14.0
2M3N	4.0	4.0	61.0	102.0	15.3	1.7	10.1	2.0	0.0	0.0	15.3
2M3N	3.0	4.0	45.0	77.0	11.3	1.7	9.0	1.0	0.0	0.0	15.0
2T2N	10.0	11.0	138.0	260.0	12.5	1.9	11.5	0.0	4.0	0.0	13.8
2T2N	6.0	8.0	89.0	145.0	11.1	1.6	8.0	1.0	0.0	0.0	14.8
2T2N	14.0	15.0	144.0	211.0	9.6	1.5	5.4	1.0	0.0	1.0	10.3
2T2N	5.0	5.0	60.0	112.0	12.0	1.9	11.1	1.0	2.0	0.0	12.0
2T2N	8.0	8.0	83.0	151.0	10.4	1.8	9.9	1.0	3.0	0.0	10.4
2T2N	8.0	8.0	76.0	122.0	9.5	1.6	7.1	1.0	2.0	0.0	9.5
2T2N	11.0	11.0	105.0	157.0	9.5	1.5	5.8	1.0	2.0	0.0	9.5
2T2N	6.0	7.0	63.0	94.0	9.0	1.5	5.5	1.0	0.0	0.0	10.5
2T2N	9.0	9.0	98.0	141.0	10.9	1.4	5.6	1.0	1.0	0.0	10.9
2T2N	19.0	19.0	134.0	194.0	7.1	1.4	4.2	0.0	6.0	0.0	7.1
2T2N	10.0	10.0	104.0	163.0	10.4	1.6	7.0	1.0	3.0	0.0	10.4
2T2N	5.0	5.0	49.0	77.0	9.8	1.6	6.8	1.0	1.0	0.0	9.8
2T2N	7.0	8.0	86.0	131.0	10.8	1.5	6.6	1.0	0.0	0.0	12.3
2T2N	6.0	6.0	84.0	137.0	14.0	1.6	9.1	1.0	1.0	0.0	14.0
2T2N	11.0	11.0	129.0	266.0	11.7	2.1	13.3	0.0	2.0	0.0	11.7
2T2I	6.0	6.0	68.0	109.0	11.3	1.6	7.7	1.0	0.0	0.0	11.3
1T2I	6.0	11.0	86.0	150.0	7.8	1.7	8.0	0.0	0.0	3.0	14.3
1T2I	11.0	18.0	86.0	155.0	4.8	1.8	7.5	1.0	3.0	3.0	7.8
1T2I	7.0	10.0	54.0	87.0	5.4	1.6	5.5	1.0	1.0	2.0	7.7
1T2I	9.0	13.0	98.0	138.0	7.5	1.4	4.0	3.0	2.0	1.0	10.9
1T2I	10.0	20.0	166.0	272.0	8.3	1.6	7.0	1.0	0.0	8.0	16.6
1T2I	10.0	15.0	143.0	208.0	9.5	1.5	5.3	4.0	0.0	3.0	14.3
1T2I	9.0	10.0	66.0	103.0	6.6	1.6	5.4	0.0	0.0	1.0	7.3
1T2I	11.0	20.0	123.0	205.0	6.2	1.7	6.5	0.0	0.0	4.0	11.2
1T2I	8.0	10.0	95.0	149.0	9.5	1.6	6.6	3.0	1.0	2.0	11.9
1T2I	9.0	16.0	101.0	177.0	6.3	1.8	7.6	2.0	2.0	4.0	11.2
1T2I	11.0	16.0	98.0	208.0	6.1	2.1	11.8	1.0	0.0	5.0	8.9
1T2I	7.0	10.0	59.0	89.0	5.9	1.5	4.5	1.0	1.0	1.0	8.4
1T2I	8.0	14.0	78.0	129.0	5.6	1.7	6.1	1.0	2.0	3.0	9.8
1T2I	8.0	17.0	109.0	210.0	6.4	1.9	9.6	0.0	1.0	5.0	13.6
3E2N	10.0	12.0	151.0	218.0	12.6	1.4	6.4	1.0	0.0	0.0	15.1
3E2N	7.0	11.0	129.0	187.0	11.7	1.4	6.1	1.0	0.0	0.0	18.4
3T2N	21.0	21.0	196.0	296.0	9.3	1.5	5.9	4.0	2.0	0.0	9.3
3T2N	17.0	16.0	142.0	220.0	8.9	1.5	6.2	2.0	6.0	0.0	8.4
3M2N	18.0	16.0	156.0	245.0	9.8	1.6	6.7	1.0	2.0	0.0	8.7
3M2N	28.0	21.0	306.0	473.0	14.6	1.5	8.3	1.0	0.0	0.0	10.9
3M2N	26.0	25.0	323.0	450.0	12.9	1.4	5.9	1.0	0.0	0.0	12.4
3T2N	27.0	21.0	245.0	350.0	11.7	1.4	5.8	4.0	2.0	0.0	9.1
3T2N	15.0	14.0	164.0	230.0	11.7	1.4	5.5	4.0	4.0	0.0	10.9
3T2N	8.0	8.0	74.0	117.0	9.3	1.6	6.7	2.0	3.0	0.0	9.3
3T2N	26.0	20.0	203.0	288.0	10.2	1.4	5.1	4.0	3.0	0.0	7.8
3T2N	15.0	14.0	140.0	177.0	10.0	1.3	3.2	4.0	4.0	0.0	9.3
3T2N	18.0	17.0	174.0	269.0	10.2	1.5	6.6	4.0	4.0	0.0	9.7
3T2N	6.0	6.0	65.0	94.0	10.8	1.4	5.7	2.0	3.0	0.0	10.8
3T2N	14.0	13.0	116.0	163.0	8.9	1.4	4.5	3.0	3.0	0.0	8.3
3T2N	13.0	11.0	115.0	192.0	10.5	1.7	8.2	4.0	1.0	0.0	8.8
3T2N	22.0	20.0	188.0	246.0	9.4	1.3	3.5	2.0	4.0	0.0	8.5
3T2N	22.0	19.0	241.0	316.0	12.7	1.3	4.8	3.0	1.0	0.0	11.0
3T2N	27.0	23.0	242.0	375.0	10.5	1.5	6.8	4.0	2.0	0.0	9.0
6M1N	6.0	4.0	85.0	119.0	21.3	1.4	9.2	2.0	0.0	0.0	14.2
6M1N	4.0	3.0	61.0	89.0	20.3	1.5	9.6	2.0	0.0	0.0	15.3
6E1N	4.0	4.0	98.0	134.0	24.5	1.4	10.1	2.0	0.0	0.0	24.5
6E1N	10.0	9.0	100.0	172.0	11.1	1.7	9.0	3.0	0.0	0.0	10.0
6E1N	8.0	8.0	66.0	114.0	8.3	1.7	8.0	2.0	0.0	0.0	8.3
6E1N	11.0	9.0	140.0	220.0	15.6	1.6	9.0	2.0	0.0	0.0	12.7
6E1N	14.0	13.0	117.0	204.0	9.0	1.7	8.5	3.0	0.0	0.0	8.4
6P1N	17.0	9.0	165.0	243.0	18.3	1.5	8.9	1.0	0.0	0.0	9.7
6P1N	18.0	16.0	211.0	303.0	13.2	1.4	6.5	0.0	0.0	0.0	11.7
6M1N	11.0	10.0	132.0	175.0	13.2	1.3	5.2	4.0	0.0	0.0	12.0

6M1N	9.0	6.0	104.0	143.0	17.3	1.4	7.4	4.0	0.0	0.0	11.6
6M1N	11.0	10.0	133.0	194.0	13.3	1.5	6.8	4.0	0.0	0.0	12.1
6M1N	7.0	6.0	137.0	197.0	22.8	1.4	10.3	1.0	0.0	0.0	19.6
6M1N	15.0	14.0	120.0	197.0	8.6	1.6	7.1	2.0	0.0	0.0	8.0
6T1N	8.0	7.0	113.0	154.0	15.1	1.4	6.8	1.0	0.0	0.0	14.1
6M1N	7.0	5.0	91.0	138.0	18.2	1.5	9.4	4.0	0.0	0.0	13.0
6M1N	11.0	10.0	154.0	233.0	15.4	1.5	8.3	3.0	1.0	0.0	14.0
6M1N	13.0	12.0	168.0	267.0	14.0	1.6	8.6	0.0	0.0	0.0	12.9
6M1N	2.0	3.0	14.0	19.0	4.7	1.4	2.2	1.0	2.0	0.0	7.0
6M1N	10.0	11.0	170.0	261.0	15.5	1.5	8.6	2.0	0.0	0.0	17.0
6M1N	12.0	13.0	122.0	210.0	9.4	1.7	8.4	2.0	1.0	0.0	10.2
6M1N	15.0	14.0	128.0	203.0	9.1	1.6	6.7	2.0	1.0	0.0	8.5
6M1N	15.0	13.0	140.0	216.0	10.8	1.5	6.8	0.0	0.0	0.0	9.3
6M1N	10.0	11.0	163.0	252.0	14.8	1.5	8.4	3.0	4.0	0.0	16.3
2M1N	9.0	10.0	68.0	100.0	6.8	1.5	4.4	2.0	0.0	0.0	7.6
2M1N	8.0	9.0	51.0	81.0	5.7	1.6	5.4	1.0	0.0	0.0	6.4
2M1N	2.0	4.0	37.0	46.0	9.3	1.2	2.7	2.0	0.0	0.0	18.5
2M1N	5.0	9.0	66.0	99.0	7.3	1.5	5.0	1.0	0.0	0.0	13.2
2M1N	2.0	3.0	23.0	28.0	7.7	1.2	1.8	0.0	0.0	0.0	11.5
2M1N	7.0	11.0	87.0	127.0	7.9	1.5	4.7	3.0	0.0	0.0	12.4
2M1N	3.0	4.0	24.0	34.0	6.0	1.4	3.5	7.0	0.0	1.0	8.0
2M1N	6.0	8.0	64.0	102.0	8.0	1.6	6.3	4.0	0.0	0.0	10.7
2M1N	2.0	3.0	30.0	42.0	10.0	1.4	4.8	2.0	0.0	0.0	15.0
2M1N	8.0	10.0	82.0	136.0	8.2	1.7	7.2	5.0	1.0	0.0	10.3
2M1N	7.0	10.0	75.0	93.0	7.5	1.2	2.0	2.0	0.0	2.0	10.7
2M1N	3.0	4.0	21.0	27.0	5.3	1.3	1.6	3.0	0.0	0.0	7.0
2M1N	3.0	3.0	23.0	32.0	7.7	1.4	3.8	2.0	0.0	0.0	7.7
2M1N	2.0	4.0	28.0	45.0	7.0	1.6	6.1	3.0	0.0	0.0	14.0
2M1N	7.0	9.0	51.0	80.0	5.7	1.6	5.1	2.0	0.0	2.0	7.3
2M1N	4.0	5.0	32.0	46.0	6.4	1.4	3.9	2.0	0.0	2.0	8.0
2M1N	6.0	6.0	69.0	96.0	11.5	1.4	5.3	1.0	0.0	0.0	11.5
2M1N	7.0	9.0	49.0	57.0	5.4	1.2	.3	2.0	0.0	2.0	7.0
2M1N	7.0	8.0	46.0	67.0	5.8	1.5	3.8	4.0	0.0	0.0	6.6
2M1N	7.0	8.0	47.0	64.0	5.9	1.4	2.8	2.0	0.0	1.0	6.7
2M1N	4.0	4.0	27.0	40.0	6.8	1.5	4.5	3.0	0.0	0.0	6.8
2M1N	4.0	4.0	24.0	48.0	6.0	2.0	10.4	1.0	0.0	2.0	6.0
2M1N	2.0	2.0	14.0	26.0	7.0	1.9	9.1	2.0	0.0	0.0	7.0

TABLE E-1. MEAN NUMBER OF SUBTASKS PER PAGE

		M1	M60A1	M109A1	UH-60A	M220A1	TOW(ITV)
-10	(NL)	15	5.4	13		3.2	10
-20	(NL)		5.7	11	11		
	(ITDT)	7.4	6.8				
-34	(NL)		7.1			5.8	
	(ITDT)	8.0	9.6				
	(TRAD)			6.0			

TABLE E-2. MEAN NUMBER OF WORDS PER PAGE.

		M1	M60A1	M109A1	UH-60A	M220A1	TOW(ITV)
-10	(NL)	158	54	192		40	120
-20	(NL)		65	108	111		
	(ITDT)	77	84				
-34	(NL)		81			69	
	(ITDT)	103	116				
	(TRAD)			89			

TABLE E-3. READING GRADE LEVEL.

		M1	M60A1	M109A1	UH-60A	M220A1	TOW(ITV)
-10	(NL)	7.1	5.3	7.6		6.2	7.7
-20	(NL)		5.8	6.3	7.2		
	(ITDT)	5.8	7.1				
-34	(NL)		7.0			6.4	
	(ITDT)	5.9	6.9				
	(TRAD)			7.0			

TABLE E-4. MEAN NUMBER OF ILLUSTRATIONS PER PAGE.

		M1	M60A1	M109A1	UH-60A	M220A1	TOW(ITV)
-10	(NL)	2.3	2.8	1.5		1.3	2.2
-20	(NL)		1.8	2.1	0.4		
	(ITDT)	1.9	1.2				
-34	(NL)		2.2			0.7	
	(ITDT)	1.7	0.5				
	(TRAD)			2.0			

TABLE E-5. MEAN NUMBER OF WITHIN CROSS REFERENCES PER PAGE.

		M1	M60A1	M109A1	UH-60A	M220A1	TOW(ITV)
-10	(NL)	1.6	0.4	0.7		0.3	0.6
-20	(NL)		0.4	1.2	0.4		
	(ITDT)	1.3	0.8				
-34	(NL)		0.4			0.4	
	(ITDT)	0.5	0.8				
	(TRAD)			1.0			

TABLE E-6. MEAN NUMBER OF BETWEEN CROSS REFERENCES PER PAGE.

		M1	M60A1	M109A1	UH-60A	M220A1	TOW(ITV)
-10	(NL)	1.4	0.5	0		0	0
-20	(NL)		0.3	0	0.3		
	(ITDT)	2.0	0.4				
-34	(NL)		0.6			0.2	
	(ITDT)	1.1	1.7				
	(TRAD)			0			

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APPENDIX F

USER SURVEY DATA

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USER SURVEY DATA

Multiple alternative questions were coded from left to right, starting with 1.

Columns 1-6: technical manual

7-10: MOS of interviewee

12-14: time in MOS (10 = 1.0 years)

15-17: time in Army (10 = 1.0 years)

18-19: rank

20: school trained for MOS

21-30: questions 1-10

31-34: question 11

35-37: questions 12-14

39: question 15

41-42: questions 16 and 17

44-48: questions 18-22

51-55: questionnaire identification number

* Each line in the following list summarizes the responses of one interviewee.

```
12345678901234567890123456789012345673901234567890123456789012345678901234567890

25510 19K     1 15E3Y122 555 12333323211 21 312 1    6-16
25510 19K1   15 15E3Y115 555 123131324 1 2  22       7-16
25510 19K2   10 50E5N115 555 123313132 1 11 2        8-16
25510 19K    10 30E5N125 555 123333222 2 11 22      10-16
25510 19K    20 85E5N125 545 123311222 2 11 22      11-16
25510 19K    18 30E4Y125 545 1333331   2 11 22      12-16
25510 19K    15 50E4N125 5 4 123333122 2 11 212     13-16
25510 19K2   10 35E5N125 545 121313123 1 11 22      14-16
25510 19K1   15 15E3Y125 555  22313132 1 11 312     15-16
25510 12B    15 2502Y134 55  1233332 3 2 11 22      16-16
25510 19K     5 36E4Y135 555 123333332 2 21 2       17-16
25510 19K    18 20E3Y125 555  23333332 1 21 22      18-16
25510 19K    20 25E4N125 555 123333132 2 11 2       19-16
25510 19K    20 35E4 115 555 133333222 2 11 2       20-16
-------------------------------------------------------------
25520T45E     3 40E2Y135 555 12 333523 2 2  2        2-16
25520T63E3    3 35E6N135 354  2313 511 1 11 22       4-16
25520T45E1    7 90E3Y125 535 121311222 1 1  32       5-16
25520H63E    19 33E4Y135 555 12 33332211 11 32       1-16
25520H63E1    9 19E3Y135 5 5 32  31532 1 1  12       3-16
25520H63E    20 80E5Y115 554 12  13112 1  1 22       9-16
-------------------------------------------------------------
25534H63H     2 35E2Y                                6-18
25534H63H1   25 25E4Y  5 555  2  31  211    22       10-18
25534H63H2   30 30E5Y  5 535  1  33  211    211 1    11-18
25534H63G    12 13E4Y124 555 11  331 211   12       12-18
25534H63A    70130W3Y125 5 5  1  33311 1 21 12       13-18
25534H63H    10 11E3Y133 444 113 13312 1 11 22       1-18
25534T45K    30 32E4Y125 545 22  11312 1 21 211 2    14-18
25534T45K    20 20E5Y115 555 12  331 2 1 21 22       15-18
25534T45K    10 20E4Y135 555 11  33322 2 11 211 2    16-18
25534T45K    45 45E4Y114 545  2  3324  1 11 22       17-18
25534T45K    23 23E4N1       2          21           18-18
-------------------------------------------------------------
21510 19E1   30 30E4Y115 555  2331144  1 11  11 2    6-17
21510 19E1   10 35E4N125 555 123133442 1 1   2       7-17
21510 19E1    3  8E2Y115 555  233 334  1 11 22       8-17
21510 19E    50 50E3Y115 455 123333122 1 11 2        11-17
21510 19E   200230E7Y125 555 123333122 2 11 211 2    12-17
21510 19E2   43 43E5Y125 555 123333132 1 11 22       16-17
21510 19E    20 25E4Y125 555 12333312211 21 22       17-17
21510 19E2   30 35E5Y125 555 123333222 1 11 22       18-17
21510 19E2   40 45E5Y125 555 123333112 1 11 211 1    19-17
-------------------------------------------------------------
21520T45N    23 30E4Y135 515 22233351211     11 1    4-17
21520T45N2   30 30E5Y125 555 122333322 2 21 22       13-17
-------------------------------------------------------------
21520H63N    20 75E6N115 555 123133312 1 11 22       1-17
21520H63N    25 30E4Y135 555 13331151211 21 22       2-17
21520H63N    15 28E4N135 553 1233113   1 2   2       3-17
21520H63N     5  7E2Y125  33  2333334  2 2  22       5-17
21520H63N    20 30E4N134 555 12 313412 1 11 22       9-17
21520H63N4   10140E7Y125 445 323323212 2 11 22       14-17
21520H63     70230W3N115 555 323333112 1 11 22       15-17
-------------------------------------------------------------
21534T42I     6 60W1Y125 555 12  33212 1 11 22       25-18
21534T45K    35 35E5Y125 555 12  33122 1 11 22       26-18
21534T45K    19 20E4Y125 555 12  33322 1 11 22       27-18
21534T45K    40 40E4Y125 555 32  3322212 11 2        28-18
-------------------------------------------------------------
21534H63H    10 10E3Y                    22          3-18
21534H63H     2  5E2Y                    2          4-18
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21534H63H	2	5E2Y										22			5-18
21534H63H	35	35E4Y	135	555		333	144		1	31	32				19-18
21534H63H	3	6E2Y	135	54	12		3344		1	1	22				20-18
21534H63H	2	6E2Y	1	55	12		11	4	1	21	2				23-18
21710N13E4	70	70E6N	325	555		13333			11			11			4-23
21720N45D1	1	5E1Y	14	555	13		4				2				3-23
21720N63D	40	40E5Y		5	555	2		323		21					5-23
21720N45D	1	5E1Y	115	555	12		4			1	1				6-23
21720N45D	3	8E2Y	115	555		211	111	321		1	2				7-23
21720N63D	5	8E2Y	115	555	2		1211			21	2				8-23
21720N63D3	20	100E6Y		15	555	133	331	112		11	1				9-23
21720N63D	15	15E3Y	122	555	13		1111	211		11					11-23
21720N45D	2	5E1Y	315	555	3		3313	111		11	1				12-23
21720N63D1	10	45E3Y	135	555	32	311	142	211		11	2				13-23
23723 67V	13	100E6N	115	5	5	113	313	121	11	21	112				1-33
23723 CIV		200	115	555		121	333	123	22	11					2-33
23723 67T3	20	130	Y	15	544	1		1	5	2	1	2			3-33
23723 67Z4	45	170E5		15	555	1		1	1	2	1	1			4-33
23723 71A	30	120	Y	15	355	1		2	3	1	1	2			5-33
23723 100BG	10	80	N	15	555	1		1	5	1	1				6-33
25910 11H	15	29E4N	114		34	113	131	112	11	11	2				1-15
25910 11H	21	21E4Y	115	555		123	33	1111		1	2				2-15
25910 11B	25	25E4N	125	554	123	1	324			1	2				3-15
25910 11H	3	23E4N	1	5	555	111				11	2				4-15
25910 11H	3	7E2N	135	5	5	231	15			2	2				5-15
25910 11C	14	140	1Y1	5	555	331	311	42	2	11	2				6-15
25910 11H	8	9E2N	135	455		233	131	2	2	11	22				7-15
25910 11H	29	29E4Y	125	555	123	313	1	212		11	32				8-15
25910 11H	40	40E5Y	115	555	123	313	123	1		22	32				9-15
25910 11H	35	35E4Y	115	555	123	131	122	11	1		211	2			10-15
25910 11H	22	22E4Y	11		154	123	113	2	11	1	212				11-15
25910 11H2	30	60E4Y	11		554	111	111	132	1	11	21	2			12-15
25910 11H	25	68E5Y	115	555	123	313	122	2	11	111	1				13-15
25910 11C	30	300	2Y1	25	444	123	113	222	2	11	211	2			14-15
25910 11H	5	9E2N	135	545		233	1		2	11	22				15-15

TABLE F-1. MEAN USAGE (QUESTIONS 2 and 12):
"How often do you use this manual?"
"On what percentage of your maintenance tasks did you use the TM?"

		M1	M60A1	M109A1	UH-60A	M220A1	TOW(ITV)
-10	(NL)	2.2	2.1				1.9
-20	(NL)		2.5	1.8	1.1		
	(ITDT)	3.4					
-34	(NL)		3.0				
	(ITDT)	2.5	2.5				
	(TRAD)						

TABLE F-2. MEAN ERROR FREQUENCY (QUESTION 3):
"On what percentage of your maintenance tasks was there an error in the TM?"

		M1	M60A1	M109A1	UH-60A	M220A1	TOW(ITV)
-10	(NL)	1.3	1.0				1.1
-20	(NL)		1.1	1.4	1.0		
	(ITDT)	1.0					
-34	(NL)		1.0				
	(ITDT)	1.4	1.0				
	(TRAD)						

TABLE F-3. MEANS OF MISSING INFORMATION RESPONSES (QUESTION 5): "How often was the information you needed not in the TM?"

		M1	M60A1	M109A1	UH-60A	M220A1	TOW(ITV)
-10	(NL)	1.0	1.1				1.4
-20	(NL)		1.2	1.0	1.3		
	(ITDT)	1.3					
-34	(NL)		1.0				
	(ITDT)	1.1	1.0				
	(TRAD)						

TABLE F-4. MEANS OF ACCESSIBILITY RESPONSES (QUESTION 6): "How often was it hard to find what you wanted in the TM (even when it was there)?"

		M1	M60A1	M109A1	UH-60A	M220A1	TOW(ITV)
-10	(NL)	1.2	1.0				
-20	(NL)		1.4	1.0	1.2		1.3
	(ITDT)	1.4					
-34	(NL)		1.3				
	(ITDT)	1.6	1.0				
	(TRAD)						

TABLE F-5. MEANS OF CLARITY RESPONSES (QUESTION 7):
"How often was the TM unclear to you?"

		M1	M60A1	M109A1	UH-60A	M220A1	TOW(ITV)
-10	(NL)	1.1	1.0				1.3
-20	(NL)		1.6	1.0	1.2		
	(ITDT)	1.3					
-34	(NL)		1.0				
	(ITDT)	1.1	1.0				
	(TRAD)						

TABLE F-6. MEANS OF EASE OF USE RESPONSES (QUESTION 9):
"Are the new style manuals easier to read and understand than the older traditional style manuals?"

		M1	M60A1	M109A1	UH-60A	M220A1	TOW(ITV)
-10	(NL)	1.0	1.0				1.0
-20	(NL)		1.8	1.7	1.0		
	(ITDT)	1.4					
-34	(NL)		1.0				
	(ITDT)	2.3	1.4				
	(TRAD)						

TABLE F-7. MEAN ILLUSTRATION QUALITY (QUESTION 10):
"How good are the illustrations in this manual?"

		M1	M60A1	M109A1	UH-60A	M220A1	TOW(ITV)
-10	(NL)	2.1	2.0				1.9
-20	(NL)		2.1	2.0	1.5		
	(ITDT)	2.0					
-34	(NL)		2.3				
	(ITDT)	1.4	2.0				
	(TRAD)						

TABLE F-8. MEAN TROUBLE SHOOTING EFFECTIVENESS (QUESTION 14):
"How effective is the troubleshooting in this TM?"

		M1	M60A1	M109A1	UH-60A	M220A1	TOW(ITV)
-10	(NL)	2.3	2.0				2.0
-20	(NL)		2.0	1.7	3.0		
	(ITDT)	2.0					
-34	(NL)						
	(ITDT)	1.9	2.0				
	(TRAD)						

TABLE F-9. MEAN TRAINING AID EFFECTIVENESS (QUESTION 18):
"If this TM was used in a course you took, how good was it as an aid to training?"

		M1	M60A1	M109A1	UH-60A	M220A1	TOW(ITV)
-10	(NL)	2.1	2.0				2.1
-20	(NL)		2.0	1.6	1.6		
	(ITDT)	2.2					
-34	(NL)		2.2				
	(ITDT)	1.8	1.0				
	(TRAD)						

TABLE F-10. COMPOSITE MEASURE (QUESTIONS 6, 7, 9, 10 and 18).

		M1	M60A1	M109A1	UH-60A	M220A1	TOW(ITV)
-10	(NL)	7.5	7.0				7.6
-20	(NL)		8.9	7.3	6.5		
	(ITDT)	8.3					
-34	(NL)		7.8				
	(ITDT)	8.2	6.4				
	(TRAD)						

APPENDIX G

COLLECTED USER VERBAL RESPONSES

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COLLECTED USER VERBAL RESPONSES

Question 4 What kinds of errors were most frequent?

M109A1

3-23*	wrong wire shown in wrong place or wrong end of wire checked
9-23	turret electrical
11-23	self-contradictory
12-23	extra step

M1

6-16	book disagrees with training or unit policy, OT book is not current
7-16	some unnecessary steps
5-16	wrench size holes on wrong border of page
9-16	misprints
11-18	pictures didn't match tank - minor mistakes
12-18	says 3 men for engine job - only need 2 - why have someone reading book?
13-18	book says change engine if find shavings in AGB - however, all AGB's have shavings - otherwise mostly wording errors
1-18	nuts and bolts left over, not covered in book - a lot of parts not covered in book - also errors of ommission
17-18	missing steps, wrong wrenches

M60A1

6-17	he did find errors in old books, but not in new ones
7-17	book tells you to do something, but doesn't tell you how
17-17	definition on what is a deadline condition, what is a shortcoming
2-17	incorrect transmission servo band bolt torque
15-17	fire extinguisher check
26-18	in -34P NSN is usually wrong

TOW (ITV)

1-15	self-contradictory - difficult for new guy
2-15	small things - omissions
5-15	omitted info on oil check
11-15	repeats itself

UH60A

1-33	torque specs inconsistent order of steps
3-33	parts manuals
4-33	misprints incomplete parts illustrations
5-33	FIP charts cannot cover all faults
6-33	misprints

* Please refer to Appendix F for specific information on the respondent and the particular TM of reference.

Question 8 How was it unclear?

M1

7-16	too simple - too basic
13-16	troubleshooting guide
15-16	Part IV Aux systems
16-16	PMCS deadline items - some should deadline, some should not
17-16	straight forward
18-16	straight forward
4-16	could be clearer showing test point hook ups for multimeter only a block now
5-16	unclear in how its worded and sentence construction
9-16	some pictures do not identify wires going into a junction
11-18	everything was made very clear
12-18	sometimes has extra unnecessary steps
1-18	words are confusing - should be in plain English
16-18	too much simple verbiage
17-18	straight forward

M60A1

6-17	leaves out some steps (e.g., breech block pin is tricky)
7-17	its easy to understand because of the level at which its written - but this can be annoying for him
12-17	the new manual is clear
17-17	no doubt when you read it
18-17	everything is clear
1-17	wording - self contradictory
3-17	can't understand some of it - mostly his lack of background
5-17	troubleshooting doesn't make sense sometimes
14-17	text is right - info is there and clear
20-18	table of contents unclear
23-18	easy to read and understand
27-18	index is not clear - hard to understand what is covered in a particular volume - somethings you look for are not indexed
28-18	straight forward

TOW (ITV)

1-15	not in plain English - you need 4 years college
2-15	inappropriate words - duplicated items in PMCS (e.g., 29 & 54)
3-15	not enough detail in some PMCS
6-15	locator views could be a lot better (e.g., oil dipstick)
7-15	everything is straightforward
8-15	very clear
11-15	some checks are not explained fully
12-15	maintenance of vehicle
13-15	very clear
14-15	boresighting procedure - system self test - TS on optical sight
15-15	everything is straight forward

Question 8 (continued)

UH-60A

3-33 parts manual doesn't show the items sometimes - also missing NSN's and part numbers

5-33 parts manuals don't have clear pictures and where the item is located is hard to find

Question 14 Any troubleshooting problems?

M109A1

4-23 you've got to be pretty stupid not to understand it

5-23 things that are left out

M1

6-16 for most cases, TS doesn't locate fault
14-16 manual needs a little more depth in TS
15-16 order of doing is confusing
16-16 operators are not allowed to do enough TS
18-16 driver should do more TS

2-16 about 40% of TS is good part replacement
4-16 STE/M1 is wrong about 75-80% - he no longer uses it - ATP is about 80% effective
5-16 uses ATP - about 75% effective STE/M1 too much time & inaccurate
9-16 STE/MI is a problem

11-18 no problems STE/M1 worked well; told where problem was but did not pinpoint it
13-18 by getting ahead of book
16-18 more depth in problems that do not occur very often
17-18 no
18-18 no

M60A1

12-17 do not go far enough; the -20 covers more
18-17 good leads to problems

1-17 getting soldiers to understand book at first
9-17 illustrations do not show which way wires go - stop at the bulkhead - needs more pictures
14-17 jumping from one volume to another is bad

27-18 no
28-18 no

UH60-A

1-33 none
2-33 doesn't cover everything that can go wrong
5-33 doesn't and can't cover all the faults
6-33 APU: there is often an illogical sequence

Question 15 Should there be more or less theory of operation taught in training programs and included in this manual?

M109A1

11-23 the more you get, the more you know
13-23 often things don't go the way you expect and you have to figure it out yourself

M1

7-16 most people don't care as long as it works
8-16 to get a better handle on tasks
14-16 to have a better understanding of how the tank works
15-16 more knowledge about the tank
18-16 would like to know more about his job

2-16 some theory of operation in books is hard to understand - what is there is a help, but must read several times
4-16 you need to understand in order to be able to work on
5-16 school confused him
9-16 would give better understanding of system

10-18 just in course
11-18 more in course and books
12-18 more in course
13-18 book is about right - more could confuse young soldier - it's his job to to teach them
1-18 he would like to get more into engine - they only teach basics - TM is about right
14-18 need to know how things work
15-18 need to know how a subsystem works and what could cause it to go bad
17-18 should have more depth on why something works

M60A1

6-17 more in course and in book to reach both people who learn better from a course and those who learn from books
11-17 more depth so you can understand what is happening
12-17 it's ok for the average crew
16-17 better understanding needed in some areas (e.g., removal of torsion bar)
17-17 more because you would understand operation better
18-17 if you understand how it works, you can understand how it doesn't work
19-18 to get a better understanding how something works and relates to other subsystems - would make it easier to repair

1-17 -10 is all operator has and more [theory] would let him do a better job
5-17 wouldn't make any difference
14-17 right for mechanic's level
15-17 get deeper so you can understand what is going wrong

19-18 to get a better understanding how something works and relates to other subsystems - would make it easier to repair
20-18 not enough depth - need to know why something is not working
23-18 needs a little more technical info

25-18 need to know how a subsystem operates
27-18 helps mechanic understand what he is trying to fix

Question 15 (continued)

TOW ITV

1-15 sort of skips around - hard to see how it fits together
2-15 would like more classes - in Europe had 2/week
11-15 more training
13-15 more would complicate matters

UH-60A

5-33 more because of the complexity of the Blackhawk
6-33 people working on UH-60 systems often do not know how or why systems work

Question 17 Could this manual be used to support OJT?

M109A1

4-23 he uses it to train new troops in his section

5-23 good for basics, but supervisory training is needed
6-23 on most tasks, he thinks pictures and text could get him through
8-23 it's easy to learn from because it breaks things down so well
9-23 it's excellent
11-23 works pretty well - no real problems
12-23 does a good job
13-23 works fairly well - better than just a verbal explanation

M1

6-16 they were alright
8-16 clear
11-16 simple terms, orderly, pictures
16-16 good task order
17-16 clear straight forward
18-16 self-explanatory
19-16 can do it yourself
20-16 good - straight forward

4-16 fairly good for OJT
5-16 a new man would get lost; needs someone to locate components and get him started then book is clear enough, he can go through task by himself
3-16 this unit doesn't want mechanics too dependent on TM's (e.g., they should know how to pull power pack)

13-18 works well for OJT
14-18 manuals are clear
15-18 shows you what you need to know
16-18 good pictures and laid out good
17-18 simple manual helps new unfamiliar mechanic
18-18 yes for troubleshooting

M60A1

6-17 book works with tank - alone could be confusing
7-17 yes, if you have an instructor there (E4 or E5)
8-17 works well, book has everything you need to know
11-17 shows everything clearly and easily
12-17 Bn policy: always use manual - it's clear and easy to follow
16-17 avoids shortcuts - manual has correct procedures
17-17 shows you the right way to do things
18-17 shows how to do maintenance; new AIT can get info
19-17 pictures help new people - shows what to expect, what it looks like

1-17 no problems in getting new men to use books
2-17 works pretty well used with tank for new man
3-17 a little hard if you are unfamiliar
5-17 it does help
9-17 shows how to do tasks clearly - he learned a lot during OJT
14-17 clear, but too many for one man to carry
15-17 clear and easy to use

Question 17 (continued)

19-18 helps new person become familiar with tank
20-18 easy to familiarize yourself with new system
23-18 easy to understand

25-18 TM is good to use if equipment is not available - task can be followed easily
26-18 there is more definition - tasks are broken down more and better
27-18 yes, in conjunction with supervisor
28-18 explains everything

TOW (ITV)

1-15 they use a Ft Benning book for OJT
3-15 pretty easy to learn from - some hard parts
4-15 pretty good
5-15 he had a little trouble understanding at first
6-15 does the job
7-15 good to use for OJT
8-15 need enough explanation to familiarize individual with system
9-15 does tell how to work the system
12-15 step by step procedures are shown to new personnel
13-15 good for OJT
15-15 good for OJT

UH-60A

1-33 very good because of level at which it is written - it more or less trains by itself on some tasks
2-33 very good except for locating part

Question 23 Was there anything that you especially liked about this TM, anything which made it easier to use?

M109A1

4-23 whole book is good

3-23 likes troubleshooting guide - helps to find stuff likes the way everything is explained
5-23 picture for each step, step-by-step, shows you circuit at each step, breakdown is good (components)
6-23 pictures paired with text - direct number reference to parts avoids confusion
7-23 likes way it's laid out - all that you need is right there also likes diagrams
8-23 the breakdown of components and how it is self-explanatory
9-23 illustrations especially good for young mechanics also likes schematics
11-23 the troubleshooting chart does a good job of pinpointing area to work in
12-23 troubleshooting guide directs you to the right area with page number - it's the best thing in the book
13-23 likes quick guide to troubleshooting - instead of index, it pinpoints page and paragraph a whole lot faster

M1

6-16 he likes index - easy to find what you need - pictures and explanation
7-16 likes divisions of book (PMCS, etc)
8-16 you can find what you're looking for cautions are good, they are clear
10-16 PMCS is good breech block section
12-16 shows exactly how to do PMCS
13-16 very useful
14-16 pre and post firing checks
15-16 likes the little books
16-16 task order is in logical sequence
17-16 gives good information lays out all procedures
18-16 PMCS section is good
19-16 easy to follow good pictures and a lot of them
20-16 everything you need to know is in it

2-16 everything is spelled out - when book is right and you go by book you can't go wrong
4-16 Chapter 6 (Fault Symptoms); about 50% get good match - ATP is pretty good - TM's are easy to use
5-16 book is self explanatory if you know how to use it
1-16 easy to read
3-16 indexes are fairly good - excellent pictures - explanations are simple TM and tank work well together
9-16 clear they are easy to read in dim lighting

10-18 likes step-by-step - it's all there
11-18 pictures, step-by-step instructions
12-18 index is to the point - page numbers good - P manual good
13-18 written at level that even below average mechanic can understand pictures are real good - it's good for teaching
1-18 likes illustrations for engine, parts locators usually can find what you need

Question 23 (continued)

14-18 illustsrations and wiring diagrams were good books are easy to read; the info is right there
15-18 tells you what you need to know to get started
16-18 illustrations good for training new people wording with pictures is good
17-18 what detail there is, is good illustrations are good
18-18 illustrations are good

M60A1

7-17 the way it's broken into volumes it's easy to understand if you don't read things into it
8-17 likes PMCS also the turret is explained pretty well
11-17 shows where things are clear and concise
12-17 easy to tell soldier what to do (i.e., "check items 1 to 10") - also can avoid repeating tasks
16-17 easy to understand - puts you where the trouble is by a picture
17-17 shows you the correct way to do maintenance on the tank
18-17 PMCS good except for sequence

1-17 pictures worded very clearly almost impossible not to understand
2-17 TS is very good - that's what he uses most
9-17 the way it is laid out - troubleshooting, how to replace parts
15-17 troubleshooting procedures are good, easy to follow

3-18 a good layout to find what you should do - the pictures show you just how to hook up STE/ICE - it explained everthing well in good detail
4-18 illustrations and wiring diagrams were good books are easy to read; the info is right there
5-18 liked the numbering of parts in illustrations for identification
19-18 illustrations are good
20-18 good for references but difficult to work out of
23-18 easy to read - all info could be found

25-18 easy to follow gives a new mechanic the information to do a job
27-18 easier to understand than the old type manual
28-18 good information

TOW (ITV)

1-15 clearer than old TM, better PMCS, better TS breakdown
2-15 the pictures - it's set up well
3-15 illustrations, locator views, PMCS easy to follow
4-15 pictures parts identified by number in illustrations
5-15 pictures, being able to match picture to part on vehicle
6-15 well organized, clear, concise
7-15 easy to use
8-15 it is ok
9-15 nothing outstanding illustrations are good
10-15 good - covers all areas
12-15 pictures instructions clear easy to find info
13-15 sufficient information info is simplified
14-15 good combination of automotive and weapon system
15-15 to the point - everything is easy to understand

Question 23 (continued)

UH-60A

1-33 likes the line drawings instead of photographs and use of volumes for different subsystems
2-33 very easy to read, charts are good - nothing seriously wrong
3-33 part and tool set up lists
4-33 part removal and reinstallation steps
5-33 FIP charts
6-33 easy to understand figures and diagrams showing the part to be changed

Question 24 Was there anything that you especially disliked about this TM? Anything which made it harder to use?

M109A1

4-23 pages fall out - about 4 books in 2 years in his section

5-23 occasionally not explicit enough
6-23 poor durability
8-23 poor durability
11-23 doesn't last very long
13-23 index could be clearer, poor durability

M1

6-16 no problems his have stayed together
7-16 durability - they fall apart in field
8-16 none comes apart too easily
11-16 poor identification of area with arrows in illustrations - three volumes - jumping PMCS from one volume to another

12-16 when doing a task, TM sends reader from one section to another paper tears easily - lose pages
13-16 not durable sequence of PMCS
14-16 too many volumes - have to jump from one volume to another on PMCS
15-16 the loose pages
16-16 nothing really bad - needs updating
17-16 nothing
18-16 TS does not go far enough at the operator level
19-16 the way it's put together - falls apart
20-16 hard to keep pages together - they tear up

2-16 no one of easiest TM's he's used durability problems, pages constantly getting ripped out (3 ring)
4-16 STE/M1 bad durability problems, especially in field use
5-16 falls apart easily (3 ring binders) lose pages
1-16 nothing - it's an easy book
3-16 doesn't like soldier A, B, C tasks where one guy is just reading TM volume - he would like condensed version for just his echelon - cut out MAC, include only what he can do
9-16 too many volumes

10-18 jump around too much - cross references between pages and books
11-18 too many books too much wasted space torn out pages (3 ring binders)
12-18 books tear too easily
13-18 make them shorter - some things are unnecessary
14-18 too many manuals reading level is too low
15-18 reading level too low
16-18 reading level some procedures with special tools take too long to do
17-18 reading level too low
18-18 difficult to find things - index also you have to go from one manual to another too often

M60A1

6-17 small problem with durability

Question 24 (continued)

7-17 should be more durable; it falls apart easily - if it gets wet, it smears and fades
8-17 no durability problems
11-17 nothing
12-17 nothing
16-17 they are ok
17-17 PMCS
19-17 deadline descriptions

1-17 no problems copies on line don't last long (about 6-8 mn)
2-17 not really durability a problem - if use screws instead of 3 ring binder, works better
5-17 nothing that hard about them
9-17 he gets lost going from one wiring diagram to another
14-17 too many volumes
15-17 too big, too much - difficult to keep together and maintain

4-18 index
5-18 you had to go through maybe 3 TM's to find what you needed - could have a better index had quite a few books with missing pages (using 3 ring binders)
19-18 have to go to too many manuals
20-18 reading level too low - not technical enough

25-18 the -20P part numbers and NSN's are sometimes different from the AMDF
26-28 -34P stock numbers
27-18 too many volumes

TOW (ITV)

1-15 needs more info - very poor durability - always falling apart - steel staples work out - they keep in binders
2-15 no
4-15 they fall apart - lose pages
5-15 none
6-15 locator views
7-15 nothing
8-15 pages are lost easily
9-15 falls apart too easily - loose leaves come apart easily
10-15 will not stay together - lose pages
11-15 some of the checks jump around and are repeated
12-15 not enough illustrations - not enough verbal detail accompanying illustrations
13-15 each subsystem's checks in PMCS should be consolidated
14-15 PMCS layout is sometimes confusing on what to do before/after/during
15-15 sometimes info is hard to find because of page numbering system also lose pages

UH-60A

2-33 P manual, omissions in troubleshooting charts
6-33 manual changes are too long in coming down

Question 25 What is you opinion of this TM? Especially as compared to TM's for similar systems?

M109A1

4-23 very positive

6-23 it's a good book definitely better than the M110 book (because of errors in that book)
8-23 uses -20N for M548 troubleshooting because this book is better
9-23 247-20 is one of worst books (many errors and unclear for new troops) 217-20N works well for teaching because of clarity and completeness
12-23 very good book
13-23 easy to work with, fantastic book, only a few bad points

M1

6-16 "real damm good books" without these books, he'd have to go to motor pool
7-16 better for training than for practical day-to-day use too much detail for an experienced man
8-16 good
10-16 good manual
11-16 fair
12-16 good
13-16 very good
14-16 good
15-16 good
16-16 good - best -10 manual in Army
17-16 good
18-16 good
19-16 good
20-16 good

2-16 very detailed, very good explanation
4-16 basically a good book
5-16 they're fair for what they cost
1-16 good book
3-16 sufficient for what you need, but has info he can't use
9-16 good

10-18 good but shouldn't jump around
11-18 gives all the info you need to know - too detailed; doesn't need to be at 3rd grade level
12-18 the TM is good - some things could be changed
1-18 good book, could be a little better
14-18 on a scale of 1 to 10 (high): 3
15-18 good
16-18 good
17-18 6 on a scale of 1->10
18-18 manual is good

M60A1

6-17 pretty good book - likes anything that helps him with his job
7-17 a good book, easy to understand, clearly illustrated easy to train with (because of picture to tank correspondence)
8-17 pretty good book

Question 25 (continued)

11-17 good
12-17 good
16-17 good
17-17 good
18-17 good - better than old one
19-17 very good

1-17 a big help, definitely, for the soldier
2-17 a better book - you can learn from them more easily easier to understand
3-17 they're helpful
5-17 a very good TM; a little thick no durability problems he has taken PMCS out for ease of use

9-17 good - has everything you need
14-17 good but older equipment should stay with old style manuals
15-17 good

3-18 excellent
4-18 pretty good book
5-18 alright - good for learning - good for when you get stuck
19-18 good
20-18 fair
23-18 good

25-18 very good
26-28 good
27-18 the manuals are improving
28-18 pretty good

TOW (ITV)

1-15 gets job done but not exceptional
2-15 it's a good book
3-15 it's alright, better than some he's seen
4-15 about the same
6-15 good book, accomplishes mission
7-15 it is ok
8-15 it is good for getting the information you need
9-15 more written detail better packaging
10-15 good
11-15 good for maintenance procedures
12-15 better than others
13-15 good
14-15 good
15-15 good manuals

UH-60A

1-33 very good
2-33 very good overall - about the best set of books he's had, especially for maintenance work
3-33 these books are easier to use for the most part
4-33 easier to read, simpler to use at AVUM level
5-33 a lot better
6-33 it's better index is easy to use

Question 26 How could this TM be better?

M109A1

3-23 remove errors improve durability

5-23 schematics should identify hot wires and direction of electrical flow turret section of -20N needs simplification, maybe more pictures improve durability
6-23 additional troubleshooting information - sometimes omits some problems in beginning, he had trouble with Table of Contents
7-23 he'd like a turret book just for 45D
12-23 clearer definition of where wires go and come from
13-23 better, bigger, clearer wiring schematics (fold-outs)

M1

7-16 make them more compact - give each tank station his own book (driver, etc) laminate lube order he'd like to see all pages laminated dispite bulk
10-16 make pages more durable - plastic paper
11-16 PMCS should have deeper coverage - put PMCS in one volume more detailed table of contents
13-16 laminate pages like lube order so pages stay clean
14-16 put 3 volumes together - have 3 sections: operation/hull/turret
15-16 make it waterproof make it smaller
16-16 laminate pages - at least PMCS separate PMCS section
17-16 increase durability of pages - laminate them
18-16 get more detail in TS and operation and maintenance
19-16 make pages more durable

2-16 raise level at which they're written
4-16 these books are better for a beginner - experienced man tends to skip stuff
5-16 more durable not as large
1-16 lose pages from 3 ring binder
3-16 more pictures in maintenance procedures to reduce cross reference would like durable book . in TS, a cross reference can be hard to follow in field - too many cross references
9-16 make pages more durable improve wiring pictures

10-18 should eliminate cross reference by having info in one place
11-18 leave out number of people required, wrench size
12-18 use color for thumb edge guide should have spec index could use a summary of safety items on wall chart
13-18 shorten some write-ups (picture tells it all)
1-18 redo index rewrite some sentences for clarity
14-18 go back to old style - have experienced mechanics validate manuals
15-18 more theory of operation - go deeper
16-18 increase reading level put preliminary procedures in -34 so direct support doesn't have to use -10 and -20
17-18 upgrade reading level clear up index

M60A1

6-17 better binding could be clearer about deadline conditions and their causes
7-17 fewer cross references
11-17 let a tanker write it explain deadlines and shortcomings in PMCS

Question 26 (continued)

12-17 authorize -20P manual to a lower level; -10 manuals do not identify all parts that are troubleshot
17-17 give PMCS a logical sequence
18-17 make a better binder and cover
19-17 improve deadline descriptions in a separate section

2-17 few more pictures
5-17 simply PMCS by organizing it better
9-17 more continuity between wiring diagrams
14-17 improve durability
15-17 make them more durable

4-18 give books an overall index put all torque specs together in one place (once you've done something a few times, you don't need detailed instructions, only specs) or would put specs at front of each task
19-18 combine some volumes needs more detail in some areas - different views in illustrations
20-18 re-evaluate and update
23-18 some more pictures

27-18 an index specifying what volume to use to make a specific repair
28-18 reduce the number of volumes

TOW (ITV)

1-15 break steps down further
2-15 move lube info to lube order - pivot steer should only be used in water
3-15 put it together better; bound instead of 3 ring binder
4-15 bind it instead of 3 ring binder
5-15 pages fall out
6-15 locator views should cover larger area
7-15 needs a durable cover and permanent binding
8-15 package it better
10-15 package better
11-15 more detail in pictures - redo PMCS; eliminate redundant checks - put PMCS in logical order
12-15 more pictures
14-15 those items in PMCS that NMC should be highlighted, (i.e., different color, print)
15-15 manual should have a binder and be packaged better

UH-60A

2-33 only problem is with distribution of changes
3-33 put all the requirements for a task in one place - i.e., removal and installation of MIR head and shaft extension in the same book

Question 27 Please use the remaining spacee to expand any of your answers or to provide other comments on Army Technical Manuals. (If you are a supervisor, please describe any important problems your troops have had in using this manual.)

M109A1

12-23 would like part number index

M1

13-16 improve sequence of PMCS and combine some inspections
14-16 need hole reinforcement
20-16 fix pages

2-16 too much detail - insult to his intelligence also, some unnecessary steps (e.g., for access to TNB, don't need to remove ready ammo box, slipring cover and elec rack shield)
4-16 no problems with cross reference
5-16 no cross reference problems
1-16 no problems with men he's supervised or in getting them to use the book
3-16 he likes books but would prefer a condensed version - should show echelon more clearly - this could get you in trouble

6-18 good for inexperienced person who is just starting - an experienced man can take shortcuts (SGT will show them how) - TM gets all dirty anyway also good for specs, safety precautions experienced man doesn't really need it in National Guard, usually don't put changes in - outdated by the time they get them - also, TM specs sometimes behind field usage
10-18 easy to read, simple to understand no durability problems
11-18 all the info should be in one book - it's too spread out in different books some nomenclature problems (e.g., transmission gears, linear valve body) likes arrows and numbers in illustrations some cross references do not point directly to next step, rather just to book to check
12-18 he troubleshoots by the book - common tasks he doesn't need the TM book says use jacks to remove engine - A-frame and sling work better (more stable) - book gives you basics quickly and easily he really likes M1 and its TM's
13-18 no real durability problems (uses masking tape along hole edge) - about 1/2 of replacement TM's due to missing pages (about 9 month life) - TM is too low in reading level - insult to his intelligence, he gets frustrated with new books about 1/2 his men need new style, 1/2 would do better with old style they are a good learning instrument no problems with his men using books (off duty make-up) school flow charts of TS very good (electronic device allowing you to avoid some steps using STE/M1)
1-18 index sometimes drives him up a wall fuel and electric systems don't identify whether for trans or AGB or what no durability or cross reference problems
14-18 have to jump from one volume to another
16-18 removal of some parts unnecessary - short cuts are possible
17-18 info is hard to find because of referrals from one manual to another index was not clear or he did not know where the item was listed reading level too low - easy to miss steps - sometimes confusing because of reading level

Question 27 (continued)

M60A1

6-17 wiring tags get lost - pictures could identify which is which
Army should tell you what TM's and FM's you need for your MOS
8-17 he might have a faster way to do the task
11-17 no RISE engine manuals in company
16-17 easy to teach new people
17-17 some illustrations do not indicate vehicle location
18-17 -10 manual needs more depth - part of -20 manual
19-17 sometimes you have to go to a mechanic to determine if your tank should be deadlined

1-17 sometimes -10 and -20 contradict each other he finds RS in -20 confusing sometimes cross references are confusing at first, but new men get used to them at first, some are reluctant to use the books but he gets them to use them better than old books; easier to understand
5-17 he likes TM 9-8000 (Principles of Engines) because it has more information on how they work - gives better understanding
9-17 they need more books - it takes too long to get them
14-17 indexing over the volumes is bad too many manuals have to be used to do a job PMCS checks jump back and forth quantity of books gets unruly when units have so many types of tanks (M60A1, M60A1 RISE, AVLB)
15-17 need some type of stand to hold manuals breakout separate volume for troubleshooting

3-18 If he had to use a TM, he'd like one like the M60 books - likes pictures which show exactly what to do no problems with cross references

TOW (ITV)

1-15 no particular problems
2-15 problems with losing pages
3-15 some areas of book could use more illustrations to make them clearer
6-15 lack spare parts for ITV - leads to readiness and morale problems
11-15 some checks are not as detailed as they should be
12-15 use ETM more
13-15 the PMCS checks jump from one subsystem to another
14-15 T3 procedures need to show what reading should appear on instrument dials laminated check lists would be helpful

UH-60A

2-33 new people can use these books with little problem if you can't read these books and do the job, something is wrong
6-33 the paper should be thicker with reinforced holes need more bulk parts listing in P manual FIP manuals are fairly good but cannot replace need for better understanding of UH60 systems

TABLE G-1. COUNTS OF RESPONSES TO QUESTION 23:
"Was there anything that you especially liked about this TM, anything which made it easier to use?"

	Clarity	Illustrations	Accessibility	Trouble-shooting	Information	PMCS
255-10	3	2	2		3	4
255-20	6		1	2		
255-34	2	4	2	1	2	
215-10	4	1	1			3
215-20(NL)	1	1	1	3		
215-34(NL)	1	1	1		1	
215-34(ITDT)	2				2	
217-20N	3	4	1	3		
237-23	3	2	1			
259-10	5	6	1	1	2	2
TOTALS	30	21	11	10	10	9

TABLE G-2. COUNTS OF RESPONSES TO QUESTION 24:
"Was there anything that you especially disliked about this TM? Anything which made it harder to use?"

	Durability	PMCS	Volumes	Low RGL	Accessibility
255-10	7	3			
255-20	3		1		
255-34	2		2	4	1
215-10	2	1			
215-20(NL)	3		1		
215-34(NL)	1		1	1	2
215-34(ITDT)			1		
217-20N	7				1
237-23	1				
259-10	6	4			1
TOTALS	32	8	6	5	5

TABLE G-3. COUNTS OF RESPONSES TO QUESTION 26:
"How could this TM be better?"

	Durability	PMCS	Index	Schematics
255-10	7	2	1	1
255-20	4			1
255-34			3	
215-10	2	4		
215-20(NL)	2	1		1
215-34(NL)			1	
215-34(ITDT)			1	
217-20N	2		1	3
237-23	1			
259-10	7	1		
TOTALS	25	8	7	6

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