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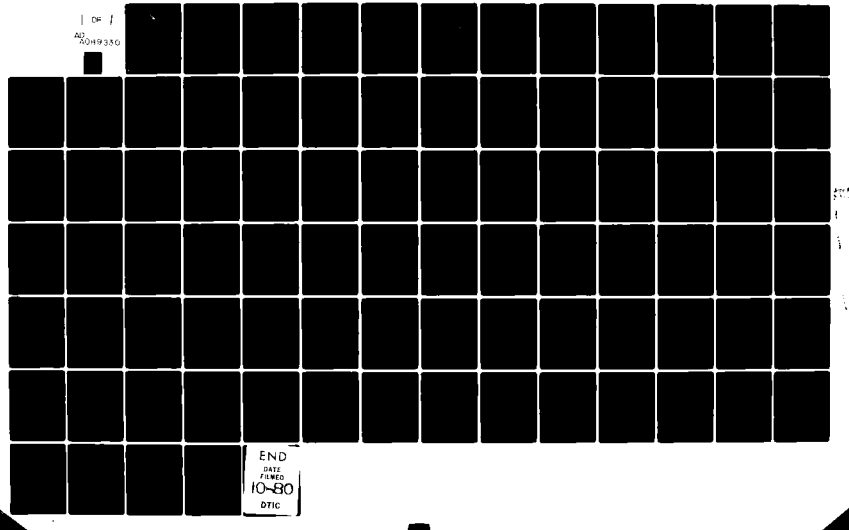

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY (ATC)

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

PROPOSED CRITERIA FOR EVALUATION OF THE RELIABILITY IMPROVEMENT WARRANTY CONCEPT

James M. Bradney, Captain, USAF
Mark M. Perkins, Captain, USAF

LSSR 63-80

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The objective of this research was to determine if a set of criteria could be nominated for the evaluation of the RIW concept. Currently, a plan for evaluating RIW is to occur in FY 82/83. The literature search revealed that the evaluation plan had not been formalized because there was no known methodology to conduct an evaluation. To aid in the formulation of an evaluation plan the researchers interviewed contracting officers and program managers to determine what criteria was important in their program. The research discovered that there was agreement among the two groups, contracting officers and program managers; however, there was disagreement among the group as a whole.

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PROPOSED CRITERIA FOR EVALUATION OF THE RELIABILITY IMPROVEMENT WARRANTY CONCEPT

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degrees of Master of Science in Logistics Management

By

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and

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CHAPTER I

INTRODUCTION

Overview

One of the most significant items of continuing concern to the Department of the Air Force is the need for improved reliability and maintainability of its weapon system's equipment (17:1). In an effort to achieve this end, the Air Force, in FY 1969, first applied the concept of the Reliability Improvement Warranty (RIW) to the acquisition process (19:N-3). In 1974, in response to a request from the Office of the Secretary of Defense, the Air Force began a formal trial program of the RIW concept.

RIW is a contractual technique used in the commercial environment and currently being utilized on a trial basis within the Department of Defense (DOD) as a means of implementing such improvements as greater equipment reliability, reduced repair costs, and lower life cycle costs. This was previously known as a "Failure Free" or "Standard" Warranty. The objective of a RIW is to motivate and encourage contractors to design and produce equipment which will have a low failure rate as well as low repair costs after failure due to field/operational use. Furthermore, this technique attempts, through the use of contractual

agreements (where the period of performance extends over several years), to provide an incentive for contractors to improve the reliability of their equipment and to reduce repair costs during the period of warranty coverage in order to maximize their profits (17:1-2).

Under the concept, the contractor is obligated to repair all warranted items, excluding exceptions stated in the contract, for the duration of the warranty period. In return for providing repairs, the contractor receives a firm-fixed fee. The fee, which is determined prior to award of the contract, does not vary with the number of units sent to the contractor for repair. If few repairs are required over the life of the warranty, the contractor's profits would likely be high. Conversely, a high item failure rate would involve a large number of repairs causing the contractor's repair costs to exceed the fixed fee. The fee, therefore, is designed to provide the contractor an incentive to manufacture more reliable items requiring fewer repairs. The contractor is authorized some latitude to change the item during the warranty period to improve the item's reliability (17:2). Government contracting officers anticipate that continued emphasis by civilian contractors to decrease failure rates will bring about benefits for the government in the form of better equipment availability and lower life cycle cost (17:29).

The RIW contract clause requires the contractor to maintain the items under warranty for the duration of the warranty period. The length of the warranty period is formally stated in the RIW clause (17:2). RIW warranty periods have varied from a minimum of two years to a maximum of six years and have averaged over three years in length (17:48).

It is important to note that RIW is not a maintenance contract and does not require that the contractor provide routine periodic upkeep, regulation, adjusting, cleaning, or other normal maintenance. A RIW also does not cover components of a warranted item which are expected to need replacement under normal use during the term of the warranty (such as filters, light bulbs, etc.). These items may be provided for by separate provisions in the contract consistent with current laws and regulations, but they shall not be included in the RIW provision. Furthermore, if the item failure can be attributed to obvious abuse, aircraft crash, tampering, or other reason beyond the control of the contractor, repair of the item is not without cost to DOD (17:16). In general, a RIW will provide for the repair or replacement of failed units as well as agreed to "no-cost" engineering changes and the calibration, adjustment and associated testing therewith (17:2).

Background

Life cycle cost is the basis of the RIW concept. The object of life cycle cost is to insure the lowest overall ownership cost to the government during the life of the hardware (11:1-1). The declining purchasing power of the defense budget dictates a need to explore ways to cut the ownership costs associated with weapon systems. In an attempt to answer this need, RIW is currently being tested within DOD for its potential to minimize these costs (18:30).

The Army and Navy studied the commercial airlines industry's contracting techniques because of their past ability to acquire more reliable equipment than the military services. During this study, it was noted that the airlines employed the extensive use of warranties. As a result, the Navy began to apply this lesson learned from the airlines by developing a warranty concept which later became known as RIW (3:B-2 to B-5).

The Office of the Secretary of Defense, in August 1974, requested tri-service experimentation with RIWs. Each service was directed to establish procedures for identifying potential contracts in which RIW could be incorporated. Following application of RIW to selected programs/contracts, the services were to evaluate the RIW concept as a potential contracting technique (8:v).

In response to the request of the Office of the Secretary of Defense, the Air Force began applying the concept of RIW to selected elements of programs which were in the early stages of development. With one exception, application within the Air Force has been limited to avionics equipment. There are currently five programs in the Air Force that involve a major application of RIW. A major application of the concept is one in which RIW has been included in the contract since the early stages of development and has not been subsequently deleted from the contract (14). These programs are listed in Appendix A. Other Air Force programs which employed the RIW concept in some stage of program development, but are not major applications are listed in Appendix B.

In July 1978, Hq USAF/RDC established Hq AFLC/LOM as the Air Force Warranty Information Center (WIC) data repository for RIW. The following generic data were to be retained in the WIC (11):

1. Analysis documentation to support determination to apply RIW on specific programs.

2. Periodic contractor RIW reports.

3. RIW administration as prescribed by AFLC Test Regulation 800-7.

4. Follow-on support determinations to ascertain the logistic support concept after completion of RIW.

The contractors' reports are not standardized in format, content, or frequency. These factors are determined by the individual program contracts. The report frequencies range from monthly to semiannually and include a summary, for the reporting period, of the number of units returned to the factory, the status of the units upon contractor receipt, contractor's action, reshipment date, compilation of mean time between failures, and pipeline performance (14).

The purpose of the WIC is to collect and store data on RIW programs. No analysis of the data for content or completeness is done at the WIC. Therefore, there is no record at the WIC to indicate whether or not the data contained in the repository fulfills the requirements of Hq USAF/RDC (14).

According to an Air Force Audit Agency report, a master plan to evaluate the impact of the RIW concept on Air Force programs and bring the trial program to a conclusion had not been prepared. An office of primary responsibility (OPR) to prepare a master plan and perform the evaluation has not been established (2:10-11).

CHAPTER II

PROBLEM DEFINITION

Evaluation Progress

A review of the literature revealed the following significant facts concerning the evaluation of RIW:

1. Trial use began in 1974 (8:v).

2. Five programs involving major applications of RIW have been established (14).

3. A WIC was established in 1978 to collect RIW data.

4. An evaluation plan for the RIW concept has not been established.

5. An OPR to develop an evaluation plan has not been identified.

Therefore, it appears that some data is being collected but without a plan for its use or evaluation. Furthermore, it is not known whether this data is complete (i.e., that all the data requested has been received by the repository).

Evaluation Need

As shown in Appendix A, the table of programs involving major applications of RIW, the warranty period for

the first program will expire in October 1980. The last program's warranty expires in January 1983. Since a potential item to evaluate might be equipment performance following the warranty period, it is anticipated that it will be possible to draw conclusions from the trial in FY 1984 (14). However, in order to do this, an evaluation plan needs to be developed to identify which factors are important in the evaluation of RIW. The need exists to identify any factors common to the five programs using major applications of RIW and determine whether any generalizations can be made from the experience of these five programs for the use of RIW in future programs.

Justification

The progress of the evaluation program points out the need for measurable parameters to evaluate the RIW concept. This need is clearly recognized within the Air Force. A 17 January 1978 letter from USAF/LG states,

> Inputs from all Major Commands involved in RIW are needed. The evaluation should address "cause and effect" relationships and draw significant conclusions from the Air Force test. Parameters must be developed to bring the RIW trial from an open-ended test to a meaningful conclusion. The evaluation results should be the foundation for establishing a corporate Air Force position on the merits of the RIW concept [10].

Problem Statement

RIW is currently under a trial program which is subject to an evaluation in FY 1982. A comprehensive plan

to evaluate the impact of the RIW concept on Air Force programs and bring the trial program to a conclusion has not been prepared. This highlights an immediate need for a list of criteria to measure effectiveness of the RIW concept. Identification of such criteria would provide a foundation for development of a master plan to evaluate the RIW concept in the Air Force.

Research Objective

The objective of this study is to formulate a set of criteria from among the current RIW programs that can be incorporated into an evaluation plan for the RIW concept.

Research Questions

1. What elements are affected by RIW in Air Force programs that use it?

2. Which of these elements are most important to evaluating the effect of RIW?

Scope

To limit this research effort, only the five programs involving major applications of RIW will be addressed in the data collection and analysis. The use of the RIW concept in the other programs was either not employed at the beginning of the contracting process, or RIW was applied to a contract and subsequently determined to be

inappropriate to the program (14). Therefore, the information on these programs is limited.

Furthermore, it is not the intent of this research effort to establish a complete evaluation plan for the RIW concept because that would take far more time and resources than this thesis term has available. This effort, then, will be limited to the identification of elements of the RIW concept upon which development of an evaluation and data collection plan can be based.

The intent of this research effort is to establish what progress has been made in the Air Force evaluation and what direction should be taken in the future. This chapter discusses the concept of RIW and its objectives followed by a development of the progress of the Air Force program established to evaluate the RIW concept.

Chapter II establishes the need and justification for an evaluation program. The problem is identified along with the limitations of this research effort.

Chapter III establishes the plan to collect and analyze the criteria of the RIW concept around which an evaluation plan can be developed.

Chapter IV contains analysis of the data collected. The thesis closes with a discussion of conclusions and recommendations in Chapter V.

CHAPTER III

RESEARCH METHOD

Overview

An important aspect of any research effort is the method employed by the researcher. This chapter describes in detail the specific procedure used in the research design including data acquisition and data analysis.

Preliminary research indicated that no common pool of knowledge about the separate applications of RIW exists (10). There was a need to identify, within the five programs, elements which were affected by RIW. To accomplish this, a method was needed to bring the experience of RIW within the five programs together to form a common pool of knowledge. A consensus of opinion was one method available to form this common pool of knowledge. A useful tool to develop successful group decisions when no one individual possesses all of the knowledge available is the Delphi Technique. This method of evaluating and tabulating independent opinions without group discussions was appropriate to develop the consensus needed for this research effort.

Delphi Method

A Business Horizons article describing the Delphi Technique, states, "Group decisions are necessary when the

scope of a problem is such that no individual has sufficient expertise and knowledge to effect a solution [1:51]."

It can be seen from Appendix D that, within each program, two different individuals are knowledgeable about RIW. Each of these individuals knows the concept as it applies to his particular program. Although an OPR, the WIC, has been established for data collection, there is no OPR in which one individual is aware of the impact of RIW on all five programs (14). For this reason, it appeared that a group decision was necessary. The Delphi Technique was first employed approximately twenty-five years ago with an Air Force sponsored program. The method was used to:

> . . . collect intuitive judgments of a group of experts in the subject area of interest with many unknowns. This technique was probably superior to rational extrapolations of known trend [4:20].

This research employed an identical procedure as was used with the first Delphi application except the subject matter of interest was RIW (see Appendix C).

Advantages and Characteristics

The Delphi method offered many advantages for this research effort.

1. It allowed experts from diverse backgrounds to make decisions. In this situation, the diverse backgrounds of the experts were considered to be their experience in the five different programs.

2. The interaction among experts was controlled by the researchers. Telephone interviews were used for data collection. The telephone interview followed by controlled feedback of interview results offered an excellent means of controlling interaction among respondents.

3. The experts were not identified to each other in any way. Geographical separation, coupled with interviewer control, offered the necessary anonymity.

4. The anonymity eliminated bias from each expert.

5. The halo effect and bandwagon effect were virtually eliminated. This was a direct result of the anonymity discussed in 3.

6. A consensus of opinion was formed by requiring justification for any significant deviation from the group average. Consensus was achieved through continuous screening and feedback of information from previous interviews (1:51-52).

Use of the telephone interview minimized problems which could have been induced by the geographical dispersion of panel experts. Use of the telephone interview also reduced the demands placed upon the respondents.

Procedure

The steps involved in the Delphi method can vary somewhat based on the application. The steps used here included the following:

1. Selection of panel experts.

2. Initial contact of panel experts.

3. Initial questionnaire/interview.

4. Follow-up questionnaires/interviews.

Selection of Panel Experts. The panel consisted of individuals whose judgments were being sought and who also agreed to participate in the project. The composition of a panel of experts is critical to the Delphi Technique effectiveness. Accordingly, four criteria were used in choosing the experts.

1. They were required to have a basic knowledge of the problem area and to be able to apply that knowledge.

2. A good performance record in the participant's particular area of expertise was required.

3. They had to have the time available to participate to the conclusion of the program.

4. All participants had to be willing to give the amount of time and effort to do a thorough job of participation (5:271).

During initial contact with the individuals it was determined how long the individuals had been working in their present capacity. It was assumed that two years in the position of program manager or contracting officer on any of the five programs would yield the experience necessary to consider the individuals knowledgeable of RIW and,

thereby, qualified under criterion 1, above. If the individuals had worked on the program two years in their present position, it was assumed that longevity and position qualified the respondents under criterion 2. Criteria 3 and 4 qualifications were established during the initial contact. Due to the knowledge and composition of the panel experts, there was homogeneity among the experts. Therefore the number of experts was limited to ten (5:273).

Contacting Panel Experts. The next step in the process was to contact the people who had been nominated during the selection process. The information that was conveyed to the experts included the purpose of the study, the primary question/problem to be analyzed, their role in reaching a solution, the importance of a concerted effort on their part to insure successful results, and the uniqueness of their abilities in the total effort (1:54).

The First Questionnaire/Interview. Appendix F contains the guide used to conduct the first interview. The primary consideration in structuring the first interview was to eliminate potential researcher bias obtained through the literature search. Balancing this consideration was the concern for allowing enough structure to the interview to stimulate the interviewee's thought processes on the subject. In other words, an interviewee's response to one very

general open-ended question might be unclear and incomplete while an interview structured around a list of specific criteria might result in a more meaningful response. Therefore, the interview was structured around a set of general elements of RIW which might lead to identifying specific criteria. Since this list of criteria might not be all-inclusive, an open-ended question was developed to gather additional elements which the interviewees believed to be important to their programs. The basic assumption was that a discussion centered around the list of general elements would stimulate more complete discussion and responses to the open-ended question.

Follow-up Questionnaires/Interviews. The second questionnaire was a compiled list of perceived criteria specified by the panelists. The respondents were provided the opportunity to apply a rank order scale to this list of criteria. A rank order scale was used because:

> . . . rank order scales have two convenient analytic advantages. One, the scales of individuals can easily be intercorrelated. Two, they partially escape response set and the tendency to agree with socially desirable items [13:505].

Using this scale each respondent was asked to rank each criteria according to his/her perception of its importance. For example, from the nominated list of criteria, the respondent was asked to rank the criteria from most

important (1) to least important (11). Since respondents answer each item, the rank order scale is more reliable than other scales which do not require responses for each item. It is also easy to use in stimulus-centered studies. If time and cost limitations require, rank order scales can be developed in an arbitrary manner (6:248-250).

Each expert ranked each nominated criterion on a scale from one to eleven. This scale was found to be quite common and used in similar situations (16:418-420). A composite of responses to the second questionnaire along with an explanation of any misconceptions on the part of any expert formed the basis for follow-on interviews.

The Delphi process requires a measure of central tendency. Central tendency was determined by the amount of agreement between rank ordered lists of criteria. The statistic used to measure agreement on this data was the Kendall's Tau. The Tau statistic is an indicator of the agreement that exists between two rank ordered lists (9:284-294). The Tau statistic was computed for each pairwise combination of rank-ordered lists. Each Tau value was then tested at the $\alpha = .05$ level of significance to determine which participants had reached a consensus regarding the rank ordering of the criteria.

Each successive round of the Delphi process consisted of tabulated results of the previous round. These

rounds allowed each respondent to compare his rankings with those of the other participants. Each participant was asked to reevaluate his rankings based upon the rankings of other participants.

The primary purpose of this information feedback is to produce more precise results and encourage opinion convergence (1:55). Although the number of questionnaires varies, it is usually conceded that at least three but less than seven are necessary for a reasonable consensus of opinion (5:272). See Appendix C for a schematic of the Delphi Technique.

Limitations

The crucial step in the entire process involves the selection of the panel of experts. The mechanics of the Delphi can be completely negated by poor panel selection and poor motivation (1:55). The motivation aspect can go through a filtering device (contacting the panel experts) which occurs prior to the first round. Any expert who does not seem interested in the project was eliminated as a potential panel member. This process of accepting or rejecting an expert was the sole decision of the researchers.

The aspect of poor panel selection is a more delicate area. It was assumed the participants involved with the current RIW program were experts because of their length of time involved with the program (at least two years). The

experts were also assumed to be qualified based on their position which allowed them access to vast amounts of information on the RIW program.

The length of time required for the analysis also presented a potential problem. This problem was alleviated by gathering the results of the questionnaires over the telephone in lieu of the results mailed to the researchers.

Source of Data

Population--The population consisted of all persons associated with RIW programs past and present.

Sample--The sample was drawn from existing RIW programs. The experts were drawn from contracting officers and program managers listed in Appendix D.

Operational Definition--The results of the final round of Delphi yielded the operational definition of the perceived opinions. The opinions were not considered operationalized until consensus was formulated.

Data Collection Plan and Analysis

As was previously mentioned, the method of gathering data was a combination of questionnaire and interview. The exact content of questions (proposed criteria) were determined by the responses of panel experts to the previous questionnaire(s). This established list of possible criteria (results from round one) were fed back to the

participants who were asked to rank each nominated criterion on a rank order scale. Upon receipt, the ratings were tabulated and analyzed using a Statistical Package for the Social Sciences (SPSS) subprogram, NONPAR CORR to compute Kendall's Tau statistic. For the purpose of this research effort, a level of significance of $\alpha = 0.05$ was used to interpret the results of this test. Based upon the analysis, a determination was made as to which, if any, pairs of respondents had reached a consensus. The subsequent rounds of questionnaires contained the tabulated ratings from the entire sample. The criteria which precluded a consensus required justification from the respondents. For example, it was anticipated that if one respondent ranked a criterion as extremely important, and another ranked the same criterion as extremely unimportant, each was to provide an explanation of any misconception. These explanations, coupled with the tabulated results of the previous round, were summarized and distributed in the succeeding rounds so that other participants could take exception to a stated position. The purpose of information feedback was to produce more precise responses and encourage opinion convergence (1:55).

CHAPTER IV

DATA COLLECTION AND ANALYSIS

This chapter summarizes and evaluates the data collected during each round of interviews. For each round of interviews, a short summary and evaluation is presented to relate the finding to the next round of interviews.

Round I

During initial data collection all panel experts were highly interested in their respective programs and expressed an earnest desire to participate.

The collection of data during round I was obtained by responses to the premailed interview questionnaire contained in Appendix E. As noted in Chapter III, there exists no common pool of knowledge about the five existing RIW programs. Therefore, the researchers, through their literature search, nominated eleven criteria that appeared to be common to current programs. The following is a list of the eleven criteria:

contractor competition

acquisition cost

equipment limitation

initial support cost

logistic support cost

reliability

maintainability

number of spares required

maintenance skill required

support manpower

equipment modification

During telephone interviews, each participant was asked to respond to the set of nominated criteria using the structured interview guide contained in Appendix F.

In Appendix G, individual responses to the questions in interview I are coded into a format of Y (yes), N (no), and U (undecided or don't know). Results of this round were used to narrow the criteria list to those evaluation criteria that were common to existing programs. The Delphi process dictates that if all (or a predetermined number of) participants fail to respond (or respond negatively) to any criterion, it should be eliminated from future consideration (1:54).

As shown in Appendix G, fewer than three interviewees responded with "yes" to four of the criteria initially nominated--logistical support cost, equipment limitation, initial support costs, and support manpower. Using the consensus principle of the Delphi method, these four

criteria were determined to be inappropriate for consideration in round II, and consequently, deleted from the list.

Results of this round were also used to supplement the list with additional criteria that were not included in the initial list. The accomplishment of this portion of the Delphi process was achieved through the use of an open-ended question (see Appendix F). The participants nominated the following list of criteria which they perceived to be important in accurately assessing the impact of RIW on existing programs: data collection, effect of RIW on the supply system, RIW contract clause, and equipment use rate.

Round I Analysis

The Delphi process is based upon the principle of using feedback from previous rounds to move toward a consensus in successive rounds (1:55). Therefore, the two types of anonymous feedback from round I (consensus on inapplicability of four criteria on the initial list and suggestion of four additional criteria) provided the foundation for constructing the list of criteria to be evaluated in round II:

acquisition cost

contractor competition

data collection

effect of RIW on the supply system

equipment modification

maintainability

maintenance skill required

number of spares required

reliability

RIW contract clause

use rate

Round II

The second round of interviews provided the participants their first opportunity to rank the RIW rating criteria. The eleven criteria ranked during this round were collected and compiled from the results of round I. Prior to contact via telephone, each interviewee received a copy of the interview II schedule as depicted in Appendix H.

Each participant was asked to consider the significance that each criterion would have in assessing the overall importance of RIW to his program. Using this perceived level of significance, the interviewee was asked to rate each criterion with "1" representing the most important and "11" representing the least important criterion.

During the telephone interview, each participant's responses were recorded. Upon completion of all telephone interviews for round II, the responses of all participants were tabulated as depicted in attachment I. This tabulation

provides a two variable matrix format of the interview results; the interviewee (number) identified along the horizontal axis and the RIW rating criteria identified along the vertical axis. The intersection of any combination of these two variables provides the ranking that one participant gave to a criterion.

Round II Analysis

As stated previously in the methodology, the Delphi process requires some measure of central tendency among the respondents as an indicator of progress toward consensus. One such measure of central tendency or agreement among two classifications is the Kendall Tau statistic (9:284-294). The Tau statistic was chosen over the Kendall Coefficient of Concordance--a test on K sets of rankings instead of two sets (9:301)--because a comparison of pairs of rankings allowed the identification of sources of non-consensus. If the Coefficient of Concordance were used, it would be possible to test only for the existence of consensus or non-consensus among the group as a whole. This test would not identify which participants disagreed in the case of non-concurrence. However, the comparison of pairs of rankings makes this type of information readily available.

The data required for this test are N pairs (in this case N = 11) of observations where each set is measured

on at least an ordinal scale. According to Gibbons, the ranking of data within each set serves this purpose (9:284).

The test statistic for this procedure is

$$\tau = \frac{S}{(1/2)N(N-1)}.$$

S is computed by comparing the number of pairs of rankings of a second respondent which are also arranged in their correct or natural order when they are sorted according to the natural order of the rankings of the first respondent. To compute S begin with the observation ranked 1 by the first respondent and count the number of ranks by the second respondent which are greater than the rank of that criterion by the second respondent. Once this has been done, the number of ranks below this observation which are smaller than its rank by the second respondent are subtracted from the first quantity. The sum of these remainders is equal to S. S is then divided by the maximum possible S which could have been obtained with that number of rankings had the two sets of rankings been in total agreement. This number can be expressed as (1/2)N(N-1) where N is the number of observations or cases--11 (15:290).

The SPSS subprogram NONPAR CORR was used to compute and test the significance of the Tau statistic for all possible pairs of comparisons of respondents' rankings (15:290-292).

Results of this computation are contained in Appendix L. The Tau statistic is the value contained in the top portion of the block while the corresponding level of significance of that statistical value is displayed in the lower portion of the block. For example, to find the outcome of comparing the ranking of interviewee 4 with interviewee 6, enter the table on the left at interviewee 4 and move across to the entry in the interviewee 6 column. The Tau value is found to be 0.6727 along with its corresponding level of significance of 0.002.

The closer Tau is to +1, the more the two sets of ranks are positively correlated. Since all of the Tau values in Appendix L are positive, all of the rankings are positively correlated.

The level of significance displayed in the lower portion of the block is based on the relative proximity of the Tau statistic to +1 or -1. The significance of Tau is determined by comparing it to a normal distribution with a standard deviation equal to

$$\left[\frac{4N + 10}{9N(N-1)}\right]^{1/2}$$

where N = 10 in this case (15:290).

The level of significance for each Tau value can be used to test the following hypotheses:

H: No association of the rankings exists.

A_+: The rankings are directly associated (9:289).

Larger values of Tau result in smaller levels of significance and a rejection of the null hypothesis. For example, if the association between the rankings of interviewees 4 and 6 is tested at the 95 percent confidence level, ($\alpha = .05$), reject the null if the actual level of significance is less than α. In other words, if the probability of rejecting the null hypothesis, when in fact no association exists, is found to be less than .05, the null hypothesis would be rejected, indicating that the rankings are directly related. Since the level of significance for the Tau correlation between interviewee 4 and 6 rankings (.002) is less than .05, it can be concluded, at the 95 percent confidence level, that the rankings of interviewees 4 and 6 are directly associated.

Performing this analysis on all of the correlations in Appendix L it was concluded (at the 95 percent level of confidence) that the rankings were all associated, with the exception of the following:

Interviewee	1	with interviewee	8
	2		4
	2		10
	3		5

Interviewee	3	with interviewee	7
	3		8
	3		10
	4		8
	5		8
	7		8
	8		9
	8		10

If a consensus had been reached in this round of the Delphi process, the null hypothesis would have been rejected for each comparison of rankings. Since this was not the case, the Delphi process was continued with a third round of interviews providing anonymous feedback from round II to the participants.

Round III

The third series of interviews provided feedback to the respondents. A letter and table of responses by all interviewees is depicted in Appendix I. This information was sent to each participant prior to telephone contact, thereby allowing the respondent to reconsider his/her ranking as compared to the rankings of the other anonymous respondents.

During this round, each respondent was asked to reconsider his/her ranking of any criterion which did not

seem to agree with the group. A response was requested in the form of an explanation of extreme positions or a change in the rank order made by the participant in round II.

The results were tabulated as depicted in Appendix K. The tabulated data is in the form of a two variable matrix in the same format as the tabulation for interview II.

Round III Analysis

The data in Appendix K was analyzed using the SPSS subprogram NONPAR CORR, as explained in the analysis section of round II (15:289-292). Results of this computation is contained in Appendix M and is in the same format as the analysis results for round II contained in Appendix L.

Following the analysis procedure for round II, the following set of hypotheses was tested using a significance level of 0.05:

H: No association of the rankings exists.

A_+: The rankings are directly associated (9:289).

Performing this analysis on all of the correlations contained in Appendix M, it was concluded (at the 95 percent level of confidence) that the rankings were all associated, with the exception of the following:

Interviewee	3	with interviewee	6
	3		10

Interviewee 4 with interviewee 5

4 10

Since the null hypothesis was not rejected in every case, it could not be concluded (in the strictest sense of the methodology) that a consensus had been reached.

Because of time constraints, a fourth round was not accomplished. However, from the data analysis accomplished to this point, it is significant to note the division of opinion at the end of round III.

Interviewees 1 through 5 are program manager's on the five programs sampled in this research, while interviewees 6 through 10 are contracting officers for those associated programs. With the exception of the comparison of the rankings of interviewees 4 and 5, the lack of consensus (failure to reject the null hypothesis) occurs in comparisons between program managers and contracting officers.

The level of significance of the Tau statistic between rankings of interviewee 4 and interviewee 5 for round III is 0.052. This level is only slightly higher than the selected alpha level of 0.05. Had the selected alpha level been only 0.002 higher, the null would have been rejected and it would have been concluded that a positive association exists in the round III rankings of interviewees 4 and 5.

The significance levels of the other three comparisons in which the null hypothesis was not rejected are all considerably higher than 0.05. Therefore, it can be concluded that the significant breakdown in consensus at the end of round III was due to differences in perception of the RIW concept that existed between contracting officers and program managers.

CHAPTER V

CONCLUSION

Summary

Gibbons suggests that when the null hypothesis of no association is rejected, it may be reasonable to conclude that there exists a consensus with regard to the ordering of the objects and that the observed results differ from a unique communal ranking only because of sampling variation (9:307). Although the null hypothesis was not rejected in all comparisons for the entire group, it was rejected for all comparisons of pairs within the subgroup of contracting officers and the subgroup of program managers. Therefore, it was concluded that there exists a consensus within the group of contracting officers and within the group of program managers regarding the ordering of the RIW rating criteria nominated in round I. It cannot be concluded, however, that a consensus exists within the entire group.

According to Gibbons, if it is concluded that a consensus exists within the group, then the ordering of ranks for the group is the same as the ordering of the sums of ranks assigned to the objects (criteria) (9:307). Since it was concluded that a consensus had been reached

within the subgroups (contracting officers and program managers) and ordering for each of these subgroups can be determined from the ranking results of round III. From Appendix K, the rankings for the two subgroups were:

Program Manager's Ranking	Contracting Officer's Ranking
1. Reliability	1. Reliability
2. Maintainability	2. Acquisition Cost
3. Acquisition Cost	3. Maintainability
4. Equipment Modification	4. Equipment Modification
5. RIW Contract Clause	5. Contractor Competition
6. Data Collection	6. Data Collection
7. Contractor Competition Use Rate (Tie)	7. RIW Contract Clause
	8. Use Rate
9. Effect of RIW on Supply System	9. Effect of RIW on Supply System
10. Maintenance Skill Required	10. Number of Spares Required
	11. Maintenance Skill Required
11. Number of Spares Required	

Between the two subgroups there exist differences in the ranking of several criteria. According to comments received from round III interviews, the following explanations were provided. RIW clause was perceived to be less important by contracting officers because "the loopholes in contracts prevent the program from working as designed and

make it difficult to determine the actual purpose of RIW." One contracting officer cited this explanation for his low ranking of RIW clause: "The author of the contract is provided guidelines from the System Project Office (SPO); sometimes these guidelines are not passed on to other members working in the contracting office. The result is simple--we as contractors don't operate with the same common body of information resulting in confusion of the intent of RIW."

The program managers provided the following explanation of their higher rating of RIW clause. "A RIW program is most effective when a MTBF guarantee is included in the contract. Our program has such a clause and it makes it easier to administer items that don't meet MTBF requirements.

Another criterion the two subgroups ranked differently was contractor competition. Contracting officers ranked the criterion as being more important. One contracting officer stated, ". . . must have basic contractor competition before even considering an RIW application. One of the basic guidelines for RIW is contractor competition--without it, the concept of an improved warranty will certainly fail." Conversely, a program manager remarked that "contractor competition has very little impact on assessing the effectiveness of RIW."

The preceding explanations account for some of the differences between program managers and contracting officers. These polarized positions indicate that the respondents feel strongly in their ranking of RIW clause and contractor competition.

The above analysis results and conclusions can now be related to the research objective--to determine a set of criteria from among the current RIW programs that can be incorporated into a plan for evaluating the RIW concept. During round I, eleven criteria were nominated and presented to the participants for their consideration. Based upon the analysis of round I results, four criteria were eliminated from the original list and four were added. Subsequent rounds did not result in any further additions or deletions to the list. The rank-ordered lists on page 34 contain the criteria which the participants, as a group, believe to be important to any plan for evaluation of the RIW concept. It is important to note, however, that this list is based solely on the perceptions of contracting officers and program managers within five system program offices.

The answer to research question 1--elements affected by RIW in Air Force programs that use it--consists of the list of criteria. Research question 2 is answered in the rank order placed on this list of criteria by the two

subgroups. It is important to note that complete agreement of the rankings was not established for the group as a whole. Only if the rank-ordered lists of each subgroup are considered separately can question 2 be addressed. Therefore, based upon the analysis, a consensus of opinion on research question 2 was not reached.

Recommended Research Areas

Opinions by the group of RIW experts sampled in this study raises questions regarding the effect that the individual's job has on his perception of important rating criteria for the RIW concept.

1. Since this research effort sampled only contracting officers and program managers, the population, as outlined in Chapter II, should be examined further. For example, contractors, design engineers, field maintenance personnel, etc., could be sampled to determine whether their perceptions are comparable to the contracting officers and program managers, and to each other.

2. As described in Chapter I, a need exists to establish a plan for data collection. Therefore, based on the evaluation criteria listed in the summary of this chapter, the feasibility of data collection for these evaluation criteria should be addressed.

APPENDICES

APPENDIX A

MAJOR AIR FORCE APPLICATIONS OF RIW (12)

Program	Contractor	Start Dt.	Warranty Period
ARN 118 TACAN	Collins Avionics Group, Rockwell International	Dec.75/ Apr.77	5 years
C-141/KC-135/C-5 Inertial Navigation System	Delco Electronics, General Motors Corp.	Mar.77	4 years
OMEGA Navigation Set	Dynell Electronics Corp.	Mar.77	5 years
F-16 Aircraft Components	General Dynamics	Jan.79	4 years or 300,000 flying hours (whichever comes first)
Flight Control Computer	Lear Siegler, Inc. (Sub.)		
Radar Antenna	Westinghouse (Sub.)		
Radar Low Power RF	Westinghouse (Sub.)		
Radar Digital Processor	Westinghouse (Sub.)		
Radar Computer	Westinghouse (Sub.)		
Heads Up Display Unit (HUD)	Marconi-Elliott (Sub.)		
Navigation Unit	Singer (Sub.)		
Radar Transmitter	Westinghouse (Sub.)		
HUD Electronics	Marconi Elliott (Sub.)		
C-141 Attitude Heading Reference System	Lear Siegler, Inc.	Oct.75	5 years

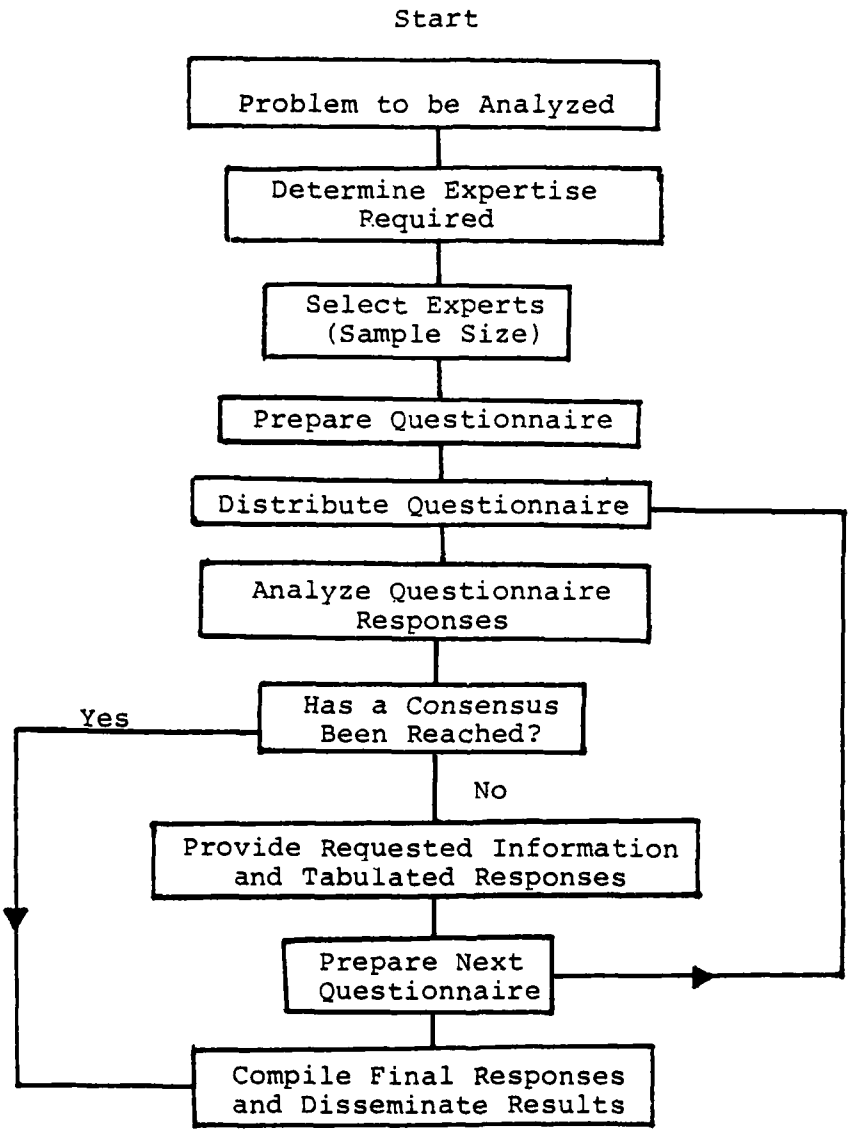
APPENDIX B

OTHER AIR FORCE APPLICATIONS OF RIW (12)

Program	Contractor
F-111 Displacement Gyro	Lear Siegler, Inc.
AV -8 C/A Airspeed Indicator	Bendix Corp.
C-130 Hydraulic Pump	Abex Corp.
Klystron Electron Tubes	Varian Associates

APPENDIX C

DELPHI TECHNIQUE (1:53)


Start
Problem to be Analyzed
Determine Expertise Required
Select Experts (Sample Size)
Prepare Questionnaire
Distribute Questionnaire
Analyze Questionnaire Responses
Has a Consensus Been Reached?
Yes
No
Provide Requested Information and Tabulated Responses
Prepare Next Questionnaire
Compile Final Responses and Disseminate Results

APPENDIX D

RESPONSIBILITY CENTERS FOR RIW (12)

System	Original Responsible Office	Current Responsibilities: Contracting Office	Current Responsibilities: Manager
TACAN Dec. 75/Apr. 77	ESD/OCN	WR-ALC/PM*	WR-ALC/MMIM*
AHRS Oct. 75	ASD/AEA	OC-ALC/PM*	OC-ALC/MMIM*
OMEGA Mar. 77	ASD/AEA	ASD/AEA*	WR-ALC/MMIM*
INS Mar. 77	WR/ALC/PM (Contract) UR-ALC/MME (RIW) OC-ALC/MMIM (Program Manager	WR-ALC/PM*	OC-ALC/MMIM*
F-16 Jan. 79	ASD/YPK (Contractor)* ASD/YPL (Program Manager)*		

* Those offices that comprise the research sample.

APPENDIX E

LETTER/INTERVIEW I

DEPARTMENT OF THE AIR FORCE

AIR FORCE INSTITUTE OF TECHNOLOGY (ATC)
WRIGHT PATTERSON AIR FORCE BASE, OHIO 45433

REPLY TO ATTN OF: LSY-1 (LSSR 63-80/Capt J. Bradney/Capt M. Perkins/ AUTOVON 785-6569)

SUBJECT: Reliability Improvement Warranty (RIW) Concept Interview

TO:

1. The attached interview plan was prepared by a research team at the Air Force Institute of Technology, Wright Patterson AFB, OH. The interview will be the first in a series of three or four. The series will be conducted using the Delphi Technique, a procedure designed to determine successful group decisions when the scope of the problem is such that no one individual possesses all of the knowledge and expertise to effect a solution.

2. The managerial position you hold within your program identifies you to be among the most knowledgeable on the Air Force experience with RIW. It is anticipated that your responses, coupled with the experience gained in other RIW applications, will shed new light on the impact RIWs have had in the Air Force.

3. Your responses in all interviews will be kept completely anonymous both within the group of interviewees, and in the report, and, of course, your participation is voluntary.

4. Capt Bradney or Capt Perkins will be contacting you by telephone in a few days. Your cooperation in providing this data will be greatly appreciated and very beneficial in advancing the documented knowledge about the impact of RIWs within the Air Force.

LESLIE J. ZAMBO, Major, USAF
Assistant Professor of Quantitative Methods
Thesis Advisor

1 Atch
Interview Plan

The purpose of this research is to determine what, if any, characteristics about Air Force RIW applications might be used to evaluate the overall effectiveness of RIW use within the Air Force.

The first interview will contain two parts. In the first part, you will be asked for some information on the following selected characteristics:

Contractor competition
Acquisition cost
Equipment limitation
Initial support cost
Logistics support cost
Reliability
Maintainability
Number of spares required
Maintenance skill required
Support manpower
Equipment modification

The following information will be requested about each of the characteristics listed above:

1. Do you feel that RIW has had a significant impact (good or bad) on this item?

2. Can you think of a standard (i.e., non-RIW application) to compare this impact with?

3. Is any information (data) related to this element being collected in your program?

The second part of the interview will ask you to identify any additional elements which you feel would be

important in assessing the impact of RIW on your program. In regard to these additional characteristics, the following two questions will be asked:

1. Can you think of a standard against which you could compare the impact of RIW on this item?

2. Is information related to this element being collected in your program?

APPENDIX F

INTERVIEW I GUIDE

As the letter you received a few days ago indicated, the purpose of this research is to determine what, if any, characteristics about Air Force RIW applications might be used to evaluate the overall effectiveness of RIW use within the Air Force. This is the first in a series of interviews to collect information about your program. Because of your experience with RIW, we anticipate that your responses will be extremely helpful in this research effort.

Today's interview contains two parts. In the first part, I will ask you for some information on the applicability of selected characteristics to your program. In the second part, I will ask you to identify any other characteristics which, in your experience, would be useful to assess the impact of RIW on your program.

The first characteristic is <u>contractor competition</u>.

1. Do you feel that RIW has had a significant impact (good or bad) on this item?

2. Can you think of a standard (i.e., non-RIW application) to compare this impact with?

3. Is any information (data) related to this element being collected in your program?

(Continue the interview by repeating the above three questions for each of the remaining items.)

Acquisition cost
Equipment limitation
Initial support cost
Logistics support cost
Reliability
Maintainability
Number of spares required
Maintenance skill required
Support manpower
Equipment modification

If you were asked to assess the impact of RIW in this program, are there additional elements which you would use in the assessment? (If the respondent replies with additional items, ask him for the following information about each one.)

1. Can you think of a standard against which you could compare the RIW impact on this item?

2. Is information related to this element being collected in your program?

This completes the interview. The information you have provided will be a great help in this research effort. It will be compiled with information gathered about other Air Force RIW applications to modify this preliminary list of criteria we have discussed today. I will contact you again in a few days to ask your opinion about this new list.

Once again, thank you for your patient participation.

APPENDIX G

INTERVIEW I RESULTS

Y - Yes N - No U - Undecided or Don't Know

Interviewee	1	2	3	4	5	6	7	8	9	10
Contractor Competition										
Sig. Impact	Y	N	Y	N	Y	Y	Y	Y	N	Y
Standard	Y	N	Y	N	Y	Y	Y	Y	N	N
Data	Y	N	Y	N	Y	Y	Y	Y	N	N
Acg. Cost										
Sig. Impact	U	Y	Y	Y	U	Y	N	N	Y	Y
Standard	Y	Y	Y	Y	Y	Y	N	N	Y	N
Data	Y	Y	Y	Y	U	U	N	N	Y	Y
Equip. Lim.										
Sig. Impact	N	U	Y	U	U	N	N	Y	U	N
Standard	N	U	Y	U	Y	N	N	Y	Y	N
Data	N	U	Y	U	Y	N	N	Y	Y	N
Init. Spt. Cost										
Sig. Impact	N	N	Y	Y	N	N	N	N	N	U
Standard	N	N	U	Y	N	N	N	N	N	U
Data	N	N	U	Y	N	N	N	N	N	U
Log. Spt. Cost										
Sig. Impact	N	N	N	U	N	N	N	N	Y	N
Standard	N	N	N	U	N	N	N	N	Y	N
Data	N	N	N	U	N	N	N	N	Y	N
Reliability										
Sig. Impact	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Standard	N	Y	U	Y	Y	N	Y	Y	Y	Y
Data	N	Y	Y	Y	Y	N	Y	Y	Y	Y
Maintainability										
Sig. Impact	N	U	Y	Y	Y	Y	Y	Y	Y	Y
Standard	N	U	U	Y	Y	N	Y	Y	Y	Y
Data	N	U	Y	U	Y	N	Y	Y	Y	Y
No. Spares Required										
Sig. Impact	N	U	U	Y	Y	N	N	U	Y	Y
Standard	N	U	U	Y	Y	N	N	Y	Y	Y
Data	N	U	U	Y	Y	N	N	Y	U	Y
Maintenance Skill Req.										
Sig. Impact	N	N	N	Y	Y	N	N	N	Y	Y
Standard	N	N	N	Y	Y	N	N	N	U	Y
Data	N	N	N	Y	Y	N	N	N	Y	Y

Y - Yes N - No U - Undecided or Don't Know

Interviewee	1	2	3	4	5	6	7	8	9	10
Support Manpower										
Sig. Impact	N	N	N	U	N	N	N	N	U	Y
Standard	N	N	N	U	N	N	N	N	U	Y
Data	N	N	N	U	N	N	N	N	U	Y
Equipment Modification										
Sig. Impact	Y	Y	Y	Y	U	Y	Y	Y	Y	N
Standard	N	Y	U	Y	Y	Y	N	Y	Y	N
Data	Y	U	Y	Y	Y	U	N	Y	Y	N

APPENDIX H

LETTER/INTERVIEW II

DEPARTMENT OF THE AIR FORCE
AIR FORCE INSTITUTE OF TECHNOLOGY (ATC)
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

REPLY TO ATTN OF: LSY-1 (LSSR 63-80/Capt J. Bradney/Capt M. Perkins/ AUTOVON 785-6569)

SUBJECT: Reliability Improvement Warranty (RIW) Concept Interview II

TO:

1. The purpose of this portion of the survey is to determine current attitudes toward criteria (that you have identified) that may be incorporated into an evaluation plan of RIW. The results of this survey will be written up into a formal research paper in partial fulfillment of the requirements for a Master of Science Degree. Your support and effort will be greatly appreciated.

2. The enclosed survey should require only several minutes to complete. Results of this survey may provide guidance in a formal evaluation of RIW.

3. The survey is designed to test opinions of those persons who have dealt with RIWs. All individuals participating are either contracting officers or corporate project managers for an item(s) under RIW.

4. Your responses to the survey will be requested by telephone in a few days after your receipt of this letter.

5. Names of individuals participating will be anonymous to one another and will not be cited in the research report. The information you have provided will be of great assistance in this research effort. Thank you for your cooperation and time.

LESLIE J. ZAMBO, Major, USAF
Assistant Professor of Quantitative Methods
Thesis Advisor

1 Atch
Interview Plan

During interview I, you were asked to identify RIW characteristics applicable to your program. Based on your responses and those of other representatives of programs that employ RIW, the following alphabetized list of characteristics has been compiled. This list consists of characteristics which might be used to evaluate the overall effectiveness of RIW within the Air Force.

If you were in a position to assess the overall effectiveness of RIW in your program, how would you rank each of the characteristics below? Please rank the following characteristics in order (1 through 11) beginning with the best characteristic as "1". If any characteristic is not applicable to your program, write "NA" in the space provided. Please include any comments you feel are necessary for clarification.

_____ Acquisition cost
Comment:

_____ Contractor competition
Comment:

_____ Data collection (the need for a standard set of data to perform analysis of equipment under an RIW)
Comment:

_____ Effect of RIW on supply system (Since most RIW items are returned to the contractor for repair, does this impact the supply system?)
Comment:

_____ Equipment modification (improvements from engineering change proposals)
Comment:

_____ Maintainability
Comment:

_____ Maintenance skill required (impact of the RIW clause on maintenance handling procedures of failed RIW items)
Comment:

_____ Number of spares required (consignment)
Comment:

_____ Reliability
Comment:

_____ RIW contract clause (Do "loopholes" in the RIW clause prevent the warranty from accomplishing its purpose?)
Comment:

_____ Use rate (This characteristic refers to the impact equipment usage--i.e., reduced flying hours due to fuel costs--has on the effectiveness of RIW.)
Comment:

APPENDIX I

INTERVIEW II RESULTS

	RIW Rating Criteria										
Interviewee	Acquisition Cost	Contractor Comp.	Data Collection	Effect on Supply System	Equipment Mod.	Maintain-ability	Maintenance Skill	Number of Spares	Reliability	RIW Clause	Use Rate
1	4	5	6	10	3	2	7	9	1	11	8
2	2	11	4	10	5	3	9	7	1	6	8
3	3	10	11	7	5	1	6	4	2	9	8
4	3	4	9	8	5	1	6	10	2	11	7
5	1	6	7	8	4	3	5	9	2	11	10
6	1	3	8	9	5	4	11	6	2	10	7
7	3	6	7	9	5	2	11	10	1	8	4
8	1	11	6	8	5	4	7	9	3	2	10
9	2	7	8	9	4	3	11	6	1	10	5
10	2	1	6	8	5	4	7	11	3	10	9

APPENDIX J

LETTER FOR INTERVIEW III

DEPARTMENT OF THE AIR FORCE
AIR FORCE INSTITUTE OF TECHNOLOGY (ATC)
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

REPLY TO ATTN OF: LSY-1 (LSSR 63-80/Capt J. Bradney/Capt M. Perkins/ AUTOVON 785-6569)

SUBJECT: Reliability Improvement Warranty (RIW) Concept Interview III

TO:

1. During interview II, you were asked to rank an alphabetized list of characteristics common to existing RIW programs. The results of interview II are provided in the following attachment. Your responses are identified by a red circle around the appropriate interviewee number (i.e. if you were interviewee 4, there appears a red circle around "4" and your results are in column 4).

2. At this time, you are requested to reevaluate your current ranking of the characteristics based upon the opinions provided by the other interviewees. The purpose of this information feedback is to provide you with new data, in the form of other expert opinions, to determine if extreme positions are properly identified. For example, if the characteristic, RIW contract clause is ranked 6, 7, 8, or 9 by other experts and your perception was that the RIW contract clause was extremely important, and your subsequent ranking resulted in 1 or 2 then either provide reason for your extreme position or rerank this characteric, whichever is appropriate.

LESLIE J. ZAMBO, Major, USAF
Assistant Professor of Quantitative Methods
Thesis Advisor

2 Attachments
1. Interview II results
2. Interview III plan

APPENDIX K

RESULTS OF ROUND III

Interviewee	Acquisition Cost	Contractor Comp.	Data Collection	Effect on Supply System	Equipment Mod.	Maintain-ability	Maintenance Skill	Number of Spares	Reliability	RIW Clause	Use Rate
1	4	6	5	9	3	2	11	10	1	7	8
2	3	8	6	10	4	2	11	9	1	5	7
3	3	9	10	8	4	1	7	11	2	6	5
4	3	7	6	8	4	1	9	10	2	11	5
5	1	6	7	9	5	3	8	10	2	4	11
6	2	6	4	8	5	3	9	7	1	10	11
7	2	6	5	9	4	3	10	11	1	8	7
8	1	9	7	8	5	2	11	10	3	4	6
9	2	7	8	10	5	3	9	11	1	4	6
10	3	1	7	9	5	4	10	8	2	6	11

APPENDIX L

KENDALL CORRELATION TEST RESULTS FOR ROUND II

INTER-VIEWEE	2	3	4	5	6	7	8	9	10
1	.4182 / .037	.4182 / .037	.7455 / .001	.7091 / .002	.5636 / .008	.6 / .06	.2727 / .122	.6364 / .004	.6364 / .004
2		.4182 / .037	.2364 / .156	.4182 / .037	.4182 / .037	.5273 / .012	.6364 / .004	.5636 / .008	.2727 / .122
3			.5273 / .012	.4909 / .018	.3455 / .07	.3091 / .093	.3455 / .070	.4909 / .018	.2 / .196
4				.6727 / .022	.5273 / .012	.5636 / .008	.1636 / .242	.5273 / .012	.6 / .006
5					.5636 / .008	.4545 / .026	.4909 / .018	.4909 / .018	.7091 / .002
6						.6 / .006	.2 / .196	.7818 / .001	.5636 / .008
7							.3091 / .093	.7455 / .001	.4545 / .026
8								.2727 / .122	.3455 / .07
9									.4182 / .037

APPENDIX M

KENDALL CORRELATION TEST RESULTS
FOR ROUND III

INTER-VIEWEE	2	3	4	5	6	7	8	9	10
1	.8182 / .001	.4909 / .018	.6727 / .002	.5636 / .008	.6364 / .004	.8545 / .001	.6364 / .004	.6364 / .004	.5636 / .008
2		.6 / .006	.6364 / .004	.6 / .006	.6 / .006	.7455 / .001	.7455 / .001	.7455 / .001	.6 / .006
3			.6 / .006	.4909 / .018	.2 / .196	.5636 / .008	.6364 / .004	.7091 / .002	.2727 / .122
4				.3818 / .052	.6 / .006	.7455 / .001	.6 / .006	.6 / .006	.3091 / .093
5					.5636 / .008	.6364 / .004	.6364 / .004	.7818 / .001	.6364 / .004
6						.6364 / .004	.4182 / .037	.4182 / .037	.6364 / .004
7							.6364 / .004	.7091 / .002	.5636 / .008
8								.7818 / .001	.4182 / .037
9									.4909 / .018

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