(Accepted for publication in *The International Journal of Aviation Psychology*, 2003)

THE STRUCTURE OF TRUST AND PROFESSIONALISM

Toward Measuring Safety Culture In Aviation Maintenance: The Structure of Trust and Professionalism

James C. Taylor, Ph.D. and Robert L. Thomas, III, Ph.D.

Santa Clara University

ABSTRACT

A revised version of the Maintenance Resource Management Technical Operations Questionnaire (MRM/TOQ), which includes measures of interpersonal trust and professional attitudes, is introduced. Factor Analyses of responses from five different samples reveal comparable factor structure. The reliability and validity of resulting Likert-type scales are tested and reported. Implications for the measurement of maintenance attitudes and opinions are discussed. It is argued that the use of MRM/TOQ will benefit both special training programs and efforts to establish attitude-performance linkages in aviation ground operations.

INTRODUCTION

The past decade has seen a dramatic increase in aviation maintenance safety programs incorporating principles of human factors and organization psychology (Taylor, 2000a). These programs are intended to influence the attitudes and behaviors of aircraft mechanics (following current US practice, hereafter called Aviation Maintenance Technicians, or AMTs). Additionally these programs have also targeted those people in support of AMTs, including their supervisors and managers as well as other related occupations and professions.

Evidence is growing that AMT professionalism and trust are key to building aviation organizations with excellent safety records. Persistent awareness of professional responsibilities is a necessary condition for maintenance safety and this element has been shown repeatedly to be a key factor in safety and human factors training (Taylor & Patankar, 2001). The professional AMT has been defined as embodying the joint characteristics of competence, control, and commitment regarding safety of flight (Taylor & Christensen, 1998, p. 83). AMT professionalism is manifest in the exercise of these characteristics; together with a willingness to take responsibility for one's own behavior, to make judgments based on reliable data, and to assertively encourage this responsibility in others involved in flight safety. This professionalism in itself is not sufficient to improve open communication and to cause widespread improvement in safety culture.

We believe that trust is also required for effective communication of safety culture. Mutual trust – i.e., trust that others will also act in the interest of safety -- among AMTs and other ground support personnel cannot be taken for granted and must be consciously supported and encouraged. This is true not only because of the historically solo nature of the AMT's occupation, but also because aviation is a multinational business, and

attitudes toward open communication and willingness to communicate have been shown to differ among national cultures (Helmreich & Merritt, 1998; Taylor & Patankar, 1999). Many airlines are trying to improve their safety culture by emphasizing communication and professionalism, together with awareness of decision-making, employee participation, and effective safety systems. Many of these programs are stymied by a low level of trust -- especially between AMTs and their managers, which results in AMT cynicism (or at least skepticism) that positive results will be achieved (Taylor & Patankar, 2001). To fully understand the concept of safety culture, significant research needs to be directed toward developing the concepts and measurements of trust and professionalism.

Interpersonal Trust as Concept and Measure

The Concept

Investigators have confirmed that the concept of trust is bipolar (includes distrust and trust) and that trust is a generic concept that includes interpersonal trust as well as trust of technology (Jian, Bisantz & Drury, 1998). In understanding the dynamics of trust in organizations, one can variously focus on the macro level or micro-level of theory and analysis (Kramer & Tyler, 1996). From the macro level, investigators answer questions about how trust is related to organizational dynamics or management. Examples of such questions are whether trust in an industry or company has declined or whether trust can be rebuilt. We are interested in macro-level trust as an indicator of organizational readiness for human factors training and safety reporting programs.

The micro-level perspective of trust considers the psychology of the individual -- why people trust, and what aspects most influence individual trust. From this micro-level, investigators posit that trust facilitates truthful communication, and leads to collaboration (Mishra, 1996). We are

interested in this micro aspect to the degree variables like individual's age and experience can influence trust.

The Measure

Questionnaire scales developed during the 1960's and 1970's measure micro-level trust as an attitude, or affective state (being trustworthy is important), or as an opinion or evaluation (this person is trustworthy). Reported scales are found to rate high in construct validity, and reliability usually using samples of undergraduate students. In use they emphasize the belief of trustworthiness (the degree to which others are seen as moral, honest and reliable) (Wrightsman, 1974). In the present study both measures for trust (attitudes and opinions) are considered and at both the micro and macro levels. Our purpose is to examine how the measures of levels of trust match the characteristics and conditions of the airline maintenance industry.

METHOD

Subjects

During 1999-2000, 3,150 employees in five aviation maintenance organizations completed questionnaires measuring their attitudes and opinions about safety, communication, goal attainment, stress management and trust. The respondents come from samples that bracket the range of organizations and job types in the commercial aviation maintenance industry. This population included employees from maintenance departments in major airlines, maintenance departments in small airlines as well as employees of commercial aviation repair stations.

The five samples in this population each represent a US-based aviation maintenance company or a separate group (i.e., maintenance department) within an airline company. Respondents in each sample include AMTs, maintenance managers, and maintenance support personnel. All can be considered naïve subjects in so far as they completed our survey before they were exposed to organizational change programs intended to influence their attitudes or

opinions. Following are brief descriptions of the size and nature of each of the five samples used.

Subject Samples

Sample A (n = 119) is a 10% stratified random sample from the maintenance department of a large passenger airline who received the survey by company mail with a cover letter from the head of maintenance. The participation (75% return rate) was quite high for this type of mail survey.

Sample B (n = 152) consists entirely of volunteers from the maintenance department of a large airline who elected to attend a company-sponsored Human Factors and Safety Training program. Sample B's surveys were administered before the training began. This sample contains a larger number of college-educated and female respondents, and is more heavily weighted toward management respondents than sample A.

Sample C (n = 2,574) respondents are maintenance department participants in another airline's Human Factors and Safety training. Sample C's surveys were also administered just before the training began. Company C's distribution of job titles is closer to Sample A for its proportion of hourly workers in the line and base maintenance operations and its proportion of middle management.

Sample D (N = 78) respondents are all the maintenance employees in a small regional airline. Like Sample A they received their surveys by company mail with management encouragement to complete it.

Sample E (n = 227) is from a large US-based aircraft repair station. Sample E's responses are from two data collection efforts. Over forty percent (n = 96) of data set E is comprised of a 10 % random sample of AMTs who participated in a mail survey. The other 131 respondents in the company E data set are the company's entire population of maintenance managers. The managers completed the same surveys as the AMTs, but did so immediately prior to receiving company endorsed Human Factors and Safety training.

Analysis of Variance (ANOVA) was used to test differences in background characteristics among the five samples. All samples differed significantly in age, $F(4, 3{,}137) = 29.2$, $p = .000$, years in present position, $F(4, 3{,}179) = 28.7$, $p < .001$, years in college, $F(4, 2{,}593) = 99$, $p < .001$, years in the military, $F(4, 2{,}671) = 79.5$, $p < .001$, years in trade school, $F(4, 2{,}497) = 137.5$, $p < .001$, and years with other airline, $F(4, 2{,}578) = 146$, $p < .001$. A chi-square test showed that the samples differed significantly in proportion of respondents who were managers, AMTs, cleaners, inspectors, clerks, and engineers, $?^2(20) = 339.18$, $p = .000$. Table 1 shows these descriptive statistics for each sample.

<Table 1 about here>

Measure

The Survey Measure: The Maintenance Resource Management Technical Operations Questionnaire (MRM/TOQ)

The MRM/TOQ developed for the present study is a further modification of a survey developed in 1991 (Taylor, 2000b). The MRM/TOQ questionnaire is a self-report measure of attitudes and opinions that are related (conceptually or empirically) to human factors and safety training in maintenance and maintenance support functions. Respondents are asked to express their degree of agreement in a series of statements. A five-point agreement scale is used.

The initial questionnaire in the present study begins with a core of 34 statements. Eight of them were new items introduced to the MRM/TOQ to examine interpersonal trust. Others were carried over from earlier versions of the MRM/TOQ, including eight items originally introduced in the Cockpit Management Attitudes Questionnaire (CMAQ) (Gregorich, Helmreich, & Wilhelm, 1990). The remaining 18 items were adapted or developed for use in the MRM/TOQ between 1991 and 1999. The 34 items were successively reduced to 27,

18 and finally 15 items through a series of Factor Analyses conducted with the five unique respondent samples described above. Table 2 lists the actual stems of all 34 items used.

<Table 2 about here>

Methodology for Combining Survey Items Into Constructs

Several previous studies report using Factor Analysis to explore and confirm the internal structure for the core questionnaire items of the CMAQ (Gregorich, Helmreich, & Wilhelm, 1990; Sherman, 1992) and the original MRM/TOQ (Choi, 1995; Taylor, 2000b). The purpose of those analyses was to provide greater reliability and simplify interpretation of survey results by combining individual item responses into a fewer number of multi-item scales. Those studies also sought to create a valid instrument to assess the degree of change and improvement achieved by the companies' safety and human factors programs. Like those predecessors the present study sought to use Factor Analysis (hereafter referred to as FA) to determine the smallest number of reliable measures for the revised survey of AMTs and others in aviation maintenance; but it also used FA to determine what new internal structure emerges when using new survey items on safety practice and interpersonal trust.

Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure were conducted for each sample to test the appropriateness of the data for Factor Analysis (Norusis, 1990, pp. 316-317). The KMO ranged from .672 to .840, and the Bartlett tests were significant ($p<.001$) in all cases. For each of the analyses for each of the samples a principal components analysis was run and initial factors were extracted based on Eigenvalues. From the scree plots obtained, the appropriate numbers of the factors were determined as specified by Norusis (1990). Initially both oblique (Quartimax) and

orthogonal (Varimax) rotations were tested; however, since the varimax solutions were uniformly more parsimonious than the quartimax the former technique was employed thereafter. In all cases the factor solutions offered good interpretability and simple structures.

RESULTS

Exploratory Factor Analysis

Progress occurred in several steps. A first exploratory FA was conducted using Sample A data. It used 34 items and resulted in 9 factors, together accounting for 66% of the variance, with the primary factor containing 8 items with loadings greater than .40. A second exploratory 34-item FA was duplicated in sample B. For sample B, this FA resulted in a larger structure of 10 factors, with a primary factor with 18 items loading above .40. Next, the 34 item exploratory analysis was repeated using two internal sub samples (maintenance stations in separate cities), from Sample B. Seven of the 18 items (numbers 25,29,30,31,32,33,34) of factor #1 were inconsistent in their loadings across the two sub-samples and were dropped from further analysis, which left 27 items to analyze.

A FA was then repeated with the 27 items for the total B sample in order to confirm the preceding exploratory FA results using 34 items in samples A and B. This 27-item FA extracted nine factors, which together accounted for 62% of the variance. The resulting structure of factors and item loadings after rotation are shown in Table 3. The first seven factors contain multiple items with loadings greater than .40. Only two of the 27 items have loadings this high or higher in two factors simultaneously. This 7-factor structure is interpretable and the factor labels are shown in Table 3. Factor I, Supervisor Trust and Safety, and factor II, Value Coworker Trust and Communication, echo the primary factors extracted in the 34 item FA computer for samples A and B. They are trust factors with different foci and

meaning from one another. Factor V, Conflict Avoidance, and Factor VI, Effects of Stress, closely correspond to factors derived from maintenance application of the earlier version of the MRM/TOQ (Taylor, 2000b). Both Factors V and VI are also substantially the same as factors derived from flight crew samples using the original CMAQ (Gregorich, Helmreich, & Wilhelm, 1990). Factors III, IV, and VII, although interpretable, are new to the 27 item FA. Factors VIII and IX contain only one item each and are thus not of significance to the present structure – except in their remoteness from its core.

<Table 3 about here>

The next step involved Factor Analysis for the 18 items common to all samples. The surveys collected from the three additional aviation maintenance samples (C, D, E) were available for further test. Each of these samples was missing one or more of the 27 items used in Samples A and B. In total, nine items from the original 27 were missing from at least one of samples C, D, or E. These nine items (numbers 2,10,12,15,17,19,25,26 and 27 in Table 2) had not been used either because the companies (being quite different from one another) requested they not be used, or the investigators felt some items were inappropriate for that application or sample. These final analyses to confirm Sample B results with the reduced set of 18 items were conducted in the three additional sites (C, D, and E) as well as the original two sites (A and B). The five samples were analyzed separately, but in a similar fashion.

Table 4 contains the factor loadings for the 18 items for all five samples. It shows that Varimax rotation resulted in 13 of the 18 items loading clearly and consistently into four scales over the five company samples. The item numbers used in Table 4 are the same as those used in Tables 2 and 3. Factor loadings above .50 for any sample were considered strong, and those above .40 were considered at least supportive to the factor

structure. Item or identifier consistency among the five samples was determined by at least four having a loading of .40 or greater.

<Table 4 about here>

Although there were differences in detail and minor differences in the structures among the solutions extracted using the separate company samples, the same four factors were derived for all five samples. Furthermore, two of these four factors reproduced the essence of the first two trust factors from the 27 item analysis -- Supervisor Trust and Safety and Value Coworker Trust and Communication -- as well as the Conflict Avoidance and Effects of Stress factors extracted from previous versions of the MRM/TOQ. This 18-item replication concluded the final development of factors derived in the present study.

Factor I: Supervisor trust and safety. As seen in Table 4, Factor I was consistently characterized by four items that suggested a trust of one's supervisor in regard to ethical behavior and safety practices involving their superior-subordinate relationship. They are "My supervisor can be trusted," "My safety ideas would be acted on if reported to my supervisor," "My supervisor protects confidential information," and "I know proper channels to report safety issues." Three other items (5, 6, and 14) are less consistent in their loading on this factor, but also expressed related assessment of vertical communication. One of these less consistent identifiers, "Mechanics ideas go up the line" (#6) had reasonably strong loadings for three of the five samples. It was decided to include the 'ideas up the line' with the four more clearly consistent identifiers/items into an index of five items for this scale. Theoretically, endorsement of the five items identifying this factor implies a favorable opinion toward a superior's trustworthiness in support of safety. The remaining two items (#5 and 14) were dropped from further deliberation.

Factor II: Value coworker trust & communication. Factor II indexes a belief in trusting one's coworkers in association with consistency in their words and deeds and their open communication in meetings and discussions. Agreement with the five items related to this factor suggests a high value for trusting coworkers in work-related discussions.

Factor III: Effects of my stress. Three items describing the effect of stress on one's performance identified factor III. Agreement with two of these items denoted imperviousness to stress, while the third was stated as a direct effect. This item, "Personal problems can affect my performance," was consistently and negatively loaded on Factor III in all five samples, while the other two items (20 and 22) had strong positive loadings for four of the five samples. Agreement with the first item and disagreement with the second and third one can be seen as congruent with professionalism, indicated by the stress management goal of many human factors and safety training programs in maintenance (ATA, 2001).

Factor IV: Conflict avoidance. Two items that suggested avoidance of interpersonal conflict represented factor IV. These items, "We should avoid disagreeing with others" and "It is important to avoid negative comments about other people's work," were each strongly loaded for four of the five samples. These items emerged, clustered together, in previous Factor Analyses (Choi, 1995; Taylor, 2000b); and a measurement scale derived from reversing the item values (called Value Assertiveness) has consistently shown positive relationships with subsequent safety outcomes (Taylor, Robertson & Choi, 1997; Taylor & Patankar, 2001). Disagreement with both items is interpreted as endorsing the professional goal of candor and openness in maintenance and safety-related communication (ATA, 2001). A third item (#21) shared less consistency than the others and was dropped from further consideration.

Creating Measures of Trust and Professionalism -- Scale Construction

In the present case, scales were created by averaging the raw scores of variables that consistently identified each factor across solutions. The scale from Factor I, labeled Supervisory Trust & Safety, was based on the average score of items 1,3,4, 6 and 7. The scale from Factor II, Value Coworker Trust & Communication was the average of scores for items 8,9,11, 13 and 24. Scales for factors III and IV were treated slightly differently. To facilitate discussion and scale interpretability, the scale for Factor III, Effects of My Stress, was constructed by summing the raw score of item 16 with the reflected (or reversed) scores of items 20 and 22 and dividing that total by three. This treatment is consistent with earlier manipulation of the original CMAQ (Gregorich, et al., 1990). The two items from Factor IV were combined into the scale called *Value* Assertiveness by reversing their raw scores before averaging. This is consistent with treatment of the same items in earlier versions of the MRM/TOQ (Taylor, 2000b).

Correlations among the developed scales were calculated for each sample to arrive at conclusions about the nature of the measures and the relationships among them. Given the orthogonal FA rotation solution used in the present study, we expected independence among the derived scales. We found a low, but remarkably consistent significant correlation (ranging between +.33 and +.39) across all five samples between Supervisor Trust & Safety and Value Coworker Trust & Communication. Despite this effort to retain independence, correlations between these two scales are perhaps explainable as evidence for a trust culture; in which employees who can trust their supervisors may also be more likely to value trust and communication with their coworkers. Evidence for relationships between stress and assertiveness scales and between them and the two trust scales was not found. Sample C yields a higher number of low magnitude, yet significant inter-

correlations, but these likely indicate the effect of type I error due to the substantially larger number of respondents in the company C sample.

Reliability of the MRM/TOQ Item and Index Measures

Cronbach's Coefficient Alpha was used to assess internal consistency of the scales. Alpha was calculated for all four scales for each sample used in the current study. Alpha coefficients for Supervisory Trust & Safety (a five-item scale) ranged from .72-.75 for the five samples, for Value Coworker Trust & Communication (five-item scale) ranged between .65-.77, for Effects of My Stress (3-item scale) are .43-.67, and Value Assertiveness (2-item scale) are .42-.62. Although the two trust scales are clearly more reliable than the stress and assertiveness measures, this is at least in part a consequence of the larger number of items that comprise the trust scales. In any event, reliability as assessed here is quite good for all measures.

Validity of the MRM/TOQ Index Measures

Macro-Level Analysis

Construct Validity

Construct validity can be defined as the ability of variables chosen by a researcher to represent a theoretical construct. Hatch (2000, p. 104) details the following among common methods of establishing construct validity: (a) conducting a factor analysis on scores from the new instrument and (b) showing that certain groups obtain higher mean scores on the new instrument than other groups, with the high- and low-scoring groups being determined on logical grounds prior to administration. Yet another approach to construct validation is highlighted by Gregory (1992, p.129): analysis to determine if intervention effects on test scores are theory-consistent. Each of these three techniques was employed in the validation of the present scales.

Factor analysis. As Stapleton (1997) asserts, factor analysis is a useful tool with which to evaluate score validity. Factor analysis can tell

us the extent to which our variables are measuring the same concepts. The implication is that when a large set of variables can load neatly into a few intended factors, evidence is granted that these variables are tapping the desired constructs. Hence, the factor analyses demonstrated here serve to establish construct validity for the MRM survey.

Organizational and occupational differences among the scales. A benefit for including the five separate samples in the current study is to examine the sensitivity of scale scores in distinguishing among aviation maintenance organizations. Investigators' prior knowledge of these samples also provides an opportunity to validate the measures based on grounded knowledge and observation about their respective histories and organizational contexts. The macro-level model of trust in organizations suggests that differences in organizations should be expected, given conditions allowing for differences in leadership climate and company culture. Table 5 shows the mean scores for each of the four index or scale measures among the five subject samples. Analysis of Variance (ANOVA) tests revealed significant differences among companies for two of the scales --Supervisory Trust & Safety, $F(4, 2{,}894) = 7.69$, $p = .000$, and Effects of My Stress, $F(4, 2{,}894) = 2.58$, $p = .036$).

<Table 5 about here>

Further, examination of interpersonal trust at the macro-level would also lead us to expect to see differences among the different occupations in aviation maintenance. Table 6 contains the mean scores for the maintenance and support occupations for the five samples.

<Table 6 about here>

Multivariate Analysis of Variance (MANOVA) was used to test the scale differences for the five companies and the six occupational categories. Three of the four scales reveal statistically significant differences among the maintenance occupations. They are Supervisory Trust & Safety, $F(5,$

2,894)= 8.55, *p*= .000, Value Coworker Trust & Communication, *F*(5, 2,894)=3.25, *p*=.006, and Effects of My Stress, *F*(5, 2,894)= 3.92, *p*= .002. Managers had the highest scores for all three of these scales and AMTs and Inspectors were among the lowest scores. The Value Assertiveness scale was the only scale not demonstrating significant differences among the occupational types or the companies.

The interaction between occupation and company for the Effects of My Stress scale was found to be significant, *F*(19, 2,894)=1.80, *p*=.018. This sole significant interaction effect reflects some modest differences on the stress scale among utility cleaners, engineers and inspectors between companies. The lack of interaction effects for any of the scales between the AMTs or managers and other occupational subgroups for the other three scales confirms that there are only minor differences among the relative ranks for the occupations over companies. This supports the assumption of validity for the scale scores for distinguishing AMTs and managers, two occupational groups which are of particular interest in the present study.

Interdepartmental differences among the scales. Next we tested the main differences for the four index measures between the two different maintenance departments -- Flight Line maintenance and Base Hangar maintenance -- across the five subject samples using a one-way Analysis of Variance (ANOVA) test. Only one of the four indices, Value Coworker Trust & Communication reveals statistically significant difference, *F*(1, 1,418)= 20.8; *p*= .000. Apparently the other three scales are not sensitive to the differences between the departments. Despite the fact that the Line maintenance mean score for Value of Coworker Trust & Communication is quite high (*M*= 4.38, *SD*=.62, *N*= 643), it is still significantly below that of Base maintenance (*M*= 4.52, *SD*= .51, *N*= 777). AMTs in the base hangars tend to be assigned to work together on complex jobs lasting as much as a week, while AMTs in flight line tend to be assigned to work alone on much shorter jobs.

These conditions may well engender greatest value for collaboration among the base-hangar AMTs and the lesser value for this attribute on the flight line.

Effect of training. Company C created a one-day human factors and safety training program, called Maintenance Resource Management (MRM) training, for all maintenance employees. The training curriculum includes modules on communication and teamwork, the effects of fatigue and pressure on stress and performance, and speaking up (assertiveness) for safety. Supervisors, managers and maintenance executives attended and participated in the program along with mechanics, inspectors, utility cleaners, and clerical employees. Previous field work had established that Co C's MRM program had succeeded in short term change, but had not sustained it due to a lack of management support (Taylor & Thomas, in press). Training participants in company C completed the MRM/TOQ immediately before their training (these pre-training surveys were used in the FA described earlier). Immediately after their training, company C participants completed a post-training survey and then completed the survey again several months later (phase two, or two-month follow-up surveys). The three attitude or belief scales (Value Coworker Trust, Effects of Stress, and Value Assertiveness) were expected to be sensitive to the effects of this training. The Supervisor Trust & Safety scale, representing respondent opinions of supervisory behavior, was expected to be more sensitive to changes in the leaders' subsequent behavior than the other three scales and to show this effect in the follow-up survey. A one-way ANOVA comparing the scale scores over the three surveys was calculated and those results showed significant changes for all four scales. Figure 1 shows the company C mean scores for the four scales before and after the training and again several months later.

<Figure 1 about here>

Figure 1 shows that the training was accompanied by an increase in scale scores, but for three of the four scales this rise is then followed by

decline two months later. ANOVA tests established statistical significance for the rise and fall of the Supervisor Trust, $F(2, 6{,}794) = 13.39$, $p = .000$, Valuing Coworker Trust, $F(2, 9{,}000) = 8.95$, $p = .000$, and Recognizing Stress Effects, $F(2, 7{,}010) = 134.41$, $p = .000$. Statistical significance of individual pairwise comparisons within each scale's value over time was determined using the Bonferroni post hoc test. The Bonferroni test is relatively conservative with regard to Type I error, and this was desirable in the present case due to the large sample size and number of comparisons. The post hoc test results of pairwise comparisons are presented in Table 7. The ANOVA for the fourth scale, Valuing Assertiveness, was also significant, $F(2, 6{,}845) = 89.12$, $p = .000$, and the mean score for that variable is seen to rise immediately after the training, and it is seen to further rise two months later (*cf.,* Figure 1). As Table 7 shows, the post-hoc tests for Valuing Assertiveness reveal that the rise over time is significant only between the survey two months after training compared with the pre-training level, *SE* = .029, $p = .000$, *Lower Bound* = .053, *Upper Bound* = *.1909.* This increase in assertiveness in the period following MRM training has been noted in previous studies (Taylor & Patankar, 2001).

<Table 7 about here>

Item Analysis

Obtaining index scores on a scale of measured intervals has important practical value for applied problems. Attitude surveys normally result in nominal or partly ordered scales, which are substantially weaker than ordinal or ordered-metric scales in their ability to describe respondent samples or be used with more stringent statistical tests and large samples. Scaling is used to overcome the problems of weak scale strength due to unsystematic combination of items or the use of single items as scales.

There are various scaling techniques to generate more robust and reliable scales approaching ordinal or even ordered-metric strength. The Likert-type scaling method is one of these and is fairly simple to construct, although certain conditions and steps must be satisfied. Likert-type scales provide improvement over individual survey or test items as well as scales simply combined by intercorrelation (Selltiz, Wrightsman, & Cook, 1976). An essential component of Likert-type scale is that component items should correlate highly with total scores on the entire scale (Selltiz, et al., 1976, pp. 418-421). Also, items should show substantial disparity between those who score high and those who score low on the scale. The combination of FA helping to distinguish which items are identified most clearly with a common construct (Table 3), and the Alpha correlations also described earlier, which confirm the internal consistency of the scales comprising that construct, provides evidence that further testing the requirements of the Likert-type scale could be satisfied for the four scales described in the present paper. To address these requirements, item analysis was conducted for each item used in construction of the four scales generated through factor analysis. This was accomplished by conducting t-tests of item mean scores between the highest and lowest quartiles for each scale. An effective test item is one that discriminates between high scorers and low scorers on the entire test or scale (Gregory, 1992, p.149). Robust differences between the highest and lowest quartiles serve as evidence that a particular item is adequately discriminating between low and high groups on the scale construct to which it is associated. Table 8 shows the Item Analysis.

Results shown in Table 8 indicate that most of the items used in the present factor analysis and scale construction are able to discriminate well between the lowest and highest quartiles. Mean differences between the lowest and highest quartile for all items were significant at $p < .001$, and non-parametric comparisons confirmed these results.

<Table 8 about here>

Micro-Level Analysis

Demographic characteristics were shown to differ within the set of respondents in the present study. Some of these individual characteristics such as time with the company, time in job or education are occupationally sensitive. On the other hand, the age and gender variables can be considered more independent of the industry and thus can be used to test the sensitivity of the four scales -- and in particular the two trust scales -- to individual differences. Several main effects of age and gender on the four scales were evident using MANOVA. There were no significant interactions found between age and gender for any of the four scales.

Three scales showed significant differences between men and women. The differences in gender showed higher Supervisor Trust, $F(1, 2{,}905) = 9.58$, $p = .002$, and Value of Coworker Trust, $F(1, 2{,}905) = 4.86$, $p = .028$ for women than men; and for the Value of Assertiveness to be greater for men than women, $F(1, 2{,}905) = 7.07$, $p = .008$.

Three scales were significantly different for respondents of different ages as well. In the case of the Supervisor Trust scale, a significant curvilinear effect, $F(4, 2{,}905) = 4.13$, $p = .002$, was manifest where the level decreased with age until 45 years and then increased again. The age and Value of Assertiveness relationship was also found to be significant and curvilinear, $F(4, 2{,}905) = 3.51$, $p = .007$, with this attitude increasing with age until 45 when it decreased again. It has been suggested that this result may be as likely explained as a cultural cohort effect as it is the effect of age -- the core of the baby boom may be more assertive than those before and those after, no matter how old they get. A significant linear relationship was also seen for Effect of My Stress, $F(4, 2{,}905) = 2.74$, $p = .027$ where this appreciation increased from the youngest to the oldest category.

DISCUSSION AND SUMMARY

The Measures

Simplifying the Survey

The present factor-analytic approach provides a useful and parsimonious solution for a survey assessment of maintenance human factors training and its subsequent diffusion and implementation. The data support the reduction of 34 variables into 15, clustered into four stable factors. Of the 15 surviving variables, 10 of these items date back to the original 1986-1990 CMAQ (Gregorich, et al., 1990) and successor surveys, and five are newly-created items measuring interpersonal trust. The four factors are easily translated into four Likert-type scales.

The Scale Characteristics

The four measurement scales derived from the factors demonstrate good psychometric characteristics. The two trust scales exhibit reasonable independence from the professionalism scales across samples and show good reliabilities. Construct validity and among companies, departments, and individual differences were also demonstrated. Further, adequate item discrimination was established through item analysis.

The first scale, Supervisor Trust and Safety, incorporates a trust of one’s supervisor in regard to ethical behavior and safety practices involving their superior-subordinate relationship. Agreement with the five items identifying this scale implies a favorable opinion toward a superior’s trustworthiness in support of safety.

Value Coworker Trust & Communication, the second scale, expresses a high value for trusting one’s coworkers’ as well as communication in meetings and discussions. Between them, these first two scales support the expectation that aviation maintenance people find interpersonal trust to be a central concept in human factors.

The third scale, Effects of My Stress, emphasizes the consideration of stressors at work and the possibility of compensating for them. Though not related to the theme of human communication or interpersonal relations, this factor proves to be an important concept for maintenance professionalism and is central to the curriculum of most human factors training programs.

Value Assertiveness, the fourth scale, emphasizes the goal of candor and openness in maintenance and safety-related communication. Openness and honesty are also important to maintenance personnel and are a focus of many human factors programs.

Both the third and fourth scales reflect professionalism in the maintenance occupation. Stress management shows professional awareness by granting importance to conditions that may degrade decision-making. Likewise, being willing to speak candidly can show a professional concern for safety and quality.

Applying the New Questionnaire

How can, and should, this instrument be used in the aviation industry? In part, it can help measure a cultural readiness of an organization for the implementation of human factors training and safety reporting programs. Organizations where lateral and vertical trust are low, and where conflict is avoided will likely be unsuccessful in either training or self-reporting programs without an intensive additional effort. If initial surveys show that trust is low and assertiveness unpopular, intensive program planning and implementation should be undertaken. Once that effort is completed, the same questionnaire can be used again to measure the magnitude of improvement in trust and professional behavior.

The application of this new version of the MRM Technical Operations questionnaire can be enhanced in several ways. As more data on trust and professionalism are collected, the opportunity to compare even small samples

against an accumulated industry benchmark increases. As more longitudinal measures are made within the same organization, greater opportunity to compare that organization's later (post intervention) effect with its previous measurements is the result.

Summary and Conclusion

A number of new and old survey questions administered to airline maintenance personnel at five qualitatively different companies and sites were factor analyzed and reduced to a valid and reliable set of scales that measure trust, assertiveness and stress management. Item reduction was determined by the strength of the loadings and the availability of item data from each sample. An impetus for including 5 distinct samples in the current study was to examine the stability in factor structure across differing organizational environments within the same industry.

Training effects on the scales were examined. These results -- as well as comparisons among the companies; between departments, among job titles, and among differences in demographic data across the companies -- show the scales to be good measures that are accurately conveying information about their intended constructs. Additionally good strength as Likert-type scales is indicated by an item analysis, which showed ability of constituent items to discriminate quite well between high and low groups for each scale.

This study shows that maintenance safety culture (although also influenced by national, organizational and occupational cultures), can be organized and studied in terms of two fundamental parameters: professionalism and trust. These two parameters can now be measured using 15 items. The final 15-item survey is included as the Appendix.

REFERENCES

ATA (U.S. Air Transport Association) (2001). *Spec 113: Maintenance Human Factors Program Guidelines.* Retrieved January 8, 2003, from http://www.airlines.org/public/publications/display1.asp?nid=938.

Choi, S. (1995). *The effects of a team training program and inferences for computer software development.* Unpublished doctoral dissertation, Los Angeles: University of Southern California.

Gregorich, S. E., Helmreich, R. L. & Wilhelm, J. A., (1990). The structure of cockpit management attitudes. *Journal of Applied Psychology*, 75, 682-690.

Gregory, R. J. (1992). *Psychological testing.* Boston: Allyn and Bacon.

Helmreich, R. L. & Merritt, A. C. (1998). *Culture at work in aviation and medicine*. Aldershot: Ashgate Publishing.

Huck, S. W. (2000). *Reading statistics and research: Third edition.* New York: Longman.

Jian, J., Bisantz, A. M. & Drury, C. G. (1998). Towards an empirically determined scale of trust in computerized systems: distinguishing concepts and types of trust. *Proceedings of the Human Factors and Ergonomics Society 42nd Annual Meeting,* Santa Monica: HFES, 501-505.

Kramer, R. M. & Tyler, T. R. (1996). Whither trust? In Kramer, R.M. & Tyler, T.R (eds.), *Trust in organizations*. Thousand Oaks: Sage Publications.

Mishra , A. K. (1996). Organizational responses to crisis: The centrality of trust. In Kramer, R.M. & Tyler, T.R (eds.), *Trust in organizations*. Thousand Oaks: Sage Publications.

Norusis, M. J., (1990). *SPSS base system user's guide*. Chicago: SPSS.

Seltiz, C.; Wrightsman, L. S. & Cook, S.W. (1976). *Research methods in social relations 3rd edition*. New York: Holt, Rinehart and Winston.

Sherman, P. J. (1992). New directions of crm training. *Proceedings of the Human Factors Society 36 Annual Meeting,* 896.

Stapleton, C. D. (1997). *Basic concepts in exploratory factor analysis (EFA) as a tool to evaluate score validity: A right-brained approach.* Retrieved January 8, 2003, from http://ericae.net/ft/tamu/efa.htm.

Taylor, J. C.(2000a). The evolution and effectiveness of Maintenance Resource Management (MRM). *International Journal of Industrial Ergonomics*, 26 (2), 201-215.

Taylor, J. C. (2000b). Reliability and validity of the maintenance resource management, technical operations questionnaire (MRM/TOQ). *International Journal of Industrial Ergonomics*, 26 (2), 217-230.

Taylor, J. C. & Patankar, M.S. (1999). Cultural factors contributing to the success of macro human factors in aviation maintenance. *Proceedings of the tenth international symposium on aviation psychology.* Columbus: The Ohio State University.

Taylor, J. C. & Patankar, M. S., (2001) Four generations of maintenance resource management programs in the United States: An analysis of the past, present and future. *The Journal of Air Transportation World Wide,* 6(2), 3-32.

Taylor, J. C., Robertson, M.M. & Choi, S., (1997). Empirical results of maintenance resource management training for aviation maintenance technicians. In *Proceedings of the ninth international symposium on aviation psychology*. Columbus, Ohio: The Ohio State University, 1020-1025.

Taylor, J. C. & Thomas, R. L. (in press). Written communication practices as impacted by a maintenance resource management training intervention. *The Journal of Air Transportation.*

Wrightsman, L. S. (1974). *Assumptions about human nature: A social-psychological analysis*. Monterey: Brooks/Cole.

Appendix

New Maintenance Resource Management/Technical Operations Questionnaire (MRM/TOQ)

Maintenance management is interested in your comments regarding human factors and safety within the department. The success of this survey depends on your contribution, so it is important to answer as honestly and fairly as you can. All answers are confidential. There are no right or wrong answers. This survey is part of a NASA-sponsored study regarding maintenance safety throughout the USA. Additional comments are welcome throughout the survey. ***Completed surveys will be sent directly to Santa Clara University for analysis.***

I. BACKGROUND INFORMATION: Today's Date: ___/___/___

1. Job Title: _____
2. Years in Maintenance at this company: _____
3. City or Station:_____
4. Present Shift: _____
5. Gender Male Female
6. Year of birth:_____
7. Past Experience or Training: (# of years: fill in below)
   Military: _____ Trade School: _____ College: ____ Other Aviation: ____
   (Specify other company if "Other Aviation":_____)
8. Non-Contract Contract
9. Where do you work? Line Hangar QC Planning Shop Stores Engineering Appearance Other

II. TECHNICAL OPERATIONS ATTITUDE MEASUREMENT:

1	2	3	4	5
Strongly Disagree	Slightly Disagree	Neutral	Slightly Agree	Strongly Agree

Using the scale above, please circle the number that best describes your opinion.

1 2 3 4 5	(1)	My supervisor can be trusted.	1 2 3 4 5	(9)	Employees should make the effort to foster open, honest, and sincere communication.
1 2 3 4 5	(2)	My suggestions about safety would be acted on if I expressed them to my lead or supervisor.	1 2 3 4 5	(10)	Personal problems can adversely affect my performance.
1 2 3 4 5	(3)	My supervisor protects confidential or sensitive information	1 2 3 4 5	(11)	Maintenance personnel should avoid disagreeing with one another.
1 2 3 4 5	(4)	Mechanics' ideas are carried up the line.	1 2 3 4 5	(12)	Even when fatigued, I perform effectively during critical phases of work.
1 2 3 4 5	(5)	I know the proper channels to route questions regarding safety practices.	1 2 3 4 5	(13)	A truly professional team member can leave personal problems behind when working.
1 2 3 4 5	(6)	Having the trust and confidence of my coworkers is important.	1 2 3 4 5	(14)	It is important to avoid negative comments about the procedures and techniques of other team members.
1 2 3 4 5	(7)	A debriefing and critique of procedures and decisions after a significant task is completed is an important part of developing and maintaining effective crew coordination	1 2 3 4 5	(15)	My coworkers value consistency between words and actions.
1 2 3 4 5	(8)	Start of shift crew meetings are important for safety and for effective crew management			

AUTHOR NOTES

This research was funded through NASA Award #NCC2-1156 to Santa Clara University, as part of a cooperative research program between the Federal Aviation Administration Office of Aviation Medicine (FAA/AAM-240) and NASA Ames Research Center.

For correspondence regarding this report contact J.C. Taylor, Engineering School, Santa Clara University, 500 El Camino Real, Santa Clara, CA 95053-0590

Table 1

Descriptive Statistics for Each Sample

	Job Role Percentage for Each Sample					
	A	B	C	D	E	Chi-Square
N	119	152	2,574	78	227	
Management	12.9%	22.0%	13.3%	26.5%	57.0%	
Maintenance	66.9%	32.0%	54.3%	49.4%	16.6%	
Other Staff	20.2%	46.0%	32.4%	24.1%	26.5%	
						$?^2(20)= 339.18$, $p=.000$

	Demographic Means for Each Sample						
	A	B	C	D	E	*F*	*p*
Age	40.42	42.36	43.30	34.08	39.81	29.2	.000
Years in Present Position	6.33	7.88	13.28	2.25	6.79	28.7	.001
Years with Another Airline	4.93	4.70	2.15	2.28	5.83	146.0	.001
Years in Military	2.99	3.40	2.23	2.24	5.26	79.5	.001
Years in College	1.01	1.95	1.07	.88	.84	99.0	.001
Years in Trade School	1.05	.66	1.15	1.08	.81	137.5	.001

Table 2

34 Initial Survey Items

15 Retained Items	19 Discarded Items
1. My supervisor can be trusted.	2. Supervisor makes realistic promises & keeps them
3. My suggestions about safety would be acted on if I expressed them to my lead or supervisor.	5. We get feedback about our performance.
4. My supervisor protects confidential or sensitive information.	10. AMTs contribute to customer service.
6. Mechanics' ideas are carried up the line.	12. I am proud to work for this company.
7. I know the proper channels to route questions regarding safety practices.	14. Other groups share our goals.
8. Having the trust and confidence of my coworkers is important.	15. My coworkers can be trusted
9. A debriefing and critique of procedures and decisions after a significant task is completed is an important part of developing and maintaining effective crew coordination.	17. Mechanics in other departments can be trusted.
11. Start of shift crew meetings are important for safety and for effective crew management.	19. Management effectiveness results from technical competence.
13. Employees should make the effort to foster open, honest, and sincere communication.	21. Management should take control in an emergency.
16. Personal problems can adversely affect my performance.	25. We can question goals.
18. Maintenance personnel should avoid disagreeing with one another.	26. Always provide written and verbal turnover.
	27. My work impacts passenger safety and satisfaction.
	28. Leads won't compromise safety.
	29. Management can be trusted.
	30. Tech Ops has a positive reputation in this company.
	31. I am encouraged to report unsafe conditions.
	32. This company has the highest maintenance standards.

Table 2 (continued)

34 Initial Survey Items

15 Retained Items	19 Discarded Items
20. Even when fatigued, I perform effectively during critical phases of work.	33. AMTs are recognized for their contributions.
22. A truly professional team member can leave personal problems behind when working.	34. Supervisors won't compromise safety.
23. It is important to avoid negative comments about the procedures and techniques of other team members.	
24. My coworkers value consistency between words and actions.	

Table 3

Confirming FA Using 27 Items, Sample B

Item	Factor I	II	III	IV	V	VI	VII	VIII	IX
Factor I (Supervisor trust & safety)									
1. My supervisor can be trusted	.80								
2. Supervisor makes realistic promises and keeps them	.80								
3. Safety ideas would be acted on if reported to suprv.	.76								
4. My supervisor protects confidential information	.69								
5. We get feedback about the performance	.51								
6. AMTs ideas go up the line	.47								
7. I know proper channels to report safety issues	.45								.43
Factor II (Value coworker trust & communication)									
8. Having the trust of my coworkers is important		.75							
9. Debriefing after major task is important		.70							
10. AMTs contribute to customer service		.65							
11. Start of shift meetings are important		.59							
Factor III (Pride in company)									
12. Proud to work for this company			.76						
13. Others should make the effort for open communication			.65						
14. Other groups share our goals			.63						

Table 3 (continued)

Confirming FA Using 27 Items, Sample B

	Factor								
	I	II	III	IV	V	VI	VII	VIII	IX
Factor IV (Coworker personal trust)									
15. My coworkers can be trusted				.71					
16. Personal Problems can affect my performance				.66					
17. Mechanics in other departments can be trusted				.61					
Factor V (Conflict Avoidance)									
18. Should avoid disagreeing with others					.77				
19. Mgt effectiveness results from technical competence					.44				
Factor VI (Effects of my stress)									
20. Even when fatigued I perform effectively						.71			
21. Management should take control in emergency						.55			
22. Professionals can leave problems behind						.53			
Factor VII (Need to speak up)									
23. Important to avoid negative comments about other's work					.51		.59		
24. Coworkers value consistency between words and action							.58		
25. We can question goals							.55		
26. I should provide written & verbal turnovers								.83	
27. My work affects passenger safety & satisfaction									.84
Eigenvalues	5.34	2.00	1.81	1.55	1.41	1.32	1.23	1.09	1.02
Percent of variance	20.1	7.4	6.7	5.8	5.2	4.9	4.6	4.0	3.8

Table 4

Factor Loadings Using 18 Items For Each of 5 Companies

Items	Samples A	B	C	D	E
Factor 1 - Supervisor Trust & Safety					
Consistent Identifiers					
1. My supervisor can be trusted	.534	.778	.723	.830	.824
3. My safety ideas would be acted on if reported to suprv.	.729	.776	.728	.673	.653
4. My supervisor protects confidential information	.514	.748	.681	.503	.693
7. I know proper channels to report safety issues	.007	.512	.432	.476	.654
Inconsistent Identifiers					
6. Mechanics' ideas go up the line	.764	.593	.641	.059	.279
5. We get feedback about the performance	.791	.487	.685	.108	.325
14. Other groups share our goals	.270	.239	.515	.121	.006
Eigenvalue	3.967	3.716	4.051	2.038	3.819
Percent of Variance:	22.0%	20.6%	22.5%	11.323%	21.2%
Factor 2 - Value Coworker Trust & Communication					
Consistent Identifiers					
8. Having the trust of my coworkers is important	.810	.620	.699	.486	.648
9. Debriefing after major task is important	.003	.801	.692	.729	.665
11. Start of shift meetings are important	.161	.601	.628	.757	.655
13. Others should make the effort for open communication	.510	.208	.773	.748	.706
24. Coworkers value consistency between words and action	.697	.150	.733	.527	.431
Eigenvalue	2.278	1.74	2.057	1.602	1.885
Percent of Variance:	12.7%	9.7%	11.4%	8.9%	10.5%
Factor 3 - Effects of my Stress					
Consistent Identifiers					
16. Personal Problems can affect my performance	-.809	-.554	-.696	-.807	-.776
20. Even when fatigued I perform effectively	.742	.683	.664	.235	.599
22. As a professional I can leave problems behind	.719	.715	.645	.292	.753
Eigenvalue	1.366	1.336	1.203	1.506	1.392
Percent of Variance:	7.6%	7.4%	6.7%	8.4%	7.7%

Table 4

Factor Loadings Using 18 Items For Each of 5 Companies

Items	Samples A	B	C	D	E
Factor 4 – Conflict Avoidance					
Consistent Identifiers					
18. Should avoid disagreeing with others	.789	.664	.815	.870	.737
23. Important to avoid negative comments about other's work	.743	.617	.787	.396	.738
Inconsistent Identifiers					
21. Managers should take control in an emergency	.004	.569	.434	.006	.000
Eigenvalue:	1.030	1.302	1.517	1.167	1.160
Percent of Variance:	5.7%	7.2%	8.4%	6.5%	6.4%

Table 5

Index (Scale) Mean Scores by Company Sample

Index	Company	N	M	SD
I. Supervisor Trust & Safety	A	116	3.65	0.86
	B	129	3.93	0.75
	C	2408	3.41	0.84
	D	76	4.06	0.66
	E	209	4.01	0.75
	Total	2938	3.50	0.85
II. Value Coworker Trust & Communication	A	116	4.53	0.52
	B	129	4.50	0.47
	C	2408	4.44	0.59
	D	76	4.39	0.50
	E	209	4.62	0.42
	Total	2938	4.46	0.58
III. Effects of my Stress	A	116	2.66	1.06
	B	129	2.94	0.88
	C	2408	3.11	0.83
	D	76	2.72	0.79
	E	209	3.14	.0.93
	Total	2938	3.08	0.86
IV. Value Assertiveness (reflected)	A	116	2.95	1.13
	B	129	2.82	1.02
	C	2408	3.10	1.09
	D	76	2.86	0.93
	E	209	2.68	1.02
	Total	2938	3.05	1.09

Table 6

Index (Scale) Mean Scores by Occupational Group

Occupation	N	M	SD
I. Supervisor Trust and Safety			
Mechanics & Leads	1813	3.35	0.84
Inspectors	112	3.34	0.88
Management & Supervisors	290	4.18	0.63
Utility & Cleaners	160	3.48	0.82
Engineers	92	3.49	0.93
Clerks, Analysts, Planners	471	3.68	0.76
II. Value Coworker Trust and Communication			
Mechanics & Leads	1813	4.41	0.59
Inspectors	112	4.38	0.63
Management & Supervisors	290	4.70	0.44
Utility & Cleaners	160	4.40	0.65
Engineers	92	4.51	0.56
Clerks, Analysts, Planners	471	4.52	0.49
III. Effects of my Stress			
Mechanics & Leads	1813	3.06	0.86
Inspectors	112	3.21	0.83
Management & Supervisors	290	3.30	0.80
Utility & Cleaners	160	2.91	0.93
Engineers	92	3.15	0.76
Clerks, Analysts, Planners	471	3.05	0.85

Table 6 (continued)

Index (Scale) Mean Scores by Occupational Group

IV. Value Assertiveness (reflected)			
Mechanics & Leads	1813	3.12	1.07
Inspectors	112	3.26	1.04
Management & Supervisors	290	2.97	1.08
Utility & Cleaners	160	2.77	1.13
Engineers	92	3.07	0.94
Clerks, Analysts, Planners	471	2.90	1.12

Table 7

Bonferroni Multiple Comparisons Post Hoc Statistics for Company C Scale Change

Comparison	*Mean Difference*	*SE*	*p*	*Lower Bound*	*Upper Bound*
Trust Supervisor and Safety					
Pre vs. Post	.0745	.0241	.006	.0168	.1322
Pre vs. 2-Month	.0589	.0259	.069	-.0031	.1208
Post vs. 2-Month	.1334	.0261	.000	.0710	.1958
Value Coworker Trust and Communication					
Pre vs. Post	.1581	.0166	.000	.1182	.1979
Pre vs. 2-Month	.0709	.0179	.000	.0281	.1137
Post vs. 2-Month	.2290	.0180	.000	.1859	.2720
Effects of My Stress					
Pre vs. Post	.3767	.0230	.000	.3215	.4318
Pre vs. 2-Month	.1576	.0247	.000	.0984	.2169
Post vs. 2-Month	.2191	.0250	.000	.1591	.2790
Value Assertiveness					
Pre vs. Post	.0663	.0320	.115	-.0103	.1429
Pre vs. 2-Month	.1218	.0288	.000	.0528	.1909
Post vs. 2-Month	.0556	.0293	.174	-.0146	.1257

Table 8

Item Analysis: Mean Differences Between Lowest and Highest Quartiles for Each Item

SCALES & ITEMS	LOWEST QUARTILE	HIGHEST QUARTILE	MEAN DIFFERENCE *
Trust Supervisor and Safety			
My Supervisor can be trusted	1.94	4.60	-2.66
My supervisor protects confidential information	2.28	4.66	-2.38
My safety suggestions would be acted upon if I reported them	2.20	4.54	-2.35
AMTs ideas go up the line	1.87	3.97	-2.10
I know proper channels to report safety issues	3.42	4.76	-1.34
Value Coworker Trust and Communication			
Debriefing after a major task is important	3.50	5.00	-1.50
Start of shift meetings are important	3.51	5.00	-1.49
Having the trust and confidence of my coworkers is important	3.88	5.00	-1.12
My coworkers value consistency between words and actions	4.07	5.00	-.93
Employees should make the effort for open communication	4.11	5.00	-.89
Effects of My Stress			
I can leave personal problems behind (reflected)	1.67	4.13	-2.46
Even when fatigued, I perform effectively (reflected)	1.97	4.34	-2.37
Personal problems can affect my performance	3.52	4.77	-1.25

Table 8 (continued)

Item Analysis: Mean Differences Between Lowest and Highest Quartiles for Each Item

SCALES & ITEMS	LOWEST QUARTILE	HIGHEST QUARTILE	MEAN DIFFERENCE *
Assertiveness (reflected)			
Avoid disagreeing with others	1.40	4.78	-3.38
Avoid negative comments about others' work	1.68	4.82	-3.13

*All Mean Differences Significant at p<.001

Figure 1. Comparing Scales Before and After Training