AN ABSTRACT OF THE THESIS OF

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Title: Content of an Ethics Course for Nondestructive Testing and Welding Inspection Personnel.

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Dr. E. Wayne Courtney

This research evaluated the ethics competencies which were determined to be important to the curriculum of an ethics course for students studying Nondestructive Testing and Welding Inspection. Data were gathered from samples of American Society of Nondestructive Testing Nationally Certified Level III's (N = 268), American Welding Society Nationally Certified Welding Inspectors - CWI's (N = 212) and American Welding Society Nationally Certified Associate Welding Inspectors - CAWI's (N = 101) who are currently licensed by their respective societies.

The twenty-nine (29) item instrument utilized a six-point Likert type scale for the data collection. The scale, which was validated by consensus using a DELPHI panel procedure, utilized the Hoyt-Stunkard

method for assessing reliability. The computed reliability for the instrument was determined to be +0.970.

Analysis of variance tests were completed for each of the twenty-nine (29) competencies to ascertain differences between ASNT Level III's, AWS CWI's and AWS CAWI's samples. Factor analysis, using the R-mode, provided for the clustering of competencies and constituted the major analysis procedure for the study.

The results of the study indicated the presence of three (3) clusters of content which were considered necessary to curriculum inclusion in an ethics course for nondestructive testing and welding inspection. The identified clusters include: I. Ethical issues and personal integrity (18 competencies), II. Ethics and the legal aspects of inspection (8 competencies), and III. Ethical theory and professional conduct (4 competencies).

Overall competency means ranged from 3.929 to 5.594; significance tests showed only five (5) rejected hypotheses for the twenty-nine (29) primary competencies. Standard errors of the mean were found to be lower for the ASNT Level III's sample.

The results of the study present a valid pattern for the development of objectives which should be included in an ethics curriculum for nondestructive testing personnel and welding inspectors.

Content of an Ethics Course for Nondestructive Testing and Welding Inspection Personnel

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CHAPTER I

BACKGROUND AND RELATED LITERATURE

Introduction

The question of ethics has long been a subject of discussion in professional circles. In a society that is becoming increasingly litigation conscious and aware of breaches of ethical conduct, it seems prudent to examine the ethics training needed by technical personnel.

U.S. History suggests that in our country, from the earliest times through the 1950's, ethical behavior was taught to future workers (students) by churches and parents (Edmonson, 1989). There is some contention that, due to the increasing number of single parent families and dual career families, parents have less and less time to devote to teaching and discussing ethical issues with children. Many churches and synagogues have experienced declines in membership and attendance. This has left workers with a large void in their ethics training.

Public institutions in the United States provided instruction in religion and ethics until 1948, when the U.S. Supreme Court declared religious instruction unconstitutional (Edmonson, 1989). Confusion still exists on this issue and, as higher education institutions become more and more research oriented, they have pulled away from many traditional

university values and away from ethics instruction. This ethical holocaust has had a tendency to create a workforce that is ethically illiterate. Webster's II New Riverside Dictionary defines ethics as the branch of philosophy dealing with the rules of proper conduct. Jewish philosopher Norman Lamm (Cited in Edmonson, 1989) recently stated:

> "My hope is that we shall learn to reassert the existence and value of spirit. Spirit is that dimension of being which lets us say of man that he has enduring importance; that there is more to him than 100 to 200 pounds of bone and glands, that man is not an irresponsible bunch of replaceable organs, but a responsible and irreplaceable image of something that transends him; that, far from an accident of biology, the human being is a devine adventure. "

Lawrence Kohlberg, his colleagues and their graduate students, carved out a new field of psychological, philosophical, and educational research. The words that best describe their work are cognitive moral development. Cognitive emphasizes the idea of organized thought processes. The term 'moral' implies decision making in situations where unusual values and the need for authority come into conflict. Development suggests that thinking about moral issues improves over time (Fenton, 1976). Kohlberg and associates investigated the educational implications of their research. They conducted studies in correctional institutions to determine if deliberate programs in cognitive moral development would affect the decision making of inmates.

Kohlberg and his associates also worked in public educational institutions trying to facilitate cognitive moral development. Their efforts have attracted attention, both pro and con, from colleagues.

Edwin Fenton (1976) in his article "Moral Education: The Research Findings" presented eleven generalizations stemming from Kohlberg's research in cognitive moral development.

They are as follows:

1. People think about moral issues in six qualitatively different stages arranged in three levels of two stages each.
2. The most reliable way to determine a stage of moral thought is through a moral interview.
3. A stage is an organized system of thought.
4. An individual reasons predominantly at one stage of thought and uses contiguous stages as a secondary thinking pattern.
5. These stages are natural steps in ethical development, not something artificial or invented.
6. All people move through these stages in invariant sequence, although any individual may stop at a particular stage.
7. People can understand moral arguments at their own stage, at all levels beneath their own, and usually at one stage higher than their own.
8. Higher moral stages are better than lower ones.
9. Stage transition takes place primarily because encountering real life or hypothetical moral dilemmas sets up cognitive conflict in a person's mind and makes the person uncomfortable.
10. Deliberate attempts to facilitate stage change in schools through educational programs have been successful.
11. Moral judgement is a necessary but not sufficient condition for moral action.

Kohlberg divided the six stages into three levels called Preconventional, Conventional and Principled. The Preconventional

level encompasses stages one and two . Stage 1: The Punishment and Obedience Orientation in which the physical consequences of doing something are used to determine if it is good or bad regardless of its value. People are reacting to punishment and rewards. They defer to those who have power over them. Stage 2: The Instrumental Relativist Orientation in which reasoning leads to actions which satisfies ones own needs and occasionally meets the needs of others. Stage 2 may involve fairness but only in a practical sense. " You scratch my back, I'll scratch yours. "(Power, Higgins & Kohlberg, 1989)

The Conventional level encompasses stages three and four. People at this level are acting upon the expectations of peer pressure regardless of its immediate consequences. Those at the Conventional level show loyalty to the social order and strive to maintain, support and justify it. Stage 3: The Interpersonal Sharing Orientation involves equating good behavior with that which pleases and gains approval of others. Individuals in this stage often conform to stereotypical ideas of group behavior. Behavior is often judged by intentions. Stage 4: The Social Maintenance Orientation equates to authority, fixed rules, and the maintenance of the social order. Proper behavior equates to doing one's duty, respecting authority and maintaining the social order for its own sake (Power, Higgins & Kohlberg, 1989).

The Principled level encompasses Stages 5 and 6. At this level people reason according to moral principles that are able to stand apart from the pressure of the group to which the individual belongs. Stage 5: The Social Contract Human Rights and Welfare Orientation is indicative of actions and standards that have been examined critically and been agreed upon by the whole of society. Stage 5 people often stress the legal point of view, but endorse the idea of change if the proper consideration for the welfare of society is given. People are bound together by free agreement and contract where no law applies. Stage 6: The Universal Ethical Principle Orientation emphasizes the decision of conscience that is guided by self imposed ethical principle such as justice, equality, dignity of the individuals. Instead of concrete rules such as the Ten Commandments, they function with abstract ethical principles (Power, Higgins and Kohlberg, 1989).

Kohlberg 's research found that most adult American's think at the Conventional level, stages 4 or 3, and only a small minority (5 to 10 %) attain full Stage 5 thought. Kohlberg believed that people fail to develop or progress to Stages 5 and 6 mainly because they have not had sufficient experiences or stimuli to set up the cognitive conflicts leading to stage change. Kohlberg suggests that those conflicts could be presented in educational settings (Power, Higgins and Kohlberg, 1989). The study of ethics by technicians in the areas of Welding Inspection and

Nondestructive Testing would present such conflicts. The study of ethics and ethical conduct encompasses all professions.

Most professions or professional organizations have a code of ethics that describe the rules of conduct for the profession. These may or may not coincide with generally acceptable ethical practices, although they usually do coincide with the legal aspects of contract and tort law. This raises the question of "Should ethics be taught to aspiring technicians, and who is to teach it?" Michael J. Schaefer (Cited in Parsons and Powell, 1988) suggests the teaching of moral thinking in conjunction with the teaching of those skills required by the profession. The focus of this research was what should be the content of an ethics course for trainees in the fields of nondestructive testing and welding inspection.

Problem Statement with Goals and Objectives

The purpose of this research was to establish the content of instruction in professional ethics for nondestructive testing and welding inspection. The focus of the study was to determine what should be taught in a professional ethics course for nondestructive testing personnel and welding inspectors.

The objectives of this study were to:

1. determine if there was a significant difference between the ethical competencies needed by nondestructive testing personnel and certified welding inspectors.
2. determine what ethical competencies should be included in a course on ethics for nondestructive testing personnel and welding inspectors

Importance of the Study

The need for research in this area has been suggested by studies representing many fields of training (Parsons and Powell, 1988; Nichols, 1987; Edmonson, 1989). Recent articles in professional journals suggest that professionals, such as architects, engineers, technicians and managers, are becoming increasingly aware of the need for ethics training in their professions. In light of these trends, it is important that employers have access to employees who possess a firm foundation in professional ethics and their application in the workplace. If employees versed in professional ethics are to be available for employment, the required competencies must be identified.

Identifying what competencies need to be taught about professional ethics in nondestructive testing and welding inspection education can be determined by surveying practitioners in the United

States, whose function it is to perform nondestructive testing and welding inspection or to supervise personnel performing these tasks. By determining what is presently taught and how practitioners perceive the importance of a set of ethical competencies, a set of required ethical competencies can be determined for an ethics course to be included in the training of nondestructive testing personnel and certified welding inspectors.

Utilizing Clustering Methods

The body of literature pertaining to techniques developed by McCormick and others (McCormick et al., 1954; Chalupsky, 1954; Scheips, 1954; Finn, 1954; Gordon and McCormick, 1969) at Purdue University to analyze the occupational requirements of industrial workers offers a model for this study's methodology. These studies utilized an analysis of job interrelationships, featuring the identification of job components, the factor analysis of the components, and the identification of clusters of jobs. Of significant importance to the proposed research was the collection of data from professional technicians who indicated competency needs for their jobs by checking appropriate lists of competencies. The methodology of data analysis used in this research emerged from these studies of job interrelationships.

The model proposed for this research develops its foundation for curriculum planning from work conducted by Courtney and Coster (1963) , where a common core of skills and experiences forms the knowledge base necessary for various occupations. The "centripetal" approach suggested by these authors focuses on the identification of the elements of the common core of skills. The elements are likely to resemble fragments of abilities and knowledge and are likely to be general rather than specialized, except as specialization relates to the entire occupation for which a person is being prepared. Where a person works is not so important as the nature of the work itself. According to this premise, an empirically-based method for determining curriculum content can be derived (Halfin and Courtney, 1971).

In the centripetal approach there is a search for the least common denominator of the occupation of interest. This common core of knowledge and skills is described in accord with a moving inward process. Figure 1 depicts a number of overlapping circles which illustrate the centripetal method of content identification (Courtney and Coster, 1963). Curriculum planning is centered on identifying the elements of common overlaps and what the worker does makes the criterion for classification within the core (Courtney, 1962).

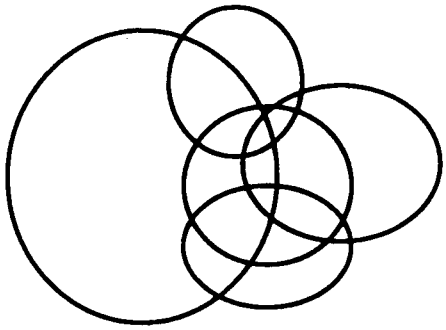

Figure 1.

Schematic Illustration of the Centripetal Approach

The elements of the centripetal paradigm are likely to resemble those included in courses ordinarily offered in the natural and physical sciences, and in liberal arts. Hence, the instruction is likely to be presented in a general format rather than as a specialized curriculum. Thus, the centripetal approach may appeal to educators who see the necessity for general education which satisfies basic literacy requirements.

The present study evolves into a problem with curriculum implications for training programs in nondestructive testing and welding inspection. The identification of the ethical concepts required for practicing technicians in the field of nondestructive testing, along with the factor-based grouping of these activities, is important to designers of curriculum for these fields. The parameters for this focus may be stated as follows:

1. Factor (cluster) identification may be completed using worker-assigned values for the purpose of verifying task statements.

2. Subject matter content may be descriptively grouped for analysis purposes. From such groupings, patterns of ethics preparation may be established for technicians in the fields of nondestructive testing and welding inspection so that basic common competencies and necessary common experiences can be identified.

3. As content is determined, performance-based objectives for preparing technicians in nondestructive testing and welding inspection may be specified.

4. Using the sequence of performance based objectives, instructional strategies may be specified for training programs.

The basic assumption surrounding the use of this curriculum model is that a standard set of parameters can be developed which provide guidance and content selection for ethics training. The present research brings this matter into quantitative focus.

It is advantageous to the nondestructive testing and welding inspection community to utilize acquired skills which are relevant to the professional roles which technicians play in the society. Closely allied to the methods of analysis which are proposed for the present study are the procedures which were utilized by Stamps (1980), who developed a list of competencies in consumer education and personal finance, and Starmach (1988), who studied statistically-related computer application needs of doctoral level university graduate majors in education. Both of

these studies, along with others (Behroozian, 1981; Burton, 1984; Samahito, 1984; Soukup, 1984; and Tauqueban, 1990) mailed survey instruments to professional workers in the field. Professionals were sampled in the research and completed the questionaires, judgementally assigning values to competency lists. Data were analyzed using factor analytic methods which parallel those used with the present research . In each instance, content validation was established, using a DELPHI panel, and reliability was ascertained through an analysis of variance method (Hoyt and Stunkard, 1952) .

Definition of Terms

It seems appropriate to define certain terms which have been used in the study.

ANSI: American National Standards Institute.

ASNT: American Society of Nondestructive Testing, Inc. is a national professional, technical society which crosses the disciplines of science, engineering, and technology, concerned with the advancement of nondestructive testing (ASNT, 1992).

AWS: American Welding Society, is a national professional society whose objective is "to advance the science and art of welding in all its branches" (AWS, 1990).

Business Ethics: a field defined by the interaction of ethics and business. Business ethics is a part or subset of general ethics (De George, 1990).

Centripetal Approach: Focuses on the development of a common core of skills or competencies that are applicable to more than one profession.

Certified Associate Welding Inspector: (CAWI) is a person certified by AWS as meeting the qualification requirements of 5.2 and 6 of ANSI/AWS QC 1-88. This standard dictates education, experience, physical requirements as well as examination requirements for CAWI's.

Certified Welding Inspector: (CWI) a person certified by AWS as meeting the qualification requirements of 5.1 and 6 of ANSI/AWS QC 1-88. This standard dictates education, experience, physical requirements as well as examination requirements for CWI's.

Cluster: a matrix of research tasks whose intercorrelations are high with factor loadings of + or - .50 or higher. A cluster is referred to as a factor (Fruchter, 1954).

Common Factor: statistical representations of some tasks or trait which two (2) or more items in the questionnaire have in common (Cattell, 1952) .

Common Variance: the sharing of variance by two (2) or more elements or tasks. In such a sharing, the elements are correlated and therefore have some traits in common (Fruchter, 1954).

DELPHI Technique: an expert opinion forecast method which interactively integrates the responses of surveyed experts (Courtney, 1988).

Ethics: a systematic attempt to make sense of our individual and social moral experience in such a way as to determine the rules that ought to govern human conduct, the values worth pursuing, and the character traits deserving development in life (De George, 1990).

Factor Analysis: consists of a collection of procedures for analyzing the relationship among a set of random variables observed, counted, or measured for each individual group. The purpose of factor analysis is to account for intercorrelations among variables by postulating a set of common factors. It can be defined as a method for extracting common factor variances from sets of measures (Fruchter, 1954).

Factor Loading: the correlation of any particular ethics competency with other ethics competencies being extracted in the same factor.

Nondestructive Testing: the application of physical principles for the detection of flaws or discontinuities in materials without impairing their usefulness.

Spurious Tasks: a task or competency with a factor loading of less than + or - .50. It is tentatively identified as clustering with the factor in which its highest factor loading occurs.

Welding Inspection: The evaluation of welds according to an accepted standard (AWS, 1988).

CHAPTER II

METHODOLOGY

The Dependent Variable

The dependent variable for the study was a scaled score which was judgmentally assigned by randomly selected subjects from a sample of professionals representing nondestructive testing and welding inspection populations. Scores were assigned on the basis of a six - point equal - appearing interval scale which provided an assessment of the competency needs of selected ethical concepts. Each component of the instrument was treated independently. Thus, twenty - nine (29) dependent variables were created for the study.

The Instrument

The instrument's design included a scaling mechanism which allowed subjects to judgmentally apply values to each of the dependent variables. The scale included the following descriptors.

Very Unimportant					Very Important
1	2	3	4	5	6

The data collection tool utilized for this study consisted of 29 ethical - oriented components and necessary demographics. The ethical - oriented items were generated using a DELPHI method for content validation. This process is detailed as follows:

The preliminary list of competency statements was developed through an initial review` of literature covering competency needs in this area, plus a review of curricula for ethics programs in engineering, business, architecture and technical training. Codes of ethics for the sample population were also used in preparing the preliminary list which included codes of ethics from National Management Association, American Society for Nondestructive Testing, and American Welding Society. The actual validation involved the input of a six (6) member DELPHI panel that was discipline specific and chosen on the basis of the following criteria:

1.) Not less than 5 years of work experience in their representative field.

2.) Represent the fields of Business, Law , Engineering, Nondestructive Testing, Welding Inspection, Ethics, and Education.

The initial stage of the DELPHI process was the reaction of each member of the panel to a suggested list of competencies relating to whether there was ambiguity or redundance within the listing of potential competencies for the instrument. The possible responses for this round were:

Retain _____

Reject _____

Revise as follows: _____

The second iteration with the panel asked the panel to react with the revised list with the following responses.

Retain _____

Reject _____

The final iteration utilized a revised list of competencies and the following Likert-type scale.

Very Unimportant 1 2 3 4 5 6 Very Important

See Appendix A for examples of letters to the panel and samples of all iterations of the instrument.

The liaison with the DELPHI panel continued until group consensus was reached. Consensus was established when the panel members as a group were in agreement 80% of the time. Items were included in the instrument if the importance level means reached the 3.5 level of the scale. (See Appendix A) The instrument was field tested

using a small representative sample of six (6) individuals taken from the intended population prior to its implementation for data collection. Minor modifications were made for clarity.

Although the DELPHI method was designed as a forecasting tool, its more promising application (Weaver, 1971) in education appears to be in the following areas:

1.) a method for studying the process of thinking about the future;

2.) as a pedagogical tool which forces people to examine the future in a more complex manner than they ordinarily might;

3.) a planning tool which may aid in examining priorities held by members of a sample of a specific population (Weaver, 1971).

The simplicity, directness of the method, ease of administration, minimal application time requirements, and low cost make the DELPHI process a logical choice for this educational research.

Usually one or more of the following properties of the application leads to the need for employing the DELPHI (Samahito, 1984):

1. The problem does not lend itself to precise analytical techniques but can benefit from subjective judgments on a collective basis;

2. The individuals needed to contribute to the examination of a broad or complex problem have no history of adequate communication and may represent diverse backgrounds with respect to experience or expertise;
3. More individuals are needed than can effectively interact in a face-to- face exchange.
4. Time and Distance costs make frequent group meetings unfeasible;
5. The efficiency of face-to-face meetings can be increased by a supplemental group communication process;
6. Disagreements among individuals are so severe or politically unpalatable that the communication process must be referred and/or anonymity assured;
7. The heterogeneity of the participants must be preserved to assure the validity of the results (e.g., avoidance of domination by quantity or strength of personality).

Instrument Reliability

Internal reliability of the instrument was established using the procedure developed by Hoyt and Stunkard (1952). The method uses analysis of variance techniques and provides a forthright method of estimating the reliability coefficient for unrestricted scoring items. This analysis included a matrix consisting of 581 subjects, 29 competencies, and one response per cell. The matrix may be projected by the following representation.

Competencies	Subjects									
1.	1	2	3	4	5	6	7.....8.....J			581
2.	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y1J	581
3.	Y21	Y22	Y23	Y24	Y25	Y26	Y27	Y28	Y2J	581
.	.	.	.							.
.	.	.	.							.
.	.	.	.							.
I	YI1	YI2	YI3	YI4	YI5	YI6	YI7	YI8	YIJ	581
.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.
K	YK1	YK2	YK3	YK4	YK5	YK6	YK7	YK8	YKJ	581
Total	Y.1	Y.2	Y.3	Y.4	Y.5	Y.6	Y.7	Y.8	Y.J	581

A two-way analysis of variance (ANOVA) produces sums of square values for subjects and items; the residual sum of squares is obtained by

finding the difference between mean square of the subjects and the mean square of the residual. The estimate of reliability is obtained according to the following formula:

$$r = \frac{\text{Mean Square Subjects minus Mean Square Residual}}{\text{Mean Square Subjects}}$$

Previous research studies using the equal - appearing interval scale for data collection in task analyses have produced scale reliabilities exceeding + 0.90 (Behroozian, 1981; Samahito, 1984; Soukup, 1984; and Burton, 1984).

Mathematical Model

The basic design for the study followed a one - way analysis of variance (ANOVA) model with three (3) levels of the independent variable. The mathematical structure of the design is:

$$Y_i = \mu + G_i + \varepsilon_{ij}$$

Where μ is an unknown constant,

G_i is the group effect, and

ε_{ij} is the residual (error) effect.

The Hypotheses to be Tested and the Expected Mean Squares

The principal interest is to determine the extent of content needs for three (3) levels of professional technicians. The major goal of the statistical analysis was to test the hypothesis relating to each of the dependent variables. The stated hypothesis was:

$$\mu A = \mu B = \mu C$$

Where, μA is the population mean for Certified Associate Welding Inspectors (CAWI).

μB is the population mean for Certified Welding Inspectors (CWI).

μC is the population mean for Level III Nondestructive Testing Personnel.

Expected mean squares and the anticipated F test for this fixed model is shown below:

Source of Valuation	df	(EMS)
Group	2	$\sigma_e^2 + \sigma_G^2$
Error	578	σ_e^2
Total	580	

Hence, the calculated F value for hypothesis derived according to:

$$F = \frac{\text{MS Group}}{\text{MS Error}}$$

The test statistics evaluated the null hypothesis using the following decision plan in conjunction with the F table.

Hypothesis	df	Computed F	α - level	Critical region
$\mu A = \mu B = \mu C$	2, 578	MSG/ MSe	.05	$F \geq 3.00$

In instances where the null hypothesis was rejected, a Tukey's ω test was made for multiple comparisons. The Tukey's ω test utilized the .01 level of significance in order to avoid Type 1 errors in the testing of alternate hypotheses.

Factor analysis was employed to determine the clustering patterns for the 29 competencies included in this research. The R-mode, with varimax rotation, was the procedure for identifying clusters of competencies. The mathematical model for the factor analysis was:

$$V_t = V_{co} + V_{sp} + V_e$$

Where V_t was the total variance,

V_{co} was the variance that two or more measures share in common,

V_{sp} was the variance which was specific to an individual measure, and

V_e was the variance attributed to error.

The criterion factor loading weight for inclusion of a competency into a cluster was initially set at .50, with the option of adjusting the level for maximizing competency identity with the parent clusters. Competencies were clustered to account for the largest percentage of common factor variance.

The Sample

The population included nondestructive testing and welding inspection specialists residing in the United States. The hypothesis of interest was to determine if there were differences across three (3) professional levels in terms of the dependent variables. The sampling

matrix illustrates the nature of the random selection of subjects to be included in the study.

The sampling matrix for the research was as follows:

	A	B	C
Ni	600	600	600

A = Certified Associate Welding Inspector (CAWI)

B = Certified Welding Inspector (CWI)

C = ASNT Nationally Certified Level III Nondestructive Testing Technician

The Data Collection.

Data for the study were gathered from sample of 1800 members who were randomly drawn from each of the populations of interest. The actual collecting of information relating to the dependent variables utilized mailed questionnaires.(Appendix A) The initial mailing produced a sample of 581 which was of sufficient size to satisfy the requirements of the study. Thus, no follow-up attempts were made regarding the nonresponders to the initial mailing.

CHAPTER III

RESULTS AND DISCUSSION

The data processing stages for the study utilized factor analysis, analysis of variance, and the Hoyt-Stunkard method for establishing reliability. In instances where the null hypotheses was rejected a Tukey's test was used to minimize the possibility of committing a Type 1 error. The assumption for homogeneity of variance was verified using the Bartlett's test.

Reliability of the Instrument

The twenty-nine (29) item instrument was tested for reliability using the Hoyt-Stunkard method. This procedure utilized analysis of variance to establish internal consistency and reliability for the six-point scale. This procedure used between-respondents variance and error variance to determine the correlation coefficient for reliability and provides a forthright solution to the problem of determining an estimated reliability coefficient for unrestricted scoring items. The reliability of this instrument was determined to be +0.970 . Therefore, the calculated results indicated consistency of response across the twenty-nine (29) major variables of interest. Table I reports the reliability calculations and result.

TABLE I

Instrument Reliability Coefficient

SOURCE OF VARIATION	df	MS	r
Respondents	49	22.996	+0.97
Residual	1372	.672	
Total	1421		

$$R = \frac{\text{MS Respondents - MS Residual}}{\text{MS Respondents}}$$

therefore,

$$r = \frac{22.996 - .672}{22.996} = +0.970$$

Results of Homogeneity of Variance Testing

The Bartlett's test (Bartlett, 1950) was utilized in determining the homogeneity of variance for hypothesis tests for difference between means for ASNT Level III's, CWI'S and CAWI's. The results of the Bartlett tests showed that the assumption of homegeneity of variance was met for each of the twenty-nine (29) variables in the study (See Appendix B).

Results of Hypothesis Testing

The study involved the description of twenty-nine (29) competencies. A total of twenty-nine (29) separate hypotheses were

included in this part of the data analysis. A total of five hundred eighty-one (581) respondents participated in the study and reacted to the six-point scale of the survey instrument. Three groups (Level III's, CWI's and CAWI's) were sampled.

The mean values for the respondents ranged from a high of 5.616 to a low of 3.810 for the Level III's, where N=268. The CWI's (with a sample size of 212) showed means which ranged from a high of 5.547 to a low of 3.873. The CAWI's (with a sample size of 101) showed means which ranged from a high of 5.713 to a low of 4.267. Means for the three groups, as well as overall means, are reported in Table II.

TABLE II

Results of Significance
Testing for Differences Between Group Means (Level III, CWI and CAWI)
(N = 581)

Competency #	$\bar{X}$	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	$S_{\bar{X}1}$	$S_{\bar{X}2}$	$S_{\bar{X}3}$	F Ratio	H_o
01.	5.320	5.354	5.250	5.376	.064	.085	.105	0.665	Not Rejected
02.	4.931	4.918	4.849	5.139	.072	.086	.103	2.079	Not Rejected
03.	3.929	3.847	3.873	4.267	.086	.101	.123	3.479	Not Rejected
04.	5.506	5.530	5.425	5.614	.062	.085	.097	1.135	Not Rejected
05.	5.318	5.325	5.231	5.485	.071	.093	.105	1.494	Not Rejected
06.	5.112	4.959	5.142	5.455	.072	.087	.102	6.529	Reject
07.	5.448	5.004	4.939	5.356	.071	.095	.091	4.306	Not Rejected
08.	5.041	5.586	5.368	5.634	.063	.086	.096	1.975	Reject
09.	5.522	5.493	5.495	5.653	.059	.082	.092	0.976	Not Rejected
10.	5.590	5.578	5.547	5.713	.063	.084	.093	0.828	Not Rejected
11.	5.365	5.429	5.245	5.446	.062	.089	.101	1.888	Not Rejected
12.	4.697	4.713	4.613	4.832	.080	.104	.132	0.881	Not Rejected
13.	5.573	5.616	5.462	5.693	.059	.088	.092	1.932	Not Rejected
14.	5.026	4.955	4.986	5.297	.069	.092	.102	3.172	Not Rejected
15.	5.239	5.149	5.255	5.446	.071	.084	.100	2.424	Not Rejected
16.	5.028	4.985	4.986	5.228	.078	.090	.108	1.548	Not Rejected
17.	5.509	5.530	5.429	5.624	.063	.085	.108	1.106	Not Rejected
18.	5.466	5.489	5.340	5.673	.066	.092	.092	2.911	Not Rejected
19.	5.494	5.507	5.401	5.653	.063	.086	.085	1.874	Not Rejected
20.	5.513	5.563	5.420	5.574	.064	.094	.095	1.080	Not Rejected
21.	4.363	4.213	4.458	4.564	.087	.097	.140	2.990	Not Rejected
22.	5.019	5.034	4.873	5.287	.071	.093	.087	4.175	Reject
23.	4.871	4.817	4.849	5.059	.068	.088	.113	1.607	Not Rejected
24.	4.618	4.642	4.571	4.653	.070	.089	.127	0.249	Not Rejected
25.	3.959	3.810	3.995	4.277	.088	.105	.147	3.761	Reject
26.	4.241	4.119	4.283	4.475	.087	.105	.139	2.328	Not Rejected
27.	4.575	4.328	4.307	4.723	.089	.102	.130	3.287	Not Rejected
28.	5.126	4.485	4.509	4.950	.079	.097	.121	4.913	Reject
29.	5.027	5.060	5.118	5.317	.068	.089	.105	1.779	Not Rejected

Group 1 is the mean for Level III's
Group 2 is the mean for CWI's
Group 3 is the mean for CAWI's

The range of the overall mean values was from a high of 5.590 on competency Number 10 (Refrain from payment to any person, business, political organization, or public official for unlawful or unauthorized purposes), to a low of 3.929 on competency Number 3 (Be conversant with traditional, norm-centered, abstract principles of moral methodology.).

The distribution of the means was as follows: Twenty (20) of the means ranged between 5.000 and 5.594 , seven (7) fell within the range between 4.000 and 5.000 and two were in the range between 3.000 and 4.000. No competency was judged at less than 3.000.

Standard errors ranged from .059 (Level III for competency 9) to .147 (CAWI's for competency 25). The standard errors for Level III's ranged from a .059 to a high of .089; CWI's standard errors extended from .086 to .105; CAWI's standard errors ranged from .085 to .147 (see Table II).

The two highest means highlighted the areas of bribery and giving false information. The lowest were concerned with ethical theory. Means for all competencies are shown in Table II. The results of the analysis of variance testing for twenty-nine competencies revealed the presence of significant differences between mean scores for Level III's, CWI's and CAWI's for five (5) of the null hypotheses. The null hypotheses were rejected when the analysis of variance was applied

indicating significant differences in the mean responses between the three groups. The competencies numbered 6, 8, 22, 25 and 28 were rejected. When these five (5) hypotheses were analyzed using the Tukey's test differences were found between group means (See Table III).

TABLE III

Results of Tukey's ω

Competency #	$\bar{X}$	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	Conclusion
06.	5.112	4.959	5.142	5.455	$\mu_3 > \mu_1$
08.	5.041	5.586	5.368	5.634	$\mu_3 > \mu_2$
22.	5.019	5.034	4.873	5.287	$\mu_3 > \mu_2$
25.	3.959	3.810	3.995	4.277	$\mu_3 > \mu_1$
28.	5.126	4.485	4.509	4.950	$\mu_3 > \mu_1$ $\mu_3 > \mu_2$

Group 1 is the mean for Level III's
Group 2 is the mean for CWI's
Group 3 is the mean for CAWI's

The grand mean score for all twenty-nine (29) competencies was 5.049. These means are reported in Appendix C.

Results of Factor Analysis

The major analysis tool used for this study was factor analysis, which was used to establish clusters of ethically related competencies. The R-mode

clustered competencies according to respondents' ratings on a 6-point scale for each of the twenty-nine (29) variables in the study.

A total of three (3) factors (clusters) having eigenvalues greater than one (1) (See Appendix G) were generated through the R-mode process where the minimum factor loading was set at .50. Fruchter (1955) classifies factor loadings of greater than .50 as being highly significant. The results of the factor analysis for the study's data verified that twenty-six (26) competency statements met Fruchter's criterion. Three spurious competencies were necessary to the results and there was one overlapping competency (Competency 25 overlapped Factor 2 and Factor 3). (See Table IV)

Titles were assigned to each of the three factors, reflecting the nature of the competencies within each cluster. The three (3) clusters included the following:

Factor I Ethical issues and personal integrity.

Factor II Ethics and the legal aspects of Inspection.

Factor III Ethical theory and professional conduct.

(Table IV shows the specific results of the factor analysis, including mean scores for each of the twenty-nine (29) competencies.)

Factor I. Ethical issues and personal integrity.

The first factor accounted for sixteen (16) competency statements with factor loadings ranging from a low of 0.559 for competency 8 (Avoid

outside activities which conflict with or impair the performance of duties) to a high of .935 for competency 13 (Refrain from providing false or misleading information to the business, its auditors, government agencies or customers.) The competency loading was the second highest of all of the twenty nine (29) competencies studied. This cluster accounted for 54.1 % of the common factor variance. (See Table V.)

The overall means for Factor I ranged from a high of 5.590 for competency 10 (Refrain from any payment to any person, business, political organization, or public official for unlawful or unauthorized purposes.) to a low of 5.026 for competency 14 (Refrain from using company property or resources for personal benefit or other improper purposes.).

Factor II. Ethics and the legal aspects of Inspection.

The second factor accounted for six (6) competencies. Factor loadings ranged from .523 to .953. The cluster accounted for 9 % of the common factor variance. The overall means for this cluster ranged from 4.241 for competency 26 (Define sexual harassment.) to 5.126 for competency 28 (Exercise due diligence in complying with employment laws and regulations.). The other competency means ranged from 4.363 to 5.027.

Factor III. Ethical theory and professional conduct.

Four competencies clustered in Factor III. Factor loading for these competencies ranged from .505 for competency 24 (Explain" Whistle Blowing " and how ethics might effect the decision making process.) to .797 for competency 2 (Explain the purpose of a Code of Ethics and the part it plays in professional conduct.).

Factor III accounted for 4 % of the common factor variance. The means for this factor ranged from a low of 3.929 for competency 3 (Be conversant with traditional, norm-centered, abstract principles of moral methodology.) to 4.931 for competency 2 (Explain the purpose of a Code of Ethics and the part it plays in professional conduct.). This factor contained those items with the lowest means of all the twenty nine (29) competencies.

TABLE IV

Results of Factor Analysis

Factor 1 - Ethical issues and personal integrity.

Competency Number	Competency Description	$\bar{X}$	V_{∞}
01.	Demonstrate understanding of the role of ethics in business, nondestructive testing and welding inspection.	5.320	0.606
04.	Demonstrate courtesy, respect, honesty and fairness in relationships with customers, suppliers, competitors and fellow employees.	5.506	0.863
05.	Comply with security regulations	5.318	0.737
06.	Understand the importance of punctuality and reliability in attendance in the work place.	5.112	0.712
07.	Understand the importance of confidentiality of customers, employees, and employer records and information.	5.448	0.859
08.	Avoid outside activities which conflict with or impair the performance of duties.	5.041	0.559
09.	Make decisions objectively without regard to friendship or improper personal gain.	5.522	0.922
10.	Refrain from payment to any person, business, political organization, or public official for unlawful or unathorized purposes.	5.590	0.855

TABLE IV (Continued)

Results of Factor Analysis

Factor 1 - Ethical issues and personal integrity.

Competency Number	Competency Description	$\bar{X}$	V_{∞}
11.	Conduct personal and business dealings in compliance with all relevant laws, regulations and policies.	5.365	0.773
13.	Refrain from providing false or misleading information to the business, its auditors, government agencies or customers.	5.573	0.935
14.	Refrain from using company property or resources for personal benefit or improper purposes.	5.026	0.587
15.	Exercise due diligence in accounting for company funds over which the technician has control.	5.239	0.724
16.	*Define conflict of interest.	5.028	0.469
17.	Provide quality service and product.	5.509	0.886
18.	Perform assigned duties to the best of their abilities and in the best interest of employers, customers and society.	5.466	0.883
19.	Refrain from making false or misleading claims of service or product.	5.494	0.902
20.	Maintain high standards of personal integrity and professional conduct.	5.513	0.857
22.	*Report questionable, unethical or illegal activities to supervisors.	5.019	0.491

TABLE IV (Continued)

Results of Factor Analysis

Factor II - Ethics and the legal aspects of Inspection.

Competency Number	Competency Description	$\bar{X}$	V_{∞}
12.	Exercise due diligence in complying with antitrust laws and trade regulations.	4.697	0.631
21.	Define discrimination.	4.363	0.646
23.	*Conserve resources and exercise due diligence in complying with Environmental laws and regulations.	4.871	0.470
25.	**Define Deontology (ethical theories not based on consequences but on consequences but on some other moral standard).	3.959	0.523
26.	Define sexual harassment.	4.241	0.771
27.	Exercise due diligence in complying with civil rights laws and regulations.	4.575	0.953
28.	Exercise due diligence in complying with employment laws and regulations.	5.126	0.897
29.	Exercise due diligence in complying with health and safety laws and regulations.	5.027	0.526

TABLE IV (Continued)

Results of Factor Analysis

Factor III - Ethical theory and professional conduct.

Competency Number	Competency Description	$\bar{X}$	V_{∞}
02.	Explain the purpose of a Code of Ethics and the part it plays in professional conduct.	4.931	0.797
03.	Be conversant with traditional, norm-centered, abstract principles of moral methodology.	3.929	0.680
24.	Explain "Whistle Blowing" and how ethics might effect the decision making process.	4.618	0.505
25.	**Define Deontology (ethical theories not based on consequences but on some other moral standard).	3.959	0.523

(* = Spurious Competency) (** Overlapping Competency)

TABLE V.

Percentage of Common Variance for the R-mode

Factor	Percentage of Variance	Cumulative Variance
1.	54.1	54.10
2.	09.0	63.10
3.	04.0	67.10

The pattern of common variance accountability structures itself in accordance with the factor analysis model, which supports the assumption that the first cluster or factor should account for the largest percent of common variance. Subsequent clusters should account for smaller percentages of common factor variance. This study's analysis substantiates the model's assumption regarding common factor variance (Bryman and Cramer, 1990).

The squared multiple correlation (SMC) for the variables ranged from a low of .359 to a high of ..865 with a mean of .677. Such a high SMC (.70 or better) translates that the observed variables accounted for a substantial variance in the factor scores (Tabachnick and Fidell, 1989).

CHAPTER IV

THE SUMMARY AND CONCLUSION

Restatement of the Problem

The purpose of this research was to establish the content of instruction in professional ethics for nondestructive testing and welding inspection. The focus of the study was to determine what should be taught in a professional ethics course for nondestructive testing personnel and welding inspectors.

The Dependent Variable

The dependent variable for the study was a scaled score which was judgmentally assigned by randomly selected subjects from a sample of professionals representing nondestructive testing and welding inspection populations. Scores were assigned on the basis of a six - point equal - appearing interval scale which provided an assessment of the competency needs of selected ethical concepts. Each component of the instrument was treated independently, creating twenty - nine (29) dependent variables for the study.

Reliability

The obtained Hoyt - Stunkard internal consistency reliability coefficient for respondents was determined to be +0.970 (See Table I). The table shows that the ratio of error variance to total respondent variance is minimal. The qualitative reliability for the instrument was considered to be very high (Courtney, 1988).

Conclusion

This research was designed to identify a core of ethically related competencies to be used in training technicians in the areas of nondestructive testing and welding inspection. Numerous procedures were utilized in determining the program needs of this population.

The Hypothesis Testing

Analysis of variance was used to test for significant differences between the Level III's, CWI's and CAWI's. The results of this testing disclosed a pattern of similarity in competency needs for the three groups (See Table II) . The anaylsis rejected five (5) of the twenty - nine null hypotheses included in the survey. There was a significant difference in competency 6 (Understand the importance of punctuality and reliability in the work place.), competency 8 (Avoiding outside activities which conflict with or impair performance of duties.), competency 22

(Report questionable, unethical or illegal activities to supervisors.), competency 25 (Define Deontology) and competency 28 (Exercise due diligence in complying with employment laws and regulations) . The remainder of the null hypotheses were not rejected indicating no significant differences in the mean responses between groups. The standard errors for the CAWI's were higher than those of the Level III's and generally higher than those of the CWI's. This could be attributed to the smaller sample size of the CAWI's, which consisted of one hundred and one (101) respondents versus two hundred and twelve (212) for the CWI's and two hundred and sixty-eight (268) for Level III's. These results do not suggest any great differences between the way Level III's, CWI's and CAWI's perceive the importance of ethically oriented competencies.

Consequently, it can be concluded that trainees in nondestructive testing and welding inspection can be taught using the same ethical content, and in common classrooms using common case studies.

Factor Analysis Conclusions

The use of factor analysis to establish clusters of ethically related competencies constituted the major statistical analysis for the study. The R- mode clustered competencies according to respondent ratings on a six point scale for each of the twenty-nine (29) variables in the study. A total of three (3) clusters (or factors) having eigenvalues greater than one

(1) (See Appendix G) were generated through the R-mode process, where the minimum factor loading was set at 0.50 (See Table IV). All loadings were positive, there were three (3) spurious competencies, and twenty-six (26) competencies were assigned to three factors through the analysis. Factor I contributed 54.1% of the common factor variance, and other factors accounted for lesser amounts. One competency was found to overlap Factor 2 and Factor 3. Spurious competencies were assigned to the factor that represented the highest loading for the variable.

Implications

The practical considerations which are forthcoming are from both the data analysis and literature review. In practice, the preparation of technicians has been to provide uniform training in relevant theory and hands-on application. There has been no practical suggestion of differentiation in the educational process for technicians in nondestructive testing and welding inspection regarding ethically related competencies. This study provides a basis upon which the following implications can be drawn:

1. The results of the study show no significant difference in the way Level III's, CWI's and CAWI's view their need for ethics related competencies. Therefore, trainees in nondestructive testing and welding inspection should be taught the same content, with the same emphasis, using the same case studies and in the same setting.

2. The resultant clusters can be organized into course content which are relevant to a technician-level curriculum and, subsequently, to the professional needs of technicians in nondestructive testing and welding inspection.

3. A common core of skills and experiences form the knowledge base for occupational entry (centripetal model). Therefore, based upon the data collected from this research, a basis for curriculum planning may be derived for such a common core of skills and knowledge regarding ethically related competencies for technicians in nondestructive testing and welding inspection.

4. The results serve as a source for formulating a sequence of performance-based objectives, instructional strategies and case studies for the training of technicians in nondestructive testing and welding inspection.

5. The procedural results of this study have verified the use of the curriculum model for purposes of content identification and instructional planning. It is recommended that the model which was utilized in the present research be considered for future curriculum development activities regarding technical training.

Suggestions for Further Study

The following suggestions for expanding the research in this area are made on the basis of the findings and conclusions of this study:

1. The present research should be replicated with the inclusion of related populations, not just those technicians training in nondestructive testing and welding inspection. Several other areas that offer national licensing come to mind and include automotive technicians, electronics and others that are recognized by the Accreditation Board for Engineering and Technology, Inc. (ABET).

2. Other demographic data should be collected to determine if characteristics such as gender, age and religious background influence the competency ratings.

3. Responses of the sample should be correlated with the responses of the DELPHI panel to determine if the relationship is strong enough to eliminate the need to survey the larger population.

4. In a future study, respondents should be asked to rank or prioritize the various competencies in their order of importance to the job.

5. Clients should be asked to judge the importance of ethical issues as they apply to their relationship with the providers of inspection and nondestructive testing services.

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APPENDICES

APPENDIX A

Letters to the DELPHI Panel with Each Iteration of the Instrument

UNIVERSITY OF ALASKA ANCHORAGE

COLLEGE OF CAREER AND VOCATIONAL EDUCATION
3211 Providence Drive
Anchorage, Alaska 99508

BACHELOR OF SCIENCE IN TECHNOLOGY

February 8, 1992

Mr. Michael Josephson
Joseph & Edna Josephson Institute of Ethics
310 Washington ST. #104
Marina Delray, CA. 90292

Dear Mr. Josephson

I am writing this letter to ask for your assistance in the development of the elements of an Ethics course or segment of a course for Welding Inspectors and Nondestructive Technicians. As a leader in your field the process would involve participating on a Delphi Panel that would develop the content of an instrument which would later be mailed to a random sample of practicing ASNT Level III's and II's and AWS Associate and Certified Welding Inspectors.

The participation on the DELPHI panel would involve responding to a written questionaire with approximately 30 items on it. This process would be repeated three or four times until 80% of the panel are in agreement on the items to be included on the questionaire, which will be sent to the aforementioned random sample. I will serve as the liaison for the work and provide each of you with feedback along the way. Should you decide to accept this offer I will send further details on the DELPHI process.

This paragraph will provide a little personal background about me and why I am interested in doing the project. I presently serve as the chairperson for the Bachelor of Science in Technology program at the University of Alaska Anchorage. I have been involved in Vocational/Technical education for twenty years in the area of Metals, Welding and Nondestructive

testing. I am a certified welding inspector (77052141) and have worked as a level II in PT, UT, RT, MT and ET. The purpose of this project is two fold. The first is to develop a set of competencies or curricula in ethics applicable to technicians who will be working in the fields of Nondestructive Testing and Welding Inspection. I have a great concern that ethics training in these areas as well other technical fields is limited to exposure to a code of ethics and little else. The second objective of this study is that the project will serve as the focus of my doctoral dissertation, required to complete an Ed.D. in Vocational Education at Oregon State University.

I would appreciate your prompt response to this request and would be happy to answer any questions you may have about this project. I can be reached at the above address or at the following phone numbers.

Home 907-346-3443.
Work 907-786-1675
Fax 907-786-6008
AFGHP@Anchorage.Bitnet

I would be happy to send a copy of my dissertation proposal to interested persons.

Thank you for your consideration.

Sincerely

Gerald H. Park
Professor

UNIVERSITY OF ALASKA ANCHORAGE

COLLEGE OF CAREER AND VOCATIONAL EDUCATION
3211 Providence Drive
Anchorage, Alaska 99508

BACHELOR OF SCIENCE IN TECHNOLOGY

June 1,1992

To: Mr. Henry Stephens, Director of Training EPRI
Dr. James Listska, Professor University of Alaska Anchorage
Mr. Chuck Hellier, President Hellier Associates
Mr. John Bartley, President American Welding Society
Mr. Robert Feole, President American society for Nondestructive Testing
Mr. Kenneth Wallack, Attorney At Law

From: Gerald H. Park

Thank you for agreeing to serve as a DELPHI panelist for the study which I am conducting to identify competencies and tasks for a course in ethics for nondestructive testing and welding inspection personnel. Your input will serve as a major contribution to the existing research information in this topic area. The major purpose of this DELPHI process is to determine the content and format for the collection of data from practicing technicians and inspectors. The results will be critical to the development of a usable ethics curricula for nondestructive testing personnel and welding inspectors.

The DELPHI technique suggests that you react individually and independently from the other panelists. I will serve as the liaison for the process and will provide each of you with feedback along the way. It is anticipated that only three or four iterations will be required before consensus is reached. Consensus among the panel will be considered complete when 80% of you agree on the content for the instrument.

The initial job for the panel members is to assess, evaluate

and if necessary to modify or add to the attached list of tasks which are to be considered for inclusion in the instrument (questionaire) to be mailed to samples of ASNT Level III's and II's and AWS Associate and Certified Welding Inspectors. Your instructions are to take each of the listed tasks or competencies and either retain, reject, or modify its contents according to your judgement of acceptability. Space will be provided for each of you to add additional competencies or tasks should you desire. A second instrument (revised and based upon your input on the first) will be forwarded to you for review at a later date.

I have included a short explanation of the Delphi process for your information.

Thanks again for agreeing to work with me on this matter. I look forward to your reactions.

Please respond by **June 20, 1992.**

Enclose your response in the envelope provided.

Content of an Ethics Course for Nondestructive Testing and Welding Inspection Personnel

DELPHI (Round One)

Direction: The major objective of the DELPHI procedure is to determine the items (tasks) which are to be included in the survey questionaire. In essence, the panel members have as their role the establishment of the content validity for the instrument. Thus, for each of the tasks, you are asked to place a check-mark beneath each statement to indicate whether you Retain or Reject the item as a part of the final questionaire. If you wish to retain the item, only after it is modified, rewrite the task in the space which is provided. If you have additional tasks to add to the instrument, please do so on the last page.

Please accept my sincere appreciation for your input in this matter. Should you have any questions regarding this process, Please contact me at this address: Gerald H. Park, 9231 Main Tree, Anchorage Alaska 99516

Technicians (ASNT LEVEL III's, AWS CWI's and CAWI's) must be able to:

1. Define Ethics.
   Retain _____ Reject _____ Revise as follows
   _____
   _____

2. Define Code of Ethics.
   Retain _____ Reject _____ Revise as follows
   _____
   _____

3. Define Traditional, Norm - Centered , abstract principles of moral methodology.
   Retain _____ Reject _____ Revise as follows
   _____
   _____

(Continued)

4. Define Historical - Critical Moral methodology.
   Retain _____ Reject _____ Revise as follows
   _____
   _____

5. Define personalist morality.
   Retain _____ Reject _____ Revise as follows
   _____
   _____

6. Demonstrate courtesy, respect, honesty and fairness in relationships with customers, suppliers, competitors and fellow employees.
   Retain _____ Reject _____ Revise as follows
   _____
   _____

7. Comply with safety, health and security regulations.
   Retain _____ Reject _____ Revise as follows
   _____
   _____

8. Demonstrate reliability in attendance and punctuality.
   Retain _____ Reject _____ Revise as follows
   _____
   _____

9. Maintain confidentiality of customers, employees, and employer records and information.
   Retain _____ Reject _____ Revise as follows
   _____
   _____

10. Avoid outside activities which conflict with or impair the performance of duties.
    Retain _____ Reject _____ Revise as follows
    _____
    _____

(Continued)

11. Make decisions objectively without regard to friendship or personal gain.
Retain _____ Reject _____ Revise as follows
_____
_____

12. Refrain from payment to any person, business, political organization, or public official for unlawful or unauthorized purposes.
Retain _____ Reject _____ Revise as follows
_____
_____

13. Conduct personal and business dealings in compliance with all relevant laws, regulations and policies.
Retain _____ Reject _____ Revise as follows
_____
_____

14. Comply fully with antitrust laws and trade regulations.
Retain _____ Reject _____ Revise as follows
_____
_____

15. Refrain from providing false or misleading information to the business, its auditors, government agencies or customers.
Retain _____ Reject _____ Revise as follows
_____
_____

16. Refrain from using company property or resources for personal benefit or other improper purposes.
Retain _____ Reject _____ Revise as follows
_____
_____

(Continued)

17. Exercise due diligence in accounting for company funds over which they have control.
Retain _____ Reject _____ Revise as follows
_____
_____

18. Define conflict of interest.
Retain _____ Reject _____ Revise as follows
_____
_____

19. Provide high quality service and products.
Retain _____ Reject _____ Revise as follows
_____
_____

20. Perform assigned duties to the best of their abilities and in the best interest of their employers, customers and society.
Retain _____ Reject _____ Revise as follows
_____
_____

21. Refrain from making false claims of service or products.
Retain _____ Reject _____ Revise as follows
_____
_____

22. Maintain high standards of personal integrity and professional conduct.
Retain _____ Reject _____ Revise as follows
_____
_____

23. Define discrimination.
Retain _____ Reject _____ Revise as follows
_____
_____

(Continued)

24. Report questionable, unethical or illegal activities to supervisors.
Retain _____ Reject _____ Revise as follows
_____
_____

25. Conserve resources and protect the environment.
Retain _____ Reject _____ Revise as follows
_____
_____

26. Define Whistle Blowing.
Retain _____ Reject _____ Revise as follows
_____
_____

27. Define Deontology.
Retain _____ Reject _____ Revise as follows
_____
_____

28. Define Utilitarianism.
Retain _____ Reject _____ Revise as follows
_____
_____

29. Explain Kohlberg's three stages of moral development.
Retain _____ Reject _____ Revise as follows
_____
_____

30. Define sexual harassment.
Retain _____ Reject _____ Revise as follows
_____
_____

(Continued)

31. (Suggested Additional Item) _____

_____

_____

32. (Suggested Additional Item) _____

_____

_____

33. (Suggested Additional Item) _____

_____

_____

34. (Suggested Additional Item) _____

_____

_____

UNIVERSITY OF ALASKA ANCHORAGE

COLLEGE OF CAREER AND VOCATIONAL EDUCATION
3211 Providence Drive
Anchorage, Alaska 99508

BACHELOR OF SCIENCE IN TECHNOLOGY

August 1,1992

To : Mr. Henry Stephens, Director of Training EPRI
Dr. James Listska, Professor University of Alaska Anchorage
Mr. Chuck Hellier, President Hellier Associates
Mr. John Bartley, President American Welding Society
Mr. Robert Feole, President American Society for Nondestructive Testing
Mr. Kenneth Wallack, Attorney At Law

From: Gerald H. Park

Each of you has reacted to the first round of the DELPHI procedure in identifying competencies to be included in the content of an ethics course for Nondestructive Testing and Welding Inspection Personnel. Attached is the ROUND TWO listing, which includes those items which have been retained, revised or added by the panel members in ROUND ONE.

Group consensus dictated that only one item be removed from the list during ROUND ONE, many items were modified for clarity and three new items were added.

Consensus among the panel will be considered complete when 80% of you agree on the content of the instrument.

I apologize for the delay in getting ROUND TWO sent to you. The U.S. Mail did not deliver one of the questionnaires until early July! This time I will phone if no response is received by the date indicated. It is anticipated that not more than three rounds will be required for completion of the competency listing.

Please respond by **August 20, 1992.**

In this round you are to take each of the listed tasks or competencies and either retain or reject, according to your judgment of acceptability.

Thanks again for agreeing to work with me on this matter. I look forward to your reactions.

Content of an Ethics Course for Nondestructive Testing and Welding Inspection Personnel

DELPHI (Round Two)

Direction: The tasks which are included below represent statements which were either retained, revised or submitted as new items from the first round. Please retain or reject each of the statements in the space provided.

Please accept my sincere appreciation for your input in this matter. Should you have any questions regarding this process, Please contact me at this address: Gerald H. Park, 9231 Main Tree, Anchorage Alaska 99516

Technicians (ASNT LEVEL III's, AWS CWI's and CAWI's) must be able to:

1. Demonstrate understanding of the role ethics in business, nondestructive testing and welding inspection.
   Retain _____ Reject _____

2. Explain the purpose of a Code of Ethics and the part it plays in professional conduct.
   Retain _____ Reject _____

3. Be conversant with Traditional, Norm - Centered , abstract principles of moral methodology.
   Retain _____ Reject _____

4. Be conversant with Historical - Critical Moral methodology.
   Retain _____ Reject _____

5. Define personalist morality.
   Retain _____ Reject _____

(Continued)

6. Demonstrate courtesy, respect, honesty and fairness in relationships with customers, suppliers, competitors and fellow employees.
   Retain _____ Reject _____

7. Comply with security regulations.
   Retain _____ Reject _____

8. Demonstrate reliability in attendance and punctuality.
   Retain _____ Reject _____

9. Maintain confidentiality of customers, employees, and employer records and information.
   Retain _____ Reject _____

10. Avoid outside activities which conflict with or impair the performance of duties.
    Retain _____ Reject _____

11. Make decisions objectively without regard to friendship or improper personal gain.
    Retain _____ Reject _____

12. Refrain from payment to any person, business, political organization, or public official for unlawful or unauthorized purposes.
    Retain _____ Reject _____

13. Conduct personal and business dealings in compliance with all relevant laws, regulations and policies.
    Retain _____ Reject _____

14. Exercise due diligence in complying with antitrust laws and trader regulations.
    Retain _____ Reject _____

(Continued)

15. Refrain from providing false or misleading information to the business, its auditors, government agencies or customers.
Retain _____ Reject _____

16. Refrain from using company property or resources for personal benefit or other improper purposes.
Retain _____ Reject _____

17. Exercise due diligence in accounting for company funds over which they have control.
Retain _____ Reject _____

18. Define conflict of interest.
Retain _____ Reject _____

19. Provide quality service and products.
Retain _____ Reject _____

20. Perform assigned duties to the best of their abilities and in the best interest of their employers, customers and society.
Retain _____ Reject _____

21. Refrain from making false or misleading claims of service or products.
Retain _____ Reject _____

22. Maintain high standards of personal integrity and professional conduct.
Retain _____ Reject _____

23. Define discrimination.
Retain _____ Reject _____

24. Report questionable, unethical or illegal activities to supervisors.
Retain _____ Reject _____

(Continued)

25. Conserve resources and exercise due diligence in complying with environmental laws and regulations.
Retain _____ Reject _____

26. Define Whistle Blowing.
Retain _____ Reject _____

27. Define Deontology.
Retain _____ Reject _____

28. Define Utilitarianism.
Retain _____ Reject _____

29. Explain Kohlberg's three stages of moral development.
Retain _____ Reject _____

30. Define sexual harassment.
Retain _____ Reject _____

31. Exercise due diligence in complying with civil rights laws and regulations.
Retain _____ Reject _____

32. Exercise due diligence in complying with employment laws and regulations.
Retain _____ Reject _____

33. Exercise due diligence in complying with health and safety laws and regulations.
Retain _____ Reject _____

34. (Suggested Additional Item)

UNIVERSITY OF ALASKA ANCHORAGE

COLLEGE OF CAREER AND VOCATIONAL EDUCATION
3211 Providence Drive
Anchorage, Alaska 99508

BACHELOR OF SCIENCE IN TECHNOLOGY

September 1,1992

To: Mr. Henry Stephens, Director of Training, EPRI
Dr. James Listska, Professor, University of Alaska Anchorage
Mr. Chuck Hellier, President, Hellier Associates
Mr. John Bartley, President, American Welding Society
Mr. Robert Feole, President, American Society for Nondestructive Testing
Mr. Kenneth Wallack, Attorney At Law

From: Gerald H. Park

Each of you has reacted to ROUND TWO of the DELPHI procedure in identifying competencies to be included in the content of an ethics course for Nondestructive Testing and Welding Inspection Personnel. Attached is the ROUND THREE listing, which includes those items which have been retained, by panel members during the first two rounds.

Please evaluate each of the items included on the attached instrument in terms of importance, as you perceive it, for inclusion in the content of an ethics course for Nondestructive Testing and Welding Inspection Personnel, based upon needs in the field.

The needs scale for your response is as follows:

6 - considered to be extremely important in need
5 - considered to be very important in need
4 - considered to be important in need
3 - considered to be of some importance in need
2 - considered to be of little importance in need
1 - considered to be unimportant in need

It is anticipated that this will be the last round which is required for completion of the task and competency listing. If you see any problems with the instrument in terms of its format or structure for use in the field, please make it known by inserting corrections on the pages themselves.

Please accept my very sincere appreciation for assisting me on this project as a DELPHI panel member. I may be reached at (907) 786-1675 or at my home phone (907) 346-3443.

Content of an Ethics Course for Nondestructive Testing and Welding Inspection Personnel

DELPHI (Round Three)

Direction: Please evaluate each of the following tasks in accordance with your perception of its importance for inclusion into an Ethics Course for Nondestructive Testing and Welding Inspection Personnel.

Please accept my sincere appreciation for your input in this matter. Should you have any questions regarding this process, please contact me at this address: Gerald H. Park, 9231 Main Tree, Anchorage, Alaska 99516. **PLEASE RESPOND BY SEPT. 20, 1992**

Circle the number that best represents importance level

Technicians (ASNT LEVEL III's, AWS CWI's and CAWI's) must be able to:

		Very Unimportant					Very Important
1.	Demonstrate understanding of the role of ethics in business, nondestructive testing and welding inspection.	1	2	3	4	5	6
2.	Explain the purpose of a Code of Ethics and the part it plays in professional conduct.	1	2	3	4	5	6
3.	Be conversant with traditional, norm - centered , abstract principles of moral methodology.	1	2	3	4	5	6
4.	Be conversant with historical - critical moral methodology.	1	2	3	4	5	6
5.	Demonstrate courtesy, respect, honesty and fairness in relationships with customers, suppliers, competitors and fellow employees.	1	2	3	4	5	6
6.	Comply with security regulations.	1	2	3	4	5	6
7.	Understand the importance of punctuality and reliability in attendance in the work place.	1	2	3	4	5	6
8.	Understand the importance of confidentiality of customers, employees, and employer records and information.	1	2	3	4	5	6
9.	Avoid outside activities which conflict with or impair the performance of duties.	1	2	3	4	5	6

Circle the number that best represents importance level

		Very Unimportant					Very Important
10.	Make decisions objectively without regard to friendship or improper personal gain.	1	2	3	4	5	6
11.	Refrain from payment to any person, business, political organization, or public official for unlawful or unauthorized purposes.	1	2	3	4	5	6
12.	Conduct personal and business dealings in compliance with all relevant laws, regulations and policies.	1	2	3	4	5	6
13.	Exercise due diligence in complying with antitrust laws and trade regulations.	1	2	3	4	5	6
14.	Refrain from providing false or misleading information to the business, its auditors, government agencies or customers.	1	2	3	4	5	6
15.	Refrain from using company property or resources for personal benefit or other improper purposes.	1	2	3	4	5	6
16.	Exercise due diligence in accounting for company funds over which the technician has control.	1	2	3	4	5	6
17.	Define conflict of interest.	1	2	3	4	5	6
18.	Provide quality service and products.	1	2	3	4	5	6
19.	Perform assigned duties to the best of their abilities and in the best interest of their employers, customers and society.	1	2	3	4	5	6
20.	Refrain from making false or misleading claims of service or products.	1	2	3	4	5	6
21.	Maintain high standards of personal integrity and professional conduct.	1	2	3	4	5	6
22.	Define discrimination.	1	2	3	4	5	6
23.	Report questionable, unethical or illegal activities to supervisors.	1	2	3	4	5	6
24.	Conserve resources and exercise due diligence in complying with environmental laws and regulations.	1	2	3	4	5	6
25.	Explain "Whistle Blowing" and how ethics might effect the decision making process.	1	2	3	4	5	6

Circle the number that best represents importance level

		Very Unimportant					Very Important
26.	Define Deontology(ethical theories not based on consequences but on some other moral standard).	1	2	3	4	5	6
27.	Define sexual harassment.	1	2	3	4	5	6
28.	Exercise due diligence in complying with civil rights laws and regulations.	1	2	3	4	5	6
29.	Exercise due diligence in complying with employment laws and regulations.	1	2	3	4	5	6
30.	Exercise due diligence in complying with health and safety laws and regulations.	1	2	3	4	5	6

APPENDIX B

Homogeneity of Variance Test Results

Bartlett's Test
Measures of Variable Sampling Adequacy
Total matrix sampling adequacy .972

Variables (Tasks)	Calculated Values
01.	.971
02.	.962
03.	.920
04.	.978
05.	.978
06.	.975
07.	.984
08.	.979
09.	.980
10.	.982
11.	.982
12.	.972
13.	.970
14.	.976
15.	.985
16.	.976
17.	.972
18.	.975
19.	.975
20.	.978
21.	.959
22.	.980
23.	.979
24.	.974
25.	.937
26.	.948
27.	.925
28.	.938
29.	.976
DF: 434	Chi Square: 15737.057

APPENDIX C
Overall Means by Variable

OVERALL MEANS BY VARIABLE

VARIABLE NUMBER	$\bar{X}..$
01.	5.320
02.	4.931
03.	3.929
04.	5.506
05.	5.318
06.	5.112
07.	5.448
08.	5.041
09.	5.522
10.	5.594
11.	5.365
12.	4.697
13.	5.573
14.	5.026
15.	5.239
16.	5.028
17.	5.509
18.	5.466
19.	5.494
20.	5.513
21.	4.363
22.	5.019
23.	4.871
24.	4.618
25.	3.959
26.	4.241
27.	4.575
28.	5.126
29.	5.027

GRAND MEAN = 5.049

APPENDIX D

Letter to Respondents

UNIVERSITY OF ALASKA ANCHORAGE

COLLEGE OF CAREER AND VOCATIONAL EDUCATION
3211 Providence Drive
Anchorage, Alaska 99508

BACHELOR OF SCIENCE IN TECHNOLOGY

January 10, 1993

Dear Colleague:

I am writing this letter to ask for your assistance in the development of the elements of an Ethics course or segment of a course for Welding Inspectors and Nondestructive Technicians. As a leader in your field the process would involve participating in a national survey that is being mailed to a random sample of practicing ASNT Nationally Certified Level III's and AWS Associate and Certified Welding Inspectors.

This paragraph will provide a little personal background about me and why I am interested in doing the project. I presently serve as the coordinator for the Bachelor of Science in Technology program at the University of Alaska Anchorage. I have been involved in Vocational/Technical education for twenty years in the area of Metals, Welding and Nondestructive Testing. I am a certified welding inspector (77052141) and have worked as a level II in PT, UT, RT, MT and ET. The purpose of this project is to develop curricula or a set of competencies in ethics applicable to technicians who will be working in the fields of Nondestructive Testing and Welding Inspection. I have a great concern that ethics training in these areas, as well other technical fields is limited to exposure to a code of ethics and little else.

I would appreciate your prompt response to this request and would be happy to answer any questions you may have about this project. I can be reached at the above address or at the following phone numbers:

Home 907-346-3443.
Work 907-786-1675
Fax 907-786-6008
AFGHP@Anchorage.Bitnet

Thank you for your consideration.

Sincerely,

Gerald H. Park
Professor, AWS # 498858, ASNT #10012AK

APPENDIX E

Final Version of Instrument

Content of an Ethics Course for Nondestructive Testing and Welding Inspection Personnel

---

PLEASE PROVIDE US WITH THE FOLLOWING DEMOGRAPHICS:

Check all that apply:

ASNT Level III _____ ASNT Level II _____ AWS CWI _____ AWS CAWI ____

If ASNT Level III list methods. _____

Number of years you have held present certification. _____

Years of formal education: _____ Degrees held: _____

Title of your present position: _____

Please accept my sincere appreciation for your input in this matter. Should you have any questions regarding this survey, please contact me at this address: Gerald H. Park, 9231 Main Tree, Anchorage, Alaska 99516. **PLEASE RESPOND BY OCTOBER 20, 1992**

Direction: Please evaluate each of the following tasks in accordance with your perception of its importance for inclusion into an Ethics Course for Nondestructive Testing and Welding Inspection Personnel.

Circle the number that best represents importance level

Technicians (ASNT LEVEL III's, AWS CWI's and CAWI's) must be able to:

		Very Unimportant					Very Important
1.	Demonstrate understanding of the role of ethics in business, nondestructive testing and welding inspection.	1	2	3	4	5	6
2.	Explain the purpose of a Code of Ethics and the part it plays in professional conduct.	1	2	3	4	5	6
3.	Be conversant with traditional, norm - centered , abstract principles of moral methodology.	1	2	3	4	5	6

Circle the number that best represents importance level

		Very Unimportant					Very Important
4.	Demonstrate courtesy, respect, honesty and fairness in relationships with customers, suppliers, competitors and fellow employees.	1	2	3	4	5	6
5.	Comply with security regulations.	1	2	3	4	5	6
6.	Understand the importance of punctuality and reliability in attendance in the work place.	1	2	3	4	5	6
7.	Understand the importance of confidentiality of customers, employees, and employer records and information.	1	2	3	4	5	6
8.	Avoid outside activities which conflict with or impair the performance of duties.	1	2	3	4	5	6
9.	Make decisions objectively without regard to friendship or improper personal gain.	1	2	3	4	5	6
10.	Refrain from payment to any person, business, political organization, or public official for unlawful or unauthorized purposes.	1	2	3	4	5	6
11.	Conduct personal and business dealings in compliance with all relevant laws, regulations and policies.	1	2	3	4	5	6
12.	Exercise due diligence in complying with antitrust laws and trade regulations.	1	2	3	4	5	6
13.	Refrain from providing false or misleading information to the business, its auditors, government agencies or customers.	1	2	3	4	5	6
14.	Refrain from using company property or resources for personal benefit or other improper purposes.	1	2	3	4	5	6
15.	Exercise due diligence in accounting for company funds over which the technician has control.	1	2	3	4	5	6
16.	Define conflict of interest.	1	2	3	4	5	6
17.	Provide quality service and products.	1	2	3	4	5	6
18.	Perform assigned duties to the best of their abilities and in the best interest of their employers, customers and society.	1	2	3	4	5	6

Circle the number that best represents importance level

		Very Unimportant					Very Important
19.	Refrain from making false or misleading claims of service or products.	1	2	3	4	5	6
20.	Maintain high standards of personal integrity and professional conduct.	1	2	3	4	5	6
21.	Define discrimination.	1	2	3	4	5	6
22.	Report questionable, unethical or illegal activities to supervisors.	1	2	3	4	5	6
23.	Conserve resources and exercise due diligence in complying with enviromental laws and regulations.	1	2	3	4	5	6
24.	Explain "Whistle Blowing" and how ethics might effect the decision making process.	1	2	3	4	5	6
25.	Define Deontology(ethical theories not based on consequences but on some other moral standard).	1	2	3	4	5	6
26.	Define sexual harassment.	1	2	3	4	5	6
27.	Exercise due diligence in complying with civil rights laws and regulations.	1	2	3	4	5	6
28.	Exercise due diligence in complying with employment laws and regulations.	1	2	3	4	5	6
29.	Exercise due diligence in complying with health and safety laws and regulations.	1	2	3	4	5	6

OPTIONAL Please Describe any situations you have had to deal with in your job that have involved ethics and decision making.

APPENDIX F

Factor Analysis

Oblique Solution Primary Pattern Matrix-Orthotran/ Varimax

Task	Factor I	Factor II	Factor III
01.	+.606	-.173	+.457
02.	+.179	-.106	+.797
03.	-.271	+.209	+.680
04.	+.863	-.075	-.022
05.	+.737	+.197	-.133
06.	+.712	+.216	-.117
07.	+.859	+.078	-.020
08.	+.559	-.032	+.296
09.	+.922	-.137	+.073
10.	+.855	-.026	+.065
11.	+.773	-.098	+.044
12.	+.197	+.631	+.009
13.	+.935	-.068	+.045
14.	+.587	+.261	+.047
15.	+.724	+.202	-.018
16.	+.469	-.016	+.429
17.	+.886	-.032	-.065
18.	+.883	-.005	-.096
19.	+.902	-.013	+.004
20.	+.857	-.169	+.153
21.	+.019	+.646	+.195
22.	+.491	+.313	+.092
23.	+.386	+.470	+.044
24.	+.110	+.313	+.505
25.	-.293	**+.523**	**+.526**
26.	-.120	+.771	+.196
27.	+.004	+.953	-.110
28.	+.148	+.897	-.187
29.	+.483	+.526	-.112

Bold are overlapping loadings

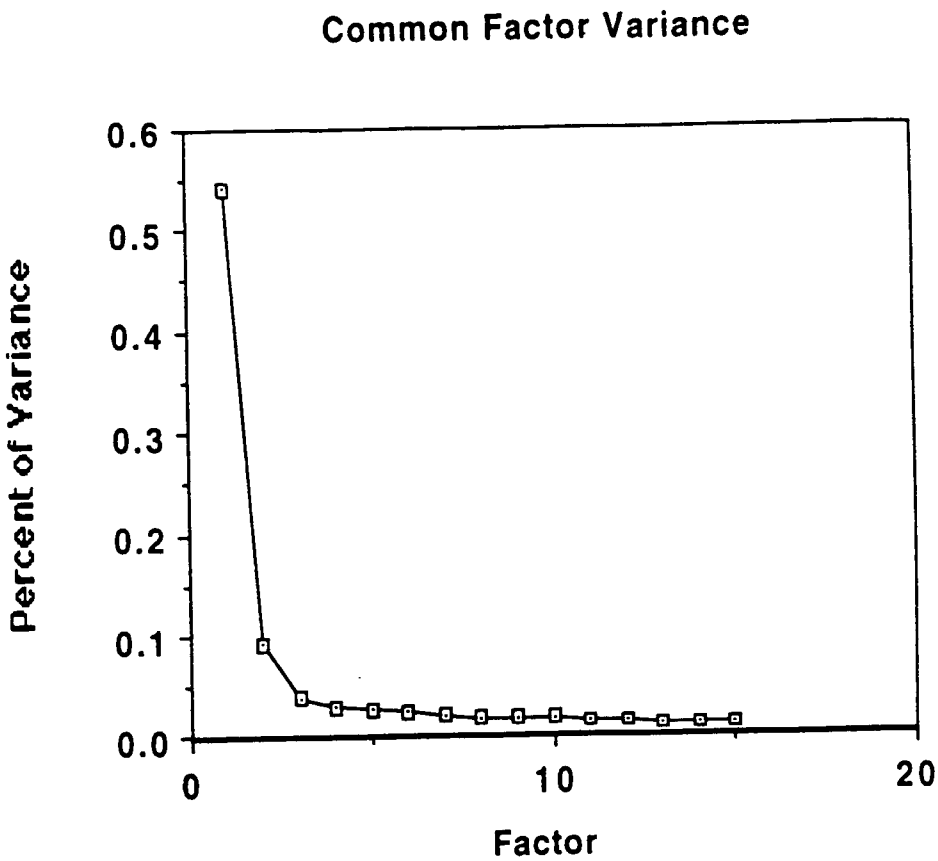
APPENDIX G

Eigenvalues and Proportion of Original Variance

Eigenvalues and Proportion of Original Variance

	Magitude	Variance Prop.	
Value 01	**15.698**	**.541**	
Value 02	**02.629**	**.091**	
Value 03	**01.083**	**.037**	
Value 04	00.880	.030	
Value 05	00.758	.026	
Value 06	00.689	.024	
Value 07	00.615	.021	
Value 08	00.558	.019	75% +
Value 09	00.532	.018	
Value 10	00.506	.017	
Value 11	00.454	.016	
Value 12	00.436	.015	
Value 13	00.373	.013	
Value 14	00.358	.012	
Value 15	00.339	.012	

(Bold = Eigenvalues greater than 1.00)


Common Factor Variance
Percent of Variance
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
Factor