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**Personnel selection and training variables versus job
performance ratings in nuclear power plants**

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PREVIEW

**PERSONNEL SELECTION AND TRAINING VARIABLES
VERSUS JOB PERFORMANCE RATINGS
IN NUCLEAR POWER PLANTS**

A Dissertation Presented

by

TERRENCE J. SMITH

**Submitted to the Graduate School of the
University of Massachusetts in partial fulfillment
of the requirements for the degree of**

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Education

PREVIEW

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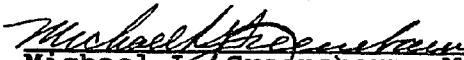
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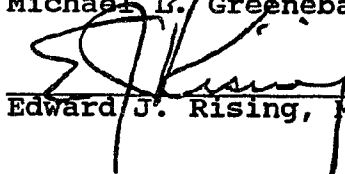
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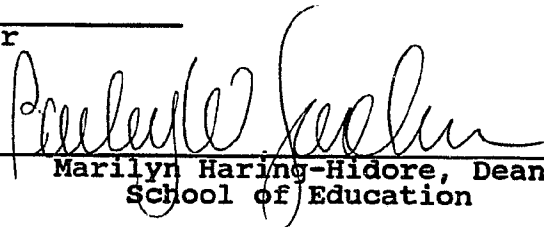
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ABSTRACT

PERSONNEL SELECTION AND
TRAINING VARIABLES VERSUS
JOB PERFORMANCE RATINGS
IN NUCLEAR POWER PLANTS

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The purpose of this study was to identify, classify and provide validity information on variables used in hiring and training nuclear power plant control room operators by contrasting these variables with job performance ratings. Fifty one control room operators and five operator instructors were evaluated for job proficiency using control room simulator performance ratings. These ratings were contrasted with the subjects' pre-employment aptitude test scores, level of formal education achieved, work attitude scores measured post selection, and training scores measured post selection. Results of the analysis were compared to a similar, but less extensive study conducted at a comparable U.S. nuclear power plant.

No single pre-employment aptitude measure used by the plant was found to be correlated with the overall job performance rating variable, simulator performance average at the .05 level of significance. Least squares stepwise multiple regression using three aptitude tests yielded an adjusted R-Squared value of .18 at the .01 level of significance. To the extent that the assumptions for robust stepwise multiple regression are met, the utilization of three aptitude tests and an attitude scale could, however, yield an adjusted R-Squared value as high as .62, at the .001 level of significance. An assessment center approach was recommended for further exploratory research in the selection of control room reactor operators.

TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS	iv
ABSTRACT	v
LIST OF TABLES	viii
GLOSSARY	ix
Chapter	
1. INTRODUCTION	1
2. LITERATURE REVIEW	6
3. METHODOLOGY	60
4. RESULTS	66
5. DISCUSSION	91
APPENDICES	103
A. LEAST PREFERRED COWORKER SCALE	104
B. SIMULATOR TRAINEE PERFORMANCE RATING SCALE	105
C. PRE-EMPLOYMENT APTITUDE TESTS	111
BIBLIOGRAPHY	112

LIST OF TABLES

Table	Page
1 Correlations between aptitude test scores, attitude scale scores, training examination scores and simulator performance ratings, using Pearson r, plant #1	67
2 Rank order correlations between level of education achieved and simulator performance ratings, using Spearman rho, plant #1	69
3 Simple r squared values between aptitude test scores, attitude scale scores, training examination scores and simulator performance ratings, plant #1	73
4 Stepwise multiple regression using aptitude test scores, attitude scale scores, training examination scores, level of education achieved, and simulator performance ratings, plant #1	76
5 Robust stepwise multiple regression using aptitude test scores, attitude scale scores, training examination scores, level of education achieved and simulator performance ratings, plant #1	78
6 Stepwise discriminant analysis for groups: passed pre-employment test, hired; passed pre-employment test, not hired; failed pre-employment test, not hired, plant #1	80
7 Stepwise discriminant analysis for groups: rated high in job (simulator) performance; not rated high in job (simulator) performance, plant #1	82
8 Canonical correlations for multiple predictors and multiple criterion scores, plant #1	83
9 Correlations between aptitude test scores and training final examination scores, using Pearson r, plant #2	85
10 Simple r squared values between aptitude test scores and training final examination scores, plant #2	86
11 Stepwise multiple regression using aptitude test scores and training final examination scores, plant #2	87
12 Stepwise multiple regression using aptitude test scores and final training examination scores, plant #1	88
13 Stepwise discriminant analysis for groups: passed pre-employment test, hired; passed pre-employment test, not hired; failed pre-employment test, not hired, plant #2	89

GLOSSARY

Assessment center - An intensive multiple techniques evaluation process. Candidates in groups of 8-12 are run through a battery of tests at a testing location typically over a 2 or 3 day period. Paper and pencil psychological measures, projective measures, interviews and both individual and group situational tests are administered. Situational tests are often miniature job situations. Candidates are evaluated by several trained assessors, who are usually high level managers and sometimes psychologists (Earles and Winn, 1977).

Forced Choice Rating Scale - Two to five descriptions of behavior are grouped together in a block. Both favorable and unfavorable statements may be included in the block. The rater is asked to select the statement that is most characteristic of the ratee and the statement that is the least characteristic (USAF Manual 50-62, 1974).

Graphic Rating Scale - a combination of numerical and descriptive scales. Various phrases or adjectives are placed below a continuous horizontal line, which represents the range of the ability or the trait being measured. The rater must consider not only the numerical range of the scale, but also the phrases that describe the various positions on the scale (USAF Manual 50-62, 1974).

Job Design/Redesign - Planned job changes to task variety, level, feedback, and job autonomy for the purpose of improving job performance, satisfaction, and work culture (Steers and Porter, 1983).

Moderator variable - a subgroup variable for whom the correlation between a criterion and a predictor variable is significantly different from the correlation for the total sample from which the subgroup was formed. For example, gender would be a moderator variable if it were found that aptitude test scores for elementary students generally predicted school grades better for females than for males (Borg and Gall, 1983).

Multiple cut off - single stage, non compensatory selection approach using several predictors. Failure on any one predictor disqualifies applicant from further consideration (Cascio, 1978).

Multiple hurdles (sequential decision strategy) - a selection approach in which cutting scores on a predictor are used to make investigatory decisions which may continue through several stages of testing before final decisions are made (Cascio, 1978).

Patterned behavior description interview - a structured approach in the which interviewers are trained in techniques of selecting and patterning questions, recording responses and rating applicants on behaviorably defined dimensions (Orpen, 1985).

Realistic job previews - A recruiting technique which emphasizes both the positive and negative aspects of a particular job or organization in order to develop accurate and realistic job expectations in applicants (Porter, Lawler Hackman, 1975).

Trainability testing - A selection technique in which a job seeker is trained to perform a sample of tasks (usually hands on tasks) involved in the job. Immediately following the training, her ability to perform the tasks is measured through a performance oriented test. The approach is based on the assumption that a person who can demonstrate the ability to learn and perform a job sample will be able to learn and perform on the total job, given appropriate on-the-job training (Siegel, 1978).

CHAPTER 1

INTRODUCTION

Background

Since the events at Three Mile Island, national reports have called for an upgrading of training at American nuclear power plants (described in Haas, Hanley, Mercer and Selby, 1983). The formation of the Institute for Nuclear Power Operations has played a key role in raising and maintaining training standards by establishing a nation wide accreditation process.

Problem

As a report from the Oak Ridge National Laboratory (ORNL) to the U.S. Dept. of Energy pointed out, nuclear power plants seem to lack a fully developed screening process based on factors that shape the performance of the central job in most plants, namely, that of the reactor operator (Haas, et al., 1983).

The main purpose of the control room reactor operator's job is to operate (including starting up and shutting down the reactor) a nuclear power plant, with its numerous associated systems, to produce electricity safely. The control room reactor operator's job encompasses extreme responsibilities. The operator must be able to handle heavy equipment as well as precision instrumentation and controls. The operator

must be able to endure long periods of physical inactivity spent monitoring the control room panels and, at a moment's notice, be able to respond immediately to alarms, malfunctions, abnormal occurrences, and emergency conditions. The job of the operator has been described as requiring the skills of a manual laborer and the intelligence of a college graduate (Thompson, 1979).

An important focus for inquiry would, therefore, be the ultimate development and validation of a taxonomy of variables that affect the job performance of control room operators. Poor job performance by nuclear power plant reactor operators cannot be tolerated by the nuclear power industry, the government or society at large. Personnel specialists, trainers and supervisors must have a clear understanding of what factors affect reactor operator job performance to assure that the most qualified people are identified, selected, properly trained and effectively managed.

The first step toward developing this understanding would be an examination of current selection and training processes to determine their effectiveness in predicting subsequent job performance.

Purposes

The main purpose of this study is to identify, classify and provide validity information on variables used in hiring and training nuclear power plant control

room operators by contrasting these variables with job performance ratings. It is hoped this approach will (eventually) yield a management strategy for more efficient and effective selection and training. More specifically, the following hypotheses, presented in the in the traditional negative form, were investigated.

Hypotheses

1. There is no significant relationship between general aptitudes measured pre-employment and job performance of control room reactor operators measured during employment.
2. There is no significant relationship between achievement in classroom training measured during training (post selection) and job performance of control room reactor operators measured during employment.
3. There is no significant relationship between highest level of formal education achieved measured pre-employment and job performance of control room reactor operators measured during employment.
4. There is no significant relationship between work attitudes measured during employment and job performance of control room reactor operators measured during employment. (Since no attitude measures from pre-employment screening are available

to this writer, concurrent data using job incumbents were collected.)

Significance of the study

Since the cost of training a single reactor operator has been estimated to be approximately \$150,000, a valid predictor of performance (during training) seems to be economically desirable, if not imperative (Haas, et al, 1983). In addition to aiding the cost effectiveness of the selection and training process, the results of this study may help to identify the best potential operators. Furthermore, the results of this study may provide insights into the nature of reactor operator job performance behaviors at nuclear power plants. The author decided to investigate the importance of work attitudes, based on a hunch that operators who were primarily task oriented in their work would be more effective in emergency situations than would be operators who were primarily oriented toward their personal relationships at work.

In addition, the results could be used to improve the predictive strength of the selection process, to clarify the performance criteria in reactor operator training programs, to help minimize reactor operator turnover, and to gear training toward individual needs and requirements. The results also could be used to improve personnel performance appraisal instruments for reactor operators, since factors affecting reactor operator performance

should be considered in the development and implementation of job performance appraisal instruments. Finally, a strong relationship between personnel selection data and performance criteria would serve to address some of the requirements of Equal Employment Opportunity law, should the need to demonstrate fairness in the selection process arise.

A clear understanding of variables affecting control room reactor operator job performance, while contributing to the vast, though often confusing, job performance literature, could have implications for formal education programs, particularly at the high school and college levels. For example, evidence of the effect on job performance of variables such as workers' attitudes, and aptitudes such as verbal reasoning, mechanical reasoning, abstract reasoning, spatial relations and numerical reasoning, should prove helpful to trade and nonvocational high school teachers, counselors, curriculum specialists and administrators. College level programs in the physical sciences and engineering could benefit from knowledge of job performance data as well, especially since nuclear engineering enrollment and degree completion statistics for students seeking bachelor's and master's degrees have been on a downward trend since 1977 (Payne, 1989). This trend was one reason the author chose to investigate the relationship between level of education achieved and job performance. Should the trend be a concern to the industry and the public?

CHAPTER 2

LITERATURE REVIEW

Introduction

Chapter two's purpose is to evaluate major substantive and methodological contributions to the study of factors affecting job performance and satisfaction. Selected issues in personnel selection and performance evaluation are also considered, because of their potential relevance to this study and future research. Key terms used in the review are defined in the glossary which begins on page ix of this dissertation.

Factors Affecting Job Performance and Satisfaction

Perhaps the most striking aspect of reviewing work performance and satisfaction literature is the sheer number of studies which have investigated a variety of variables associated with work performance and satisfaction. Whereas other reviews have focused on theoretical propositions concerning satisfaction and performance, this review examines only empirical research investigating variables affecting both performance and satisfaction. Many of the studies in this review are not theory-based and do not attempt to interpret findings in relation to theoretical propositions.

In addition, discussion of theoretical propositions must be limited to provide a manageable framework for

investigation, though some references to the potential implications for conceptual models will be made. The conceptual framework proposed by Porter & Miles (1974) serves as a useful model for organizing the variables for review and analysis in this paper. That model, originally developed to address variables affecting motivation, is expanded and applied here to organize variables affecting both job performance and satisfaction. Thus, the variables reviewed here are grouped as those unique to individuals, those arising from the nature of the job, and those associated with the organizational environment. The list of variables which follows is neither exhaustive nor arbitrary; it represents those variables which have been investigated and reported most frequently.

First, personal characteristics were limited to age, academic grades, needs, personality traits, sex role and physical fitness. Next, job related characteristics associated with job performance, for the purpose of this review, included job design, feedback, decision-making involvement, job related stress/burnout, and goal setting.

Last, work environment characteristics were limited to pay, levels of communication, and leader/follower compatibility.

Personal Characteristics

Bourne (1982) reported that as people grow older, they shift importance from extrinsic rewards to intrinsic

satisfaction. Job motivation can also be affected by external and physiological conditions associated with aging. Researchers investigating the effect of age on performance, should use performance indices that are valid & reliable across the life span, according to Alexander and Barrett (1982), in order to ensure non discriminatory indicators of the performance of older workers. They found that many employee performance measures provide no norms for older groups.

Considerable research has investigated the association between academic grades/test scores and both job performance and satisfaction. Samson et al.'s (1984) synthesis of the results from thirty five studies of job performance in various fields indicated that on average only 2.4 percent of the variance in performance criteria such as income, job satisfaction and effectiveness ratings could be accounted for by academic grades at the undergraduate and graduate levels. Samson et al. did find that job performance predictions based on academic indices were somewhat higher in nursing and business, somewhat lower in engineering and teaching and not significant for MD's and PhD's. Of course the relative homogeneity of groups completing degree programs reduces predictor variance and thus, the correlations obtained. Similar low correlations were reported by investigators seeking to predict performance and satisfaction for occupational therapists using qualification certification instruments (Muthard et al., 1976).

There is some evidence that academic preparation of vocational education graduates, however, may affect attitudes, if not performance. A survey of over 1500 former students (completers and leavers) and over 775 employers/supervisors indicated that work attitude of former vocational education students received consistently high ratings by employers (Mass. Dept of Education, 1982). Former vocational students were also rated as better prepared than coworkers (non vocationally trained) by almost eighty percent of the employers. No evidence of academic preparation as a predictor of performance was reported. Gill (1982) has suggested that there may be an optimum range of intelligence for trainability in decision making and consequently, for management potential. The author suggested that intelligence is overemphasized in assessing management potential and should be seen as a moderator for trainability, rather than an achievement level. Along the same line, Sternberg and Wagner (1987) have reported "work related common sense," as measured by the authors' Tacit Knowledge Inventory for Managers, to be more effective than standard intelligence measures in predicting one's ability to learn how to solve practical job-related problems.

Individual needs and values have been examined as predictors of performance and moderators of role stress and performance outcomes relationships. Beehr, Walsh and Taber (1976) have reported that Higher Order Need Strength, or need for achievement and growth, serves as a moderator of relationships between individually valued

performance outcomes (e.g. satisfaction) and role stresses. Steers (1975) has also found that need for achievement can moderate the job performance-job satisfaction relationship.

Support for the moderating role of employee Higher Order Need Strength (HONS) has also been reported by Abdel (1980), who found that for strong HONS individuals, job performance is positively related to intrinsic as well as extrinsic job satisfaction sources. No such relation was found for weak HONS individuals. Further support for the moderating effect of HONS has been obtained by Spector's (1985) meta-analysis of twenty studies providing high and low need strength correlations. Spector's results provide some evidence of the HONS moderator effect for relationships between job scope and job satisfaction, motivation and performance. The strongest evidence was for the HONS moderator effect on the relationship between job scope and job satisfaction. High HONS employees showed stronger correlations with all outcomes (satisfaction, motivation & performance) than did weak need strength employees. More research is needed to assess the findings reported in Kuhn et al.'s (1971) earlier work, which found that satisfaction of needs low on Maslow's hierarchy, such as security and social needs, was more closely associated with job performance than satisfaction of higher needs, such as autonomy and self actualization.

Personality characteristics have also been investigated as potential predictors of performance and

satisfaction. Matteson et al. (1984) investigated the relationship between Type A (achievement oriented) and Type B (affiliation oriented) behavior, sales performance and job satisfaction among 355 life insurance agents, but found no significant differences between Type A and Type B agents on job satisfaction and sales performance measures.

The importance of using personality test data to predict performance in stressful occupations is underscored by the study of 650 corrections officers undertaken by Inwald et al. (1981). Officers whose recruitment Minnesota Multiphasic Personality Inventory (MMPI) scores were rated as "not acceptable" (N=48) had significantly more corrective interviews, absences, and tardiness during the initial ten months of employment, than did those in the marginal (N=164) or acceptable group (N=448).

Significant correlations were found between supervisor rated performance of secondary school guidance counselors and tested personality characteristics (Wiggins and Weslander, 1986). Counselors rated as effective had higher test scores in self esteem and tolerance for ambiguity and expressed higher job satisfaction than did counselors rated as ineffective by supervisors. Funk (1968) investigated the relationship between dogmatism scores and measures of job performance for 486 county agricultural extension agents. The results of correlations between Brayfield Rothe Job Satisfaction Scale, Rockeach Dogmatism Scale (Form E), supervisor ratings and personal information indicate that higher performance