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Robert F. Reardon
Solvay Advanced Polymers, LLC., USA

Thomas Valentine
University of Georgia, USA

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Robert F. Reardon
Solvay Advanced Polymers, LLC., USA
Thomas Valentine
University of Georgia, USA

Abstract: *A study was conducted at twelve manufacturing facilities. The data from this study indicated the response of blue-collar workers to imposed technological change can be conceptualized as having seven factors: Disgruntlement, Job-security concerns, Accommodation, Informal learning, Resistance, Discussion, and Formal learning. Cluster analysis of the data identified three types of blue collar workers: Complainers, Team players, and Loners. In this study, membership in the Team players cluster increased as a function of age.*

Purpose of the Study

Modern manufacturing settings constantly struggle to preserve a competitive edge. Companies look to increase productivity, improve product quality, respond more quickly to the marketplace, and decrease operating costs, while complying with government safety and environmental regulations. Managers often invest in new or improved technologies to meet one or more of these goals, and technology change is happening at unprecedented rates in many manufacturing sectors. These innovations are planned at the management level, often with little or no input from the blue-collar workers on whom the company's production relies. As a result, by the time blue-collar workers learn of the change, it is a "done deal" and their task is to adapt to externally imposed changes that can profoundly affect their jobs. To date, scholars have examined many aspects of technology change, but more often from managerial perspectives focusing on process or cost-benefit data. Little effort has been made to understand and conceptualize the ways in which blue-collar workers respond to the changes that have come to characterize the manufacturing workplace.

The purpose of this study was to conceptualize and understand the responses of blue-collar workers when faced with externally imposed technological change. Two research questions guided the study:

1. How can these responses best be grouped into conceptually meaningful dimensions of response to imposed technological changes?
2. How can these employees be grouped into types based on their response in each of these dimensions?

Theoretical Framework

No area of the literature describes the response of blue-collar workers to imposed technological change. Therefore, this work was theory generating. It drew on several existing areas of the literature. These areas included diffusion of innovations, technological change management, the learning organization, and informal learning.

Diffusion of Innovations

Rogers (1995) describes the diffusion of innovations through groups and organizations. This work assumes that the decision to adopt an innovation is voluntary. Therefore, the findings from this body of literature are not directly applicable to the situation where technological change is thrust upon blue collar workers. However, some findings may provide ideas which are starting points for this work. For example, Rogers (1995) describes how opinion leaders affect

the adoption decisions of new innovations. Likewise, opinion leaders might have an impact on the responses of blue-collar workers toward imposed change.

Technological Change Management

Several authors (Havelock & Havelock, 1973; Levine, 1980; Tornatzky, 1983) have described research associated with the implementation of innovations. Most of this literature describes innovations that are planned and implemented with the assistance of change agents. In most cases, the changes are isolated changes to an otherwise stable environment. This research was conducted from the standpoint of the organization or change agent, and did not focus on the responses of individuals to imposed change.

Learning Organizations.

Learning organizations are designed to stimulate learning at all levels (Senge, 1990; Watkins & Marsick, 1994). Social networking is an important part of learning in a learning organization (Marsick & Watkins, 1999). The responses of blue-collar workers to imposed technological change might depend on whether or not the change takes place in a learning organization.

Informal Learning

Numerous authors have described informal learning and experiential learning in organizations (Cseh, 1998; Lave & Wenger, 1991; Marsick & Volpe, 1999). The literature indicates that the majority of workplace learning is informal (Stolovitch & Keeps, 1999). Presumably, informal learning is an important response to imposed technological change.

There was no coherent model or theoretical framework to describe the response of blue-collar workers to imposed technological change. However, these areas of the literature suggest some of the ways that these employees might respond to this situation.

Research Approach

This data for this study was collected through the responses to survey questionnaire. The steps included survey development, validation, data collection, and data analysis. This process took approximately six months.

Survey Development

The literature of diffusion of innovations, informal learning, learning organizations, stages of concern, and technological change management was carefully reviewed for anything that might be a response of workers to imposed change. These were recorded in a database. Next, the researchers reviewed the transcripts of two prior qualitative studies of change in the workplace. These transcripts were examined for dialogue that might be a response that blue-collar workers would have to imposed technological change. These were also recorded in the database. Finally, a brainstorming session was held with four blue-collar workers from a manufacturing facility. The workers were asked to describe how they dealt with imposed technological change. The session was audio-taped and transcribed. This transcript was closely examined for responses to change. These responses were also recorded in the database.

At the end of this process, the database had 220 items in it. The items were reviewed by the researchers. Redundant items and items that did not fit the description of employee response to imposed technological change were eliminated. After this review, the pool of items was 72.

The pool of items was reviewed by a panel of four doctoral students in human resource development. They were asked to eliminate redundant items, and items that did not fit the definition of employee response to imposed technological change. This reduced the pool of items to 54 items. The panel was also asked to add any responses that they felt were missing. The panel did not suggest any new items.

These 54 items were assembled into a survey questionnaire. Each item was a Likert-style item with possible responses of "Strongly agree," "Agree," "Disagree," and "Strongly disagree." This questionnaire was tested by giving it to five individuals. Their impressions and comments were recorded. Several suggestions and corrections were incorporated into the questionnaire.

The questionnaire was tested in a pilot study, given to 44 blue-collar workers (Reardon, 2004). The pilot study went well and the questionnaire was not modified.

Validation of the Item Pool

Several steps were taken to make sure that the items in the questionnaire were valid. They were pulled from three sources (literature, qualitative studies, and the brainstorming session). They were reviewed by four students of human resource development. It was felt that these steps resulted in a pool of items that were actual responses to imposed technological change.

Several steps were taken to make certain that the list of responses was complete. First, items were pulled from different sources (brainstorming session, literature, and past studies). Second, at the end of this process, no new items were being uncovered. A third check on the adequacy of the coverage is the reduction in numbers of items during the review process. The reviews eliminated items that were redundant or that did not fit the definition of the central construct. The 75% (from 220 to 54) reduction in items supports the concept that the list was saturated. These steps support the assertion that the list of 54 items adequately addresses the construct of employee response to imposed technological change.

Data Collection

The target population for this research was blue-collar workers in manufacturing. Data were collected from twelve manufacturing sites throughout the southern United States. Each participant received a package with the questionnaire, a cover sheet soliciting their participation, a sheet describing their rights within the study, and an envelope to return the survey. Most of the surveys were distributed at shift meetings or training sessions.

Of the 583 packages distributed, 288 complete questionnaires were returned. The data were entered into a spreadsheet. The spreadsheet was examined for blanks or values that were not correct. A random audit of ten questionnaires was conducted to verify data entry. No errors were found.

Findings

There were two goals of this study. The first was to discover the dimension of blue-collar response to imposed technological change. The second was to uncover a typology of blue-collar worker, based on these dimensions.

Dimensions of Worker Response

The survey had 54 items designed to measure the central construct of blue-collar worker response to imposed technological change. Exploratory factor analysis was used to identify the dimensions of response.

Two traditional methods were tried at first. The minimum eigenvalue solution indicated the fourteen-factor solution. Examination of the scree plot is another traditional means of selecting the best solution. In this case, this method was ambiguous. It seemed to indicate solutions of four, seven or nine solutions.

The goal of this analysis was to find a factor solution that was conceptually meaningful with as few as factors as possible. Factor solutions were generated for the cases of two through ten factors using Varimax rotation. These solutions were carefully examined to determine if they were conceptually meaningful (Perdue, 1999). The seven-factor solution appeared to be the best

possible solution. This solution accounted for 49.7% of the variance. The seven factors in this solution were named Disgruntlement, Job-security Concerns, Accommodation, Informal Learning, Resistance, Discussing the Change, and Formal Learning (Reardon, 2004, 2005).

Factor I: Disgruntlement. The first factor included twenty items with loading at or above 0.45. These employee responses seem to share disgruntlement as a theme. They reflect the anger, dissatisfaction, discontent and frustration of the employee and might be seen (from the viewpoint of the employee or the company) as undesirable responses.

Factor II: Job-security concerns. The second factor grouped responses related to employees' sense of security. These items mention concern over the ability to do the job, losing prestige relative to coworkers, and coworkers losing their jobs.

Factor III: Accommodation. The employee responses found in Factor III were labeled Accommodation because they seem to describe the employees' attempts to relate the imposed technological change to their environment. They describe the employees' attempts to teach others how to use the imposed technological change, or how they modified the change to fit their situation.

Factor IV: Informal learning. Factor IV grouped employee responses that described some forms of experiential or informal learning. The high means for these items indicated that they were some of the strongest employee responses to imposed technological changes.

Factor V: Resistance. A common theme that cuts across the employee responses of Factor V is resistance to the imposed technological change. The employees did not want to adopt the imposed technological change and took steps to delay or avoid adoption. These employee responses are different from Factor I: Disgruntlement since these employee responses reflect an action taken against the imposed technological change.

Factor VI: Discussing the change. Factor VI included items related to the discussion of the imposed technological change. In the literature, this discussion is reported as social networking.

Factor VII: Formal learning. These employee responses are actions of the employees to take part in training or learning opportunities sponsored by the company or the implementers of the imposed technological change.

Typology of blue-collar worker

Cluster analysis is a tool used to differentiate the blue-collar workers in this study into groups, based on their responses to the questionnaires. K-means cluster solutions were calculated on the factor scores for the cases of 2 through 6 clusters. The most meaningful solution found was the three-cluster solution, shown in Table 1.

Table 1. Three Types of Blue-collar Workers.

Type	Type Label	Defining Characteristics
1	Complainers	High disgruntlement, high discussion, and low resistance
2	Team players	Low disgruntlement, high accommodation, and high informal learning
3	Loners	Low accommodation, low informal learning, and low discussion

Cluster 1 was called "Complainers" because these workers appeared to be unhappy with the imposed technological change, but felt powerless to oppose the change. They showed their discontent in discussions with others. Cluster 2 seemed to be workers that worked with their coworkers and the imposed change. The label for this group was "Team players." The final

cluster did not work with others or the change. They were called "Loners," because of the apparent lack of interaction.

We looked at how various groups distributed across these clusters (Table 1). Roughly 30% of the employees were Loners or Complainers and 40% were Team players.

Table 2. Demographics of each cluster.

	Number	Cluster 1 Complainers	Cluster 2 Team players	Cluster 3 Loners
Everyone	287	28.6%	40.4%	31.0%
Role				
Hourly-employee	251	31.5%	38.2%	30.3%
Supervisor	22	4.5%	68.2%	27.3%
Race				
African-American	66	18.2%	47.0%	34.8%
White	198	30.3%	40.9%	28.8%
Age				
Twenties	15	46.7%	20.0%	33.3%
Thirties	67	35.8%	37.3%	26.9%
Forties	108	27.8%	46.3%	25.9%
Fifties	71	18.3%	40.8%	40.8%
Sixties	9	22.2%	55.6%	22.2%
Education				
High school	195	26.2%	42.6%	31.3%
Diploma	25	36.0%	36.0%	28.0%
Associate degree	34	32.4%	41.2%	26.5%
Bachelor degree	20	30.0%	35.0%	35.0%
Graduate degree	4	50.0%	50.0%	0.0%

Note that the supervisor membership in "Complainers" was very low. This may be because they are in a position of power, and are in a position to accommodate the change. Likewise, African-American membership in the "Complainers" was lower than the general population. The very low number of female participants makes any analysis inappropriate.

An interesting trend is apparent when cluster membership is viewed as a function of age. Younger workers tended to be in the "Complainers," whereas older workers were more "Team players." There were not any clear-cut trends when cluster membership is viewed as a function of education.

Implications for Adult Education Theory and Practice

This work has some clear implications in adult education practice in the manufacturing workplace. The answer to the first research question revealed seven dimensions of blue-collar worker response to imposed technological change. Formal and informal learning take place, as well as accommodation and discussion. The imposed changes also generate disgruntlement, resistance and job-security concern. These are responses to which the adult educator in this situation must attend.

The answer to the second research question demonstrates that there are three types of workers, Complainers, Team players, and Loners. Since a higher percentage of older workers appear to be "Team players," adult educators in manufacturing might look to these older workers

to provide leadership for change. Presumably, Team players may be able to shape employee opinion and facilitate the adoption of new technology.

There should be further research to validate the findings of this study. For example, the results from this study indicate that African-American worker membership in the "Complainers" is lower than White workers. It is not clear why this would be the case. A qualitative study might provide a better understanding of the perspectives of African-Americans and other groups in manufacturing, specifically related their response to imposed technological change.

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