An Assessment Method of Psychosocial and Organizational Factors for Injury Risk Impact of Automation

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1. Introduction

A complex manufacturing process that has been performed mostly manually over several decades is undergoing a major process change with the introduction of automation. The process change and new equipment is predicted to reduce physical injury risk by alleviating the physical injury risk factors present in the manual process. Injury risk is multi-factorial and includes psychosocial, organizational and individual factors in addition to the assessed physical risk factors. The goal of the described evaluation was to assess changes in these other potential contributors to injury risk before and after introduction of the automated process. The developed assessment tool may be applied in different organizations to assess psychosocial and organizational climate conditions and impacts of change.

2. Method

2.1 Subjects

Thirty-two full-time hourly equipment operators and mechanics in areas with pending introduction of automation took part in the assessment. All personnel were volunteers and no personally-identifying information was collected to ensure all responses were anonymous. The study protocol and instrument were reviewed by the company Institutional Review Board and ruled exempt.

2.2 Procedures

A written questionnaire was completed by participants during paid pre-shift meetings. The developed questionnaire tool comprised assessment of safety climate, psychosocial and mental workload factors. The questionnaires were completed in pre-shift team meetings. All questions comprised standardized scales which were scored and compared in a between-subjects group analysis before and after automation. The pre-automation questionnaire responses were collected in May 2014, with the post-automation responses to be collected for inclusion in the final results and presentation. Between-subjects t-test comparisons of pre-post scores for each standardized scale were used to evaluate statistical differences. An analysis of variance (ANOVA) was run with post-hoc tests as appropriate to evaluate interaction effects between scales. Physical injury risk factor data were also be assessed using standardized observational data in a company injury risk assessment system.

2.3 Apparatus

The questionnaire was comprised of three standardized scales: 1) NASA Task Load Index (TLX) (Vidulich and Tsang, 1986) for mental workload, 2) Karasek’s Job Content Questionnaire (Karasek, 1985) for Psychological Demand and Control, and 3) an Abbreviated 7-item DeJoy Safety Climate Survey (Jorgensen et al., 2007). Basic demographic information were collected categorically to assess any influences of age, gender or length of employment.

3. Results
The Job Demands Score average (Std. Dev.) was 30.1 (6.6), the Skill Discretion Score was 26.9 (6.1), and the Decision-making Authority Score was 24.8 (8.8). The resulting Job Decision Latitude (Skill Discretion + Decision-making Authority) Score was 51.6 (31.7).

The Mental Workload Score averages (20 point scale) were Mental Demand: 10.3 (5.8), Physical Demand: 9.6 (4.9), Temporal Demand: 11.3 (5.0), Performance: 7.8 (5.5), Effort: 13.5 (3.6), Frustration: 10.9 (5.7). The average scores (1: Strongly Disagree to 4: Strongly Agree) from the 7-item safety climate scale ranged from 2.7-3.0 (0.7-0.9), resulting in a composite score of 19.8.

4. Discussion

The average Psychological Demand-Job Control scores measured were lower than US National average scores from previous US Quality of Employment Surveys (Karasek et al., 1985;1998). While the Job Demands score was close to the reported US average of 30.9 (+/- 8.5), the Job Decision Latitude score was lower than the US average of 70.3 (+/- 15.6). The Decision Latitude score may be expected to be lower than average across occupations for the industrial manufacturing process that was assessed.

Most of the Mental Workload scale averages were near the middle of the 0-20 visual-analog scales, with the exceptions of Performance, which was possibly lower than US averages, and Effort, which was higher. These results relate that workers were likely perceiving a higher-level of Effort on average than previously reported population averages. The baseline safety climate score was positive across the group, with scores for all measures consistently near “Agree” on the categorical scale.

The use of this instrument demonstrates use of a method that can be easily deployed, generally taking less than 10 minutes to complete, to obtain the status of the psychosocial, job demand and safety climate conditions in most work environments. These results can be successfully used to target workplace improvement activities and to assess the effects of changes due to automation or other changes in organization.

References


