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Carl Mikael Lind, Mikael Forsman & Linda Maria Rose. *Development and evaluation of RAMP I – a practitioner’s tool for screening of musculoskeletal disorder risk factors in manual handling*. Pages: 165-180.

RAMP I is a screening tool developed to support practitioners in screening for work-related musculoskeletal disorder risk factors related to manual handling. RAMP I, which is part of the RAMP tool, is based on research-based studies combined with expert group judgments. More than 80 practitioners participated in the development of RAMP I. The tool consists of dichotomous assessment items grouped into seven categories. Acceptable reliability was found for a majority of the assessment items for 15 practitioners who were given 1 h of training. The usability evaluation points to RAMP I being usable for screening for musculoskeletal disorder risk factors, i.e., usable for assessing risks, being usable as a decision base, having clear results and that the time needed for an assessment is acceptable. It is concluded that RAMP I is a usable tool for practitioners.

- **Keywords:** RAMP tool, risk assessment, risk management, manual materials handling, checklist, observation, reliability, usability

Yingyu Zhang, Linlin Jing, Qingguo Bai, Tiezhong Liu & Yan Feng. *A systems approach to extraordinarily major coal mine accidents in China from 1997 to 2011: an application of the HFACS approach*. Pages: 181-193.

This study aimed to provide a greater understanding of the systemic factors involved in coal mine accidents and to examine the relationships between the contributing factors across all levels of the system. Ninety-four extraordinarily major coal mine accidents that occurred in China from 1997 to 2011 were analyzed using the human factors analysis and classification system (HFACS). The empirical results showed that the frequencies of unsafe behaviors, inadequate regulation and failure to correct hidden dangers were the highest among five levels, 14 categories and 48 indicators, respectively. The odds ratio technique was applied to quantitatively examine the relationships between contributing factors. Various statistically significant associations were discovered and should receive greater attention in future attempts to develop accident measures. In addition, several

strategies concerning the main contributing factors and routes to failure are proposed to prevent accidents from reoccurring in an organization.

- **Keywords:** accident analysis, systems approach, human factors analysis and classification system, extraordinarily major coal mine accidents

Rahul Jain, Makkhan Lal Meena, Manoj Kumar Sain & Govind Sharan Dangayach. *Pulling force prediction using neural networks*. Pages: 194-199.

Purpose. In ergonomics and human factors investigations, pulling force (PF) estimation has usually been achieved using various types of biomechanical models, and independent approximation of PF was done with the help of upper extremity joints. Recently, multiple regression methods have gained importance for task-relevant inputs in predicting PF. Artificial neural networks (ANNs) also play a vital role in fitting the data; however, their use in work-related biomechanics and ergonomics is inadequate. Therefore, the current research aimed to accomplish comparative investigation of ANN and regression models by assessing their capacity to predict PF values. Methods. Multipositional PF data were acquired from 200 subjects at three different handle heights and body locations. ANN and regression models were formed using a random sample of three subsets (75% training, 15% selection, 10% validation) for proving the outcomes. Results. The comparison of ANN and regression models shows that the predictions of ANN models had a profoundly explained variance and lower root mean square difference values for the PF data at three handle heights. Conclusions. These outcomes advise that ANNs offer a precise and robust substitute for regression methods, and should be considered a useful method in biomechanics and ergonomics task assessments.

- **Keywords:** industrial ergonomics, manual handling, neural network, handle height, pulling force

Yung-Hsiang Cheng. *Railway safety climate: a study on organizational development*. Pages: 200-216.

The safety climate of an organization is considered a leading indicator of potential risk for railway organizations. This study adopts the perceptual measurement-individual attribute approach to investigate the safety climate of a railway organization. The railway safety climate attributes are evaluated from the perspective of railway system staff. We identify four safety climate dimensions from exploratory factor analysis, namely safety communication, safety training, safety management and subjectively evaluated safety performance. Analytical results indicate that the safety climate differs at vertical and horizontal organizational levels. This study contributes to the literature by providing empirical evidence of the multilevel safety climate in a railway organization, presents possible causes of the differences under various cultural contexts and differentiates between safety climate scales for diverse workgroups within the railway organization. This information can be used to improve the safety sustainability of railway organizations and to conduct safety supervisions for the government.

- **Keywords:** safety climate, railway organization, factor analysis, multilevel safety climate

Thanwadee Chinda, Veeris Ammarapala & Suthathip Suanmali. *Key factors influencing management decisions concerning safety equipment selection*. Pages: 217-227.

The construction industry involves many hazardous activities that may expose workers to a wide variety of health hazards. Selection of construction safety equipment is crucial in

ensuring workers' safety. This article aims to examine key factors influencing management decisions concerning safety equipment selection, utilizing exploratory factor analysis (EFA) and the analytic hierarchy process (AHP). A questionnaire survey is conducted in the construction companies in Bangkok, Thailand. The factor analysis extracts 103 sets of data into six key factors – namely supplier agreements, supplier support, personal, equipment design, safety-related policies and cost value factors – with a total of 20 associated items. The AHP results conclude that the safety-related policies, equipment design and personal factors are the most important factors when selecting construction safety equipment. A construction company can use the study results as a checklist to help assess different safety equipment, and to select the best equipment.

- **Keywords:** analytic hierarchy process, construction safety equipment, exploratory factor analysis, Thailand

Boris Agarski, Miodrag Hadzistevic, Igor Budak, Slobodan Moraca & Djordje Vukelic. *Comparison of approaches to weighting of multiple criteria for selecting equipment to optimize performance and safety.* Pages: 228-240.

Nowadays every piece of working equipment and tools has to comply with safety standards and laws. This study investigated multi-criteria methods for selecting working equipment in order to optimize performance and occupational safety. The multi-criteria decision-making (MCDM) method was applied to the problem of selecting optimal working equipment using four different criterion weighting approaches (direct weighting, revised Simos procedure, Fuller's triangle and analytic hierarchy process). Groups of economic, technical and safety criteria were defined and five weighting scenarios were developed. Although the four weighting methods produced similar results, in some situations they produced different criterion weighting factors. The final output of the MCDM method was the identification of the optimal forklift in the five weighting scenarios. Although we have applied the MCDM method to a forklift selection problem, it can be applied to all sorts of working equipment in contexts where economic, technical and safety selection criteria can be identified.

- **Keywords:** multi-criteria, occupational safety, working equipment, weighting approaches

Konrad Kulikowski. *One, two or three dimensions of work engagement? Testing the factorial validity of the Utrecht Work Engagement Scale on a sample of Polish employees.* Pages: 241-249.

Work engagement, as conceptualized by the Utrecht Work Engagement Scale (UWES), is a work-related positive state of mind that is characterized by vigour, dedication and absorption; however, it still remains unclear how many dimensions work engagement comprises. This study tested the factorial validity of 11 different UWES factorial models that are available in the literature using a confirmatory factor analysis approach on a large sample of multi-occupational Polish employees (N = 1420). The two-factor UWES-6, comprising vigour and dedication, was found to be reliable and remained invariant across samples drawn from four different organizational positions. It also presented a better fit than the three-factor UWES-9, which is a scale used as a standard in contemporary research on work engagement. The findings suggest that the three-factor UWES-9 might not be an optimal measure of work engagement in Poland.

- **Keywords:** work engagement, UWES, Utrecht Work Engagement Scale, factorial validity, confirmatory factor analysis, Polish

Dorota Raczkiewicz, Tomasz Saran, Beata Sarecka-Hujar & Iwona Bojar. *Work conditions in agriculture as risk factors of spinal pain in postmenopausal women. Pages: 250-256.*

The aim of the study was to evaluate the risk factors for spinal pain in Polish postmenopausal women working in agriculture. The study included 1751 randomly selected postmenopausal women aged 45–65 years. The women were exposed to hazardous work conditions, in particular the use of force and heavy lifting, often more than 10 kg and with frequency of at least once a day. Two-thirds of them suffered from spinal pain, mostly in the lumbar spine and less frequently in the cervical and thoracic spine. The prevalence of spinal pain depended on exposure to health risks associated with overwork, early onset of menopause and increasing age. The prevalence of pain in the lumbar spine correlated positively with higher frequency of heavy lifting and using excessive force during agricultural work. The severity of spinal pain correlates positively with the age of pain onset and negatively with level of education.

- **Keywords:** menopause, work conditions in agriculture, spinal pain

Vitharanage Hashini Paramitha Vitharana & Thanwadee Chinda. *Structural equation modelling of lower back pain due to whole-body vibration exposure in the construction industry. Pages: 257-267.*

Whole-body vibration (WBV) exposure is a health hazard among workers, causing lower back pain (LBP) in the construction industry. This study examines key factors affecting LBP due to WBV exposure using exploratory factor analysis and structural equation modelling. The results confirm five key factors (equipment, job related, organizational, personal, social context) with their 17 associated items. The organizational factor is found the most important, as it influences the other four factors. The results also show that appropriate seat type, specific training programme, job rotation, workers' satisfaction and workers' physical condition are crucial in reducing LBP due to WBV exposure. Moreover, provision of new machines without proper training and good working condition might not help reduce LBP due to WBV exposure. The results help the construction companies to better understand key factors affecting LBP due to WBV exposure, and to plan for a better health improvement programme.

- **Keywords:** exploratory factor analysis, lower back pain, structural equation modelling, whole-body vibration exposure

Anna Marszałek, Grażyna Grabowska, Krzysztof Łęzak & The Secret Study Group. *Evaluation of a new ballistic vest design for compliance with Standard No. PN-V-87000:2011 using physiological tests. Pages: 268-277.*

Research into newly developed ballistic vests to be worn by police officers under clothing was carried out with air temperature conditions of +20 °C. A ballistic vest should incorporate protective features, comfort and ergonomics. The thermal strain on users who wore the vests was evaluated as an average and individually, after they had been conditioned in high (+50 °C), low (−40 °C) or neutral (+20 °C) air temperatures, while performing various occupational activities. Research involved six police officers aged 36–42 years, who wore civilian clothing used in moderate environmental conditions. During the tests, physiological parameters (internal temperature, local skin temperatures and amount of sweat secreted) were determined. The ease of doing exercises while wearing the vests, vest service and level of discomfort in use were assessed. Research showed that the vests tested, both as an average and individually, meet the requirements of Standard No. PN-V-87000:2011 (clause 4.5).

- **Keywords:** ballistic vest, thermal strain, ergonomics

Mariusz Dąbrowski & Jarosław Górski. *Influence of the milling tool setup on occupational safety in furniture making.* Pages: 278-286.

One of the most serious causes of accidents in furniture making is kickback of machined material. The aim of this study was to determine the influence of the milling tool setup on hazards associated with kickback in furniture making. The speed of kickback was accepted as the measure of these hazards. The experiment involved controlled changes in milling tool setup, projection of cutting knives over the body of the milling tool, number of cutting knives and clearance angle. Multifactor analysis of variance was applied to the results of individual experiments, showing statistically significant factors and their interactions. Inspection and analysis of traces left by the cutting knives of the tools on the test pieces made of wood materials supported inferential statistics. The obtained results verified some common opinions and ideas on the impact of the milling tool setup on the hazards resulting from kickback in furniture making.

- **Keywords:** kickback, ejection, milling, occupational safety, furniture making, hazards

Ángela Asensio-Martínez, Michael P. Leiter, Santiago Gascón, Stephanie Gumuchian, Bárbara Masluk, Paola Herrera-Mercadal, Agustín Albesa & Javier García-Campayo. *Value congruence, control, sense of community and demands as determinants of burnout syndrome among hospitality workers.* Pages: 287-295.

Employees working in the hospitality industry are constantly exposed to occupational stressors that may lead employees into experiencing burnout syndrome. Research addressing the interactive effects of control, community and value congruence to alleviate the impact of workplace demands on experiencing burnout is relatively limited. The present study examined relationships among control, community and value congruence, workplace demands and the three components of burnout. A sample of 418 employees working in a variety of hospitality associations including restaurants and hotels in Spain were recruited. Moderation analyses and linear regressions analyzed the predictive power of control, community and value congruence as moderating variables. Results indicate that control, community and value congruence were successful buffers in the relationships between workplace demands and the burnout dimensions. The present findings offer suggestions for future research on potential moderating variables, as well as implications for reducing burnout among hospitality employees.

- **Keywords:** burnout, stress, engagement, hospitality industry, value congruence, community, workplace

Evanthia Giagloglou, Milan Radenkovic, Sasa Brankovic, Panagiotis Antoniou & Ivana Zivanovic-Macuzic. *Pushing, pulling and manoeuvring an industrial cart: a psychophysiological study.* Pages: 296-304.

One of the most frequent manual occupational tasks involves the pushing and pulling of a cart. Although several studies have associated health risks with pushing and pulling, the effects are not clear since occupational tasks have social, cognitive and physical components. The present work investigates a real case of a pushing and pulling occupational task from a manufacturing company. The study initially characterizes the case in accordance with Standard No. ISO 11228-2:2007 as low risk. An experiment with 14 individuals during three modalities of pushing and pulling was performed in order to further investigate the task with the application of electrophysiology. At the end, a simple questionnaire was given. The results show electrophysiological differences among the

three modalities of pushing and pulling, with a major difference between action with no load and fully loaded with a full range of motions on the cart to handle.

- **Keywords:** pushing–pulling, electrodermal activity, Standard No. ISO 11228-2:2007

Amisha Kanji, Katijah Khoza-Shangase & Liepollo Ntlhakana. *Noise-induced hearing loss: what South African mineworkers know. Pages: 305-310.*

Purpose. The current study aimed to investigate the knowledge of mineworkers regarding noise-induced hearing loss in the South African gold and non-ferrous mining subsectors. **Method.** A descriptive research design was adopted. Semi-structured interviews were conducted with 90 participants who comprised managers, supervisors and miners. Data were analysed qualitatively. **Results.** The majority of participants (97%) acknowledged working in a noisy environment and demonstrated knowledge of the consequences of this exposure on their hearing function. Although all but one participant indicated having known the importance of using hearing protection devices (HPDs), less than 50% reported consistent use of HPDs. This highlights gaps in education and training, as well as implementation monitoring. All participants reported knowledge regarding the importance of hearing monitoring, but a lack of understanding of their test results. **Conclusions.** Current findings contribute towards evidence regarding internal barriers to effective application of best practice in hearing conservation programmes (HCPs). Findings highlight the important role of occupational audiologists in South African mines and the need for individualized education during medical surveillance to enhance efficacy of HCPs. Comprehensive education and training programmes regarding noise exposure and exposure measurements with consistent HPD efficiency assessments are recommendations emanating from these findings.

- **Keywords:** knowledge, mineworkers, noise-induced hearing loss, South Africa

John D. Bullough, Andrew Bierman & Mark S. Rea. *Evaluating the blue-light hazard from solid state lighting. Pages: 311-320.*

Purpose. New light sources including light-emitting diodes (LEDs) have elicited questions about retinal damage, including the blue-light hazard. Some organizations have recommended avoiding using LEDs with correlated color temperatures exceeding 3000 K, since they tend to produce greater short-wavelength energy. This article provides quantitative comparisons among light sources and use cases as they affect the blue-light hazard. **Methods.** The spectral radiant power characteristics of incandescent, fluorescent, LED and daylight sources were evaluated in terms of blue-light hazard using standard procedures for phakic, aphakic and pseudophakic eyes. **Results.** Under most use cases, LEDs do not exhibit greater risk for the blue-light hazard than other sources (e.g., incandescent). Because they generally produce little to no ultraviolet energy, LEDs often present less risk to aphakic eyes. **Conclusions.** LEDs present no special concerns for the blue-light hazard over some other common sources in typical use cases because photophobic responses limit exposure to bright sources. Where photophobic responses might not occur (e.g., eye surgery patients or premature infants) or where individuals suppress these responses (e.g., stage actors), caution is necessary. Evidence remains inconsistent regarding the risk of human retinal damage from long-term exposures to light insufficient to reach acute blue-light hazard thresholds.

- **Keywords:** retinal hazard, photoprotection, lighting, spectral power distribution

Meysam Eyvazlou, Ali Dadashpour Ahangar, Azin Rahimi, Mohammad Reza Davarpanah, Seyed Soheil Sayyahi & Mehdi Mohebali. *Human*

reliability assessment in a 99Mo/99mTc generator production facility using the standardized plant analysis risk-human (SPAR-H) technique. Pages: 321-330.

Introduction. Reducing human error is an important factor for enhancing safety protocols in various industries. Hence, analysis of the likelihood of human error in nuclear industries such as radiopharmaceutical production facilities has become more essential. Methods. This cross-sectional descriptive study was conducted to quantify the probability of human errors in a 99Mo/99mTc generator production facility in Iran. First, through expert interviews, the production process of the 99Mo/99mTc generator was analyzed using hierarchical task analysis (HTA). The standardized plant analysis risk-human (SPAR-H) method was then applied in order to calculate the probability of human error. Results. Twenty tasks were determined using HTA. All of the eight performance shaping factors (PSFS) were evaluated for the tasks. The mean probability of human error was 0.320. The highest and the lowest probability of human error in the 99Mo/99mTc generator production process, related to the 'loading the generator with the molybdenum solution' task and the 'generator elution' task, were 0.858 and 0.059, respectively. Conclusion. Required measures for reducing the human error probability (HEP) were suggested. These measures were derived from the level of PSFS that were evaluated in this study.

- **Keywords:** human error probability, standardized plant analysis risk-human technique, 99Mo/99mTc generator production facility, radiopharmaceutical