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Elpidio Maria Garzillo, Maria Grazia Lourdes Monaco, Antonio Spacone, Enrica Inglese, Monica Lamberti & Domenico Pompei. SARS-CoV-2 emergency in the workplace: are companies ready to protect their workers? A cross-sectional survey. Pages: 683-690.

Purpose. The SARS-CoV-2 pandemic has affected all aspects of everyday life worldwide, including the entire working sector. This study aims to evaluate the response capacity of some Italian companies to the emergency about workers' health and safety. *Methods.* Data were cross-sectional, collected by a specially drafted 19-item checklist sent to 60 enterprises located in the province of L'Aquila, Abruzzo, Italy. *Results.* Forty-one companies (68%) responded by filling in the checklist; more than 50% have fewer than 50 employees each and most of the companies belong to the food industry and the financial services. Adherence to the containment measures for the COVID-19 emergency was analysed, especially relating to job organization, social distancing, sanitization and specific training. Large enterprises and the banking sector showed ductile work reorganization according to the containment measures compared to small companies and the food sector. *Conclusions.* Italian companies have shown a good response to the regulatory restrictions resulting from the SARS-CoV-2 emergency. This is a worthy premise for the imminent management of Phase 2, with the progressive reopening of Italian companies.

- **Keywords:** SARS-CoV-2 occupational health and safety lockdown containment measures

Yulita Yulita, Mohd Awang Idris & Maureen F. Dollard. Effect of psychosocial safety climate on psychological distress via job resources, work engagement and workaholism: a multilevel longitudinal study. Pages: 691-708.

Objective. Our innovation was to propose a multilevel model to explain how an organizational factor, psychosocial safety climate (PSC) – the climate for worker psychological health – related to work investment (work engagement and workaholism) and, in turn, psychological distress. *Methods.* Longitudinal data were collected in Peninsular Malaysia across 26 police departments from 392 police personnel, matched across 4 months, and were tested using hierarchical linear modeling. *Results.* The

analysis revealed between-group effects linking PSC to job resources, to work engagement and to workaholism. When PSC operated by improving job resources, aside from increased work engagement, it could unwittingly boost workaholism. However, this only existed under low PSC conditions. The secondary function of PSC buffered the impact of job resources on workaholism and psychological distress. When PSC was high, job resources reduced both workaholism and psychological distress, suggesting that PSC enabled resources to do their job of mitigating unfavorable conditions. *Conclusions.* Results support a multilevel PSC-extended job demands-resources motivational path with cross-links, and PSC's moderation function, as an explanation of worker psychological health. Confirming PSC as a leading indicator and the importance of a motivational path, this article presents new evidence in support of targeting PSC to improve worker psychological health.

- **Keywords:** job resources psychological distress psychosocial safety climate workaholism work engagement

Moien Kiani, Mohsen Asgari, Faezeh Abbas Gohari & Zahra Rezvani. *Safety climate assessment: a survey in an electric power distribution company.* Pages: 709-715.

Introduction. This study aimed to investigate safety climate and its structural dimensions as well as establish a relationship between safety climate and demographic variables in a power distribution company. *Method.* This cross-sectional study included 200 workers. The safety climate questionnaire recommended by the UK Health and Safety Executive was applied containing 43 questions in 11 dimensions. Demographic information was also assessed. SPSS version 22.0 was applied to analyze the data. *Results.* In total, 179 workers participated in this survey. The response rate was high (89.5%). Safety climate had the highest correlation with the management commitment dimension ($r = 0.754$). The total score of safety climate in this company was 3.37 on a scale ranging from 1 to 5. Among safety climate factors, the highest score was for safety-related training (3.87) but work pressure had the lowest score (2.80). Among demographic variables, a significant relationship was observed between safety climate and age ($r = 0.180$). *Conclusions.* Management as an organizational power can exert great influence on the promotion of safety climate. Moreover, adopting efficient training programs and making a balance in workload for decreasing work pressure can improve safety climate.

- **Keywords:** safety climate, management commitment, safety-related training, workload

Garima Verma, Rajnarayan Tiwari, Anjana Verma, CNV Sai Bharath & Shubhi Tomar. *Occupational lower back pain among bus conductors of Udupi district, Karnataka.* Pages: 716-720.

Although studies have reported lower back pain (LBP) in professional drivers, the conductors travelling in the same bus who share the same working environment are often neglected. Thus, the present study was undertaken to assess the prevalence of LBP and the factors associated with it. The study included 237 bus conductors from government bus depots. The data regarding occupational, non-occupational and environmental factors were collected by interview technique using a structured questionnaire. Self-reported back pain in the last 12 months in or near the lumbosacral spine was considered a case of LBP. The study revealed that 27.4% had LBP. The multivariate analysis suggested that tobacco smoking, self-reported bad road conditions and lack of enough breaks during work were significant risk factors. Thus, to conclude, the conductors are at risk of LBP that can be attributed to occupational as well as non-occupational factors.

- **Keywords:** lower back pain, conductors, vibration

Jin Tian, Zheyang Lin & Feng Wang. *Resilient trade-offs between safety and profitability: perspectives of sharp-end drivers in the Beijing taxi service system. Pages: 721-733.*

Background. Trade-offs are common behaviors of resilient systems, when the systems adapt to changing situations to meet multiple goals. *Objective.* In the context of the Beijing taxi service system (BTSS), this work investigates the sharp-end taxi drivers' trade-offs between work safety and business profitability, demonstrates their resilience in balancing these two goals and identifies factors that contribute to the trade-offs. *Methods.* An empirical framework incorporating questionnaire surveys, semi-structured interviews, field observation, data screening and categorization was adopted. Data were collected from a random sample of 70 taxi drivers. *Results.* In the drivers' decisions we found a slight bias in favor of profitability rather than safety (regardless of their finances), and a high level of resilience that the drivers had developed in making strategies for the trade-offs. Trip distance, possibility of traffic congestion, redundant consumption, weather conditions, road features and real-time broadcast information were identified as determinants of the drivers' decision-making. *Conclusion.* The findings inform BTSS organizational layers and regulators about the sharp-end drivers' needs for productive safety, and provide an evidence base for making more definitive recommendations about support provision and resource re-allocation in an effective and proactive manner.

- **Keywords:** trade-offs, resilience, safety, profitability, taxi drivers

Maša Legan & Klementina Zupan. *Prevalence of mobile device-related musculoskeletal pain among working university students: a cross-sectional study. Pages: 734-742.*

The aim of the present study was to investigate usage patterns of mobile devices and their impact on users' musculoskeletal system among working university students in Slovenia at the Faculty of Chemistry and Chemical Technology of the University of Ljubljana. An Internet-based survey was sent to students' e-mail addresses and students provided information about usage patterns and reported on musculoskeletal pain (MSP) that may relate to mobile device usage in the past 12 months. A total of 535 students (63% females and 37% males) aged 18 years or older completed the survey and fulfilled the inclusion criteria. The results showed that the prevalence of MSP was 39.6%. Most musculoskeletal symptoms were reported in the back (57.1%) and shoulder (50%). Statistically significant differences in exposure to mobile devices and MSP between genders were found ($p < 0.05$). This study highlights the importance of knowledge of mobile device ergonomics among working students.

- **Keywords:** mobile device, working university students, musculoskeletal pain, prevalence, ergonomics

Zygfryd Juczyński & Nina Ogińska-Bulik. *Ruminations and occupational stress as predictors of post-traumatic stress disorder and burnout among police officers. Pages: 743-750.*

The profession of policeman is one of the most stressful. It is associated with exposure to traumatic experiences. This research study aimed to determine the predictors of symptoms of post-traumatic stress disorder (PTSD) and occupational burnout and to examine how they correlated in policemen. We searched for these predictors in cognitive activity, and specifically in ruminations and perceived job stress. The study was conducted with 120 police officers who have experienced traumatic events related to

their job. The study showed that intrusive ruminations serve as a predictor that intensifies PTSD, while certain stressful work conditions are predictors of burnout. The results suggest that numerous mechanisms are at play in the pathogenesis of PTSD and burnout. Police officers cope much better with exposure to traumatic stressors than with stressful work conditions. This leads to a practical conclusion regarding the necessity of preventing the everyday job stress experienced by police officers.

- **Keywords:** post-traumatic stress disorder, burnout, ruminations, work-related stress, police officers

Ziqi Zhou, Yu Zhang, Lingli Sang, Jiayang Shen & Yulong Lian. Association between sleep disorders and shift work: a prospective cohort study in the Chinese petroleum industry. Pages: 751-757.

Objective. This study aimed to understand the prevalence of sleep disorders among shift workers and analyze the relationship between sleep disorders and shift work. *Methods.* Baseline data were collected from subjects who were then followed for 2 years in a prospective cohort study. The cohort ultimately included 2453 people starting in May 2013, and follow-up with questionnaires was performed in July 2014 and October 2015. Sleep disorders were assessed with the Pittsburgh sleep quality index. *Results.* The risk of sleep disorders among two-shift workers (relative risk [RR] = 1.318, 95% confidence interval [CI] [1.025, 1.695]), three-shift workers (RR = 1.326, 95% CI [1.048, 1.679]) and four-shift workers (RR = 1.334, 95% CI [1.062, 1.675]) was higher than that among non-shift workers, and an increasing trend was observed in sleep disorders as the number of shifts increased. *Conclusions.* Shift workers have a higher incidence of sleep disorders than non-shift workers. An increasing linear trend was observed between the number of shifts and sleep disorders. In the petroleum industry, it is necessary to decrease the frequency of shifts to reduce the incidence of sleep disorders among shift workers.

- **Keywords:** shift work, sleep disorders, cohort study

Mahendra Kumar Atal, Sanjay Kumar Palei, Dhanjee Kumar Chaudhary, Vivekanand Kumar & Netai Chandra Karmakar. Occupational exposure of dumper operators to whole-body vibration in opencast coal mines: an approach for risk assessment using a Bayesian network. Pages: 758-765.

Whole-body vibration (WBV) is one of the leading risk factors for development of musculoskeletal disorders (MSDs) that develop symptoms of lower back pain, pain in the neck and shoulders, digestive problems, blood pressure and diabetes among professional dumper operators. The present study specifically aimed at assessing the WBV exposure of 79 dumper operators engaged in two Indian opencast coal mines through vibration measurements followed by questionnaire survey. From the daily frequency-weighted root mean square exposure, dumper operators have experienced vibration levels higher than the Health Guidance Caution Zone (HGCZ) of Standard No. ISO 2631-1:1997. However, on the basis of daily vibration dose values, 60.8% of operators have experienced vibration levels above the HGCZ. Finally, an attempt was also made to explore the potential of a Bayesian network to predict the risk factors for WBV of dumper operators in development of MSDs to prioritize the factors for human health risk assessment.

- **Keywords:** whole-body vibration, vibration dose value, Bayesian network, dumper operators, risk assessment

María-Victoria Sánchez-Rebull, Angels Niñerola, Ramon Ferrer-Rullan & Ana-Beatriz Hernández-Lara. Six Sigma for workplace safety

improvement: improving hazards and unsafe conditions in a metallic packaging manufacturing company. Pages: 766-778.

Six Sigma has been applied as a business process improvement strategy in many companies worldwide with great results. On the other hand, workplace safety constitutes a key issue for company managers due to their responsibility. The aim of this article is to demonstrate how using Six Sigma can reduce accidents. A case study is conducted on a large European metallic packaging manufacturing company. As a result, the company presented a reduction of lost time accidents from 97 to 30 that saved a lot of time and cost. The σ value achieved was 4.24. This project shows the effectiveness of Six Sigma as an improvement tool in the human resources area, despite most of the previous Six Sigma research being focused on manufacturing aspects. The case studied can be useful either for large companies or small and medium-sized companies interested in improving safety.

- **Keywords:** Six Sigma, case study, workplace safety, define, measure, analyse, improve and control, process improvement

Majed H. Moosa & Leo P. Oriet. Factors affecting safety performance in the construction industry: an empirical study using structural equation modelling. Pages: 779-789.

The Saudi construction industry is among the largest in the region – and, for workers, among the most dangerous industries. The importance of this study is assisting to reduce hazards, sources of risk and perceptions of safety in the construction sector. Using a quantitative survey measure administered to a small ($n = 276$) sample of individuals, this study aimed to contribute to empirical understandings of safety performance in this unique context. A multivariate safety performance model was developed to ensure compatibility with the structure of the survey measure. The survey data revealed a strong consensus expressing negative views of every safety dimension and variable tested, with only tiny minorities selecting positively valenced responses. To test the descriptive power of the model as a whole, a structural equation modelling technique was used to assess the correspondence between the relationships constituting the model and their significance relative to empirical data.

- **Keywords:** construction industry, safety culture, safety system, Saudi Arabia, safety performance model, structural equation modelling, analysis of moment structures

Guzin Kaya Aytutuldu, Tansu Birinci & Ela Tarakçı. Musculoskeletal pain and its relation to individual and work-related factors: a cross-sectional study among Turkish office workers who work using computers. Pages: 790-797.

Objective. Office workers are commonly exposed to work-related musculoskeletal pain. This study investigated the individual and work-related risk factors linked to musculoskeletal pain and pain-related disability among Turkish office workers who work using computers. *Methods.* One-hundred and fifty office workers were included. Data were collected using an online survey with a combination of the Nordic musculoskeletal questionnaire, Oswestry disability index (ODI), neck disability index (NDI) and disabilities of the arm, shoulder, and hand questionnaire short-form (Q-DASH). The participants were divided into four subgroups: no pain ($n = 26$), lower back pain ($n = 37$), neck pain ($n = 49$) and upper-extremity pain ($n = 38$). *Results.* There were differences between subgroups in terms of the condition that feet touch the floor and the condition that the keyboard, mouse and wrist are in a straight line ($p = 0.013$ and $p = 0.025$, respectively). Working years was correlated with the ODI score ($\rho = 0.802$, $p = 0.041$). There was also

a significant correlation between the NDI score and working hours ($p = 0.415$, $p = 0.003$), while Q-DASH was correlated with body mass index and working years ($p = 0.406$, $p = 0.014$, and $p = 0.327$, $p = 0.043$, respectively). *Conclusions.* Pain-related disability was associated with various risk factors such as physical inactivity, body mass index, working hours, working years and workplace ergonomics in the office workers.

- **Keywords:** lower back pain, musculoskeletal disorders, neck pain, upper extremities, working conditions, work using computers

Joana Amaro, Ana Catarina Queiroga, João Amaro, Ingrid Sivesind Mehlum & Raquel Lucas. *Work-life prevalence of self-reported occupational injuries in mothers of a birth cohort.* Pages: 798-808.

Purpose. This study investigated self-reported occupational injuries among mothers in a large birth cohort study and the relation of their characteristics to different injury outcomes: occurrence, severity, temporal proximity and recurrence. *Methods.* We asked 4338 women whether they had been in 'an accident at work, even if it did not require medical treatment', and the number of accidents throughout their working life, type of injury and whether it occurred within the last 12 months. *Results.* Over one-fifth (21.8%) of working-age mothers reported having at least one occupational injury throughout their working life. Wounds and superficial injuries were the most frequently reported types of occupational injuries (11.0%), followed by dislocated bones and joints, sprains and strains (10.7%). Women who reported a history of occupational injuries also had a higher likelihood of reporting a work-related health problem (adjusted odds ratio [OR] = 2.64; 95% confidence interval [CI] [2.27, 3.07]) and of having a partner who also reported an occupational injury throughout their working life (adjusted OR = 1.86; 95% CI [1.33, 2.62]). Associations remained fairly stable across all outcomes. *Conclusions.* Our findings point towards a broadened understanding of occupational injury consequences and research focusing on family-level factors that account for the embeddedness of workers in households.

- **Keywords:** cohort study, women's health, occupational injuries

David Baeza Moyano & Roberto Alonso González Lezcano. *Effects of infrasound on health: looking for improvements in housing conditions.* Pages: 809-823.

The latest technological innovations have considerably increased the field of application for infrasound, and the possible risks that infrasound may present to those exposed to it must be taken into account. The main task of this article is to organize and summarize recent studies on the most common artificial emitting sources and the effects that these non-audible frequencies have on health when absorbed by the body, as well as presenting the existing regulations, a discussion and a series of conclusions that clarify aspects of infrasound. The intention of the authors of this article is that what is exposed in this review can be used to address and determine future lines of research and promote architects to take the spaces of installations within a building very seriously as well as carry out competent administration considering a minimum distance from the road to where habitable buildings are planned.

- **Keywords:** infrasound, healthy architecture, occupational safety, healthy construction, human well-being

Ertuğrul Taçgın & Zeynep Sağır. *Development of an intelligent knowledge base for identification of accident causes based on Fu et al.'s model.* Pages: 824-841.

In this study, an intelligent knowledge base (IKB) is developed based on a model developed by Fu et al. for identification of accident causes, which may play a significant role in preventing accidents. This IKB has been generated using eight sample accidents reported in the literature and tested by two additional accidents. The causes of these sample accidents were identified according to a model taxonomy developed by Fu et al. For the test, an oil spill and a refinery accident are considered in two case studies. This study proved 89.47 and 73.01% success rates, respectively, for the identification of additional accidents causes based on the developed IKB. These results obtained from only eight sample accidents are considered promising because as the number of sample accidents increases, the success rates are expected to increase further. This IKB was prepared as part of a more comprehensive intelligent system to be developed.

- **Keywords:** intelligent knowledge base, accident causation models, occupational accidents, accident analysis

Linlin Jing, Wei Shan & Yingyu Zhang. *Why the government should be blamed for road safety.* Pages: 842-855.

The government plays an important role in road safety. However, the effectiveness of the government in the context of road traffic accidents (RTAs) is rarely measured quantitatively. This study aims to quantitatively examine the effects of government regulation on human and organizational factors. A contributing factors classification framework of RTAs is presented based on the human factors analysis and classification system, one of the most popular systems approaches. A total of 405 major RTAs was collected over a 20-year period (1997–2017) in China and analyzed through the structural equation model. The results lead to two main conclusions: the frequency of inadequate regulation, which has reached 343, is the highest frequency among all contributing factors; government regulation exhibits significant effects on organizational influences, unsafe supervision and unsafe behaviors. These findings provide a new perspective for accident prevention that can be initiated by the government in policy-making and regulatory activities.

- **Keywords:** major road traffic accidents, systems-based approach, structural equation model, government regulation, human factors analysis and classification system

Ines Rassas, Aouatef Mahfoudh, Amira Khelil, Charfeddine Amri, Neila Chaari, Adnène Henchi, Taoufik Khalfallah, Mohamed Akrouf & Irtyah Merchaoui. *Strain-based work-to-family conflict as a predictor of lumbar and cervical pain in Tunisian nursing staff.* Pages: 856-862.

Objective. This study aimed to examine the association of the different dimensions and forms of work–family conflict with the occurrence of neck and lower back pain (LBP) in Tunisian nurses. *Methods.* We conducted a cross-sectional study on nurses assigned to a district hospital in Tunisia. The work–family interface was assessed with the work–family conflict scale of Carlson et al. Psychosocial and organizational constraints at work were assessed through the nursing work index – extended organization in its specific version designed for nurses. Assessment of neck and lumbar pain was carried out with the standardized Nordic musculoskeletal questionnaire. *Results.* Seventy-two nurses participated in the present study (participation rate = 100%) with a mean age of 42.38 ± 10.85 years. Binary logistic regression analyses retained strain-based work-to-family conflict as a significant determinant of both LBP ($p < 10^{-3}$; odds ratio [OR] = 5.07; 95% confidence interval [CI] [2.1, 11.7]) and neck pain ($p = 0.001$; OR = 6.8; 95% CI [2.13, 22]). *Conclusions.* Strain-based work-to-family conflict was found to predict lumbar and cervical pain more than the other types of conflict in nursing staff. Thus, reducing strain in health-care settings should be a central component of the preventive approach of musculoskeletal disorders in nursing staff.

- **Keywords:** lower back pain, cervical pain, nurses, work–family conflict scale

Mahboubeh Es'haghi, Asgar Nikravesh, Mohammad-Javad Fereydoni & Nader Shabani. *Understanding factors influencing workers' unsafe behaviors through social network analysis in the mining industry. Pages: 863-871.*

Background. In this study, we aimed to discover why workers engage in unsafe behaviors and reach a deep understanding of all causes influencing unsafe acts among workers in a mining industry. We also aimed to determine which causes play a more important role in the occurrence of unsafe acts. *Methods.* First, we determined the unsafe acts through observation and then investigated the factors affecting them based on semi-structured interviews. In order to identify the most important causes, we utilized centrality indicators including the degree and betweenness centrality of the social network analysis using UCINET version 6.0. *Results.* In total, 3058 unsafe acts were observed and 85 causes, classified into 14 factors, were found to influence the behavioral intention of workers. In this study, inadequate supervision, with the highest degree of centrality, proved to be of great influence on performing unsafe behaviors. In addition, inadequate training, with the highest betweenness centrality, was determined as the main intermediary in the mining industry under investigation. *Discussion and conclusion.* The findings indicate that workers' unsafe acts are affected by different causes, leading to significant implications for policy-makers seeking to reduce unsafe behaviors and to improve workplace safety in the mining environment.

- **Keywords:** unsafe behaviors, influential causes, social network analysis, mining industry

Chai Fong Ling, Radin Zaid Radin Umar & Nadiah Ahmad. *Development of a predictive model for work-relatedness of MSDs among semiconductor back-end workers. Pages: 872-882.*

Objective. Limited models are available to predict work-relatedness of musculoskeletal disorders (MSDs) among semiconductor back-end workers. This study aims to develop a model to predict the MSDs development among back-end workers. *Method.* Potential MSD risk factors were extracted from 277 work compensation investigation reports conducted between 2011–2019. Binary logistic regression approach was used to determine significant predictors. *Results.* Significant predictors ($p < 0.05$) include poor posture (odds ratio [OR] = 1.822; 95% confidence interval [CI] [1.261, 2.632]), forceful exertion (OR = 1.741; 95% CI [1.281, 2.367]), static posture (OR = 1.796; 95% CI [1.367, 2.378]), lifting and lowering (OR = 1.438; 95% CI [0.966, 1.880]), transferring (OR = 1.533; 95% CI [1.101, 2.136]), pushing and pulling (OR = 0.990; 95% CI [0.744, 1.317]), repairing machines (OR = 0.845; 95% CI 76 [0.616, 1.159]), preventive maintenance (OR = 1.061; 95% CI [0.765, 1.471]) and quality inspection (OR = 0.982; 95% CI [0.729, 1.322]). Confounding factors and employment duration played crucial roles in the model. Cross-validation of predictive model was 86.2%, while face validation among 30 experts was 7.9/10 (SD 1.9). *Conclusion.* The model allows practitioners to predict potential MSD cases among semiconductor back-end workers and proactively plan appropriate mitigation measures.

- **Keywords:** work-relatedness, musculoskeletal disorders, ergonomics, back-end semiconductor, predictive model

Chidiebele Petronilla Ojukwu, Precious Chinecherem Oqualaji, Stephen Sunday Ede, Rita Nkechi Ativie, Chigozie Okwudili Obaseki, Adaora Justina Okemuo & Franklin Onyedinma Irem. *Pulmonary functions and*

associated risk factors among school teachers in a selected Nigerian population. Pages: 883-889.

Objective. This study aimed to determine pulmonary functions and associated risk factors among school teachers. *Methods.* This cross-sectional ex-post facto study included 121 participants (20 males and 101 females). The setting for this study included 11 private schools and eight government schools. Participants were recruited using non-probability sampling techniques. Subjective data were collected using a self-administered asthma questionnaire. A spirometer was used for measuring pulmonary function values and data were analyzed using descriptive statistics and one-way analysis of variance for inferential statistics. The α level was set at 0.05. *Results.* Age, gender, duration of employment, type of school, school level taught, type of teaching board, working hours per day, previous occupation, usage of carpet and usage of rugs were significantly associated with the forced vital capacity prediction ($p = 0.000, 0.010, 0.000, 0.032, 0.013, 0.000, 0.027, 0.000, 0.000$ and 0.041 , respectively). Also, the forced expiratory volume in 1 s and the peak expiratory flow were statistically different with alcohol consumption ($p = 0.015$) and place of residence ($p = 0.004$), respectively. *Conclusion.* Teachers using chalkboards are at increased risk of developing occupationally related pulmonary impairments. Hence, there is a need to shift from routine chalkboards to whiteboards.

- **Keywords:** pulmonary functions, respiratory diseases, teachers, chalk and blackboards

Wuji Lin, Jingyuan Lin, Yang Yang, Jiejie Liao, Weijie Chen & Lei Mo. The difference in the warning effect of different warning signs. Pages: 890-900.

Introduction. Warning signs play a very important role in safeguarding life and property in dangerous situations. Previous studies have mainly focused on the physical properties of warning signs, and few studies have been conducted on the different types. *Methods.* In Experiment 1, the oddball paradigm and the go/no-go paradigm were used to study the warning effect of different types of warning signs. In Experiment 2, the dual-task paradigm was adopted. *Results.* In Experiment 1, the results showed that a warning sign with text as content had the worst warning effect, followed by the combination of image and text, and a warning sign with an image as content had the best warning effect. In Experiment 2, it was found that different types of warning signs would have different effects on the performance of the secondary task. *Conclusions.* The reason for this may be the different processing methods used for text and image. Therefore, in dangerous situations that require a quick response, simple and understandable graphics should be used as the content of warning signs. In complex circumstances, it may be necessary to use a combination of image and text for warning sign content.

- **Keywords:** warning signs, oddball, go/no-go paradigm, dual-task paradigm

Ibrahim Mosly. Factors influencing safety performance in the construction industry of Saudi Arabia: an exploratory factor analysis. Pages: 901-908.

The construction industry presents many risks that threatens workers physically and business owners financially. Safety performance can assist in reducing risks on construction sites. This study aims to explore and identify the factors that influence safety performance in the construction industry of Saudi Arabia. Through a literature review, 37 factors that influence safety performance were identified from research studies worldwide. These factors were evaluated by industry participants from Saudi Arabia and ranked according to their mean values through survey questionnaires. Furthermore, exploratory factor analysis was used for dimension reduction, and 10

components clustering the 37 factors were revealed and discussed. The outcomes of this study will assist the different construction industry stakeholders in enhancing safety performance at project sites, and in turn create a safer working environment for workers with fewer risks and accidents.

- **Keywords:** factors, exploratory factor analysis, questionnaire, construction, Saudi Arabia, safety

Fulei Chu, Shuzhen Liu, Ming Guo & Ruijian Liu. *Group strength in safety performance: the effects of group characteristics on individual personality expression in high-speed railway operators.* Pages: 909-922.

Objectives. In diverse working situations, the predictive effect of individual personality on job performance is not always the same. Thus, how to best understand and use personality in the workplace has been an important issue in recent years. *Methods.* Based on trait activation theory, the present study provides initial evidence from high-risk organizations (high-speed railway organizations) regarding interactionist effects of group-level characteristics on the relationship between individual personality (Big Five model) and safety performance (both safety compliance and safety participation). Data were obtained from a sample of high-speed rail operators from nine railway bureaus ($N = 1012$ from 86 working groups). *Results.* The results indicate that group conscientiousness, agreeableness and neuroticism enhance the relationship between individual personality and safety performance, while group openness weakens the relationship between individual personality and safety performance, and group extraversion has no effect on their relationship. *Conclusion.* These results suggest that high-risk organizations should focus not only on individual factors but also on the interactions between individual factors and group situations in individuals' safety performance.

- **Keywords:** personality, trait activation theory, group characteristics, safety performance, high-speed railway

Koppiahraj Karuppiah, Bathrinath Sankaranarayanan & Syed Mithun Ali. *A fuzzy ANP-DEMATEL model on faulty behavior risks: implications for improving safety in the workplace.* Pages: 923-940.

The occurrence of occupational accidents and injuries has always been a major concern for industrial management. Such undesirable incidences are higher in developing countries, especially in India, than in developed countries. This research aims to identify, analyze and evaluate the faulty behavior risks (FBRs) that trigger occupational accidents and injuries. Using a data triangulation strategy, this study identified 19 FBR factors under five categories. An integrated approach comprising the fuzzy analytic network process (ANP) and the decision-making trial and evaluation laboratory (DEMATEL) method is proposed for assessing these FBRs. The five most prominent critical risk factors are the absence of continuous monitoring, defective equipment and maintenance, cognitive bias, proper signage and adverse ambient working conditions. The study postulates some implications for industrial management to mitigate occupational accidents and injuries based on the outcomes.

- **Keywords:** Faulty behavior risks, data triangulation strategy, occupational accident, fuzzy ANP-DEMATEL

Qingwen Zhang, Hongling Guo, Pin-Chao Liao, Dongping Fang & Man Fu. *Optimizing safety-measure combinations to address construction risks.* Pages: 941-957.

Objectives. Most methods used to develop construction risk responses address the risk-mitigation optimization problem by solving the objective functions. They are passively achieved by satisfying constraint conditions, which are not adequate for efficient construction management. This study aims to provide an active optimization strategy for selecting risk responses. *Methods.* We combined set pair analysis (SPA) with the technique for order preference by similarity to an ideal solution (TOPSIS) to control the construction risks to an acceptable level instead of excessively to the minimum level. SPA is employed to assess the pre-mitigation and post-mitigation risk levels based on the uncertainty theory, and the TOPSIS is used to rank safety measures based on their risk-mitigation effects. A case study of concrete pumping for a super high-rise building was used to exemplify how the proposed optimization model assists risk control and to validate its reasonability. *Conclusion.* The developed TOPSIS–SPA-based method figures out the optimal safety-measure combination reducing construction risks economically to an acceptable level with the fewest number of measures. The findings can assist decision-makers in formulating cost-effective risk-control schemes.

- **Keywords:** construction risk, acceptable risk level, optimal safety measure, set pair analysis, technique for order preference by similarity to an ideal solution

Katharina F. Pfaffinger, Julia A. M. Reif & Erika Spieß. *When and why telepressure and technostress creators impair employee well-being.* Pages: 958-973.

Objectives. This article describes the effects of two specific information and communication technology (ICT) demands (telepressure, technostress creators) on employee well-being, and investigates a mediating effect of detachment (Study 1) and moderating effects of technostress inhibitors on the effects of ICT demands on well-being (Study 2) and detachment (Study 3). *Methods.* Three quantitative studies with employees (Study 1, N = 296; Study 2, N = 142; Study 3, N = 316) were conducted. *Results.* The results support the negative effect of ICT demands on several well-being indicators. They also show how detachment mediates the effect of telepressure on well-being (Study 1) and how technostress inhibitors moderate the effect of technostress creators on well-being (Study 2). Technostress inhibitors further buffer negative effects of technostress creators on detachment (Study 3). *Conclusion.* Interventions to reduce negative consequences of ICTs by increasing the level of technostress inhibitors (e.g., technical support) or facilitating employee detachment (e.g., through communication policies) are derived. The findings confirm that general models explaining stress and well-being are applicable to new forms of job demands and extend existing empirical support for the effect of ICT demands on well-being. Future research should investigate the interplay between the studied variables within a moderated mediation model.

- **Keywords:** information and communication technology demands, technostress creators, telepressure, well-being, detachment

Josep M. Argilés-Bosch, Josep Garcia-Blandón & Diego Ravenda. *Labour accidents and financial performance: empirical analysis of the type of relationship in the Spanish context.* Pages: 974-990.

This article performs empirical research and finds a negative relationship between accidents in the workplace and financial performance. The relationship is stronger and more persistent for performance 1 year ahead than for the current year. We find no significant evidence of curvilinear U-shaped or inverted U-shaped relationships. Results are strong across different industries and samples, variable definitions and model specifications. The study contributes to the scarce extant research with reliable data and samples of a wide span of industries. The study also contributes methodologically with refined analyses of the curvilinear relationship and providing robust widespread inference for a large number of industries.

- **Keywords:** labour accidents, accidents in the workplace, financial performance, profitabilitysafety

Bruno Leban, D. Fabbri, L. I. Lecca, M. Uras, M. Monticone, M. Porta, M. Pau & M. Campagna. *Characterization of hand forces exerted during non-powered hospital bed pushing and pulling tasks. Pages: 991-999.*

Accurate assessment of biomechanical risk associated with pushing/pulling tasks represents a challenging issue, especially in the health system where personnel are often required to maneuver beds and carts. Most studies in this field have been carried out in the laboratory, while few data have been collected under actual working conditions. This study aims to characterize the forces exerted during non-powered hospital bed maneuvering. Twenty participants were required to move a bed (equipped with a customized handlebar to measure exerted forces) along an actual hospital path including straight, turn and maneuver phases. The results show that higher forces are associated with the initial phase (peak and mean values 222 and 68 N) while the straight, turn and maneuvering phases required similar (lower) efforts. The combined effect of left, right and transversal forces suggests that the trunk of the operator might experience axial rotation, thus calling for further investigations of this aspect.

- **Keywords:** push/pull, hand force, hospital bed

Negin Esmaeili & Jahanyar Bamdad Soofi. *Expounding the knowledge conversion processes within the occupational safety and health management system (OSH-MS) using concept mapping. Pages: 1000-1015.*

Objectives. Given the efforts made to incorporate knowledge management into the occupational safety and health management system (OSH-MS), this research attempts to illustrate how the knowledge conversion processes are accomplished within key elements of the OSH-MS. *Methods.* This study uses concept mapping (CM) as an integrated approach for mirroring participants' viewpoints about the interaction between tacit and explicit knowledge in the OSH-MS. OSH and knowledge management experts of the National Iranian Oil Company (NIOC) and its subdivisions were invited to complete the CM process. *Results.* Interpretation of the maps and graphical representations generated indicates that the concepts within the key elements of the OSH-MS are sorted into different clusters, including Knowledge Application, Knowledge Dissemination, Knowledge Socialization and Knowledge Presentation. Regarding the participants' ratings, the Knowledge Application cluster is rated as the most important, and Knowledge Socialization is rated as the most prevalent. Conversely, Knowledge Presentation is rated the least important and prevalent. *Conclusions.* The results simulated in MATLAB version R2018a and JMP version 13.2 help in better understanding the interplay between tacit and explicit knowledge in the key elements of the OSH-MS and clarify the potential programmable areas to improve organizational performance.

- **Keywords:** knowledge management, tacit knowledge, occupational safety and health management system, explicit knowledge, knowledge conversion, concept mapping

Juyeon Park. *The role of base-layer cooling conditions in human error occurrences during doffing of personal protective equipment in health care. Pages: 1016-1024.*

This study compared error rates during the personal protective equipment (PPE) removal process under different base-layer cooling conditions while performing the doffing procedures. Ten participants were recruited and received training on the standard doffing

procedures before participating in the experiments. The participants were randomly assigned to one of the three base-layer conditions and ran on a treadmill for 30 min. Their physiological biometrics were monitored during exercise trials, and error rates were calculated. The results revealed a significant difference in error rates when PPE was worn over base-layer scrubs made of a cooling fabric versus when it was worn over the conventional medical scrubs. Further, there was a strong negative relationship between the body coverage amount with the cooling fabric and error rates occurring during the doffing procedures. Findings suggested practical considerations for the operational monitoring system and improved PPE design to avoid unintentional errors during the doffing procedures.

- **Keywords:** personal protective equipment (PPE)doffing procedureserror analysiscooling fabricbase layerhealth care

Mengqi Yuan, Yuchen Wei, Qiqi An & Jie Yang. *Effects of a liquid cooling vest on physiological and perceptual responses while wearing stab-resistant body armor in a hot environment.* Pages: 1025-1032.

This study determines the effects of a liquid cooling vest (LCV) on physiological and perceptual responses while wearing stab-resistant body armor (SRBA). Ten healthy male volunteers wearing SRBA performed human trials with the LCV and without (control) in a hot environment (30 °C and 40% relative humidity). Physiological parameters and perceptual responses were recorded during the tests. The results indicated that the difference in the mean skin temperature and scapula skin temperature between the two conditions was up to 1.2 and 2.5 °C, respectively. The LCV did not significantly decrease the core temperature, heart rate, sweat loss, oxygen consumption, rating of perceived exertion and restriction of movement. However, a significant difference was observed between conditions in terms of evaporation efficiency and thermal sensation. Therefore, the LCV attenuated an increase in thermal sensation but did not mitigate physiological strain. This work can provide fundamental knowledge for high-performance personal cooling system development.

- **Keywords:** stab-resistant body armor, heat stress, physical strain, thermoregulation, personal cooling system

Marwa M. Zalat, Soliman M. Amer, Ghada A. Wassif, Shereen A. El Tarhouny & Tayseer M. Mansour. *Computer vision syndrome, visual ergonomics and amelioration among staff members in a Saudi medical college.* Pages: 1033-1041.

Objectives. Nearly 60 million people suffer from computer vision syndrome (CVS) globally, resulting in reduced work productivity. This study aimed to determine the prevalence of CVS, describe the working conditions, visualize ergonomic factors and determine preventive measures application among university staff members. *Methods.* A cross-sectional study was conducted with university medical staff members using a semi-structured questionnaire that included a validated CVS questionnaire. *Results.* CVS prevalence was 81.2%. Dryness, headache, feeling that sight is worsening and difficulty in focusing on near vision were the most experienced symptoms. Prevalence of CVS was significantly higher among females (52.3%), those having a higher mean work duration (21.65 ± 7.55 years), those who frequently use a smartphone (84.9%) and those spending most of their screen time during both day and night (87.1%). Visual ergonomics and preventive measures application, such as correct screen level, regular cleaning of the screen, appropriate illumination and use of eye drops, were significantly associated with negative CVS. *Conclusions.* These results raised attention to the essential need for visual assessment of university staff members for early and proper diagnosis of

CVS to minimize its impact on working performance. Accordingly, it is recommended to organize university-based awareness programs regarding CVS for working personnel.

- **Keywords:** computer vision syndrome, visual ergonomics, staff members, medical college, Saudi Arabia

Soheil Abbasi, Neda Gilani, Mostafa Javanmardi, Seyed Shamseddin Alizadeh, Saeid Jalilpour & Milad Safari. *Prioritizing the indicators influencing permit to work system efficiency based on an analytic network process.* Pages: 1042-1052.

A permit to work (PTW) system is a formal procedure designed to control non-routine and hazardous works. However, this system by itself does not prevent incidents, and various factors contribute to its efficiency. This study aims to prioritize the indicators influencing system efficiency. To do this, indicators of the system were identified and scored by 15 safety experts. Next, priority weights of the indicators were analyzed by an analytic network process and Super Decisions version windows 2.10. Accordingly, the nine main indicators and 43 sub-indicators influencing the PTW system were ranked. The main indicators from high to low were preventive actions, training, safe procedures, emergency system, control and corrective measures, coordination, monitoring, details of the permit form and documentation, respectively. The present work helps identify the involved indicators in PTW system efficiency. Thereby, the experts can prioritize and perform measures to prevent failures in the system and decrease accidents.

- **Keywords:** permit to work, safety, permit to work indicators, analytic network process

Neelesh K. Sharma, Mayank Tiwari, Atul Thakur & Anindya K. Ganguli. *A systematic review of methodologies and techniques for integrating ergonomics into development and assessment of manually operated equipment.* Pages: 1053-1065.

Objective. Humans have limited power and require mechanization, to meet high energy demand, through equipment. We initiated this study to accumulate data from previous research to identify critical issues and approaches in implementing ergonomic principles into the design, intervention, development and assessment of manually operated equipment. *Method.* The literature search was carried out in scientific databases: Scopus and PubMed. Fifty-three research articles, meeting the inclusion criteria, were selected for this review. *Results.* The study indicated a propensity of countries with lower-middle-income and high-income groups, and of the agricultural and manufacturing sector toward research and development of manually operated equipment. A thorough study of the equipment design process revealed that health and safety was the prime motivator in the pre-design phase, an experimental prototype approach was most utilized in the design phase and a direct measurement technique was most frequently used in the post-design phase. *Conclusion.* The study highlights the scarcity of research in the integration of ergonomics into the design of manually operated equipment among countries with the low-income group. This study also promotes the use of virtual design and assessment techniques for cost-effectiveness.

- **Keywords:** ergonomics, musculoskeletal disorder, design, ergonomic interventions, manually operated equipment

Azam Karami Mosafer, Elnaz Taheri, Abdulrahman Bahrami, Seyed Mohammad Zolhavarieh & Mohammad Javad Assari. *Comparing formaldehyde risk assessment in histopathology laboratory staff using*

three methods based on US EPA approaches in the west of Iran. Pages: 1066-1076.

Objective. In different studies, various models have been used for exposure risk assessment of formaldehyde, so this study was conducted to compare existing methods. *Method.* This cross-sectional analytical study was performed in the pathology section of four hospitals in the west of Iran in 2016. Personal air sampling was performed using National Institute for Occupational Safety and Health (NIOSH) method 3500. Risk assessment with existing methods and comparison between them was performed with the statistical tests. *Results.* 71% of participants were exposed to values above the threshold limit value. The carcinogenic risk obtained for the staff of the studied hospitals ranged from 3×10^{-6} to 3.07×10^{-4} . The potential dose of exposure to formaldehyde varied from 73.22 to 3216.06 $\mu\text{g} \cdot \text{day}^{-1}$. The hazard quotient value was more than 1 in 71.4% of cases. *Conclusion.* The results of the existing methods for carcinogenic risk assessment are almost similar. In general, the Risk Assessment Information System (RAIS) is recommended because of its simplicity and reduction of error probability, saving time and cost. The results of this study can be used as a guide to select the appropriate risk assessment method for planning, providing appropriate control measures and risk management.

- **Keywords:** formaldehyde, histopathology laboratories, health risks, occupational exposure

Francisco Javier Soto-Rodríguez, José Manuel Pérez-Mármol, Claudio Bascour-Sandoval, Claudio Muñoz-Poblete & Gabriel Nasri Marzuca-Nassr. The association of musculoskeletal complaints and individual and work-related factors with work ability in Chilean white-collar and blue-collar workers. Pages: 1077-1084.

Objective. The maintenance of good work ability has proven to have a positive effect on health, quality of work and productivity. There is little evidence regarding the association between musculoskeletal complaints, individual and work-related factors, and work ability in blue-collar and white-collar workers. *Methods.* A cross-sectional study of hospital and university workers ($n = 360$) was performed to determine the association between musculoskeletal complaints, individual and work-related factors, and work ability; two multiple linear regression models were created. *Results.* In white-collar workers, musculoskeletal complaints of the dorsal/lumbar region ($\beta = -0.259$) and the wrist/hand segment ($\beta = -0.151$) were significantly associated with reduced work ability. A higher body mass index ($\beta = -0.227$) was also negatively associated with the dependent variable. In blue-collar workers, musculoskeletal complaints of the dorsal/lumbar region ($\beta = -0.317$) and the elbow/forearm segment ($\beta = -0.171$) were significantly associated with lower work ability. Increased age ($\beta = -0.204$) was associated with reduced work ability in this group. No significant correlations were found between work-related factors and work ability. *Conclusions.* Musculoskeletal complaints and individual factors, but not work-related factors, are associated with work ability in Chilean blue-collar and white-collar workers. Nevertheless, the variables that explain the change in work ability are different between these groups.

- **Keywords:** blue-collar worker, musculoskeletal complaint, white-collar worker, work ability, work-related factor

Azam Esmaily, Sara Jambarsang, Farough Mohammadian & Amir Houshang Mehrparvar. Effect of shift work on working memory, attention and response time in nurses. Pages: 1085-1090.

Objective. The present study aimed to investigate the relationship between shift work and cognitive performance in nurses. *Methods.* The present before–after study included 35 female nurses 25–40 years old with similar mental and physical workload. Working memory, response time and attention were assessed using Wechsler and Stroop tests. The variables were measured at the beginning and the end of three working shifts (morning, afternoon and night). An interval of 3 days was considered for performing an after-shift test to eliminate the learning effect. Data were analyzed using repeated-measures analysis of variance (ANOVA). *Results.* At the end of all three shifts, nurses' working memory ($p = 0.039$) and interference score ($p = 0.04$) were significantly decreased, but their response time was not significantly affected during a shift. The decrease in working memory after the night shift was significantly higher than after the morning and evening shifts ($p < 0.001$). *Conclusion.* The results of this study showed that shift work can affect some aspects of cognitive function (working memory and attention) in nurses, and this effect was more prominent after a night shift.

- **Keywords:** shift work, cognitive function, working memory, attention, response time, nurse

Maša Legan & Klementina Zupan. *Prevalence of mobile device-related lower extremity discomfort: a systematic review.* Pages: 1091-1103.

Mobile device users often experience musculoskeletal discomfort due to the intensive use of these devices in static body postures. Prolonged sitting and standing at work and in free time are risk factors for various diseases and all-cause mortality. Prolonged static postures are the main cause of lower extremity discomfort. A systematic search of the articles was conducted in four different electronic databases. All selected papers were appraised using a critical appraisal tool. Fourteen studies were selected for the review. The prevalence of musculoskeletal complaints ranged from 0.4 to 72.9%. Mobile device-related lower extremity discomfort ranged from 0.4 to 9.6%. The most common body posture among mobile device users in the selected studies was sitting. There is some evidence for the association between lower extremity pain and mobile device use. Experts should take this review as a basis to provide appropriate and effective ergonomic measures, especially for working mobile device users.

- **Keywords:** mobile device, lower extremity discomfort, musculoskeletal discomfort, prolonged body posture, prolonged sitting

M. A. Faghy, M. J. Duncan, A. Pringle, J. Buchanan Meharry & C. M. P. Roscoe. *UK university staff experience high levels of sedentary behaviour during work and leisure time.* Pages: 1104-1111.

Objective. Reducing sedentary behaviours at work is imperative. Before effective strategies can be developed there is a need to understand profiles of activity within particular roles and organizations. This study aimed to determine activity profiles of staff by job title at a UK university. *Methods.* Three-hundred and seventeen participants completed the international physical activity questionnaire – short form to determine physical activity profiles. Fifty-one participants also wore a wrist-worn GENEActiv accelerometer for 7 days and completed a self-report diary denoting work and leisure hours. *Results.* Twenty-one per cent of respondents were categorized as inactive and achieved 298 ± 178 metabolic equivalent minutes (MET-min)/week. Those in administrative roles were most sedentary (501 ± 161 min/day). Accelerometer data highlighted that sedentary time was identical between job roles (pooled mean 8746 ± 823 counts) and equated to $84 \pm 9\%$ of total time. During working hours, management, professional and specialist job roles had the highest level of sedentary time (2066 ± 416 counts). *Conclusion.* Time spent undertaking sedentary activities during working hours contributes to reduced overall activity and can impede productivity,

performance and health. Interventions encouraging regular movement and preventing sedentary behaviours at work are therefore required.

- **Keywords:** physical activity, job role, sedentary behaviour, accelerometry

Nektarios Karanikas & Bhargavi Dhruv Jani. *Frequency of examination and perceived contribution of factors relating to work-related musculoskeletal disorders of physiotherapists.* Pages: 1112-1129.

Objective. Literature confirms that many physiotherapists suffer from work-related musculoskeletal disorders (WMSDs), but studies mention different, complementary and contradictory findings regarding risk factors. This scoping review aimed at revealing the most frequently examined and contributory WMSD factors mentioned in recent studies about physiotherapists. *Methods.* Based on specific inclusion/exclusion and appraisal criteria, 11 studies published between 2012 and 2018 were included in the analysis. The factors recorded per publication were grouped into 18 categories, the frequency of their appearance across the sources was counted and the median ranks of their relative reported contribution were calculated. *Results.* Excessive workload was found to be the most contributory factor, followed by the application of manual orthopaedic techniques. However, demanding and repetitive manual tasks were the most common factors investigated in the publications reviewed. A medium-strength correlation was found between the frequency of examination and reported contribution of factors but with a noticeable range of the confidence interval possibly due to the diversity of the approaches in the studies reviewed. *Conclusions.* The findings indicate a relative discordance between the level of contribution of each factor to the development of WMSDs and the types of factors most frequently addressed by studies.

- **Keywords:** physical therapy, physiotherapists, musculoskeletal disorders

Kåre Karlsson, Salmir Nasic, Lars Lundberg, Jan Mårtensson & Anders Jonsson. *Health problems among Swedish ambulance personnel: long-term risks compared to other professions in Sweden: a longitudinal register study.* Pages: 1130-1135.

Objectives. This study aimed to investigate whether Swedish ambulance personnel differ in the extent of suffering from health problems compared to other occupational groups. *Methods.* Two cohorts of ambulance personnel from 2001 and 2008, with 1778 and 2753 individuals, respectively, were followed regarding assignment of diagnostic coding (International Classification of Diseases codes) until 2016. These two cohorts represent all who were employed as ambulance personnel by public employers during these years. Two comparison groups were added: other healthcare workers and other professions. All data were retrieved from national registers. The χ^2 test was used for statistical calculation. *Results.* Swedish ambulance personnel are at a significantly higher risk of being affected by 'Paroxysmal tachycardia, atrial fibrillation and flutter, other cardiac arrhythmias', by 'Other intervertebral disc disorders' and by 'Arthropathies', when compared to both comparison groups in both cohorts. Almost similar results were seen for 'Gonarthrosis' and for 'Dorsopathies'. *Conclusions.* Swedish ambulance personnel run the risk of being affected by certain diseases and injuries to a greater extent compared to other professions.

- **Keywords:** Ambulance personnel, occupational injury, work-related diseases, work-related stress, register study

Kristina Eliasson, Mikael Forsman & Teresia Nyman. *Exploring ergonomists' experiences after participation in a theoretical and*

practical research project on observational risk assessment tools. Pages: 1136-1144.

Objective. The aim of this qualitative study was to explore how ergonomists experienced an e-learning concept as a tool for knowledge translation; furthermore, to explore what, if any, impact the knowledge translation had regarding the ergonomists' work with risk assessments. *Methods.* Twelve Swedish ergonomists employed in the occupational health service (OHS) participated in a research project, which included an e-learning program in risk assessment training. Focus group interviews and individual interviews were used for data collection. *Results.* The ergonomists appreciated the e-learning concept, e.g., its flexibility enabled them to decide when and where to practice. The concept was considered feasible within the context of the OHS. The ergonomists experienced an increased knowledge of different observation-based risk assessment tools, which expanded their professional toolboxes. Additionally, they began to reflect more regarding the reliability of risk assessment tools and how to enhance quality in risk assessment assignments. *Conclusion.* This study showed that e-learning may comprise an efficient knowledge translation for improved risk assessments in the OHS. The program contributed to changes in ergonomists' risk assessment procedures, e.g., in the selection of tools, increasing the number of observers, employing a participatory approach and more often actively involving stakeholders during the risk assessment process.

- **Keywords:** e-learning, knowledge translation, participatory, risk assessment procedure

Serhii Cheberyachko, Yurii Cheberyachko, Mykola Naumov & Oleg Deryugin. Development of an algorithm for effective design of respirator half-masks and encapsulated particle filters. Pages: 1145-1159.

Objective. Social and economic situations in the modern world require new approaches to the development of respiratory protective equipment. This study aimed to improve the three-dimensional modeling process for respirator half-masks and encapsulated particle filters. *Methods.* Basic provisions of the theory of non-stationary filtration and hydroaerodynamics, the Nelder–Mead method and the linear interpolation equation were used. *Results.* The peculiarity of the algorithm is the adjustment stage of the design process aimed at checking efficiency of the half-mask. The surface of the half-mask was constructed according to the coordinates of a three-dimensional model of a worker's head. *Conclusion.* For the first time, the regularities of an algorithm for designing the half-mask surface of dust respirators were defined based on the data for three-dimensional coordinates of key points of anthropometric parameters of workers' faces. The pressure difference on the encapsulated particle filters of dust respirators is determined by the particle filter's resistance coefficient and air flow through them, and the diameter ratio of their outlets and inlets. The developed algorithm provides product verification at the design stage using criteria evaluating parameters of a polygonal model of the head, preliminary calculation of the protection factor and checking the tightness of the prototype.

- **Keywords:** algorithm, model, half-mask, dust respirator, obturator, coefficient of insulation

Tulay Basak, Gul Sahin & Ayla Demirtas. Comparison of surgical gloves: perforation, satisfaction and manual dexterity. Pages: 1160-1166.

The purpose of this study was to assess the effectiveness of two different surgical gloves (powdered latex and powder and latex free) for glove perforation frequency, problems and satisfaction with glove usage and manual dexterity levels during surgical operations that include scrub nurses. Scrub nurses wore antiallergenic gloves (powder and latex free) gloves during three operations, double latex and powdered gloves during three

operations and single latex and powdered gloves during three operations. The gloves were checked for punctures after each surgery with a water-inflation test. In our study, 19% of single gloves and 18.1 % of double gloves and 4.8% of powder and latex free worn by scrub nurses were punctured during surgery. None of the inner gloves in double gloves were punctured. Although wearing double gloves restricts manual dexterity, results in discomfort problems such as perspiration and fetor and results in a low satisfaction rate among scrub nurses, double gloves are protective against injuries and punctures.

- **Keywords:** surgical gloves, scrub nurse, perforation, satisfaction, manual dexterity

Emir İbrahim Işık, Koray Soygun, Öykü Ceren Kahraman & Elif Figen Koçak. *The effect of the menstrual cycle on the sense of touch, grip strength and manual dexterity of dental students.* Pages: 1167-1175.

Objectives. This study aimed to evaluate through comparative tests the effect of the menstrual cycle on levels of depression, sleep quality and grip strength, fingertip touch and manual dexterity of students in the Dental Faculty. *Methods.* The study sample was formed from female students of the Dental Faculty. The total 70 participants comprised 31 from the first year and 39 from the final year. Evaluations were made in two different consecutive phases of the menstrual cycle. Data were collected using the Beck depression inventory (BDI), the Pittsburgh sleep quality index (PSQI), handgrip and lateral grip strength measurements, fingertip two-point discrimination sensory measurement, the Semmes-Weinstein monofilament test, the O'Connor tweezers skill test and the Purdue pegboard test. *Results.* A statistically significant difference was determined between the menstrual and ovulation phase measurements of the BDI, PSQI, Semmes-Weinstein monofilament test (right), the O'Connor tweezers skill test and Purdue pegboard test (right + left), and the Purdue Pegboard test (total and assembly) ($p < 0.05$). *Conclusions.* The menstrual cycle does not affect the sense of touch, grip strength and simple hand skills. However, task-focused skills requiring care and the manual dexterity needed for the use of instruments are affected.

- **Keywords:** dental students, grip strength, manual dexterity, menstrual cycle, sense of touch

Jamal Biganeh, Azadeh Ashtarinezhad, Davood Behzadipour, Narges Khanjani, Atefeh Tavakoli Nik & Majid Bagheri Hosseinabadi. *Investigating the relationship between job stress, workload and oxidative stress in nurses.* Pages: 1176-1182.

Objectives. Occupational stress and workload are common risk factors among nurses that increase absenteeism, reduce the quality and quantity of patient care, increase care costs and increase the patient safety risk. The relation between these risk factors and oxidative stress levels has not been clearly defined. *Methods.* This study was conducted with 258 participants (126 nurses as the case group and 132 healthy adults as the control group). Information was collected using a demographic questionnaire, the nurses' occupational stress scale and the NASA task load index workload questionnaire. Blood samples were taken from the participants and then the levels of malondialdehyde (MDA), superoxide dismutase (SOD), catalase and total antioxidant capacity (TAC) were measured in the serum samples. Independent t tests and one-way analysis of variance were used for statistical analysis. *Results.* SOD and TAC were significantly higher and MDA was significantly lower among the case group compared to the control group. TAC levels significantly decreased with increased stress. MDA levels showed negative associations with stress and workload. Nurses experience high levels of occupational stress and

workload. *Conclusion.* Biomarkers such as SOD, TAC and MDA are the most important predictors of work stress and overwork in this study.

- **Keywords:** antioxidant activity, job stress, nurses, workload

A. Rahman, N. A. A. Tuah, K N. Win & A. S. C. Lai. *A survey of noise-induced auditory symptoms in manufacturing workers in Brunei Darussalam.* Pages: 1183-1188.

Noise-induced auditory symptoms (NIASs) refer to symptoms that develop after exposure to loud noise, where common symptoms are tinnitus and hearing difficulty. If not detected early or prevented, NIASs may lead to the development of noise-induced hearing loss (NIHL). This cross-sectional study aimed to investigate the prevalence rate of common NIASs and contributing occupational factors among manufacturing workers in Brunei Darussalam. The response rate for this study was 81.7%. The prevalence rate of NIASs was 18% and the most commonly reported symptom was 'ears feeling full after leaving a very noisy place' (10.5%). This study showed a strong association between the absence of hearing protective device use (adjusted odds ratio = 2.118, $p = 0.040$) and having at least one reported NIAS. The study findings can be used to plan and implement policies where there is a risk of occupational noise exposure to prevent NIASs and further development of NIHL.

- **Keywords:** noise-induced auditory symptoms, manufacturing, noise controls, industrial health, occupational health

Tânia M. Lima & Denis A. Coelho. *Gender differences in associating musculoskeletal complaints, housework, electronic device usage and physical exercise for administrative workers.* Pages: 1189-1197.

Objectives. This study assessed musculoskeletal complaints (MSCs) in administrative workers, associating MSCs with non-paid housework, home use of electronic devices and physical exercise, while keeping a distinctive gender approach. This may promote the development of more effective preventive measures, by meeting the specific strengths and weaknesses of each gender. *Methods.* Ninety-six administrative workers (58 women and 38 men) who used computers more than 50% of their working time participated in a cross-sectional study. A questionnaire concerning individual socio-demographic data, habits and lifestyle, and including the Nordic musculoskeletal questionnaire (NMQ), was deployed. Gender-based odds ratios for MSCs in body areas over the previous 12 months and correlation coefficients between habits and lifestyle variables and NMQ variables were computed. *Results.* Women did not incur a higher risk of MSCs than men. Analysis of the association did not yield meaningful associations for either gender. Results suggest giving future consideration to development of gender-specific preventive measures. *Conclusion.* Computerized work performed concomitantly with physical exposures outside the workplace showed mixed associations with MSCs, according to gender and depending on the kind of exposure. Results are indicative of the need for development of gender-specific preventive measures.

- **Keywords:** musculoskeletal complaints, gender, office workers, house, work, electronic devices, physical exercise

Adrian Furnham. *Motivational profiles and safety-related traits.* Pages: 1198-1203.

This article is concerned with the relationship between the job motivational and preference profile of individuals and their engagement in safety behaviours. Studies have investigated personality traits but not motive and value correlates of risk-related

behaviour. More than 25,000 Americans completed a questionnaire on safety-related competencies in the workplace that measured six different, but related, safety-related traits. They also completed a motivational measure of preferences and values used extensively in personnel assessment and selection. The six safety dimensions yielded two factors labelled observant and resilient that, along with the total score, were the criterion variables. Step-wise regressions indicated that those with high needs for affiliation, hedonism and recognition tended to be less safety conscious. The two different factors also showed a different pattern of demographic and motivational correlates. Problems of method invariance are discussed, as well the role of job motivation individual differences in safety-related traits and competencies.

- **Keywords:** safety behaviours, bright side, dark side, personality, motivation

Elizabeth Maynard & Don Harris. *Using neural networks to predict high-risk flight environments from accident and incident data.* Pages: 1204-1212.

Flight risk assessment tools (FRATs) aid pilots in evaluating risk arising from the flight environment. Current FRATs are subjective, based on linear analyses and subject-matter expert interpretation of flight factor/risk relationships. However, a 'flight system' is complex with non-linear relationships between variables and emergent outcomes. A neural network was trained to categorize high and low-risk flight environments from factors such as the weather and pilot experience using data extracted from accident and incident reports. Negative outcomes were used as markers of risk level, with low severity outcomes representing low-risk environments and high severity outcomes representing high-risk environments. Eighteen models with varied architectures were created and evaluated for convergence, generalization and stability. Classification results of the highest performing model indicated that neural networks have the ability to learn and generalize to unseen accident and incident data, suggesting that they have the potential to offer an alternative to current risk analysis methods.

- **Keywords:** neural networks, flight safety, flight risk, modelling, safety management

Ahmad Mehri, Javad Sajedifar, Milad Abbasi & Mohammad Ali Tajbakhsh. *The effect of veiling luminance on the disability glare of car headlamps designed in Iran.* Pages: 1213-1218.

Objectives. One of the main risk factors involved in increasing driving accidents at night is due to the veiling luminance of the car's headlights reducing the contrast of images in the retina and, thus, reducing the visual performance of drivers. The aim of this study is to investigate the veiling luminance caused by the headlights of the best-selling vehicles in Iran. *Methods.* Using the Stiles-Holiday disability glare equation, the veiling luminance of headlights of common vehicles at distances of 10–100 m for both high-beam and low-beam modes of oncoming vehicles was measured on a road for healthy (young, middle-aged and older) drivers. *Results.* Under high-beam illumination, as the cars approached each other, the average illuminance of the car headlights gradually increased. Moreover, age had a significant impact on the veiling luminance. This study also showed that, in same-age groups, the Samand Souren and Peugeot Pars cars had the highest and lowest mean veiling luminance, respectively. *Conclusion.* The findings showed that the illuminance (at large distances between two cars) and the angle between the source of glare and the eyes of drivers (as two cars approach to each other) have a dominant influence on the disability glare.

- **Keywords:** disability glare veiling luminance car traffic accidents illuminance visual performance

Samuel Bert Boadi-Kusi, Peter Osei-Wusu Adueming, Francisca Ama Hammond & Ebenezer Oduro Antiri. *Computer vision syndrome and its associated ergonomic factors among bank workers*. Pages: 1219-1226.

Objectives. This study aimed to describe the prevalence of ergonomic factors associated with computer vision syndrome (CVS), and knowledge and practices of computer usage among bank workers in the Cape Coast Metropolis, Ghana. *Methods.* A comprehensive eye examination was performed for 139 bankers in the Cape Coast Metropolis. Measurements of ergonomic practices at workstations were carried out and self-administered questionnaires were used to collect socio-demographic data, symptoms of CVS and associated factors as well as knowledge, attitudes and practices of the bankers on CVS. Descriptive statistics and logistic regression were carried out to compute the different proportions and relevant associations. *Results.* Headaches (73.4%), eyestrain (65.5%) and itching (63.3%) were the most common reported symptoms. The prevalence of CVS in the study population was 71.2% with a high level of poor ergonomic practices (78.4%) at computer workstations. With regard to knowledge, attitudes and practices of the participants on CVS, 68.3% of the participants had low levels of knowledge on CVS, while 90.6% had negative attitudes towards CVS and 46.0% of the participants had poor practices. *Conclusion.* Bankers had a high prevalence of CVS. Ergonomic practices, females and computer usage were all associated significantly with the presence of CVS.

- **Keywords:** computer vision syndrome, prevalence, ergonomics, bankers, Ghana

Clayton H. Rocha, Gabriela Lisboa, Fernanda Y. O. M. M. Padilha, Camila M. Rabelo & Alessandra G. Samelli. *Effects of hearing protector devices on speech intelligibility: the importance of individualized assessment*. Pages: 1227-1234.

Objectives. This study aimed to compare speech intelligibility in noise with and without hearing protection devices (HPDs). *Methods.* Fifty-one workers were distributed into three groups: noise-induced hearing loss group (NIHLG), normally hearing noise-exposed group (NG) and normally hearing non-exposed to noise group (CG). A free field system was used to emit monosyllables (65, 70 and 75 dB) and pink noise in different signal-to-noise ratios (SNRs) (0, -5, -10 and -15). *Results.* In situations with HPDs, all groups showed a decrease in the percentage of correct responses with an increase in noise level. The HPD had little effect on speech intelligibility in the NIHLG and NG. Considering the effect caused by the HPD on speech intelligibility, it was observed that the group with the greatest loss was the CG for SNRs of -5, -10 and -15. *Conclusion.* Although speech intelligibility is influenced by the hearing threshold, the noise level and SNR are crucial for good speech intelligibility, either with or without an HPD. It is highlighted that the NG had worse results when compared with the CG, which may indicate changes in the auditory pathway resulting from continuous noise exposure, even in the absence of changes in the audiometric thresholds.

- **Keywords:** ear-protective devices, noise, occupational, signal-to-noise ratio, speech discrimination tests, speech intelligibility

Yan Wang, Suxia Liu, Jingjing Zhang & Jingjing Zhong. *The evaluation index system of non-rigid demand service quality in safety production: based on the whole process*. Pages: 1235-1243.

The evaluation index system of non-rigid demand service quality in safety production delineates the production safety-related services that are procured by enterprises from service organizations and are not mandatory by the state. Construction of the evaluation index system of non-rigid demand service quality in safety production is an effective way

to improve the quality of the demand service. Based on the INDSERV model and on-site interviews, this study constructs a whole-process safety production non-rigid demand service quality evaluation model, clarifies the evaluation indicators and conducts on-site investigations to verify the effectiveness of the model, and further analyzes the data to determine each evaluation index weight. A safety production non-rigid demand service quality evaluation index and evaluation scale were constructed. Effective exploration was performed on the evaluation index system of non-rigid demand service quality in safety production, which provides a guarantee for promoting the development of the non-rigid demand service market.

- **Keywords:** safety production service, safety production demand service, INDSERV model, safety production demand service quality evaluation, safety production demand service quality evaluation scale

William Mbang Bian, Jerson Mekoulou Ndongo, Wiliam Richard Guessogo, Edmond Ebal Minye, Peguy Brice Assomo Ndemba, Georges Gassina, Samuel Honoré Mandengue & Abdou Temfemo. *Musculoskeletal disorders and risk factors among heavy load carriers in Yaounde city, Cameroon.* Pages: 1244-1250.

Objectives. This study assessed musculoskeletal disorders (MSDs) and their correlates among heavy load carriers in Yaounde city, Cameroon. *Methods.* A descriptive cross-sectional study was conducted on 301 healthy male handlers. Descriptive statistics were used to determine prevalence while logistic regression was performed to determine associated factors. *Results.* MSD prevalence was 100 and 87.7% during the last 12 months and 7 days, respectively. Main sites affected were, respectively, the lower back (84.1 and 61.1%), hips/thighs (81.1 and 47.2%) and neck (74.7 and 43.2%). MSD risk factors were age 25–30 years during the last 12 months (odds ratio [OR] = 2.8; 95% confidence interval [CI] [−1.2, 6.5]) and 7 days (OR = 4.2; 95% CI [−1.7, 10.7]) for the neck and the last 12 months (OR = 2.6; 95% CI [−1.1, 5.8]) for shoulders. Overweight was a risk factor for wrists/hands in the last 12 months (OR = 2.7; 95% CI [−11.0, 7.2]). Seniority of 5–10 years was a risk factor for the lower back (OR = 1.8; 95% CI [−1.0, 3.3]) and hips/thighs (OR = 3.2; 95% CI [−1.7, 5.8]) in the last 7 days. *Conclusion.* Handlers showed high MSD prevalence in most sites, e.g., lower back, upper back, hips/thighs, shoulders and neck. Associated significant factors were age, overweight and seniority.

- **Keywords:** musculoskeletal disorders, risk factors, heavy load, Cameroon

Mei Liu, Heap-Yih Chong, Pin-Chao Liao & Linyu Xu. *Incorporation of hazard rectification performance for safety assessment.* Pages: 1251-1264.

Objectives. Safety assessment helps the development of continuous improvement strategies in construction safety, especially coping with dynamic changes to the on-site environment with uncertainties. This article proposes a composite safety assessment based on on-site conditions to facilitate improved and proactive construction safety management. *Methods.* First, based on evident rectification records, we utilized set pair analysis, a grey rough approach and a coevolution approach to quantify overall safety performance. Second, we incorporated two safety performance indicators into a composite assessment framework, using rough set theory and fluid dynamics. Finally, the assessment results of the seven completed projects were compared. *Results.* The coevolution approach had novel advantages in assessing rectification performance and the fluid dynamics approach could enhance the proactive warning ability of the safety assessment. *Conclusion.* Theoretically, the research contributes to new insights into the quantification of construction safety assessment under dynamic on-site conditions.

Practically, it also contributes to the active and objective measurement of management performance and promotes the dynamic and stable safety performance evaluation for on-site construction.

- **Keywords:** safety, performance assessment, on-site environment, construction industry

Hamidreza Abbasianjahromi, Emadaldin Mohammadi Golafshani & Mehdi Aghakarimi. *A prediction model for safety performance of construction sites using a linear artificial bee colony programming approach.* Pages: 1265-1280.

The reputation of the construction industry as one of the most world's dangerous industries is because of its tremendous accident and fatality rate. In this study, a prediction model for construction projects' safety performance was presented as an alarm system. The proposed model can predict the safety performance at the beginning of the project. To do so, firstly, data preparation and, secondly, developing an automatic regression model were carried out as the two main steps of the study. To collect data, after identifying effective criteria, a questionnaire was developed. Next, an innovative machine learning method, named linear artificial bee colony programming, was used to discover the relationship between the identified criteria and safety performance. The results of one-dimensional and two-dimensional sensitivity analysis show that the four criteria of management commitment to safety, safety training, safety team and safety budget are the most important factors that influence safety performance.

- **Keywords:** safety performance, prediction model, machine learning, linear artificial bee colony programming, construction industry

Martin Sedlár. *Work-related factors, cognitive skills, unsafe behavior and safety incident involvement among emergency medical services crew members: relationships and indirect effects.* Pages: 1281-1290.

Objectives. This study examines relationships between work-related factors – stress and fatigue, cognitive skills – situation awareness and cognitive flexibility, unsafe behavior and safety incident involvement among emergency medical services (EMS) crew members, and whether cognitive skills and unsafe behavior together indirectly affect the relationship between work-related factors and safety incident involvement. *Methods.* A sample of 131 EMS crew members working in ground ambulances (physicians, paramedics, ambulance drivers) completed self-report questionnaires. *Results.* The correlation analysis showed significant positive interrelationships between work-related factors, unsafe behavior and safety incident involvement, and that cognitive skills were significantly negatively related to these variables. The multiple indirect effects analysis revealed significant indirect effects of both work-related factors on safety incident involvement through situation awareness and unsafe behavior, but not through cognitive flexibility. *Conclusion.* In terms of reducing the number of EMS provider and patient safety incidents, the findings suggest the importance of reducing stress and fatigue in EMS crew members, improving their cognitive skills, in particular situation awareness, and supporting their safety compliance behavior.

- **Keywords:** stress, fatigue, non-technical skills, situation awareness, cognitive flexibility, unsafe behavior, safety incidents, emergency medical services

Mostafa Mirzaei Aliabadi, Iraj Mohammadfam & Keyvan Salimi. *Identification and evaluation of maintenance error in catalyst replacement using the HEART technique under a fuzzy environment.* Pages: 1291-1303.

Objectives. A necessity for this study was felt in the catalyst replacement process as a maintenance operation, because some fatal incidents have occurred due to human error in process industries during catalyst replacement operation. Identification and evaluation of human error is essential in predicting and reducing accidents in maintenance operation. *Methods.* The human error assessment and reduction technique (HEART) as a human reliability analysis was applied in this study. Because the HEART method uses expert judgment, it is possible to make a bias in the assessment. Fuzzification and aggregation opinions of a heterogeneous expert group in a trapezoidal fuzzy set were used to mitigate this deficiency. *Results.* Evaluation results showed that the subtask 'Entering the reactor' with human error probability (HEP) of $9.2E-1$ and the subtask 'Reduce temperature while reducing feed' with HEP $1.3E-3$ had the highest and lowest chance of human error, respectively. *Conclusions.* In order to reduce the likelihood of human error, it is necessary to take appropriate actions based on the task-specific error producing condition (EPC).

- **Keywords:** human error, fuzzy logic, human error assessment and reduction technique, catalyst replacement, maintenance

Flávia Lopes Gabani, Arthur Eumann Mesas, Mayara Cristina da Silva Santos, Alberto Durán González & Selma Maffei de Andrade. *Chronic musculoskeletal pain and occupational aspects among Brazilian teachers.* Pages: 1304-1310.

Objectives. This study aimed to determine the association between working conditions and chronic musculoskeletal pain (CMP) in regions of the body in teachers. *Methods.* A cross-sectional study was performed with 958 teachers from Brazil. Outcomes were chronic pain in the upper limbs, lower back and lower limbs. Independent variables were characteristics and perceptions about the work. Poisson regression models were adjusted by socio-demographic, lifestyle and co-morbidity variables. *Results.* After adjustments, strong associations were observed between a negative perception regarding writing on the board and pain in the upper limbs (prevalence ratio [PR] = 4.65; 95% confidence interval [CI] [2.02, 10.70]) and lower back pain (PR = 2.10; 95% CI [1.06, 4.15]) and between a negative perception of standing duration and pain in the lower limbs (PR = 3.98; 95% CI [1.54, 10.26]). Additionally, the number of workplaces, number of students and conditions for carrying teaching material were associated with pain in the upper limbs. Time in the profession and a negative perception of work-life balance were associated with pain in the lower limbs. *Conclusions.* Different work conditions were associated with CMP in different body regions. Policies to improve teachers' working conditions, such as providing furniture that meets teachers' ergonomic needs, are needed to reduce CMP.

- **Keywords:** teacher, occupational health, musculoskeletal pain, chronic pain

Emil Lager & Marika Melin. *Proactive flight safety – a feasibility study on optimal use of flight data monitoring and incident reports in an airline.* Pages: 1311-1315.

Objectives. This study aimed to identify problems with the use of flight data monitoring (FDM) and incident report systems in an airline, present considerations for improvement and suggest a model of how these considerations relate to increased flight safety and lower costs. *Methods.* Data were collected from information technology systems and interviews with managers in key positions. The study involved identification and evaluation of available sources of FDM and incident reports, interviews with people in positions with ownership of change, relevant perspectives of safety-related challenges and model creation. *Results.* Problems include the sheer amount of data collected, floor and ceiling effects, arbitrary cut-off points and lack of interconnectivity with other

sources. The incident report system has practical problems (user-interface rigidity, online dependency), unclear responsibility for the overall process and disagreement on what requires follow-up, resulting in fewer reports getting written. Put together, detection of dysfunctional patterns is difficult. *Conclusion.* Simple proactive interventions using the current data and report systems can ensure higher levels of flight safety and lower costs. This begins with ecologically valid FDM providing a basis for efficient identification and handling of incident reports, which enables learning from malpractices and facilitates communication between management and flying staff.

- **Keywords:** Analysis of safety data, error monitoring and reporting systems, knowledge elicitation/acquisition, human–system interface, feasibility