Editorial

This edition is later than the intended sequence of publication dates ... which may not surprise readers who noted that the previous edition also was delayed. Many factors contribute to this reality and are likely to do so for the foreseeable future. It requires time and effort to acquire a reliable flow of journal material; time to distribute prospective papers to appropriate referees; receive their feedback; and work with the authors to produce the final draft for publication ... or sadly in some cases to advise the writer that a paper has not been accepted; any of these factors may disrupt a planned schedule. Once all material is to hand, it must be correlated and formatted for electronic and hard copy dispatch to the publisher. There the final document is created and a proof copy returned to the editor for checking and final approval before printing and distribution. The voluntary activity must fit into personal and commercial schedules. Given our anticipated yet uncertain manuscript delivery, it can not be expected that EA will be handled instantly on arrival at Acute Concepts; there will be other clients whose work is already in the system. Our uncertainty also makes it difficult to attract advertising material that is time critical. While the editor believes it is important to maintain a quarterly schedule, it may be necessary to limit circulation to three issues per annum for a period in order to achieve a sustainable journal output. No decision is requested at present but a careful assessment is necessary. This situation is not unusual in a fledgling enterprise and should resolve itself when there is a wider appreciation of processes and time lines.

This edition continues to offer a varied selection of interesting material. Robin Burgess-Limerick provides an early report about a research project that addresses safety considerations in the mining industry. Heather Dale shares some of her findings from a graduate diploma project that investigated participatory ergonomics in five different industries. In the Forum section, Eric Wigglesworth continues to challenge us to think about the past and future directions of occupational health and safety research and management. These stimulating papers deserve a response in future editions by members of the ergonomics community. The editor is grateful to Jacquie Wissenden who continues to provide information about the HFESA Victorian Branch activity ... members in other states are invited to follow her example!

It is interesting that various issues seem to surface periodically across disciplines and geographical locations. One such item arose at a recent NSW Branch meeting in relation to advice being offered to the public by persons of uncertain experience in response to a perceived commercial opportunity. In this instance it related to people offering their services as OHS&E auditors. This is a difficult problem that may lie dormant for long periods and then cause an upsurge of alarm in response to a particular event. Members present at that meeting were also concerned about the standard and abilities of the official community watch dogs ... in other words, who checked the checkers? It is the same with outbreaks of so-called ergonomic products that periodically attract attention and a resounding gnashing of teeth by ergonomics professionals! In many instances these situations merely highlight the need for buyer beware — but sometimes the ignorance can cause actual injury or even death. Then there is the inevitable talk about responsibility, accountability, duty of care and finally allocation of blame for unwanted outcomes.

There is a real risk of harm being inflicted through the ignorance of people who do not know what they do not know. Recent internet discussion forums have also noted this problem in relation to some opinions expressed by expert witnesses from various disciplines. It applies equally to professionals, clients and business opportunists. This situation is fostered in a culture which seeks the lowest tender regardless of adequate and accurate detail. It affects building construction, product choices, and selection of service providers. There are limited means of controlling the fall-out. As one large building contractor noted, by the time the inadequacies are exposed, the genuine practitioners may have closed down because of a reduced cash flow. At that stage, who will be willing, available and capable of rectifying and completing a failed project, quite apart from the necessary further expenditure that is claimed to often reach a 2.5 to 1 ratio based on the original estimate accepted by the client?

Many professional societies continue to agonise over the advantages and disadvantages of various accreditation schemes (beyond disciplinary qualifications) that are intended to inform the general public about an appropriate competency level. All groups appear to have confronted human factors — personalities, loopholes and administrative difficulties that can limit their overall effectiveness. One of the major obstacles — especially for professional groups which are heavily dependent on voluntary officers — relates to the time needed for efficient design, implementation and continuous monitoring of any system and its human components. This is another example of complexity in action for which there are no simple solutions. The only option is a reliance on constant vigilance and responsible action by individuals and organizations that are supported by respected adjudicators and that offer protection for concerned parties. Transparency and confidentiality can be difficult to handle in tandem.
A recent incident highlights the ramifications and possible harm resulting from people not knowing what they do not know. One of our members, Margaret Head, has been involved in designing and marketing a mailroom security system which has received national and international attention. Another company then saw a commercial opportunity and began to offer an ordinary biological safety cabinet that it says could be installed in any office for secure opening of suspect mail! The company incorrectly describes and illustrates this as a laminar flow cabinet on its website (obviously unaware of the operational characteristics of the various classes of cabinet and their level of containment and related hazard management).

Suspect mail should remain unopened on site; be removed in a secure isolator; and be taken by the attending Hazmat team to an appropriate controlled environment/cleanroom laboratory for investigation. Many threats are found to be a hoax, but genuine threats do occur, and all must be treated similarly in the first instance. To use an open-fronted cabinet in a general office would compromise the suspect mail, the cabinet, the personnel, and the office environment, quite apart from causing serious injury or even death from handling genuinely hazardous material in such conditions. The scientific misunderstanding and apparent endorsement by some agencies who should be better advised is most disturbing. Sadly, terrorism and opportunism are current features of the new millennium. Those members interested in the matter of ergonomics and security in the built environment should check out the symposium on this topic to be held during Cyberg 2005.

From 15 September to 15 October 2005 the triennial IEA cyberspace conference will be online. The early bird registration closed on 1 July, but registration is still open and available throughout the conference. This is an affordable opportunity that should not be missed by any internet friendly ergonomists. Some 81 international papers will be online for the month. Do not miss this chance to learn more about human factors operating across the globe. Dr Andrew Thatcher and his team in South Africa have worked extremely hard to produce a stimulating and valuable experience.

An early notice about the November HFESA Conference 2005 in Canberra is also included in this edition. It provides a little information about the invited speakers and program. In addition there are details for a host of other conference opportunities.

This editorial concludes with a message of sympathy for anyone and everyone affected by the latest terrorist atrocity in London. No man is an island: we all grieve for this failure in human behaviour that is being promoted by misguided extremists. There is an overwhelming need for calm resolve to reject such appalling actions while maintaining respect for people of goodwill on both sides of an ideological divide. This is the ultimate challenge for human multiculturalism in our world.

Shann Gibbs PhD
Editor

From the Internet

A human factors fairy tale:

Three men were hiking through a forest when they came upon a large, violently raging river.

Nearing to get on the other side, the first man prayed, "God, please give me the strength to cross the river."

Poof! God gave him big arms and strong legs and he was able to swim across in about 2 hours, twice almost having drowned.

After witnessing that, the second man prayed, "God, please give me strength and the tools to cross the river."

Poof! God gave him a rowboat, strong arms and strong legs and he was able to row across in about an hour after once almost capsizing.

Seeing what happened to the first two men, the third man prayed, "God, please give me the strength, the tools and the intelligence to cross the river."

Poof! He was turned into a woman. She checked the map, hiked one hundred yards upstream and walked across the bridge.

Shann Gibbs

Law of Mechanical Repair:

After your hands become coated with grease, your nose will begin to itch.

Law of the Workshop:

Any tool, when dropped, will roll to the least accessible corner.

Law of the Telephone:

When you dial a wrong number, you never get an engaged tone.
Law of the Alibi:  
If you tell the boss you were late for work because you had a flat tyre, the next morning you will have a flat tyre.

Variation Law:  
If you change queues, the one you have left will start to move faster than the one you are in now.

Bath Theorem:  
When the body is immersed in water, the telephone rings.

Law of close encounters:  
The probability of meeting someone you know increases when you are with someone you don’t want to be seen with.

Law of the Result:  
When you try to prove to someone that a machine won’t work, it will.

Law of Biomechanics:  
The severity of the itch is inversely proportional to the reach.

Theatre Rule:  
At any event, the people whose seats are furthest from the aisle arrive last.

Law of Coffee:  
As soon as you sit down to a cup of hot coffee, your boss will ask you to do something which will last until the coffee is cold.

Verna Blewett

Letters

Hi Shann

Would it be possible to put a notice in the Journal to the effect that there are now 5 issues of the HFESA Newsletter, and that if members haven’t received all copies could they contact the secretariat to check that their email address that Jane has is correct? Jane or I could email back issues to those who haven’t received their copy.

Am looking forward to the next Journal!

Best wishes,
Christine Zupanc
HFESA Newsletter Editor

Hi, Shann!

I was looking through a recent issue of Ergonomics Australia (which looks great, by the way) and noticed two things. First, I was trying to locate the HFESA Web site to give to someone who made an inquiry, but it’s not on the first page with the other contact information. You might want to add it there. Second, is it possible for you to include information about the HFES 49th Annual Meeting to your calendar for the next issue? Here are the details:

Royal Pacific Resort at Universal Orlando
Contact HFES, P.O. Box 1369, Santa Monica, CA 90406–1369 USA,
Tel: +1 310–394–1811
Fax +1 310–394–2410,
www.hfes.org

Thanks!
Lois

Lois Smith, Communications Director
Human Factors and Ergonomics Society
E: lois@hfes.org.
Good day,

I am Debkumar Chakrabarti writing from the Indian Institute of Technology, Guwahati, India. It is my pleasure to inform you that the third International Ergonomics Conference ‘Humanizing Work and Work Environment HWWE 2005’ of the Indian Society of Ergonomics (ISE), is scheduled to be held in December 10–12, 2005 at Indian Institute of Technology Guwahati.

The first (HWWE 2001) was held in 2001 at IIT Bombay and the second (HWWE 2004) was organised at NITIE, Mumbai in 2004.

An Announcement/ invitation cum call for paper brochure is attached herein. It is a PDF acrobat 5 file named ‘IITG-HWWE2005’ and for details visit IIT Guwahati website below. On behalf of the organizing committee HWWE 2005, I cordially invite you to participate. I believe that you will be interested to visit this North-eastern part of India while participating in the conference. Along with all areas of Ergonomics, addressing issues applicable to small scale sector and cottage industries will be given special focus, which is specifically relevant to this part of the country.

I would request you to circulate this information among your members and also to the others who are interested. Please inform us in advance, so that we may take preparatory actions accordingly.

With warm regards, Debkumar Chakrabarti, PhD, Organising Secretary International Ergonomics Conference HWWE 2005, Indian Institute of Technology Guwahati
Email: hwwe2005@iitg.ernet.in, dc@iitg.ernet.in
Phone: 91-361-258-2453/ 2497/ 2500
Fax: 91-361-2690-762
Web: www.iitg.ernet.in, www.iitg.ac.in

Dear Colleague,

You are cordially invited to submit a paper to the 4th International Conference on Information Technology in Asia (CITA’05) which will be held in the capital of Sarawak – Kuching, Malaysia from 12-15 December 2005.

CITA’05 (http://www.cita05.org) provides a platform to bring together researchers and practitioners from different research descriptions and fields of industry, to contribute to a pool of knowledge and experience as well as to collaborate in addressing the issues of applying, integrating and monitoring the ubiquitous computing. Thus, The theme of the conference for this time is Pervasive and Ubiquitous Computing: Computing Anytime, Anywhere for Everyone.

Topics of Interest

CITA’05 invites full-paper submissions, which may address theoretical, methodological or practical aspects in applying, integrating and monitoring the ubiquitous computing structure. (Papers not explicitly addressing these themes below are also welcome.):

Ubiquitous Computing Infrastructure
• Mobile Computing
• Wireless Networks
• Grid Computing
• Security, Integrity, Privacy and Trust

Community Informatics
• ICT for Rural Communities
• E-commerce and E-Business
• Assistive Devices and Technologies
• Telecommuting & Virtual Organisations
• Social Intelligence

Human Computer Interaction
• Adaptive Interfaces
• Multimedia Representation
• Virtual Environment & Augmented Reality
• Culture-Centred Design and Evaluation
• Multimodal Devices and Ubiquitous Systems Design
• Web Usability and Design

Knowledge Networks and Management
• Digital Library
• Visualisation of Information and Knowledge
• Semantic Web
• Knowledge Discovery
• Decision Support
• Cooperative Work
• Web Farming and Mining

Ubiquitous Information Management
• Data Models for Ubiquitous Computing
• Ubiquitous Information Retrieval
• Information Filtering
• Multi-dimensional Databases and OLAP
• Multimedia Information Management
• Use and Management of Metadata
• Personalised Information System
• Distributed Information Systems
• Location Independent Control & Access

Ubiquitous systems Engineering
• UML
• Sentient Computing
• P2P Computing
• Protocols and Development Tools
• Multimedia Description and Query Languages
Agents & Autonomous Systems
- Conversational Systems
- Navigation Guides
- Recommender Systems
- Mediators and Middleware
- Personalisation

Computational Models and Systems
- Bio-Informatics and Life Science Computing
- Ubiquitous Learning Systems
- Distributed Intelligence
- Environmental Modelling
- Computational Societies and Markets

Emerging Technology
- Wisdom Web

**Paper Submission:** Full papers should be sent taking into account the following:

1. Major themes of the conference as listed above.
3. Paper drafts of 3500 to 5000 words, in English. Refer to the paper format in the conference website.
4. Author or co-authors with names, addresses, telephone numbers, fax numbers and e-mail addresses.

Authors are invited to submit an electronic soft-copy of their draft paper through the conference’s web site. Please refer to http://www.cita05.org/submission/ for on-line paper submission. You may also submit your paper via email to papers@cita05.org. otherwise three copies of the full papers may be sent to the following postal mail address:

**CITA’05**
Faculty of Computer Science and Information Technology
Universiti Malaysia Sarawak (UNIMAS)
94300 Kota Samarahan Sarawak Malaysia
Fax Numbers: + 60 82 672301

**Paper Reviews and Publication:** Submitted papers will be reviewed by an International Review Committee. Accepted papers, which should not exceed 10 single-spaced double-column typed pages, will be published in the conference proceedings. Best papers will be selected for awards and recommended for journal publications in the Journal of IT in Asia.

**Conference Workshop:** Workshop sessions will be held on the 12th December 2005.

**Important Dates:**
- August 16, 2005 (5pm, Malaysian Time) Deadline for paper submissions
- October 3, 2005 Notification of acceptance
- October 24, 2005 Deadline for camera-ready papers
- October 31, 2005 Deadline for early registration

**Venue:** Kuching is the capital of Sarawak. The land of the fabled White Rajahs, the hornbill and the orang utan, Sarawak is the largest State in Malaysia and by far the most exotic. Its rainforest, the size of Austria, houses the world’s richest and most diverse ecosystem. This ancient virgin rain forest is home to 27 ethnic groups; people each with their own distinct language, culture and lifestyle.

Kuching city has all the modern amenities with multi-storey buildings blend with structures from colonial days and the colourful Malay and Chinese shop houses. The Sarawak River has long been the center of Kuching life and the Waterfront, a beautifully landscaped esplanade, is the main gathering place for Kuching’s population, especially as the sunsets beyond the scenic Matang Mountains. For more information visit http://www.sarawaktourism.com.

**Contacts:**
Assoc. Prof. Narayanan Kulathuramaiyer  
(Conference Chair)  E-mail: nara@fit.unimas.my

Sapiee Jamel (Programme Co-Chair)  
E-mail: sapiee@fit.unimas.my

Dr. Alvin Yeo (Programme Co-Chair)  
E-mail: alvin@fit.unimas.my

**Conference Secretariat**
Phone: + 60 82 671000 ext 370, 556
Fax: + 60 82 672301

Conference Secretary: Dr. Jane Labadin  
secretariat@cita05.org or cita05@fit.unimas.my

We would appreciate it if you could circulate this email to your colleagues. Thank you very much and look forward to seeing you in Kuching.

Sincerely,
CITA’05 Committee
http://www.cita05.org
### IEA Column

The publication “Ergonomic Checkpoints” was developed jointly between the IEA and the International Labour Organisation (ILO) and launched in 1996. Since this time, it has proven to be one of the most popular publications sold by the ILO.

As part of my responsibility as the IEA Chair for International Development, a major project has been undertaken during 2005 to review the contents of this book in anticipation for a re-launch of the 2nd edition at the IEA Congress, Maastricht, The Netherlands during July 2006.

After successfully obtaining funding from the ILO, I had the opportunity to facilitate a workshop prior to the South East Asian Ergonomics Society (SEAES) conference in Bali during May 2005. This brought together representatives from the IEA and the ILO from around the world with particular representation from the Asian region. We spent 2 days under the guidance of Prof. Kazutaka Kogi, Japan who was one of the original authors as well as Prof. Martin Helander, from Singapore who was also involved in the original publication.

A team of 14 ergonomists worked together for 2 solid days in reviewing both the text, illustrations, as well as range of new checkpoints to be included in the new edition. It truly was an example of international cooperation by a group of volunteers to produce a practical resource for developing countries.

We will continue to refine and edit this publication during the remainder of this year to enable the ILO sufficient time to enable printing for the launch.

I also was privileged to represent HFESA at the SEAES annual general meeting in Bali during May. It is evident that 6 countries within the Asian region have now formed their own Federated Society which places a different focus on the need for a single SEAES. At the AGM, it was resolved to form a working part to determine future options for SEAES in light of the emergence of independent ergonomic societies within this region.

A particularly poignant moment for me was the official dinner at Government house in Denpassar. A choir sang folk songs from participating countries and a wonderful rendition of “I Still Call Australia home” was sung.

As the only Australian amongst the 400 attendees, you can’t help but feel slightly emotional in such circumstances.

In July, I will be representing HFESA at the IEA Council meeting in San Diego, USA. At this meeting I will be presenting a brief report on the activities of HFESA. I look forward to a briefing with Max Healy in Sydney prior to the meeting to accurately represent a perspective on behalf of the members and Board.

In December, I am planning to facilitate another workshop focussing on “Ergonomic Checkpoints in Agriculture” in conjunction with Prof. Kogi the author, and the IEA President, Prof. Pierre Falzon. This will be held prior to the Indian Ergonomics Society (IES) meeting at Guwahati, in North East India. It would also be an opportunity for other Australian delegates to this meeting to participate if interested.

Another IEA activity underway is benchmarking of Masters in Ergonomics education programs. A series of workshops are being conducted in conjunction with international conferences across the world to enable educators of ergonomics to review a draft paper outlining the core educational requirements in a Masters program. If any Australian member would like to review this material, contact the Chairperson of this IEA committee, Stephen Legg in New Zealand.

I look forward to reporting to the HFESA members on the outcomes of the IEA council meeting from San Diego.

Regards and Best Wishes,

David C Caple
HFESA Delegate to IEA
International Ergonomics Association (IEA) K.U. Smith Student Award

The IEA K.U. Smith Student Award honours a deserving student responsible for an application of or contribution to ergonomics/human factors (E/HF). The next award will be presented during the IEA 2006 XVIth Triennial Congress, scheduled to convene July 10-14, 2006, in Maastricht, Netherlands.

The Award winner will receive a cash award of US $3,000. Depending upon need, an additional stipend for travel to the Congress also may be awarded to the winner. Certificates will be awarded to two runners-up.

Any student enrolled in an accredited post-secondary institution (college, university, technical, or vocational school) worldwide is eligible to apply for the award. All areas of E/HF are eligible for consideration. Examples of applicable projects include an applied E/HF project, a human performance study or analysis, a design project or product, a research project undertaken in the laboratory or field, or a theoretical/conceptual contribution to E/HF.

A student wishing to apply for the award should submit the following to the IEA Student Award Committee:

1. Five copies of the abstract for a paper that the student has authored, that documents an application of or contribution to E/HF on the part of the student.

2. A resume for the student, with the student’s name, full address, e-mail and phone numbers, institution enrolled in, experience, list of publications, and a summary of accomplishments and/or contributions related to the field of E/HF. The resume should be limited to 4 pages in length.

3. A letter from the student’s academic advisor on institutional letterhead certifying the following: (1) that the paper described in the abstract was written by the student; (2) that the student was enrolled in the academic program at the time that work described in the abstract was carried out; (3) when the work described in the abstract was carried out; and (4) that the abstract is being submitted for the IEA K.U. Smith Student Award.

The IEA Student Award Committee will select the awardee and two runners-up using a two-stage procedure:

1. review of abstracts and resumes; and

2. review of full paper.

Students who have successfully passed the first stage will be invited by the IEA Student Award Committee to submit full papers for final selection. Two selection criteria will be used to select the awardee and runners-up:

1. Quality of contribution to E/HF, as documented in the full paper; and

2. Other accomplishments in and contributions to E/HF, as described in the resume.

Deadlines for the award process are as follows:

Oct. 2, 2005 Abstracts, resumes and advisor letters must be received by the IEA Student Award Committee (the address for submitting applications is given below).

Nov. 6, 2005 Applicants eligible for submitting full papers will be notified by this date.

Jan. 8, 2006 Full papers from eligible applicants must be received by the IEA Student Award Committee by this date.

Feb. 5, 2006 Applicants informed of results of award evaluation by this date.

March 1, 2006 Full paper by winner due to IEA 2006 Congress Program Committee by this date (visit www.iea2006.org/ for details).

(NOTE: The IEA 2006 Congress Program Committee will reserve a slot for the award winner to present her/his paper. The winner does NOT have to meet the Oct. 1, 2005 deadline for submitting paper abstracts. However, the winner must submit her/his full paper to the IEA 2006 Congress Program Committee by March 1, 2006.)

Applications for the IEA K.U. Smith Student Award should be sent to the Chair of the IEA Student Award Committee:

Chair: Prof. Michael Smith
Department of Industrial Engineering
University of Wisconsin, Madison
1513 University Avenue
Madison, WI 53706
Fax: 608-262-8454
Email: mjsmith@engr.wisc.edu
TECHNOLOGY IMPROVING PERFORMANCE

The ACT Branch of the Human Factors and Ergonomics Society of Australia would like to invite you to attend our upcoming National Conference in November 2005. The theme of the conference “Technology Improving Performance” will capture human interaction and experience within the expanse of technological innovations and developments.

This Conference will provide a balance of research and theory with professional experience and practice in the areas of cognitive, psychological, organisational and physical ergonomics. We are pleased to offer sessions presented by very highly regarded and expert speakers in the field. Our experienced practitioners will also be offering workshops in their areas of expertise.

Our invited speakers include:

Professor Jan Dul
Professor of Ergonomics Management

Professor Nikki Ellis
Centre for Military and Veteran’s Health

Professor Penelope Sanderson
Professor of Cognitive Engineering and Human Factors

Dr Peta Miller
National Occupational Health and Safety Commission

Our Conference Forums will include the following topics:

- The National Perspective
- Ergonomics and Education
- Design to Implementation
- Adaptive Technologies

The Human Factors and Ergonomics Society of Australia Annual Conference program and registration forms will be released soon!
Noticeboard

CYBERG 2005: ADVANCE PROGRAMME

KEYNOTE ADDRESSES
Preliminary guidelines for wise use of IT by children
Straker, L., Pollock, C. & Burgess-Limerick, R.
Ergonomics and design: a user-centred design method. Soares, M.
Developing Countries - Working together to bridge the gap. Caple, D.

PHYSICAL ERGONOMICS
Ergonomics in the Health Industry
Ergonomics and Manual Handling Tasks
Workspace Design
Ergonomics & Visual Displays
Gait and Physiology

COGNITIVE ERGONOMICS
Cognitive issues in Ergonomics
E-learning issues
Human Computer Interaction Theory
Knowledge Management
Evaluation of Online Experiences

ORGANISATIONAL ERGONOMICS
Community-based Ergonomics Interventions

GENERAL ERGONOMICS ISSUES
Educating people about Ergonomics
Methodology in Ergonomics
Usability Evaluations

SYMPOSIUM
Ergonomics in safety and security - mailrooms, general offices and health facilities
Gibbs, S., Head, M. & Brown, D.

SPECIAL SESSION
Building and maintaining an online academic conference series. Thatcher, A.
Experiences with persons who maintain online communities. Cakir, A.
Bridging the digital divide in rural communities in Malaysia. Yeo, A.

SECOND CALL FOR PARTICIPATION TO OZCHI 2005

CITIZENS ONLINE: CONSIDERATIONS FOR TODAY AND THE FUTURE
Annual conference of the Australian Computer-Human Interaction Special Interest Group
21 - 25 November 2005
Canberra, Australia

OZCHI is the annual conference for the Computer-Human Interaction Special Interest Group (CHISIG) of the Human Factors and Ergonomics Society of Australia, a non-profit event. It is Australia’s leading forum for work in all areas of Human-Computer Interaction. We invite contributions on all topics related to Human-Computer Interaction (HCI) including practical, technical, empirical and theoretical aspects.

OZCHI 2005 will include workshops and tutorials running on the 21st and 22nd of November, a Doctorial Consortium on the 22nd of November, and presentations of papers, posters, case studies, panels and demonstrations on the 23rd-25th of November.

For more information on individual tracks, themes, or general OZCHI information go to www.ozchi.org .

2ND BIENNIAL CONFERENCE ON THE MANUAL HANDLING OF PEOPLE
Monday 31 October 2005 - Wednesday 2 November 2005
Brisbane Convention and Exhibition Centre Merivale Street South Brisbane Queensland EARLYBIRD REGISTRATION CLOSES 31 AUGUST 2005

For more information, please call
Michelle Bordignon, Conference Secretariat
I AM EVENTS
Level 1/ 131 Leichhardt Street
Spring Hill Qld 4001
Phone: 07 3834 3333
Email: michelle@iamevents.com.au
16th World Congress on Ergonomics: IEA2006

The preparations of the next congress of the International Ergonomics Association are going very well. Since the 2nd announcement many proposals for sessions have been submitted. Almost all IEA Committees and Groups have announced to meet in Maastricht during the congress week (10-14 July 2006). An actual overview of all submitted proposals can be found on the congress' website www.iea2006.org. The overview will be updated at least every 2 months.

Please know that many of these session proposals are invitations: you can send in your own contribution or ideas for that specific session to the convenor, or to the congress organizers. Of course proposals for further sessions, or for individual papers and posters are welcome as well. The deadline for session proposals and individual abstracts is October 1, 2005.

Poster abstracts can be submitted until January 1, 2006. We have chosen for an upgraded posters' presentation. Each poster will remain on it’s board all week long; you can indicate at which times you will be available for interaction with those interested. The posters will be displayed in the walking area where participants stroll during the day.

Within the congress theme “Meeting Diversity in Ergonomics” we encourage interactive sessions, like ‘hands on workshops’, round table discussions, and any other interactive kind of session that allows participants to experience aspects of ergonomics or to improve their skills.

The enthusiasm of so many people that we meet everywhere is most promising for the congress. Be sure you will experience a great event when coming over to Maastricht, the Netherlands’ best town to be!

IEA2006 Congress Chair
Wellbeing and Workplace Factors

On 15 March 2005 following the presentation on Human Error, Jennie Barnett presented her findings of a literature review on Wellbeing and Workplace Factors carried out during her final year of ergonomics studies at La Trobe University, Melbourne in 2004.

Wellbeing is about how people feel about themselves and the settings they live in. It is typically a combination of physical health, psychological state, personal beliefs and social relationships. While physical health may be believed to be a state where there is an absence of any symptoms of ill health, a disability may not affect a person’s sense of wellbeing appreciably owing to adaptations and acceptances. Spiritual, cognitive and affective factors influence a person’s mental or psychological wellbeing, and social wellbeing results from the various social contacts experienced in work and non-work settings.

Paid employment has beneficial effects on wellbeing but these factors are traded off against the factors of work demand and risk. These factors include:

- specific task demands such as high effort and consequences of error;
- overall job demand that can decrease self-esteem such as overload, underload, meeting deadlines, and interpersonal conflicts;
- contextual demands that can cause psychological strain and burn-out such as interruptions, disruptions, career uncertainties, role ambiguity and task variance; and
- long working hours that can cause increased psychological and physiological symptoms.

To deal with these factors, a person has various coping resources:

- individual factors such as age, gender, intelligence, locus of control, stress levels at home, experience and state of health;
- workplace social factors in the form of social support from co-workers, supervisors and senior management which contribute to a sense of belonging;
- instrumental support such as good tools and equipment and adequate staffing; and
- environmental factors such as comfortable and appropriate lighting, noise and temperature.

To increase wellbeing, a person needs to feel a sense of individual control with high decision latitude in relation to work. Performance and behaviour are indirect influences on wellbeing while self-evaluation is a strong predictor. If a person feels that their work is of good quality, they are more likely to feel satisfied with their job and will experience less stress and fatigue. OHS legislation emphasises preventing harm and perhaps wellbeing programs could offer a better long-term solution.

Jacquie Wissenden

Human Error: Causes and Countermeasures

A presentation at the Vic Branch PD evening 15 March 2005 by Dr Wendy Macdonald and Dr Owen Evans, Centre for Ergonomics and Human Factors, Faculty of Health Sciences, La Trobe University, Melbourne

Ergonomics has important applications to the prevention of human error and resultant injuries. More broadly, ‘macroergonomics’ principles can be applied to promote the individual wellbeing of people at work, which goes considerably beyond the prevention of illness and injury.

Wendy presented a conceptual model of the work system, showing relationships between individual states of health and wellbeing, individual work performance, and some of the key characteristics of work, jobs and the broader organisation affecting them.

When Australian ergonomists use a design-based approach to influence or enhance error management, mostly they do it by modifying a design to reduce a harmful consequence of error, rather than to reduce error rates. Wendy and Owen argued that ergonomists need to pursue both approaches, which means that they need to be more aware of the need to identify and control hazards that make errors more likely, as well as those that increase the risk of injury following an error.

James Reason’s ‘Swiss cheese’ model provides a useful framework to support error reduction. According to this model, management errors and deficient organisational processes result in latent errors that reduce the system’s defences, for example, where understaffing could lead to increased fatigue and a consequently higher risk of errors. Latent failures in the workplace and organizational environment can also be attributed to errors of policy makers; designers of equipment and work processes; the actions of managers or supervisors; maintenance errors and routine violations of safety-related procedures.

Effective error prevention requires identification of their major causes, which is greatly helped by an understanding of how humans process information, and the degree to which performance is automatized. Based on this approach, errors can be categorised as...
Slips, trips and lapses (occurring when performance is partly or wholly automatized), and mistakes (occurring when people are making deliberate decisions).

Studies of the performance of aircraft maintenance workers have found that only a small percentage of their errors are ‘mistakes’ (in the above sense). Mostly they result from slips and lapses, and this is the kind of error that is most effectively prevented by the design of work and workplace components. For example, Hale and Glendon (1987) identified the following guidelines:

- ensure unambiguous information to support the response selection and action control;
- avoid information overload;
- minimize disruptive external events which might result in slips or lapses; and
- provide clear signals of the need to ‘switch up’ from a largely automatized performance mode when more attentional resources are required.

Consistent with this, the Victorian Code of Practice for Plant (1995) identifies the following sources of hazard:

- lack of visual or acoustic signals and warning devices indicating abnormal conditions and providing feedback on actions taken during operation;
- inadequate precision and logic in the operating instructions;
- unsuitable location and design of critical controls and displays of information;
- lack of account for population stereotypes or expectation of how control operating direction relates to the action resulting from that control; and
- potential for error resulting from complexity of the operator’s tasks or the overload of signals and information to be processed by the operator.

In conclusion, designing to minimise the consequences of errors, rather than their causes, is typically the simplest and therefore the most common approach. To minimise error rates, changes to plant and equipment design — as well as to the design of work organisation and jobs, is likely to be required. To minimise routine violations, work culture changes in addition to the above factors are necessary.

To achieve this, conventional hazard ID, assessment and control methods are inadequate. Ergonomists working within the OHS domain need to identify and assess a broader range of hazards, hazardous conditions and hazardous states that increase error rates, based on an understanding of the different types of errors, and the different kinds of factors that provoke them.

Jacquie Wissenden
Reducing Injury Risks Associated with Underground Coal Mining Equipment
Robin Burgess-Limerick

Abstract
This paper describes the initial stages of an ongoing project funded by the Australian Coal Associated Research Program which aims to reduce injury risks associated with underground coal mining equipment. The initial stage of the project has involved analysis of the full-text field of 1000 compensation claims associated with underground coal mining equipment. This analysis suggests that a relatively small number of equipment types account for the majority of claims. Development equipment is especially likely to be involved; particularly a continuous miner, load-haul-dump vehicle, shuttle car, or portable bolting rig. Personnel transport is also commonly involved. Together these categories of equipment account for more than 93% of equipment related injuries. Coding of the text field was undertaken and a novel graphical presentation utilised to present relationships between equipment type, activity, and injury mechanism. This analysis highlights particular issues for further examination. For example: 15% of all underground equipment related injury claims have been caused by a vehicle hitting a pothole or equivalent obstacle, and causing injuries to the driver or occupants (or both), suggesting that roadway maintenance is an extremely high priority control measure. A further 10% of equipment related injuries occur during the handling of cable used to power continuous miner or shuttle cars — suggesting that efforts expended on a mechanical solution would be cost effective. Similarly, muscle strain while using a portable bolter; slipping off the platform of a continuous miner; and driving/travelling in a vehicle which runs into some obstacle; each account for another 5% of injuries. Analysis of injury statistics places emphasis on relatively high frequency events and risks — underestimating the importance of high consequence, but rare events. Consequently the analysis of injury statistics has been supplemented by observation of development equipment in use; as well as interviews with miners and engineers to identify hazards such as interactions between pedestrians and vehicles, and vehicle rollover. The ongoing project involves undertaking systematic audits of development equipment injury risks at sites in Queensland and New South Wales to identify additional risks, and particularly, existing controls. These controls will be disseminated to the industry as a whole. Where uncontrolled risks remain, the aim of the project is to facilitate communication between sites, companies, manufacturers and ergonomists both nationally and internationally to develop trials and implement suitable design controls.

Introduction
Working with or near underground coal mining equipment is an inherently hazardous undertaking because of the multiple sources of injurious energies and the adverse environmental conditions. Australian compensation statistics suggest that 44% of all lost time claims in the mining industry are associated with equipment. The importance of controlling these risks is recognised by the coal mining industry. Xstrata Coal New South Wales (XCN) initiated the current research project and funding for a further two years has been made available by the Australian Coal Association Research Program

This paper reports the outcomes of the initial phase of this project, including the results of an analysis of the full-text field of 1000 compensation claims for injuries involving equipment. These data are supplemented by the results of two site visits and a summary of related information which has informed the design of subsequent stages of the project.

Analysis of injury data
Conventional analysis of injury statistics typically provides tables detailing the breakdown of injuries by body part, nature of injury, mechanism of injury, or agency of injury. Whilst such analyses are necessary, and may be helpful to track broad trends over time, they provide little assistance in determining where control measures should be targeted. The initial stage of this project was to obtain the data held by the relevant workers’ compensation insurer (Coal Services). The data collected by Coal Services includes a text description as written on the compensation claim form of how each injury occurred. The detail provided varies. Some typical entries are provided in Table 1 as an example.
Table 1: Examples of text fields and coding.

<table>
<thead>
<tr>
<th>Text sample</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHILE PULLING C/MINER CABLE BACK TO ROLL INTO RIB HE STRAINED HIS R/GROIN</td>
<td>Continuous miner</td>
</tr>
<tr>
<td></td>
<td>Handling</td>
</tr>
<tr>
<td></td>
<td>Strained</td>
</tr>
<tr>
<td>WHILE HE WAS A PASSENGER IN THE TRANSPORTER ON THE TRAVEL ROAD THE VEHICLE</td>
<td>Transport</td>
</tr>
<tr>
<td></td>
<td>Travelling</td>
</tr>
<tr>
<td></td>
<td>Hit hole/rough road</td>
</tr>
<tr>
<td>STRAINED HIS R/NECK SHOULDERS &amp; BACK</td>
<td></td>
</tr>
<tr>
<td>WHILE STEPPING DOWN FROM C/MINER AFTER DOING ELECTRICAL MAINTENANCE HE</td>
<td>Continuous miner</td>
</tr>
<tr>
<td>TWISTED HIS R/KNEE - Egress</td>
<td>Egress</td>
</tr>
<tr>
<td></td>
<td>Other</td>
</tr>
<tr>
<td>SLIPPED OFF STEP AT THE REAR OF ABM WORK PLATFORM JARRING HIS LOWER &amp;</td>
<td>Continuous miner</td>
</tr>
<tr>
<td>UPPER BACK WHEN HE HIT THE GROUND</td>
<td>Handling</td>
</tr>
<tr>
<td></td>
<td>Slipped off</td>
</tr>
<tr>
<td>WHILE HE WAS BOLTING THE ROOF IN MG/23 BELT ROAD WHEN PUSHING THE DRILL</td>
<td>Portable bolter</td>
</tr>
<tr>
<td>RIG TO THE ROOF HE STRAINED HIS R/UPPER ARM - R/FOREARM &amp; R/SOULDER</td>
<td>Bolting</td>
</tr>
<tr>
<td></td>
<td>Strained</td>
</tr>
<tr>
<td>WHILE DRIVING S/CAR FROM BOOTEND TO FACE TURNING INTO CUT THROUGH FRONT</td>
<td>Shuttle car</td>
</tr>
<tr>
<td>OF CAR STRUCK RIB SLIDING HIM OFF DRIVERS SEAT STRIKING OPPOSITE SEAT</td>
<td>Driving</td>
</tr>
<tr>
<td>WITH BOTH KNEES- CARTILAGE INJURY</td>
<td>Ran into</td>
</tr>
<tr>
<td>WHILE TRAVELLING ALONG MAIN ACCESS ROAD PERSONNEL CARRIER STRUCK LARGE</td>
<td>Transport</td>
</tr>
<tr>
<td>HOLE IN ROAD THROWING HIM OFF SEAT STRIKING HIS HEAD ON ROOF OF TRANSPORT</td>
<td>Travelling</td>
</tr>
<tr>
<td>JARRING HIS NECK</td>
<td>Hit hole/rough road</td>
</tr>
<tr>
<td>WHILE BOLTING ON THE O/D SIDE OF C/MINER RETRIEVING THE DRILL STEEL WHEN</td>
<td>Continuous miner</td>
</tr>
<tr>
<td>HE STEPPED BACKWARDS TO REPLACE THE DRILL STEEL ONTO THE RACK HE SLIPPED</td>
<td>Bolting</td>
</tr>
<tr>
<td>OFF THE SIDE OF THE C/MINER STRAINING HIS LOWER BACK</td>
<td>Slipped off</td>
</tr>
<tr>
<td>WHILE USING RIB BOLTER ON ABM C/MINER ONE OF HIS FEET SLIPPED OFF THE</td>
<td>Continuous miner</td>
</tr>
<tr>
<td>EDGE OF WORK PLATFORM CAUSING HIM TO TWIST HIS UPPER BODY STRAINING HIS</td>
<td>Bolting</td>
</tr>
<tr>
<td>NECK - LOWER &amp; UPPER BACK</td>
<td>Slipped off</td>
</tr>
<tr>
<td>WHILE HE WAS DRIVING THE WAGNER UNDERGROUND LOADER TO THE SURFACE WHEN</td>
<td>LHD</td>
</tr>
<tr>
<td>HE RAN OVER A HEAP OF COAL WHICH HAD COME AWAY FROM THE RIB JARRING HIS</td>
<td>Driving</td>
</tr>
<tr>
<td>LOWER BACK</td>
<td>Hit hole/rough road</td>
</tr>
<tr>
<td>WHILE DRIVING AN EIMCO WITH A BULK DUSTER ATTACHED EIMCO LURCHED IN A</td>
<td>LHD</td>
</tr>
<tr>
<td>POTHOLE OVERTURNING &amp; TRAPPING HIS R/ARM BETWEEN THE ROLL BAR &amp; THE RIB</td>
<td>Driving</td>
</tr>
<tr>
<td>FEARING DIESEL WAS LEAKING IN CASE OF AN EXPLOSION HE USED A STANLEY KNIFE</td>
<td>Hit hole/rough road</td>
</tr>
<tr>
<td>TO AMPUTATE R/LOWER ARM</td>
<td></td>
</tr>
</tbody>
</table>
XCN operated six underground coal mines in NSW at the time the project commenced. These mines are diverse in their age, history, and injury rates. While the sample of mines is not random, there is no reason to believe they are atypical of Australian underground coal mines. The data, including the text field, for the most recent 1000 compensation claims involving underground equipment at these six sites were provided by Coal Services. The injuries to which these data refer occurred during the period January 1991 to May 2004. The analysis consisted of the investigator reading the full text field and coding each injury for the equipment involved, the activity being undertaken at the time of the injury, and the causal mechanism (see Table 1 for examples). The coding categories were not pre-structured, but rather evolved during the data analysis in a method similar to Glaser & Strauss’s constant comparative coding (1967). The tabulated combinations for codes are presented graphically in Figures 1-5.

The first finding of note is that a relatively small number of different equipment types account for most injuries. Development equipment is especially likely to be involved, particularly continuous miners (29.2%), load-haul-dump vehicles (LHD) (27.1%), shuttle cars (10.9%), and portable bolting rigs (15.3%). Personnel transporters (10.8%) are also commonly involved. Together these categories of equipment accounted for more than 93% of equipment related injuries (Figure 1). This high concentration of injuries around specific equipment and mechanisms creates an opportunity to investigate targeted design controls which will reduce injury risk.

More detailed graphical presentations of combinations of codes for different equipment (Figures 2-6) provide additional information. For example, 15% of all underground equipment related injuries were caused by a vehicle (LHD, Shuttle car or Transport) hitting a pothole or equivalent obstacle and causing injuries (head, neck, back, shoulder) to the driver or occupants. These data suggest that roadway maintenance should be an extremely high priority for underground coal mines. Control of the risks at this level is more likely to be effective than improved seating, although this also may be justified to reduce the cumulative effects of lower amplitude whole body vibration.

Figure 2.
Activity and injury mechanism for 292 compensation claims associated with continuous miner at six underground coal mines. Line width proportional to number of claims.

Another 10% of equipment related injuries occurred during the handling of continuous miner or shuttle car cable. The continuous miner and shuttle cars are powered by high voltage current, delivered through extremely heavy cables. Manually moving these cables is an extremely common cause of compensable injuries. Attention to devising appropriate design controls for cable handling should be another high priority. Similarly, muscle strain while using a portable bolter; slipping off a continuous miner; or driving/travelling in a vehicle which runs into some obstacle; each account for another 5% of injuries and are therefore high priorities for control.
Compensation data are one source of information to assist in determining opportunities for reducing injury risk. Compensation data do have limitations however, one being the tendency to under-emphasise low frequency, high consequence, events. For example, within the 1000 reports was a recent incident in which a Load-Haul-Dump vehicle overturned, with the consequence of an amputated arm. This was coded as LHD — driving — hit hole/rough road; and thereby disappears as just one of 71 other similarly coded incidents. However this single incident has resulted in XCN sponsoring a dramatic redesign of the vehicle cab in conjunction with the manufacturer to ensure that this risk is controlled in the future.
Site visits

Two site visits to two very different mines (Beltana High Wall and West Wallsend) were undertaken to gain further information to inform the design of subsequent stages of the project. It was noted that some injury risks identified had been satisfactorily controlled at one site but not the other, and vice versa. Other risks are currently in the progress of being addressed at one or other site. In particular, the LHD cab redesign initiated by XCN in response to the roll-over incident will incorporate height adjustability, roll over protection, and other design improvements. A third group of risks exists which are not currently being addressed at XCN sites (although as yet unidentified controls may exist elsewhere. For example work is being undertaken at other sites on the redesign of shuttle car cabs, continuous miner bolting rigs, and personnel transport seating). One aim of the project is to attempt to ensure that these efforts are collated for the benefit of the industry as a whole. Where uncontrolled risks remain, the aim of the project is to facilitate communication between sites, companies, manufacturers and ergonomists both nationally and internationally to develop, trial and implement suitable design controls. Table 2 summarises the risks identified to date, and the status of control measures.

Table 2:
Summary of risk identified in phase 1, and current status of controls

<table>
<thead>
<tr>
<th>Injury risk</th>
<th>Control status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Continuous Miner</strong></td>
<td></td>
</tr>
<tr>
<td>Falling off miner</td>
<td>Partially controlled by hand rails on some continuous miners.</td>
</tr>
<tr>
<td>Access/egress</td>
<td>Partially controlled on some equipment. Additional design work required to implement satisfactory access/egress systems for all continuous miners.</td>
</tr>
<tr>
<td>Awkward postures</td>
<td>Severity varies across miner models. Being addressed, but further investigation is required into bolting design.</td>
</tr>
<tr>
<td>Manual loading of rods</td>
<td>Controlled on some miners by loading of pods (i.e. packs of bolting materials on to miner via LHD).</td>
</tr>
<tr>
<td>Handling roof mesh</td>
<td>Partially controlled by “ski jump”. Further design work is required to implement a satisfactory system on all miners. A radical new design replacing current mesh may be worth exploring. New miner models may have better system for mesh handling.</td>
</tr>
<tr>
<td>Handling vent tubes</td>
<td>Uncontrolled at sites observed. Controls may exist at another site or further design work may be required.</td>
</tr>
<tr>
<td><strong>Shuttle car</strong></td>
<td></td>
</tr>
<tr>
<td>Restricted cab space and difficulty of access/egress</td>
<td>Partially controlled at some sites through redesign of cab. Will be considered as part of future shuttle car procurement. Work also has been done elsewhere to increase cab space.</td>
</tr>
<tr>
<td>Rough rides causing jarring neck and back</td>
<td>Partially controlled at some sites through improved seating. A control which isolates the of cab from the shuttle car would be preferable.</td>
</tr>
<tr>
<td>Restricted visibility increases risk of collision</td>
<td>Currently uncontrolled. It may be possible to improve visibility by providing height adjustability for the shuttle car cab.</td>
</tr>
<tr>
<td>Control-response</td>
<td>Currently uncontrolled. Incompatibility when driving to the face.</td>
</tr>
<tr>
<td><strong>LHD</strong></td>
<td></td>
</tr>
<tr>
<td>Sideways seating causes awkward posture</td>
<td>Currently uncontrolled. The proposed LHD cab redesign will include 15 degree rotation in each direction which will provide partial control of this risk.</td>
</tr>
<tr>
<td>Restricted visibility increases risk of collision</td>
<td>Currently uncontrolled. The proposed LHD redesign includes height adjustability that will improve visibility.</td>
</tr>
<tr>
<td>Limited cab space causes risk of injury</td>
<td>Currently uncontrolled. The proposed LHD redesign includes improved access/egress cab space.</td>
</tr>
<tr>
<td>Exposure to whole body vibration causes risk of back injury</td>
<td>Currently uncontrolled. The proposed LHD redesign includes improved seat to reduce WBV exposure. Adequate reduction of WBV exposure requires appropriate match between seat and increased operator mass, which may be difficult to achieve for the complete range of potential operators.</td>
</tr>
<tr>
<td>Roll over</td>
<td>Currently uncontrolled. Proposed LHD redesign includes ROPS and axle load cells to sense unstable conditions.</td>
</tr>
</tbody>
</table>
A potentially high consequence incident involving an LHD striking a pedestrian underground which occurred at one of the mines following the site visit has highlighted the general risk of vehicle/pedestrian interaction underground, A “High potential risk incident report” prepared by the site safety systems coordinator (Harvey, 2005) described the incident as follows:

When mucking out a heading with an Eimco, a development technician handed over operation of the vehicle to the deputy while he took his crib break. The deputy reversed the Eimco ready to turn a corner and unload the bucket into a shuttle car. As the deputy proceeded to turn the corner, the technician attempted to cross the road and was struck by the bucket of the Eimco. The technician was looking at the shuttle car as he was expecting it to move before the Eimco, which he assumed was parking.

In this case the pedestrian escaped serious injury, however the incident was potentially fatal. The incident highlights the potential consequences of the poor driver visibility inherent in current LHD cab designs.

This is not a new observation. Simpson et al (1996) similarly suggested that many underground vehicle collisions are at least in part a consequence of restricted driver visibility, and visibility restrictions while driving Load-Haul-Dump vehicles (LHD) is one of the few aspects of mining equipment design which has been the subject of formal research. The research has largely been restricted to documenting the extent of the problem and providing methods for assessing the lack of visibility associated with current designs (eg., Eger et al., 2004; Tyson, 1997). Recommendations for LHD redesign arising from the research include raising the sitting position where possible.

By the nature of their use in restricted spaces, LHD vehicles are essentially bi-directional, and are commonly driven for long distances in “reverse”. A control-response incompatibility exists between the steering wheel and the effect of vehicle direction in this situation. While experienced operators are able to adapt to this incompatibility, the potential for incorrect responses exists if a rapid avoidance response is required.

Extreme visibility issues also exist with shuttle cars. These are also bi-directional vehicles in that without turning they “shuttle” coal between the continuous miner at the face and the boot end of the conveyor belt. An incompatibility between the steering wheel action and vehicle response exists when driving the shuttle car towards the face. This is an extreme violation of a fundamental human factors principle (eg., Worringham & Beringer, 1998) which has potential to contribute to high consequence events, especially when combined with the visibility issues.

In an otherwise largely unhelpful document titled “Design guidelines for underground mining equipment” (Teniswood et al., 1990), the results of a survey of suggested shuttle car modifications included the suggestion that consistency of steering direction should be maintained regardless of the direction of travel. Another suggested modification was vertical adjustability of the shuttle car cabin to improve visibility, and semi-suspension to reduce vibration transmission.

Conclusion

The analysis of compensation data and results of the site visits have been incorporated in an audit tool for assessing the control of injury risks associated with underground coal development equipment. Subsequent stages of the project include the use of this tool in audits of 12 Australian underground coal mines to assess the degree to which risks are currently controlled and document the ways in which the risks are being controlled for dissemination to the industry as a whole. Where uncontrolled risks remain, the aim of the project is to facilitate communication between sites, companies, manufacturers and ergonomists both nationally and internationally to develop, trial and implement suitable design controls.

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Abstract

This paper describes a participatory ergonomics program (PEP) that has been implemented in five industrial workplaces: a metal refinery, a bulk material handling facility, a manufacturing plant, a stevedoring company and a carton factory. The program commenced with a review of reported incidents and workers' compensation claims which were then tracked over the subsequent five years. Patterns and trends were noted over time and among workplaces. Workers were involved in training sessions which identified and assessed high risk tasks and then generated recommendations for discussion. The process of reviewing incidents and claims highlighted the need to address slips, trips and falls as well as a review of mobile equipment. Ergonomics interventions included alterations to workplace layout; the elimination of some tasks; provision of selected equipment and tools; and changes in work practices, training and work organization. Control measures were implemented and then evaluated. The results indicate that these measures reduced the incidence of sprains and strains following an improvement in working postures; a reduction in forceful exertion as well as repetitious and prolonged tasks. Although some fluctuation in incidents and claims continues, an overall improvement has been sustained in comparison to the claims history prior to the PEP intervention. The program has facilitated a change in culture whereby ergonomics principles are included in everyday work activities. Management and workers have been encouraged to work together for the common goal of reducing injuries; and to appreciate that their input is vital for the safe operation of their workplace. This has a beneficial effect on morale which in turn may be seen to infer an increase in productivity. These results support the available literature about successful implementation of PEPs in industrial workplaces.

Introduction

This project was undertaken as part of a Graduate Diploma in Ergonomics at the University of Queensland. It reviews the period 1997–2002 during which Participatory Ergonomics Programs (PEPs) commenced in 1998 at five industrial workplaces:

- a metal refinery (Company A) with almost 200 employees and contract labourers operating 24 hours per day, 7 days per week;
- a bulk material handling facility (Company B) with 16 employees plus 10 contract labourers operating 24 hours per day, 7 days per week as required;
- a manufacturing plant (Company C) employing 12 men plus 6 contract labourers operating 24 hours per day, 7 days per week although workers were present from Monday to Friday with Wednesday being a maintenance day and occasional inspections by the supervisors on weekends;
- a stevedoring company (Company D) with 70 employees and contract labourers working irregular shifts as required and capable of operating 24 hours per day, 7 days per week; and
- a carton factory (Company E) with 122 employees and contract labourers operating 2 shifts per day from Monday to Friday and incurring overtime as required.

All workplaces comprised a stable, ageing workforce with little turnover; although some redundancies did occur in all of the companies either prior to, or during, the PEPs. The majority of people were blue-collar workers with limited formal education. Management participated throughout and actively pursued change at all locations. Several problem areas were handled simultaneously – so a large number of workers were involved and had a strong influence on the implementation of changes which in turn affected the outcome of the PEPs.

The PEP design was similar in each workplace. Factors such as management changes, location and program duration caused variation in the program implementation for example:

- the metal refinery had the most intensive program;
- the bulk handling facility had the longest running program (26 months); and
- the manufacturing plant had the shortest and least intensive program (6 months).

Following a review of previous incidents and workers' compensation claims, the PEPs sought the involvement of all workers in the identification and control of work related risks. Task analysis was used to identify known hazards and introduce risk control measures. This was done in accordance with the preferred hierarchy of control for occupational health and safety (OHS) risks which includes elimination; substitution; engineering; administration; and provision of personal protection as necessary.
Literature Review

A literature review was undertaken in the areas of organisational behaviour, participatory ergonomics programs and field studies to determine available information about the concept of participatory ergonomics programs.

Organizational behaviour

When considering organizational behaviour it is necessary to determine the core competencies which are crucial for the survival of business in current and future markets. Prahalad and Hamel (1990) define core competences as communication, involvement, and a deep commitment to working across organisational boundaries. They state that when individuals work together they build on individual people-embodied skills which facilitate organisational knowledge creation, continuous innovation and competitive advantage. Thus knowledge should be regarded as the most significant resource within a company.

Participatory ergonomics programs

Morken et al (2002) describe a PEP as using workers’ knowledge and problem-solving skills to reduce resistance to change, improve worker communication and motivation, and reduce musculoskeletal injuries. In addition it leads to companies changing the ways they operate and thus a PEP can have a lasting impact. (St-Vincent et al, 1998)

Yet another description (Wilson, 1995) claims that a PEP involves people having sufficient knowledge and power to influence both processes and outcomes, by planning and controlling their work activities to achieve their desired goals. Maciel (1998) says that while information, knowledge and power are required, power is dependent upon information and knowledge.

Nonako & Takeuchi (1995) discuss the process of converting an individual’s tacit (unconscious) knowledge into organisational knowledge. They note that tacit knowledge contains both cognitive and technical components. It is gained from experience rather than training; and is dependent upon the development of brainstorming techniques for dynamic interaction. Highly practical information can be difficult to convert into formats that add to, or restructure knowledge. It will rely on modes of knowledge conversion that include internalization, externalization and socialization. There are variations between countries and Nonako and Takeuchi consider that Westerners focus on explicit knowledge while the Japanese focus on tacit knowledge. Their model could be considered to be an example of a PEP since it consists of sharing tacit knowledge, creating concepts, justifying concepts, building an archetype and cross-levelling knowledge.

Ingelgard & Norrgren (2001) regard PEPs as a macroergonomics approach – the implementation of technical and social subsystems – which incorporates organisational and psychosocial aspects as well as the design of human-machine interfaces. They observe a high positive correlation between learning strategies and economics results, as well as a significant moderate positive correlation between top-management involvement and the quality of working life. They suggest that ergonomics improvements are change processes that should be integrated with everyday workplace activity changes. Finally they note that decisions at company level are influenced by external factors such as markets, legislation and technology.

The advantages of PEP over a traditional ergonomics intervention are the compiling of skills and knowledge (Loisel et al, 2001). They site a decrease in work related musculoskeletal disorders (WRMDS), decreased absenteeism and an improved psychosocial work environment as positive outcomes of PEP. This is supported by Laitinen et al (1998) who describe similar outcomes from participatory ergonomics. Similarly, Haims & Carayon (1998) say that the benefits of PEP include worker motivation, job satisfaction, improved performance, improved health, reduced WRMDS, quicker implementation of technological and organisational change as well as improved solutions to ergonomics problems. They also describe the need for flexibility in a PEP to accommodate organisational change.

Likert et al (1989) suggests that the history, structure and culture of the organization should be taken into account in the PEP. This is supported by Amell, Kumar and Rosser (2001) in order to integrate loss management and improve business viability. Changes to work methods can be difficult to implement as workers may not consider them to be necessary; they may be costly and workers may refuse to change. (De Jong & Vink, 2000) The use of task analysis to understand workers’ activities is supported by Garrigou et al (1995). St Vincent et al (1998) suggest that variations in work are the most difficult part of the analytical process.

Amell, Kumar and Rosser (2001) state that a comprehensive ergonomics program should incorporate occupational injury and illness surveillance. They note that workplace risk factors for low back pain and upper extremity WRMDS should include both physical and psychosocial components such as extreme posture; excessive muscular force; physical fatigue; and repetitive tasks; as well as job satisfaction; worker perception of strain; discomfort and mental fatigue.
Owing to the cyclical nature of musculoskeletal complaints (which may show improvement unrelated to the PEP) Westgaard and Winkel (1997) recommend a prolonged period of follow-up on the results of a PEP. A participatory approach undertaken to improve working conditions and back care knowledge indicates reduction in sick leave which continued five years after the intervention. (Wickstrom et al, 1993) This is similar to the effectiveness of a corporate ergonomics program which lasted years after its implementation according to Moore and Garg (1998). These writers also note an increase in incident reporting; and a decrease in WRMSDs, lost time, and workers’ compensation costs.

Amell, Kumar & Rosser (2001) advise that operation and maintenance of efficient procedures and workflow should be considered. The design of tasks and equipment should accommodate the workers’ limitations of physical; psychophysical and cognitive abilities. Westgaard and Winkel (1997) quote Nordic statistics that claim 30–40% (and 50–90% in some occupations) of musculoskeletal disorders are work-related and could have been avoided by modifications in the work environment. They also report that at the time of writing, lower arm, shoulder and neck symptoms were as frequent as the low back pain which previously dominated the statistics. Finally, they advise that a certain intensity of exercise interventions has been found to improve musculoskeletal health — while discomfort reports are useful because fatigue and discomfort may lead to pain and clinical signs of injury.

**Method**

The training course that was implemented by the writer included basic back anatomy, back pain risk factors, cognitive and ergonomics aspects of work activity, principles and examples of task layout changes and the theory of PEP.

**Aim and Objectives**

The aim of this program was to identify the high risk WRMSD tasks, assess them and recommend control measures. By doing this, it was expected that both the incidence and severity of workplace musculoskeletal disorders would be reduced. The workforce would be provided with the theoretical knowledge and practical skills necessary for the prevention of workplace injuries and thereby give the workers an opportunity to reduce their own risk of injury. In future, the workforce would be able to identify hazardous tasks and implement methods of risk control. They would also understand, and be able to utilize, basic back care and appropriate manual handling techniques.

**Program Content**

**Group training of Supervisors**

The training program provided a theoretical and a practical session which included a review of injury statistics, an overview of spinal anatomy, manual handling procedures and risk assessment. The training presented all supervisors with the knowledge required to determine the risk of WRMSDs in non-routine tasks. Then high risk routine tasks in this injury category were determined by having the workforce create a risk assessment checklist. Risk assessment in accordance with the Code of Practice on Manual Handling was included. The assessment and control of identified risks were outlined and the need for further manual handling training was indicated on the risk assessment checklists.

**Content of training for the workforce**

Information on National, State and Company injury statistics was provided by the writer to the workers. Education on the structure and function of the spine was included. This provided the foundation on which to build the relationship between the anatomy, posture, fitness and manual handling principles. Spinal stability and muscular control plus the importance of exercise and fitness as well as the principles of appropriate manual handling were discussed.

**Risk identification**

High risk tasks were identified by the workers and confirmed by the task analysis conducted by the writer. The Workplace Health and Safety Officer (WHSO) and supervisors also identified high risk tasks.

**Risk assessment including Task Analysis**

Each of these high risk tasks was assessed in consultation with the workforce and a number of workers were observed performing the tasks in order to integrate any variations. The Task Analysis included recording the frequency and repetitions of the task as well as the work environment, equipment, access, personal protective equipment, task speed, cognitive demands and work organisation. Quantitative assessment was carried out using the ergonomics assessment tools of the Ovako Working Posture Analyzing System (OWAS, Karhu, Kansi, & Kuorinka, 1977) and the Rapid Upper Limb Assessment (RULA, McAtamney, & Corlett, 1992) as well as observation, discussion and photography.
OWAS and RULA were selected since awkward working postures had been observed and were highlighted by workers and supervisors. Both OWAS and RULA were quick to administer and equipment is not required. The scores proved useful in discussions with workers and management and provided a means of prioritising the implementation of control measures. OWAS was used where it was considered that there was a risk of back injury and RULA where injury to the upper limbs or neck was more likely. In some tasks both OWAS and RULA were administered.

The OWAS risk scale range from ‘no action required’ to ‘immediate action required’ covered four possibilities that were useful in assessing the risk of back and leg injuries. The score was calculated from the analysis of the position of the back, arms and legs as well as the force required to perform the task. RULA likewise was used to determine the risk of neck and arm injuries on a similar scale from one to four. This score was calculated from an analysis of the position of the shoulders, lower arms, wrist, neck, trunk; muscle action; and the force required to perform the task.

Implementation of control measures
Prioritization was determined by using a risk assessment process in accordance with the hierarchy of control noted earlier. It included elimination, substitution, engineering and administrative measures. This process commenced with a feedback session to the WHSO and supervisors. A copy of the task analysis and risk control options was provided. The workplace personnel then were responsible for implementing control measures. An update on the progress of the implementation of risk control measures was conducted periodically.

Variations in the program
The PEP remained basically the same throughout its implementation in each of the five companies. However modifications were made to accommodate the culture, nature of tasks, business operation and management strategies of each company. The most challenging aspect related to the stevedoring company as the stevedores were unaccustomed to the process of a participatory program. Initially, there was suspicion and resistance.

The analysis of data was conducted in the same manner for each company. Some companies were computerized – while for others the analysis was performed manually. Data on incident reports was missing for two of the companies. Following this intervention all but one company have introduced computerized incident records. One company became self-insured during the period of the program and workers’ compensation data was not available.

A Discomfort Survey from the Manual Tasks Advisory Standard (DWHS,1999) was conducted in the carton factory. This provided confirmation of the identification and assessments of the high risk tasks in that workplace. Warm-up exercise programs were initiated at the metal refinery and at the carton factory. These did not continue at either workplace. However, some of the workers continued to use the stretches they found useful in improving their comfort levels at the end of a shift. These tend to be posture reversal stretches. Slips, trips and falls training sessions were conducted in four of the workplaces (the metal refinery, bulk handling facility, manufacturing plant and the stevedoring company). These sessions covered information on the frequency and consequences of slips, trips and falls as well as housekeeping principles, equipment issues, personal risk factors (balance, fitness, body build) and lighting. A review of footwear took place. Prevention strategies were outlined according to the hierarchy of control noted earlier.

Ergonomics Interventions
At the metal refinery, workplace layouts were altered to reduce the need to carry loads or to improve working postures. This included reducing the need to bend and to reach. Trolleys, forklifts, cranes, hoists and machines were provided to reduce the risk from lifting and carrying loads such as a large, 30kg plate which was previously manually lifted, rotated and carried (Fig 1).
Figure 1. Provision of a trolley to rotate and move a plate improved the working posture and reduced the forceful exertion required to perform the task.

Modifying the rollers and tilting them reduced the friction effect and used gravitational energy to facilitate the movement of large, heavy boxes. This reduced the force required to initiate movement from a strong push force to a fingertip action. A more upright posture was then adopted by workers performing this task (see Figure 2 below).

Figure 2. The rollers were modified to reduce the force required to move the boxes.

Drum tippers were fabricated by the workers employed in that section of the workplace as a short-term risk control measure (Figure 3 below). The task was later eliminated in line with the principle of continuous improvement. Improved housekeeping and improved footwear reduced the risk of slips, trips and falls. In some instances, the size and weight of the load was increased and a mechanical device was then used to move it. In other instances, loads such as buckets were made smaller and emptied more frequently. Some work practices were altered and some tasks were mechanised. The frequency of the performance of some tasks was reduced following modifications in work practices and work areas.
In the bulk handling facility (company B) ergonomics interventions included:

- a change in the workplace layout which improved working postures and access;
- replacement of seating in mobile equipment;
- provision of equipment to improve working posture and reduce the frequency and duration of tasks such as shovelling;
- modifications to existing plant to reduce the need for shovelling; and
- contracting a Supersucker truck which is a truck with a pump and large hoses designed to remove sludge and so eliminate the need for shovelling in some cases.

The provision of raised lockers for tool bags meant that bending and twisting while raising and lowering a load at the beginning and end of the shift could be eliminated.

Ergonomics interventions at the manufacturing plant (company C) included:

- modification of the workplace layout to reduce the risk of slips, trips and falls; and
- cutting steps into a wall to improve access.

Further changes involved the provision of additional equipment including:

- a mobile crane on contract, to eliminate a manual lifting and carrying task;
- a hand truck with a winch to reduce the risk of lifting and carrying 30kg loads;
- an end loader used to move loads which were previously being pushed;
- gas cylinders to be placed on the utility by a hoist rather than by manual handling; and
- a spike to pick up, or break up, spillage of clumps rather than picking it up in a bending or squatting position.

Other manual tasks were reduced by alterations to work practices and seating in the mobile equipment was replaced.

At the stevedoring (company D), ergonomics interventions included:

- modifications to the crane cabin and seating;
- changes to the terrain over which the mobile equipment was operated;
- provision of equipment to improve working posture and to reduce the need for lifting and carrying;
- use of a forklift to reduce manual handling;
- modifications to the control room layout to improve visibility and allow for an improved working posture;
- improvement to illumination in the work area to reduce the risk of slips, trips and falls;
- changes in work practices to reduce the need for manual handling;
- use of water pressure to reduce the force required to unblock chutes; and
- provision of more fire hoses and outlets to reduce the risk of injury from the manual handling of hoses.

At the carton factory (Company E), ergonomics interventions included:

- modifications to the workplace layout to provide improved working postures;
- provision and modification of equipment to reduce the need for pushing forces;
- a change in the workplace layout which improved working postures and access;
replacement of the forklift fleet to provide better visibility (through improved forklift design) and improved seating which generated better working postures;
relocation of pipework to allow improved access for maintenance tasks
provision of a pallet dispenser; and
use of forklifts rather than manual handling to move pallets.

Changes to work practices and tasks allowed some manual tasks to be eliminated. A strapping task was automated and a set of rollers was motorised. The scheduling of maintenance tasks was modified to allow sufficient assistance and time to perform tasks without delaying production.

Outcomes
The PEPs represented comprehensive management of the risk of injury. The focus of the PEPs had been the involvement of all people at the workplaces. Risk control options were outlined according to the OHS hierarchy of control noted previously. Feedback was given to the WHSO, the supervisors and the workers as well as management. Risk control options were implemented. A significant effort was made to reduce the risks of WRMSDs at each of these workplaces. A lasting impact seemed to have been made that lead to companies changing the way they operated.

The use of OWAS and RULA assessment tools allowed workers, supervisors and managers to prioritise hazards and implement risk control measures. Some tasks were assessed using both methods as it was considered that there was a risk of both back and upper limb injuries. These are quick tools to use as they do not require sophisticated equipment. OWAS has been determined as having high inter-rate reliability (Karhu et al, 1977) yet neither OWAS nor RULA take account of heavier loads, environmental factors, workplace layout, work organization, vibration or individual factors. Repetition and duration are not adequately addressed. For these reasons, other factors beyond those highlighted by the OWAS and RULA scores were considered. A multifaceted approach is best suited to the heavy work and dynamic awkward postures that had been adopted for the performance of tasks at the workplaces represented in this project.

Both OWAS and RULA are simplistic measures of risk which need to be used in conjunction with other factors. Their scale of one to four is too small to allow adequate differentiation between levels of risk. As RULA is based on OWAS, it inherits some of its adverse characteristics. Nevertheless as most of the high risk tasks in this study involved bending and twisting while carrying a load OWAS, in particular, highlighted this type of injury. Usually several changes will need to be implemented to reduce an OWAS or RULA score since often there will be more than one risk factor present in a task.

A reduction in risk factors at these five companies involved a reduction in forceful exertion, awkward postures, repetition, duration and vibration hazards.

Table 1. Number of high risk tasks analysed, eliminated or reduced

<table>
<thead>
<tr>
<th></th>
<th>Total number of high risk tasks analysed</th>
<th>Number of high risk tasks which were eliminated</th>
<th>Number of high risk tasks in which the risk was reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal refinery (Company A)</td>
<td>65</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>Bulk material handling facility (Company B)</td>
<td>8</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Manufacturing plant (Company C)</td>
<td>10</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Stevedoring company (Company D)</td>
<td>18</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Carton factory (Company E)</td>
<td>35</td>
<td>6</td>
<td>11</td>
</tr>
</tbody>
</table>
Review of Incident Reports and Workers’ Compensation Data

The majority of incidents are the result of a combination of factors. (Amell, Kumar & Rosser, 2001) They entail direct injury costs and indirect costs such as lost productivity, overtime, supervision of injured workers, recruitment, training and human resources department costs. These factors need to be considered in the review of the claims history of each company.

The workplace health and safety legislation and the workers’ compensation legislation remained consistent during the period covered in this project. Any modification to the reporting of incidents, administration of sick leave and claims management for each company was considered in the review of incident and claims history. Since both statutory and damages claims costs will be reflected in an employer’s premium, it is vital to reduce the occurrence of injuries in order to reduce that premium.

Figure 4. Metal Refinery Incidents and claims

The metal refinery PEP was completed between January 1998 and January 1999. This was the most intense PEP in regard to time involved onsite. The size of the workforce in this company remained much the same during the PEP. Back injuries were the most consistent and frequently reported incidents of sprains and strains – with lower limb incidents matching back incidents in 2000. Back injury workers’ compensation claims were the most frequent except for 2000 when lower limb injuries were the most frequent type of claim. Concerning days lost, there was no similar trend.

Figure 5. Bulk Handling Facility Incidents

The bulk material handling facility’s PEP was completed between May 1998 and November 2000. This was the longest PEP. Commencement was delayed until after re-structuring was completed and the workforce was reduced significantly as a result of redundancy offers. The worksites were reduced from two locations to one location. Back injuries were the most consistent and frequently reported incidents except for 2001 – at which time they were matched by neck or shoulder and lower limb incidents. A review of this company’s statutory claims history for the period 1997 to 2002 was not possible as it became a self insurer during this time.

Figure 6. Manufacturing Plant Incidents and Claims

The PEP at the manufacturing plant was the shortest program and was completed between March 1998 and September 1998. It was at a geographically distant site and as a consequence had the least onsite involvement. Back injuries were the most frequently reported incident of WRMSD in 1997 and 2002 with lower limb incidents matching back incidents in 1999 and 2001. There were no workers’ compensation claims after 1999. Of the WRMSD claims, back injuries accounted for the majority of days lost claims although they were not the most frequent claims. There was an increase in lost days from 1997 to 1998 and no days lost since 1998.
The carton factory PEP was completed between July 1998 and December 1998 and was limited by budget restrictions. It saw a gradual downsize of the workforce from 122 in 1997 to 76 in 2002. In addition, there was a change from employing casuals to hiring through labour hire agencies. Casuals made up 20-25% of the workforce.

Back injuries were the most frequently reported incident of WRMSD in 1998. Upper limbs were the most frequently reported WRMSD in 1999 and 2002, and shared this status with lower limb incidents in 2000 and back incidents in 2001. Back injury workers’ compensation claims were most prevalent in 1997 and 2001. Back injuries were the most frequent cause of lost days in 1998 and 1999.

The PEP at the stevedoring company was completed between September 1998 and August 2000. Back injuries were the most frequently reported incident of sprains and strains each year — except 2000 when lower limb and neck injuries were prevalent. Reported incidents associated with the mobile plant decreased until 2001 and 2002 when there was a sharp increase, particularly in 2002. Back injury workers’ compensation claims were the most frequent in 1997, 1999 and 2002. There was no trend in lost days.

**Pattern and Trends**

There is a pattern among the total number of incidents: usually half were WRMSDs of which a quarter were back disorders. Other frequently occurring complaints related to the neck, shoulder and lower limb sprains and strains. This is similar to state-wide data for the period 1997–2002 where approximately half the total claims related to WRMSDs and one fifth of the total incidents were for back injuries.

The number of identified high risk tasks and the subsequent consultant hours required for the PEP were dependent upon the number of workers in each place. For every four workers, there was usually one high risk task identified — the exception being in the manufacturing plant where for every two workers, one high risk task was identified.

It is difficult to be sure that the patterns and trends revealed in the review of incident and workers’ compensation data were solely the result of the PEP intervention. Each workplace had been exposed to a variety of external and internal influences. There was a change in management in all of the companies during the period 1997 – 2002. Fortunately, each new manager embraced the PEP, maintained support for it and was committed to a reduction of injuries at the workplace.

It is interesting that 2001 was the year in which each company had an increase in reported injuries as the first PEP finished in December 1998 and the last PEP finished in November 2000. It could be inferred that the impact of the PEP was not long lasting and was most effective during its implementation. However, both reported incidents and lodged claims remained lower than before the implementation of a PEP and the results have been more dramatic and longer lasting than any previous programs involving an internal and external audit process, or behaviour modification.

The PEP acted as a facilitator for change in company culture. The analysis of incident and claims data highlighted the need for a survey of mobile equipment in both the metal refinery (2001) and the stevedoring company 2003); while the metal refinery replaced most of its fleet of mobile equipment. The implementation of the recommendations from the survey conducted in the two companies resulted improvements for operating postures, increased fields of vision and improved comfort levels as reported by the operators. Mobile equipment injuries decreased in those companies although the workforce in some sections of the metal refinery was resistant to rotation of mobile equipment operators within a shift.
The above results indicate a need for ongoing work once risks have been identified; and this is in line with a philosophy of continuous improvement. This approach might be undertaken largely by the workforce that has undergone learning through a PEP. Reinforcement about the value of ergonomics in everyday activities is required.

Guidelines for future programs

The timing of the implementation of PEPs is crucial. It is not recommended that a PEP be implemented when a company is undergoing restructuring or downsizing. At these times, the mindset of the workforce is on job preservation rather than safety concerns. Supervisors are focussed on maintaining production in the face of a reduced workforce. Morale is low and budget restrictions can limit the implementation of a PEP.

There appears to be a direct correlation between the size of the workforce, the number of identified high risk tasks and the time required to implement a PEP. It could be anticipated that one high risk task would be identified for every four members of a workforce. For every member of the workforce, one hour of a consultant’s time should be allocated to the implementation of a PEP. Management usually seeks this type of information before undertaking such a program as it has an impact on costings and timeframes. The size of the workforce, as well as the size and location of the workplace, influence the intensity and duration of a PEP. The significant results of a PEP are easier to interpret in larger workforces — since an increase or decrease of one or two injuries in a smaller sample size could exaggerate their significance.

Current research and standards should be consulted prior to commencing a PEP in order to determine which tool would be suitable for a risk assessment. In regard to assessment of high risk tasks, some of the workforce could be trained in the use of ergonomics tools as part of the PEP. A risk assessment checklist should be based on the current legislation. While any checklist has limitations, it is a starting point for the identification of high risk tasks by the workforce. The PEPs in this project were implemented prior to the availability of the Manual Tasks Advisory Standard and ManTRA. The development of ManTRA (Burgess-Limerick et al, 2003) addressed the need for a tool which included a range of risk factors as outlined in the Manual Tasks Advisory Standard. Various body regions may be assessed using this tool which has a five point scale.

Biomechanical, psychosocial and environmental factors and the interaction among them should be considered in this type of assessment. Heart rate levels and oxygen consumption could also be included to determine the physical demands of the tasks and the physical capacity of individuals.

The results of these PEPs, as well as state wide workers’ compensation claims data and a literature review, support an emphasis on the control of back injuries. Slips, trips and falls are a common source of WRMSD. The control of these hazards can be addressed through training; and improvements to illumination in work areas, footwear; walking surfaces, stair design and housekeeping. Fitness and balance are other factors to be considered. Warm-up exercise programs appear to have little effect unless someone in the workforce ensures their continuance. On-the-job stretches may be more effective than exercise programs in overcoming the effects of awkward postures.

Computerisation of incident and injury data makes the review process faster and more efficient. Changes in the recording process or category definitions can affect the review outcomes. A PEP should be part of an overall safety management program that incorporates equipment, procedures and the behaviour of the workforce. A review of mobile equipment should include seating, cabin layout, whole body vibration, cabin access, position of controls, and job rotation of operators. Documentation of work procedures should take into account the manual handling demands of any task.

An individual’s work capacity also needs to be considered when attempting to reduce the number of WRMSDs. This may commence as part of the recruitment process and be ongoing. Workplace assistance given to workers returning to work after an injury is beneficial. Early intervention to manage injuries will help to reduce lost time and claims costs. All workplaces discussed in this paper encouraged the early reporting of incidents following their participation in the PEPs.

It is considered that this approach could be replicated in other workplaces. The level of cooperation varied between workplaces and was dependent on their culture and the status of the company in regard to restructuring. The length of a PEP and the withdrawal of a change agent can affect the sustainability of the intervention and its outcomes. There was no control group for this study as it is difficult to find appropriate alternative groups since workplaces are individualistic and exposed to a range of industry specific information and legislation to promote safe operation.
A cost-benefit analysis could be used in discussion with management prior to the implementation of a PEP. The effect of a PEP on productivity is often difficult to determine as so many other factors influence productivity. Future research could perhaps attempt to isolate the effectiveness of a PEP on overall productivity. Certainly, the reduction in injuries and lost days must be regarded as having an impact on the productivity of a company.

The unique culture of each workplace needs to be acknowledged. This was recognized in the PEPs implemented for this project and helped to reduce resistance to changed work practices. The use of task analysis tools provided a structured catalyst for the PEPs and this was supported by the available literature. The processing of tacit knowledge into company knowledge took place as workers were involved in the identification and control of the risk of injury in their workplaces.

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“It just makes good sense to implement ergonomic workstations that are easily adjustable.”

- Users can find the desk height that works best for them
- Added flexibility for different occupational tasks
- Sit or stand while working
- Improves employee retention, health, moral and satisfaction
- Dynamic, productive and healthier way to work
- Quick, effortless and easy adjustment regardless of the weight on the work surface
- Reduced absentees and employee turnover
- Increased productivity (employees can take “micro-breaks” without leaving their workstation)
- Reduced costs: ergonomic programs can reduce workers compensation claims

Alternating between sitting and standing positions is the most effective way to maintain productive workflow
following layoffs, retrenchment and conditions of employment generally, there can be little doubt. But the system has serious limitations in its application to health and safety.

For example, McKay (1987) in his review of the first two years of WorkSafe Australia (which was the working title for NOHSC), commented that its tripartite structure “has inhibited the capacity of the Commission to develop the basic products required to implement occupational health and safety practices.” He also pointed out that “There will always be between unions, industry and government with some fundamental conflicts of interest. This is not inappropriate, but such conflicts should not be allowed to prevent effective operation of the Commission.”

A specific example of the limitations of a tripartite system in the important context of radiation protection was identified by Hewson and Torlach (1994) who agreed that the involvement of the workforce in the process of decision making in relation to health and safety improvements at the workplace had benefit, but pointed out the limitations in the following terms: “The system whereby representatives of parties involved made decisions about what should happen in workplaces of which they had incomplete comprehension was of concern. Problems arose when the following of “process” superseded resolution of the technical matters at issue. Moreover, because of the structure of representation on tripartite bodies, there might be socio-political reasons for adopting positions that were inconsistent with scientific fact.”

That is precisely the point of McKay’s recommendation that “Expertise rather than tripartism should be the principal criterion by which memberships of Committees and working parties are derived.”

TRIPARTISM OR SCIENCE?

At the time of McKay’s report, employment injuries were recorded on a State-by-State basis, with substantial variations between them in terms of definitions, coverage and presentation. For example, the only State tabulating injuries by hour-of-day and day-of-week was Queensland, and those data were used by this author throughout the 1980’s when he was teaching in the Graduate Diploma in Occupational Hazard Management course at the (then) Ballarat CAE. One salient feature of those data is presented in Figure 1 below. Although these data are for the years 1971/72, they exemplify the general pattern which continued year after year (ABS Catalogue 6301.3)
These data prompt two questions. First, why are there more injuries on Mondays than on Tuesdays than on Wednesdays than on Thursdays than on Fridays? Second why are there more injuries in the mornings than the afternoons for every day of the week? This daily pattern — and the hebdomadal distribution, available then only in the Queensland data, prompts these questions. It seems reasonable to suggest that these distributions are meaningful in some way that lies outside our current understanding. They were therefore originally published in 1976 in the hope that they would form a launch pad for some new line of investigation. Unfortunately, that response did not emerge from the tripartite discussion, debate and negotiation that were the hallmarks of the NOHSC structure in the next two decades. In the opinion of this author, the answers to those questions are only likely to emerge from a scientific examination of the data. Until then, our knowledge will be incomplete.

**CONTRAST WITH THE NATIONAL HEALTH AND MEDICAL RESEARCH COUNCIL (NHMRC)**

It is appropriate to examine the extent to which the NOHSC structure and philosophy compares with that of the other major body that is primarily responsible for Australia’s health – the NHMRC. There are three major points of difference.

**i) Terms of reference**

First, the NHMRC was established by the *National Health and Medical Research Council Act 1992*. The four statutory obligations imposed by the Act are:-

- to raise the standard of individual and public health throughout Australia;
- to foster the development of consistent health standards between the various States and Territories;
- to foster medical research and training and public health research and training throughout Australia; and
- to foster consideration of ethical issues relating to health.

In contrast, the objectives of NOHSC, as set out in Section 7 of the *National Occupational Health and Safety Commission Act 1985* are:

- the development among the *members* of the community of an awareness of issues relevant to *occupational health and safety matters* and the facilitation of public debate and discussion on such issues;
- the provision, in the public interest, of a forum by which representatives of the Government of the Commonwealth, the Governments of the *States* and of employers and employees may consult together in, and participate in the development and formulation of policies and strategies relating to occupational health and safety matters; and
- the provision of a national focus for activities relating to *occupational health and safety matters*.

The comparison with the NHMRC is stark. The NHMRC principal requirement is “to raise the standard of individual and public health throughout Australia”. Had that objective been mirrored for NOHSC, and had that organisation been required to “raise the standard of occupational health and safety throughout Australia” we might still have a viable organisation seeking a scientific basis for its endeavours.

Instead, the Act went on to list some 25 functions by which NOHSC could achieve its objectives, commencing with “formulating policies and strategies”, “co-operation between Commonwealth and State”, “declaring national standards and codes of practice” and so forth.
There is no information about the scientific basis of these activities until item 19, “to carry out, arrange for, or assist research on OHS matters”.

In the opinion of this author, these terms of reference are unscientific and irrelevant to injury prevention, and were also criticised in the MacKay Report (1987). He offered four recommendations to enhance the management, direction, efficiency and effectiveness of the Commission. The first three criticisms had their origins “in the original organisational structure and operational concepts of the Commission.”

One consequence of these unfortunate terms of reference was that NOHSC did not carry out one of the basic tasks necessary to underpin effective countermeasure strategies — the provision of comprehensive injury data.

**ii) The National Data Set (NDS)**

One of the early steps in the conquest of any public health problem is the provision of an adequate data set. In simple terms, if we can’t count, we can’t control. In more precise terms, an early step in any public health program is the substitution of quantitative data instead of qualitative judgements. It is only after this step that an investigator is able to state that the subject of his/her study differs from others in a particular way, and is also able to state the direction and extent of this difference.

Support for this view, as applied to the public health problem of accidental injury, goes back at least 37 years. The first resolution of the first road trauma seminar of the Royal Australasian College of Surgeons in 1968 stated that:

> Reduction of the incidence and alleviation of the consequences is possible through the application of scientific method: it is not likely to be achieved by any other approach ... lack of adequate data is restricting the formulation of countermeasures into crashes and injuries.

> The mass data collected in Australia are not sufficient to enable adequate road safety research to be undertaken.

Although these criticisms were made in the context of road traffic accident data, they apply with equal validity to OHS data, and have done so throughout history.

The first attempt to count the number of occupational injuries in Australia was published some 35 years ago (Wigglesworth, 1970) and devoted three whole pages to the limitations of State-based compensation data which at that time excluded employers, self-employed persons (including outworkers), Commonwealth employees — including members of the defence services — on an Australia-wide basis. The data also excluded certain groups varying from State to State. Examples were domestic servants working less than 48 hours weekly in Tasmania: officers of religious or voluntary organisations earning less than $700 in NSW, or fishing vessel crew members paid by a share in the profits in Queensland, South Australia, Western Australia and Tasmania!

Six years later, a further paper described the extent of these exclusions and estimated that about 20% of the labour force seemed to be excluded (Wigglesworth, 1976).

After its formation in 1985, an early NOHSC proposal was to develop an improved collection of occupational injury data and this heightened anticipation that the data problem would at last be tackled. It was but, alas, only in a tripartite manner. NOHSC has developed over the last twenty years a “National Data Set for compensation-based statistics” (NDS).

The title says it all. The NDS includes extensive sections on definitions, classifications, concepts and so forth and, admirable though those developments are, they do not address the basic scientific need which was — and unfortunately still is — to provide a data set covering the entire labour force. That could have been tackled in several ways, using whatsoever means were available — including, if necessary, the “Statistics” power of the Australian Constitution. Under Section 51 (xii) statistical information on population, national accounts, finance, education, industry and public health is now routinely collected. Given that the public health problem of occupational injury now costs $34 billion dollars, or 5% of GDP, (NOHSC Annual Report 2003–2004) the time is now overdue to use that power to produce accurate data that will underpin a more scientific approach to occupational injury control. Instead, the tripartite system mandated by their Act resulted in NOHSC adopting the wrong approach to this basic requirement.

The NOHSC Annual Report for 2003–2004 goes on to state that. “In 2002–2003, there were around 134,000 compensated injury and disease claims resulting in one week or more lost from work…..The full extent of the incidence of work-related injury and disease, however, is much higher than these figures suggest. A survey undertaken by the Australian Bureau of Statistics in 2000 estimated that the number of workers who experienced a work-related injury during that year was 447,000. (ABS Catalogue 6324.0 work related injuries September 2000.)
Whilst there are differences between the inclusion criteria for the two collections, examination of the ABS data shows that 189,400 persons were compensated for their injury, whilst 13% of the 259,900 persons who were not compensated (or 34,000) had more than ten days off work. The true figure is therefore substantially greater than the NOHSC estimate. The tripartite preference for qualitative judgement over quantitative data continues to act as a fundamental barrier to the essential pre-requisite for scientific progress.

The NOHSC Annual Report suggests that “the difference in these data is that workers’ compensation data does not cover some segments of the workforce, in particular, self-employed workers” So, after twenty years of tripartism, NOHSC has rediscovered information known to the scientific community for the last 35 years.

iii) Membership

The NHMRC includes nominees of Commonwealth, State and Territory health authorities, professional and scientific colleges and associations, unions, universities, business, consumer groups, welfare organisations, conservation groups and the Aboriginal and Torres Strait Islander Commission and has twenty-nine members. Of these, seventeen hold Professorial title, whilst a further ten have Doctoral qualifications. In other words, although health providers and health consumers are both represented on Council, membership is gained by expertise and knowledge – not by affiliation alone.

By contrast, NOHSC is a tripartite body that includes three members nominated by the Australian Council of Trade Unions; three members nominated by the Australian Chamber of Commerce and Industry; a further eight nominated by the States and Territories, and the remainder appointed by the Commonwealth Government. Of the eighteen Commissioners in office at June 2004, one held professorial title: five had a Masters degree, and a further eight had a Bachelor’s degree. The most common discipline was that of law, listed for four of the eighteen Commissioners and this seems appropriate for tripartite discussion, debate and resolution.

Most commissioners held senior administrative positions, usually in the areas of employment, workplace relations, occupational safety, occupational health and workers’ compensation. It follows that NOHSC could have had significant value as an avenue for disseminating research findings and incorporating those findings into appropriate initiatives – if there had been some mechanism for promoting research.

VALE NOHSC

This is indeed a sorry recitative. The public health problem (not the industrial relations problem) of occupational injury now costs a staggering 5% of GDP or $34 billion annually. It is therefore time to re-examine possible future attempts to reduce the toll of occupational health and safety in Australia to see if a different method should now be adopted.

In this context, the Government proposal is depressing. The suggestion is for NOHSC to be replaced by yet another tripartite body, the Australian Safety and Compensation Council (ASCC) with a brief to:

(a) advise the Workplace Relations Ministers’ Council (WRMC) on policy initiatives to improve workplace safety, workers’ compensation arrangements and rehabilitation and return to work of injured employees; and

(b) oversight implementation and further development of the National OHS Strategy.

The provision of scientific information gets no mention, and in the opinion of this author that proposal does not separate out the two objectives of:

(a) preventing injuries; and

(b) compensating injury victims.

It should.

TWO HISTORICAL ITEMS

Item 1

Thirty six years ago, the editor of Personnel Practice Bulletin, the official publication of the Department of Labour and National Service (as it then was) rejected a paper “Incidence and distribution of occupational injuries in the States of Australia” on the grounds that “The Bulletin is a medium for reporting practices and authoritative views that managers and others are likely to find of direct practical help.” Paraphrased, this implies a preference for qualitative judgement rather than quantitative analysis. Put more bluntly, forget science: promote opinion.

An excellent evaluation of that point of view was written by Quinlan (2000) whose scathing commentary on the research involvement of the National Occupational Health and Safety Commission commences with the words “Forget evidence”, whilst the most recent plea for evidence-based information is that of Cowley (2005) who wrote “Many of our interventions are based on what seems like a good idea...
at the time …but we still lack a strong evidence base for what intervention strategies work and what do not work.”

**Item 2**

Chalmers and Whitworth (2001), in their review of Australian health in the second half of the 20th century, emphasise the value of research and research support. In 1951, the NHMRC allocated $170,000 for research and training (equivalent to about $6 million today), whereas by 2001, the allocation had increased thirtyfold to $176 million. amongst the plethora of successes resulting from this expenditure, and cited by these authors, just one is repeated here. The Australian Therapeutic Trial in Mild Hypertension (1980) has conservatively saved over 50,000 Australian lives and well over a billion dollars in healthcare costs.

This is but one of the achievements of health research, which are graphically displayed in Figure 2. The outstanding feature is the reduction in the infectious and parasitic diseases: the second feature is the reduction in road trauma deaths in the past 25 years, following the introduction of systematic programs of research: the third is the insidious growth in suicide deaths, where research is still spotty; the final feature is that “all other accidents” (of which occupational injuries form a part) now exceeds all others. The need for research into these areas seems, to this author, to be self-evident.

Even more chilling is the Chalmers and Whitworth quotation from the 1951 Jubilee number of the Medical Journal of Australia in which Sir Charles McDonald, Censor-in-Chief of the Royal Australasian College of Physicians wrote:

> Australian discoveries have been disappointingly few and, compared with those of England and America, of minor importance. Little investigational work has come out of clinical schools and still less from individual physicians, and the emoluments of medical practice far outstrip the comparative pittance offered to young men (sic) anxious to engage in research.

Sir Charles’ words, written in the context of health and medical research in 1951 apply with an almost uncanny relevance to the situation relating to occupational health and safety research in 2005.

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**Figure 2.** Twentieth century Australian average annual mortality, showing the current pre-eminent position of “all other accidents”
HERE’S TO HEALTH

One tiny part of the Australian health success story relates to Tuberculosis. In 1951, the number of deaths was 1538 with a mortality rate of about 13 per 100,000 of population. In 2001 the population had more than doubled, but the number of tuberculoses deaths had been decimated to a total of 108, at a rate of 0.6 per 100,000 of population. To that public health success, the contribution of science was substantial: the contribution of tripartism nil.

The moral is clear. After twenty years of tripartism, the public health problem of occupational safety and health should now be realigned. It is here suggested that responsibility for OHS should be transferred from the qualitative judgement environment of the Department of Employment and Workplace Relations to the quantitative analysis environment of the Department of Health and Ageing. There are four reasons.

First, there is an excellent overseas model for Australia to follow. In recent years in the United States of America, an excellent source of injury mortality data has been developed by the Centers for Disease Control (CDC) (www.cdc.gov). The CDC is an agency of the Department of Health and Human Services, and included in its twelve Centers and Institutes are (a) the National Centre for Injury Prevention and Control (NCIPC) and (b) the National Institute for Occupational Safety and Health (NIOSH). In other words the American NIOSH is NOT part of the Department of Employment and Workplace Relations, but is part of the Department of Health and Human Services. It is here suggested that the time is now ripe for Australia to follow that model which has no element of tripartism.

Even the most superficial examination of the US system demonstrates its value for injury prevention purposes – the web-based Injury Statistics Query and Reporting System. (WISQARS) The website is www.cdc.gov/ncipc and its interactive database includes information on 36 categories of unintentional injury deaths plus two categories of violence-related intentional deaths (homicide and suicide). It lists total deaths and age-adjusted mortality rates for each of these categories with subsets by age, race and gender if required both for the United States as a whole and for each State and census region. It is a superb epidemiological resource.

Second is the recent Productivity Commission Report on Workers’ Compensation and Occupational Health and Safety whose first recommendation was:

Replace the tripartite National Occupational Health and Safety Commission with a smaller body appointed on the basis of skills and expertise.

This sensible proposal to replace tripartism with expertise would take OHS away from the realm of opinion and into the realm of science. Unfortunately, the Government rejected that proposal on the ground that “the role of the Australian Government is to facilitate the development of a nationally consistent framework for OHS and workers’ compensation” It is difficult to find any logic behind this statement which is akin to saying that the government wishes to develop a nationally consistent framework for wheat and sheep! These admirable parallel objectives (probably not amenable to tripartite governance), have totally different methods of implementation! So too have the parallel objectives of OHS and workers’ compensation.

Compensation may well be a legitimate area of tripartite activity for discussion, debate and negotiation covering such areas as equity, consistency and so forth. Safety is not a matter for discussion, debate and negotiation: it is a matter for scientific investigation, discovery and implementation.

In the opinion of this author, the Productivity Commission recommendation did not go far enough. Of course there should be a small expert body to tackle the problems of occupational health and safety in Australia (and with no involvement in compensation issues, other than scientific utilisation of compensation data). That body would most appropriately be located in an environment with an ethos accustomed to the application of science in order to improve health. In short, the replacement Occupational Health and Safety organisation should be located within the Department of Health and Ageing.
Third, a start has already been made. NICNAS (the National Industrial Chemicals Notification and Assessment Scheme) was transferred from NOHSC to the Department of Health and Ageing in 2002-2003. NICNAS is the regulatory body for industrial chemicals and was established in 1990. One wonders why it took from then until 2002 to transfer it to a Department with a more scientific orientation.

Finally, twenty years of tripartism have been singularly unsuccessful. According to the 2003-2004 NOHSC Annual Report, the Australian economy will suffer to the extent of about the equivalent of the annual GDP for Tasmania, the Northern Territory and the Australian Capital Territory combined. The number of Australians injured at work is somewhere between 134,000 and 447,000. In the words of its present Chairman, “our national performance is half as good as it ought to be”

For all these reasons, it is now time to reject tripartism and to embrace science in the way that it has contributed to other areas of Australian health.

Here’s to Health!

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Conference Calendar

2005

22–27 July 2005 — HCI International 2005
11th International Conference on Human-Computer Interaction
1st International Conference on Augmented Cognition
Caesar’s Palace, Las Vegas, USA
Internet: www.hcii2005.engr.wisc.edu

23–26 August 2005 — ICOH International Conference
Psychosocial Factors at Work
Okayama, Japan
Internet: www.wops2005.jp

11–15 September 2005 — International Conference
Fatigue Management in Transportation Operations
Seattle, Washington, USA
Contact: Shelley Feese
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Internet: www.cyberg.wits.ac.za

19–23 September 2005 — IOHA 2005
International Occupational Hygiene Association (IOHA)
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26–30 September 2005 — 49th Annual Meeting HFES (USA)
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European Association of Cognitive Ergonomics
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10–12 December 2005 — HWWE 2005
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12–15 December 2005 — CITA’05
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11–16 June 2006 — ICOH
International Conference on Occupational Health
Milan Italy
For more information as it comes to hand consult:
ICOH website: www.icoh.org.sg

10 – 14 July 2006 — IEA 16th Triennial Congress — Meeting Diversity in Ergonomics
MECC Congress Centre, Maastricht, The Netherlands
Conference Website: www.iea2006.org
Contact: Ernst AP Koningsveld
Congress Chairman. E: nvve@planet.nl

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