CONTENTS

2 Editorial

3 Letters

Surely we can improve the design of WCs, Harry Sebel OAM
A bizarre legal case, Max Hely
Great predictions ... Famous last words, Max Hely

9 President's Message

12 Branch News

13 International Ergonomics Information

13 Liberty Mutual Prize

13 IEA/ HFES Congress 2000

13 Adams & Gibbs Call for Colloquia Participants

14 IEA Journal of Ergonomics Research

15 Asia Pacific Journal of Ergonomics

15 NZES Conference 1999 Report

16 Thumbnail sketches of members' ergonomic interests

17 Computer Vision Syndrome, Jenny Long

17 Featured Article

Ergowatch: a new manual handling management tool, Dennis & Barrett

28 Noticeboard

29 Electronic Resources

29 Conference Calendar

31 Instructions for Contributors

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The Ergonomics Society of Australia Inc.
Canberra Business Centre
Bradfield Street, Downer ACT 2602
ESA URL http://www.ergonomics.org.au
tel: 02 6242 1951 fax: 02 6241 2554
e-mail: esa@interact.net.au

Promoting systems, spaces and designs for People
Editorial

Summertime ... and Australia is playing. Our publisher went to Thailand and got probable food poisoning— that certainly spoilt his play and extended his absence! This was not to our disadvantage really; we probably need to be pragmatic and accept that the first issue of the year will late February/early March having allowed time for Australia to return to work. Those of us who did not escape can feel virtuous ... or martyrs! My personal thanks are extended to Robin Burgess-Limerick who has done everything possible to smooth the transfer of editorial responsibilities ... even to providing me with the first major article for 2000. Please readers, continue to share a synergy of ideas, knowledge and experience that could help generate a more accurate and reliable public awareness of ergonomics— as well as increasing in-house appreciation of its diversity.

There has been considerable angst (both locally and overseas) about the widespread commercial misunderstanding and even abuse of the term ergonomics. Such problems are not restricted to our discipline, but our difficulties are exacerbated by our small numbers which are spread across the length and breadth of Australia— and comprise concentrated populations in major cities at least 1000kms apart; small groups in regional centres; and individual members in remote areas. It should not be surprising that individuals who specialise in one aspect of ergonomics may feel isolated even within a generic crowd of ergonomists ... let alone among the wider professional community.

Until our membership reaches a critical mass we will continue to battle this isolation. The development of the Internet has helped immeasurably in reducing physical distance as an obstacle to timely interaction across vast geographical separations. Regardless of this new tool becoming ever more widely accessible, its benefits and attitude changes (our own and others) are only gained by active and informed participation. We can choose to be victims of small membership, disparate sectional interests and geographic isolation OR we can take advantage of every opportunity to enhance our sense of corporate unity in diversity. It is not the problem itself, but how we choose to deal with any problem, that will affect our professional identity crisis and future standing among our peers and the wider public.

We desperately need to enhance our sense of national identity as a critical mass of ergonomics professionals. This journal is one readily available channel to assist this process. It will happen if member states take advantage of the opportunity to pool information rather than focus on restricted circulation state newsletters. Having been privileged to receive occasional copies of other states’ newsletters I invariably found them at least as interesting as the local one and wished the details were more widely shared. Other disciplines provide an all states CPD program in their journals - starting with the intended annual program that is given regular updates. We too can do this. State newsletters began because the original enabling numbers were parochial. Our developing national awareness behoves us to make psychological adjustments and financial savings via national activity. After all, this is the age of globalisation. We either adapt to the new efficiencies that are forcing people to change from thinking locally first and then globally, to thinking globally first and then locally, (Friedman T, The Lexus and the Olive Tree, HarperCollins, p117, 1999) or our local presence and effectiveness become historical.

Shann Gibbs PhD
email: shann@ gibbsplus.com.au
'SURELY WE CAN IMPROVE THE DESIGN OF WCS'

Let me start off by mentioning that I've recently undergone a ruptured-appendix operation, which was followed fairly closely by a prostate-reaming procedure—both carried out in a very fine Sydney hospital, where the care was excellent. But in my several weeks there in all, I was realistically reminded that WC toilet-pans everywhere badly need re-inventing!

Virtually every make of vitreous china toilet-pan that I've seen in Australia—and indeed overseas, with the possible exception of one or two in Italy and Japan—shares the same shortcomings. These fundamental devices, used in our daily lives during much of the Twentieth Century, certainly need a good re-working for the Twenty-First Century! Vitreous-china toilet-pans may have represented a huge step forward from the "Family Three-Holer" which probably prevailed in many Australians areas a hundred years ago, but these designs are now simply not good enough for the Year 2000 and beyond.

The problem is that the design of these toilet-pans does not seem to have enough relevance to the way that the human body actually operates! Let me deal frankly with a number of toilet-pan ergonomic shortcomings:

1. Around the top of a vitreous china toilet-pan is a "collar", behind which the water is supposed to circulate when the cistern is flushed, and to then spray out from below this collar and thus thoroughly wash the contents off, then out of the pan.

But this collar is often so deep (like the high collars that men used to suffer) that some of the "stuff" which we all so often have to dispose of, collects on the outside of this collar— which never gets flushed.

2. The collar often projects forward so much from the surface of the inside of the pan that it makes it difficult for the necessary subsequent toilet-brushing to get at the "stuff" stuck immediately underneath.

3. It seems to me that this collar should be of minimum depth and projection, and should be set as high as possible relative to the seat, so as to actually keep away from the flow of "stuff" from above.

4. Too often, the actual water-jet that is flushing the pan is very uneven. It regularly leaves some surface areas unwashed. Therefore I believe that the first re-design job is to completely reshape the inside of the actual WC pan. The inside shape of the pan perhaps should be ovaly-spherical—instead of the user sitting upon what is in effect a cone balancing on its point (which actually maximises the areas that the "stuff" can fall onto). It then requires an appropriate contour and size of hole on top, upon which the moulded and well-shaped seat will rest snugly.

5. As far as the design of the moulded plastic toilet-seat is concerned, after obtaining skilled pragmatic medical advice, on the 'action' upon sitting on it, the three-dimensional shape of this seat should tend to 'open-up' the anal orifice. Currently that anal orifice tends to close down as the body's weight applies! On plan, the 'hole' in the seat also should be designed and shaped to be suitable for the different anatomical structures of reasonably large males and females.

The underside of the seat should also be as smooth as possible, for easy and effective cleaning. Inevitably, even with the present weak flushing systems, splashing-up from below does occur.

6. Obviously, the amount of water going through the flushing system is also an important factor. The water authorities in Australia—as well as in many overseas countries—now impose serious regulations to limit the volume of water (six litres) permitted for each flush ... probably down from nine litres originally.

The authorities may have been too smart for their own good, since in order to finish the job properly you often have to wait and re-flush and maybe even flush again. Thus you can use 12 or 18 litres instead of the original 9 intended in the regulation!

The stronger the flushing action, the less water that should be needed. That is the next item for a re-design emphasis.

7. Actually, to make the best use of the water you have, you need it to fall from a height— to have some 'head' in fact. In the 'old days' the cistern was always high up — we had to use a chain! The water then came down into the pan in a rush and did a much better job per gallon then used. For whatever reason, the cistern was
lowered and mounted just above the WC pan — thereby reducing the speed and effectiveness of the water-flush.

8. What to do? I’m not necessarily suggesting that we put the cisterns back up to ceiling level — but why not, if they’re mounted in a duct and you can move the cisterns up or down, as you like?

Originally the cisterns of ‘low-level suites’ were made of vitreous china. Engineers/designers of those cisterns made sure that the shape of the cistern itself took into account the fastest through-put and the least trouble for the vitreous china manufacturing processes— which still involve days of costly multiple high-temperature firings in huge ovens. Not surprisingly, when injection-moulded plastic technology became practical around the seventies, the engineers’ then-aim was to shape the moulded-plastic versions of the cistern to look as close as possible to the glazed ceramic originals. We are still living with that philosophy today.

It should be possible to redesign a completely new, half the thickness, flat-against-the-wall moulded plastic cistern shape that will go up much higher and perhaps even provide a comfortable back-rest shape for the new ‘throne’ as well as speeding the water flow to the pan and flushing more effectively.

9. Provision of an electric power point on the wall by the toilet would offer a vista of alternatives for achieving far more effective water jets or sprays (and even exhaust fan outlets) into the WC pan, while using an absolute minimum of water. There are also several other known techniques, whereby water is forced into the pan under some pressure. These need to be reviewed thoroughly.

10. Furthermore, by using a simple electronic timer — a form of microchip — the whole often-noisy ‘floating ball-cock’ system could be rendered obsolete instead of sometimes wasting more water in a day than is actually used in the flushing itself!

I realise that a small proportion of hospitals and office-buildings do have a virtually direct-from-the-mains flushing system that certainly works better ... but that increased flushing-pressure is inevitably followed by far more splashing!

I’ve only dealt with one major product in this letter, but I realise that there is a long list of other products and equipment in every hospital which do not work ergonomically as well as they should do. Hospital-equipment specifiers need to force a showdown with their manufacturers in order to improve the ergonomics of these products. Actually, they’ll be doing these manufacturers a great favour! From the hospital’s point of view, there are millions of dollars that could be saved each year, in terms of nursing and cleaning staff labour.

Harry Sebel OAM
The Harry Sebel Consultancy
23 Yarranabbe Road, Darling Point, Sydney, NSW

A BIZARRE LEGAL CASE – MUST READ!!

(A true story, by Kurt Westervelt (Associated Press), forwarded from the Forensic Listserv of the HFES).

At the 1994 annual awards dinner given for Forensic Science, AAFS President Dr Don Harper Mills astounded his audience with the legal complications of a bizarre death.

Here is the story:

On March 23, 1994 the medical examiner viewed the body of Ronald Opus and concluded that he died from a shotgun wound to the head. Mr. Opus had jumped from the top of a ten story building intending to commit suicide. He left a note to that effect, indicating his despondency. As he fell past the ninth floor his life was interrupted by a shotgun blast passing through a window. He was killed instantly.
Neither the shooter nor the descender was aware that a safety net had been installed just below at the eighth floor level to protect some building workers and that Ronald Opus would not have been able to complete his suicide the way he had planned.

"Ordinarily," Dr. Mills continued, "a person who sets out to commit suicide and ultimately succeeds, even though the mechanism might not be what he intended, is still defined as committing suicide."

That Mr. Opus was shot on the way to certain death, but probably would not have been successful because of the safety net, caused the medical examiner to feel that he had a homicide on his hands.

The room on the ninth floor, whence the shotgun blast emanated, was occupied by an elderly man and his wife. They were arguing vigorously and he was threatening her with a shotgun. The man was so upset that when he pulled the trigger he completely missed his wife and the pellets went through the window, striking Mr. Opus.

When one intends to kill subject A but kills subject B in the attempt, one is guilty of the murder of subject B. When confronted with the murder charge the old man and his wife were both adamant.

They both said they thought the shotgun was unloaded. The old man said it was his long-standing habit to threaten his wife with the unloaded shotgun. He had no intention to murder her. Therefore the killing of Mr. Opus appeared to be an accident; that is, the gun had been accidentally loaded.

The continuing investigation turned up a witness who saw the old couple's son loading the shotgun about six weeks prior to the fatal accident. It transpired that the old lady had cut off her son's financial support and the son, knowing the propensity of his father to use the shotgun threateningly, loaded the gun with the expectation that his father would shoot his mother. The case now becomes one of murder on the part of the son for the death of Ronald Opus.

Now comes the exquisite twist. Further investigation revealed that the son was, in fact, Ronald Opus. He had become increasingly despondent over the failure of his attempt to engineer his mother's murder. This led him to jump off the ten-storey building on March 23rd, only to be killed by a shotgun blast passing through the ninth story window. The son had actually murdered himself so the medical examiner closed the case as a suicide.

Max Hely
Chairman NSW Branch

GREAT PREDICTIONS ... FAMOUS LAST WORDS ...

(showing how much faith we put in the pronouncements of the experts ... readers might like to make further contributions in this vein)

[The following was published in the Sydney Morning Herald, 1/1/2000]

"Well-informed people know it is impossible to transmit the voice over wires and, if possible to do so, the thing would be of no practical value." The Boston Post, 1865.

"Everything that can be invented has been invented." Charles Duell, Director, US Patents Office, 1899.

"There is no likelihood man can ever tap the power of the atom." Robert Millikan, Nobel Prize physicist, 1923.

"Who the hell wants to hear actors talk?" H.M. Warner, Warner Bros., 1927.

"A rocket will never be able to leave the Earth's atmosphere." The New York Times, 1936.

"I think there is a world market for maybe five computers." Thomas Watson, IBM president, 1943.

"Television won't last because people will get tired of staring at a plywood box every night." Darryl Zanuck, 20th Century Fox co-founder, 1946.

By the year 2000, we will undoubtedly have a sizeable operation on the moon; we will have achieved a manned Mars landing and it's entirely possible we will have flown with men to the outer planets." Wernher von Braun, NASA rocket engineer, 1969.

"There is no need for any individual to have a computer in their home." Ken Olsen, president of Digital Equipment Corporation, 1977.

Max Hely
Chairman NSW Branch
Greetings and best wishes for the 21st Century to all ESA members. We will no doubt witness a range of new challenges including many within ESA. I feel extremely confident that we are well positioned to continue to develop in line with our key goals.

I would like to welcome Shann Gibbs to her new role as EA editor. This edition is the first produced by Shann and I feel confident she will maintain her high professional standards in undertaking this role.

Many thanks to Robin Burgess-Limerick for his role as previous EA Editor. Robin will continue to edit EA Online.

A brief update on our 4 goals:

1. PROFESSIONAL DEVELOPMENT

Each of the Branches now has determined its scientific and social program for 2000. I encourage any member to contact their Branch committee if they are unaware of planned events so they can enter them into their diaries now.

During 2000, we will be encouraging two initiatives to improve the quality and variety of programs.

a. Joint meetings with a range of other professional associations to learn from each other and to develop greater technical depth in discussions. One example in Victoria will be with the Australian Physiotherapy Association’s Ergonomics and Occupational Health Group to discuss the implementation strategy of the new WorkCover Manual Handling Regulation and Code of Practice.

b. Continuing Education courses for ergonomists will be developed in consultation with Universities. These would be costed to encourage maximum participation and target competencies in the ESA Certification program.

2. MEMBERSHIP

It is pleasing to see the ongoing interest of new members joining ESA. We now have a number of very active members in Tasmania and would love to hear of a volunteer interested to convene a meeting in Hobart or Launceston for them to determine opportunities for locally based professional development.

The subcommittee developing the new ESA Certification model is continuing to document the Assessment criteria and Guidelines materials. Details of the new model should appear in the next edition of EA, and the ESA Website (ergonomics.org.au) for your information. We will be encouraging consultation within the Branches and feedback to your Board members before appropriate motions are developed for the 2000 AGM in Adelaide in October.

3. PROMOTION

I am pleased to inform members that Liz Pratt (Vic) has been invited to undertake the role as the Federal ESA Public Affairs Officer. Liz has extensive experience in this area both within the Vic Branch Committee, and other “not for profit” organizations. Liz will be consulting with Branches to identify ergonomics research that should be promoted in the general media. This will assist in broadening the public exposure to ergonomics and ensure quality control of materials released from the ESA. I thank Liz for accepting this role and encourage all members who are undertaking ergonomics research worthy of publicity to contact Liz directly or Christine Stone via the ESA office.

4. FINANCE

The issue of centralization of ESA funds has gained a new urgency and driver with the GST introduction on 1st July 2000. Christine Stone has been closely monitoring the reporting and recording needs for ESA Branches. It is evident that centralization of accounts is the only viable system for the ESA to comply with GST requirements—both legally and functionally. Ros Kushinsky and Christine will be developing guidelines in consultation with Branch Treasurers during the forthcoming months.

I have been exploring a range of opportunities for "corporate patrons" of ESA. This may take the form of:

a. Research funding of a post graduate student to study areas of ergonomics relevant to the funding company and of interest to the student. The ESA would receive a contribution from this funding to help promote the research and ergonomics generally.
b. Patrons to commit their support to ESA over a 3 year period including conference sponsorship; EA advertising; and promotion of their support for ergonomics applications.

Feedback from initial discussions with selected corporations who have previously supported ESA has been most promising. I am hopeful of finalizing our first research patronage within the next month.

Any members with suggestions of suitable "corporate patrons" to be contacted should e-mail Christine Stone or myself.

I look forward to a safe, healthy and prosperous New Year for all ESA members and their families.

Regards

David C Caple
ESA President.

---

**New Members**

**QLD**

Mrs Melanie McGaw  
2 Cycas Court  
CORNUBIA QLD 4130  
Member  
Lecturer

**VIC**

Mrs Emilia Costanzo  
18 Saunders Street  
WEST COBURG VIC 3058  
Member  
OHS Consultant

Ms Lisa Stevens  
3/24 Twyford Street  
WILLIAMSTOWN VIC 3016  
Affiliate  
Senior Claims Manager

Ms Fiona Cunnigham  
118 Alexandra Street  
EAST ST KILDA VIC 3183  
Member  
Client Services Manager

Mr Orlando Omizzolo  
418 Rathdowne Street  
NORTH CARLTON VIC 3054  
Member  
Chiropractor

Ms Alison Cocks  
15/61 Robe Street  
ST KILDA VIC 3182  
Member  
Physiotherapist

**NSW**

Mr Scott Cornwell  
97 River Road  
EMU PLAINS NSW 2750  
Member  
Group OS&E Manager
Ms Jenny Long
29 Frazer Street
LEICHHARDT NSW 2040
Upgrade to Member
Optometrist

Ms Lena Kesoglou
PO Box 2188
NORTH PARRAMATTA NSW 1750
Affiliate
Rehabilitation Manager

Miss Anna Kuhnemann
C/- IRS Total Injury Management
Level 5, 345 George Street
SYDNEY NSW 2000
Affiliate

WA
Ms Kerrie Sims
C/- Aboriginal Legal Service
PO Box 2720
SOUTH HEADLAND WA 6722
Upgrade to Member
Project Officer

Mr Damian Broderick
PO Box 337
WEST LEEDERVILLE WA 6903
Member
Principle Occupational Therapist

Ms Courtney-Jane Harris
77 Blencowe Street
WEST LEEDERVILLE WA 6903
Member
Occupational Therapist

TAS
Mrs Karen D’Alessandro
PO Box 647
MOONAH TAS 7009
Member
OH&S Rehabilitation Nurse Consultant

SA
Ms Janet Baines
8 George Street
PARADISE SA 5075
Member
Principal Manipulative Physiotherapist

Mr Paul Rothmore
39 Ninth Avenue
ST PETERS SA 5069
Member
Consultant Physiotherapist (OH&S)

Mr David Mallett
Human Resources Manager
City of Port Adelaide Enfield
PO Box 110
Corporate Nominee Member
PORT ADELAIDE SA 5015

Mr Mick Strawbridge
City of Port Adelaide Enfield
PO Box 110
PORT ADELAIDE SA 5015
Corporate Nominee Member
[Ed: January is clearly the month that people ‘have gone bush’ and cannot be located! Please identify 2000 state Journal Reps & urge them to send in the news for next edition please! In particular I would appreciate a copy of each state’s scientific program so that we can all appreade the range of topics and interstate travelers can tune in to networking opportunities. This all helps to generate a national image of the discipline.]

NEW SOUTH WALES

NSW CONTINUING EDUCATION PROGRAM 2000
Wednesdays, 6.00 for 6.30 pm @ Worksafe Australia Auditorium
92-94 Parramatta Road, Camperdown (opp. Sydney Uni.)

This venue is still current but we are on notice that Worksafe will be moving in a couple of months and a new meeting venue must be determined. Watch this space for details!

March, 1st
Is There Anyone Home in the Ergonome?
Rob Hall August, 8th

April, 5th
Universal Design in Work and Public Spaces
Mark Relf

May, 3rd
Designer?

June
WORKSHOP – theme (& date) to be advised ...

July, 5th
Development of Standards
Michael Sanderson

August, 8th
ANNUAL GENERAL MEETING
Venue to be confirmed

September
OLYMPIC GAMES
NO NSW BRANCH MEETING

October, 8-11th
ESA Annual Conference in Adelaide: Ergonomics for life:
At work, home, and leisure
NO NSW BRANCH MEETING

November, 1st
Breaking new ground – Graduate Ergonomics Research
Topics & Speakers to be advised ...

December, 6th
to be advised ...

DETAILS OF THE NEXT TWO MEETINGS :

MARCH, 1ST
IS THERE ANYONE HOME IN THE ERGONOME? ROB HALL

How might we benefit from trying to expand our view of the "subject" from being a "cognitive spine with eyes" that sits in chairs, pulls levers and misreads warning signs to being a more "rounded" creature with aspirations and emotions? A review of current thinking about personality and the "Big Five Factors" provides the background for his presentation. He demonstrates through examples, how taking personality factors into account can add to our understanding of what people do when dealing with the physical world— including how they make choices about the things they do with their time, energy and money.

About the Presenter
Rob Hall is currently an Honorary Visiting Fellow in both the School of Psychology and the School of Marketing at UNSW; a consultant in social and marketing research; and a co-founder of Environmetrics. He has a PhD in Psychology (Signal Detection Theory) and describes himself as an "environmental psychologist" interested in people and their interaction with their environments. Initially from the experimental, lab-based tradition, Rob became entranced by useability and the uses of designed spaces while working with architects and designers.
As a person with quadriplegia, Mark readily understands the problems faced by people with mobility impairments and through his work on various committees he also understands the many access issues and barriers experienced by people with other disabilities. He advocates the use of Universal Design principles to maximise functionality for a wider consumer market. He believes that these principles will result in increased sales; the reduction of hazards at work and at home; accelerate return to work programs and increase independence for older people and people with disabilities as well as benefiting the general community. This approach offers benefits for both environments and products as for example:

- at work— consumer products, appliances, equipment and workspaces; and
- in public domain street furniture, transport and building access.

About the presenter
Mark Relf is the Deputy Chief Executive Officer of the Australian Quadriplegic Association that is at the forefront of advocacy for the creation of accessible environments. He participates on a wide range of committees that pursue this cause and as a member of Standards Australia ME/64 Committee he has contributed to many access standards. His primary areas of expertise relate to transport and the built environment. He has conducted access audits and appraisals of plans for numerous local councils, the State Rail Authority, Civil & Civic, the Roads & Traffic Authority, Sydney Harbour National Park, Centennial Park, the State Library, cinema complexes, multi-storey apartment buildings, hotels and adaptable housing projects.

2000 LIBERTY MUTUAL PRIZE IN ERGONOMICS AND OCCUPATIONAL SAFETY AND 2000 LIBERTY MUTUAL MEDAL IN ERGONOMICS AND OCCUPATIONAL SAFETY

Applications are now being accepted for the 2000 International Ergonomics Association (IEA)/Liberty Mutual Prize in Ergonomics and Occupational Safety. This $5,000 award recognises individuals who have made significant contributions to the reduction or prevention of work-related injuries and/or to the advancement of theory, understanding, and development of occupational safety research.

In addition, the Liberty Mutual Medal in Ergonomics and Occupational Safety (awarded every three years) will be given in 2000. This honour is given to the best of the Liberty Mutual Prize awardees from the previous three years and consists of a medal and $15,000.

To be considered for the Liberty Mutual Prize, candidates must submit a letter of application and five copies of an original, previously unpublished research paper relevant to the field of occupational safety and ergonomics. An international review committee will select the winning contribution.

The annual prize and the triennial medal will be presented at the IEA/HFES 2000 Congress in San Diego. The deadline for submission is March 1, 2000. For further information, contact Martin Helander, School of Mechanical and Production Engineering, Nanyang Technological University, Singapore 639798;
Tel: + 65-790-6398; Fax: + 65-791-1859;
E-mail: mahel@ntu.edu.sg
Applicants will be notified by June 2000.

IEA/HFES CONGRESS 2000

The next Triennial Conference of the IEA will be held in San Diego, California, USA from Monday 31 July to Friday August 4 2000 (inclusive). In spite of various extensions the deadline is now past for submitting material for presentation and the final program should be issued in a couple of months time. For those interested in attending it will be worth checking the
conference web-site http://iea2000.hfes.org for the early registration deadline that will offer a considerable saving on later bookings.

The Scientific Program Committee has converted an IEA Workshop Proposal by Neil Adams and Shann Gibbs, to a half-day Colloquia Session. In this format the chair (Neil and Shann) invites selected participants (preferably limited to between ten to twenty persons) who are then asked to prepare a position paper for discussion on the day. The chair is required to generate an article on the outcome of the Colloquia, for an IEA publication of their choice.

Neil and Shann’s topic: Training, Attitudes and Safety—Myth, Faith and Reality

ABSTRACT:

The recent findings of the Australian Royal Commission of Inquiry into the causes of the gas explosion at Esso’s Longford, Victoria plant on September 25, 1998 raised instant and angry debate among safety professionals, lawyers, unionists and government agencies. The Commission found that the fundamental cause of the accident (in which two men were incinerated and the damage to the plant cut gas supplies to the state for at least ten days) was the Company’s failure to have given adequate training and instruction. This finding reinforces the long-held belief that if only we give the right sort of training— in the right way— we will produce safe behaviours and safe systems of work. The authors would not deny the value and importance of training, but would see it as no more than supplementary to some more influential organizational characteristics or behaviours that have major, perhaps over-riding implications for safety. The Colloquia will be based on theory and practice determined over:

• Gibbs’ decade of formal research into the complex system effects and relationships that produce quite unsafe work practices at all levels of the health industry in relation to cytotoxic drugs and their handling and disposal; and
• Adams’ preparation of over 5,000 reports for use as an expert witness in workers’ injury claims over the last fifteen years.

Their experiences have led them to conclude that the pervasive influence of attitudes and other organizational culture factors can entirely negate any value that may inhere in training alone. It is intended to address the following concerns:

• Training: why is there such misplaced reliance on it?
• What attitudes and whose attitudes determine safety performance?
• Fuzzy sets— a realistic approach to organic systems that are interactive and adaptive rather than remaining in a bivalent safe or unsafe condition.
• Accident prevention has to depend upon understanding accident causation— consider proximal causes (including demand characteristics of the situation/task that produces the injury) and distal causes (including system functions or Reason’s "hidden pathogens").
• Maintenance in its broadest sense: why is there such neglect of this aspect of safety provision and is there a difference between "safety provision" and "accident prevention"— as it applies to plant, personnel and systems?
• How do we change the demand characteristics of hazardous tasks?

Notice of this Colloquia will be given international exposure and persons interested in participating are asked to contact Shann Gibbs, E-mail: shann@gibbsplus.com.au as soon as possible and provide a brief outline of their experience and perspective on the issues for possible inclusion in the limited number of participants.

IEA JOURNAL OF ERGONOMICS RESEARCH

This new electronic journal seeks contributions. It is intended to maintain a very high standard for the acceptance of refereed articles and to publish them within six months of submission. The IEA intends to make a major promotion of this new journal in the northern hemisphere summer— prior to the Triennial Conference. Please note that the editor has moved from Sweden to Singapore and his current contact details are:
THE ASIAN JOURNAL OF ERGONOMICS: PRACTICE AND ITS THEORY

This will be the official journal of the Pan Pacific Council on Occupational Ergonomics (PPCOE). It aims to:

• provide a forum for new developments in theory, application, and results of empirical research on ergonomics in the pan-Pacific region;
• promote the awareness of ergonomics in the pan-Pacific area by publishing quality articles from all over the world; and
• cater to the demand for regional and international collaboration on ergonomics and ergonomics related issues.

Professor Min K Chung, Pohang, South Korea, is Editor-in-Chief and will head an International Editorial Board. Barbara McPhee, Sydney, Australia, is a member of the journal’s Executive Committee. It is intended to begin publication in 2000 and contributions are actively sought. Meanwhile the first issue will comprise invited papers from ergonomists in each member country. Further details may be obtained from:

Barbara McPhee, E-mail: bmcphee@ozemail.com.au
Dr Min K Chung, E-mail: mck@postech.ac.kr

The website for the journal is: http://iems.net/aje

Interested authors should submit four copies of their paper in English to the editor-in-chief. All submitted manuscripts will be peer reviewed based on originality, thoroughness, and usefulness. Electronic submission via e-mail is strongly encouraged for rapid communication and review process.

NEW ZEALAND ERGONOMICS SOCIETY CONFERENCE 1999

As Dr Tom Leamon said in his Keynote Address, this relatively small gathering of some sixty people generated a great sense of delegate interaction—something that can be missing in large events. The Kiwi hospitality was wonderfully generous and inclusive of the quite large contingent of off-shore delegates. Verna Blewett, Ian Simpson and Shann Gibbs provided an Australian presence among presenters and were very well received. Topics covered a broad spectrum of academic research and practical case studies. The IEA sponsored a special evening garden party (arranged by the New Zealand Conference Committee) prior to the NZES Conference Dinner, in order to highlight the Liberty Mutual Prize presentation to 1999 winner—Dr Shirleyann Gibbs—by Professor Martin Helander, Chair of IEA Awards Committee in the presence of Dr Tom Leamon, Vice President, Liberty Mutual and also a former IEA President.
Contributions are sought for this section of the Journal in 2000. The following is an invited sample from a NSW presentation in August 1999, to begin sharing ideas.

**COMPUTER VISION SYNDROME**
Jennifer Long, Vision Ergonomist

Computer Vision Syndrome is the name given to a collection of visual symptoms that may be experienced by people who use computers. The symptoms include:

- Blurry distance vision
- Red eyes
- Sensitivity to glare
- Blurry near vision
- Sore eyes
- Double vision
- Headaches
- Irritated eyes
- Eye strain

Epidemiology studies have shown that 75-90% of computer users experience at least one of these symptoms, while 47% experience 2 or more symptoms. There are three possible causes of these symptoms:

1. The person
2. The workstation and environment
3. Work practices

**THE PERSON**

**DRY EYE**

When we concentrate, we tend not to blink as frequently. Therefore the tear film on the front of the eye evaporates, producing symptoms of dry eye (e.g. gritty, sore eyes). These symptoms may be worse if:

- The person is older. The tear film often changes its constituency and becomes thinner as we get older.
- The person is directly exposed to heating or air-conditioning. This will evaporate the tears more quickly.
- The monitor is positioned at eye level. The person’s eyes will be open wider than when gazing downward (e.g. when reading a book), so more tears will evaporate.
- The person is wearing contact lenses.

**PRESBYOPIA**

As we get older, it becomes harder for the eye to focus on close objects. This loss of focussing ability is called presbyopia. Symptoms include blurry vision for close objects, headaches, sore eyes, difficulty changing focus from near to distance objects and from distant to near objects.

As a general rule, single vision lenses and computer (extended focus) multifocals are the best optical correction for presbyopes (although ultimately it is up to the wearer which lens design they prefer). These lens designs help the wearer maintain a more neutral posture when looking at their monitor.

**LONG SIGHTEDNESS (HYPEROPIA)**

A long sighted person can see more clearly in the distance than for close distances. This can affect people of all ages. The symptoms include blurry vision for close objects, headaches, sore eyes, red eyes and watery eyes.

**ASTIGMATISM**

With astigmatism, light does not focus sharply on the retina. This is often due to an irregularly shaped cornea. Astigmatism can affect people of all ages, producing symptoms of blurry vision for close objects, blurry vision for distant objects, headaches, sore eyes, red eyes and watery eyes.

**SHORT SIGHTEDNESS**

A shortsighted person can see more clearly for short distances than for far distances. Shortsightedness can affect people of all ages, and is often worse after looking at a computer screen for long periods. Regular rest breaks and eye exercises can reduce these symptoms.

**THE WORKSTATION AND ENVIRONMENT**

**MONITOR HEIGHT**

Positioning the monitor below eye level will help avoid neck and back problems, especially for people who wear bifocal and multifocal spectacles. It will also reduce the incidence of dry eye and the incidence of direct glare from overhead lights.
GLARE
If the illumination is uneven at a workstation, then the eye will need to constantly readjust to the different light levels. This can cause tired, sore eyes. It is also important to eliminate reflections on the screen from overhead lights or from windows, as this can make reading more difficult.

CLEANLINESS
Ensure the monitor and any anti-glare screens are free from dirt, dust and fingerprints. Not only will dirt make the characters hard to read on the screen, but the eyes may focus on the dirt, not the work, causing headaches, sore eyes and blurry vision.

AIR QUALITY
Poor air quality can produce symptoms that mimic dry eye problems.

WORK PRACTICES
Rest breaks are important to reduce visual and mental fatigue. Don’t overlook issues such as stress and dissatisfaction with work, as these can produce symptoms similar to Computer Vision Syndrome symptoms.

WAYS TO REDUCE SYMPTOMS OF COMPUTER VISION SYNDROME
Encourage a regular eye examination
Encourage the use of appropriate eyewear
Lower the monitor
Reduce direct exposure to air-conditioning and heating
Eliminate glare
Ensure cleanliness of the screen
Encourage rest breaks

INTRODUCTION
Lower back pain (LBP) due to manual handling (MH) imposes a considerable financial and social cost on the community (Worksafe Australia, 1993; Nachemson, 1992). For example in 1994-95 workers compensation claims in Australia cost $4.1 billion (Worksafe Australia, 1996), with back injuries accounting for 28% of these claims, 69% of which were caused by over exertion during lifting (Worksafe Australia, 1995).

One approach to LBP prevention involves the study of the forces acting on the spine during MH. The main assumption underlying this approach is that the risk of injury to the low back associated with MH is causally related to spinal loading (McGill, 1997). According to this approach, if spinal loads associated with MH can be accurately determined, then potentially dangerous MH tasks can be identified and risk control strategies implemented.

The first comprehensive and commercially available software package for estimating the spinal loads associated with MH tasks was the three-dimensional static strength prediction program (3DSSPP, University of Michigan, 1993). 3DSSPP is a static biomechanical model that computes compression and shear forces at the lumbosacral (L5/S1) joint from input describing the orientation of the segments of the body and the magnitude and direction of the hand load. Estimates of L5/S1 compression force can be compared with prescribed safe lifting limits to ascertain the degree of low back injury risk associated with specific MH tasks. Stevenson (1998) previously published a review of...
In this journal. In the current paper we review a new software package for managing MH developed at the University of Waterloo, known as Ergowatch.

The purpose of this review is to: (i) describe the main features of Ergowatch, with particular emphasis on the part of Ergowatch known as 4D Watbak, which is a biomechanical modelling tool concerned with estimating and evaluating spinal loads; and (ii), to provide an example of how Ergowatch can be applied to the analysis of a ‘real world’ MH task. Specific attention will be paid to the theoretical basis of Watbak, including a discussion of its main assumptions and limitations.

DESCRIPTION OF ERGOWATCH

Ergowatch is a four-part software program based on the latest scientific research that was specifically designed for use by Occupational Health and Safety practitioners. Ergowatch consists of 4D Watbak, NIOSH Tool, Snook Tool and PDD Checklist programs and operates on the Windows 95 platform. The version reviewed here is Ergowatch Beta Version 1.1, which was released for review in 1999. It is expected that Ergowatch will be officially released early in 2000.

4D WATBAK

4D Watbak is a biomechanical modelling program that estimates the loads acting at the junction between the 4th and 5th lumbar vertebrae as a function of body segment angles, lumbar spinal curvature and the magnitude and direction of the hand load. The four dimensions of Watbak are the three dimensions of space and one of time. The time dimension is incorporated to estimate the cumulative loads acting on the spine during tasks performed over a full working day. The beta version of Watbak reviewed in this article is restricted to the sagittal plane, however the full three-dimensional version of Watbak is expected to be released in the year 2000 as a program upgrade.

NIOSH TOOL

The NIOSH Tool implements the National Institute of Occupational Safety and Health (NIOSH) manual handling equations (NIOSH, 1981; 1991) to estimate acceptable and maximum weight limits for specific MH tasks, which can then be compared to the actual weight lifted. Weight limits are calculated by the 1981 equation from horizontal and vertical position of the load, vertical displacement of the load, lifting duration and frequency parameters. The 1991 equation uses the same parameters as the 1981 model as well as a qualitative assessment of the coupling of the hand to the load and the degree of twisting in the MH task.

SNOOK TOOL

Based on psychophysical research by Snook (1978) and Snook and Ciriello (1991), the Snook Tool predicts the maximum acceptable weight of a specific MH task (MAWL) for certain percentages of the population. Lifting, lowering, pulling, pushing and carrying tasks can be analysed by the Snook tool, based on input describing gender, object dimensions, the distance the object is moved and the frequency of the lift. The output indicates the maximum weight that is physiologically acceptable for specific percentiles (90, 75, 50, 25 & 10%) of the population. According to Snook et al. (1978), workers who lift loads that are acceptable to less than 75% of the population are three times more likely to develop LBP.

PHYSICAL DEMANDS DESCRIPTION CHECKLIST (PDDC)

PDDC contains the Functional Capacity Evaluation (FCE) and the Physical Demands Description (PDD) questionnaires, which have been adapted from the 1980 Ontario Ministry of Labour, Physical Demands Analysis form. FCE and PDD questionnaires are designed to identify risks in the workplace and provide an indication of the ability of an employee to perform a MH task safely. The assessment provided by these questionnaires is based on strength, mobility, sensory/ perceptual, work environment and conditions of work.

DESCRIPTION OF THE 4D WATBAK SPINAL MODELLING PROGRAM

In this section a brief account of the theoretical basis of Watbak is provided, followed by a description of the Watbak User Interface, and a discussion of the main assumptions and limitations of Watbak.
The current 2D beta version of Watbak represents each subject using 14 body segments (i.e., 2 x hand, 2 x forearms, 2 x upper-arm, head, trunk, 2 x thigh, 2 x shank and 2 x foot segments). Mass, length and centre of mass (COM) of each body segment are estimated from the subject’s height and weight, based on the equations developed by Plagenhoef (1971), Dreyfuss (1966) and Zatsiorsky and Seluyanov (1983). Spinal loads are calculated via Newtonian equations that sequentially calculate the reaction forces of each joint of the upper body starting at the hands. Reaction forces in the joints of the lower extremities are calculated starting at the ground reaction force (GRF) applied to the foot segments. The resultant GRF is estimated via vector addition of the subject’s body weight and the hand load vector.

L4/L5 compression forces are estimated from the sum of the reaction force normal to the vertebral end plate and the compression force due to the lumbar musculature. Normal reaction forces and moments at L4/L5 are calculated via static equations of motion. The compression force due to the lumbar musculature is calculated from the moment generated at L4/L5, assuming a single equivalent muscle model with an extensor moment arm of 6 cm (Potvin et al., 1991; McGill et al., 1986). If the moment about L4/L5 is a flexion moment, a single equivalent abdominal muscle force with a moment arm of 4.5 cm is assumed (McGill, 1996).

Watbak calculates two types of shear force, reaction shear and joint shear. Reaction shear is calculated from the sum of the hand load and upper body weight forces acting parallel to the vertebral end plate, whilst the joint shear force also incorporates the effect of forces exerted by the lumbar muscles and ligaments. McGill and Norman (1987) and MacIntosh and Bogduk (1987) reported that the lumbar extensor musculature is aligned oblique to the lumbar spine when the lumbar lordosis is maintained, and is aligned parallel to the vertebral column at L4/L5 during full flexion. Therefore, Watbak incorporates a posterior shear force from the lumbar extensors during lordosis and no shear force during lumbar flexion. Although Watbak assumes that no posterior shear force is produced by the lumbar extensors when the lumbar spine is flexed, the model does incorporate the anterior shear force generated by the obliquely aligned spinal ligaments (McGill, 1988). Ligament forces in both the lordotic and fully flexed postures are estimated based on a moment arm of 6 cm (Potvin et al., 1991). Joint shear force is subsequently calculated by adding any anterior shear force produced by the ligaments to the reaction shear force and subtracting any posterior shear force generated by the lumbar extensors. Watbak defines anterior shear force as positive and posterior shear force as negative.

To aid the user when interpreting the spinal compression and shear forces estimated by Watbak, these forces can be compared to lumbar spinal force limits reported in the literature. L4/L5 spinal compression limits incorporated into Watbak include; (1) the NIOSH Action Limit (AL) and Maximum Permissible Limit (MPL) (NIOSH, 1981), (2) the age and gender related limits set by Jager et al. (1991), and (3) the population specific limits recommended by Genaidy et al. (1993). According to NIOSH (1981), L4/L5 compression forces above the AL (3433 N) are considered potentially hazardous for some workers and require ergonomic or administrative intervention, whilst L4/L5 spinal forces above the MPL (6376 N) are considered hazardous to most workers and immediate task modification is recommended. In 1991 the NIOSH equation was modified to give the Recommended Weight Limit (RWL) and Lifting Index (LI). The RWL assigns a weight that nearly all healthy individuals could lift over a full eight-hour shift without a significantly increasing the risk of developing LBP. The LI is calculated by dividing the weight lifted during the MH task by the RWL. A LI greater than 1.0 poses an increased risk of LBP for some individuals, whilst a value over 3.0 indicates an increased risk of LBP for a substantial fraction of the workforce. The 1981 and 1991 spinal compression limits set by NIOSH are neither age nor gender specific.

Compared to limits for spinal compression, less attention has been paid to the development of spinal shear force limits. Watbak includes University of Waterloo Action Limit (UW AL) and University of Waterloo Maximum Permissible Limit (UW MPL) lumbar shear force.
Shear UW limits are only appropriate for anterior shear experienced at L4/L5. No posterior shear force limits have been set. Anterior L4/L5 shear limits in Watbak are gender specific and have been set at 500 N (UW AL) and 1000 N (UW MPL) for men and 330 N (UW AL) and 660 N (UW MPL) for women.

Cumulative spinal forces and torques are calculated by multiplying the joint load by the duration of the task and are reported as cumulative forces or torques (N.s or Nm.s) per task or per shift. Because the peak spinal force is multiplied by time the cumulative force is likely to be over predicted by Watbak.

Finally Watbak uses statistical odds ratios to generate LBP Index estimates (from 0-1) from peak and cumulative forces. The LBP Index is designed to indicate the level of risk for acute and cumulative load based on research by Norman et al. (1998), which used a regression analysis to predict LBP ‘cases’, as a function of lumbar spine moment, L4/L5 compression force, L4/L5 shear force and the force experienced at the hand.

Watbak User Interface

Watbak presents input entry points and output data in a dual panel format. The left panel has five tabs (Info, Job, Posture, Force & Output) whilst the right panel displays a mannequin representation of the task being analysed. An example of the user interface for a worker lifting a car tyre from the ground is presented in Figure 1.

(See Page 25 for Figure 1.)

Height, weight, gender and age of the worker must be specified in the ‘Info’ tab before Watbak can generate any output data. Subject and analyst details can also be recorded in the ‘Info’ tab, along with any explanatory notes.

Before Watbak provides a mannequin representation of the worker in the right panel an action needs to be added to the task list in the ‘Job’ tab. The number of repetitions and the duration of MH tasks under analysis are defined in the ‘Job’ tab so that Watbak can calculate cumulative load estimates. To analyse a single task only one action needs to be defined, however Watbak is also able to group and analyse many different MH tasks performed by an employee. Grouping tasks can be particularly useful in identifying risky MH practices amongst the many tasks performed throughout a working day.

Symmetrical and asymmetrical postures can be created in the ‘Posture’ tab by adjusting the individual body segment angles, with an accuracy of up to 1/100th of a degree. Alternatively the posture can be manipulated by ‘clicking & dragging’ individual segments of the mannequin in the right panel, with corresponding joint angles simultaneously displayed in the ‘Posture’ tab. By default Watbak limits the range of motion (ROM) of each body segment, including the lordosis of the lower back, based on functional anatomical ROM research conducted by Magee (1987). The lumbar spine switches automatically to a flexed posture once the hip angle is greater than 80 degrees, however, both the ROM limitations and automatic lumbar flexion can be overridden if required.

The magnitude, direction and distribution of the external load in each hand can be manipulated in the ‘Force’ tab. As the hand load is manipulated its vector representation on the mannequin and the corresponding change in spinal load estimates are simultaneously updated by Watbak.

Watbak calculates an array of acute and cumulative force estimates from anthropometric, posture and hand force inputs, which are presented in a variety of tabulated and graphical forms in the ‘Output’ tab. One of the most useful graphical representations of acute L4/L5 compression and joint shear force displays the lumbar forces as bar graphs (eg. figure 1b). A choice of three types of lumbar compression limits (NIOSH, Jager or Genaidy) can be superimposed upon the graph to compare with the calculated compression loads. Likewise gender specific University of Waterloo shear force limits are superimposed on the joint shear bar graph to aid in evaluation of the lumbar shear loads, but only when Watbak calculates an anterior shear force at L4/L5, as posterior shear force limits have yet to be determined.

Although there are no limits for cumulative loads where injury becomes more likely, estimated cumulative forces are useful when comparing the risk associated with various MH tasks. Cumulative and acute loads during
unaccounted time (i.e. periods during a shift where no task is analysed) are calculated assuming a standing posture with the trunk flexed 5 degrees. Cumulative loads are presented in units of N.s or Nm.s.

LBP Index ratios based on epidemiological research by Norman et al. (1998) are also reported in the ‘Output’ tab. LBP Indexes (ranging between 0 and 1) can be used to gauge the LBP risk associated with particular MH tasks. (E.g. A LBP index of 0.67 represents a 67% chance of reporting LBP).

ASSUMPTIONS AND LIMITATIONS OF WA T B A K

Like all models Watbak is based upon a number of assumptions, which limits the way MH tasks can be analysed by the model. It is important for the user to be familiar with these assumptions and limitations so that Watbak results can be properly interpreted.

The current beta version of Watbak only provides a 2D analysis in the sagittal plane, thus analysis of actions that are not performed in the sagittal plane are prone to error. Bone (1990) indicated that postures that are in excess of 30 degrees from the sagittal plane incur calculation errors of up to 10% in disc compression. It is therefore recommend that analysis of postures be restricted to those within 30 degrees of the sagittal plane.

Watbak is a static program that does not include the effects of inertial forces. McGill and Norman (1985) found average lumbar moments 19% higher using a dynamic analysis when compared to estimates from a static model. Likewise, Frievalds et al. (1984) estimated that the inertial force experienced during dynamic lifts could increase the static load by as much as 40%. These studies indicate that Watbak tends to under predict the spinal forces associated with dynamic lifts, thus under these circumstances the estimated spinal loads need to be interpreted with caution. In order to increase the safety margin when calculating spinal loads for dynamic movements the inertial hand load can be input into the model rather than just the weight of the hand load. The inertial hand load is the force experienced by the hands rather than just the weight of the load. Using the inertial hand load in an otherwise static model is referred to as a quasi-dynamic model, which tends to over predict the spinal forces. Therefore, using the inertial hand load in Watbak will typically produce a more conservative estimate of lumbar spinal loads.

Watbak also limits the analysis of MH tasks to a discrete point in time. Thus, a time history of continuously changing lumbar spinal forces during a MH task cannot be determined. This limitation is particularly relevant when analysing cumulative loads, where the integration of the force/time curve would provide a much better estimation of cumulative loads rather than multiplying the acute load by the duration of the MH task.

Although Watbak incorporates a certain degree of anatomical detail in the estimation of lumbar compression and shear forces, it remains a reductionist approach that calculates lumbar spinal forces based on a single equivalent muscle model. As a reductionist model Watbak cannot be used to provide insight into the mechanism of the lumbar spine, and it is better suited to compare L4/L5 forces between tasks and provide an overall indication of the risk of LBP. One mechanism that is overlooked by Watbak is the effects of co-contraction. Dieën and Looze (1999) examined the sensitivity of single equivalent muscle models to co-contraction of the trunk muscles, and found that scaling the oblique activity from 0 to 30% dramatically increased both compression and anterior shear estimates at L5/S1. Watbak underestimates the effects of co-contraction of the lumbar musculature in two ways. Firstly the contraction of the antagonistic muscle group will directly contribute to compressive force, and secondly this added antagonistic muscle contraction would require greater agonistic muscle force to maintain a static posture. The contraction of both the antagonistic and agonistic muscle groups accentuates the lumbar spinal compression due to the reaction forces.

Watbak is designed to analyse tasks where the only part of the upper body that is in contact with the external environment is the hands, creating another limitation. Therefore, the only way to estimate spinal loads, if for example the shoulder is used to help lift a load, is to measure the load on the shoulder and to convert this force to an equivalent load on the hands. In practice this equivalent hand load can be quite a difficult force to predict accurately.
Lumbar spinal curvature has a substantial effect on joint shear force estimates calculated by Watbak. In a lordotic posture the extending muscular force reduces the reaction shear force, whilst in the flexed position the ligaments produce a substantial anterior shear force. Interestingly, lumbar spinal curvature (flexed or lordotic) does not affect the L4/L5 compression force. Watbak only enables the user to calculate spinal loads based on either a lordotic or a fully flexed lumbar spine. However, in many MH tasks spinal curvature may be between the two extremes offered by Watbak.

A summary of the main assumptions and limitations of the Watbak model is given in Table 1.

Table 1. Summary of the main assumptions and limitations of Watbak adapted from the 4D Watbak Users Manual

**ASSUMPTIONS**

1. Functional movement of the body can be represented by 14-ridged links connected by hinge joints.
2. Body segment masses, lengths and COMs are accurately estimated by the subject's height and weight.
3. The analyst can accurately measure the hand force vector and posture for the MH task under investigation.
4. The lumbar extensor (or flexor) muscles are functionally represented by a single equivalent force vector with a moment arm of 6 cm (or 4.5 cm).
5. There is no co-contraction of trunk extensors and flexors.

**LIMITATIONS**

1. Analyses (in the current beta version) are limited to a sagittal plane.
2. Watbak should not be used to analyse MH tasks involving large segmental accelerations.
3. Watbak can only calculate L4/L5 spinal loads for discrete point in time, not changing forces across time.
4. Watbak does not explicitly model the detailed anatomy and mechanics of the lumbar spine, and so it is not appropriate to used Watbak to provide insight into the mechanisms of the lumbar spine.
5. The model is limited to use the hand force vector as the only external force.
6. Lordotic posture can only be switched between fully flexed and fully lordotic positions.

**APPLICATION OF WATBAK**

Watbak can be used to analyse "real" MH tasks, and can also be used as part of a design process to estimate loads associated with hypothetical MH tasks. Indeed, one of the advantages of the biomechanical modelling approach to MH in general is that MH tasks can be evaluated prior to implementation in the workplace. For example, potentially dangerous tasks may be simulated instead of subjecting the worker to unnecessary risk. Similarly, different ways of performing a MH task can be assessed to determine which method is associated with the lowest spinal loads (eg. Varcin & Barrett, 1998).

In order to illustrate the way in which different manual handling practices can be modelled and evaluated by Watbak a simple example is provided. The MH task chosen for analysis is routinely performed by tyre technicians in mechanics workshops and tyre outlets and involves lifting a car tyre from the ground and placing it on a tyre-changing machine. Due to the mass of the tyre and the postures involved, it might be expected that the task may place the worker at some risk of injury to the lower back, especially given the repetitive nature of the work.

**METHODS**

Tyre technicians were observed changing car tyres during a standard eight-hour shift. On average, tyre technicians took approximately 5 seconds to lift the tyre from the ground and place it on the tyre-changing machine, and repeated this task up to 100 times in a day. The average mass of a car tyre was 18 kg, which was assumed to be evenly distributed between both hands. The postures adopted by one representative male subject (Age: 35 yrs, Height: 1.83 m, Weight: 85 kg) at the
instant the tyre was lifted from the floor were measured and recorded on the ‘4D Watbak Single Action Data Collection Form’.

Analysis of the MH task, including estimates of L4/L5 compression and shear forces were obtained using Watbak. The static analysis provided by Watbak was considered appropriate for the analysed MH task due to the relatively high hand load and long coupling times involved.

Since a lordotic lumbar spinal curvature is recommended during MH (McGill & Norman, 1994), and the joint shear force calculated by Watbak is also dependent on lumbar spinal curvature, spinal loads were analysed for both a flexed and lordotic lumbar spine. To assist in evaluating the risk associated with the MH task NIOSH and Snook analyses were also performed.

RESULTS AND INTERPRETATION

The subject performed the tyre-lifting task with a flexed lumbar spine using the segment angles displayed in Table 2. Body segment angles are defined in clockwise direction from the vertical axis.

Table 2. Body segment angles for a representative subject lifting a car tyre from the floor.

<table>
<thead>
<tr>
<th>Body Segment</th>
<th>Segment Angle (Degrees)</th>
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<tbody>
<tr>
<td>Head</td>
<td>66</td>
</tr>
<tr>
<td>Trunk</td>
<td>80</td>
</tr>
<tr>
<td>Arm</td>
<td>12</td>
</tr>
<tr>
<td>Forearm</td>
<td>14</td>
</tr>
<tr>
<td>Hand</td>
<td>8</td>
</tr>
<tr>
<td>Thigh</td>
<td>66</td>
</tr>
<tr>
<td>Leg</td>
<td>-30</td>
</tr>
<tr>
<td>Foot</td>
<td>50</td>
</tr>
</tbody>
</table>

The Watbak dual panel user interfaces, showing (a) the posture tab and (b) the output tab on the left panel, together with the mannequin representation of the worker for the tyre-changing task are displayed in Figure 1.

Watbak estimated a L4/L5 compression force of 4343 N for a flexed lumbar spine, which is between the NIOSH AL and MPL. NIOSH guidelines recommend ergonomic or managerial intervention for MH tasks associated with compression forces above the action limit (AL = 3433 N). Similarly the L4/L5 reaction shear force (614 N) with a flexed lumbar spine was above the UW AL of 500 N. When using a flexed lumbar spine the extensor musculature provided no posterior shear force and the ligaments were aligned so as to dramatically increase the anterior joint shear force to 1567 N. This calculated anterior joint shear force is above the 1000 N UW MPL recommended by McGill et al. (1998) indicating that the worker is at high risk of injury to the lower back.

Both the L4/L5 compression and reaction shear forces estimated by Watbak were the same for the lordotic lumbar curvature as they were for the flexed lumbar spine. However, the major difference that occurred when the task was analysed with a lordotic lumbar curvature was the decrease in joint shear force estimates. When using a lordotic lumbar spine curvature the extensor musculature of the lower back provided 389 N of posterior shear force, reducing the reaction shear force to an anterior joint shear force of 225 N.

The results from Watbak indicate that a lordotic lumbar spinal curvature is the preferred technique for lifting the car tyre, due to the substantially lower joint shear force experienced compared to those calculated for a flexed lumbar spine. However, in order to analyse the tyre-changing task with a lordotic posture the range of motion (ROM) limits imposed by Watbak had to be overridden, which indicates that this MH task could not be performed with a lordotic spinal curvature without altering the overall posture and possibly effecting the calculated spinal loads.

The combined LBP Index is based on the overall effect of all the individual LBP Index parameters (ie. peak hand load, peak and cumulative L4/L5 moment, peak and cumulative compression and peak and cumulative reaction shear Indexes). The combined LBP Index for the tyre-changing task was 0.56, which indicates a 56% chance of the subject reporting LBP.
The NIOSH and Snook Tools were used to analyse the tyre-changing task and the results are displayed in Table 3.

Table 3. Results for the analysed tyre-changing task using the NIOSH and SNOOK analysis tools. The NIOSH results represent the hand load weight corresponding with the AL and MPL. Snook results are estimates of the hand load that different percentiles of the population are capable of lifting.

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<tbody>
<tr>
<td>AL : 9.95 KG</td>
<td>90</td>
<td>75</td>
<td>50</td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td>RWL : 11.64 KG</td>
<td>14</td>
<td>20</td>
<td>27</td>
<td>34</td>
<td>12</td>
</tr>
<tr>
<td>MPL : 29.86 KG</td>
<td>14</td>
<td>10</td>
<td>8</td>
<td>16</td>
<td>8</td>
</tr>
</tbody>
</table>

Results from the NIOSH Tool indicate that a weight of 18 kg is between the AL and MPL from the 1981 equation, and above the RWL from the 1991 equation. The ratio of the RWL to the 18 kg load gives a LI greater than 1.0, which indicates an increased risk of injury to some fraction of the workforce (NIOSH, 1991). In agreement with the results from Watbak, results from the NIOSH Tool indicate a need for ergonomic or managerial intervention.

Snook Tool results indicate that approximately 75% of the male population and 10% of the female population are capable of lifting the 18 kg load without significant ‘physiological strain’ (Snook, 1978). According to Snook et al. (1978), 2/3rds of low back injuries can be prevented if the load is less than the 75% MAWL. Therefore, using the Snook Tool, this particular tyre-lifting task is relatively safe for a majority of the male workforce, but poses a high risk of injury to the female workforce.

SUMMARY AND CONCLUSION

The main features of a new MH management tool known as Ergowatch have been reviewed, with particular attention given to the spinal modelling tool in Ergowatch known as Watbak. The theoretical basis of Watbak was described and the main assumptions and limitations discussed. In particular, it was emphasised that Watbak is suitable for the analysis of MH tasks that are performed slowly, with the load held in the hands. Although the beta version is restricted to analysis of tasks performed in the sagittal plane, the full version will allow analysis of tasks involving 3D motion.

In order to demonstrate how Ergowatch can be applied to the analysis of a ‘real world’ MH task, a ‘case study’ analysis of a worker lifting a car tyre from the ground onto a tyre-changing machine was performed. L4/L5 compression and shear force estimates and LBP Index results from Watbak, together with NIOSH and Snook results, indicate that the tyre lifting task placed the worker at risk of injury to the lumbar spine and that some form of administrative or ergonomic intervention is warranted.

It is envisaged that Ergowatch has the potential to be a useful tool for preventing LBP in industry.

REFERENCES


Figure 1. Watbak dual panel user interface showing (a) the posture tab and (b) the output tab on the left panel, together with the mannequin representation of the worker on the right panel. The bar graphs in the output tab represent the magnitude of the spinal compression and shear force estimates by Watbak, and are shown relative to the NIOSH compression force and University of Waterloo shear force limits.


acceptable weights and forces. Ergonomics, 34(9), 1197-1213.


1. JOHN LANE MEMORIAL SCHOLARSHIP
The Monash University Accident Research Centre has, in honour of the late Dr John Lane, established the John Lane Memorial Scholarship. The Centre will provide $20,000.00 per year for three years for PhD research in any area of injury prevention relevant to the Centre's activities. The recipient will be a graduate of the Centre. The scholarship will be advertised shortly in the press.
Contact: Dr Michael Regan, Senior Research Fellow Accident Research Centre, Monash University Wellington Road, Clayton, Victoria 3168 Australia Tel: 61 3 9905 1838 Fax: 61 3 9905 4363 E-mail: michael.regan@monash.edu.au

2. NOTES ON THE PRINCIPLES OF ERGONOMICS
The new and extensively revised edition of Mike Stevenson's Notes on the Principles of Ergonomics is now available for purchase by members of the Society, rather than being confined to students. Mike will send details of the contents, price and means of ordering on request:
E-mail: Mike_Stevenson@bigpond.com.au Phone: 02 9948 8448.

3. IBM ERGONOMICS UPDATE
This publication is now on-line, in effect, at the Healthy Computing site—a web site devoted to helping in the comfortable use of a computer and providing extensive ergonomic and environmental information at one location. Just click on News and Awards. An item on CyBerg was run in the Spring '99 Edition. A distribution list is being created for people who would like to be notified when a new edition is published. Please advise Don Maclay if you wish to nominate yourself or others for this list. Contact:
Don Maclay, Editor IBM Ergonomics Update E-mail: maclay@ibm.net

4. POSITION INQUIRY
My name is David Leopold and I am basically looking for a way to find myself a career in Human Factors Engineering. In June, I will be separating from the United States Air Force after my initial 5 year service commitment. I earned a BS in Human Factors Engineering from the United States Air Force Academy in 1995 and have been serving in the Air Force as an Air Weapons Officer aboard the Airborne Warning and Control System (AWACS) for the past 3 years. If there is any information you can provide as far as listings for available jobs please contact me via email. Any information would be sincerely appreciated.
David Leopold Capt, USAF 552 OSS/OSK E-mail: whamo25@gateway.net
Electronic Resources

OSHA Proposes new ergonomics standard

US Coast Guard Research and Development Centre
Human Factors Reports
http://www.rdc.uscg.mil/rdcpages/hfac-docs.html

1998 Federal Aviation Administration Office of the Chief Scientific and Technical Advisor for Human Factors, AAR-100


HUMAN FACTORS & ERGONOMICS RESOURCES
http://www.2-SIR.com/Human_Factors/


Conference Calendar

2000
4 - 9 March
Blankenship Functional Capacity Evaluation Certification Seminar, Sydney
Contact: Tony Mitchell, FCE Australia
Tel: 07 3394 3655 Fax: 07 3847 4125 E-mail: workman@ozemail.com.au

8 - 10 March
Australian Pacific Healthy Cities Conference 2000
Canberra. Tel: 02 6251 0675
E-mail: consec@spirit.com.au Web: www.healthycitiescanberra.org.au

19 - 22 March
Fatigue Management Alternatives to Prescriptive Hours of Service. "Strategies for Programme and Promotion Evaluation", Fremantle.
Tel: 618 9322 6906 Fax: 618 9322 1734 E-mail: conwes@congresswest.com.au

4 - 6 April
Ergonomics Society 2000 Annual Conference
Stoke Rochford Hall, Grantham, Lincolnshire, UK
Contact: Ergonomics Marketing Ltd
Devonshire House, Devonshire Square
Loughborough, Leicestershire LE11 3DW, UK
E-mail: ergsoc@ergonomics.org.uk

4 - 6 April
Safety in Action 2000 Conference
Melbourne Convention Centre
Registration:
Tel: 03 9654 7773 Fax: 03 9654 5596
E-mail: safety@aec.net.au
Mail: Safety in Action 2000 Conference
Australian Exhibitions & Conferences Pty Ltd
PO Box 82 Flinders Lane
Melbourne, VIC 8007

(A number of ESA members will be presenting at this Conference organised by the Safety Institute of Australia. It will be held in conjunction with a major trade show and members of ESA are invited to support this kindred organisation.)
6 & 7 April  
Third Annual Hospital & Health Facilities Conference  
The Avillion Hotel, Sydney  
Tel: 02 8235 5300  Fax: 02 9290 3844  
Email: registration@informa.com.au  
Mail: IBC Conferences  
GPO Box 2728  
Sydney, NSW 2000

23 - 26 May  
The International Society of Occupational Ergonomics and Safety 15th Annual Conference, Portland, Oregon.  
Web: http://isoes.org

19 - 22 July  
Web: http://www.asb-biomech.org

23 - 28 July  
Stockholm, XXVII International Congress of Psychology  
Web: http://www.icp2000.se

30 July - 4 August IEA 2000  
2000 in San Diego, California, USA.  
Contact IEA/HFES 2000, HFES, PO Box 1369, Santa Monica, CA 90406-1369, USA; E-E-mail: HFES@compuserve.com  
Web: http://iea2000.hfes.org

22 - 25 August  
Asia Pacific Conference of Computer Human Interaction,  
South East Asian Ergonomics Society Conference,  
Singapore. E-mail: myklim@ntu.edu.sg

27 August - 1 September 26th  
ICOH International Conference, Singapore.  
Contact Secretariat ICOH2000  
c/o Dept of Community Occupational and Family Medicine. Faculty of Medicine MD3, Lower Kent Ridge Road, Singapore 119260.

9 - 11 October, ESA 2000 Conference, Adelaide  
Ergonomics for life: At work, home, and leisure  
Hilton International Hotel, Adelaide, South Australia  
Contact: Ergonomics Conference Secretariat  
Conference management PO Box 6129, Halifax Street, Adelaide SA 5000  
Tel: + 61 8 8227 0252  Fax: + 61 8 8227 0251  
E-mail: sapro@camtech.net.au

25 - 27 October  
E-mail: icep@cranfield.ac.uk  
Web: www.cranfield.ac.uk/coa/coa_conf.htm

19 - 25 November  
Injury 2000 Prevention and Management  
National Convention Centre, Canberra  
Tel: 07 3858 5410  Fax: 07 3858 5510  
Email: injury2000@im.com.au  
Mail: Injury 2000 Prevention and Management  
PO Box 1280  
MILTON QLD 4064

2001  
8 - 13 July  
2001, XVIIIth Congress of the International Society of Biomechanics  
Zurich, Switzerland  
E-mail: isb2001@biomech.mat.ethz.ch  
Web: www.isb2001.ethz.ch

August 5-10  
New Orleans HCI International 2001 9th International Conference of Human-Computer Interaction.  
Web: http://hcii2001.engr.wisc.edu

2002  
August 3 - 8, 4th World Congress on Biomechanics,  
University of Calgary Canada.

9 - 11 October  
ESA 2000 Conference, Adelaide  
2 pages are inserted in centre of “EA” Journal
Information for Contributors

Editor: Dr Shirleyann M Gibbs
Gibbs + Associates Pty Ltd
25 Melaleuca Drive St Ives NSW 2075 Australia
Tel: + 612 9983 9855 Fax: + 612 9402 5295
E-mail: shanng@gibbsplus.com.au

The deadline for each issue is 15th of the previous month etc ... the deadline for April issue is March 15.

Contribution

Contributions to Ergonomics Australia are always welcomed and encouraged.

The activities, achievements, experiences, views and opinions of Members are always of interest. These can be in the form of letters, notices, notes, commentaries and articles.

Graphics (photos, illustrations, drawings, computer graphics etc) are particularly welcome and should be camera ready. Photos need not be black and white and negatives are not required.

The preferred form of submissions is via e-mail, either in the body of a message, or as an attachment. Files may also be mailed on floppy, (or Zip disc if very large). Microsoft Word or Corel WordPerfect are the preferred formats (the new editor cannot transcribe MacIntosh files that are not in IBM type format.) Handwritten submissions will only be excepted in exceptional circumstances.

Any inquiries about contributions should be directed in the first instance to the Editor.

Information for Advertisers

Inquiries

All advertising inquiries should be directed to the Federal Office of the Society.

Contact: Ms Christine Stone
T: 02 6242 1951 Fax: 02 6241 2554
E-mail: esa@interact.net.au
9am-1pm Monday to Thursday and 9am-12 noon on Friday

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The finished page size of the Newsletter is B5 (270mm x 176mm)

Printed column sizes are 210mm x 152mm (double) or 21mm x 72mm (single)

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Mr Goro Jankulovski, Acute Image Pty Ltd
Tel: 03 9381 9696 Mobile: 0414 605 414
E-mail: goro@percept.com.au

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Enclosure not requiring folding $375
Enclosure requiring folding $420
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