



Centre for Human Factors Engineering

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Nature & Motivation of Human Factors Engineering

Human Factors Engineering deals with the design of systems and products that people use at work, in daily life and leisure. Human factors design typically involves examining the total system, comprising an account of how users interact with the device(s) to perform their tasks on a workstation under a specific environment. Its objective is to ensure human-centered design, such that systems, jobs, products, user interfaces and environments, are designed to complement the physical and mental abilities of users, and also accommodate their limitations.

Human-centered design begins with an understanding of users' characteristics and the tasks they are expected to perform. Functional support features and user interfaces are then designed to ensure safe and effective operation, so as to maximise the productivity of the overall system. Human-centered design ensures products and systems that are functionally appropriate and user friendly, and thus well accepted by their users.

In the case of automation, Human Factors Engineering contributes to the specification of an optimal allocation of functions between the machine(s) and human(s). The more hi-tech and complex a device or system is, the more crucial Human Factors Engineering contributions would be. In this respect, an inadequate account of human factors might lead to system rejection, incomplete realisation of system potential, high incidence of human error, or worse, total failure of the system.



Effects on Human Performance on Transitions Between Night Vision Goggles & Cockpit Displays

Human Factors Engineering is now a well established subject worldwide. It has been recognised by all the major multi-national corporations (MNCs), as a key discipline for ensuring successful product design and system development.

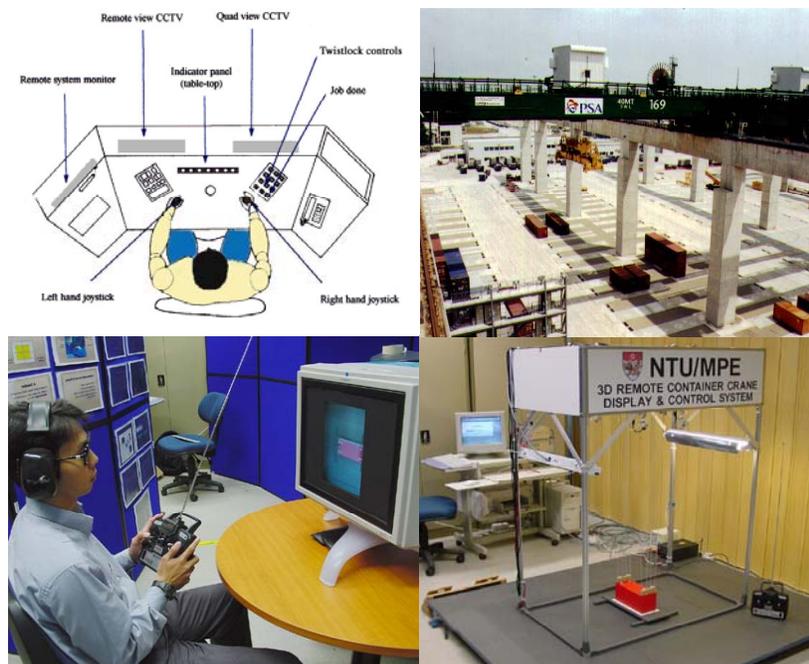
The Centre for Human Factors Engineering (CHFE)

The Centre for Human Factors Engineering has been set up to advance the following objectives:

- *To lead in the development of world-class degree level education and R&D programmes, so as to advance cutting edge human factors engineering knowledge and expertise in Singapore.*

Singapore, being a commercial and IT hub, has been very successful in attracting to our shores, world-class industrial partners and investors to set up R&D and business operations. In particular, MNCs such as Hewlett Packard, Honeywell, Nokia, and Philips, have been increasing their product design activities here. To support these exciting developments in innovative product design, a pool of human factors engineers is required. Unfortunately, such human capital (formally trained human factors engineers) is scarce in Singapore. To counter the shortfall, the Centre for Human Factors Engineering aims to develop and provide in-house training courses for professionals working in industry, and formal degree programmes for specialist knowledge in the discipline.

The Centre for Human Factors Engineering aims to work closely with commercial organisations, statutory boards & ministries, to undertake leading edge R&D collaboration programmes targeted at the development of state-of-the-art products and systems.



Development of a 3D Display System to Enhance Operator Performance of Remote Container Handling

- *To serve as a resource and competence centre for industry to tap into expert human factors engineering knowledge.*

The Centre for Human Factors Engineering aims to support Singapore industry in improving the design and effectiveness of user interfaces, workstations, work processes, and work environment. It aims to address the needs of a multi-structural, multi-cultural, highly mobile and ageing consumer and working population - trends that are not only visible in Singapore but worldwide. These issues must be considered as in an intensely competitive global market, the clarion call is to "think global and act local".

The Centre for Human Factors Engineering serves as a repository of information and a resource centre, with consultancy expertise and laboratory facilities that may be drawn upon to advance Singapore's capability to compete in the knowledge economy, and in the design and development of innovative services, products and systems.



A Variable Back Profile Chair

Laboratory Facilities

Facilities presently available include an extensive usability laboratory for user requirements definition activities (such as focus groups and studies of team dynamics) and for evaluating the effectiveness of simulations, prototypes and final designs of systems, hardware and software products. The usability laboratory comprises a one-way observation mirror with sophisticated video-recording equipment and software for event and behavioural data analysis. The Centre for Human Factors Engineering is equipped with a Peak Motus motion system that can track eye and body movements in 3D space. The Centre also has human modeling software for quick simulation and analysis human-workspace/workstation interaction. The Center shares facilities with the Design Research Centre, which houses advanced rapid prototyping systems and a well equipped virtual reality cluster. The Centre for Human Factors Engineering is thus positioned well to address the entire spectrum of design concerns, extending highly desirable art-to-part capabilities to encompass ideation/concept definition, art/virtual design/computer aided design/simulation, and finally the production of a first physical prototype.



EMG & Goniometer Studies for Flexible Assembly Workstations

Research & Development Activities & Areas of Interest

Topics include human factors, ergonomics, HCI, user interface design, VR, CSCW, mobile computing and infocomm devices, teamwork, safety engineering, vision, product design, affective design, cross cultural design, usability engineering, system analysis, occupational health and safety, work systems, rehabilitation engineering, industrial and environmental ergonomics, human error, task analysis, workstation and workspace design and evaluation, process control, office ergonomics. Application areas are wide-ranging covering industrial systems, consumer products and military systems.

Ongoing and Completed R&D Projects

Professor Martin Helander

- A Framework for Evaluating Adapted Passenger Cars for Drivers with Physical Disabilities.
- Human Engineering of Sensor Fusion Systems in Fighter Aircraft.

Associate Professor Lim Kee Yong

- Development and Integration of a Structured Human Factors Method with the Jackson Systems Development Method.
- The MUSE Method for Usability Engineering.
- Development of a Structured Task Analysis (STA) Method to Support User Interface Design.
- Towards a Taxonomy of Domestic Tasks for IT Applications Development.
- Application of a Human Factors Structured Analysis and Design Method in the Development of Recording and Access Technology for Meetings.
- Facilitating Active Learning in Small Groups: Tutorial Strategies and Assessment Methods.
- Tutoring E304 Computer Engineering: A Paradigm Shift.
- Design and Demonstration of a Digital Tour Guide System.
- Development of Compensation Schemes for GPS Satellite Signal Loss for a Digital Tour Guide System.
- Development of an Interactive User Interface Design Tutor for Public Information Systems Development.
- A Human Factors Study of the Pervasiveness and Effectiveness of Computer Command Keys.
- An Investigation of the Potential Application of Virtual Reality Technology in E-Commerce.
- Development of a Prototype Digital Tour Companion for the Zoo.
- Development and Evaluation of a Stereoscopic 3D Display System for Remote Freight Handling.
- Human Factors Investigation of Luminance Effects on Visual Performance Due to Viewing Transitions Between NVG and Cockpit Displays.
- E-Commerce: Facilitating Business to Customer Mass Customisation of Products Via the Internet.
- Development and Test of a Proprietary User Interface for Text Mining.

- An Investigation of the Interaction Between Visual Convergence and Accommodation During NVG Focal Adjustment.
- Design and Development of a 360-Degree Omni-View Periscope for Various Military Applications.
- Development of a Metaphor Based E-Learning Application for National Education.
- Development of an Infra-Red Thermographic System for Thermo-Profiling User-Product Comfort.
- Characterising the Nature of Affective Design of Consumer Products.
- Human Factors and Socio-Technical Considerations in Ensuring User Acceptance of E-Commerce Applications.

Associate Professor Samuel Lim Yoke Eng

- Intelligent Virtual Rehabilitation System for the Elderly with Memory Deficit.
- Knowledge-Based System for Optimization of Workplace Design.
- 2D Development of Virtual Indoor Environment for Rehabilitation.
- Constrained Display Devices.
- Smart Home Emergency Response Systems.
- Network Printer Applications in Collaborative Work.

Assistant Professor Chui Yoon Ping

- Development and Evaluation of a Stereoscopic 3D Display System for Remote Freight Handling.
- Human Factors Investigation of Luminance Effects on Visual Performance Due to Viewing Transitions Between NVG and Cockpit Displays.
- Community Human Factors Participation and Practice.
- Color Printing Applications in Collaborative Work in Office Settings.
- Decision Making Process of a Civil Airline Commander.
- Anthropometric Survey of Pre-Enlistees and Male Population of the Singapore Armed Forces.
- Development of a Biomechanical Model Based Virtual Simulation System for Analysis of Cervical Injury in High G Aircraft Environments.
- Determination of Inertial Properties of the Head Neck/Head Gear Complex.
- Characterisation of the Structural and Kinematic Properties of the Cervical Spine.
- Characterisation of the Effects of Myopia on Shooting Performance.
- An Evaluation of the Impact of Asynchronous Verbalization as a Support Process for Virtual Cooperative Design.
- Development of a Motion Sickness Platform Using VR Technology.
- Assessment of Team Situation Awareness in a Multi-Crew Simulated Combat Platform.

Funding Secured by Research Group Members

Professor Martin Helander

- National Aviation Research Organization (NFFP). ISAC - Situation Awareness in the Cockpit. SEK 3,000,000 (U.S. \$ 350,000)
- Swedish Board for Strategic Research. Support for Graduate School of Human-Machine Interaction. 1997-1999. About SEK 2,000,000 per year. (U.S. \$ 250,000 per year).

Associate Professor Lim Kee Yong

- Ministry of Defence, UK (1988 to 1991): UK£300,000 RARDE - Development and Integration of a Structured Human Factors Method with the Jackson System Development Method
- Ministry of Defence, UK (1991 to 1992): UK£120,000 RARDE - Wavell OPEVAL: Extension and Test of an Integrated Structured Human Factors Method with the Jackson System Development Method
- National Computer Board, Singapore (1994): S\$50,000 Development of an Interactive User Interface Design Tutor for Public Information Systems Development
- Nanyang Technological University, Singapore (1996 to 1999): S\$185,000 - Research Programme on Smart Product Design
- Nanyang Technological University, Singapore (1997 to 1998): S\$160,000 - Development of a Usability Laboratory
- Ministry of Defence, Singapore (2000 to 2001): S\$30,000 - Human Factors Investigation of Luminance Effects on Visual Performance Due to Viewing Transitions Between NVG and Cockpit Displays
- Nanyang Technological University, Singapore (2000-2001): S\$20,000 - Development of a 3D Stereoscopic Display System for Remote Container Landing
- US Air Force, AOARD (2001): S\$53,000 - An Investigation of the Interaction Between Visual Convergence and Accommodation During NVG Focal Adjustment

Associate Professor Samuel Lim Yoke Eng

- AcRF (1991): \$58,400 - Biomechanics and Ergonomics of Wheeled Mobility System for the Singapore Disabled Population
- AcRF (1998 to 2002): \$131,060 - Intelligent Design and Visual Simulation of Human-Product Interactions in a Virtual Environment

Assistant Professor Chui Yoon Ping

- Ministry of Defence (1996): \$70,950 - Anthropometric Survey of Pre-Enlistees and Male Population of the Singapore Armed Forces
- Ministry of Defence (1997): \$99,000 - Determination of Inertial Properties of the Head Neck/Head Gear Complex

- Ministry of Defence (1997): \$77,000 - Characterisation of the Structural and Kinematic Properties of the Cervical Spine
- Ministry of Defence (1998): \$98,000 - Development of a Biomechanical Model Based Virtual Simulation System for Analysis of Cervical Injury in High G Aircraft Environments
- Ministry of Defence (1998): \$15,000 - Characterisation of the Effects of Myopia on Shooting Performance
- Nanyang Technological University, Singapore (2000): S\$13,500 An Evaluation of the Impact of Asynchronous Verbalization as a Support Process for Virtual Cooperative Design
- Ministry of Defence (Pending): \$466,000 - Assessment of Team Situation Awareness in a Multi-Crew Simulated Combat Platform

Editorial and Professional Activities of Research Group Members

Professor Martin Helander

- Past President, International Ergonomics Association.
- Editor-in-Chief, IEA Journal of Ergonomics Research, IEA Press, 1998-2001
- Associate Editor: International Encyclopedia of Ergonomics and Human Factors, Taylor and Francis, 1997-2000.
- Editorial Board: International Journal of Cognitive Ergonomics, Lawrence Erlbaum
- Editorial Board: Applied Ergonomics, Elsevier Science.
- Editorial Board: Human Factors and Ergonomics in Manufacturing, Wiley.
- Editorial Board: Human Factors in Transportation, Lawrence Erlbaum.
- Editorial Board: The International Journal of Cognition, Technology & Work, Springer-Verlag.
- Editorial Board: Theoretical Issues in Ergonomics Science, Taylor and Francis.
- Editorial Board: Universal Access to the Information Society, Springer-Verlag.
- Editorial Board: Handbook of Forensic Human Factors and Ergonomics, Taylor and Francis.

Associate Professor Lim Kee Yong

- Chairman, Ergonomics Society of Singapore
- Founding and Steering Committee Member, Asia Pacific CHI SIG
- Immediate Past President, South East Asian Ergonomics Society
- Singapore Representative to IFIP TC13 on HCI
- Honorary Research Fellow, Ergonomics & HCI Unit/UCLIC, University College London, UK
- Fellow of Ergonomics Society, UK
- Council Member, International Ergonomics Association

- Member, Technical Committee for Personal Safety and Ergonomics, General Engineering and Safety Standards Committee, SPRING
- Primary Author: The MUSE Method of Usability Engineering, Cambridge University Press, UK, October 1994.
- Chief Editor: Proceedings of First Asia Pacific Conference on Computer Human Interaction (APCHI'96), Singapore.
- Chief Editor: Proceedings of the Joint ASEAN Ergonomics and Asia Pacific Conference on Computer Human Interaction 2000, Singapore, Elsevier Science.
- Editor, The Human Factor, Newsletter of the Ergonomics Society of Singapore.
- Editor, The Human Factor (SEA), Newsletter of the South East Asian Ergonomics Society.
- Editorial Board: Asian Journal of Ergonomics, Pan Pacific Council on Occupational Ergonomics.
- Editorial Board: INHENYERIYA International Journal of Engineering, College of Engineering, De La Salle University, The Philippines.
- Editorial Board: International Journal of Human Ergology, Centre for Academic Publications, Japan.
- International Scientific Advisory Panel: International Encyclopedia of Ergonomics and Human Factors, Taylor and Francis.

Associate Professor Samuel Lim Yoke Eng

- Member, Technical Committee on General Safety (Singapore Productivity and Standards Board)
- Auditor, Ergonomics Society of Singapore

Assistant Professor Chui Yoon Ping

- Vice-Chairperson, Ergonomics Society of Singapore
- Adjunct Research Scientist, Defence Medical Research Institute, Singapore.

Publications (1999 Onwards)

Professor Martin Helander

- Dahlbäck, G.O., Helander, M.G. and Rehn, T. (1999). User Centred Design Process for Optimizing Large Defence Systems. Proceedings of QERGO, International Conference on TQM and Human Factors. 322-330. Linköping, Sweden: Linköping University.
- Helander, M.G. (1999). A Model of the Customer in Electronic Commerce. Proceedings of the 9th Conference of the New Zealand Ergonomics Society. p 40-43. New Zealand Ergonomics Society: Palmerston North, New Zealand.

- Helander, M and Du, X. (1999). From Kahneman to Kano: A Comparison of Models to Predict Customer Needs. Proceedings of QERGO, International Conference on TQM and Human Factors. 315-321. Linköping, Sweden: Linköping University.
- Helander, M.G. and Khalid, H.M. (1999). Modelling Customer Needs in Web-based Do-it-Yourself Design. In: Abesekwera, J., Lonnroth, E-R, Piamonte, D.P.T. and Shanavaz, H. (Eds.), Proceedings of the 10th Year Anniversary Ergonomics Conference. p. 9-13. Lulea University of Technology, Sweden.
- Helander, M.G. and Willén, B.Å. (1999). Design for Human Assembly (DHA). In: Karwowski, W, and Marras, W. (eds.) The Occupational Ergonomics Handbook. p.1849-1865. Boca Raton, FL: CRC Press, Inc.
- Helander, M.G. (2000). Seven Reasons for Not Implementing Ergonomics. International Journal of Industrial Ergonomics, 25, 97-101.
- Helander, M.G. (2000). Theories and Models of Electronic Commerce. Proceedings of the XIVth Triennial Congress of the International Ergonomics Association and the 44th Annual Meeting of the Human Factors and Ergonomics Society. p. 2-770 to 2-773. Santa Monica, CA: Human Factors and Ergonomics Society.
- Helander, M.G. (2000). Anthropometric Design of Workstations. In Tate, D. (Ed.). Proceedings of First International Conference on Axiomatic Design. pp 130 -139. Cambridge, MA: Institute for Axiomatic Design.
- Helander, M.G. and Skinnars, Ö. (2000). Use of Cognitive Walkthrough for Evaluation of Cockpit Design. . Proceedings of the XIVth Triennial Congress of the International Ergonomics Association and the 44th Annual Meeting of the Human Factors and Ergonomics Society. p.1-616 to 1-619. Santa Monica, CA: Human Factors and Ergonomics Society.
- Helander, M.G. and Jianxin, J. (2000). e-Product Development (eDP) for Mass Customization. Proceedings of IEEE CMIT conference. Singapore.
- Helander, M.G., Little, S. E. and Drury, C.G. (2000). Sensitivity and Adaptivity to Postural Change in Sitting. Human Factors, 43, 617-629.
- Helander, M.G. and Khalid, M.H. (2000). Modeling the Customer in Electronic Commerce. Applied Ergonomics, 31, 609-919.
- Khalid, M.K. and Helander, M.G. (2000). Issues in the Design and Usability of Virtual Environments. In H.M. Khalid (Ed.) Virtual Reality: Select Issues and Applications, London: ASEAN Academic Press, Chapter 4, pp. 43-62.
- Helander, M.G. (2000, in press). Theory and Practice in Design of Electronic Commerce. In: Ward. D., Weikert, C., Hoonhout, J. and Ramaekers, J. (Eds.). Human-System Interaction: Education, Research and Application in the 21st Century. p. 2-22. Maastricht, The Netherlands: Shaker Publishing.
- Drury, C.D., Maheswar, G., Das, A. and Helander, M.(2001). Improving Inspection using Binocular Rivalry. International Journal of Production Research, 39, 2143-2153.
- Helander, M.G. (2001). Design Cognition. In W. Karwowski (Ed.) International Encyclopedia on Ergonomics and Human Factors, p 426-430. London: Taylor & Francis.
- Helander, M.G. (2001). Theories and Methods in Affective Human Factors Design. In: M.J. Smith, G. Salvendy, D. Harris and Koubek, R.J. (Eds.). Usability Evaluation and Interface Design. Volume 1 of the Proceedings of HCI International 2001, 357-

361. Mahwah, N.J.: Lawrence Erlbaum Associates.

- Helander, M.G. and Khalid, H.M. (2001). Interface Design for Mass-Customization in e-Commerce. In: C. Stephanidis (Ed.). Universal Access in HCI: Towards an Information Society for All. Volume 3 of the Proceedings of the HCI International 2001, 73- 77. Mahwah, N.J.: Lawrence Erlbaum Associates.
- Helander, M.G., Khalid, H.M. and Tham, M.P (Eds.) (2001). Proceedings of International Conference on Affective Human Factors Design. London: Asean Academic Press. ISBN 1-9011919-28-5.
- Helander, M.G. and Jiao Jianxin (2001). e-Product Development (ePD) for Mass Customization. Technovation - International Journal of Technical Innovation and Entrepreneurship, in press.
- Khalid, M.K. and Helander, M.G. (2001). Automatic Speech Recognition. In W. Karwowski (Ed.) International Encyclopedia on Ergonomics and Human Factors, p 631-635. London: Taylor & Francis.
- Tham M.P , Foo C.H. and Helander, M.G. (2001) Human Factors Considerations in the Choice of Display Size for Mobile Computing and Communication Devices. Proceedings of the Malaysian Ergonomics Conference 2001. Kuala Lumpur: University of Malaya, CAD-CAM Center.
- Helander, M.G. (2002, in press). Electronic Product Development (ePD) for Mass Customization. Plenary Address. Proceedings of Sixth International WWDU Conference. Berchtesgaden, Germany, May 2002.
- Helander, M.G. (2002, in press). Hedonomics - Affective Human Factors Design. Proceedings of HFES 46th Annual Meeting, Baltimore, Maryland, September, 2002.
- Helander, HM.G. (2002, in press). Theories and Methods on Affective and Pleasure Based Design. Proceedings of XXV International Congress on Applied Psychology, Singapore, 2002.
- Helander, M.G. and Lin, L. (2002, in press). Axiomatic Approach in Ergonomics Design with an Extension of the Information Axiom. Journal of Engineering Design, 13 (4).
- Helander, M.G. and Jiao, J.R. (2002, in press). Coupling in Design of Human Computer Interaction. Implications for Usability. Proceedings of 2nd International Conference on Axiomatic Design, Cambridge, MA: MIT.
- Helander, M.G. (2002, in press). Forget About Ergonomics in Chair Design? Focus on Aesthetics and Comfort! Ergonomics.
- Khalid, H.M. and Helander, M.G. (2002, in press). A Framework for Customer Needs in Product Design. Theoretical Issues in Ergonomics Science.
- Caldenfors, D. and Helander, M.G. (2002). Top Down Reasoning Breeds Creativity in Design Synthesis and Evaluation. Submitted for review.
- Khalid, H,M, and Helander, M.G. (2002). Facilitating Mass Customization in Web-based Do-It-Yourself Product Design, Submitted for review.
- Helander, M.G. and Caldenfors, D. (2003, in press). Creativity Increases Trough Top-Down Design Procedures. Proceedings of HFES 46th Annual Meeting, Baltimore, Maryland, September, 2002.

Associate Professor Lim Kee Yong

- Lim, K.Y. (1999). Human Factors Prospects in the New Millennium: Golden Age or Sunset? Keynote Paper in: Proceedings of the Australian Ergonomics Society 1999 Conference, OzErg'99, Fremantle, Australia.
- Lim, K.Y., Xu, H. and Fok, S.C. (1999). User Centered Design and Prototyping of a Portable Digital Tour Guide System. In: Contemporary Ergonomics, Proceedings of the Ergonomics Society's 1999 Conference, Leicester, UK, Taylor and Francis.
- Lim, K.Y. et al (2000). Proceedings of Fourth Asia Pacific Conference on Computer Human Interaction (APCHI'2000)/ASEAN Ergonomics 2000 Conference, Singapore. Elsevier Science.
- Ng, M.C. and Lim, K.Y. (2000). An Assessment of Various Two-Dimensional Display Designs for a Camera Based Remote Freight Handling System. In Proceedings of the Joint ASEAN Ergonomics and Asia Pacific Conference on Computer Human Interaction 2000, Singapore. Elsevier Science.
- Pang, T. K., Lim, K. Y. and Quek, S. M. (2000). Design and Development of a Stereoscopic Display Rig for a Comparative Assessment of Remote Freight Handling Performance. In Proceedings of the Joint ASEAN Ergonomics and Asia Pacific Conference on Computer Human Interaction 2000, Singapore. Elsevier Science.
- Quek, S.M., Lim, K.Y. and Chui, Y.P. (2000). The Effect of 2- and 3-Dimensional Displays on Remote Crane Control Performance. In: Contemporary Ergonomics, Proceedings of the Ergonomics Society's 2000 Conference, Grantham, UK, Taylor and Francis.
- Quek, S.M., Lim, K.Y., Pang, T.K. and Chui, Y.P. (2000). An Assessment of Container Handling Performance Using 2- and 3-Dimensional Remote Crane Displays. In Proceedings of the Joint ASEAN Ergonomics and Asia Pacific Conference on Computer Human Interaction 2000, Singapore. Elsevier Science.
- Tey, L.K., Lim, K.Y. and Chui, Y.P. (2000). An Investigation of the Effect of Night Vision Goggles on Cockpit Task Performance. In: Contemporary Ergonomics, Proceedings of the Ergonomics Society's 2000 Conference, Grantham, UK, Taylor and Francis.
- Tey, L.K., Lim, K.Y. and Chui, Y.P. (2000). Visual Performance Effects Due to Different Luminance Levels of Cockpit Devices. In: Proceedings of the Asia Pacific Military Medicine Conference, Singapore, 2000.
- Tey, L.K., Lim, K.Y. and Chui, Y. (2000). An Investigation of Luminance Effects on Visual Performance in Military Cockpit Tasks. In Proceedings of the Joint ASEAN Ergonomics and Asia Pacific Conference on Computer Human Interaction 2000, Singapore, Elsevier Science.
- Wong, C.H. and Lim, K.Y. (2000). An Assessment of the Rationale and Effectiveness of Accelerator Keys in Computer Applications. In: Contemporary Ergonomics, Proceedings of the Ergonomics Society's 2000 Conference, Grantham, UK, Taylor and Francis.
- Wong, C.H. and Lim, K.Y. (2000). Development of an Interactive Tutor for Designers of Internet Enabled Public Information Kiosks. In Proceedings of the Joint ASEAN Ergonomics and Asia Pacific Conference on Computer Human Interaction 2000, Singapore. Elsevier Science.

- Xu, H., Lim, K.Y. and Fok, S.C. (2000). Application of Virtual Reality to Enhance User Experience of Electronic Commerce (eCommerce) Transactions. In: Contemporary Ergonomics, Proceedings of the Ergonomics Society's 2000 Conference, Grantham, UK, Taylor and Francis.
- Yeo, E. and Lim, K.Y. (2000). How Well Do Consumer Electronic Products Meet Human Factors Guidelines? The Case of Remote Control Handsets. In Proceedings of the Joint ASEAN Ergonomics and Asia Pacific Conference on Computer Human Interaction 2000, Singapore. Elsevier Science.
- Lim, K.Y. (2001). MUSE*JSD: An Exemplar of Structured Integration of Human Factors and Software Engineering Methods. In W. Karwowski (Ed.) International Encyclopedia on Ergonomics and Human Factors. London: Taylor & Francis.
- Lim, K.Y. (2001). Structured Integration of Human Factors and Software Engineering Methods. In W. Karwowski (Ed.) International Encyclopedia on Ergonomics and Human Factors. London: Taylor & Francis.
- Lim, K.Y. (2001). The MUSE Method for Usability Engineering: Rationale & Overview. In W. Karwowski (Ed.) International Encyclopedia on Ergonomics and Human Factors. London: Taylor & Francis.
- Lim, K.Y. (2001). Human Factors Concerns: New Economy, Old World Problems. Keynote Paper in: Proceedings of the International Ergonomics and Sport Physiology Conference, Manuaba A (ed.), Bali, Indonesia.
- Wong, C.H. and Lim, K.Y. (2001). Developing an Interactive Tutor for Programmers and Designers of IT2000/SingaporeOne Applications. In Proceedings of the Australian Ergonomics Society Conference 2001, Adelaide.
- Tey, L.K., Lim, K.Y. and Chui, Y.P. (2001). An Investigation of Luminance Effects on Military Cockpit Task Performance. In Proceedings of the Australian Ergonomics Society Conference 2001, Adelaide.
- Tey, L.K., Lim, K.Y. and Chui, Y.P. (2001). Human Factors of Night Vision Goggles. In Proceedings of 10th New Zealand Ergonomics Society Conference 2001, Rotorua.
- Lim, K.Y. (2002). Case File of Human Factors Practice: How Well We Do is a Case of Where We Draw the System Envelope for Multi-Disciplinary Design. Keynote Paper to be published in the International/Indonesian Conference on Ergonomics and Sports Physiology, Bali.
- Lim, K.Y. (2002). Limited Usage of Accelerator Keys: An Assessment of Human Factors Concerns Beyond Users' Ability to Recall. Submitted to the Asia Pacific CHI Conference 2002, Beijing, China.
- Lim, K.Y. and Quek, S.M. (2002). Enhancing Operator Performance of Remote Container Landing: An Assessment of a 3D Stereoscopic Control and Display System. Submitted to the Australian HF2002 Conference, Melbourne.
- Chew, K.B. and Lim, K.Y. (2002). Enhancing the Field of View for Remote and/or Enclosed Operators: Design and Development of an Omni-View Periscope System. To be published in the International/Indonesian Conference on Ergonomics and Sports Physiology, Bali.
- Quek, S.M. and Lim, K.Y. (2002). Enhancing Operator Performance of Remote Container Landing: The Development of a 3D Stereoscopic Display System. To be

published in the International/Indonesian Conference on Ergonomics and Sports Physiology, Bali.

- Tey, L.K., Lim, K.Y. and Yeo, C.B. (2002). Human Factors of Night Vision Goggle Deployment in the Cockpit. In Proceedings of the Asia Pacific Military Medicine Conference, Malaysia, 2002.
- Wong, C.H. and Lim, K.Y. (2002). Design and Development of an Interactive Tutor to Support Human Factors User Interface Design Contributions to Internet-Based Applications. To be published in the International/Indonesian Conference on Ergonomics and Sports Physiology, Bali.

Associate Professor Samuel Lim Yoke Eng

- Fok, S.C., Guo, W.H. and Lim, S.Y.E. (1999). Potential of Virtual Reality for Training and Rehabilitation. Human Factors Engineering Technical Session, MINDEF DRD Seminar, Singapore, 1999.
- Lim, S.Y.E. and Teh, S.L. (1999). A Computer-Aided Tool for the Assessment of Thermal Comfort in an Indoor Environment. AIRAH Journal, 1999, Vol.53, No.12, p 32-35.
- Lim, S.Y.E. and Fok, S.C. (1999). Current Development of Intelligent Ergonomic Design System in MPE. Human Factors Engineering Technical Session, MINDEF.
- Guo, W.H., Fok, S.C. and Lim, S.Y.E. (2001). Fuzzy-based Control in a Virtual System for Memory Rehabilitation. 5th World Multi-Conference on Systemics, Cybernetics and Informatics, Orlando, USA, Jul, 2001.DRD Seminar, Singapore, 1999.

Assistant Professor Chui Yoon Ping

- Quek, S.M., Lim, K.Y. and Chui, Y.P. (2000). The Effect of 2- and 3-Dimensional Displays on Remote Crane Control Performance. In: Contemporary Ergonomics, Proceedings of the Ergonomics Society's 2000 Conference, Grantham, UK, Taylor and Francis.
- Quek, S.M., Lim, K.Y., Pang, T.K. and Chui, Y.P. (2000). An Assessment of Container Handling Performance Using 2- and 3-Dimensional Remote Crane Displays. In Proceedings of the Joint ASEAN Ergonomics and Asia Pacific Conference on Computer Human Interaction 2000, Singapore. Elsevier Science.
- Tey, L.K., Lim, K.Y. and Chui, Y.P. (2000). An Investigation of the Effect of Night Vision Goggles on Cockpit Task Performance. In: Contemporary Ergonomics, Proceedings of the Ergonomics Society's 2000 Conference, Grantham, UK, Taylor and Francis.
- Tey, L.K., Lim, K.Y. and Chui, Y.P. (2000). Visual Performance Effects Due to Different Luminance Levels of Cockpit Devices. In: Proceedings of the Asia Pacific Military Medicine Conference, Singapore, 2000.
- Tey, L.K., Lim, K.Y. and Chui, Y.P. (2000). An Investigation of Luminance Effects on Visual Performance in Military Cockpit Tasks. In Proceedings of the Joint

ASEAN Ergonomics and Asia Pacific Conference on Computer Human Interaction 2000, Singapore, Elsevier Science.

- Chui, Y.P. (2001). Teamwork in Complex Systems. Man Machine Interface Workshop organised by Rafale-Dassault Aviation-Defence Medical Research Institute-DSTA, Singapore.
- Tey, L.K., Lim, K.Y. and Chui, Y.P. (2001). An Investigation of Luminance Effects on Military Cockpit Task Performance. In Proceedings of the Australian Ergonomics Society Conference 2001, Adelaide.
- Tey, L.K., Lim, K.Y. and Chui, Y.P. (2001). Human Factors of Night Vision Goggles. In Proceedings of 10th New Zealand Ergonomics Society Conference 2001, Rotorua.

Selected Abstracts

- *Caldenfors, D. and Helander, M.G., Top Down Reasoning Breeds Creativity in Design Synthesis and Evaluation.*

Finke's notion of pre-inventive structure in top-down design was tested using Suh's methodology for axiomatic design. Two groups of experimental subjects designed controls and displays for an "intelligent" automobile. One group was instructed to consider functional requirements and derive the design in a top-down fashion. The other group was also informed about functional requirements, but were not instructed to use any particular design procedure. The first group produced significantly better designs than the second group - they were more creative, more practical and fulfilled design goals better. Top-down reasoning with careful consideration of functional requirements generated better design. Suh's methodology has an extra bonus in that it forces a slow deliberation of design features that seems to enhance creativity in design.

- *Chui, Y.P., Teamwork in Complex Systems.*

The emphasis of human factors research has always been on the physical and cognitive abilities and limitations of people and the impact of these factors on human performance. However, man hardly ever works in isolation. It must not be forgotten that the social environment forms as much the work envelope for an individual as the physical environment. In recent years, we see more and more of team related research emerging in the human factors literature. It is important to remember that automation effects operating at the individual level may become compounded when distributed across teams. Likewise if we can hack what makes a person work efficiently, we can improve that person's performance. But if we can twig a team of people to work more effectively, we can harvest the synergy that is manifested from that teamwork. Teamwork lies in the crux of all military engagements. With the diminishing manpower faced by the Singapore Armed Forces (SAF), which will only exacerbate in the future, exploiting the synergy of team performance is the logical step. The presentation provides an overview of the underlying mechanisms of teamwork, and present some case examples of accidents caused by team related factors (e.g. crew coordination, communication failure). The presentation also

highlights important research issues on teamwork in complex system that must be addressed in order to ensure a formidable fighting workforce for the SAF.

- *Helander, M.G. and Lin, L., Axiomatic Design in Ergonomics and an Extension of the Information Axiom.*

Axiomatic Design as a design principle has been increasingly used in product and system development. This paper introduces Axiomatic Design as a foundation to ergonomic design. Three examples demonstrate how Axiomatic Design can be used for biomechanics design of hand tools and for anthropometric design of workplaces. *The Independence Axiom* was used to demonstrate how design activity can be structured to avoid time consuming iterative improvements of design solutions: a decoupled design can indicate the ideal design sequence. For one case study it was demonstrated that the number of design iterations would be reduced if the Task or Environment would first be designed followed by the Operator's workstation and the Machine. *The Information Axiom* was used for anthropometric design of a work place. Direct application of the Information Axiom is not appropriate for ergonomic design. A new way of calculating the information contents in anthropometric design is suggested. This involves a re-definition of the concepts of system range and design range, and results in a new formulation for calculation of information content. Through these design examples the application of Axiomatic Design in ergonomics seems promising.

- *Helander, M.G. and Khalid, H.M., Modeling the Customer in Electronic Commerce.*

E-commerce is important to human factors because of its economic impact and because ease-of use is crucial to the success. A systems model is used to illustrate the information flow between three subsystems in e-commerce: Store Environment, Customer, and Web Technology. In the process of purchase, a customer makes several decisions: to enter the store, to navigate, to purchase, and to pay. For a successful conclusion of a purchase, customer decisions must be supported with information that is available in the Store Environment. This artificial environment must be designed so that it can support customer decision-making. At the same time it must be pleasing and fun and create a task with natural flow. Customers have different Needs, Competence and Motivation, which affect decision-making. It may therefore be important to customize the design of the e-store environment. The paper summarizes existing research. Future research will have to investigate perceptual aspects, such as presentation of merchandise, cognitive issues such as product search and navigation, and decision making while considering economic parameters.

- *Helander, M.G., Little, S.E. and Drury, C.G., Adaptation and Sensitivity to Postural Change in Sitting.*

Three psychophysics methods were used to determine perceptible changes in seat height, seat pan angle and backrest angle using an experimental chair. In Method of Adjustment the chosen chair settings were affected by the initial setting. For example a high initial setting of the seat height led to a high selected setting and a low setting led to a low value. The difference between settings was referred to as "Not Noticeable Difference" (NNDs). Method of Limits was used to determine acceptable chair settings using verbal limits such as "too high" and "too low". Using

the Method of Constant Stimuli “Just Noticeable Differences” (JNDs) were determined for chair height (1.5 cm), seat pan angle (1.2 deg.) and backrest angle (1.7 deg.). The corresponding values for NNDs and Verbal Limits were about twice as large: chair height (2.5 cm), seat pan angle (4 degrees) and backrest angle (3 degrees). NNDs and verbal limits are unobtrusive measures. They are considered more valid than JNDs, which exaggerate the need for adjustability. The results have implications for design of office chairs.

- *Helander, M.G., Forget about Ergonomics in Chair Design? Focus on Aesthetics and Comfort!*

Chair users have difficulties distinguishing between chairs of different ergonomics quality. Many ergonomics features that are supposed to relieve discomfort in sitting are indistinguishable because they cannot be perceived. This is due to poor proprioceptive feedback from ligaments, joints and the spine. The joints are relatively insensitive to small changes in angle. The spine cannot sense differences in pressure due to different body postures. Esthetics features on the other hand, and features related to comfort and relaxation, are easier to perceive and differentiate. A study of ergonomics chairs verified that users could distinguish between parameters that relate to esthetics and comfort, but had difficulty in distinguishing between ergonomics features. In the end esthetics may be more important than ergonomics – at least to the customer who will be guided more by aesthetics than longer-term ergonomic factors.

- *Lim, K.Y., Human Factors Prospects in the New Millennium: Golden Age or Sunset?*

To answer the provocative question posed by the title, the paper presents a number of real case-studies from which a number of assertions may be drawn. First, it is proposed that human factors should enhance the effectiveness of its contributions further, by meeting certain requirements in its practice. The requirements are set out in the paper. Second, it is then argued that if the latter requirements are met, then the question lies not in the continued relevance of human factors, but whether it would play a key role in the design and development of future product and systems. Finally, it is suggested that the new millennium could hold promise for a ‘golden age’ of human factors design contributions, if researchers and practitioners track recent technological trends in industry and imminent socio-economic developments. In doing so, human factors could then prepare and target better, emergent opportunities and requirements for its contributions. To initiate efforts in this direction, a number of recent case scenarios are reviewed for readers to ponder about their implications for human factors input.

- *Lim, K.Y., Case File of Human Factors Practice: How Well We Do is a Case of Where We Draw the System Envelope for Multi-Disciplinary Design.*

It is indisputably accepted within our community that Human Factors/Ergonomics is a multi-disciplinary subject, with contributions from engineering, psychology, physiology, anthropometry, etc. Yet, paradoxically, human factors/ergonomics practitioners to this day, exhibit a tendency towards specialisation in their own narrow areas of expertise. This tendency would not be surprising if one were to return to the time when our discipline has just emerged through the initiatives of

pioneers with backgrounds in its constituent subjects. However, the situation should be very different today, as ergonomics education and training has emphasized invariably an integrated multi-disciplinary approach. Consequently, the persistence to this day of such a narrow scope of human factors practice, can not be considered a healthy sign in the development of our discipline. To provide a comprehensive and effective design solution, a human factors practitioner must, at all times, adopt a multi-disciplinary design perspective and apply the systems approach. In this way, both physical and psycho-social implications of a specific system or product design may be addressed. To support this assertion, this paper will present a number of real case-studies to illustrate the dangers and pitfalls of adopting a narrow scope of human factors practice.

- *Lim, K.Y., Human Factors Concerns: New Economy, Old World Problems.*
In this talk I will characterise some issues encountered in the New Economy sweeping the globe, led by first by automation and then the IT and internet revolution. Would such momentous developments imply great consequential changes for the knowledge and practice of Ergonomics/Human Factors? The answer is perhaps a big NO and a small yes, since similar old world problems would still manifest themselves in the new economy. I will illustrate and argue for my hypothesis using real case studies so show that old human factors problems will persist in new economy work settings. For the limited changes we need to undertake, I will pose them as challenges. The objective of the talk is to demonstrate to your participants the scenario of human factors practice, as they undertake it now and the future, might not be so overly contrasting.
- *Lim, K.Y. and Quek, S.M., Enhancing Operator Performance of Remote Container Landing: An Assessment of a 3D Stereoscopic Control & Display System.*
A freight company in Singapore has developed and implemented the world's first semi-automated camera-based remote control crane system to pick-up and land freight containers. A centralised computer commands the crane to move a container between locations, while the operator performs the skilled task of vertically landing/picking up the container. However, the 2 dimensional (2D) camera-based system compromises somewhat the depth perception required for the container landing/pick-up task. For instance, the operator may experience difficulty in judging container height relative to the prime mover chassis. Their ability to control container landing/pick up speed and thus, throughput, may be affected. Similarly, container landing impact may be controlled poorly. To address these problems, depth perception needs to be restored. A desk-top virtual reality system comprising a three-dimensional (3D) stereoscopic display, has thus been developed to meet this requirement. Subject tests with a scale model has shown that the 3D stereoscopic display can enhance operator performance of container landing impact ($P < 0.01$). For the small scale test rig, no significance difference in container landing speed is found between the displays as expected. Thus, it may be concluded that a 3D stereoscopic display has shown promise in enhancing operator performance of container landing with apparently no loss in throughput.

- *Lim, K.Y., Xu, H. and Fok, S.C., User Centered Design and Prototyping of a Portable Digital Tour Guide System.*

A portable digital tour guide system was developed to help tourists during their stay in Singapore. The system provides tourists with general information and news/current affairs about Singapore; and advises them of their present location, the places of interest, and the routes to get there. The aim of the system is thus to make sightseeing easier and to help tourists get the most out of their stay in Singapore. It is envisaged that the device to be developed would eventually include a Global Positioning System (GPS) and a Geographical Information System (GIS). To ensure a user-friendly product, the system was designed using a user-centered approach. This paper reports the findings of a survey and how they were used to establish user requirements and to define the conceptual design of a portable digital tour guide system. The results of the survey indicated that although the overall interests of tourists may be broadly similar, the priority and emphases placed by them on specific needs and interests can vary across the sub-categories defined. In particular, the ranking of interest in specific places of attraction and the extent of expressed interests in these places may differ across tourist categories. It is therefore important that the system to be developed should include sets of functions that accommodate specific needs of each category of tourists. This paper suggests how a set of functions and itineraries may be derived for different groups of tourists using a systematic approach involving basic statistical analysis. Functional support provided by the portable digital tour guide system such as itinerary planning, strategies for database search and problem solving, and dialogue messages, was defined according to user models associated with particular tourist categories. An interactive multimedia prototype design was then specified, followed by expert reviews and usability testing. The expert and user feedback elicited was used to identify necessary enhancements between design iterations. In this way, an effective end user friendly design of the final system could be better ensured.

- *Lim S.Y.E. and Teh S.L., A Computer-Aided Tool for the Assessment of Thermal Comfort in an Indoor Environment.*

A computer-aided tool has been developed to assist both the expert and novice (i.e. those less knowledgeable) in thermal comfort assessment. The tool was created from a knowledge-based platform (Kappa-PC), with its thermal comfort computation based on the findings of Fanger (1970). In the expert segment of the tool, the users are to provide intimate quantitative inputs of the six governing parameters, namely: metabolic rate, clothing resistance, air velocity, air temperature, mean radiant temperature and relative humidity. The novice are asked to evaluate the situation in simple qualitative terms. These parameters are subsequently processed by the software, to provide the user with an estimated predicted mean vote (PMV) rating. A useful diagnostics tool has also been incorporated in the computer-aided assessment tool to provide the user with the rationales for the PMV rating. It also recommends the appropriate actions or design changes to improve the computed PMV rating.

- Quek, S.M., Lim, K.Y. and Chui, Y.P., The Effect of Two- and Three-Dimensional Displays on Remote Crane Control Performance.*

A local freight company has implemented a camera-based system to pick-up and land containers from a yard onto a prime mover and vice versa. However, a two-dimensional (2-D) camera-based system deprives the operator of the depth perception required for container handling. In particular, the operator may encounter difficulties in judging the speed of container landing, and the distance of the container to the prime mover chassis and to another container. To support depth perception, a three-dimensional (3-D) camera and display system may be developed to enable stereoscopic vision. A mock-up of such a system that includes basic crane controls is being built, to enable an assessment of the efficacy of the proposed 3-D set-up. The assessment will involve performance testing with subjects. The results of the tests will be reported at a later date. This paper reviews the shortcomings of the existing 2-D system and describes the set-up constructed to enable performance tests on the 3-D system proposed.
- Quek S.M., Lim, K.Y., Pang, T.K. and Chui, Y.P., An Assessment of Container Handling Performance Using a Two- and Three-Dimensional Remote Crane Display.*

A local freight company has implemented a 2D camera-based remote crane system to pick-up and land containers from a yard onto a prime mover and vice versa. However, a two-dimensional (2-D) camera-based system deprives the operator of the depth perception required for container handling. In particular, the operator may encounter difficulties in judging the speed of container landing and the distance of the container to the prime mover chassis or to another container. To support depth perception, a three-dimensional (3-D) camera and display system may be developed to enable stereoscopic vision. A mock-up of such a system that includes basic crane controls has been built, to assess the efficacy of the proposed 3-D set-up in terms of performance time, accuracy and force of impact of container positioning and landing. The assessment involves performance testing with subjects. Initial test results show that depth perception supported by the 3-D stereoscopic display setup enhanced performance of container landing, while no significant positioning performance enhancement was observed between 2-D and 3-D displays.
- Tey, L.K., Lim, K.Y. and Chui, Y.P., An Investigation of the Effect of Night Vision Goggles on Cockpit Task Performance.*

Night missions in military operations involving high performance vehicles require an increased dependence on night vision devices such as night vision goggles (NVGs). In this operation scenario, an area of human factors concern is the compatibility between the NVG and horizon display with respect to the capabilities of human vision (<http://www.alhra.af.mil/alhra/efforts/nvd.html>). Landmark work reported by the US Air Force involved subjects looking at an alphanumeric stimulus through an NVG followed by naked eye viewing of a horizon display. This paper reports a follow-up of the work and extends the scope of investigation in several directions; namely the introduction of a more ecologically valid visual stimulus in the NVG

view, a wider survey of the implications of other cockpit display devices, a profiling of elapsed time on viewing performance after transiting between the NVG and cockpit devices, and a study of potential blinding effects in bi-directional transitions between the NVG and cockpit displays.

- *Tey, L.K., Lim, K.Y. and Chui, Y.P., An Investigation of Luminance Effects on Visual Performance in Military Cockpit Tasks.*

As Operation Desert Storm demonstrated, there is an increasing dependence on night vision devices such as night vision goggles (NVGs) in military missions. One human factors concern related to this development, is the compatibility of luminance level between NVGs and cockpit displays such as the horizon display. Landmark work reported by US Air Force involved subjects looking through an NVG at an alphanumeric stimulus followed by naked eye viewing of an analogue ball horizon display. This paper reports a follow-up of previous work by the US Air Force and Rabin and Wiley (1994) and extends the scope of investigation in several directions; namely the introduction of ecologically valid visual stimuli for the NVG view, and a study of potential visual performance degradation when transiting between NVG and cathode ray tube (CRT) horizon display views.

- *Wong, C.N. and Lim, K.Y., Development of an Interactive Tutor for Designers of Internet Enabled Public Information Kiosks.*

This paper investigates the quality of the user interface design of applications targeted at the SingaporeOne (S-One) initiative. These interactive applications are accessed via the internet or specially designed internet enabled kiosks. To this end, an expert walkthrough of the systems was conducted. The walkthrough revealed that the user interface design of many of these applications were rather poor in usability and inadequate in task support functionality. This may be due to the low level of human factors awareness among programmers. As a result of their poor understanding of human factors design guidelines and concepts, the programmers were misled to believe simply that a graphical user interface was all that was needed to ensure usability. To raise the awareness of human factors concerns, an interactive design tutor may be developed to provide programmers with explicit real examples extracted from the expert walkthrough conducted earlier. Examples of good user interface design and common inadequacies will be provided as illustrations. In this way, programmers may then be able to understand and apply human factors design principles better. It is hoped that the increased uptake of human factors would translate into the design and development of more effective and usable S-One applications.

- *Wong, C.N. and Lim, K.Y., An Assessment of the Rationale and Effectiveness of Accelerator Keys in Computer Applications.*

This paper examines the provision of accelerator keys in popular computer applications on both PC and Macintosh platforms. A total of fourteen versions of six applications were investigated. The accelerator keys were categorised into specific groups to facilitate user testing. Two tests, namely a questionnaire test to evaluate users' ability to recall and recognise accelerator keys, and a hands-on performance

test, were conducted. The results of the questionnaire tests showed that users were better at recognising accelerator keys than at recalling them. However, their performance for both tests was rather poor. Users recognised and used mainly generic accelerator keys, and appeared reluctant to release the mouse. From the test results, it is recommended that other than generic accelerator keys, the number of accelerator keys provided should be minimised.

- *Xu, H., Lim, K.Y. and Fok, S.C., Application of Virtual Reality to Enhance User Experience of Electronic Commerce (E-Commerce) Transactions.*

One of the main concerns of current electronic commerce systems is how to provide users with crucial information and yet maintain their desirable experience of real world transactions when business activities are conducted online. This paper introduces an analytic model that facilitates the mapping of crucial characteristics of real world transactions onto electronic world transactions. By cross mapping these characteristics, a basis could be established to examine how virtual reality technology could be recruited to enhance users' experience of e-commerce transactions. To advance the model, a cyber shopping case study involving activities associated with the manipulation of virtual products and the optimization of webpage design, are examined.

- *Yeo, E. and Lim, K.Y., How Well Do Consumer Electronic Products Meet Human Factors Guidelines? The Case of Remote Control Handsets.*

This paper reports the results of an expert walkthrough to uncover common human factors inadequacies of more than 30 remote control handsets currently in the market. Predictions of potential problems identified through the walkthrough were later verified via a small scale user survey and interview. Explicit examples of possible design modifications of the remote control handsets extracted from the expert walkthrough, were then proposed to help designers learn about the appropriate application of human factors guidelines.

Future Plans

- Establish strategic R&D collaboration programmes with industry.
- Establish wider R&D collaboration with the international community.
- Expand laboratory capabilities to include remote telemetry instrumentation.
- Organise a fourth international conference in the discipline.
- Wider involvement in design standards.

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