

FRONTLINE



Editorial - Bob Stone

This quarter I resisted the urge to fulfil my DTC contractual commitment early - to write an editorial a month or so before the publication process for the second edition of *Frontline* had started in earnest. Ever hopeful of an HFI-relevant titbit from the Press or a senior defence representative, I scoured the newspapers and listened intently to broadcasts on the radio and TV. Nothing, except for a number of predictable statements referring to the recent 5-month review of the Government's White Paper on Defence. Then, at the 11th hour, when editorial desperation had almost set in, my patience was rewarded. On 21 July, commenting on the Parliamentary speech by the Secretary of State for Defence, an ITV newscaster boldly concluded that, "... today was a war between technology vs. manpower ... and technology won". Gold dust - a quote that we in the HFI community could use in our PowerPoint presentations and conference papers for at least the next 18 months! After that, it just got better and better. An hour or so later and a different broadcaster stated, "... another objective is to free up funds for investment in hi-tech digital systems, such as Network Enabled Capability or "NEC", enabling British forces to work more easily with their American counterparts."



NEC - there's that phrase again. There are those who believe "NEC" to be the saviour of our overstretched and undermanned Armed Forces. Others, including the Defence Committee believe that it may not be a pre-requisite, nor the main contributor to the future of "effects-based operations", defined by the US as:

A process for obtaining a desired strategic outcome or "effect" on the enemy, through the synergistic, multiplicative, and cumulative application of the full range of military and non-military capabilities at the tactical, operational, and strategic levels.

(Source: US Joint Forces Command Glossary; www.jfcom.mil/about/glossary.htm)

Nothing new there, then. So where is this all leading? Well, returning to NEC, we in the UK are often told that it is better to use the phrase "network enabled capability", rather than "network centric warfare (NCW)", as preferred in the US. Depending on who you talk to in the UK defence arena, one of the reasons for this is that the words "...enabled capability" apparently stress a *people-centric* philosophy as opposed to one that focuses on networks and technologies. I wish I could believe that. One of the things we in the HFI DTC are becoming very aware of, especially as we travel around the UK speaking to current and future stakeholders and beneficiaries of our research is that, all too often, "manpower", "personnel", "people" - call the grouping what you will - has effectively been treated as a free commodity in the procurement planning process, with actual educational, training, and operational costs rarely made explicit for fear of advertising a defence system's true cost! This issue was also a common theme in our recent HFI Symposium, reported elsewhere in this edition of *Frontline*.

So what of the future of "manpower", "personnel", "people" and their exposure to the new (-ish) generation of NEC technologies - C4ISTAR, uninhabited vehicles, synthetic environments and so on? Certainly, we should be encouraged by the attention paid to relevant human factors issues - cognition, perception, HCI, team dynamics and psychology - listed in the MoD's introductory pamphlet on Network Enabled Capability, available as a download from the MoD Web Site (http://www.mod.uk/linked_files/issues/nec/NEC%20Pamphlet.pdf). However, translating these good words into adopting sound HFI practice as we in the UK rush to match our US colleagues' apparent technological superiority will require a considerable change in culture across the defence community. ▶

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▶ I recall a parallel situation, albeit on a much smaller scale, faced by myself and colleagues at Manchester's Royal Infirmary back in 1994 whilst conducting early research into the use of simulators for the future training of laparoscopic (keyhole) surgery. We had just been carried away on a wave of false promises (as it turned out) from high-tech Virtual Reality developers and vendors in the USA. We were assured that field-proven, high-fidelity, multi-sensory, networked human body simulators for surgical training were to become available in a matter of months. We were further convinced (I am now ashamed to confess) that, by "immersing" qualified and trainee surgeons alike within these virtual bodies, using sophisticated head-mounted displays, "CAVE" video-wall enclosures, or multi-screen displays, we would be part of a global revolution in enabling technologies for the medical sector. In brief, this revolution simply did not happen. The expensive (6-figure) graphics computers failed to deliver credible or believable anatomical and physiological simulations (in some cases fostering *negative* transfer of training from the synthetic to the real) and, as is still the case today, the human interface technologies were totally inappropriate for the tasks under consideration. Significant money and time was wasted. Yet, a subsequent and very short (3-week) human-centred study of the needs of those at the "sharp end" - the surgeons themselves - demonstrated that what was actually required was *not* a technologically advanced, "wow, that's amazing" system, but a simple, low-cost part-task skills trainer using primitive virtual objects that were symbolically representative of the procedures involved in keyhole surgery. Result? A simulator that eventually became a mandatory training component in the international courses of one of Europe's leading surgical institutes.

If ever there was a time when HFI processes should become a mandatory component of the procurement process in the UK, surely it is now. "Today was a war between technology vs. manpower ... and technology won" ... I do hope not.

Prof. Bob Stone

Special Issue of *Ergonomics* on Command and Control

Receipt of papers deadline 31st December 2004

Command and control environments continue to represent a challenging domain for human factors research. We take a broad view of command and control research, to include C2, C3, and C4 as well as human supervisory control paradigms. This special issue of ERGONOMICS will publish original research into operator or system models, studies of operator or team performance, design or evaluation of novel visualisation, interaction and display technologies, case studies, and theoretical review papers. We are interested to hear about research on any of these topics in domains as diverse as the emergency services (e.g., police, fire, and ambulance), civilian applications (e.g., air traffic control, rail networks, and energy distribution) and military applications (e.g., land, sea and air) of command and control.



Details on the format of papers may be found in the journal or at <http://www.tandf.co.uk/journals/authors/tergauth.asp>

Please email your papers in pdf format to either of the guest editors: Neville.stanton@brunel.ac.uk or C.BABER@bham.ac.uk

Alternatively send four paper copies to either of the addresses below:

Professor Neville A. Stanton
BITlab
School of Engineering and Design
Brunel University
Uxbridge
Middlesex
UB8 3PH
UK

Dr Christopher Baber
School of Electrical and Electronic Engineering
University of Birmingham
Edgbaston
Birmingham
B15 2TT
UK

Planned deadlines for the papers are as follows:

31 December 2004:	Receipt of manuscripts	1 August 2005:	Receipt of second reviews of manuscripts
10 January 2005:	Send manuscripts for review	15 August 2005:	Send manuscripts to authors for corrections
14 March 2005:	Receipt of first reviews of manuscripts	19 September 2005:	Receive revised manuscripts
21 March 2005:	Send manuscripts to authors for corrections	3 October 2005:	Write editorial
23 May 2005:	Receive revised manuscripts	24 October 2005:	Send editorial and manuscripts for Publication
6 June 2005:	Send revised manuscripts out for review		

Report on the Human Performance, Situational Awareness & Automation Technology II conference held in Daytona, Florida (22-25 March 2004)

Report by Prof Neville Stanton, Paul Salmon and Dr Guy Walker, BITlab, Brunel University

This meeting brought together international research scientists from around the world to consider issues relating to human performance, situational awareness and automation. The conference was chaired by Dr. Dennis Vincenzi (Embry-Riddle Aeronautical University) and Dr. Mustapha Mouloua (University of Central Florida). The scientific committee comprised Prof. Jean Bresson, Dr. John Deaton, Dr. Mica Endsley, Prof. Peter Hancock, Dr. David Kaber, Dr. Anthony Majoros, Prof. Regis Mollard, Prof. Raja Parasuraman, Dr. Mark Scerbo, and Dr. John Wise.

The conference keynote address prepared by Prof. Neville Moray on 'Automation in the 21st Century' was presented by Prof. Tom Sheriden in his absence. The talk outlined a number of wider points concerning human performance, automation and specifically Situational Awareness (SA). One of the main arguments was that existing methods for measuring SA are ordinal rather than quantitative. The conclusions centred around future directions, covering the loosely coupled nature of SA theory and how existing data on human performance could help to support increasingly quantitative measurement. Another notable figure at the conference was Prof. Joel Warm, who talked about psycho-physiological correlates of mental workload.

The topic of SA dominated the conference papers. The main themes were design to support SA, measurement of SA, and distributed SA. Very little effort was expended on defining SA or questioning the validity of the concept. Relevant papers to the HFI-DTC included Dr. Kip Smith's paper on 'Initial experiments on leader presence and communication mode on combat performance', Major A. J. Masys paper on 'Situation awareness: An actor network theory perspective,' & Dr. Mark Koltko-Rivera's paper 'The Peacekeeper: how the role of the modern soldier has changed and how that affects workload.'

Paul Salmon presented a paper on the measurement of SA in C4i systems. The paper included a review of existing approaches to the measurement of SA. In summary, the paper recommended that existing approaches are inadequate for the assessment of team or distributed SA, and recommended a multiple measures approach when assessing SA in C4i systems.

Dr. Guy Walker presented a paper on measuring and predicting SA. The paper outlined a novel integration of methods to enable the prediction of SA for aiding in interface design. The paper also followed some of the themes of the conference keynote address in discussing existing approaches to SA measurement in terms of objectivity, quantitative measurement and the loosely coupled concept of SA, as well as presenting some findings in support of these points.

Prof. Neville Stanton presented a session keynote address on the developments of an agent-based theory of systemic situational awareness. The ideas in the paper proposed a move from analysing SA of individuals to a higher-level of analysis that can account for multiple agents (both human and non-human) in dynamic systems. The agent-based approach draws upon systems theory and focuses on the interactions between agents. Propositions for the theory were presented.

All three papers were well received by the audience and the papers gave us the chance to introduce the HFI-DTC to an international audience.

Further information on the conference may be found at www.faculty.erau.edu/hpsaa/



Work Package 3 - Summary

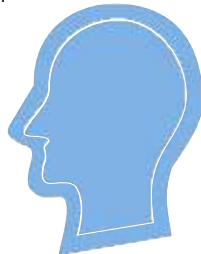
“Can this soldier, with this training, perform these tasks, to these standards, under these conditions?”

This question embodied the US Army's innovative attempt to integrate combat, training and equipment development with the characteristics of personnel during all phases of the system life-cycle. This approach to system acquisition, created in the 1980's was known as MANPRINT (Manpower and Personnel Integration). The approach arose from a growing recognition that traditional human factors methods were becoming inadequate for dealing with the increasing technological complexity of military systems. In addition, modern warfare was changing, increasing in scale, speed and interdependence. A new method of ensuring that human factors were adequately addressed in this emerging context was needed. In the UK, the MoD developed this approach as 'Human Factors Integration' (HFI). HFI is a process for ensuring that human factors issues are considered in terms of their impact on the system throughout its life-cycle by considering them at every stage in the design process. HFI recognises the fact that people are a key component of every major system used in both the military and civil sectors, with the potential for significant impacts on the operational effectiveness of designed systems.

HFI is characterised by its six domains - Manpower, Personnel, Human Factors Engineering, Training, Health Hazards and System Safety. The HFI process provides a framework to systematically consider each domain during acquisition and to identify the best balance of investment and capability across domains.

Within the UK, HFI has not proved entirely successful for a variety of reasons despite being in existence for approximately 20 years. The role of Workpackage 3 within the HFI DTC is to examine the reasons why HFI has not achieved its potential and to bring about changes where they are needed.

The first stage of this work involved trying to understand why the current HFI process isn't being applied, or only applied in some projects to a limited extent. An extensive survey was carried out, drawing on a variety of sources, to reveal these 'barriers' to HFI. This survey involved examining published papers and guidance material in addition to conducting interviews and workshops. Whilst MoD groups involved in procurement, particularly within the Defence Procurement Agency (DPA) were an important stakeholder



group in this respect, great care was taken to elicit the views of those practitioners within industry. The HFI DTC places great emphasis on the need to learn from the experiences of civilian and commercial organisations and, conversely, to make the results of its research available to those organisations outside of the MoD.

The results at this stage found a great number of reasons why HFI isn't being implemented or isn't having the expected results. In brief, the most common of these include the following:

- HFI needs a strong champion or owner within the MoD
- The current HFI guidance is difficult to understand
- Difficulty in scoping the effort needed for HFI at the start of a project
- Difficulty in tailoring the HFI process for different project types, sizes and project roles
- HF requirements need more thought - how to generate, write, get them into the User and System Requirements Documents, track them and maintain adherence in design
- There are no easily determined acceptance criteria for HF requirements
- There is often a failure to integrate HFI within the wider project
- Better training for HFI is needed
- There is no common understanding of what makes a good HFI practitioner - HFI competencies are required

In the next 18 months, the HFI DTC will be implementing a series of measures to address these problems. In the meantime, work has already commenced to provide knowledge, guidance, tools and techniques to improve the HFI process. These include the following:

Development of a Human Factors Impact Tracking Tool (HFITT) to provide a fast and effective means of scoping the HFI effort required at the start of a project, particularly where new and emergent technologies are being introduced. HFITT provides an early scoping of effort, costs and the timescales over which activities need to be conducted.

Development of a prototype HFI Desk-Top Support tool to perform the following functions:

- Provide the central facility to support HFI
- Incorporate everything required to manage HFI in one place - guidance, methods, tools, databases and templates
- Provide tailored guidance and support by project role and programme phase
- Act as the central core that links to other HFI DTC software tools e.g. the methods guidance software tool and HTA and CTA Task Analysis tools being developed elsewhere in the HFI DTC

Although very much in its infancy at the moment, an initial version of the HFI Desktop Support Tool will shortly be available on the HFI DTC website - www.hfidtc.com

Spreading the Word -

Work Package 4 and DTC Awareness

In contrast to the other Defence Technology Centres currently in operation, the HFI DTC is somewhat unique in that from the outset we have had a work package dedicated to raising awareness and disseminating information to an audience comprising end users, stakeholders and practitioners alike. The HFI dissemination activities have been aimed not only at the UK defence community, but also on the international stage, via participation in NATO, Western European Armaments Group (WEAG) and The Technical Cooperation Panel (TTCP) groups and specific events. Of course, promoting the goals and benefits of HFI within defence is central to what the HFI DTC is trying to achieve, but we are also trying to make sure that we seize any opportunities for the "spin-in" and "spin-out" of knowledge from and to relevant human-centred activities in appropriate civil domains as well.

The reason for setting up an explicit programme of information dissemination was made very clear in our original proposal to the MoD. Our HFI consortium was very keen to avoid the situation currently evident in a number of technology-focused endeavours, such as that provided by the Virtual Reality community. One of the main criticisms levelled at the so-called "VR Centres of Excellence", be they any of the numerous academic visualisation centres that have become evident over the past 5 years or so, together with other large, not-for-profit institutions, is that they have produced little of practical use to service the needs of a rapidly-expanding industrial user base. It is a fact that an enormous amount of R&D funding has been allocated by national and international bodies, with the original aim of producing technologies and processes suitably tailored for use by companies large and small. Whilst many academic papers have been generated as a result of the R&D programmes, they have consistently failed to package and disseminate any end-user relevant results in an appropriate form. The same is true, to a somewhat lesser extent, of the defence community. For many years now, commercial and government-sponsored defence organisations with a human factors capability have been producing copious amounts of human performance data, focused guidelines, test bed results, new technology reviews, and so on. However, a good proportion of the documents charting these activities have been committed to the archives of the organisations concerned, with many (if not most) failing to be read by the internal groups they were originally targeting, let alone the wider defence community.

So what are we doing to make sure the "word" is spread? In fact the activities contained within Work Package 4 are too numerous to describe in detail here and range from MoD

and industry workshops, conference keynotes, lecture series and the coordination of special journal editions by our academic partners, to the staging of this year's HFI Symposium (reported elsewhere in the newsletter) and next year's HFI DTC mini-conference (more on that in the next edition). It will also come as no surprise that this *Frontline* newsletter is a contractual deliverable of Work Package 4. Already, members of the DTC have presented overview and work programme-specific papers at such functions as HCI 2003 (Crete), I/ITSEC 2003 (Orlando), IMAGE 2003/2004 (Phoenix), the TTCP HUM-TP9 HIS Workshop 2004 (Ottawa) and many more. In addition the team spends a considerable time "on the road", presenting to key stakeholders within the MoD and throughout the industrial and academic defence community.

In addition to these activities, we have also been working closely with our DSTL colleagues to set up what is known as a Process Improvement Cell (PIC) within the confines of the DPA at Abbey Wood. The overall aim of the PIC is to elicit relevant information and contacts from within this part of the MoD, thus helping to strengthen the future case for HFI. Also under development by the PIC team (led by Mike Goom of MBDA and Pam Newman of SEA see *Meef The Team*) is a desktop software tool to provide practical guidance to users in conducting HFI in the defence equipment procurement cycle. Another aim of the PIC is to help examine the barriers to adoption of HFI principles throughout the IPT community (and within the MoD generally) and to address how these problems can be overcome in future projects.



Setting up the PIC was by no means a trivial task, requiring considerable negotiation on the part of the Consortium and key representatives from DSTL. However, at the time of writing, the PIC has been in place for just around 9 months and, during that time, DTC personnel have been afforded opportunities to brief IPTs and other interested parties. The PIC has also provided an invaluable service to the DTC by acting as conduit for general awareness raising and for further information requests on the DTC together with applications from IPTs for attending the 2004 HFI Symposium.

We would strongly encourage *Frontline* readers to make contact with us if they have a requirement to find out more about the work programmes of the DTC, or if they feel that members of their organisations might benefit from being exposed to the principles of HFI. We have the capability to respond rapidly to reasonable requests for information and would be delighted to pass on our knowledge, either via a small group presentation or by short, focused mini-courses. Contact details for Bob Stone and Karen Lane can be found on the back page of this edition.

DTC's First HFI Symposium Judged a Success by Attendees

Over 130 pre-registered participants - some from as far away as Australia - filled the main lecture theatre within the Defence Procurement Agency's (DPA) Abbey Wood complex in North Bristol on 25 May 2004 to receive presentations from a wide range of HFI practitioners and stakeholders. This was the first biannual HFI Symposium to be staged as part of the current HFI DTC contract, taking over responsibility for the event from DSTL, the previous organisers.

With the aim of attracting more HFI stakeholders than before from within the DPA (thus avoiding the problems of "preaching to the converted"), the overarching themes for the day's proceedings were experiences of applying HFI in practice and case study reports. In this respect, as well as members of the UK's human factors community, the organisers were particularly pleased to record an increase in Integrated Project Team (IPT) delegates over previous years (the recorded numbers were 8 attendees from University, 67 from Industry and 59 from MoD).

Chaired by Prof. Bob Stone (HFI DTC and University of Birmingham), the day's proceedings were introduced by Dr Geoff Barrett of DSTL, who, as Technical Authority for the DTC, provided a brief overview of the concepts behind the DTCs generally, the HFI Centre and outlined its role in the research and scientific strategy of the MoD generally. The main proceedings were kicked off by an overview of HFI, delivered by Mike Goom (HFI DTC and MBDA). Widely recognised as one of the UK's HFI pioneers and an active practitioner of the early MANPRINT initiative, Mike's review of the six domains of HFI were illustrated by examples including Multiple Launch Rocket System (MLRS) and some of the more widely-quoted instances of human error, such as the *Herald of Free Enterprise* disaster and the shooting down of an Iranian Airbus by the *USS Vincennes*.

Roy Dymott and Steve Harmer (MBDA and BAE Systems) presented a detailed paper charting their experiences whilst implementing a Synthetic Environment (SE) system for the assessment phase of Indirect Fire Precision Attack (IFPA), a project sponsored by the Deep Target Attack DEC. In particular, their presentation described a series of three early experiments designed to investigate the use of SEs in the examination of decision-making, command and control structures and general concepts of use. Their experimental programme serves to confirm the growing importance of SEs, particularly in the identification and resolution of new HFI issues and in securing the early "buy-in" of project stakeholders and subject matter experts (SMEs).



QinetiQ's Roger Harvey, another recognised HF practitioner, provided a unique insight into one of the age-old issues surrounding the adoption of HFI within equipment acquisition, namely how to quantify the impact of investing in human-centred endeavours. Reporting on a 2-year study funded in the late 1990s by the Chemical/Biological Defence and Human Sciences domains of the MoD (CRP), Roger described the use of "influence diagrams" to illustrate and, importantly, quantify, the key linkages between HFI

costs and benefits. Two such generic influence diagrams were shown, one for the HFI manpower domain, the other for the personnel domain and Roger went on to describe how, using the Powersim "stock-flow" management software, the linkages in these generic diagrams were applied to an "exemplar" weapon system (LAW) in an attempt to analyse the cost-benefit linkages and to extend the concept to all six HFI domains.



Departing slightly from traditional symposium practice, the first invited keynote of the day was given just before the lunch break. Vice Admiral James Burnell-Nugent CBE, ADC, Second Sea Lord, delivered a rousing "state of the nation" speech, drawing on his years of experience as an RN submarine commander and issuing many challenges to the HFI community, not to mention its sometimes sceptical "adopters". 2SL's overriding message was clear. For far too long now, the manpower component of whole-life defence systems costs have been effectively ignored - humans have been, and continue to be regarded as a free commodity, even though their costs are very real and can - will - add substantially to those typically published in IPT procurement notices. The Vice Admiral also called for reliable, long-life tools, not only for understanding the costs of people but also their overall effect on whole-life processes. He pointed out that some tools do exist, but they're typically not accepted and, therefore, remain unused. "Treat and use people for what they're good at, not as second rate machines", was his parting message.

In order to provide some contrast with HFI perspectives in the UK, the second invited keynote of the day was presented after lunch by Nancy Dolan, Director of Acquisition Programs at the US Navy HSI Office/N12 Acquisition Programs Branch. Ms. Dolan described the HSI work she has been responsible for coordinating within the US Navy, the main thrust of which has attempted to raise the awareness of the human as a warfighter, not as the uppermost (and, thus, delimiting) tier of the traditional mission-requirements-tasks-hardware/software-human triangle, but as the *central* (i.e. "human-centred") tier of that triangle. Ms. Dolan went on to describe an integrated series of US initiatives and programmes, under the generic title of *FORCEnet*, including the Congressionally-mandated *SEAPRINT* (Systems Engineering, Acquisition, Personnel Integration), which bridges the gap between the Sea Warrior initiative (primarily aimed at navy personnel issues) and warfighting capability.

Given the encouraging attendance of IPT representatives, the next presentation by Pam Newman (HFI DTC and SEA) was particularly timely and related to the establishment by the HFI DTC of a Process Improvement Cell (PIC) within the DPA at Abbey Wood. The PIC forms part of the DTC's information dissemination and awareness activities and its presence at Abbey Wood has been kindly sponsored by the Future Business Group. The main aim of the PIC, which was officially launched on 17 November, 2003, is to strengthen the case for adopting HFI throughout the IPT structure. To do this involves the careful handling of information, not just outwards from the DTC's research programmes, but inwards as well. Ms. Newman explained that DTC personnel staffing the PIC are

responsible for eliciting relevant information from procurement personnel within the MoD, the aim of which is to determine what problems exist in the understanding and implementation of HFI within the whole-life procurement process. This information can then be fed back to the DTC and its stakeholders and can be used to analyse and tackle the barriers to HFI adoption, providing relevant courses and material as necessary.

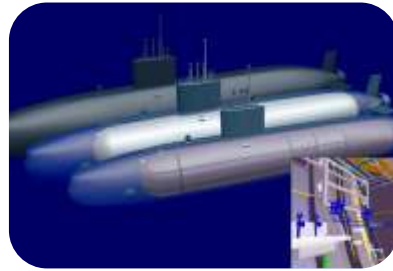
The afternoon's proceedings continued with a review of another 2-year study, this time conducted in the area of HFI planning within the Defence Logistics Organisation (DLO) and DPA IPTs by Jo Davies and her team at ESE Associates in collaboration with QinetiQ. Specifically, Ms. Davies concentrated on training-related HF issues associated with the In-Service segment of the CADMID cycle. Through a process of interviews with appropriate IPT members, appropriate projects were down-selected based on four criteria - *capability area* (strategic deployment, manoeuvre, strike and information superiority), *project size* (above or below £100 million), *time in-service* (pre- and post-mid-life upgrade) and *level of procurement control* ("high" or "low", for example: bespoke vs. COTS, UK-alone vs. international collaboration, etc.). The IPT interviews were based on discussions around a range of technical HF topics, culled from Sea Systems Publication SSP10 (e.g. personnel, training, operability, environment, system safety, etc.) and the results were analysed to highlight the top 3 issues in each topic. In the context of training, the study highlighted particular concerns relating to training facilities, including *trainer representation* (the lack of operational representation and the consequent increase of reliance on on-the-job training),



maintainer training aids (particularly for support staff and the need to train them in the care of equipment) and *trainer utilisation* (with reference to poor utilisation of simulators and the distinct lack of multiple aircrew trainers - unlike the case for the RN).

Charles Kirke, an independent HFI consultant provided an informative and entertaining presentation on a case study for the *Phoenix* Unmanned Air Vehicle (UAV) conducted for QinetiQ. Dr Kirke provided some clear examples of lessons "learned the hard way", from the relatively low costs of applying of HFI at the outset of a project (in contrast to the significant expense incurred if applied during later stages) to the need to design systems for fatigued users, not fresh ones. He also stressed the need to consider a "mix" of genders in future systems design, together with aspects of organisational culture.

Chris Lowe from Human Engineering provided an interesting insight into HFI processes by contrasting a number of case studies from the civil domain with experiences from defence projects. He also gave examples of the attitudes towards the management and organisation of HFI within the defence and civil communities, including the role of standards (London Underground was cited as a good example of taking standards seriously), methodologies and procedures. The day's proceedings concluded with a short overview from Prof. Bob Stone, building on the earlier BAE Systems/MBDA and ESE Associates offerings and discussing the benefits of considering low-cost SE technologies in the HFI process.



As well as expounding the virtues of up-and-coming games engine technologies in future simulations (a subject to be revisited in a future edition of *Frontline*), he introduced some early DTC methodological work designed to help the HFI and

non-HFI practitioner to define appropriate content, fidelity, real-time interactive devices and interaction styles for synthetic environments for part-task training applications.

Since the Symposium, a high-level review of the feedback forms has been undertaken. Over 50 questionnaires were returned to the organisers on the day, with others being delivered during a period of two weeks or so thereafter. The critical and constructive comments catalogued in these forms will prove very useful in planning future events and range from allowing more time for question-and-answer sessions to securing a broader cross-section of tri-service attendees. Overall, 88% rated the Symposium as "average" to "good" and an identical percentage gave "average" to "high" ratings when asked to judge the relevance of the event to their current job or role. One very pleasing statistic was that 100% stated they would attend another HFI Symposium and, whilst the majority of respondents (83%) also felt that an annual HFI Symposium was desirable, the contractual and logistical issues supporting such an event need to be carefully reviewed. With 90% of respondents reporting that they would support an HFI DTC-specific symposium in 2005, the consortium is currently addressing the possibility of "merging" the two events, possibly over a two-day period. The outcome of those deliberations will be reported in the next issue of *Frontline*. As well as the questionnaire-based feedback, the Symposium has generated a number of important follow-on activities, including a more in-depth interaction on HFI and manpower planning with the 2SL's team in Victory Building, Portsmouth, the provision of high-level HFI support to the Lynx IPT and a "return-visit" invitation from the US HSI Office. An invitation to publish in the DLO monthly newsletter has been accepted and requests for briefings to DLO, the Supportability Engineering (ILS) Working Group and Defence Ordnance Safety Group are under consideration.



All mainstream speakers during the day have kindly agreed to make Adobe® Acrobat® copies of their PowerPoint presentations available on the HFI DTC Web Site, and these can be downloaded from the following URL:

http://www.hfidtc.com/public/HFI_DTC_Events.htm.

Prof. Bob Stone
HFI DTC Work Package Leader

Autonomy Rules?

Since the advent of highly capable uninhabited vehicles, notably in the application domains of offshore oil and gas exploration and defence, attention has increasingly focused on the development of technologies necessary to endow robotic platforms with the onboard capability to plan missions, navigate over considerable distances, avoid obstacles and execute quite complex surveillance and manipulative tasks with minimal intervention on the part of the human.

Unsurprisingly (to the human factors community at least), this preoccupation with *autonomy* has not met with widespread success. Historical evidence from the 1980s and 1990s notably from early DARPA

projects in the US and, in the UK, the MARDI (Mobile Advanced Robotics Defence Initiative) and ARRI (Advanced Robotics Research Initiative) programmes confirms the indispensable role of the human operator. That role forms part of a complex control continuum that ranges from direct teleoperation during critical mission phases and recovery modes of control to the high-level supervision of single or multiple (swarming) platforms. Yet, despite a wealth of international experience and knowledge on the topic of human factors for uninhabited systems, very little of practical relevance has ever been published in the form of accessible guidelines and standards. One notable exception is Appendix B3 (Human Computer Interface) of STANAG 4586, *Standard Interface of the Unmanned Control System (UCS) for NATO UAV Interoperability*. Yet, even here, the absence of any appropriately packaged knowledge relevant to UAV (unmanned air vehicles) human interface design has



forced the authors to use unmodified extracts from the ubiquitous international ergonomics standard supporting the use of visual display terminals, ISO 9241!

To help redress this situation, research being conducted by the University of Birmingham in Work Package 3 of the HFI DTC (described elsewhere in this Newsletter) has resulted in the development of an early experimental human factors test bed based on Virtual Reality (VR) or Synthetic Environment (SE) technologies. The aim of the *Alchemy* test bed is to support the development of new guidelines and standards relating (initially) to operator display and control requirements for STAR (Intelligence, Surveillance, Target Acquisition & Reconnaissance) UAVs, deployed in support of homeland security operations in urban environments. An

additional aim of *Alchemy* is to demonstrate the application of low-cost VR/SE test beds to (a) the Concept, Assessment and Demonstration phases of the CADMID process, and (b)

the six domains of HFI (manpower, personnel, training, system safety, health hazard and human factors engineering).

Developed by Birmingham researchers Bob Stone, Chris Collis and Eugene



Ch'ng in only 12 weeks from concept, the test bed's real-time SE is based on Microsoft's managed DirectX 9.0 API, the C# .NET language and incorporates, where appropriate, software elements from games engine technologies. *Alchemy* supports experimentation with a wide variety of human-system interface issues, including "overview" (exocentric) vs. teleoperation (egocentric) control modes, UAV sensor type (conventional camera vs. thermal imager vs. night vision), camera field of view



(narrow, wide, panoramic), keyboard + mouse vs. joystick control vs. tracked, head-mounted display + joystick control (including simple force feedback for indicating close-in building turbulence effects) and transmission time delays from/to the operator control station.



The iSTAR UAV on which *Alchemy* is based is that developed by the US company Allied Aerospace and flown autonomously for the first time in May, 2004 (www.alliedaerospace.com/UAVs.htm). In addition, a mobile UAV delivery system has been included within the simulation, based on an uninhabited land vehicle, or "marsupial", currently under evaluation by the US Space and



Naval Warfare Systems Command (SPAWAR; www.nosc.mil/robots/). A three-dimensional model of the University of Birmingham's Electronic, Electrical and Computer Engineering (EECE) building has been constructed, together with the adjacent Health Sciences annex, car parks, insurgent-occupied offices and open ground (parts of which also feature in experimental C4I/mobile computing work associated with the HFI DTC's work programme). The EECE building has many ideal features for conducting virtual urban iSTAR UAV operations, including prominent ledges, recesses and set-back windows, constrained passages and a roof-mounted radar dish installation. These features provide excellent targets and challenging landing sites within which the virtual vehicle can "perch" for simulated surveillance activities.

For further information, contact Prof. Bob Stone at the University of Birmingham (r.j.stone@bham.ac.uk).

Consortium Members' News Corner

Independent Safety Advisor (ISA) for Future Lynx IPT

SEA has been contracted by the Defence Procurement Agency (DPA) to be the Lynx ISA.

The Ministry of Defence (MoD) has engaged SEA as the ISA for the Future Lynx programme. Working in concert with the Future Lynx IPT located at Yeovilton and with the Prime Contractor Westlands Helicopters. SEA is conducting a series of independent audits of the Future Lynx Safety System.

Project Manager for SEA, Steve Cicone explains; "the programme of work during the assessment phase entails an assessment of the Lynx safety assurance process to provide confidence that the requirements of JSP 553 and Defence Standards 00-56 are being met for both the hardware and software aspects of the programme. This has involved SEA adopting the role of informed independent and working with the IPT, Augusta Westland Helicopters Ltd and QinetiQ on their procedures and processes to ensure compliance with the stringent software and hardware safety standards".

Supporting SEA are a team of software specialists from York University lead by Professor John McDermid enabling full assurance to be achieved to Software Integrity Level 4 (SIL4).

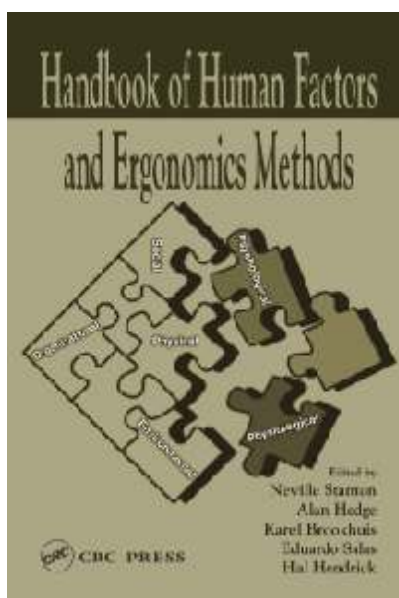
The initial programme of work that contributes to the body of evidence required for Main Gate is complete. The team will continue providing ongoing advice, safety panel assistance and reviews until after Main Gate approval



when there will be another full Safety Audit to confirm the programme is ready to enter the Demonstration Phase.

Commenting on SEA's wider System Safety activities, SEA Programme Manager Geoff Hoyle commented "The Battlespace Division is positioned to attract other key safety roles for the DPA following on from earlier programmes that we have successfully conducted. SEA has prepared and delivered Safety Cases for ten training systems under contract to the Maritime Training Systems IPT and is Prime Contractor for Sonar 2112, currently being fitted in the Submarine Flotilla, which has been delivered with a full safety case and supporting documentation. At the other end of the spectrum, during the Urban Operations Study for the DPA's Future Business Group, items of COTS equipment are considered as candidates for military use and each equipment must have a safety and risk assessment conducted prior to being cleared for trial. This has meant the completion of over 80 assessments to date and the process is ongoing. Through the use of our associates in academia and industry, SEA will tailor a versatile and customised team to meet the requirement for the task."

Handbook of Human Factors and Ergonomics Methods



Handbook of Human Factors and Ergonomics Methods delivers an authoritative and practical account of methods that incorporate human capabilities and limitations, environmental factors, human-machine interaction, and other factors into system design. The Handbook describes 83 methods in a standardized format, promoting the use of methods that may have formerly been unfamiliar to designers. Six sections comprise the Handbook, each representing a specialized field of ergonomics with a representative selection of associated methods. The sections highlight facets of human factors and ergonomics in systems analysis, design, and evaluation. An onion-layer model frames each method; working from the individual, to the team, to the environment, to the work system. Each chapter begins with an introduction written by the chapter's editor, offering a brief overview of the field and a description of the methods covered. The Handbook provides a representative set of contemporary methods that are valuable in ergonomic analyses and evaluations. The layout of each chapter is standardized for ease-of-use, so you can quickly locate relevant information about each method. Content descriptions are brief, and references are made to other texts, papers, and case studies. Standard descriptions of methods encourage browsing through several potential methods before tackling a problem. Further information is available at www.crcpress.com

Meet the Team



Pam Newman BSc (Hons) MSc

Pam leads Work Package 3 of the HFI DTC, which has two major research themes; to improve and update the MoD HFI process and to investigate the methodological and implementation issues of using synthetic environments to support human-centred design.

Pam's human factors experience began at DERA (now QinetiQ) where she worked in the Air Systems Human Factors Group at Farnborough. During this time she was involved in European collaborative research on the use of simulators in training and contributed to the development of performance and workload measures for use in training and in the assessment of single Vs two-seater aircraft workload. Following this, Pam moved to Marconi Electronic Systems in Chelmsford where she fulfilled the role of HFI lead in Marconi's TRACER reconnaissance vehicle programme. More recently at SEA, she has worked on a variety of civil and MoD programmes including supporting the West Coast Main Line project, deriving human-machine interface requirements for the Future Lynx project, developing a method for determining future training requirements and training simulator fidelity, and working on the design of BBC outside broadcast vehicles.

Michael Goom - BSc, FErgS



Michael Goom is the Ergonomics Technologist with MBDA Missile Systems. He went to Loughborough University to study Ergonomics and Cybernetics and graduated in 1970 with a BSc in Ergonomics.

He joined the British Aircraft Corporation's Guided Weapon Division (which subsequently became MBDA Missile Systems) as a Human Factors Engineer within their Research Department. A driving interest has been the integration of human factors into the system development process. To further this interest he transferred to the Systems Engineering Department in 1977 where he was responsible for writing the human factors components of system specifications. He was also responsible for devising and managing human factors programmes aimed at reducing the risk of human characteristics degrading the performance of the total system. In 1985 Michael became involved in the US pilot trials for their MANPRINT programme which aimed to formally integrate human characteristics into the system development process. The success of the US programme caused the UK MoD to institute a similar programme. Michael was involved with the original MANPRINT study for the UK and has played a significant role in its development and transition to Human Factors Integration since that time. He was chairman of the MoD/Industry HFI Working Group from its inception until 2004. This body is charged with developing the mechanisms by which customers and prime contractors can specify and deliver HFI in the real world. Michael was awarded the Ergonomics Society's William Floyd Medal for 2002 for 'Outstanding contribution to ergonomics'.



Stephen Brackley - B Sc (Hons), MBCS, MIEE

Stephen is an experienced Project Leader with 25 years in large Real-Time airborne (Eurofighter, Nimrod, Merlin) and ship borne (Destroyers, Frigates) software systems. Based at BAES, Warton, he is the HFI Operations Manager responsible for the project plan, finances, processes and procedures. Prior to this he worked on Eurofighter testing and producing release certification documentation for the Integrated Monitoring, test and Recording Subsystem, and the Displays & Controls Subsystem.

Stephen moved to Warton as the Project Leader responsible for setting up and managing Ael's participation in the development of the Tactical Command and Sensor Subsystem, part of the Mission Systems procurement for the Nimrod MRA4, the Replacement Maritime Patrol Aircraft. Prior to this Stephen was based at Ael, Yeovil where he was primarily involved with the software development of the Merlin Mission System. Before joining Ael Stephen worked for Ferranti Computer Systems on the software development for both Frigates and Destroyers. Stephen graduated from the University of Surrey with a degree in Mathematics with Statistics.

Dr Don Harris, BSc PhD MErgS CPsychol ILTM

Don Harris is the Reader in Human Factors Engineering in the Human Factors Group at Cranfield University. His principal teaching and research interests lie in the design and evaluation of flight deck control and display systems, accident investigation and analysis, system safety and flight simulation and training. He is currently Director of the MSc in Human Factors and Safety Assessment in Aeronautics. Until recently Don was also an aircraft accident investigator (specialising in human factors) on call to the British Army Division of Army Aviation and in addition has worked in the safety assessment of helicopter operations for North Sea oil exploration and exploitation.



Don is a professional member of the Ergonomics Society and a Chartered Psychologist. He is the Chairman of the International Engineering Psychology and Cognitive Ergonomics conference series, and chaired the DTI/EUREKA conference on Human Factors Criteria for Flight Deck Certification. He sits on the editorial boards of the International Journal of Cognitive Ergonomics (Lawrence Erlbaum Associates) and the International Journal of Cognition, Technology and Work (Springer-Verlag). He is also co-editor in chief (with Helen Muir) of the academic journal, 'Human Factors and Aerospace Safety' (published by Ashgate).

The Director's Cut

In this and future Frontline issues I intend to write a few paragraphs about different aspects of how we operate as an HFI DTC and how we are meeting the essential and specific outcomes that our MoD sponsors require. A point to note is that we are a relatively small DTC compared to the other two DTCs (i.e. DIF and ERMS) only half their size in fact. This means that we are a close-knit team of researchers and that we currently have a very focussed and carefully constructed research programme.

As the person in overall charge, one of my jobs is to ensure that our research programme produces exploitable results and that we stay in close touch with our MoD stakeholders. We do not want to produce voluminous reports that are read by a few people and then consigned to the shelf. Instead, we are committed to producing results that will really help the UK defence community (both MoD and Industry) become better at HFI, a view strongly echoed by our colleagues in the RAO and DSTL.

Ensuring our research is exploitable is an important goal for us. I am using the Technology Readiness Level criteria as one guide for judging how far we should go in our research work. It can be argued that DTC research ends at TRL 3 or 4, whereas the DPA IPTs, for example, require much higher TRL thresholds for pull-through into procurement programmes. There is therefore a potential gap. However, as has been pointed out to me by a colleague in the FBG at ABW, at the Concept, Assessment and Development stages of the CADMID cycle, lower TRL thresholds are acceptable.

In the HFI DTC we are not researching or developing hardware or software devices in the usual way, but instead, we are researching (human) processes and better methods of ensuring that a user centric/usability based approach to defence equipment design and procurement is adopted. This puts a different emphasis on exploitation because we

have to convince people to do things differently from a HFI perspective.

I have come to HFI from an Operational Analysis and Simulation & Modelling defence background. I am therefore very keen to ensure that we deliver a range of computer based tools and HFI design aids that support more user centred and usable equipment design and procurement (the HFE/HMI part of HFI).

This brings me back to the issue of TRL thresholds. We currently deliver demonstrators and demonstrations of potential HFI tools at the end of a research task, and I don't think we can expect the defence community to use or accept these HFI tools at basic TRLs. One solution is to move up the ladder to a higher TRL threshold for the most promising HFI tools, either within the HFI DTC (a risky approach as we are not set up for development) or by engaging a defence software company to help develop these tools. Another approach, which is preferred by our DTC technical panel, is to offer these products as "shareware" to potential users on

the understanding that we get some feedback as to their suitability and usability.

We are still considering this aspect of exploitability and in what form and state of development to offer these particular products of our research. Please let us know if you have particular views on this topic.



Dr David Morris
HFI DTC Director

Prof. R. J. Stone
PRINCIPAL INVESTIGATOR

Tel: +44 (0) 121 414 7395
Fax: +44 (0) 121 414 4291
Mob: +44 (0) 7740 858901
Email: r.j.stone@bham.ac.uk
URL: www.hfidtc.com



Dr. Karen P. Lane
RESEARCH MANAGER

Tel: +44 (0) 1935 445324
Fax: +44 (0) 1935 443111
Mob: +44 (0) 7736 379917
Email: karen.lane@aeroint.com
URL: www.hfidtc.com

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