A new 'normal' in defence human factors?

Even before Covid-19 locked us down and forced a new way of working, it hasn't always been easy to arrange face-to-face meetings to investigate human computer interface design. So, having to carry out trials remotely, **Ed Oates** turned to crowdsourcing, with encouraging results

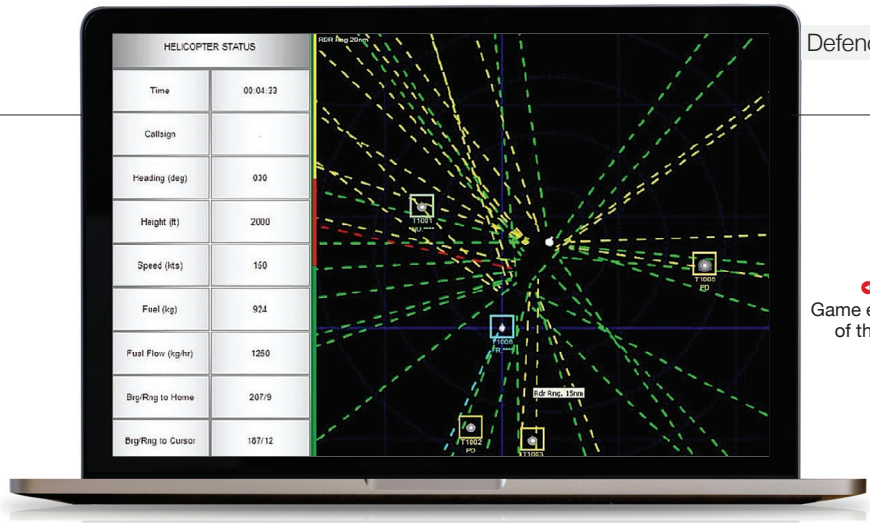
Working in UK defence, I've experienced restrictions in access to subject matter experts due to their operational deployments, routine embarkations, travel budget limitations and just the physical distances in moving people from one location to another. Typically, a small number of senior operators from the equipment end-user organisation will be allocated to support human-computer interface (HCI) development at the manufacturer's human factors laboratory or development test site. The problem comes when they're unable to attend but Covid-19 has made that 'normal', so what's the new way of working?

This was one of the issues I wanted to address in my PhD thesis: "Crowdsourcing with Serious Games for Defence Procurement", where 'crowdsourcing' – the technique of mass voluntary involvement across the internet/intranet - was used for HCI design innovation, prototyping and testing.

In this case, a 'Serious Game' means a 'game with a business purpose', so if a popular computer game like Minesweeper had a close relationship to real world mine-sweeping in the Royal Navy, then it may have a business use in training naval personnel. Unfortunately, the game of Minesweeper has an HCI, simulated environment and a set of rules that doesn't match the reality of mine-sweeping, but what if a game were to be made that did emulate reality and allowed defence equipment to be previewed in a web browser within the context of a military task? This was the first part of the research to be addressed.

A web browser game was built to host an emulation of an in-service HCI, together with a representative synthetic environment and players were asked to complete a military maritime search task. The game's HCI, representing a mission system, brought together the controls, functions and displays within the Merlin Mk2 helicopter: tactical symbols, radar, camera and electronic support measures for detecting ships' radars. The game was then offered to all-comers with access to the Ministry of Defence (MOD) intranet to play and provide design ideas.

I presented the ongoing research at the CIEHF's conference in Birmingham in 2018 and had some practical advice from experts in mission system interface design, like Jo Davies (see her article "Creating the cockpit", *The Ergonomist*, Nov-Dec 2020). Now the thesis



Serious Game emulation of the tactical display

has been completed and accepted by Cranfield University, I wanted to see how it connected with other work in defence HCI design.

One of the findings was that design ideas, though all coming from within MOD, came from both inside and outside the equipment end-user organisation which widened the diversity of ideas. The usual situation, where a small number of subject matter experts are consulted, may have been able to come up with all the design ideas given enough time but those involved in crowdsourcing know that most of the smartest people work for someone else and go out to find them.

The concept of crowdsourcing innovation includes the transfer of ideas from one domain to another and some of those who played the game had experience in acoustic data processing and were able to offer their favourite controls and displays for use in the electromagnetic spectrum. Acoustic analysis looks at frequencies, pulses and bearing rate-change, which readily translated into the electronic support measures displays. Some other players had completed exchange tours with different defence systems and other nations' defence equipment and were able to offer innovative design ideas for inclusion in the game. As the web browser game was the medium supporting the design process, it was relatively straightforward to encode the new design ideas and let the players/users decide what worked for them.

Another finding was the benefit in avoiding meetings. Nick Gkikas ("Cutting-edge cockpit design", *The Ergonomist*, 567, Sep-Oct 2018) and Suzy Broadbent in her YouTube presentation (www.youtube.com/watch?v=6BXdJsHonWA) indicate that the human factors of meetings may over-ride the human factors of interface design, skewing an engineering process away from its objective ends. In contrast, playing an online game removed the opinion or group-think element of meetings. This crowdsourcing construct of the research retained users' independent perspectives so that suggested design components were not subjected to peer assessment until they were built into the game, and even then their use was only recorded in the game's log files and assessed against task-based criteria of 'effectiveness' and 'efficiency'.

As the main theme of the research was crowdsourcing, the final stage included an aggregation mechanism which sifted the game log files to indicate which set of controls and displays made a difference. With the players' in-game selections recorded in the log files and these data affected by player cognition and situational awareness, there was a lot of noise obscuring the signal of effective/efficient use of the HCI. The research followed the crowdsourcing innovation phase with a series of competitions or tests where 100 players submitted 1000 game log files and these, with careful filtering, provided a quantified rationale for which elements of the HCI might be taken forward to a fielded design.

'Making a difference' in effectiveness and efficiency was the output criterion, and those who produced the best results were not all from the senior operator group. In fact, a number of officer cadets, still in boot camp, were more successful and this is another finding of the research, that those with a history or past experience of previous HCIs may stick to 'old ways' and not make full use of the more innovative displays and controls. With defence systems sometimes taking many years to bring into service, it seems worth questioning the value of a small number of senior operators involved in the design process when they may well be retired by the time the new generation have to 'fight' the system provided for them. James Surowiecki's book, *The Wisdom of Crowds*, has a sub-title, "Why the many are smarter than the few" and offers more thoughts on crowdsourcing and where and how the technique may be applied.

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Designing and building a web browser game demands particular skill sets and the engineering task of verifying and validating what is after all, a simulation, makes further demands in any future implementation of this proposed new process. The game needs to play as a game, offering the player agency through choice of actions and a changing challenge with realistic elements of chance to engage them over multiple games. The simulation part of the game requires access to real system data and ultimately to the players' belief in the game's task. Within this research, a feedback questionnaire ran alongside the game and acted as validation of the displays and maritime tasks. As with any research, there were bumps and road-blocks along the way. For those who follow on after this research, they may well find a lack of understanding in what 'crowdsourcing' is.

There also needs to be organisational support and here the Royal Navy part-funded the research and gave support through their DARE Innovation Team. Future users of serious games for HCI design may also have to overcome defence blog moderators blocking access, or managers exclaiming that their people "don't have time to play computer games!", but whoever tries this technique, please let me know.

So, what did I find in this research that might be of use to human factors practitioners? Lack of direct access to users to help with HCI design need not be a show-stopper. In fact, a crowdsourcing construct has advantages by independently obtaining a diverse range of ideas and views while retaining an objective design process on the route to a final design.

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2021-07-01
Chartered Institute of Ergonomics and Human Factors
https://www.ergonomics.org.uk/Public/Resources/Publications/The_Ergonomist.aspx
Oates E. (2021) A new ‘normal’ in defence human factors? The Ergonomist, Volume 548, July-August 2021, pp. 24-25

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