Human Factors in the Trenches

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SUMMARY

The Universal Battle Trench (UBT) project is an initiative to develop a novel, rapidly deployable trench system aimed at enhancing the safety and operational efficiency of military personnel. When the project was still in its early conceptual phase it incorporated Human Factors (HF) expertise to guide its early evolution. This involved a task analysis, modelling utilising 3D printing, trials, and an Early Human Factors Assessment, which facilitated early design changes, enhancing safety and cost-effectiveness.

KEYWORDS

Human Factors Integration, Trenches, UCD,

Method

The goal of the Universal Battle Trench (UBT) project is to create an innovative, quickly deployable in-field fortification system, the UBT, that will improve military personnel's operational effectiveness and safety. Engaging HF expertise early in the UBT project is a rare but highly beneficial move, especially as the project is still in its early conceptual stages, as findings can be acted upon with comparatively low cost. A task analysis, two trials, a 3D printed model, and the creation of an Early Human Factors Assessment (EHFA) were among the methods used to incorporate human factors into the concept development process. This allowed for the consideration and, when practical, early application of design changes, which ultimately proved to be safer and more economical. This case study demonstrates how using HF as early in a project as feasible improves design, safety and deployability.

Phase 1 - Task Analysis: To ascertain the operating needs and the tasks that users will conduct using the UBT system, the first stage comprised a Hierarchical Task Analysis (HTA). The identification of user needs, operational settings, and prospective system usage difficulties facilitated discussions about the aims and ambitions of the project and bring some of the key user focused activities to the fore. The source data for this was derived from both interviews with the project team and reviews of the concept of operations. Each operation's component tasks and subtasks were broken down and analysed, covering the deployment, usage in different settings, and recovery of the UBT system. The HTA was then utilised to assess the UBT system's dimensions, building techniques, and protective capabilities in comparison to other trench systems, most notably the Split Hairpin Shelter. The outcome of this analysis provided a detailed understanding of the user interactions with the UBT system, highlighting areas where design improvements could enhance usability, safety, and efficiency.

Phase 2 - Human Factors Assessment: This stage focused on assessing the UBT system from a human-centric perspective. The goal was to evaluate how well the system's design met the identified user needs and operational requirements. The assessment involved two separate user trials

activities, both of which evaluated the system's ergonomics, usability, and safety. This was supplemented with an ongoing expert assessment utilising a 3D printed model. Trial one was a deployment, usability, and survivability assessment at Radnor Ranges, to determine the practicability of the UBT and the effects of representative blast impacts. The second trial included a representative user base and deployment on Salisbury plain to get an understanding and feedback about the UBT, including benefits and potential improvements. The 3D printed model was important to the delivery and economy of the project as the client was geographically located at the other end of the country, and the 3D scale model enabled ongoing review away from the client base. The activities included reviewing the design for ease of handling, risk of injury and user comfort. The outcome of this phase was 37 recommendations which were then reviewed with the project team.

Phase 3 - EHFA: The EHFA represented a more comprehensive and formalised evaluation of the UBT system in the context of Human Factors Integration (HFI). Its aim was to bring together initial issues and considerations for the UBT solution, setting a foundation for future HF and HFI activities. The EHFA is also a product of the UK MOD acquisition process, therefore already having it in place before going to market gives a level of competitive advantage. Alongside the EHFA report, the initial HFI RAIDO (Risks, Assumptions, Issues, Dependencies, and Opportunities) register was initiated to document and manage these elements.

The Advantage of the Application of HF

The application of HF processes in the UBT project significantly enhanced the outcomes by ensuring that the system was not only technically proficient but also user-centric, safe, and operationally efficient. The following are some of the benefits identified:

- ***Enhanced User Safety and Comfort:*** By focusing on HF, the project team was able to identify and mitigate potential safety risks associated with the deployment and use of the UBT system. For instance, risks were identified such as identifying potential for injury during the lifting and placement of U pieces (particularly to and from below ground level), identification of finger traps, and hazards related to the steel bar pegs used in the geocell technology.
- ***Improved Usability and Efficiency:*** The HF analysis led to concept design that considered the ease of use and efficiency of the UBT system. For example, the system's modular design, allowing for easy extension to accommodate more soldiers, influenced by understanding the end-users' needs and operational contexts. This user-centric approach included maintainability and logistical considerations which has supported the UBT concept to be rapidly deployed and used effectively in various field conditions, enhancing operational efficiency.
- ***Identification of Training Needs:*** The HF analysis highlighted the need for specific training for the deployment and use of the UBT system. Recognizing this early in the development process allowed for the planning for appropriate training programs, ensuring that personnel would be well-prepared to use the system effectively.
- ***Use of 3d Printed Models:*** The ability to use the project design drawings to develop a scaled 3d printed model was not only a cost effective and practical tool for aiding analysis but is also a good mechanism for demonstrating potential issues rather than simply trying to describe them.

Conclusion

The UBT project itself represents a significant advancement in military fortification technology, with a strong emphasis on human factors and user-centric design. The comprehensive analysis

delivered across three reports demonstrates the project's commitment to developing a system that is not only effective in providing protection but also considers the ease of use, safety, and operational efficiency for military personnel. The identification of risks and opportunities further positions the UBT system as a versatile solution with potential applications beyond its initial military scope. The application of Human Factors in the UBT project was instrumental in creating a system that was not just technically sound but also tailored to the needs, safety, and efficiency of its users, as well as considering the wider impacts of support, maintainability, and recovery. This holistic approach has significantly enhanced the overall effectiveness and potential impact of the UBT system.