

The right fit for the Forces

A new study is helping to improve military equipment by gathering up-to-date body measurements from UK service men and women

Human factors engineers need accurate anthropometry data to design equipment that's fit for purpose. This is absolutely true in the defence sector, when designing military systems, equipment and clothing for use under extreme operational conditions and in the most severe environments. Yet human factors engineers are using data acknowledged by the Ministry of Defence (MOD) to be not fully representative of today's Armed Forces personnel. This is particularly so for women and minority ethnic groups.

The last comprehensive anthropometry survey of UK Armed Forces personnel was in 2006-07. To address the lack of wholly representative data, the MOD's Defence Ordnance Safety Group (DOSG) placed a contract with QinetiQ to conduct a new, comprehensive, tri-service anthropometry survey.

The 2006-07 survey had measured 92 dimensions from 2,470 personnel. It was determined that all these should also be measured in the new survey, along with a significant number of new measurements that are required to support the development of new body armour.

It's widely acknowledged that "women are not small men" and this is never more critical than when designing body armour that will not only save lives but which also has the potential to reduce the incidence of musculoskeletal injuries, the most common cause of medical downgrading and medical discharge in both service men and women.

The development of body armour is complex. Not only must the armour protect the wearer but it must also do so in a manner that reduces restriction of movement to a minimum and doesn't incur unacceptable thermal or physical discomfort. Most importantly, the armour must offer protection to the critical areas of the body. A 2016 study identified protection of the heart, great vessels, liver and spleen to be of paramount importance. Therefore, to enable new body armour to be designed and optimised to protect these organs, 53 new dimensions must be measured.

The development of body armour also requires the measurement of the sizes and positions of the critical internal organs. A separate but related study, also initiated and funded by DOSG, was launched to acquire the necessary data and is being led by the Defence Science and Technology Laboratory (Dstl).

An important aspect of the overall requirement is the development of a Transition Plan. The MOD intends to transition the capability to measure anthropometry to the three services – Army, Royal Navy and RAF. Ideally, each service will have the same hardware and software and follow the same measuring protocols. In this way, it's hoped that an enduring capability will be developed and the measuring of service personnel will become 'business as usual', meaning the database will be continually updated and maintained.

An analysis of MOD requirements concluded that 163 body

dimensions had to be measured. These comprised the 92 dimensions measured in the 2006-07 survey plus 53 needed to meet the requirements for new body armour, 12 required for compatibility with the JACK digital human modelling tool and an additional six deemed necessary. As 30 dimensions were replicated to provide left and right-hand values, the total was 193. QinetiQ calculated it will be possible to sample 2,875 personnel with the available time and funding.

A personnel sampling strategy has been devised to gather sufficient data points in the following primary demographic groups: sex, ethnicity and age; and in the following secondary groups: service, ranks and service groups.

During the 2006-07 survey, the overall percentage of females measured was 12.6%, with the relevant services representation being Army (77%), RAF (20.9%) and Royal Navy (16.5%). The stratified sample design will generate substantial percentage increases: Overall (30.8%), Army (29.8%), RAF (36.7%) and Royal Navy (33.5%).

Two Vitronics Vitus body scanners have been purchased by the MOD. These complement an existing scanner purchased by the RAF Centre of Aviation Medicine and will be given to the Army and the Royal Navy on the conclusion of this study.

Anthroscan software has also been procured. This allows the capture of pixelated meshes; from very simple to highly accurate full figure. A cloud of 3D data points (approximately 1.5 million) is produced and a colour photographic textured map. If the MOD wishes to measure some further dimensions, after the study has concluded, these may be captured from the stored meshes.

A pilot study has been designed to ensure that the scanners and software can capture 3D data from participants and extract the measurements required accurately and consistently and with sufficient fidelity. Different materials will be scanned to determine whether there are any special requirements for underwear for participants.

It's anticipated that new data to support the development of improved and inclusive body armour will be available in September 2023 and that all data gathering will have been completed by the end of 2023. It's planned that the HFI Technical Guide for Anthropometry (Cummings, 2022) will be updated to include the new data in 2024.

This will be freely available to all via the MOD's Defence Gateway portal. It's further anticipated that a new anthropometry data analysis tool will be developed and that this will also be freely available to all. ■

About the authors

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