UDT
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# Human centred solutions to optimise human performance in the undersea domain

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#UDT2019

# A human-centered design and assurance methodology for submarines

The location of the air conditioning vent causes complaints and is addressed with user modifications.

More thought into its location would not cost more but would **save crew frustration for the next 30 years.**

# A human-centered design and assurance methodology for submarines

- Develop and demonstrate a **design process** and methodologies.
- Investigate habitability to **develop criteria for design** development and assessment of designs.
- Development of **exemplar habitability designs** to facilitate rest and reduce fatigue.
- Development of physical layouts and apply anthropometric data for design and **assessment of the physical fit**.

# Why does human at the centre matter?

**The myth of the warrior**, that fatigue can be overcome by adequate motivation, has influenced military operations in the past (Shay, 1998).

**Work is cognitive** in nature (as opposed to physical).

Managing fatigue to **increase the ability to make complex decisions** fast becomes a defining advantage.

Managing fatigue; via work design (shift schedules); habitation; food

# Why does human at the centre matter?

**…positive morale…**

Attracting talented individuals, long term crew retention.

&

**…peak mission readiness…**

Fatigue.

# Human Centred Design Principles

1. Understand users, tasks and environments.

2. Users are involved throughout the process.

3. Design is driven user-centered evaluation.

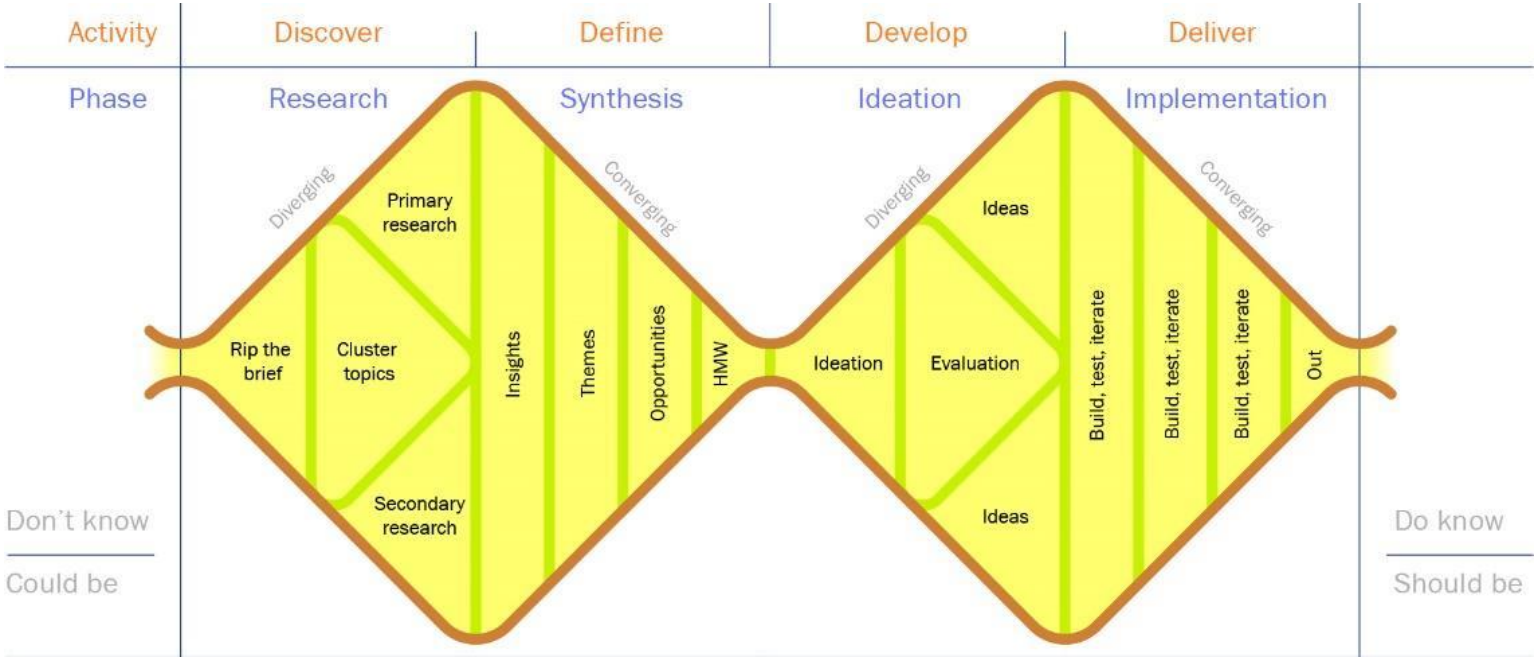
4. The process is iterative.

5. Address the whole user experience.

6. Include a variety of skills and perspectives.

ISO 9241-210 Ergonomics for human-system interaction – Human-centred design for interactive systems.

# Human Centred Design Process

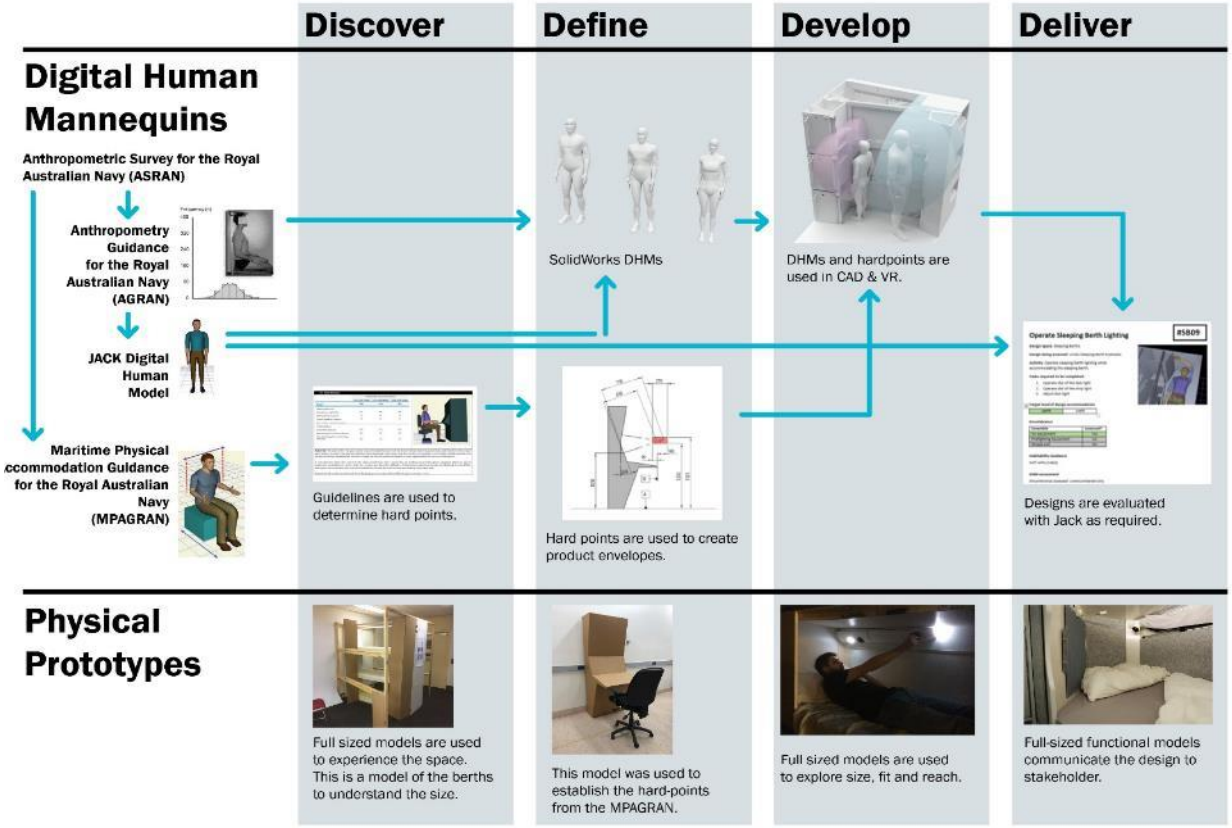



The Double Diamond developed by the UK Design Council. This diagram is by Dan Nassler from the consultancy Hyper Island.

# Human Centred Design Process

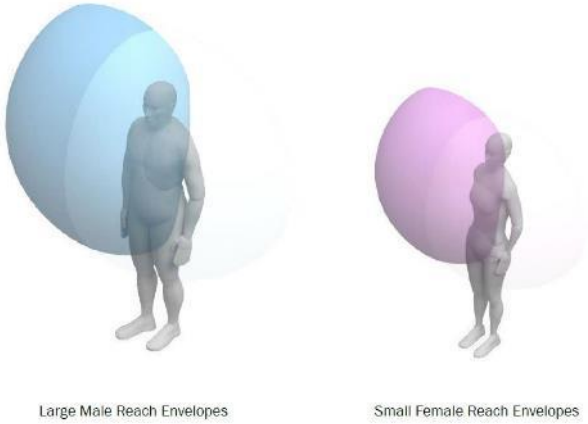
| | Discover | Define | Develop | Deliver |
|---|---|---|---|---|
| **Anthropometry** | **Methods**<br>Literature Review<br>Existing Environments<br>  <br>Guidelines are investigated. | Digital Human Model<br>Define Hard-points<br>  <br>Hard points are used to create product envelopes. | Documentation<br>Evaluation<br>Physical Models<br>Hard-points & DHM in CAD<br>  <br>Solidworks DHM with reach envelope in used in CAD. | Final Documentation<br>  <br>Designs evaluated with Jack as required. |
| **Habitability**<br>**Usability** | **Methods**<br>Literature Review<br>Image Review<br>Site Visits<br>User Workshops<br>Prototype Construction<br>  <br>User needs are discovered. | Affinity Diagramming<br>Mind Mapping<br>Scenarios<br>Criteria<br>Documentation<br>  <br>  <br>User needs are described as scenarios and criteria. | CAD Models - VR<br>Prototype - Physical & Virtual<br>Concept Presentations<br>Co Design Workshops<br>Documentation<br>  <br>  <br>Designs are developed in consultation with users and stakeholders. | Final Documentation<br>CAD Models<br>VR Experiences<br>Physical Models<br>  <br>  <br>Designs are communicated via documents, models and VR. The design is described in terms of user needs and provide evidence to support the proposal. |

# Application of Anthropometric Data

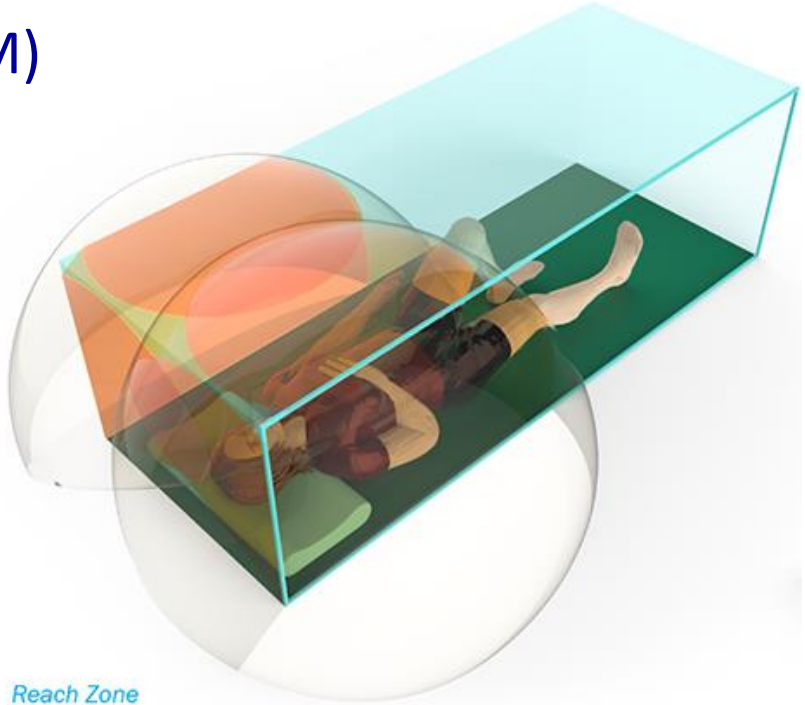


# Application of Anthropometric Data

Digital Human Models (DHM) are used in CAD models for ergonomics analysis.




The reach envelope for the smallest female from the JACK software

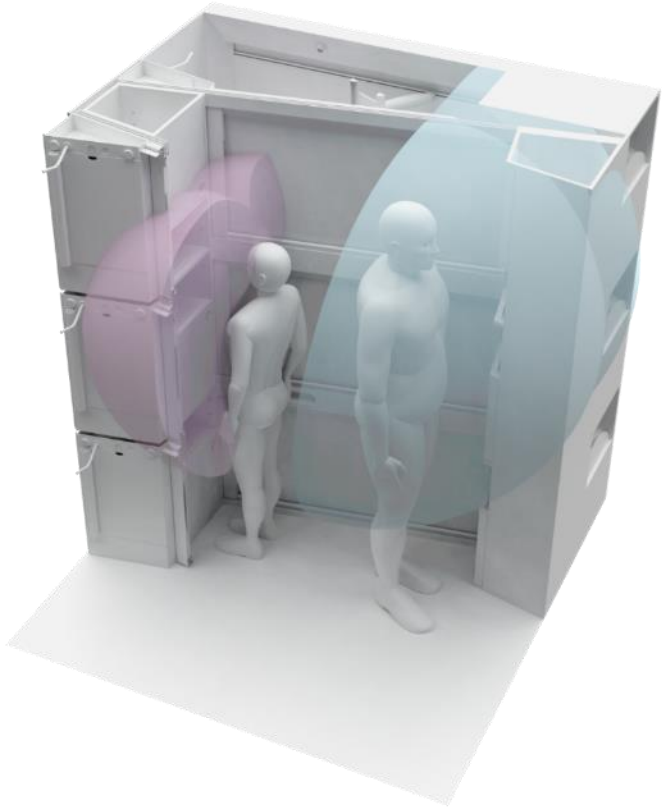


*Reach Zone*

Above: 5th percentile female reach envelope for left and right hand sides if the occupant was at full reach. Orange areas indicate reach zones on the surface of the boundary of the berth.

# Application of Anthropometric Data

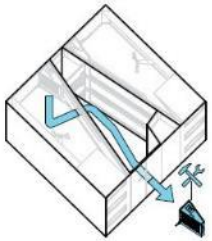
DHMs are used in all stages of the process to develop designs that accommodate human sizes and reach envelopes.



# Criteria & Scenarios

The research leads to criteria and scenarios to inform the design and evaluate design proposals.

## Maintenance of the In-Berth Elements



### Why do people do it?

If some part of the berth or cabin malfunctions people will want to be able to open it up and access the interior for troubleshooting and repair. Any item should be able to be removed without needing to remove other parts and the fixings (e.g. bolts) should be easily accessible. While on deployment the submarine needs to be self sufficient and submariners should be able to easily fix things without external assistance.

**Bedding**

- The berth needs to contain a mattress, pillow and light quilt.
- Changing the bedding should be easy and straightforward.

A sample of design criteria for sleeping berths.

# Physical Model Making

Models are used to explore and develop design proposals.

Early sleeping berth prototypes.

# Physical Model Making

Models are used to explore and develop design proposals.

Early mess prototype in cardboard to establish sizing and layout.

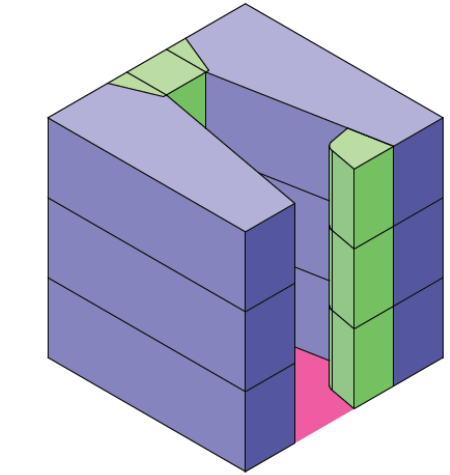
# Virtual Reality

VR provides an immersive experience to assist with the development, and communication of design proposals.

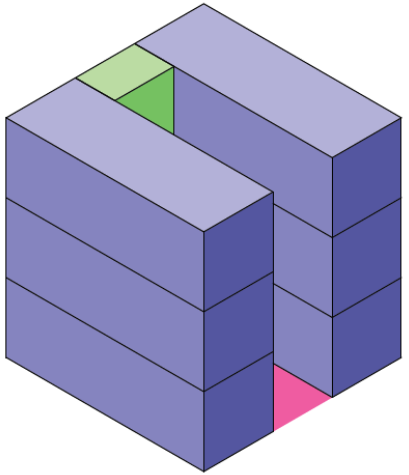
It is now fast and easy and is used at all stages of the design process.

# Outcome

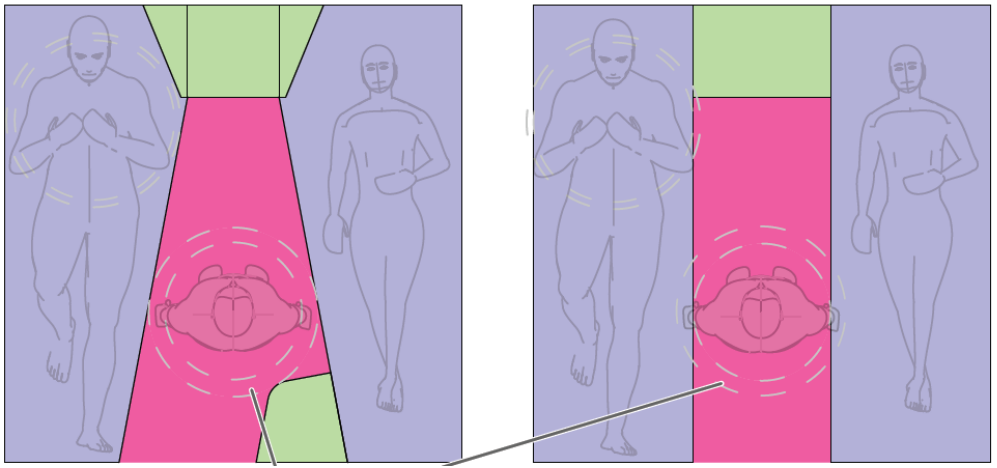
Efficient use of space.



Tapered berth



Rectangular berth



A diagram showing the advantages of the tapered berth arrangement.

# Outcome

Tapered berths and clever storage addresses user needs.

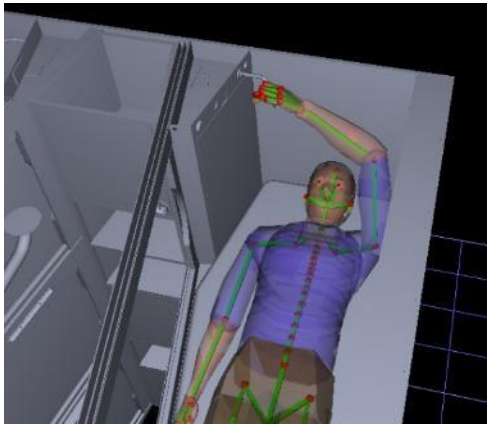
# Outcome

Full sized prototype for user engagement

# Anthropometry

Evaluation;

- CAD (2D Standard, 3D, VR),
- Human simulation software
- Physical prototype



# Questions?

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