

# Application of innovative tools and methods for Human Factors analysis



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[sydneymetro.info](http://sydneymetro.info)



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# Human Factors (HF)

HF scientific discipline that combines the knowledge of mind (psychology) and body (ergonomics).

Rail National Law

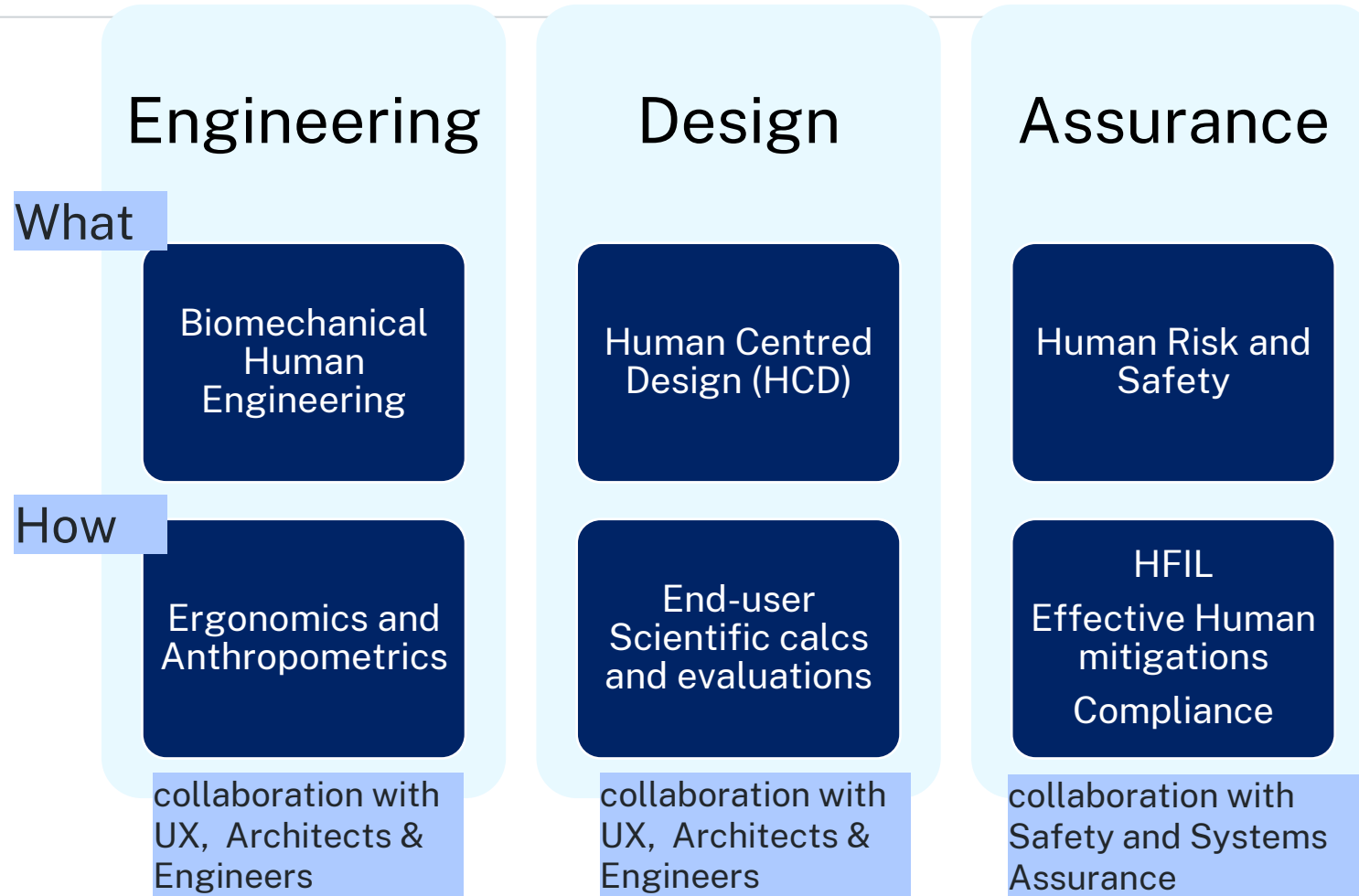
Improve engineering and design of product, people and processes

- Efficiency
- Effectiveness
- Safety
- Usability



# Human Factors Sydney Metro

## EDA



# HF verification and validation tools: low to high fidelity mock-ups



# Mock-ups ?

## Why use ?

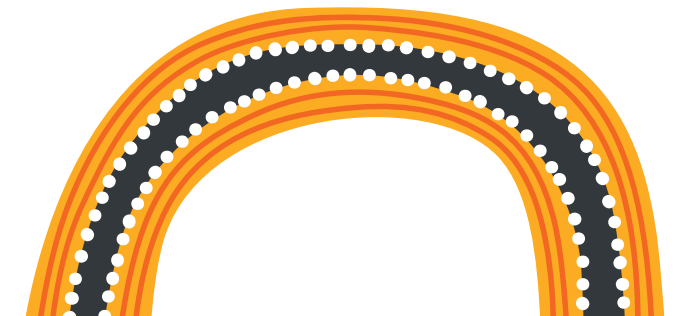
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### What is a mock-up ?

- A simulated replication of the system, environment or process to enable full user interaction and behaviour
- Can be wireframe, card-board, augmented reality, virtual reality or even physical prototype model
- Provides control conditions during evaluation assessments to assess user behaviour before product procurement
- Real-time amendments to the product or process providing cost benefit to customers.

### What is fidelity ?

- The level of realism of the prototype in relation to how it will be designed or engineering in reality
- The immersive nature of the mock-up should allow the users to act out the tasks so that their behaviour and performance can be measured
- Depending on the life-cycle of the project, low to high fidelity mock-ups can be deployed to support rapid prototyping techniques



# Mock-ups in relation to verification and validation

## When best to use ?

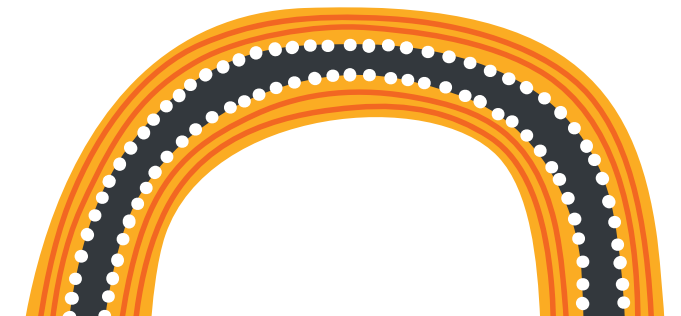
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### Verification

- “Are we doing the right thing ?”
- Low-medium fidelity is best so not to over engineer the solution at early stages when the design is not so mature
- “Chauffeured prototyping” and “Rapid prototyping”

### Validation

- “Have we done the right thing”
- High fidelity – at this point should be a full immersive replication
- Can be used as a demonstration tool later for stakeholders (when not used for user testing)



# Wireframes mock-ups

## Verification



Example Driver  
Machine Interface

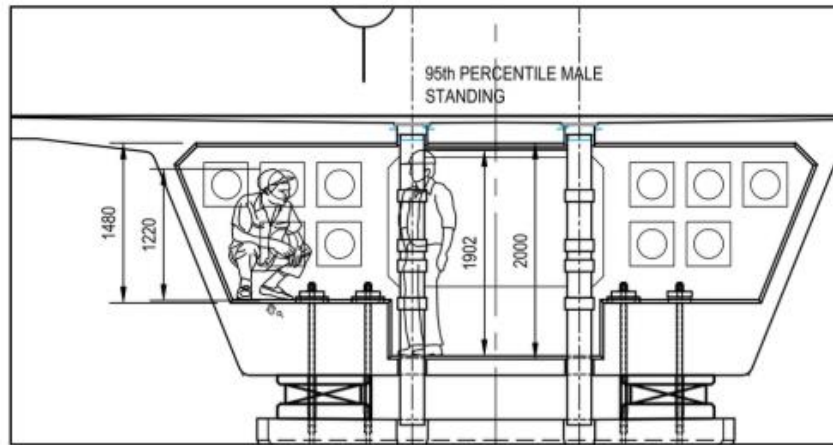
*Not Sydney Metro !*



# Low fidelity mock-ups

## Verification

Figure 2 – View of workspace behind the pier segment diaphragm



Entering workspace

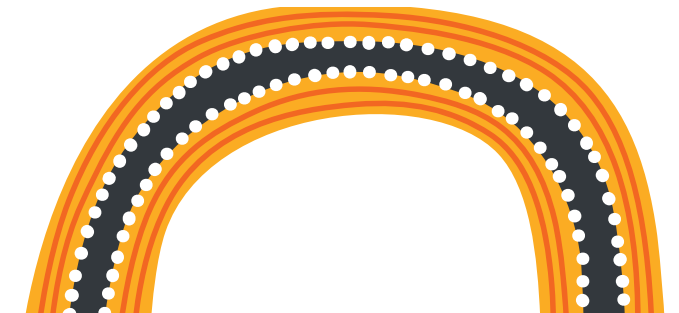
Placing 'tool' on farthest tendon cap

Turning within space

Turning within space

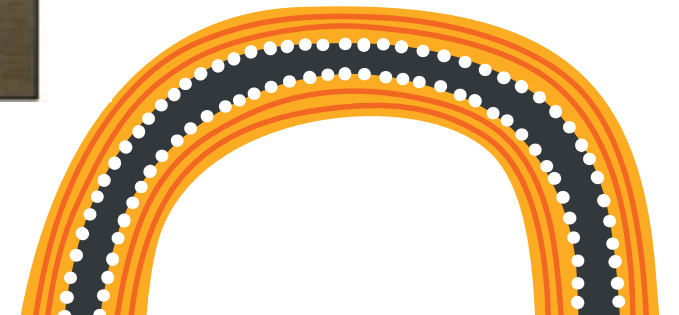
Placing 'tool' on middle tendon cap

Figure 1 – Sequence of photos images<sup>9</sup> showing movement in the space



# High-fidelity mock-ups

## Validation



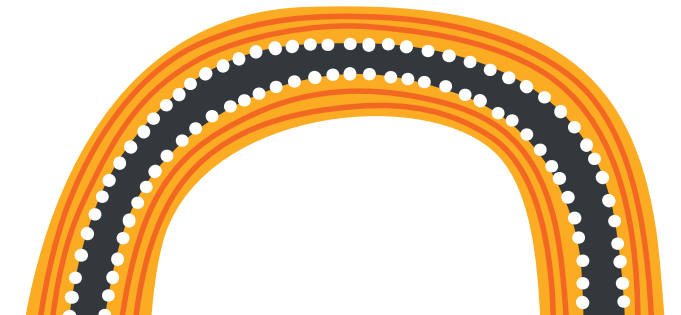
# Augmented reality (AR) mock-ups

Either verification or validation



Credit: HS2 Limited.

HS2 launched an immersive AR technology that created a replica of its new London hub, the Old Oak Common station



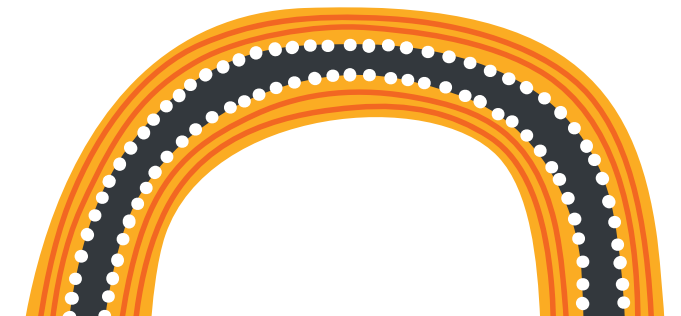
# Full scale physical mock-ups

## Validation and Testing and commissioning phases



*A full-scale mock-up of a new train for Moscow subway, that will be built by Siemens.*

*Example not Sydney Metro !*



# Role of the Human Factors Specialist

## What benefits the HF SME brings to the use of mock-ups ?

| HF SME   | Output   |
|--|--|
| Practical and suitable methods                               | HFIP / Test Plans  |
| Understanding the user needs                                 | HF User Requirements Registers (HFUR)                                |
| Understanding user task and performance                      | Task Analysis<br>User trials with mock-ups                           |
| How to measure performance                                   | Selecting right tools and data analysis<br>User trials with mock-ups |
| Understanding the results and what this means for the design | Test Reports / HF assurance report                                   |
| Evidence of integration                                      | Compliance tracking HFUR and recording risks in HF Issues Log        |

# Good to know

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- Consider different types of mock-ups to provide flexibility in your program
- Program development time for your mock-ups testing as well as ideation time into the design
- Secure your development team as well as end-users. Don't forget "train the trainer".
- Pilot your mock-ups before end user testing
- Caution regarding digital reality – specialist software and sometimes motion sickness so provide different controllers (does not have to be head-sets)
- Don't confuse user testing vs stakeholder demonstration with the type of mock-up sessions that you will program into your design process.
- *DRAFT ISO 9241-820 Ergonomics of human-system interaction. Part 820: Ergonomic guidance on interactions in immersive environments including augmented reality, and virtual reality*

# Summary

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- Mock-ups allow you to create a simulation of your product or process before procurement
- Fidelity relates to how immersive the mock-up is to allow users an enactment of tasks and behaviour
- Low fidelity useful at early stages of the design
  - Supports rapid prototyping
- High fidelity useful at more detail stages of the design
  - Supports validation testing processes with end-users as well doubling up as demonstrations tool for visitors or stakeholders

# Thank you



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