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Supporting Human-Centric Production – *Simulation, Optimization and Digitalization*

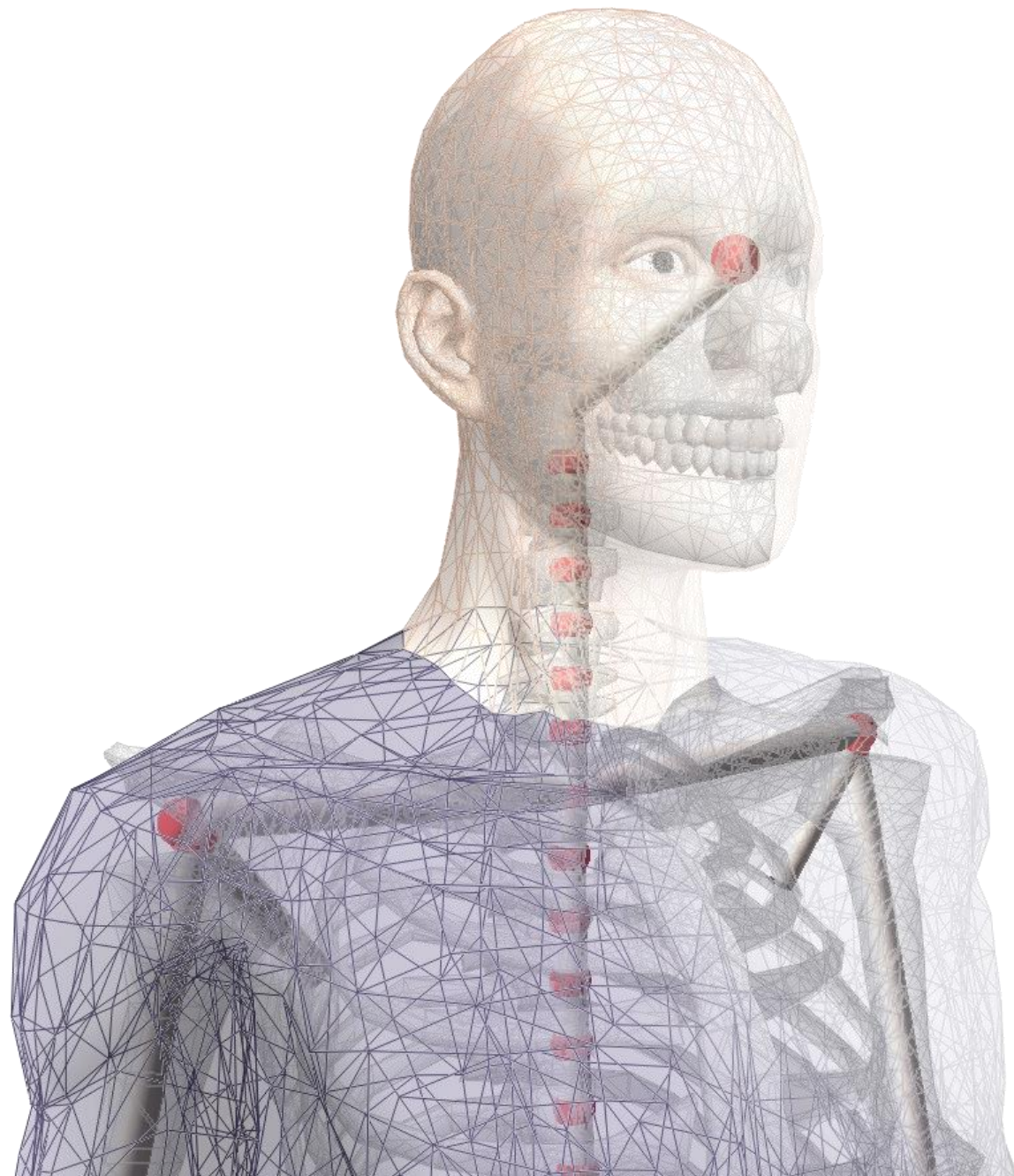
Dan Högberg

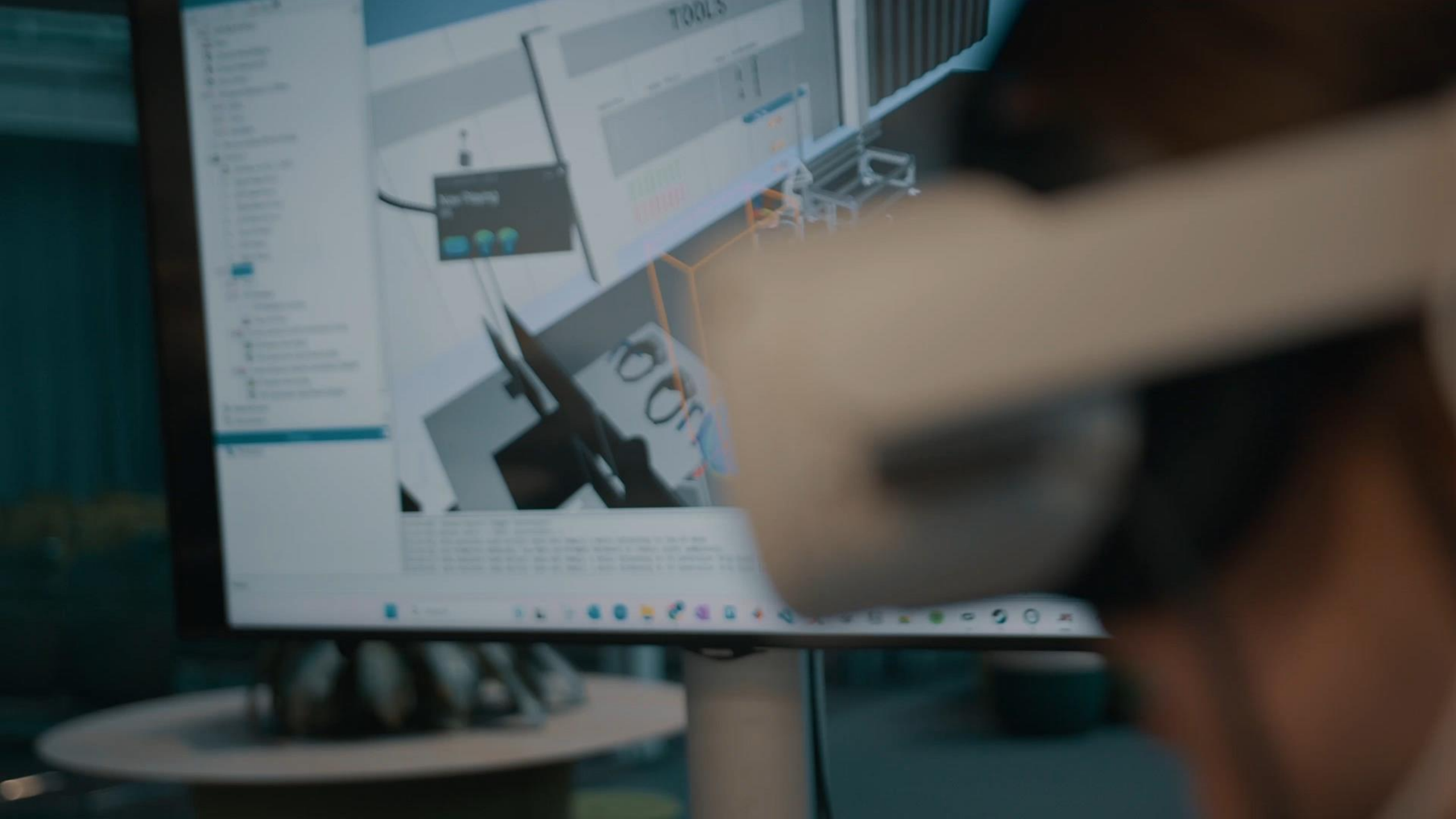
Professor of Product Development
School of Engineering Science
Virtual Engineering Research Environment
University of Skövde

Swedish Manufacturing R&D Cluster Conference 2024



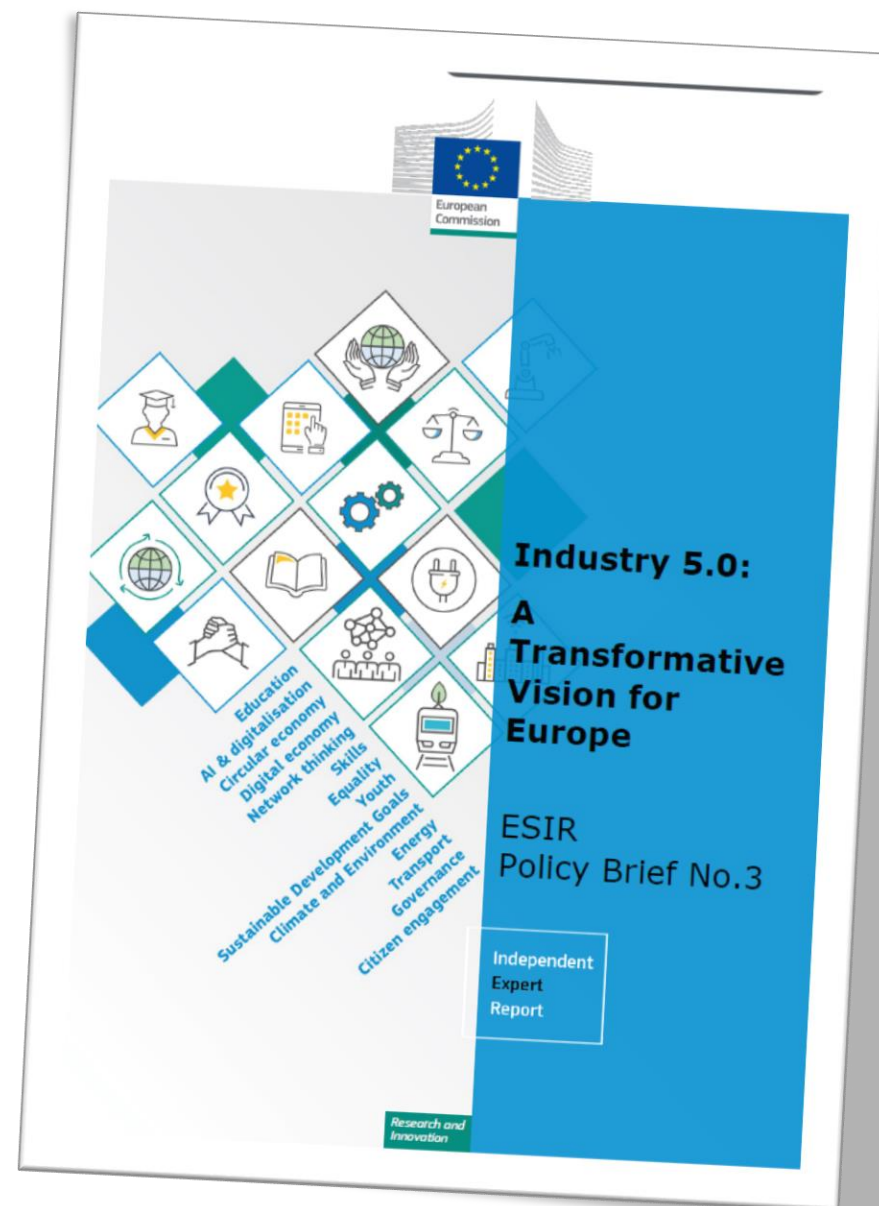
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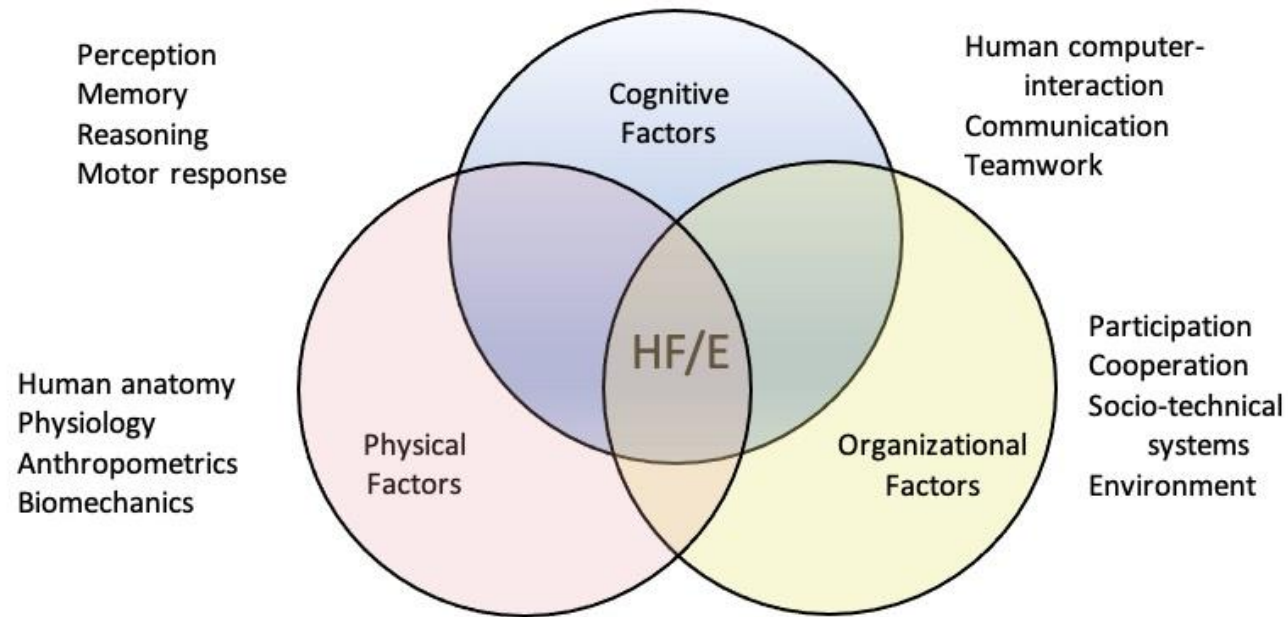




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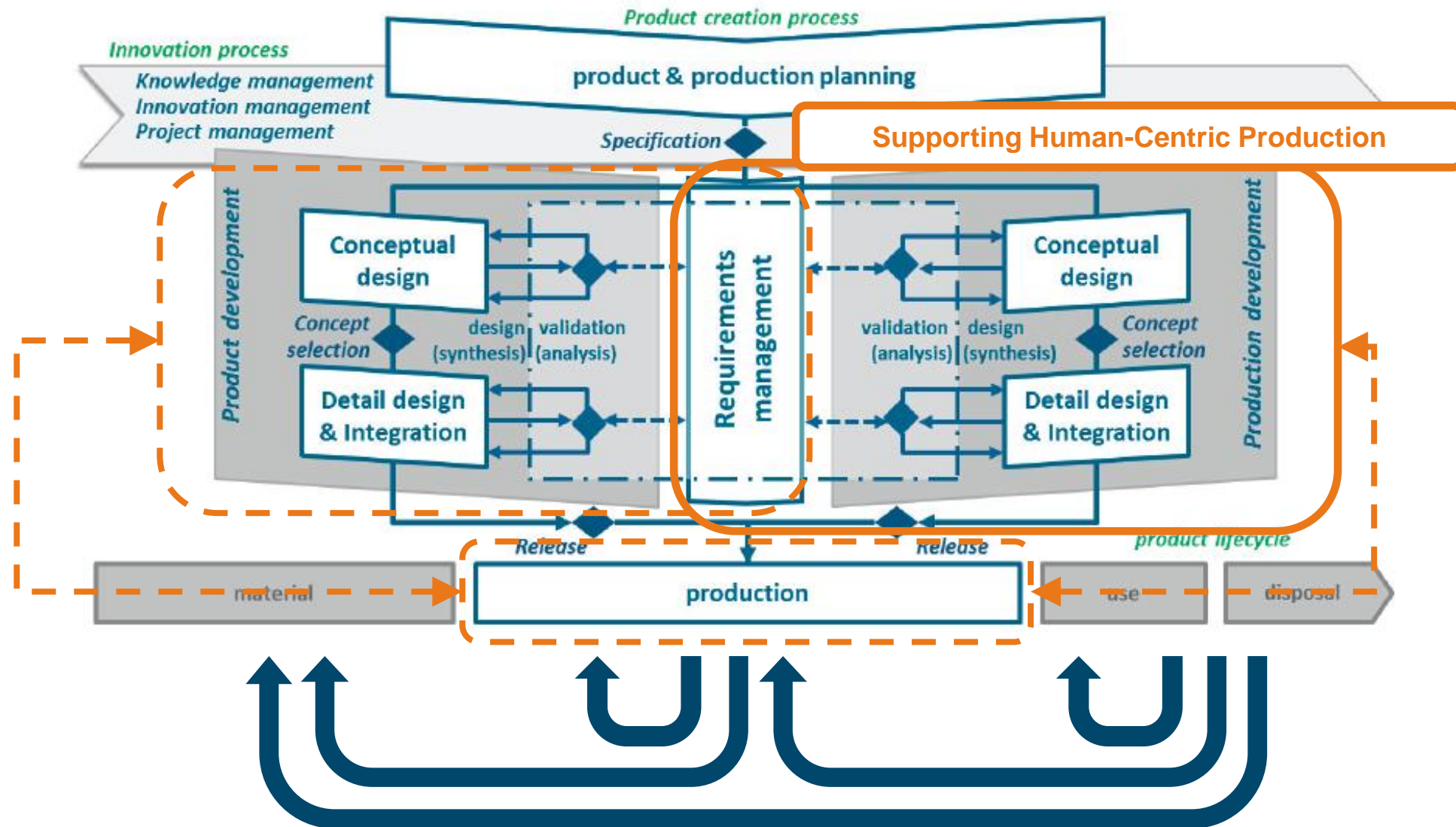
Ergonomics (Human Factors)



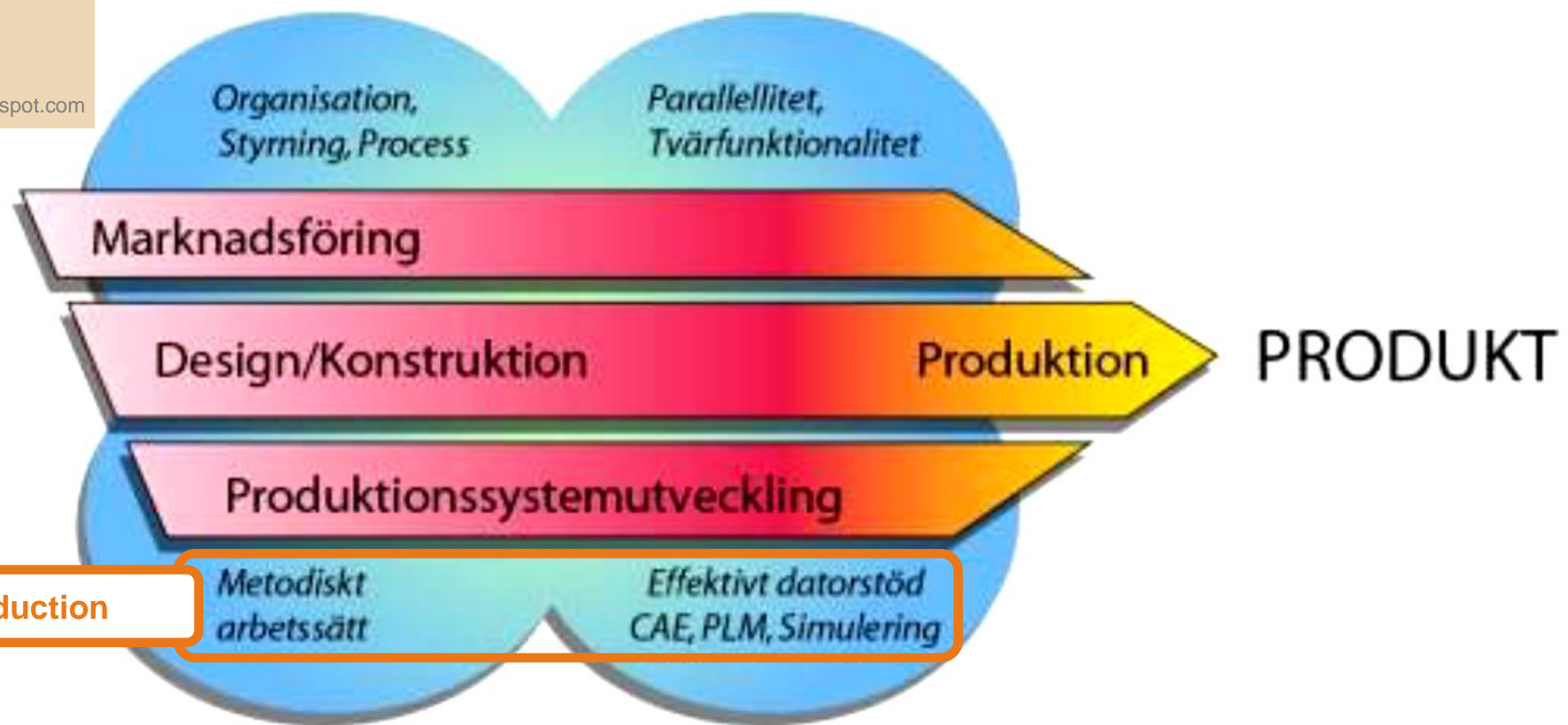
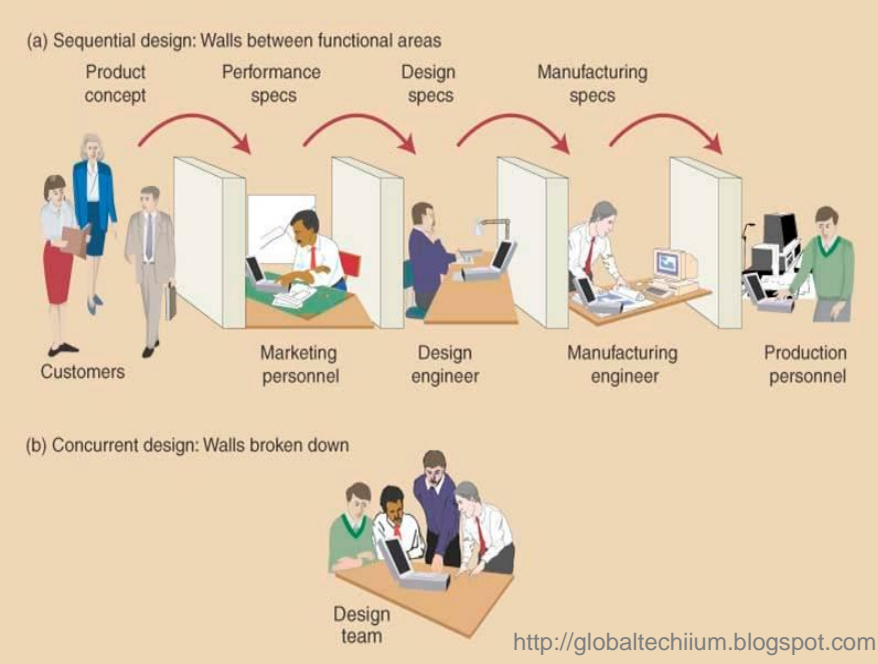
Ergonomics principles are rooted in essential core values:

- humans as assets
- technology as a tool to assist humans,
- promotion of quality of life,
- respect for individual differences, and
- responsibility to all stakeholders.

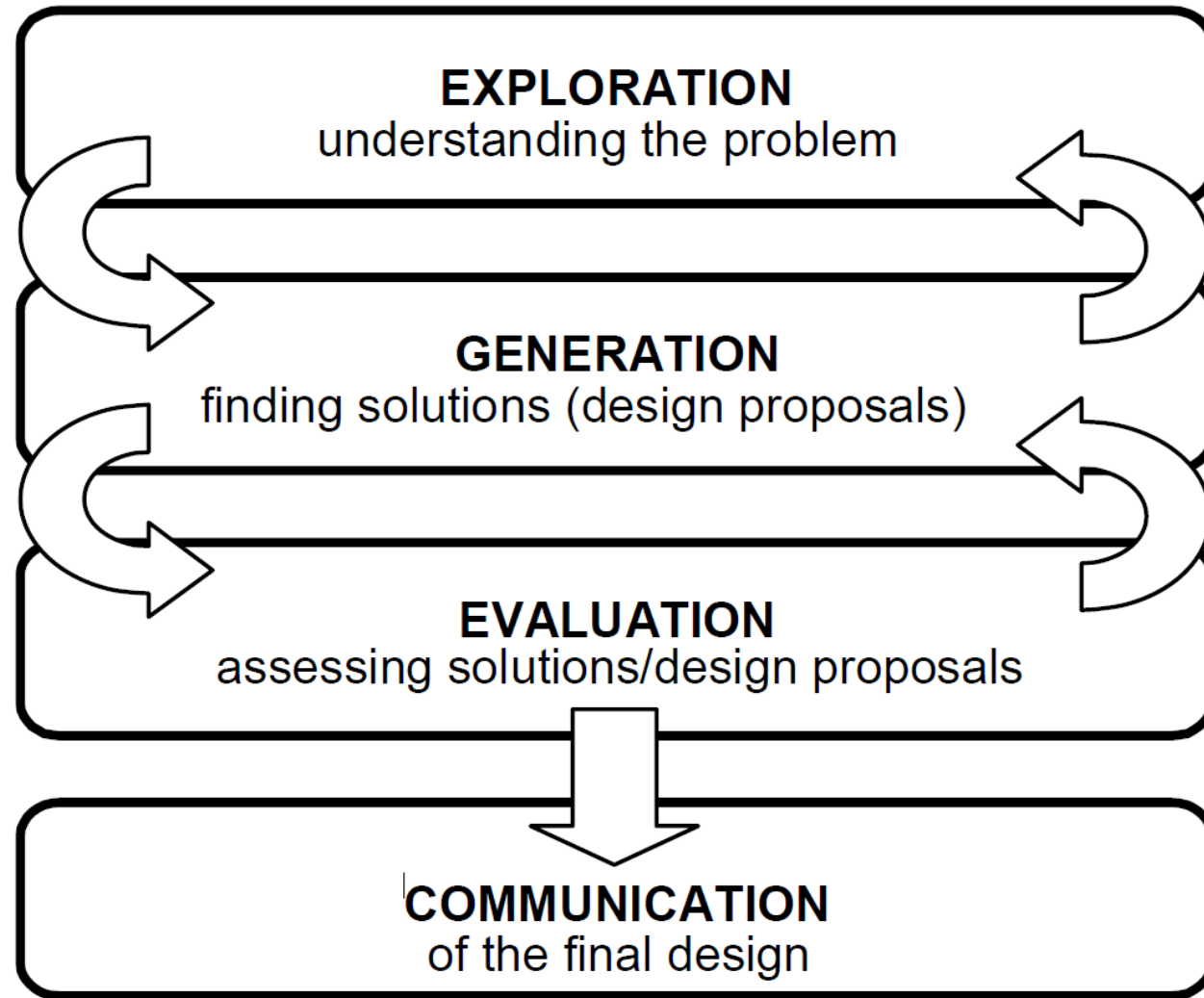
Ergonomics focuses on optimizing two closely related outcomes: Performance and Well-Being

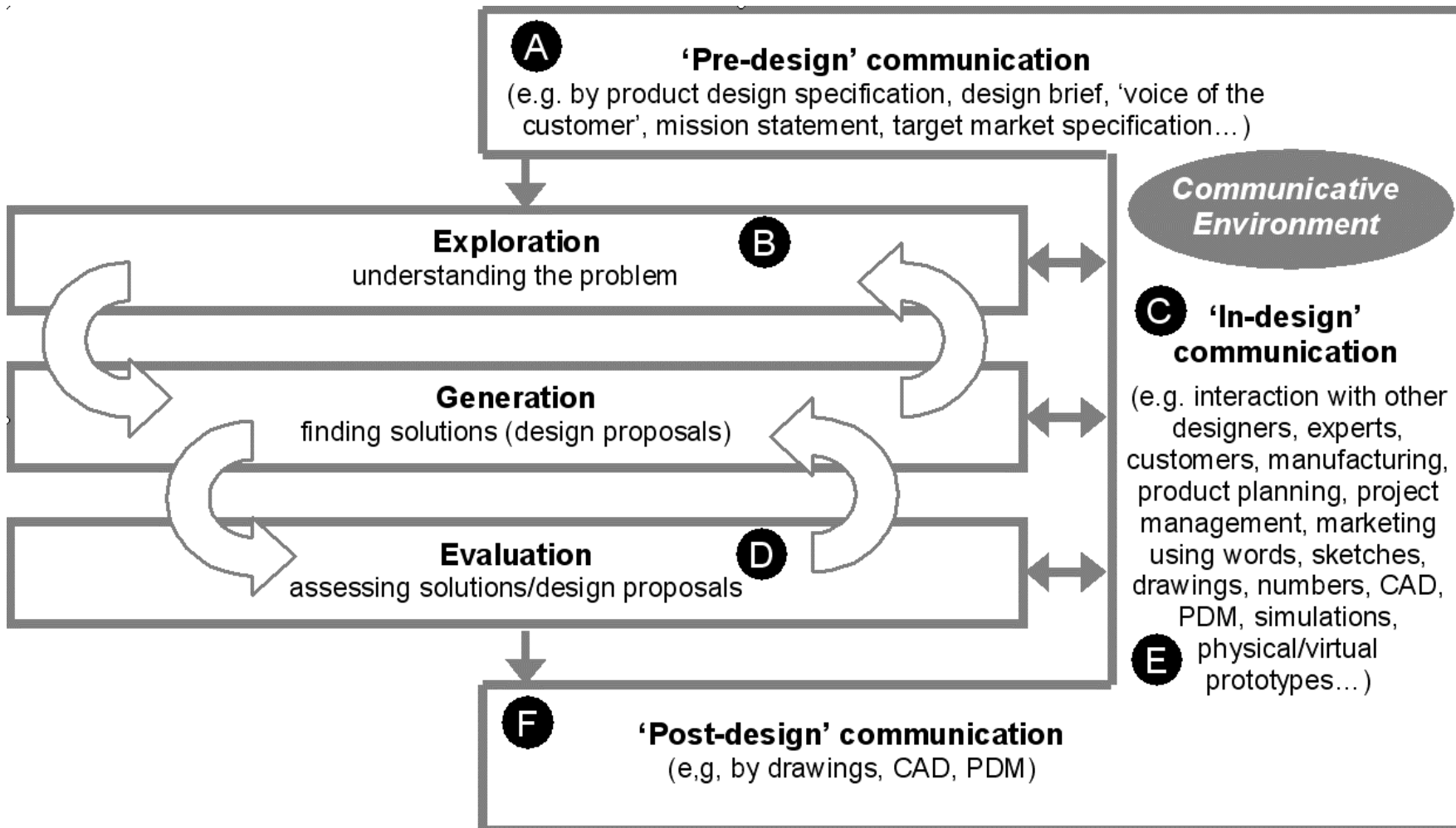


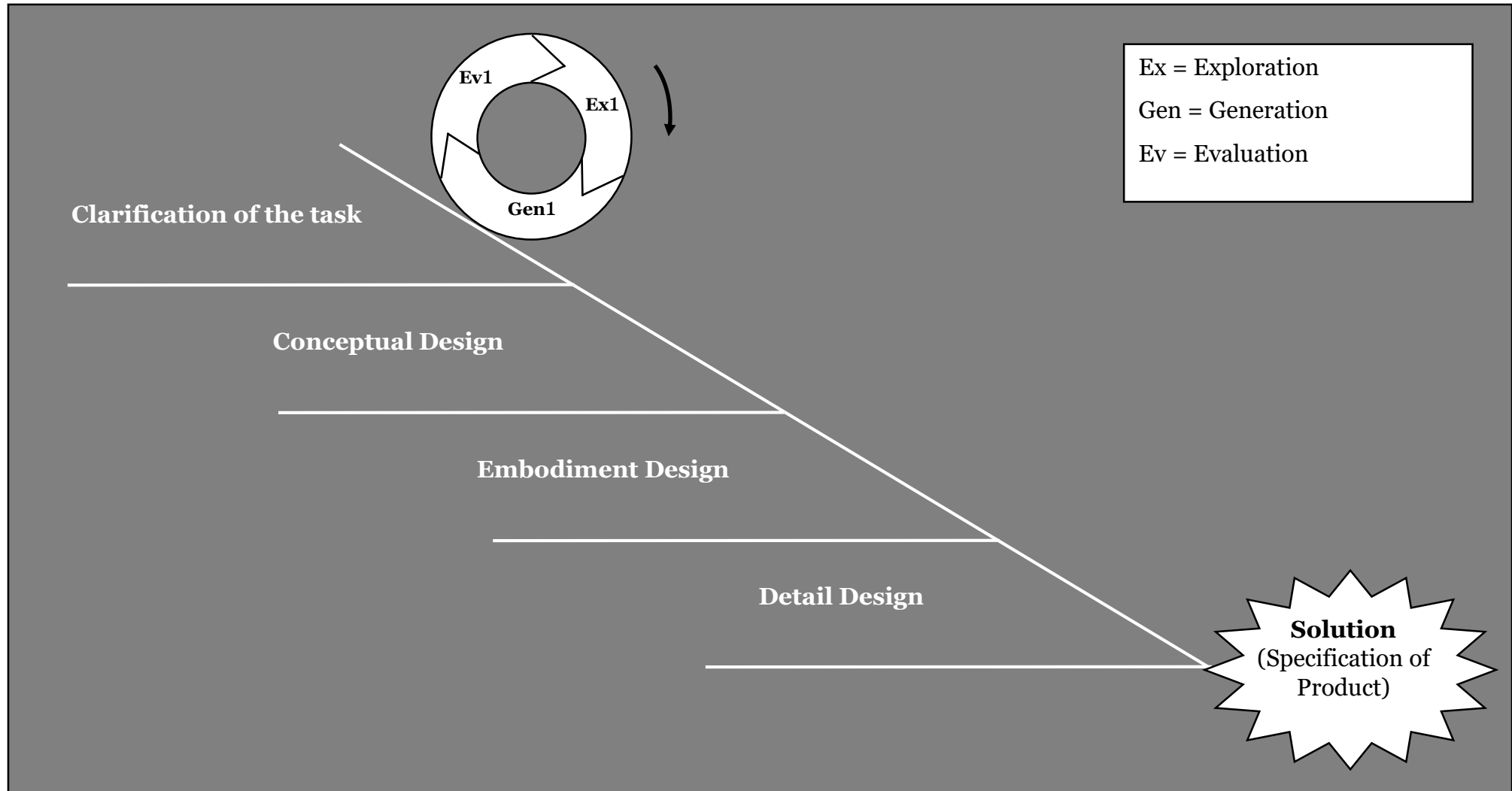
Modified from Vielhaber and Stoffels, 2014



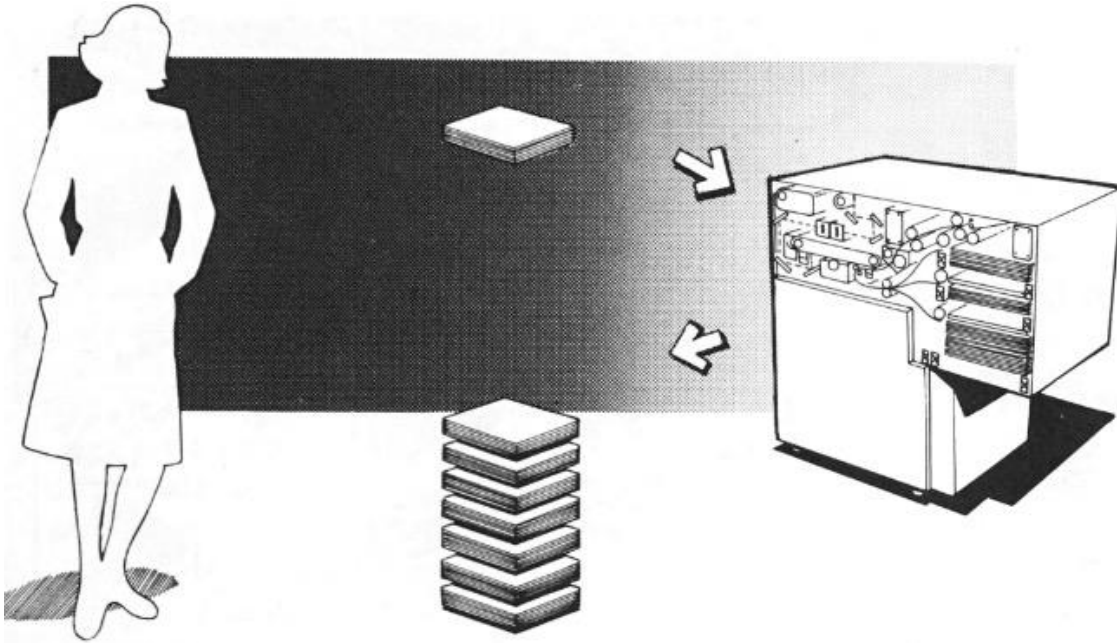
Supporting Human-Centric Production



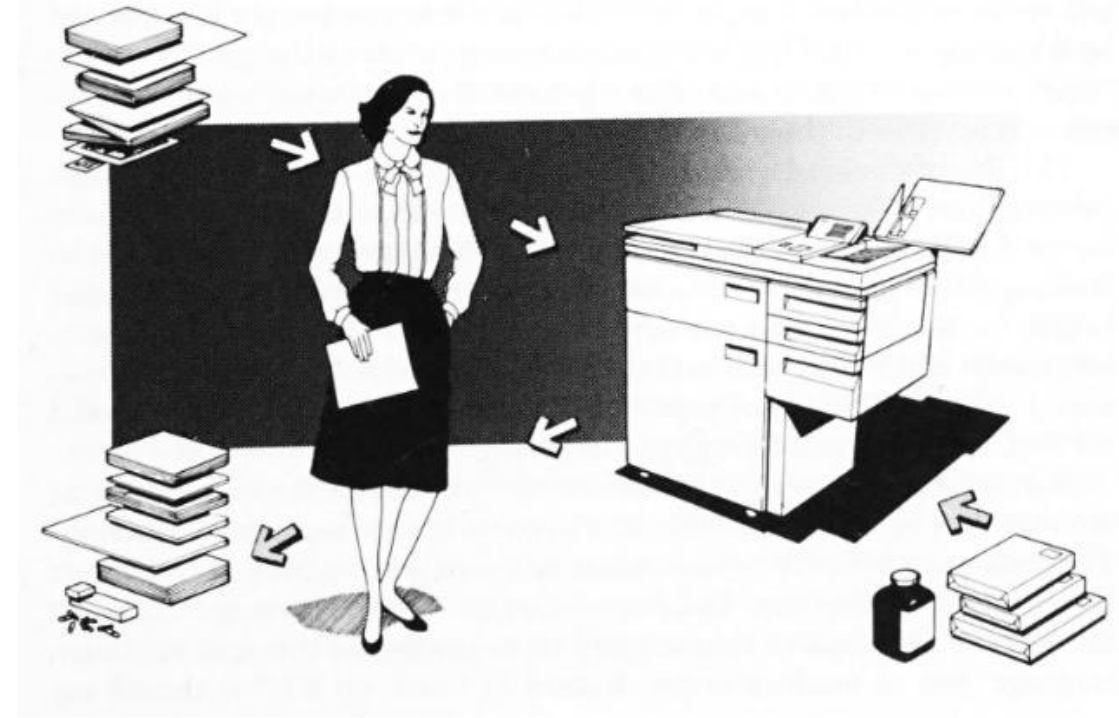




Machine centred view

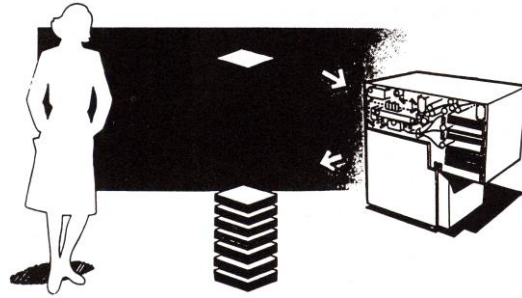


System view / User and use centred view

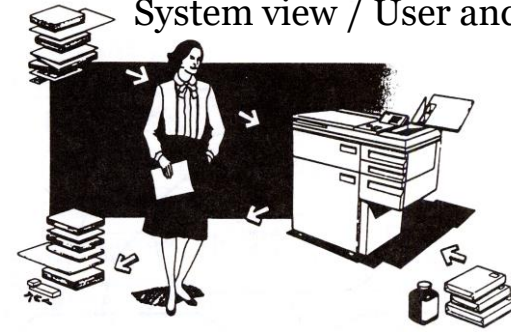


Ergonomics: Harness the Power of Human Factors in Your Business (1989), by Edmund Klemmer (Editor).
Chapter: Redesigning Xerox: A Design Strategy Based on Operability by Arnold S. Wasserman.

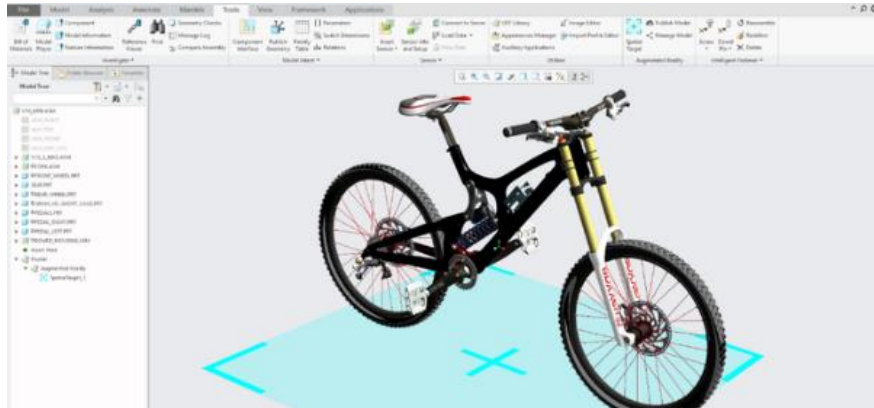
Machine centred view



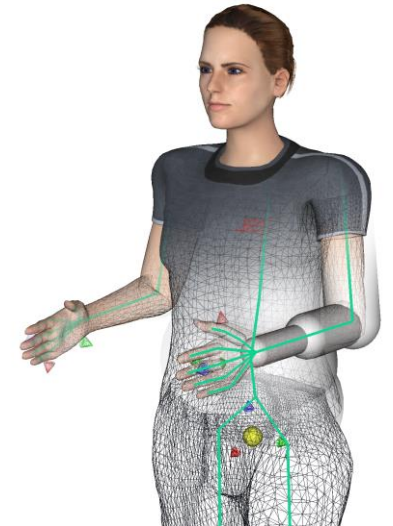
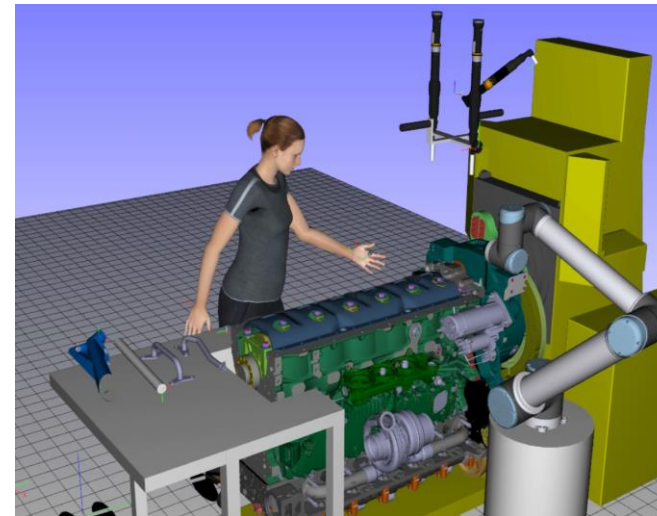
System view / User and use centred view

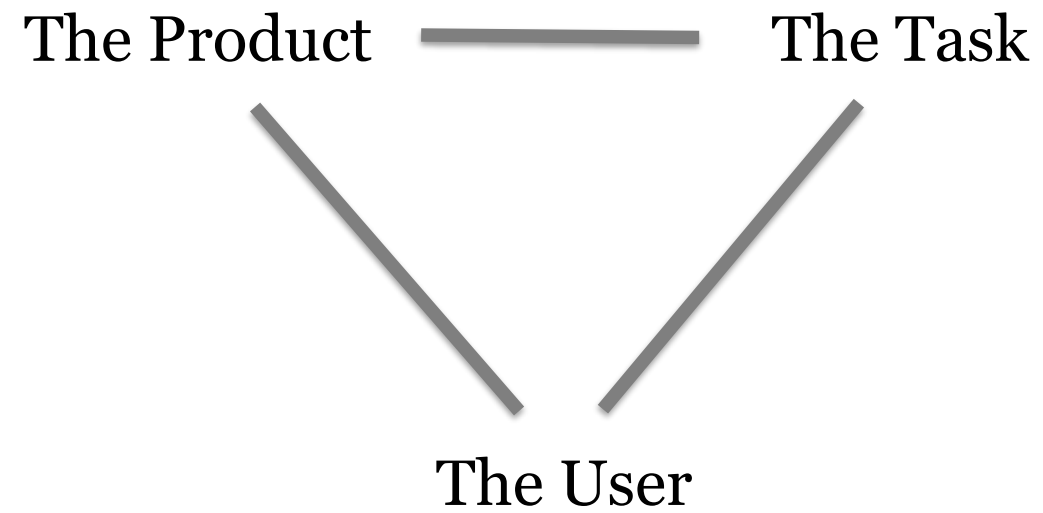


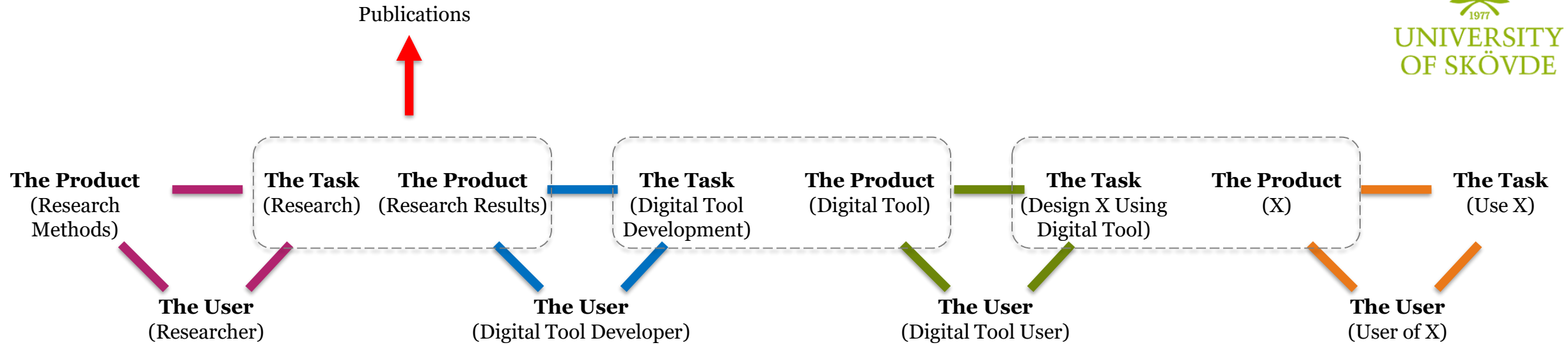
CAD/CAE/Simulation tools



CAD/CAE/Simulation tools & Digital Humans







Stakeholder Effects Logic for Societal Impact

Researchers

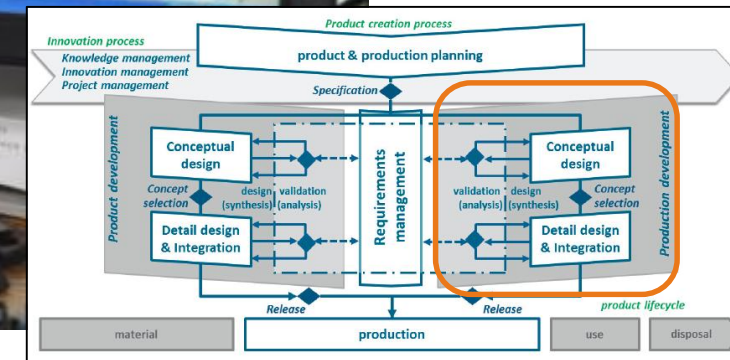
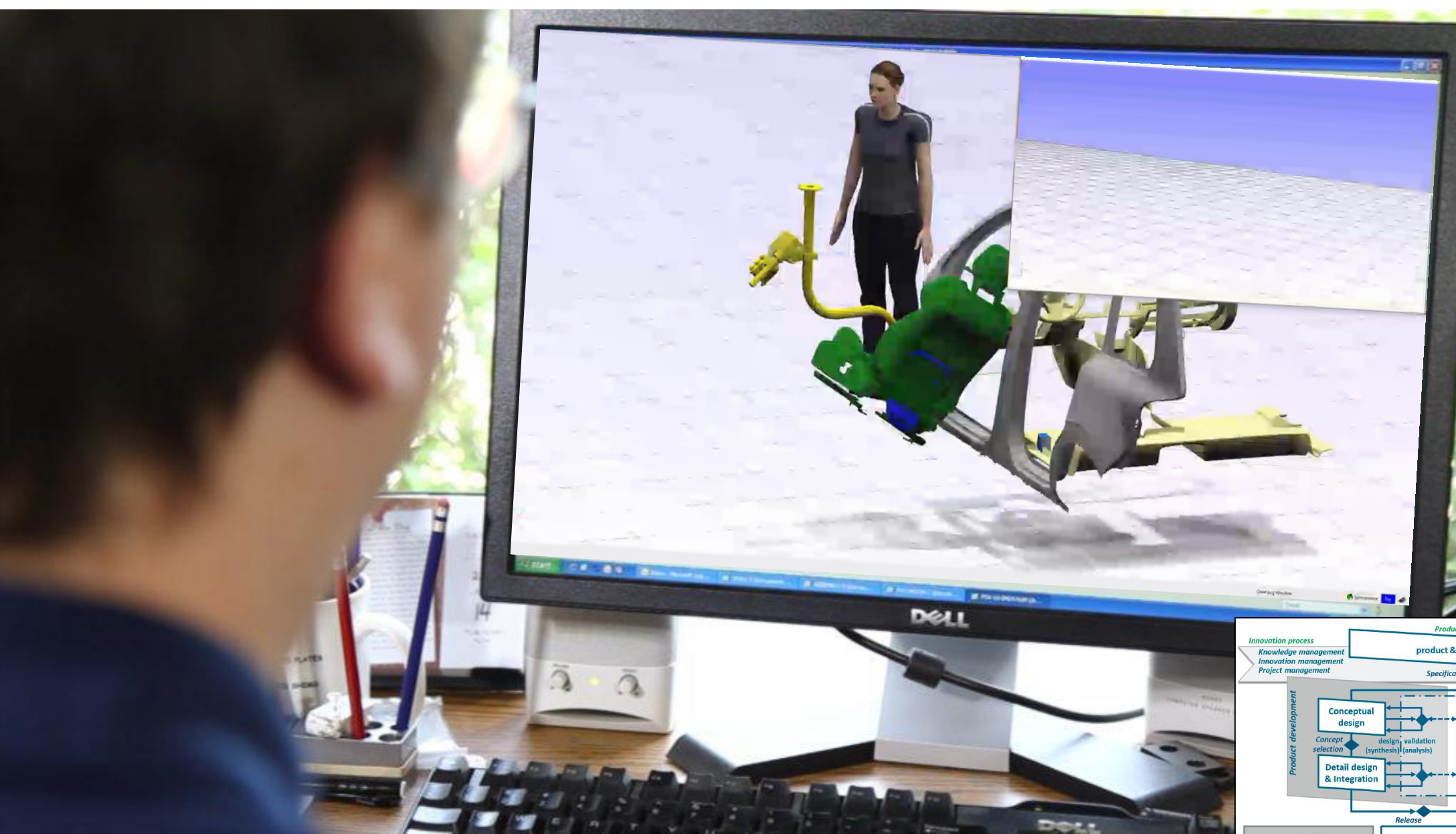
Software
Developers

Engineers

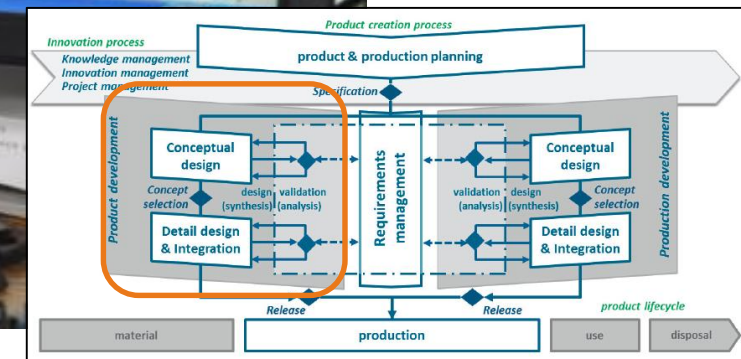


Workers / End Users

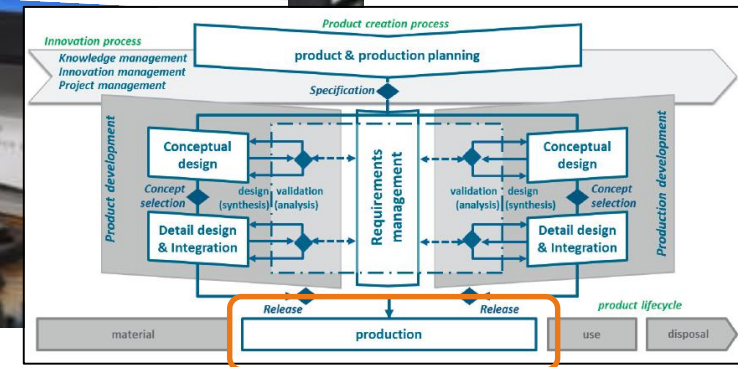
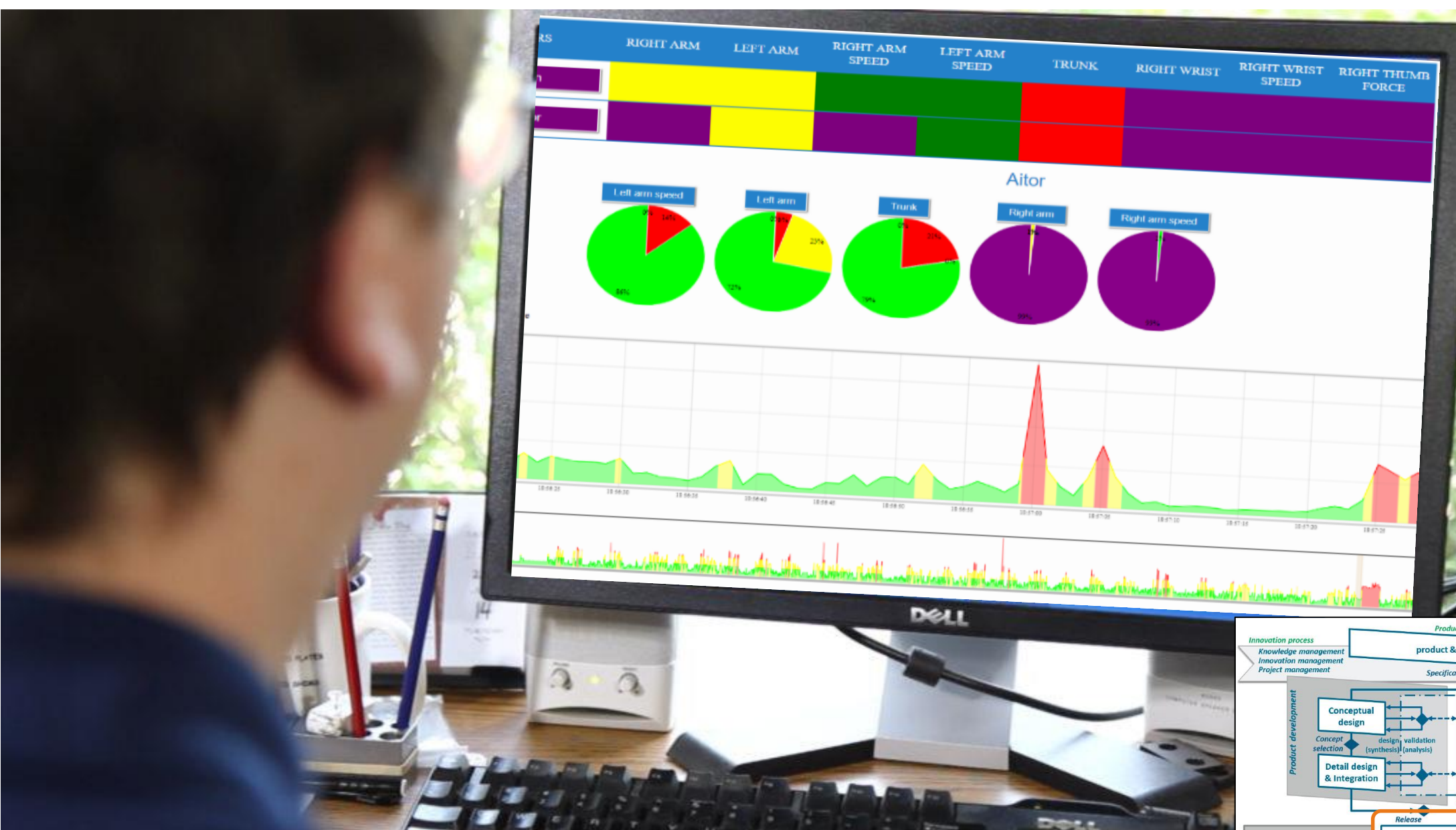




Proactive design for **assembly** (production) ergonomics, already in the virtual world (IPS IMMA, Volvo Cars)



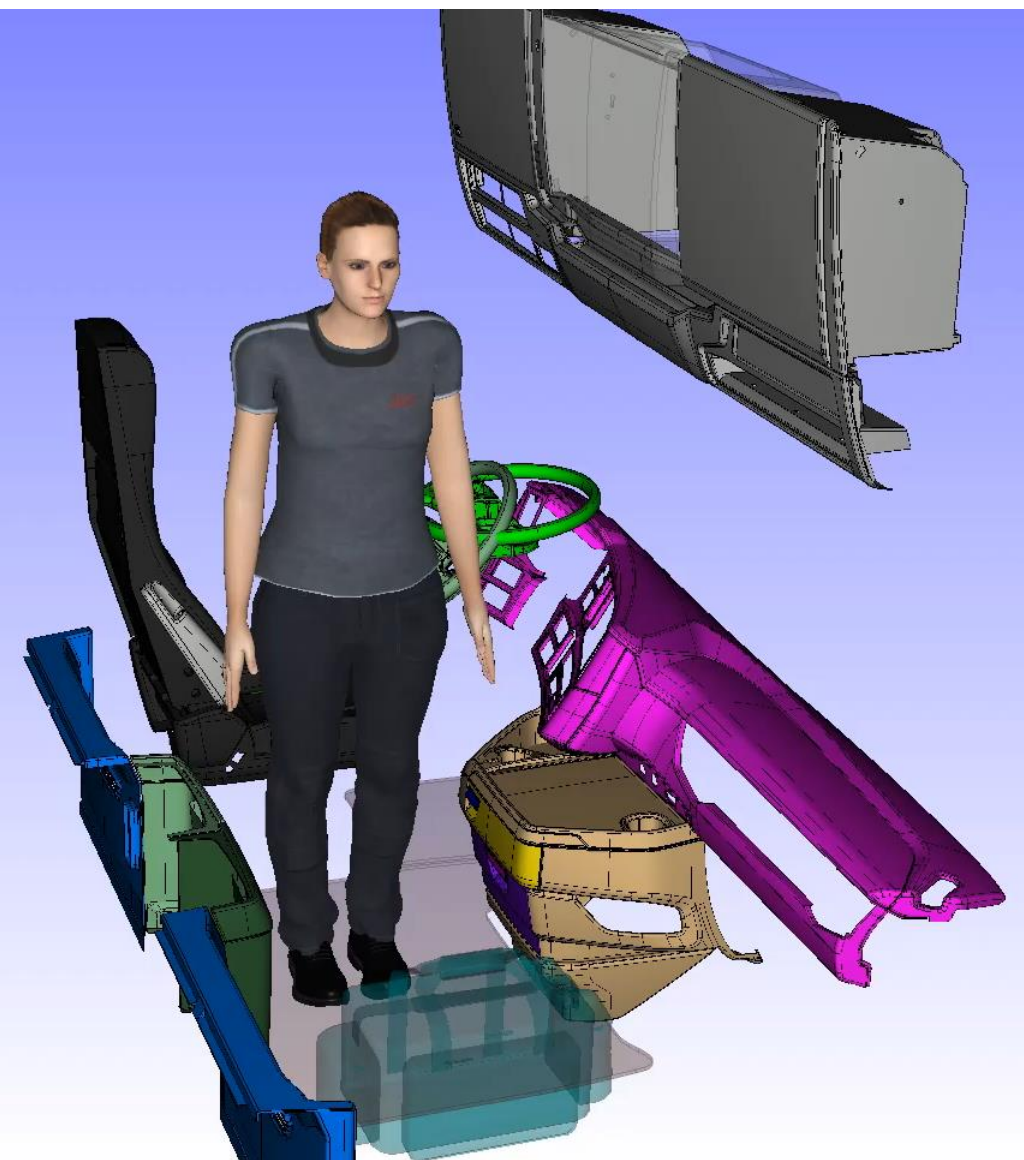
Proactive design **vehicle** (product) ergonomics, already in the virtual world (IPS IMMA, Volvo Trucks)



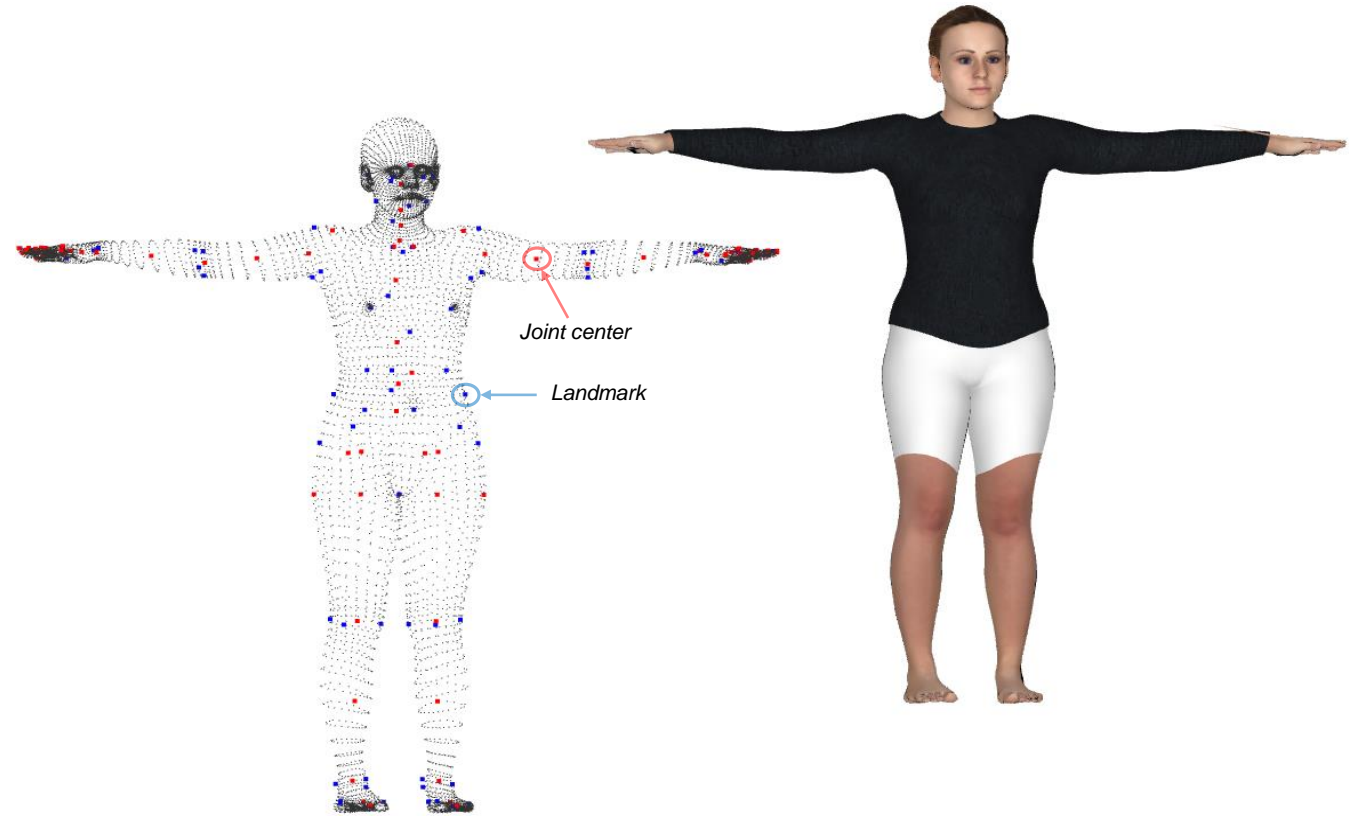
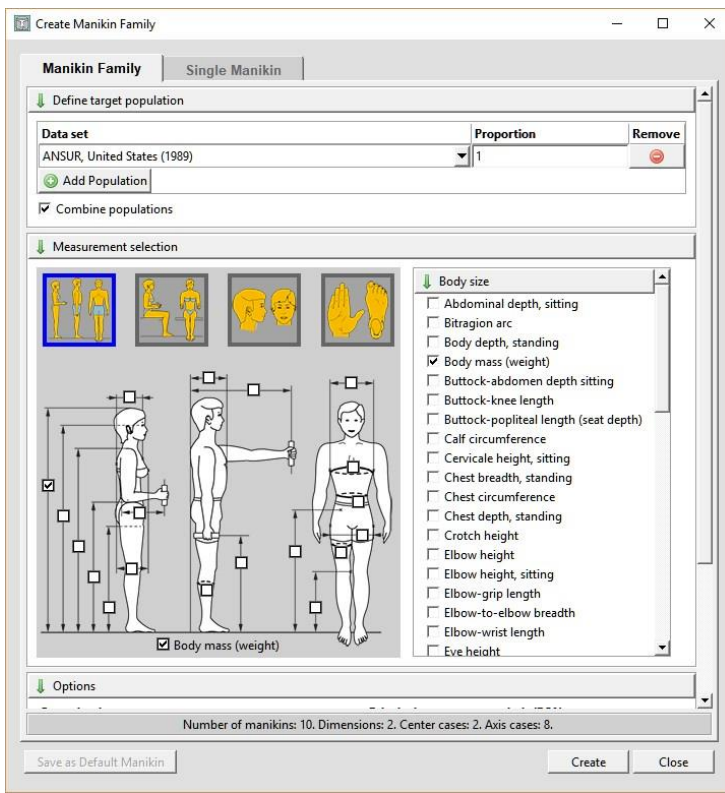
Support engineers and ergonomists to ensure good ergonomics for all operators (HiS, Smart Textiles project)

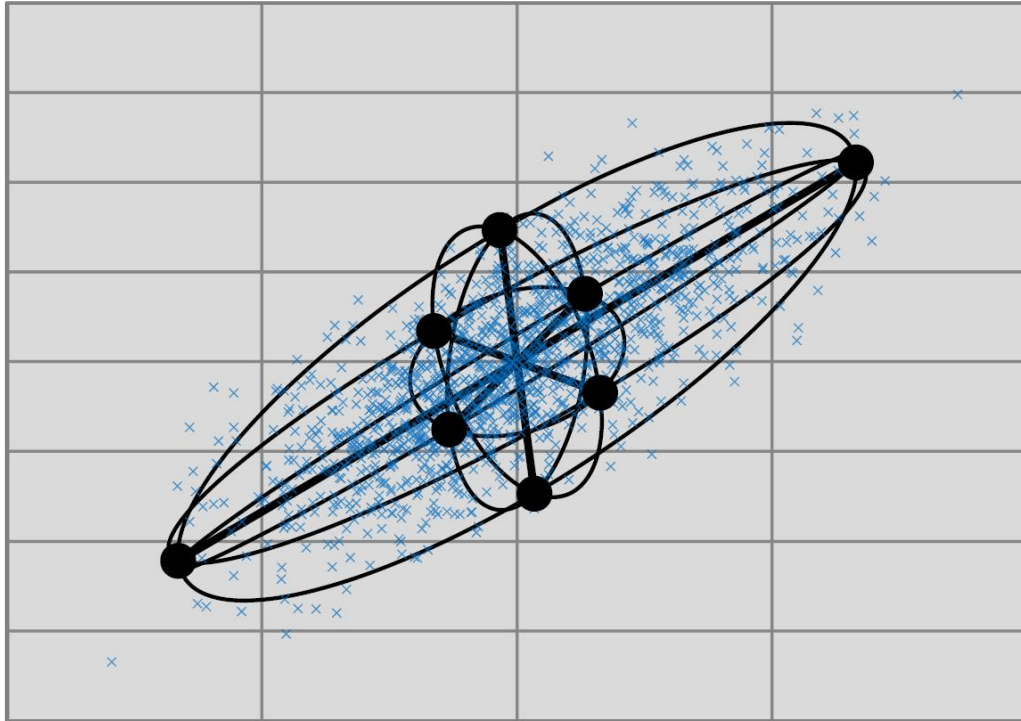


Simulation (in a point cloud scanning) of the Production Systems Lab at Chalmers (IPS IMMA, Chalmers)

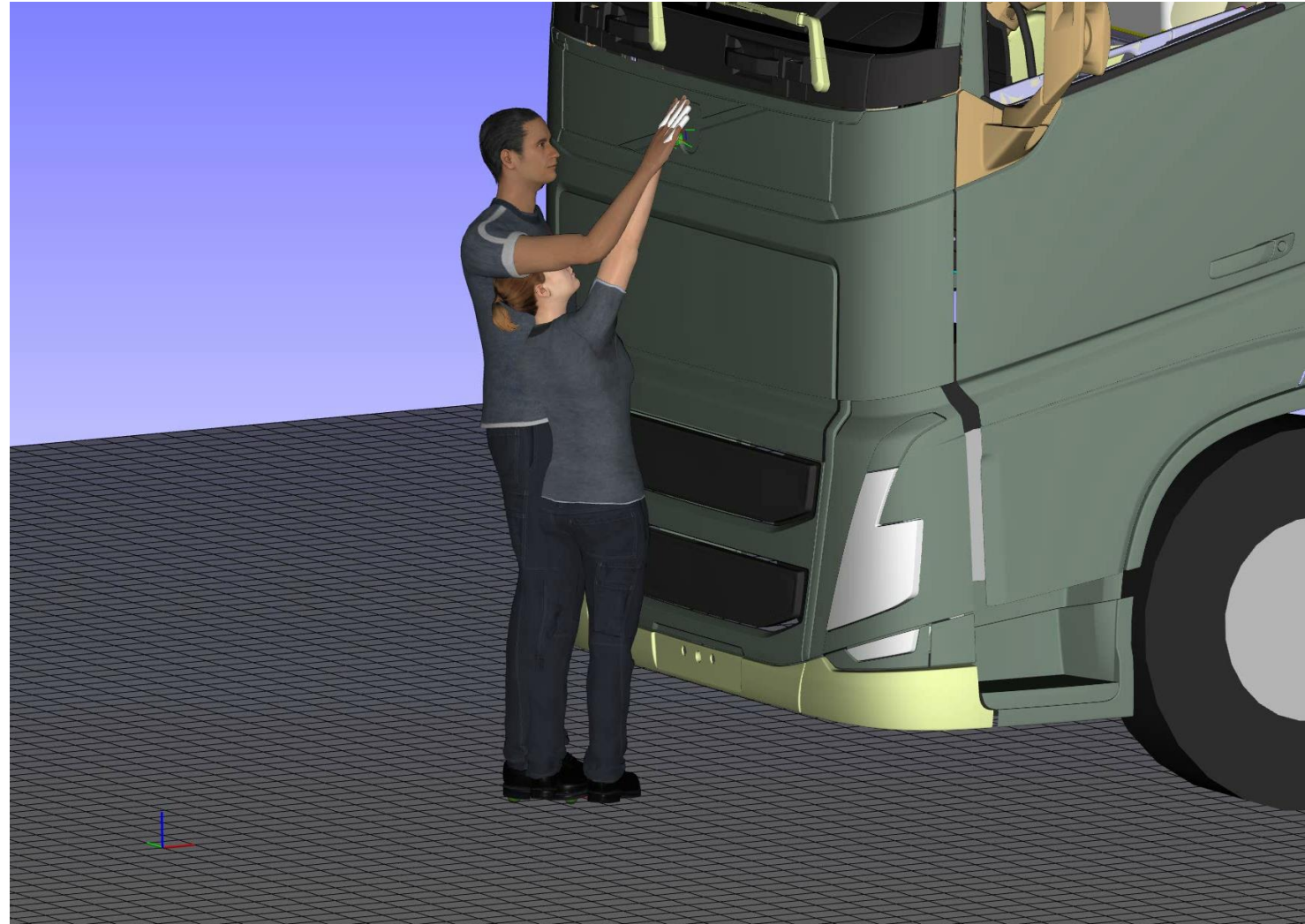


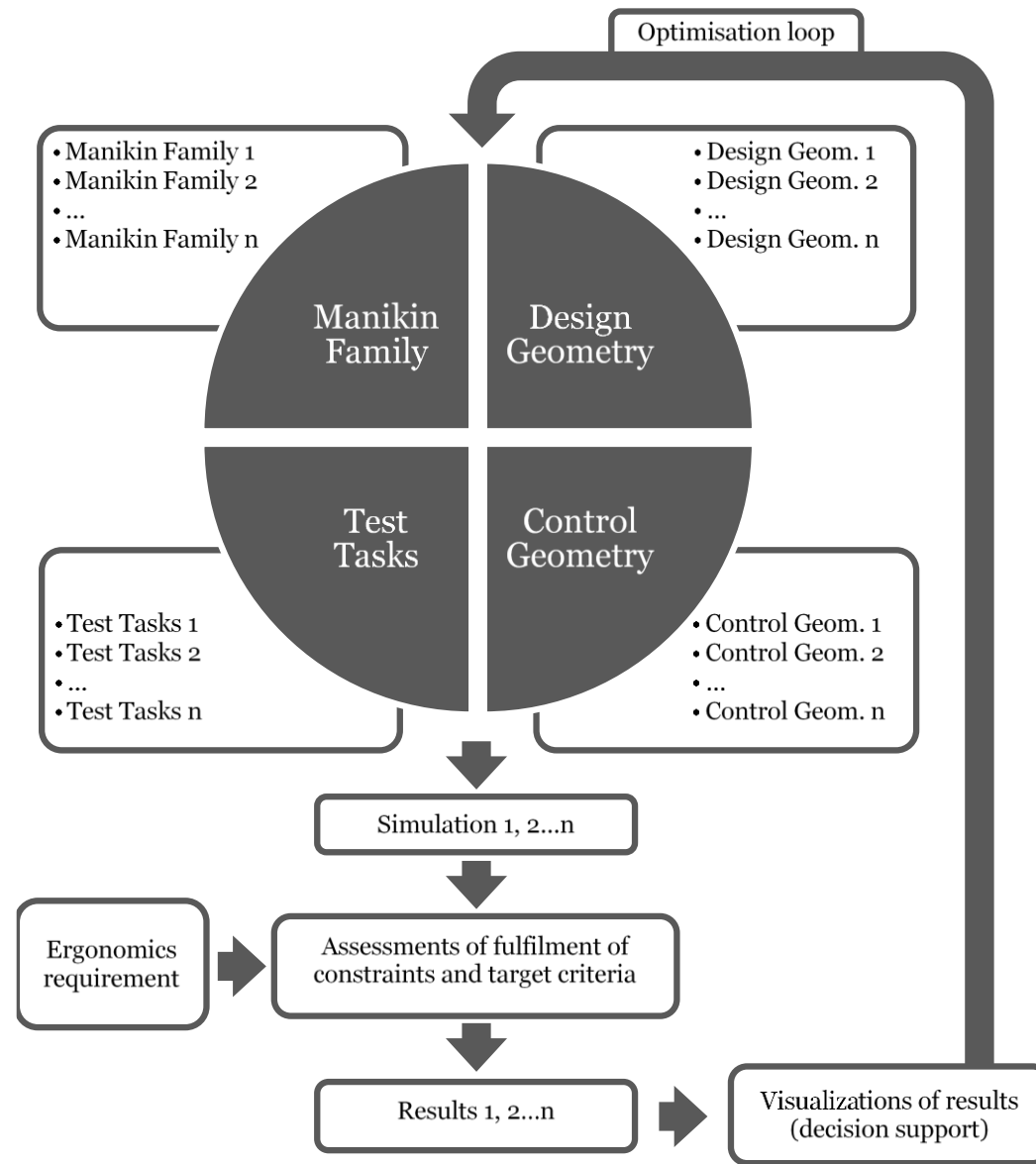
Simulation of vehicle (product) ergonomics (IPS IMMA / Scania / Volvo Trucks / Volvo Cars)

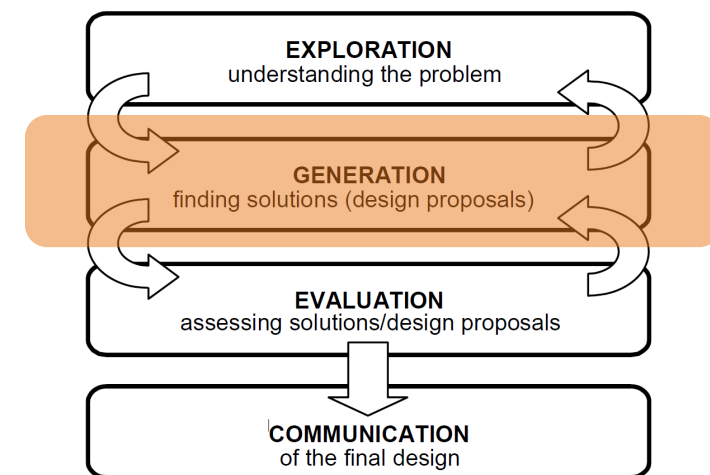
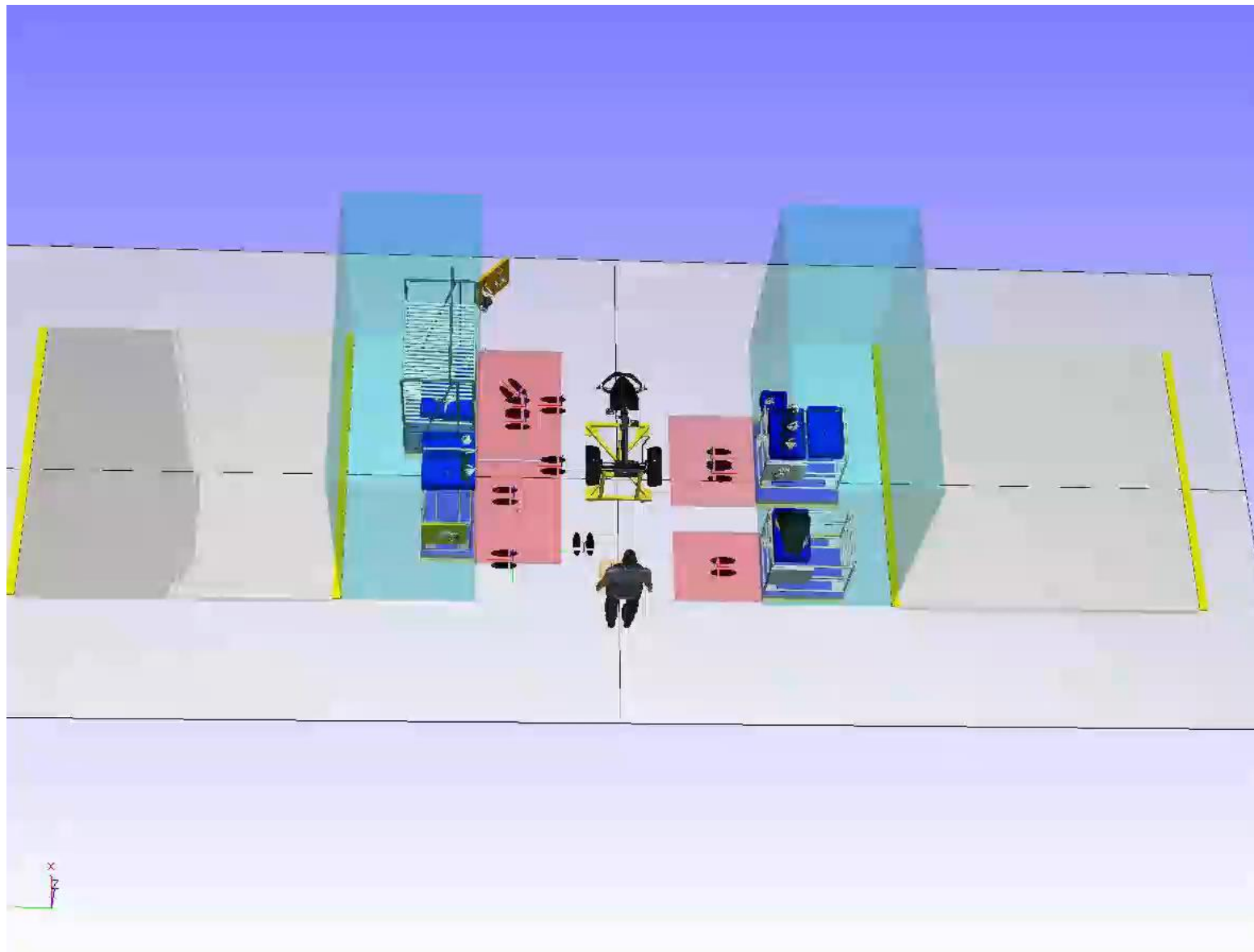




Four dimensional confidence hyper-ellipsoid, viewed in one of the six orthogonal projections

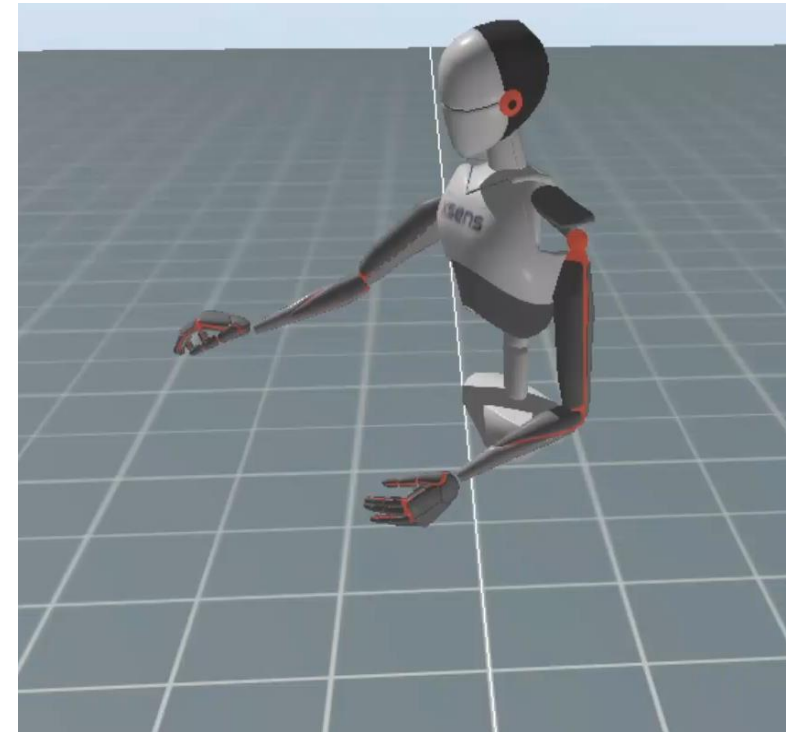
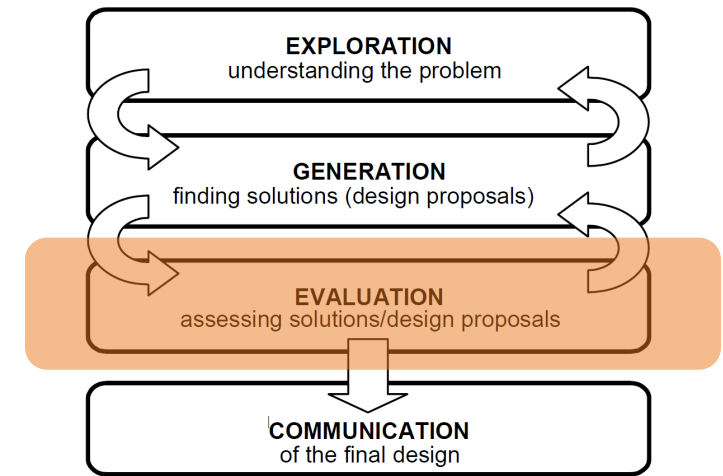




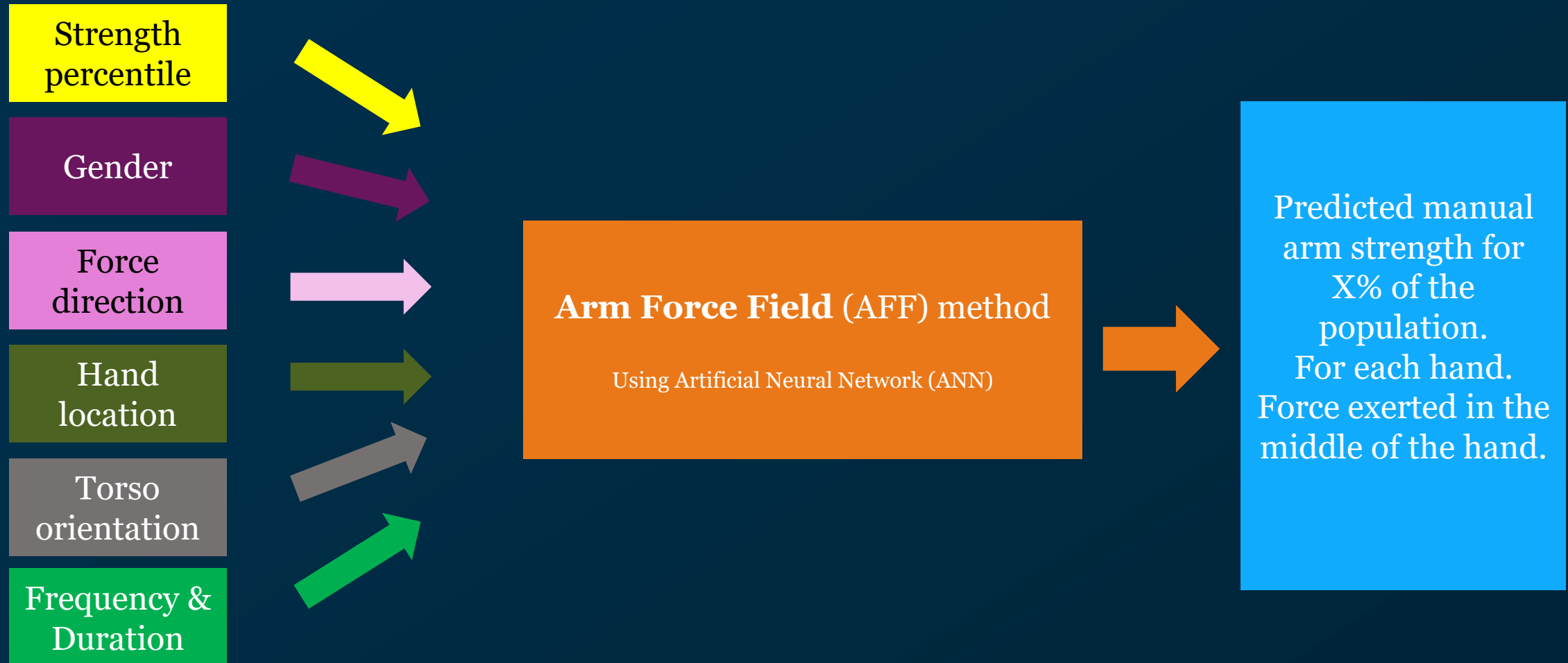


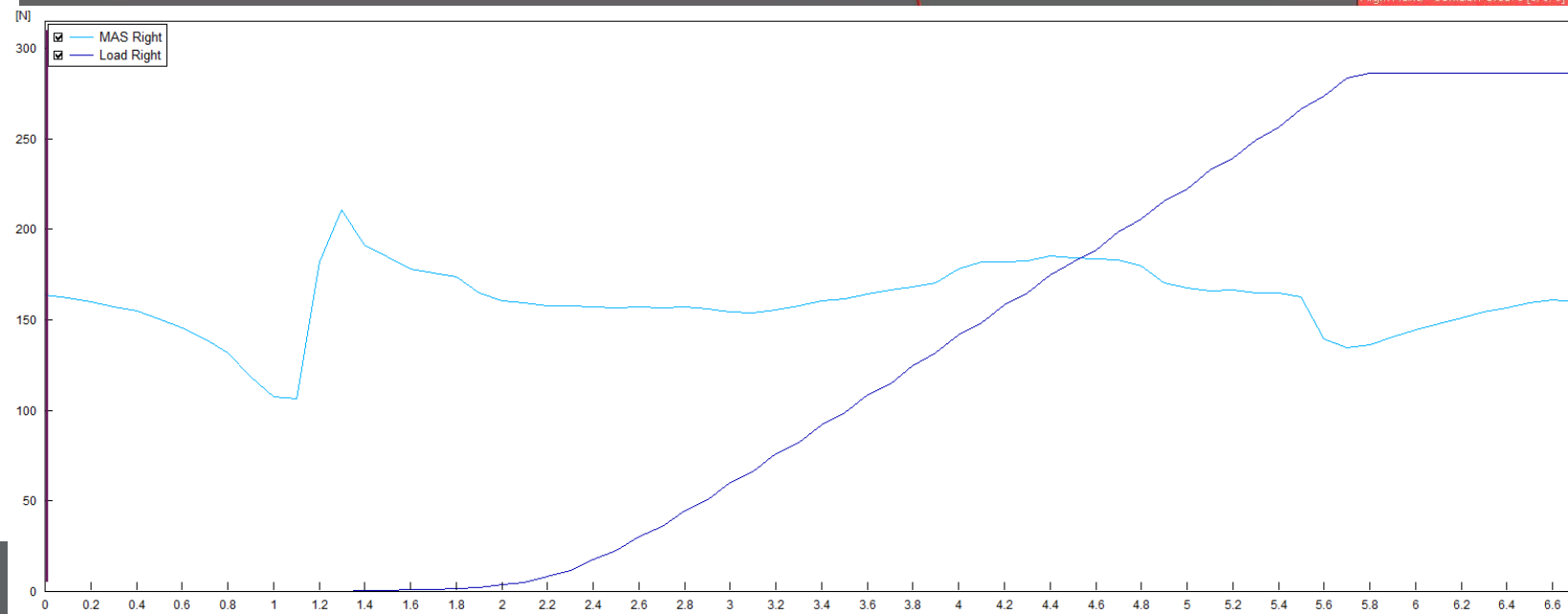
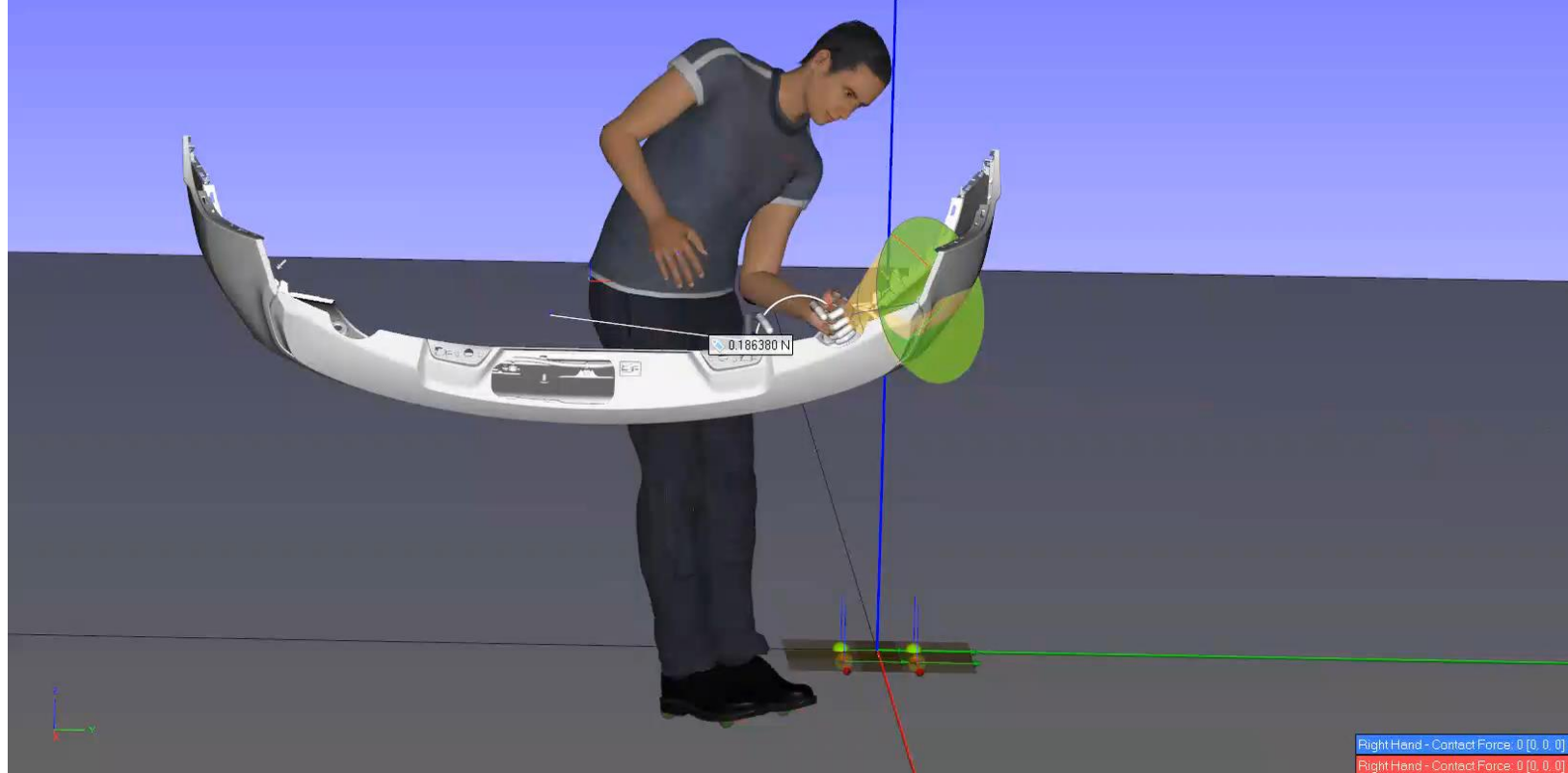
Scania Smart
Factory Lab

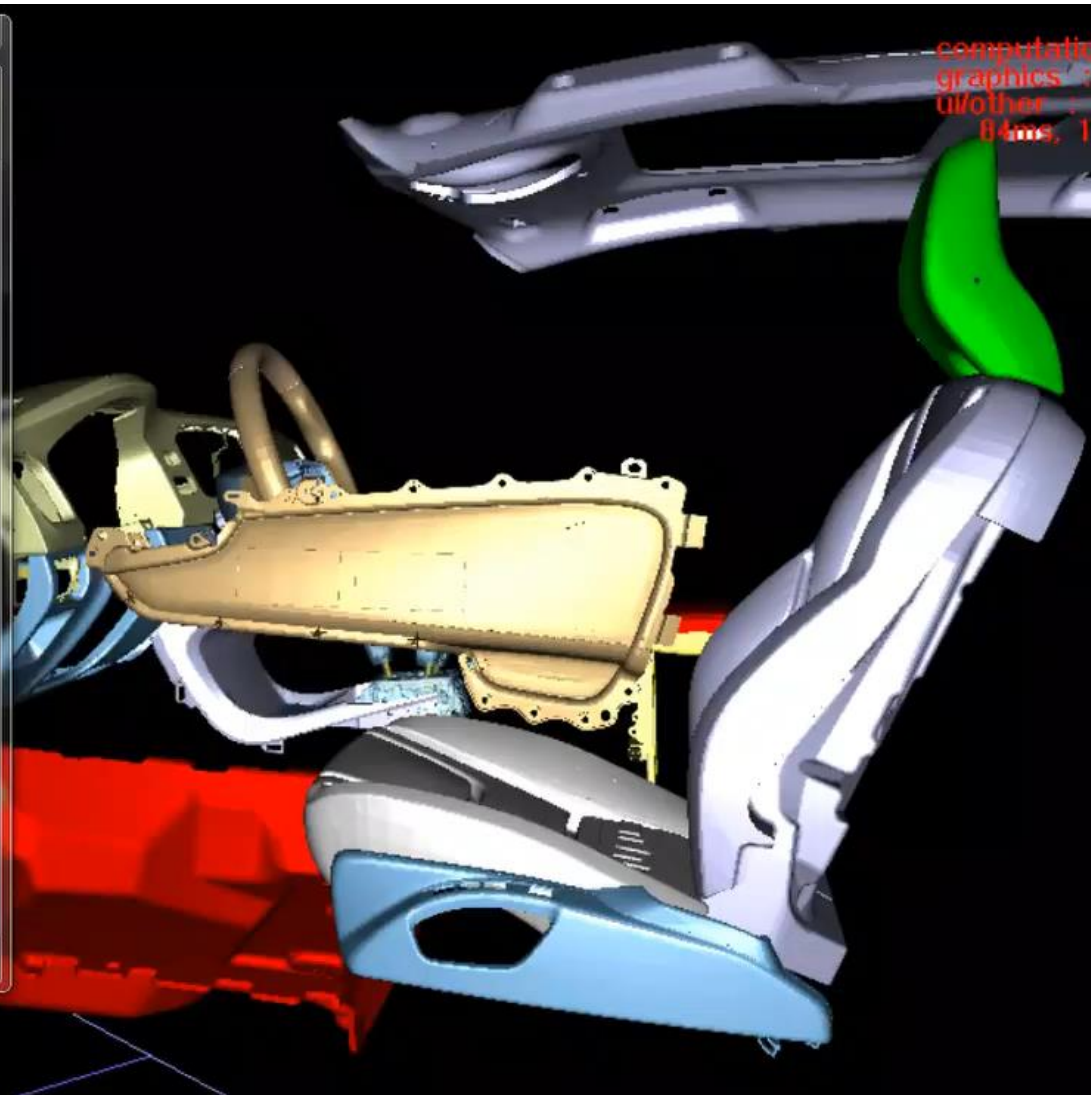
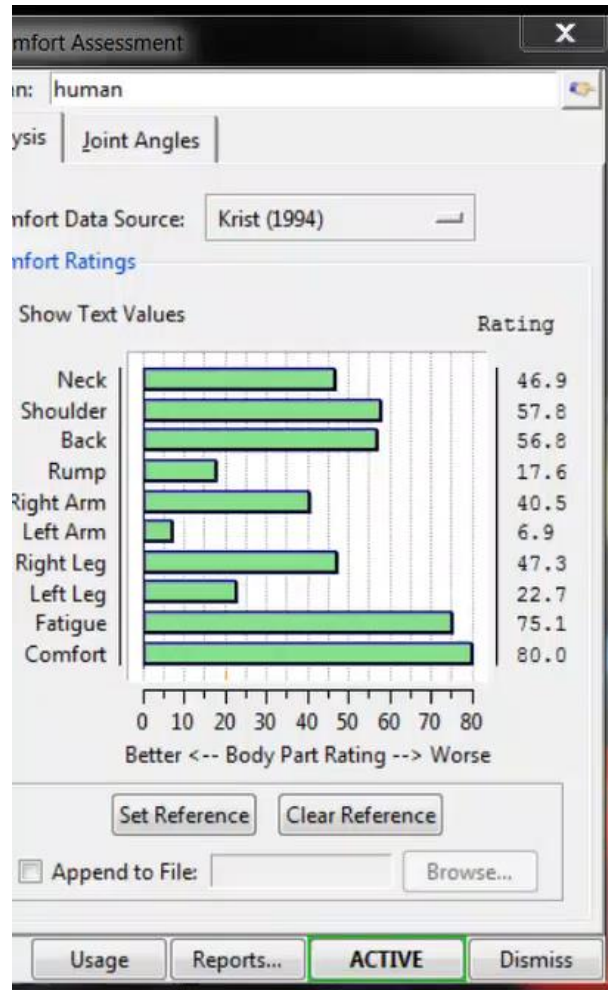
CLASSIFICATION OF HANDGRIPS



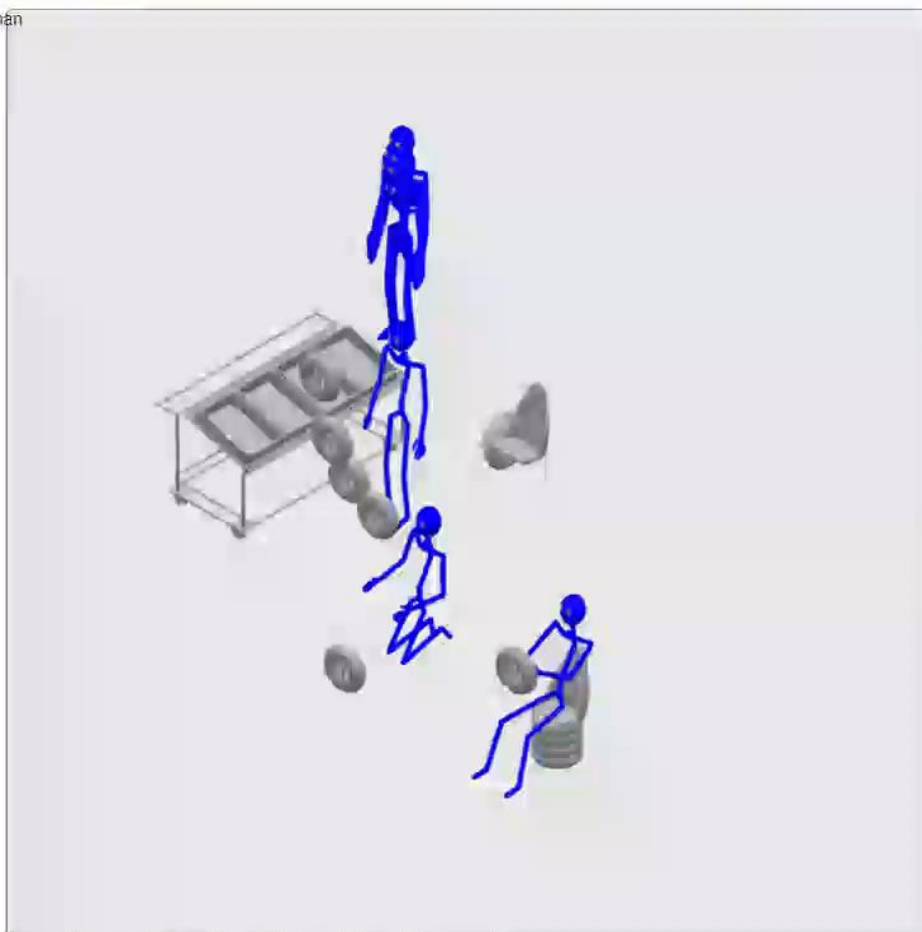
ARM FORCE FIELD (AFF) METHOD







- ☐ CC2201L_forceatlas3_multiman
 - ☐ Active Objects
 - ☐ Static Geometry
 - Measures
 - Mechanisms
 - ☐ Processes
 - ☐ Simulations



ISO Front Back Left Right Top Bottom

- ☒ Grayscale
- ☒ Detailed geometry
- ☐ Show value adding markers
- ☒ Draw spaghetti

- Standing

00:00:00.0

- Family 1

- Male_w=78_s=1756

+ Stickie View

+ Force Area

+ Value Adding Time

+ Graphs

+ Interactions

+ Interactions

- OWAS

Open OWAS Assessment

Current State:

Lundqvist index:100

Action Category:1

Both arms below shoulder level

Back straight

Standing on both legs straight

10kg or less

+ Kneeling

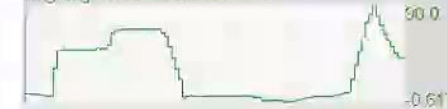
+ Sitting

+ Walkabout

Options

Back bend

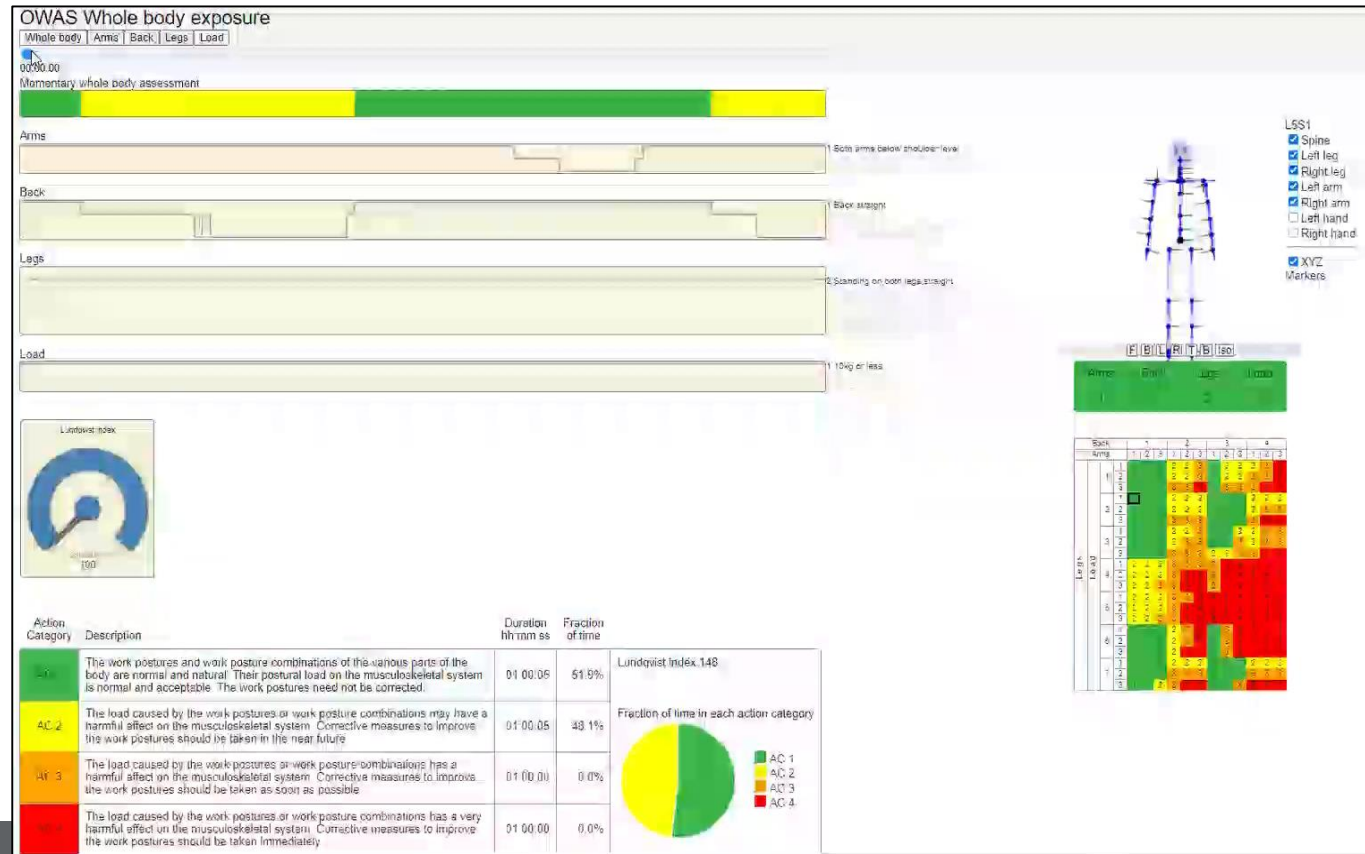
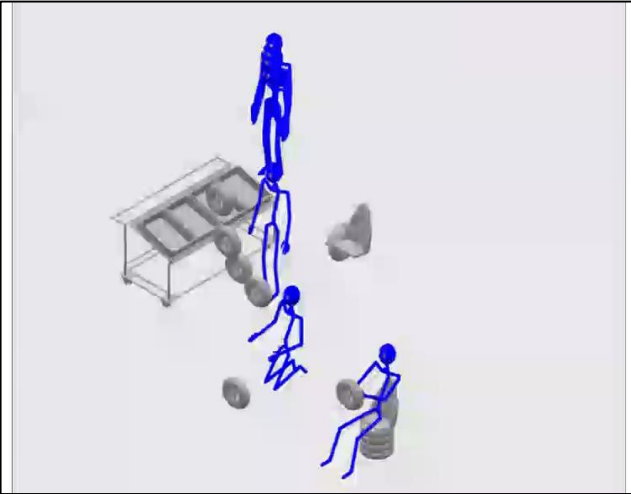
Ang deg -7.334613081564445



Owas velocity

m/s: 0





United Nations 2030 agenda for sustainable development

Goal 3: Ensure healthy lives and promote well-being for all at all ages.

3 GOOD HEALTH AND WELL-BEING



Target 3.D. Emergency preparedness

Strengthen the capacity...for **early warning**,
risk reduction and management of...health risks.



and:

Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

8 DECENT WORK AND ECONOMIC GROWTH



Target 8.2. Diversify, Innovate and Upgrade for Economics Productivity

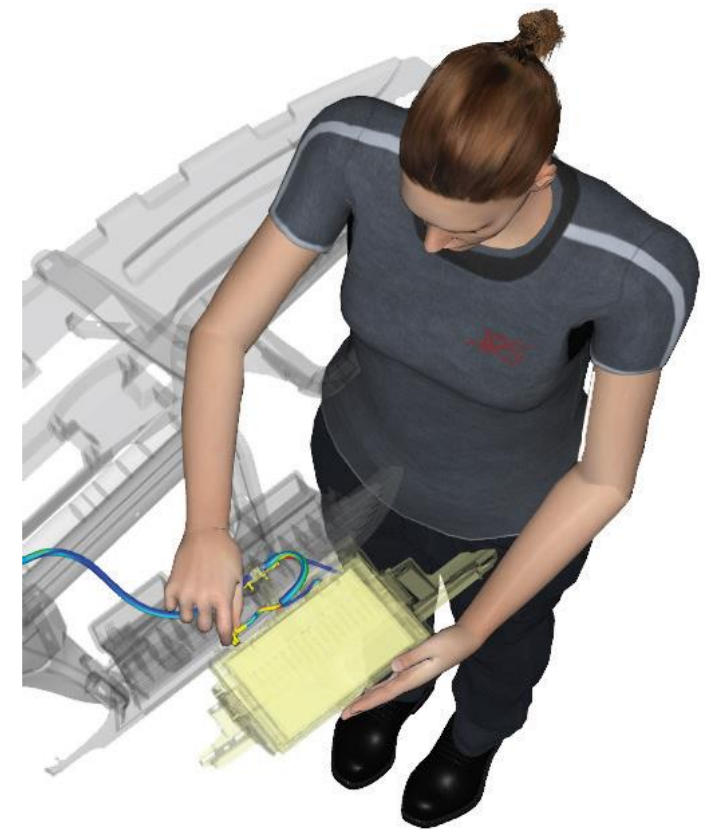
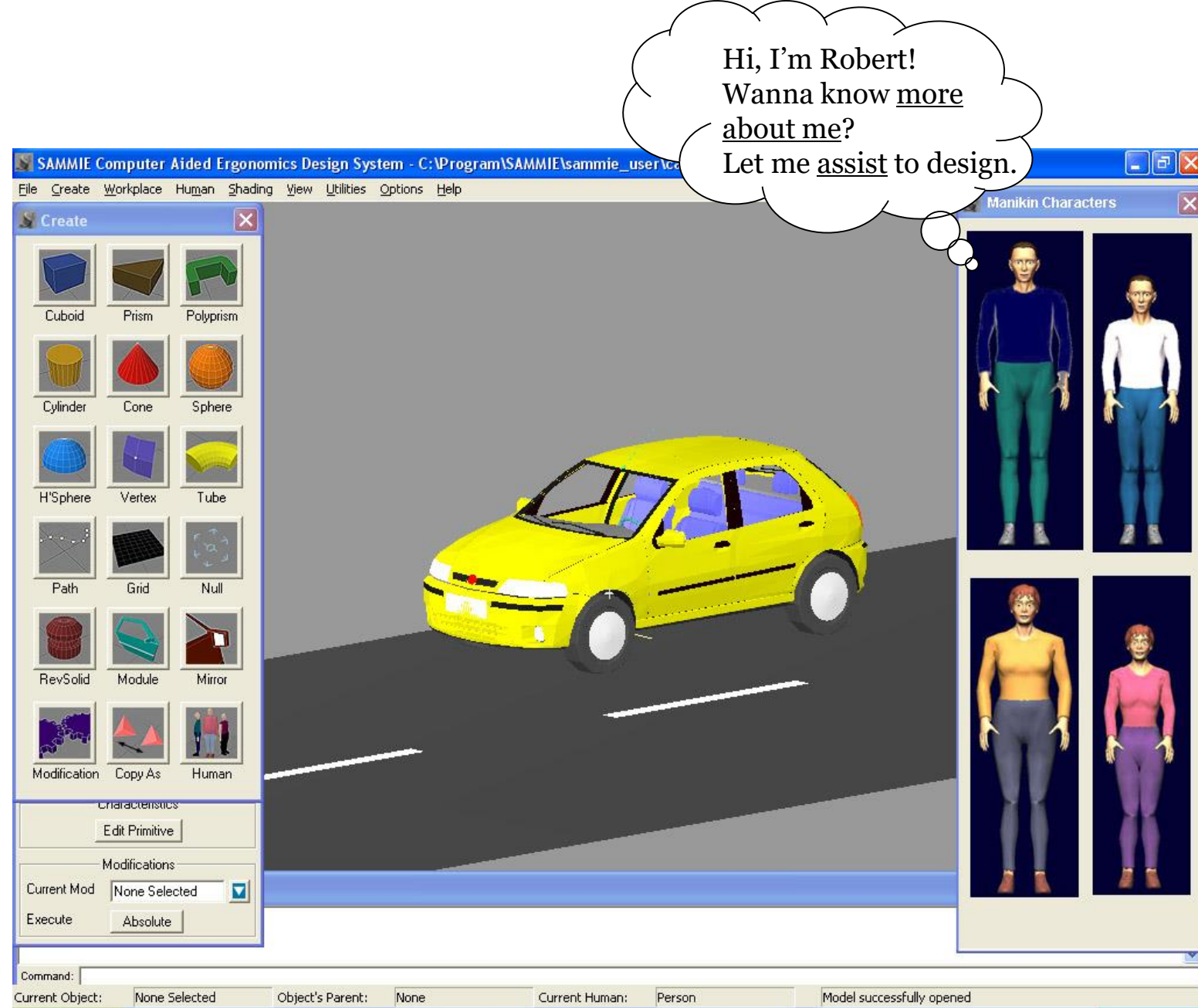
Achieve higher levels of economic productivity **through... technological upgrading and innovation**, including through a focus on high-value added and labour-intensive sectors.



Target 8.5. Full Employment and Decent Work with Equal Pay

By 2030, achieve full and **productive employment and decent work for all** women and men, including for young people and persons with disabilities....

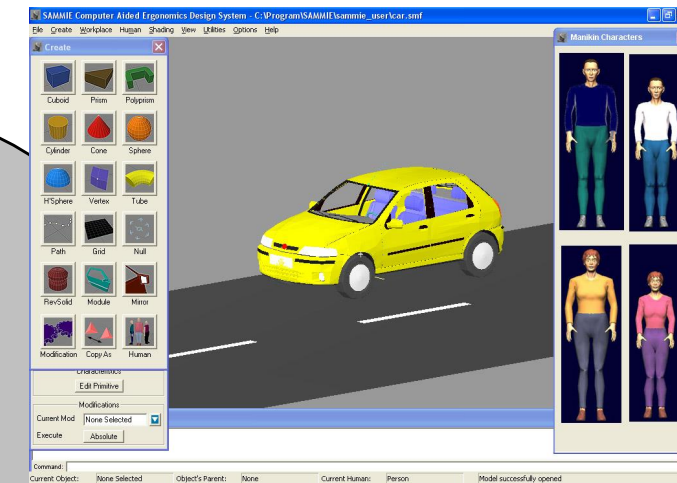
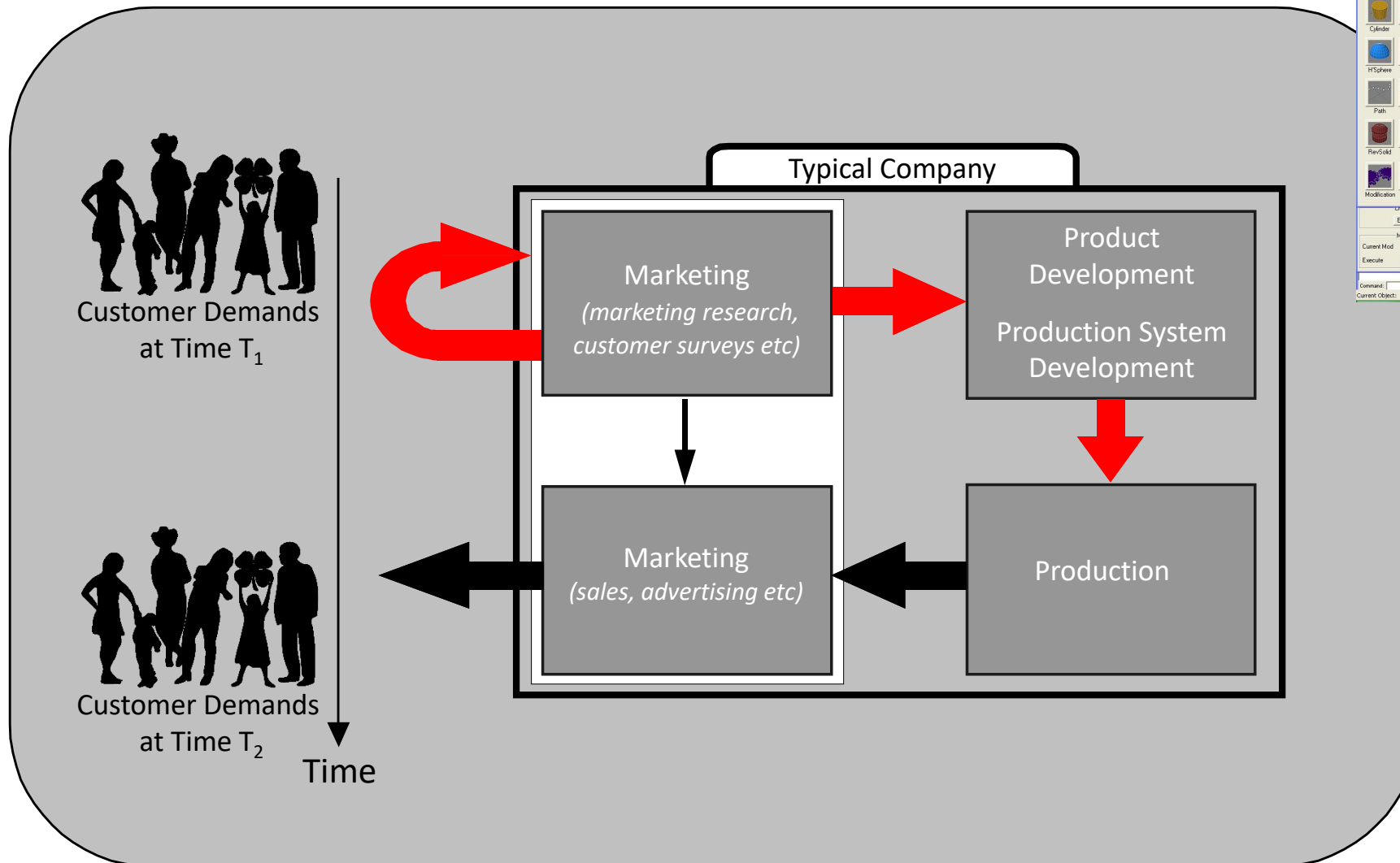




IPS IMMA

Annual Conference of the Ergonomics Society, Cambridge, 6 Apr 2006, Dan Högborg

University of Skövde





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