The Virtual Human

"Heilmeier Catechism"

Human Systems Integration
Human Human Performance
Human Physiology
Human Simulation
Human Cognition
Human Health

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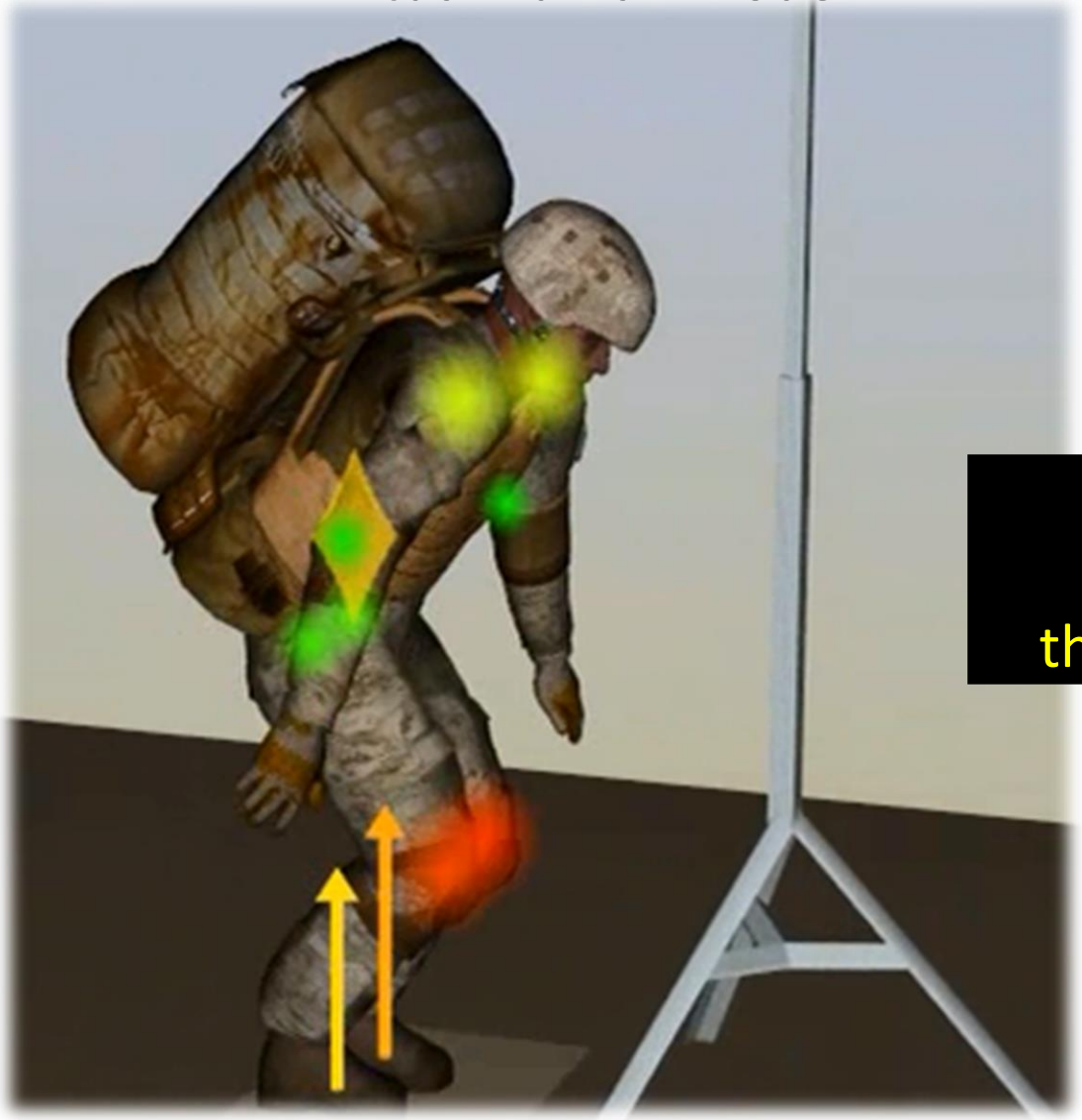
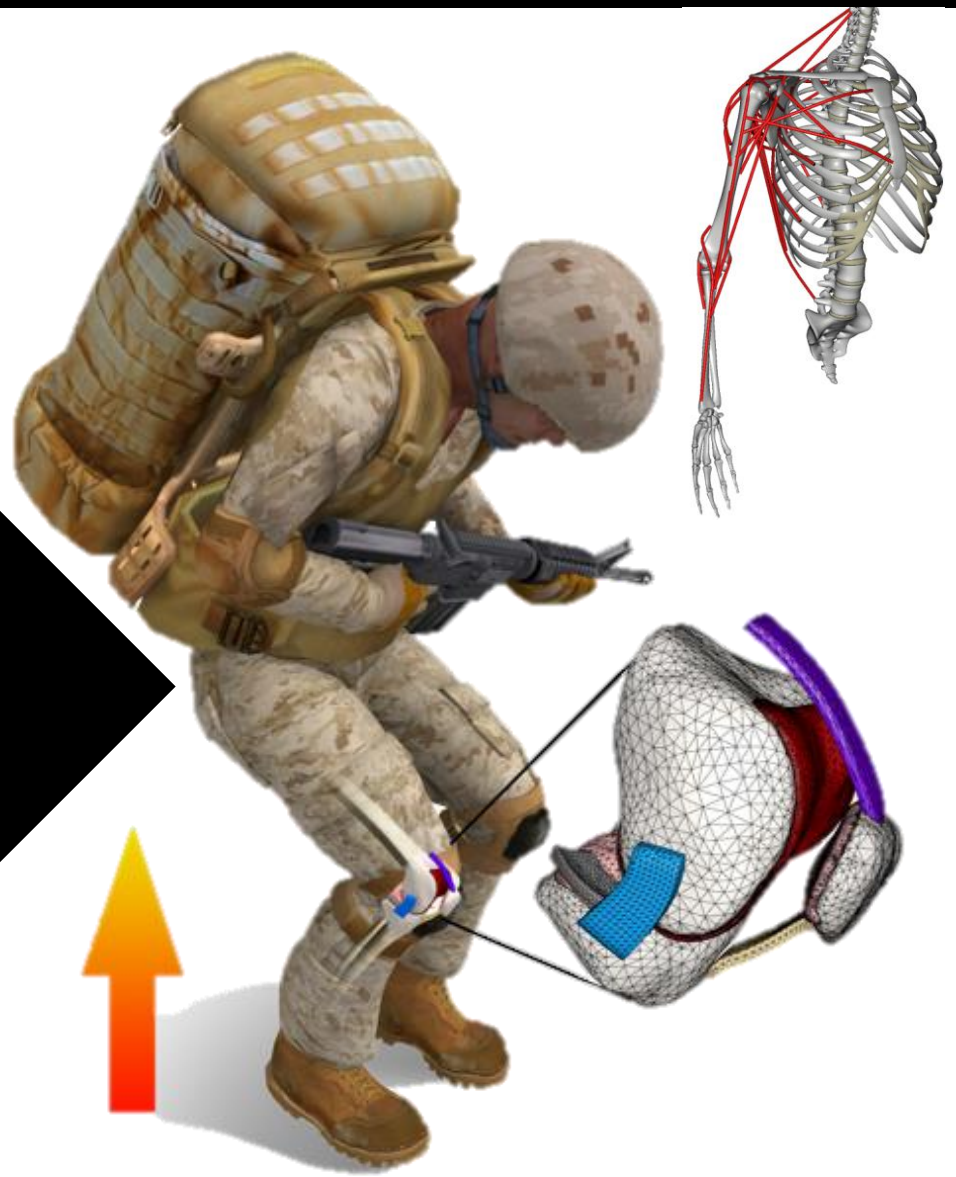
What are you trying to do?

A virtual human model



Increase human performance through simulation

Quantifying and optimizing human biological, cognitive capabilities



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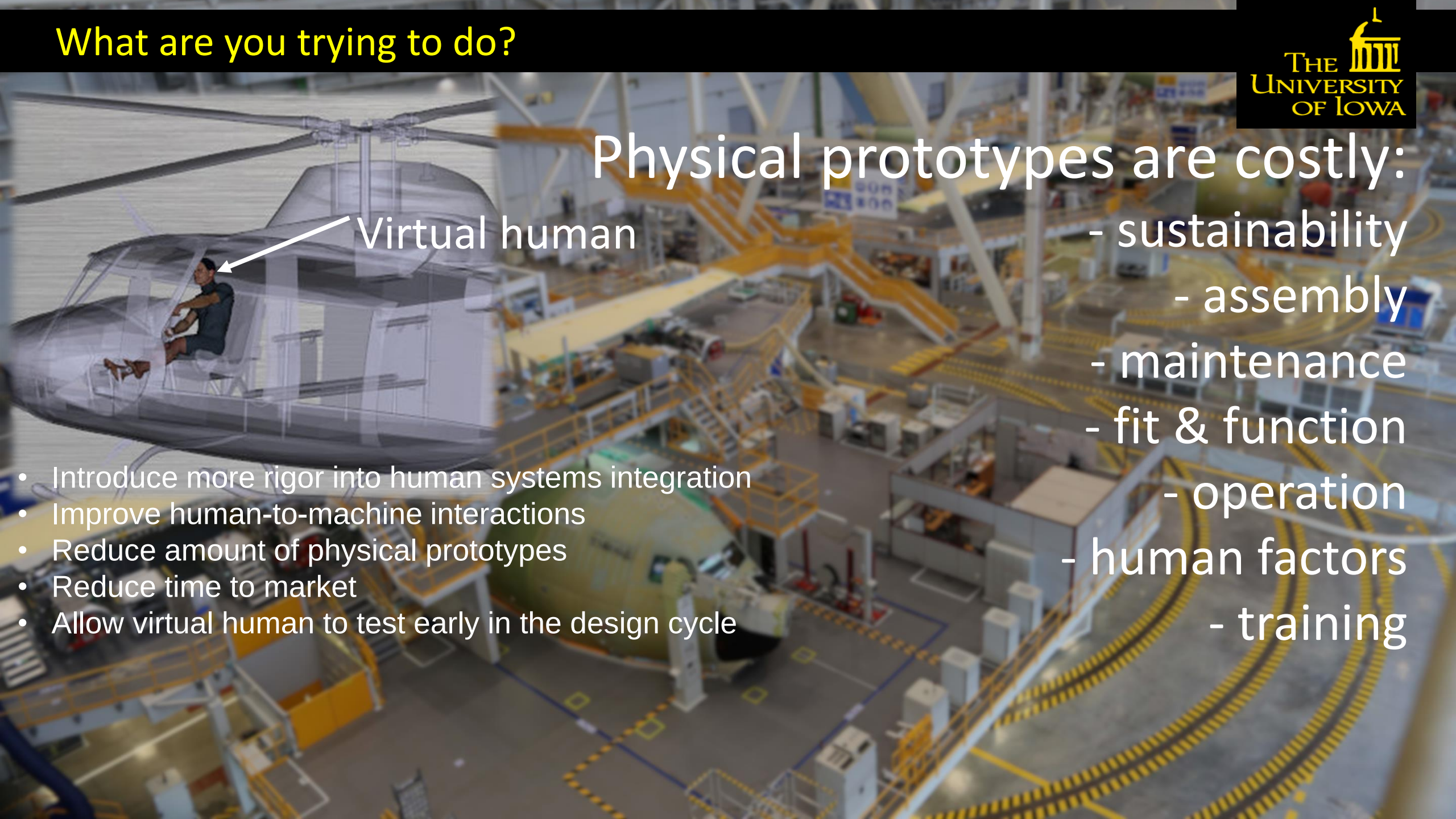
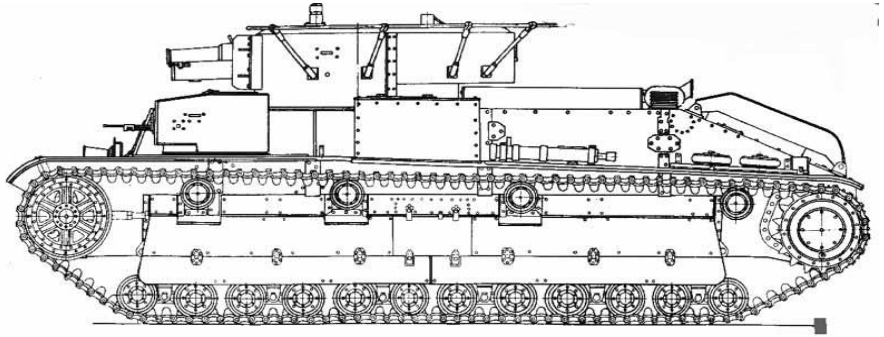


- Introduce more rigor into human systems integration
- Improve human-to-machine interactions
- Reduce amount of physical prototypes
- Reduce time to market
- Allow virtual human to test early in the design cycle

Physical prototypes are costly:

- sustainability
- assembly
- maintenance
- fit & function
- operation
- human factors
- training

Why?



Reduce Physical Prototypes

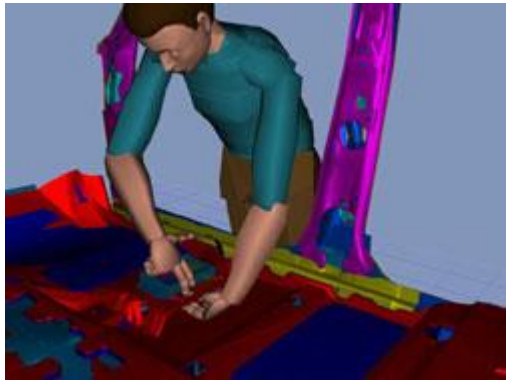
First prototype, before production
- 15 years
- $2 Billion

Testing and evaluation requires significant human involvement

Can be done by a virtual human

How is it done today, and what are the limits of current practice?

- Computer human models are introductory
- Human digital models are developed for specific applications with significant limitations
- Current digital human models are not physics-based nor contain cognitive or biological fidelity
- Current digital models are not validated
- Current digital models are not realistic



Example current digital human model

- SIEMENS Jack
- Dassault Systemes

What is new in your approach and why do you think it will be successful?

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What is new

- Modeling behavior and social aspects
- Physics-based predictive methods for simulation
- Mathematical modeling of interpretable dynamic, complex human social systems
- Integrated approach

  (physics, physiology, biomechanics, cognitive)
- Realistic, validated, and high fidelity

Why

- Rigorous methods for predictive human modeling have shown great potential
- Ingredients (pieces of the technology) have finally matured
- Significant data has been collected and can now be used to develop and validate modeling and simulation.

Who cares? If you succeed, what difference will it make?

- All branches of the military
- Any entity that is concerned with human performance and safety
- Any entity that desires to conduct tradeoff analysis involving humans
- Any entity that desires to test new equipment involving humans

Who cares? If you succeed, what difference will it make?

Studies have shown reduction in cost & time because of modeling & simulation. If a physics-based cognitive and biological digital human model is created, it will result in a significant impact:

- Save Lives: The ability to use digital humans instead of humans in high risk environments
- Save Time: Reduce the amount of time by testing human factors digitally
- Save Cost: By decreasing the amount of physical prototypes needed
- Improved human-machine-interaction: By brining the human into the loop during the design phase

Dalal, A. F.. "Go Lean, Save Green.“ ASQ Six Sigma Forum Magazine, May 2009: 33-35.

What are the risks?

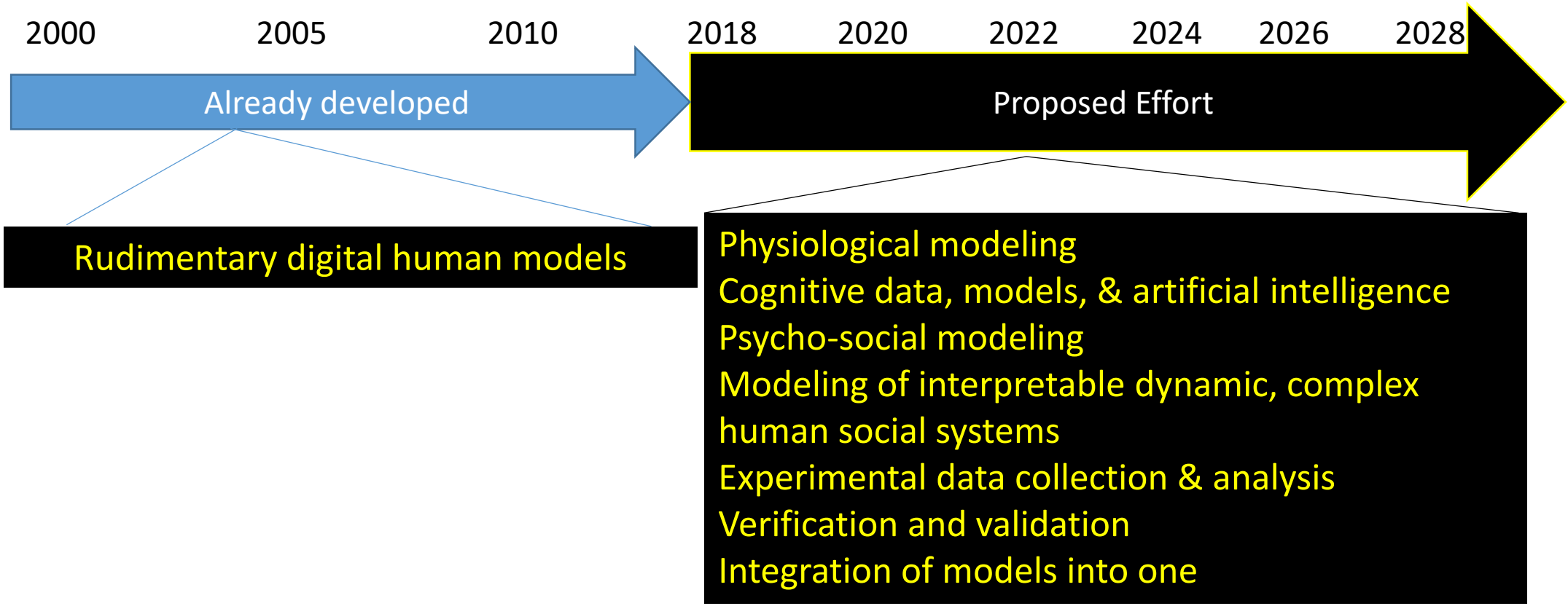
Technical challenges

- Obtaining data for cognitive and biological models
- Human physics-based M&S
- Computational power for human simulation
- Fidelity needed
- Cost of validation
- Integration into one comprehensive virtual human

Cultural challenges: Disbelief in simulation results

Ref. Simulation Based Acquisition: A New Approach, *Report of the Military Research Fellows,* DSMC 1997-1998

How much will it cost?
How long will it take?



Estimates: $20-30 Million

What are the mid-term and final “exams” to check for success?

- Ability to use a digital human model to reduce number of design prototypes
- Ability to use a digital human model to improve human performance
- Reduction of cost and time in the design of large military systems
- Ability to use digital human models to reduce risk
- Ability to use digital human models to conduct cognitive studies, trade-off analysis.

Thank you

Karim Abdel-Malek
The University of Iowa
319.400.0278
Amalek@engineering.uiowa.edu