



Uniting Human Data — A Warfighter Digital Twin Competences Framework

Andy Fawkes | IT2EC | London | 11 April 2024

Inspiration



Warfighter Data

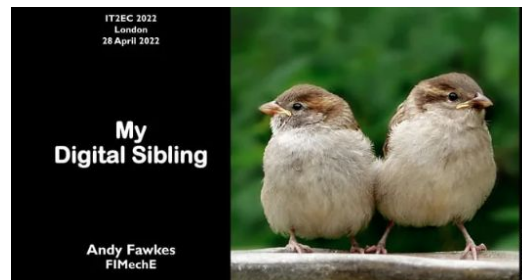
- Data and Evaluation
- Learning Futures
- XR Data




NORTH ATLANTIC TREATY ORGANIZATION
 SCIENCE & TECHNOLOGY ORGANIZATION

TECHNICAL ACTIVITY PROPOSAL

Panel/Group	MSG	Activity Title	
Reference Number	MSG-ET-056	Training Data Analytics and Standards	
Activity Type	Exploratory Team		
Panel Approval Date	Board Approval Date	Activity Start Date	Activity End Date
17 Oct 2023	17 Oct 2023	18 Jan 2024	18 Jan 2025



Professional Engineer Interviews

- 2012 to present day
- Chaired/Co-Panelist – 200 Interviews
- Overseen – 250 Interviews
- Competence-Based Interviews

**This is a
Speculative
Idea**

**Humans have
Competences,
might their
Digital Twins?**



Outline

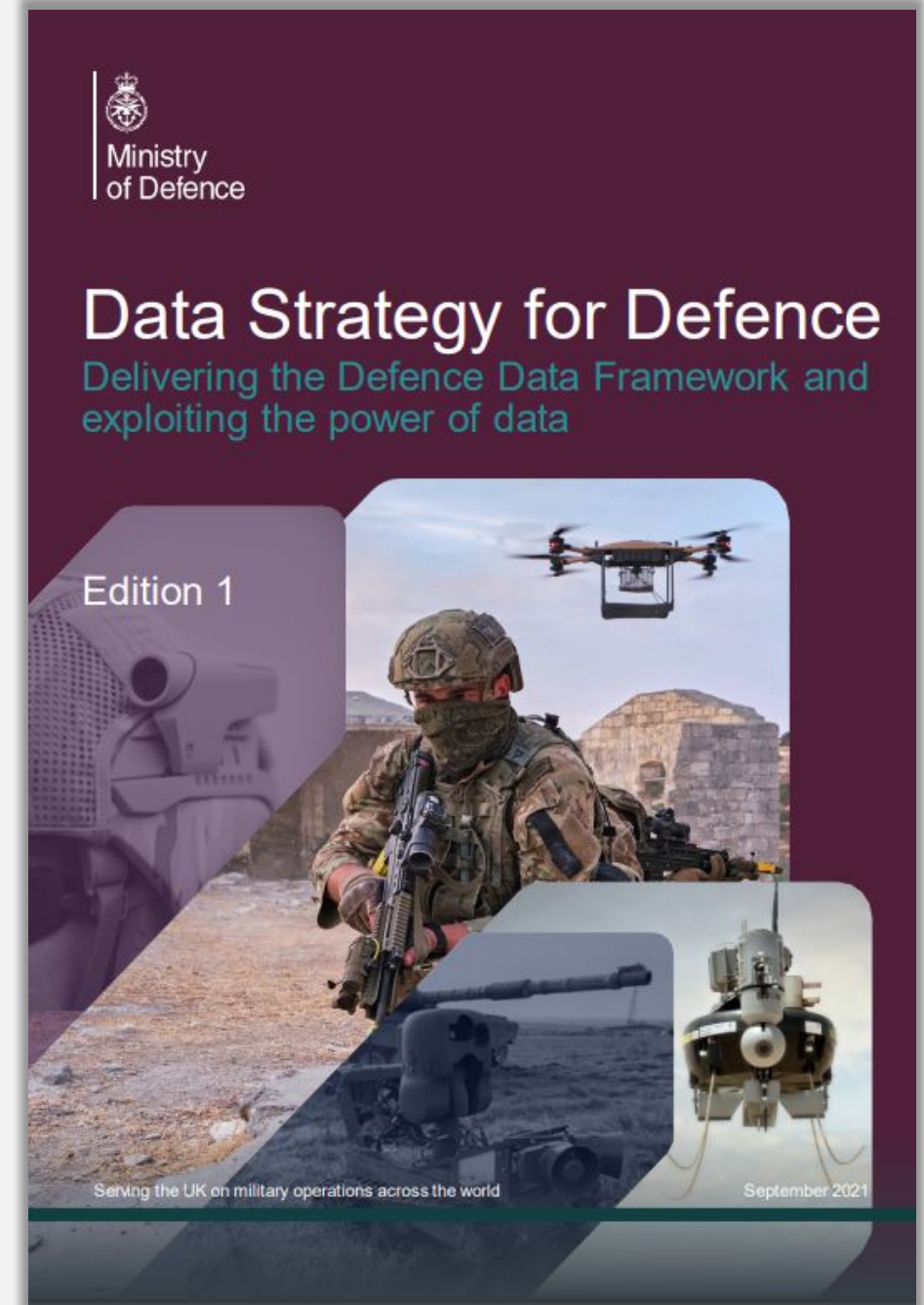
- **What is the Problem?**
- **Warfighter Digital Twin Concept**
- **Warfighter Digital Twin Use Cases**
- **Proposed Competence Framework**
- **Challenges & Opportunities**
- **Way Forward?**

What is the Problem?

“... data is treated as a strategic asset, second only to people.

Defence must capture, curate, share and exploit data more effectively and consistently pan-Defence to deliver better decisions and outcomes.

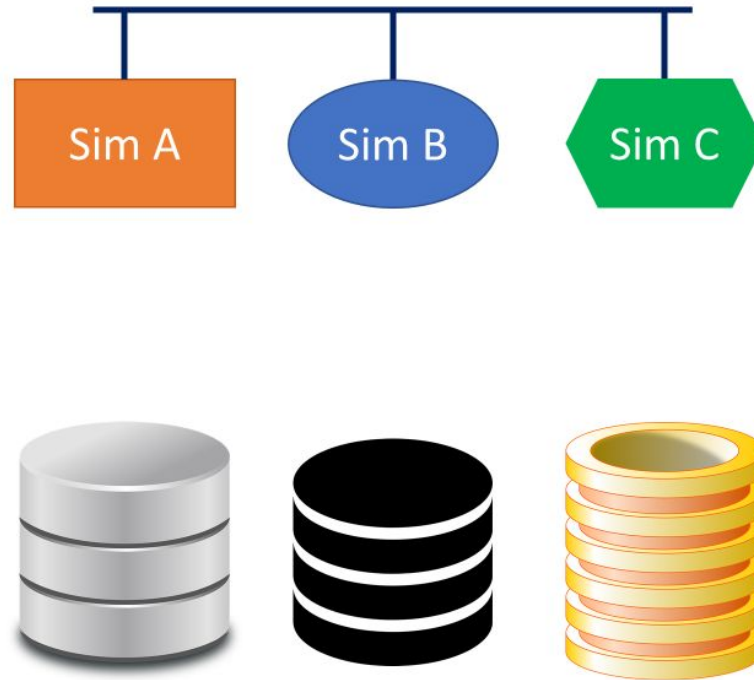
Mastering data will require a paradigm shift in behaviour and culture.”



Data Exploitation in Military Training

- USAF Pilot Training Next & Pilot Training Transformation initiatives
 - Explored wearable biometric devices to collect and monitor physiological data, such as changes in heart rate.
 - Instruction was assisted by data collection software and artificial intelligence-based applications designed to assist students in identifying training tasks for self-guided learning.
- The British Army's Collective Training Transformation Programme (CTTP) has placed emphasis on training data exploitation:
 - “data will be captured and exploited to drive change and efficiency ... creating the ability to dynamically control the training environment to set an appropriate level of complexity and challenge ... and bring data to a single place for analysis, with common data standards enabling an ambitious use of data analytics pan-Army”
- UK Royal Air Force (RAF) Project iDAS (immersive Data driven Airmanship Simulator)
 - Aimed at helping the explore the benefits of data analysis to assess pilot behaviour and identify characteristics of good airmanship.

Data - The Next Frontier of Simulation Interoperability?



“(Personal) Data is hard to access, technology is ageing, and processes and culture are not suited to the information age.

A fractured ecosystem has created the need for manual workarounds and interventions across the force

...

With many systems in play that either speak different data languages or are unable to communicate at all, there is no single view of data across the Armed Forces.”

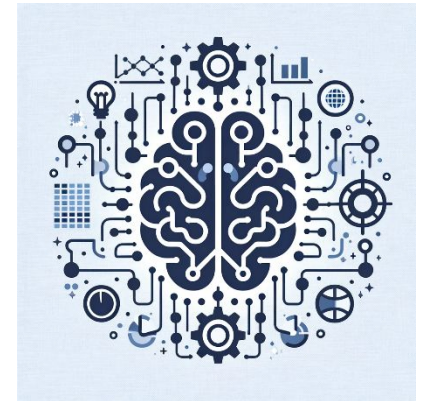
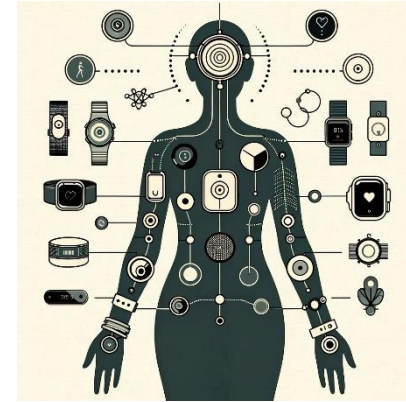


Warfighter Data Here, There, Everywhere



Technological Change & Data

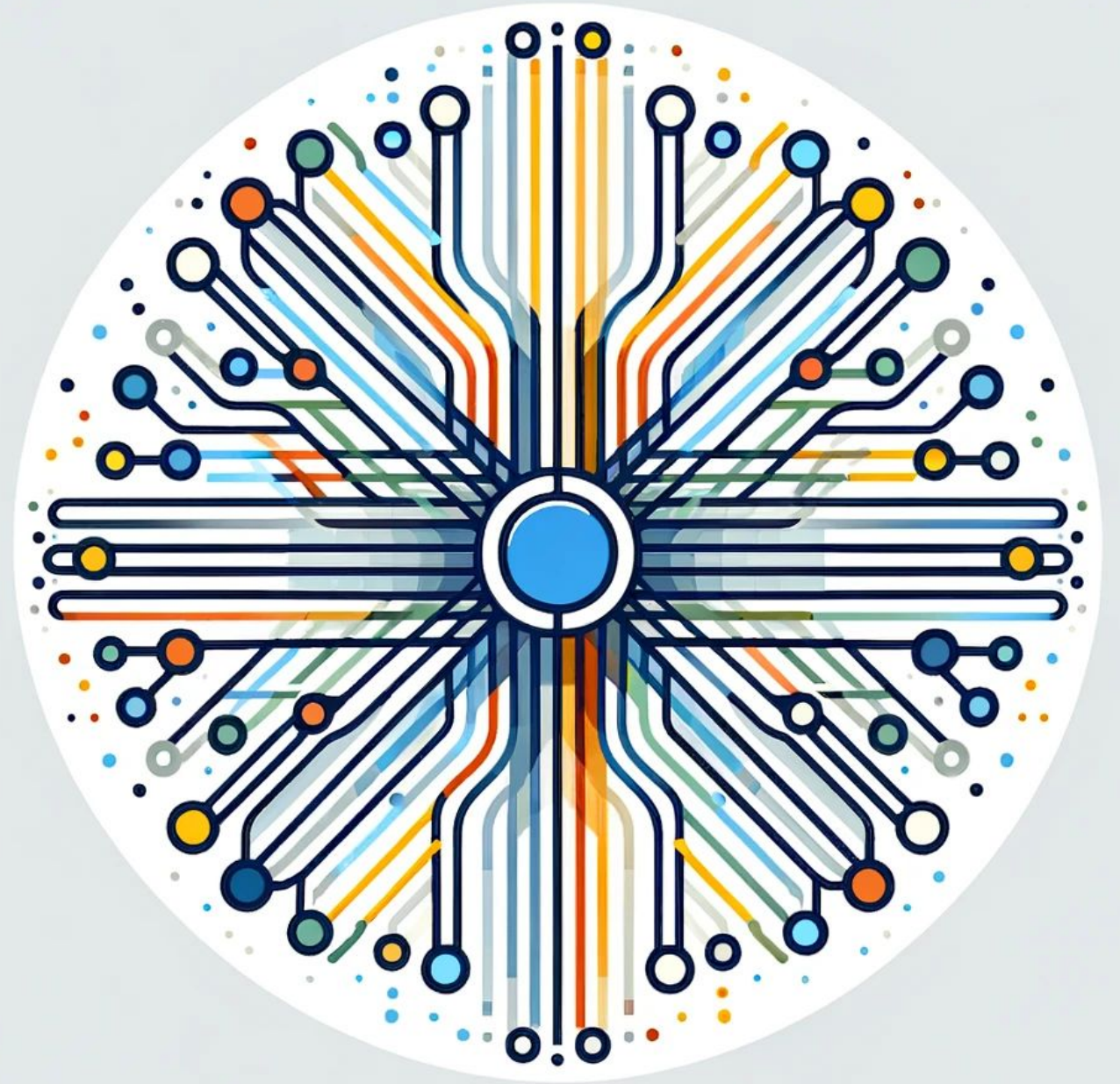
- Capture
- Distribute
- Store
- Analyse
- Exploit





Personal Data Security, Privacy and Ethics

**Is There a way to
Bring Together and
Unite Human Data
on an Enterprise
Basis?**



Warfighter Digital Twin Concept

What is a Digital Twin?

Wikipedia

“a virtual representation that serves as the real-time digital counterpart of a physical object or process”.

Arup

“the combination of a computational model & a real-world system, designed to monitor, control and optimise its functionality. Through data and feedback, both simulated & real, a digital twin can develop capacities for autonomy and to learn from and reason about its environment.”

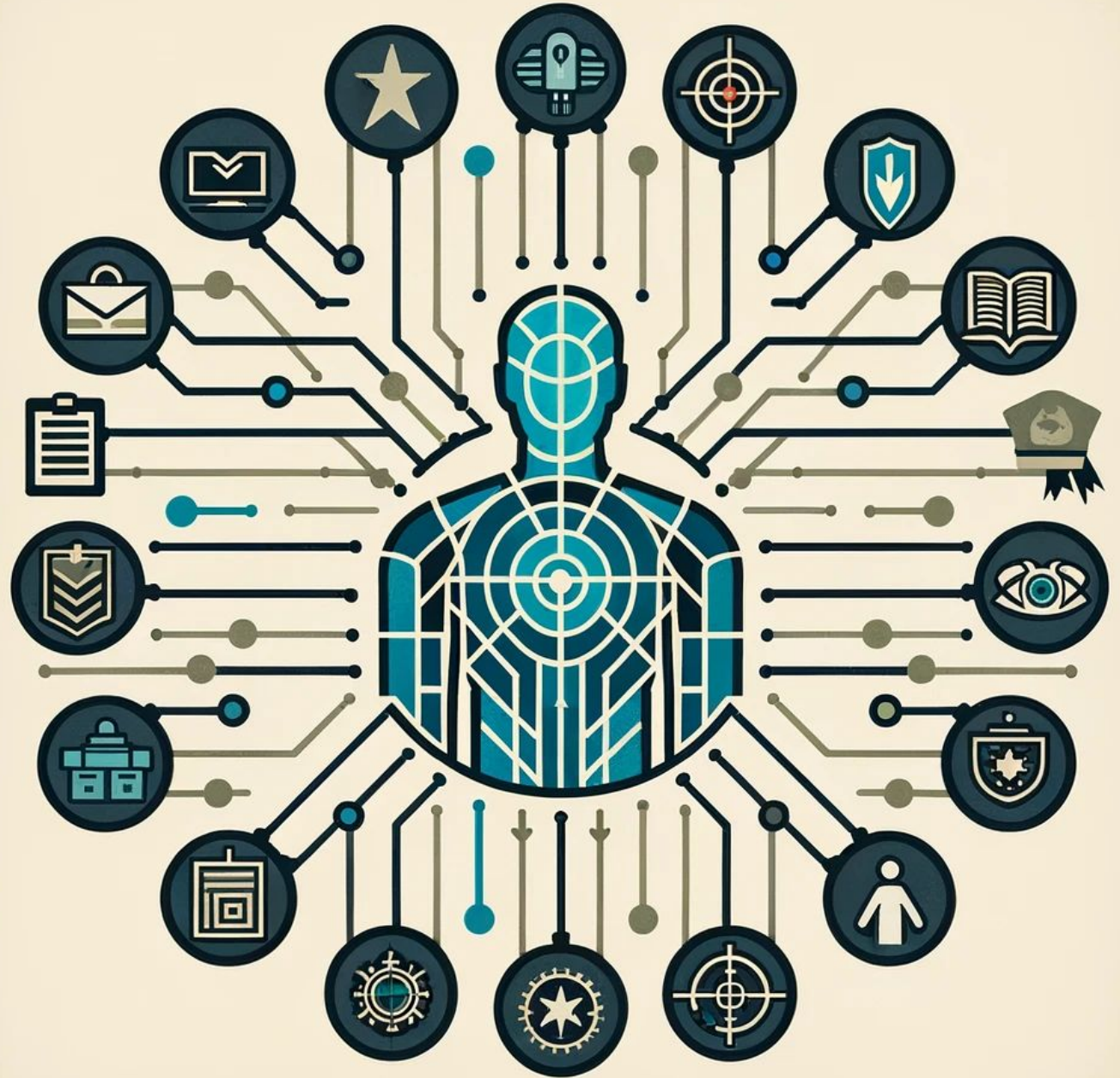
Wright, Louise & Davidson, Stuart. (2020) - characterised by:

- a model of the object,
- an evolving set of data relating to the object,
- a means of dynamically updating or adjusting the model in accordance with the data, &
- being associated with an entity that actually exists (*a digital twin without a physical twin is a model*)

What is Meant by a Warfighter Digital Twin?

The digital twin replicates and records the warfighter's physical, physiological, and behavioural characteristics, with synchronous and asynchronous data interchange between the human and the digital twin

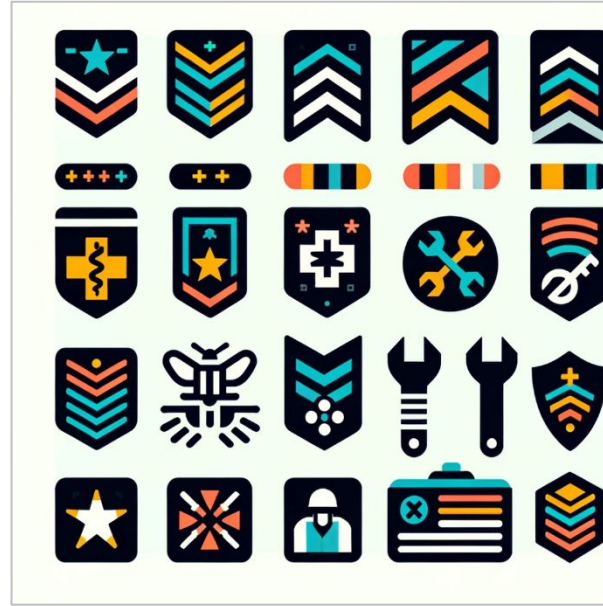
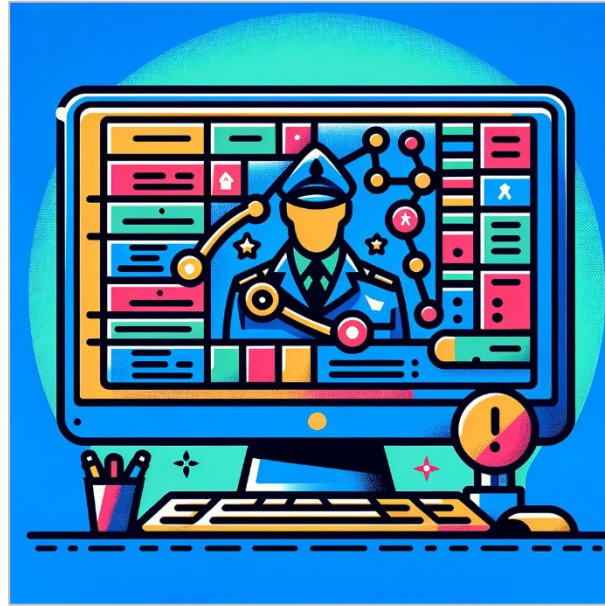
**To Unite Warfighter
Data across multiple
applications including
training and
education, operations,
health, research,
acquisition, and
career management**



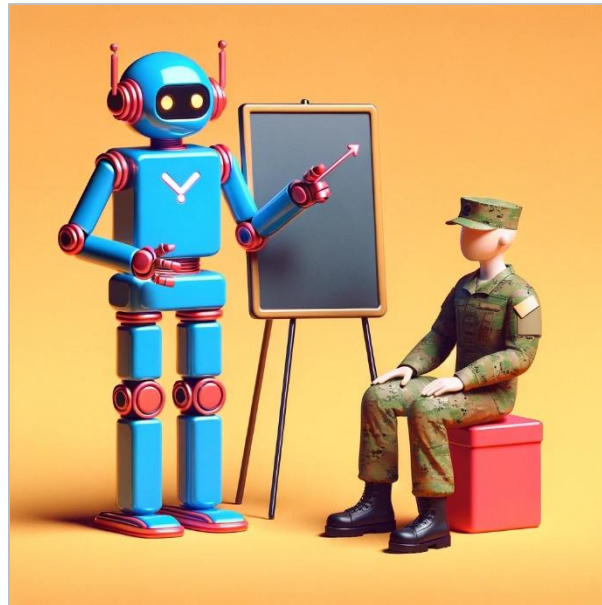
Warfighter Digital Twin Use Cases

Some Use Cases

#1



Career Planning and Recording and Health Monitoring



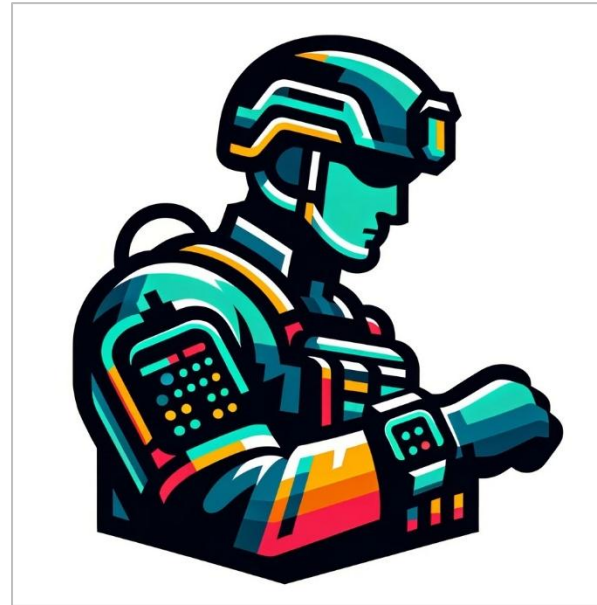
Education and Training

Some Use Cases

#2



Human Factors Studies and Equipment Acquisition Optimisation



Operational Planning, Warfighter Monitoring and Operating Autonomous Systems

Proposed Competence Framework

IMechE Competence Framework

	Description
A	Knowledge and understanding Formal training, learning new engineering knowledge across industries, understanding emerging technologies, and developing innovative technological solutions to complex problems.
B	Design, development and solving engineering problems Identifying and conducting investigations and research for engineering tasks; evaluating and implementing solutions, learning from feedback for continuous improvement.
C	Responsibility, management, and leadership Planning and managing engineering tasks, including budgeting, risk assessment, and stakeholder negotiation; leading teams and promoting continuous quality improvement.
D	Communication and interpersonal skills Effectively communicating complex information and proposals in English, demonstrating interpersonal skills, and showing awareness of diversity and inclusion.
E	Personal and professional commitment Adhering to relevant codes of conduct, managing safety and sustainable development in work, engaging in continuous professional development, and upholding ethical responsibilities.

Level	Explanation
Level 4 Expert	Performs activity in a wide range of complex or non-routine contexts. Substantial personal autonomy - can develop others within the activity.
Level 3 Skilled	Performs activity in a range of contexts, supervision required in more complex circumstances. Significant responsibility and autonomy - can oversee the work of others.
Level 2 Familiar	Performs activity in some complex or non-routine contexts. Some individual responsibility or autonomy.
Level 1 Aware	Performs activity with significant supervision & guidance. Performs basic routine tasks, little / no responsibility.

Competence Scoring Structure

IMechE Competences - Wide Applicability

- Different Engineering
 - e.g. Machines, Structures, Process, Devices, Systems
- Different Sectors
 - e.g. Energy and Power, Automotive, Aviation, IT, Maritime, Construction, Academia, Defence/Military



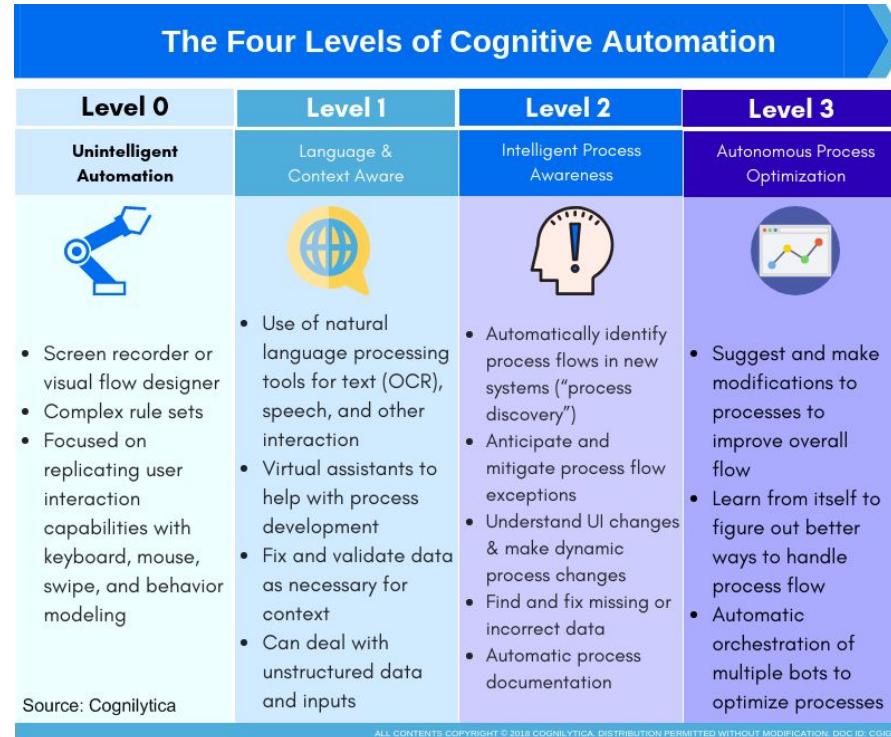
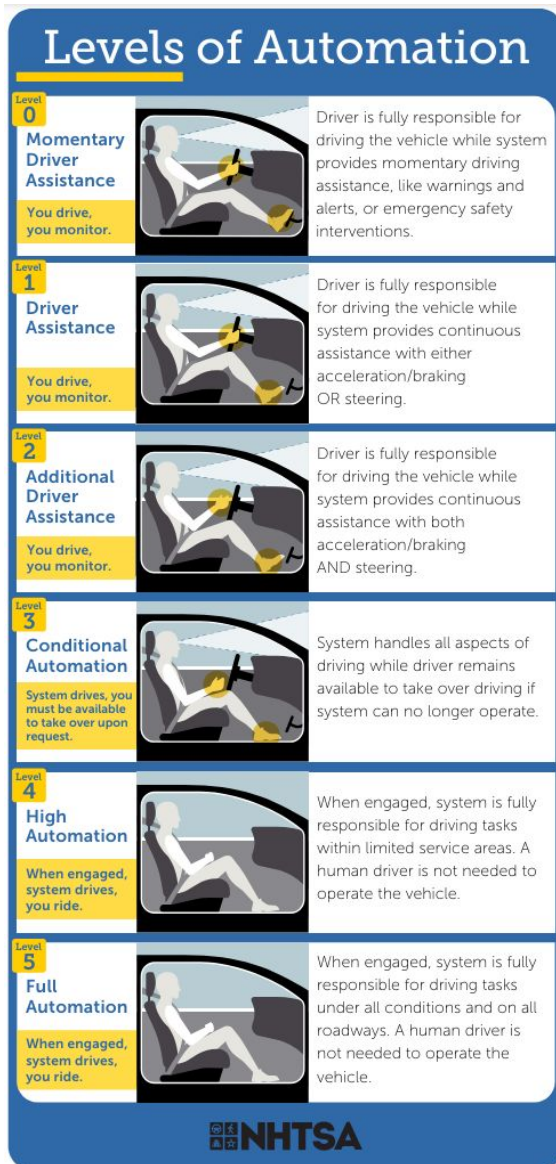
Proposed Warfighter Digital Twin Competence Framework

	Description
A	Knowledge, Skills and Medical/Physical Attributes Captures the knowledge and skills of the warfighter through career and their development plans including legacy and real time data and used to create the digital avatar of the warfighter
B	Applying Knowledge and Skills Expresses what activities the warfighter is qualified and not qualified to do and their adaptability.
C	Responsibility and Autonomy Expresses the risk of the warfighter’s activities, for example in terms of operational impact, safety, and cost, and the level of risk that the warfighter can hold and the degree to which they can act autonomously.
D	Communication Expresses how and what the warfighter digital twin will interface/ communicate with, including digital systems, other digital twins and with human warfighter(s) including any technical and process standards.
E	Privacy, Security and Ethics Determines the access to the warfighter data and rules by which it is controlled and managed, including what it can and cannot be used for.

Level	Explanation
Level 4 Expert	Performs role in a wide range of complex or non-routine contexts with high levels of autonomy.
Level 3 Skilled	Performs role in a range of contexts, human supervision required in more complex circumstances.
Level 2 Familiar	Performs role in some complex or non-routine contexts but requires supervision & guidance.
Level 1 Aware	Performs basic routine tasks, little / no responsibility and requires significant supervision & guidance.

Competence Scoring Structure

Range of Autonomy Descriptions



COGNILYTICA 2019

Level	Name	Description
1	Human Operated	A human operator makes all decisions. The system has no autonomous control of its environment although it may have information-only responses to sensed data.
2	Human Delegated	The vehicle can perform many <u>functions</u> independently of human control when delegated to do so. This level encompasses automatic controls, engine controls, and other low-level automation that must be activated or deactivated by human input and must act in mutual exclusion of human operation.
3	Human Supervised	The system can perform a wide variety of <u>activities</u> when given top-level permissions or direction by a human. Both the human and the system can initiate <u>behaviors</u> based on sensed data, but the system can do so only if within the scope of its currently directed tasks.
4	Fully Autonomous	The system receives <u>goals</u> from humans and translates them into tasks to be performed without human interaction. A human could still enter the loop in an emergency or change the goals, although in practice there may be significant time delays before human intervention occurs.

The DoD Unmanned Systems Integrated Roadmap FY2011-2036

Recruit
In-Training
Trained
Trainer

Challenges & Opportunities

Some Challenges

Bad Days & Bias	Can training performance during personal struggles negatively impact a warfighter's career permanently? Balancing data-driven insights with fair evaluation raises ethical and privacy concerns.
Data Standards	Getting all the different stakeholders to agree on how data is formatted and exchanged accurately and securely.
Storage Demands	Retaining all data is costly and impractical and striking the right balance between storage limitations and valuable insights will require clear retention policies and prioritisation.
Data Avalanche	Aggregating warfighter data can push its classification level, necessitating stricter security measures and potentially limiting access for those who need it most.
Security vs. Access	Finding the sweet spot between robust data security and ensuring authorized personnel have timely access to crucial information will be a constant challenge.
Ethical Dimension	Navigating the complex landscape of warfighter data privacy, security, culture, and ethical considerations demands well-coordinated planning and implementation.

Numbers of Stakeholders

- The Warfighter (!)
- Colleagues
- Commanding Officer
- Career Managers
- Personnel Policy Makers
- Recruiters
- Financiers
- Researchers
- Legal
- Operational Planners
- Acquisition Staff
- Data and IT Managers
- ...

Some Opportunities

Enhanced Training & Education	The digital twin can be integrated into training systems, assist in debriefings, and interact with human counterparts, potentially leading to a more immersive and effective training experience.
Career Management	Offers continuous support to the individual warfighter and the wider enterprise by maintaining an up-to-date digital counterpart throughout the warfighter's career, even potentially after service.
Operational Planning & Readiness	Provides commanders with comprehensive dashboards offering rea-time insights into personnel readiness, the impact of training, and overall unit preparedness.
Equipment Development & Testing	Supports the testing and refinement of military equipment and systems under various scenarios, contributing to more informed decisions in equipment design.
Unified Data Management	Helps unify disparate human resource digital systems, ensuring data is always up-to-date and accessible, thus improving overall personnel management and operational efficiency.
Interoperability & Standardization Across Forces	Promotes interoperability and standardization across different branches and units, facilitating more cohesive and efficient operations.

Way Forward

Way Forward

Invest in Technology & Infrastructure	Secure funding and resources for the development and maintenance of digital twin technologies and supporting infrastructure.
Standardization and Interoperability	Develop and enforce standards to ensure human digital twin technologies are interoperable across various military branches, enhancing collaboration and efficiency.
A Focus on Training & Education	Implement specialized training programmes to equip military personnel with the necessary skills to effectively use and benefit from digital twin technologies.
Promote Collaboration & Knowledge Sharing	Encourage collaboration between different branches of the military, industry, and academic institutions to foster innovation and share best practices.
Ensure Continuous Evaluation & Adaptation	Regularly assess the effectiveness of the digital twin framework and make adjustments as needed to address emerging challenges and integrate new technologies.
Robust & Appropriate Data Security Measures	Implement stringent security protocols to protect sensitive data and ensure the privacy and integrity of digital twin applications.

“Do Nothing” in Enterprise Warfighter Data Management is Not an Option

- Despite challenges, ignoring warfighter data is not a sustainable option
- Human data is becoming increasingly important for all aspects of defence, from recruitment through to operational effectiveness
- Embracing the challenges of human data management is essential for building a future-proof defence force



Questions

?



	Description
A	Knowledge, Skills and Medical/Physical Attributes Captures the knowledge and skills of the warfighter through career and their development plans including legacy and real time data and used to create the digital avatar of the warfighter
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