Modelling and Simulation as a Service (MSaaS) – an ecosystem to support force preparation and decisions

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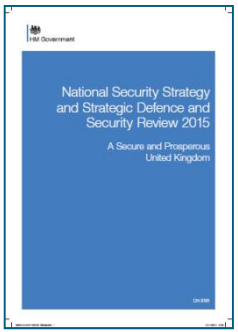
Preparing for Tomorrow

M&S Vision

Strategic Drivers

- UK National Security Strategy and Strategic Defence and Security Review (2015)
  - Recognises a world changing rapidly and fundamentally
  - Defence needs to secure the Armed Forces' advantage into the future



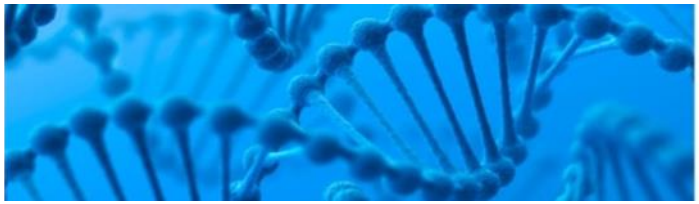
- Joint Force 2025
  - Full Spectrum of Operations
  - Defence Innovation Initiative

- MOD Science and Technology Strategy 2017
  - *S&T plays a central role in Defence thinking and culture, directing and applying innovative research and thinking to meet the current and future strategic needs of Defence and Security."*

Preparing for Tomorrow

"It is a truism that in an increasingly complex, competitive and connected world, the challenge is not responding to what we know today, but rather preparing for what tomorrow might bring."

UK Ministry of Defence,
Global Strategic Trends to 2045



How is it done today? What are the limits of current practice?

- Piecemeal and Stovepipe
  - Limited re-use or ability to leverage previous investments
  - Paying for similar M&S and data services more than once
- Traditional development/procurement
  - Unable to meet fast changing and uncertain futures
  - Unable to keep force elements at high level of readiness
  - Increasingly unaffordable

Vision

An agile ecosystem of modelling and simulation services to readily compose an integrated live and synthetic environment, representing an increasingly complex, competitive and connected world, in which to prepare the current and future force for whatever tomorrow may bring.

Preparing for Tomorrow

Delivering the Vision through MSaaS

Responding to Strategic Drivers (1)

- Simulation systems need to be more agile
  - To rapidly model Future Operating Environments
  - To represent the Full Spectrum Of Effects
  - Human behaviour, asymmetric threat, information superiority, high readiness, contingent operations, international by design, Joint Force 2025
- Technological advances (from non-defence sectors) impacting on the way simulation is provided
  - ‘Cloud First’ NATO / UK Defence ICT / Information Strategy

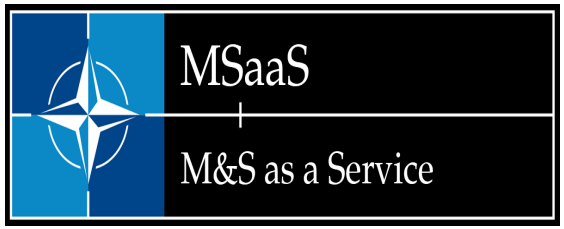
Guidance
Defence information strategy

Responding to Strategic Drivers (2)

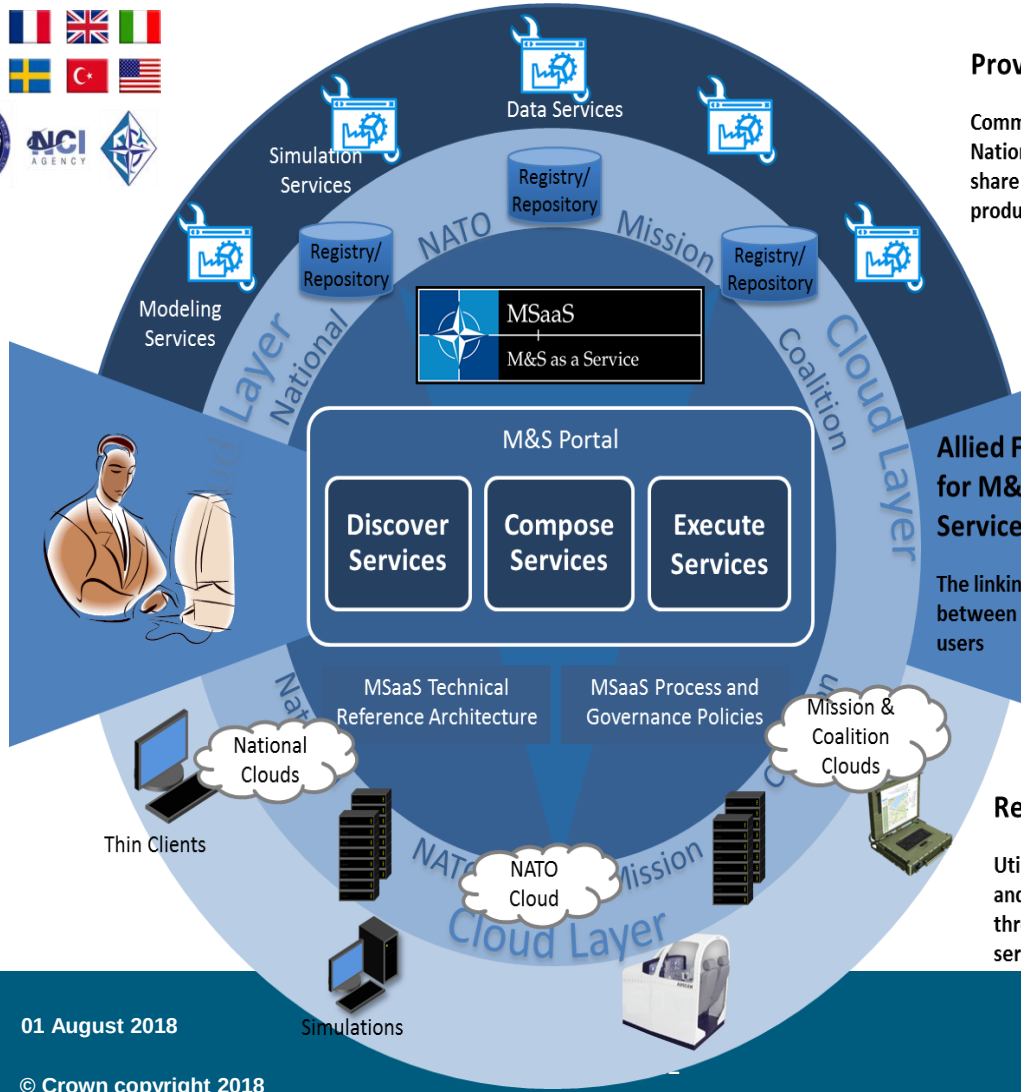
- UK Defence policy requires enterprise level Modelling and Simulation (M&S) coherence
- Defence Modelling and Simulation Coherence (DMaSC)
  - Value for money across the enterprise (highest priority)
  - Conformance to standards and re-use of common data, models and platforms
  - Consistent, enduring, accessible, agile and adaptable solutions
  - Development of a Catalogue of Common M&S Products & Services
  - Development of Defence Simulation Centre (DSC) to aid centralised governance, delivery and management of simulation assets.
- Force Preparation, Mission Rehearsal, Decision Support, Concept Development and Experimentation

NATO Modelling & Simulation as a Service Definition

MSaaS is a paradigm to deliver secure agile simulation based capabilities by making M&S products, data and processes conveniently accessible and available on-demand in order to enhance operational effectiveness



NATO MSG-136/164



Provide & Share

Community of Interest (NATO, National, Industry, Academia) to share common M&S processes, products and datasets

Allied Framework for M&S as a Service

The linking element between providers and users

Reuse & Benefit

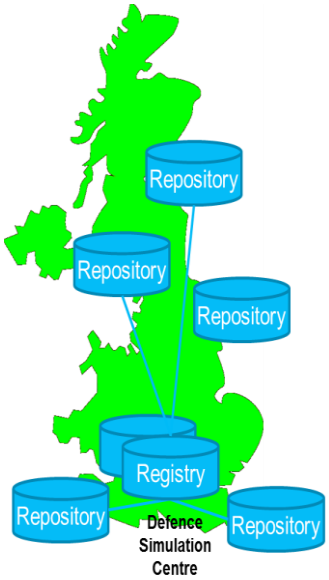
Utilise an adaptive modelling and simulation capability through a combined set of M&S services

MSaaS Guiding Principles

- An on-demand fully transparent and integrated method of moving from an operational requirement to an executable simulation that can deliver that requirement
- Sharing of acquired capability, including hardware, software, services and infrastructure
- A semi-automated composition of simulations re-using existing capability where possible and integrating new if required
- Deployment and execution of simulations decoupled from specific hardware and infrastructure to enable flexible and scalable use

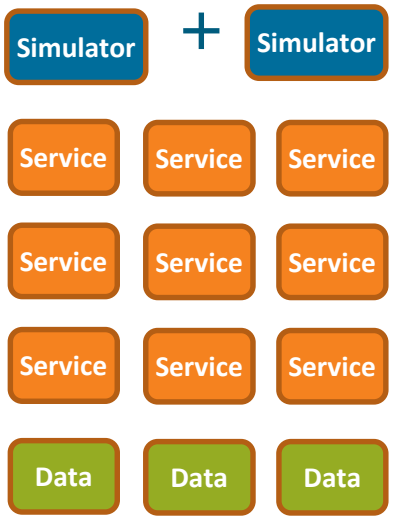
MSaaS Concept Overview

Discovery



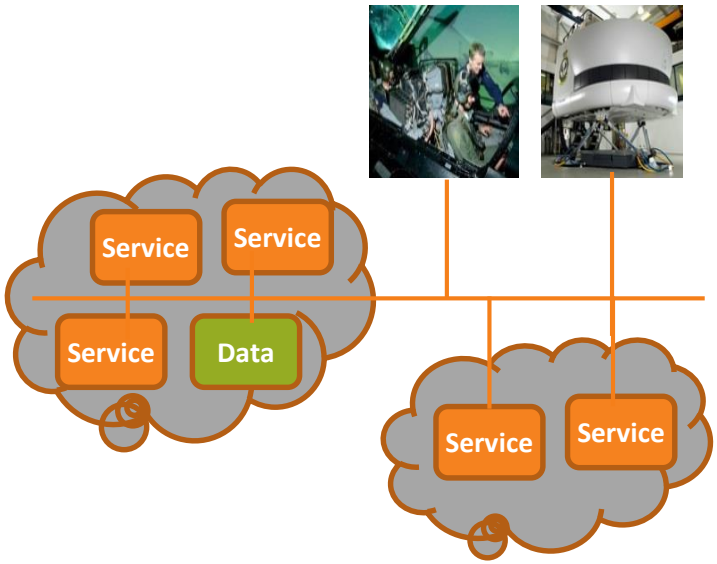
Search and Discover Simulation Resources to enable sharing and re-use

Composition



More agile service based architectures to reduce the cost of the integration cycle

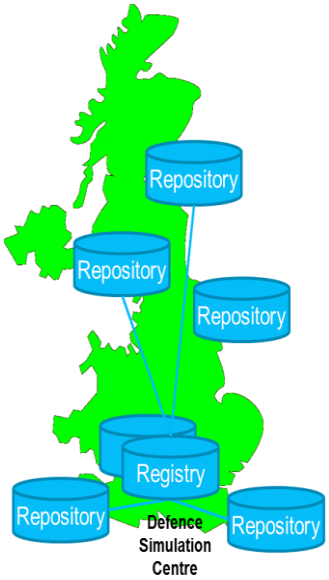
Deployment / Execution



Infrastructure enables on demand access, availability, scalability and fault tolerance

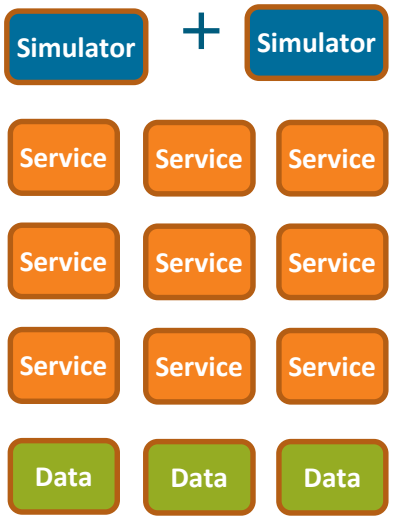
MSaaS Concept Overview

Discovery



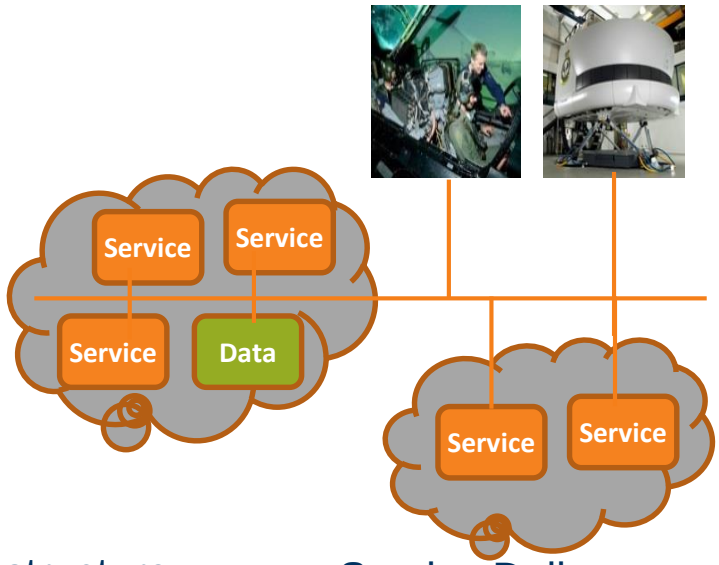
Simulation Resources
- Simulation assets
- Simulation data
- Simulation services
- Simulation Compositions

Composition



Simulation Services
- Terrain Service
- CGF
- Platform simulation

Deployment / Execution



Infrastructure
- Local Area Network
- Private Clouds
- Public Clouds
- Hybrid Clouds

Service Delivery
- Virtual Machines
- Docker Containers
- Web Services
- Security services

Implementation Challenges and Benefits

Risks, Challenges

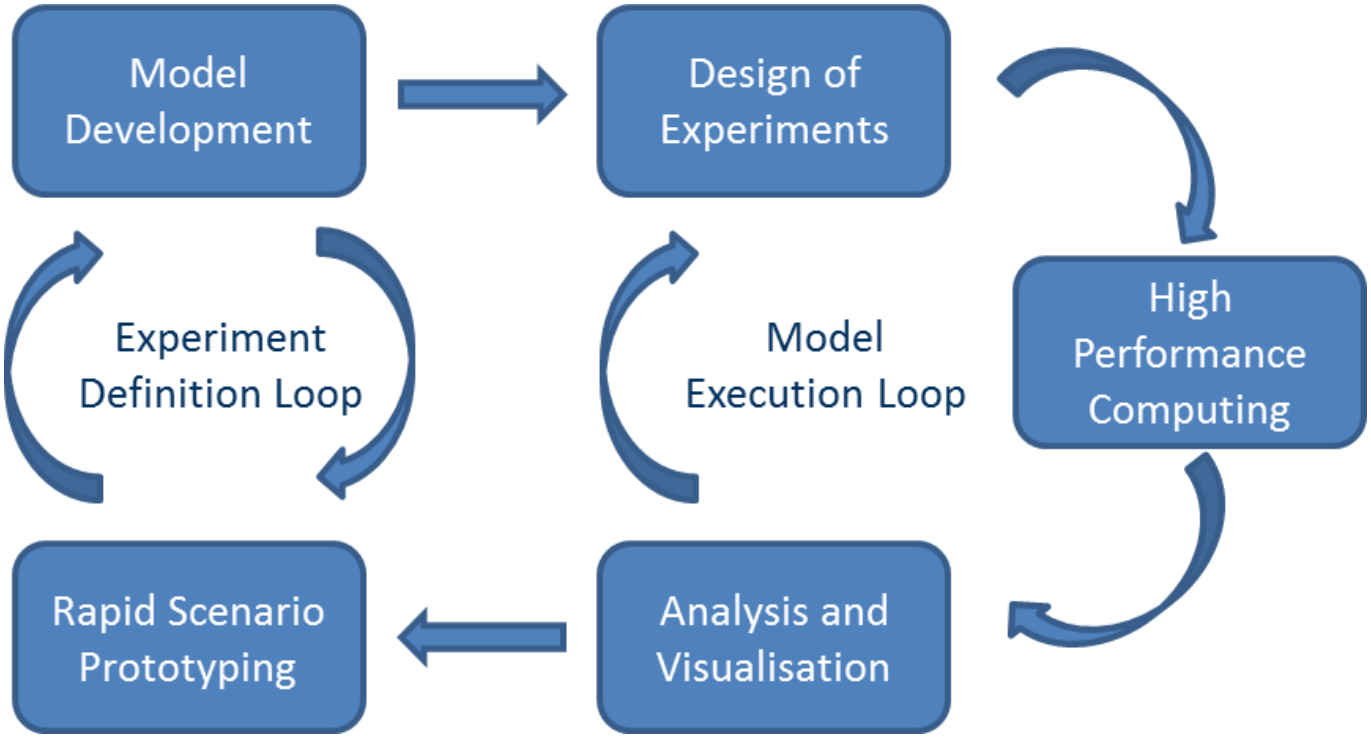
- **Ecosystem**: Needs to be established and “seeded”, and needs to scale sufficiently to return on investment
- **Commercial and Business Models:** Potentially disruptive approach to acquiring and providing capability i.e. Pay as you go services
- **Champion:** Policy and Strategy (both NATO and national levels)
- **Through Life Capability Management:** Needs supporting through life to sustain inertia
- **Cloud Latency:** When the cloud is not physically located close to the point of use. This particularly affects services that are accessed synchronously at high rates. For these cases, it may be necessary for the service to be downloaded to local hardware
- **Security:** Vulnerability to cyber-attacks, need to align security approaches with Defence ICT approaches

Potential Benefits of MSaaS

- **Operational**: Rapid adaptation to changing needs
- **Cost Savings**: Buy once use many approach, access coalition partner capabilities, reduce integration & deployment cost
- **Consistency**: Promotes reuse of common simulation assets
- **V&V**: Track usage and fitness for purpose of common assets
- **Availability**: On demand access 24/7 whenever/wherever
- **Scalability**: Scale up or down as required
- **Resilience**: Fault tolerance if services fail
- **Environmental**: Greener Footprint

MSaaS Benefit	Relevance to Analysis and Simulation-based Decision Support
Reuse of M&S resources	+ Facilitates composition of study from a library of existing M&S resources. + Offers opportunity to store the whole simulation run for audit purposes. + Easy approach to be able to re-run a particular simulation or study if required. - Sufficient V&V in re-using models/simulations needs to be considered to ensure the model is fit for purpose.
Reduces cost of providing M&S capability	+ Reuse of simulation assets, composition and execution tools makes it faster and easier to design simulations and studies.
Deliver M&S capability whenever/wherever needed	+ Possible to execute and access studies and results from different locations
Enables rapid adaptation to changing needs	+ Enable easy iteration of the model execution loop + Easy to add/remove capability from a known baseline
Reduces technical skills required for deploying simulation environments	+ Potential to provide a composition capability whereby analysts could generate experiments by 'dragging and dropping' components from a library.
Provides efficient use of hardware	+ Ability to execute many different studies in parallel simultaneously. + Maximise hardware use to reduce the time to execute a study by scaling on the cloud

Implementing Services for Analysis and Simulation-based Decision Support



Example Data Farming Process (Source: NATO MSG-155)

Summary

What difference will it make?

- Greater Agility
  - Rapid representation of future operational environments
  - Representing Full-spectrum of effects
  - Integrated real world data feeds
- Greater Effectiveness
  - Force preparation and readiness
  - Mission rehearsal and operational decision support
  - Capability experimentation, development & delivery
- Greater Efficiency
  - On-demand service based ecosystem i.e. (MSaaS)
  - Commercial technology adaptation
  - Capability development risk and cost reduction

Summary

- MSaaS approach can help to maximise effect of simulation
  - Exploits ICT technological advances & meets operational challenges
  - Approach informing Simulation Policy & Strategy
  - Compliments & enhances extant MOD activities (i.e. DSC, Information Strategy)
- Technology is maturing to deliver an Initial Operating Capability
  - Discovery Services (registry, repository)
  - Semi-automated Composition
  - Cloud execution of simulation services (legacy, containerisation, web services)
- Further development is required to achieve the full benefits
  - Organisational, automation, service based architectures, security
  - Potential to investigate development beyond Force Preperation to evaluate benefits/challenges for Operational Research community