AI Testbed framework for composable behaviour representation

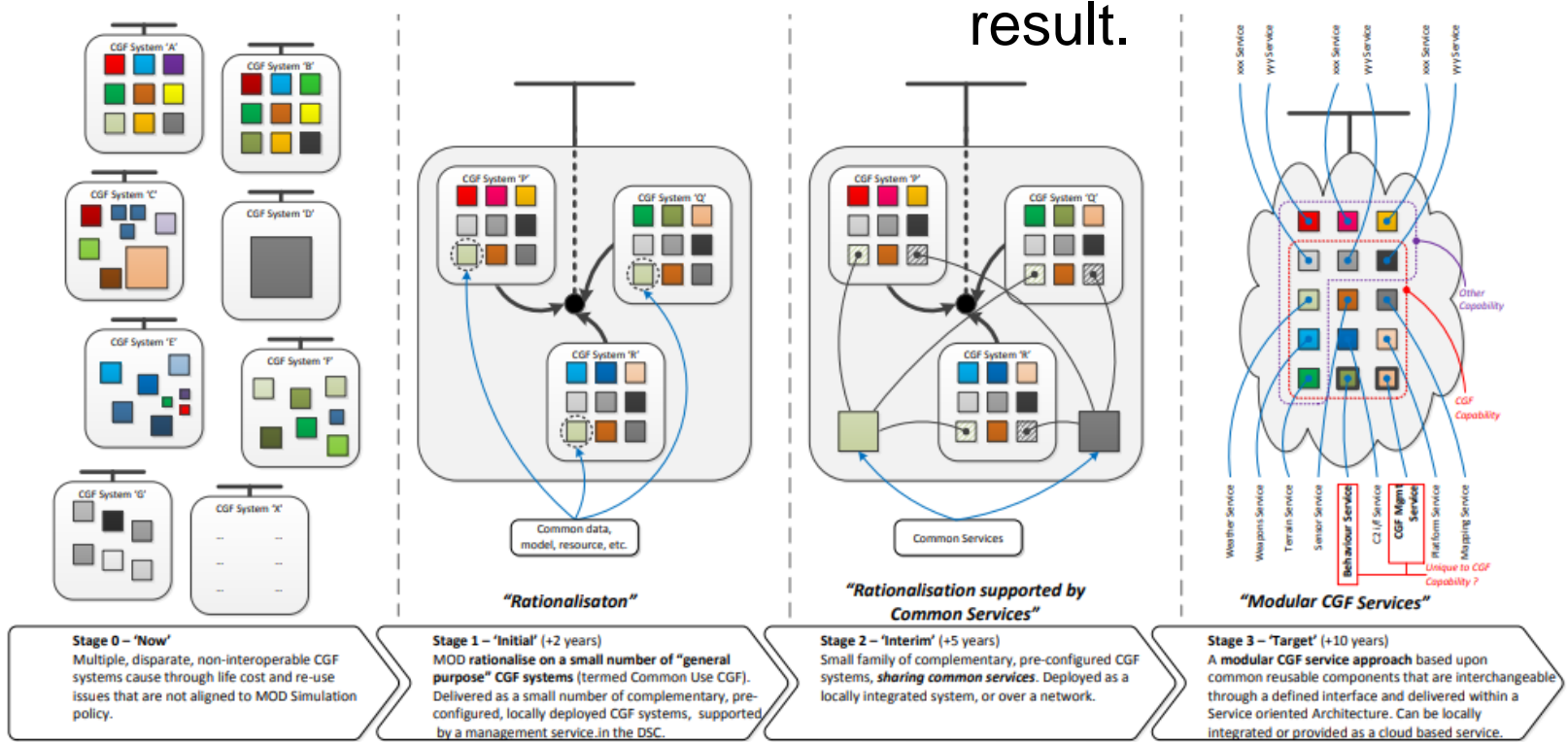Matthew Smith – UK MOD Dstl
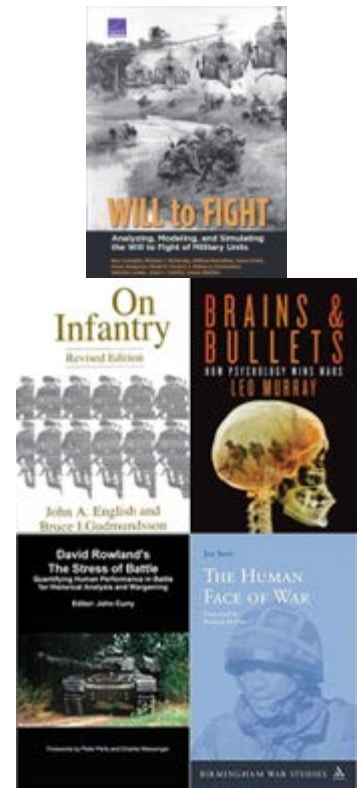
David Robson – Newman & Spurr Consultancy

- No single Computer Generated Force (CGF) represents the full breadth of behaviours that occur in operational environments.

- Often, multiple CGFs need to be utilised which creates interoperability challenges and may result in limited and redundant functionality as a result.

- How can we better understand approaches for the development of common simulation components for modelling Computer Generated Forces (CGF) Behaviours?

- First step was to develop an AI testbed which could be used to investigate novel approaches to behavioural representation in military simulations

- This will later allow us to test theoretical work previously conducted into the development of composable behaviours.

Combat Participation / Will to Fight test case

- Inspired by RAND Will to Fight study*

- Based on existing Dstl Historical Analysis material (David Rowland, Jim Storr, Dermot Rooney etc)

- Effect hard to quantify but vital to represent manoeuvre warfare

- Under represented in many military training simulations, but available in some commercial games

*Connable B et al. Will to Fight: Analyzing, Modelling, and Simulating the Will to Fight of Military Units, Santa Monica, Calif.: RAND Corporation, RR-2341-A, 2018. As of April 23, 2021: https://www.rand.org/pubs/research_reports/RR2341.html

- Tabletop Wargame

  - City level urban combat in Grozny 1994/5 with platoon level forces.

- COTS Computer Simulation

  - Combat Mission: Shock Force 2. Street level urban combat in modern Syria with section level forces.

  - Perception of events by a CGF is key to representing these factors

- Excel Model

  - Created an Excel based "Close Combat Participation Model" (CCPM) analysis tool

- Conclusions

  - Suppression and flanking are poorly characterised parameters, especially in constrained environments.

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- **"Hacking into the Combat AI of Watch Dogs 2"***

- Basic Logic of reaction to contact
  - **First Cover:** Initial Reaction to Contact
  - **Neighbouring Cover:** Shoot and Move
 - **Second Cover:** Gain a Tactical Advantage

- Search Criteria
  - Distance to target
  - Distance to Move
  - Angle to Target
  - *Line of sight*

	Distance to Target	Distance to Move	Protection	Line of Sight
First Cover	Medium	High	Low	No
Neighbouring Cover	High	Medium	Low	Yes
Second Cover	High	Medium	Medium	Yes

*Dickie-Clarke, C. (2018). *Hacking into the Combat AI of Watch Dogs 2*. [online] www.youtube.com. Available at: https://www.youtube.com/watch?v=c06DZ81Tbmk [Accessed 16 Sep. 2021].

- Unreal 4 Based

- Plugin based design

- Support for dismounted close combat entities including:

  – Tasks

  – Stances

  – Formations

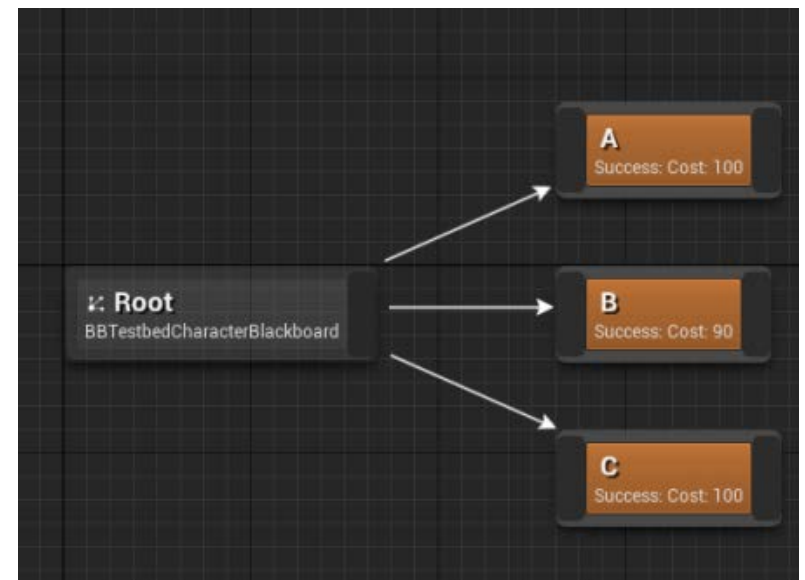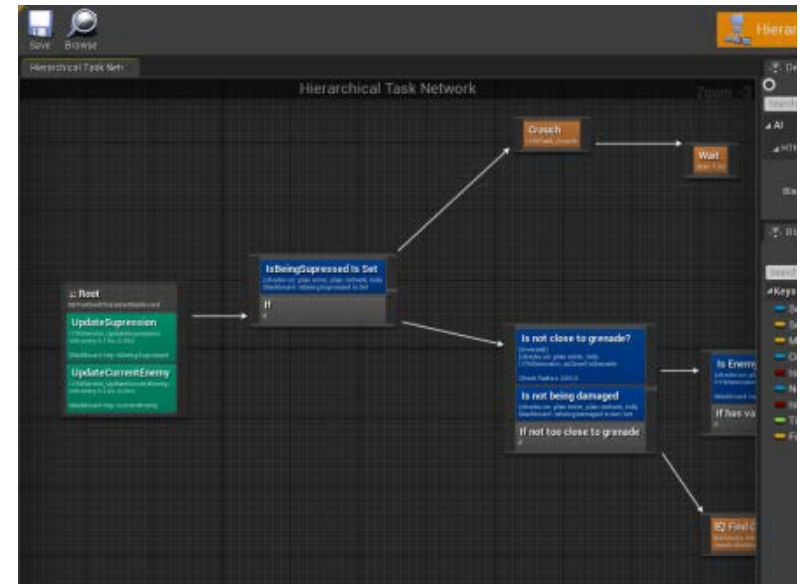 – Factions

- Utilisation of existing UE4 Capabilities

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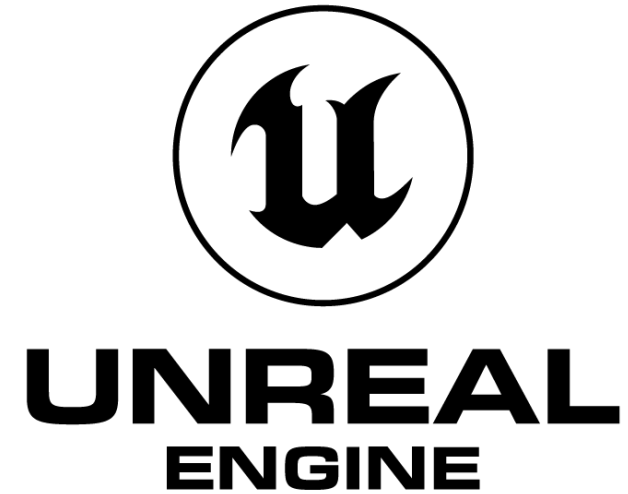
- ## Sense
  - Perception Components
  - Environmental Query System (EQS)
- ## Think
  - Blackboard
  - ~~Behaviour Trees~~ (more on this in a minute)
- ## Act
  - Navigation Mesh

- Core AI Logic

- Multiple 'plans' can be explored before choosing the preferred course of action

- Combining Planning and a Tree structure together allows multiple styles of AI programming depending on complexity/performance requirements

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- The Unreal Engine supports the 'Sense, Think, Act' paradigm.
- Behaviour Trees are limited to choosing a single course of action
- The replacement with a HTN has enabled Forward Planning which in turn allows more realistic and complex behaviours to be authored

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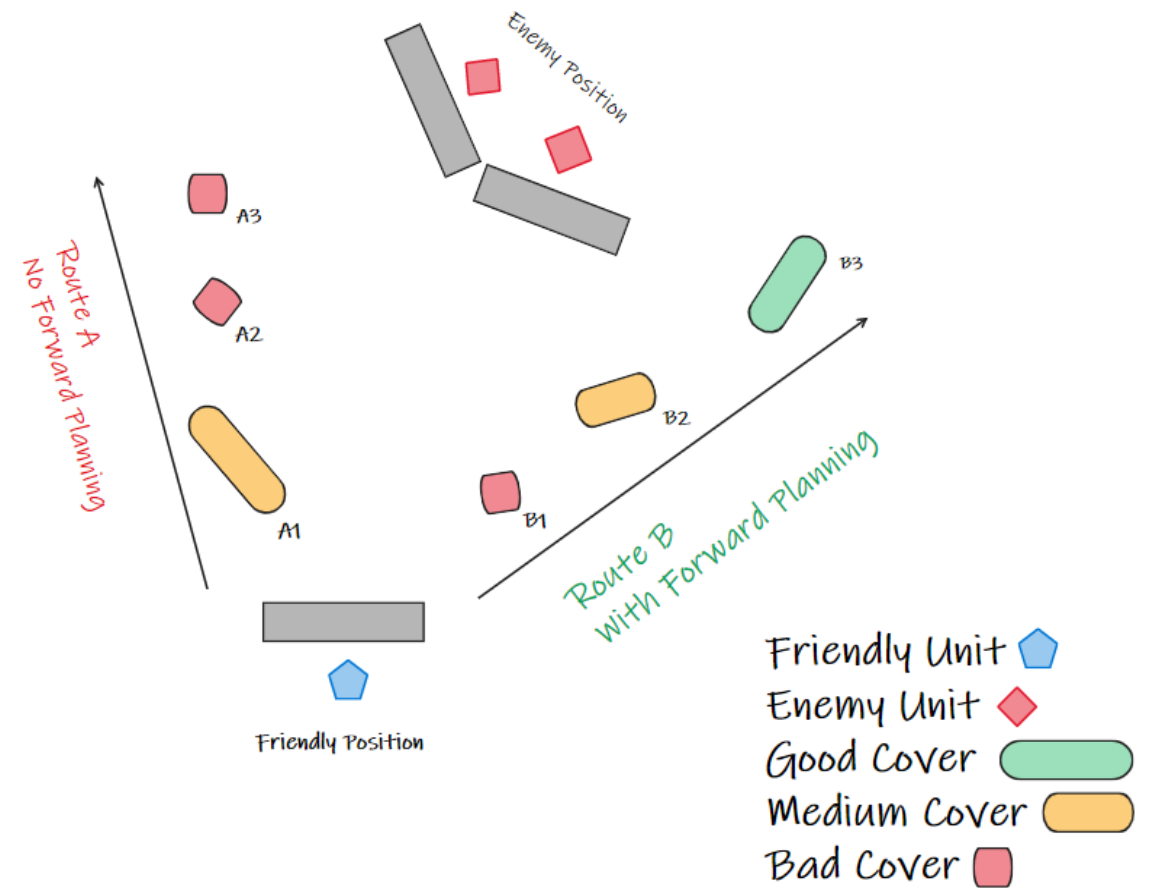
- UE4 is a good candidate for an AI testbed

- Team-based support adds significant complexity

- The time to author behaviours is significant

- Combat Participation or "Will to Fight" is a core concept that should be built into an AI framework from the outset.

- Developing a runtime editing capability is a key addition for longer-term use.

Tools

- Continue to monitor commercial games developments

- Continue exploration of Unreal Engine capabilities to support other prototyping tasks.

Behaviours

- Encode sample UK Battle Drills as HTN's to stress the framework.

- Explore how Will-to-Fight can be applied at other scales of simulation (Section, Company, Brigade)

- Develop an understanding of the behavioural information that must be passed between simulation components.

Path's to exploitation

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Questions?

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