Mission Command Model

“Improving decision support through automated planning technologies in simulation models: Mission Planner”

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DSTL/PUB104299

Outline

- Simulations & automated decision making
- Mission Planner
- Mission Command Model
- Summary

Why build simulations?

- The ultimate aim of Operational Analysis is to improve the quality of decision making
- Decision makers need to understand which military capabilities are critical for campaign success
  - What is actually required?
  - What level of performance does it have to achieve?
- Military campaigns are complex, involving systems of systems
- Fundamental requirement
  - How does a decision impact the system of systems?
  - How much risk is being taken?

Why automate decision making?

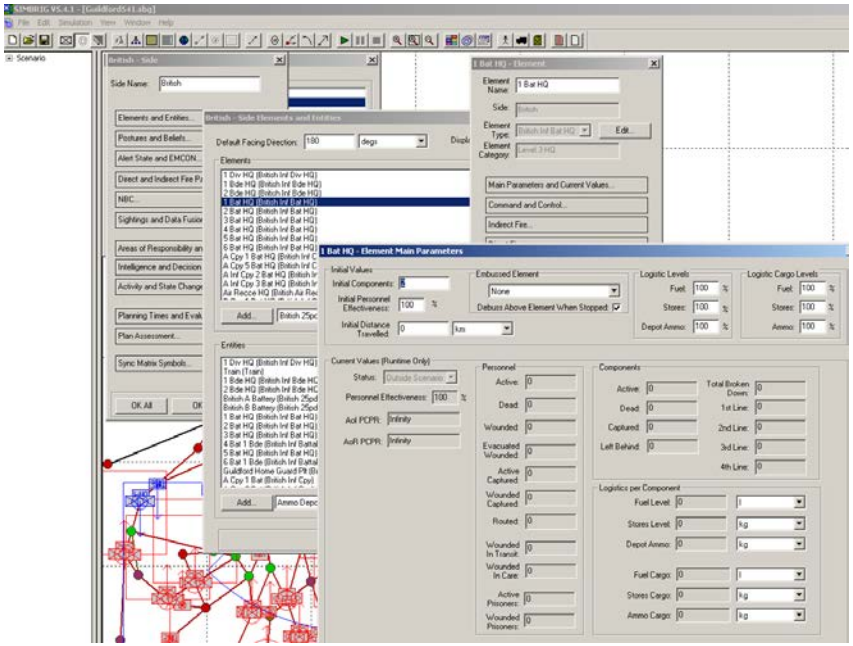
- Decision making needs to be reflected in models either
  - Externally, by scripting events as input to the model, or
  - Internally, by automating the decision making process

- Military campaigns:
  - Complex systems
  - Thousands of interacting parts
  - At least two sides, each actively trying to disrupt the other
  - Massive feedback potential
  - Changes in technology and legal framework subject to often rapid change

- Scripting is rigid and can be fragile; Automation offers flexibility

Traditional model running

- Create a base-case
  - Single course of action in a scenario
- Run stochastic variations around that base-case
  - Usually variations are based on uncertainty in systems' performance
  - Variations can produce strange results as the script fails
- Analysis is limited by:
  - Long set-up time for the scenario
  - Small number of variations due to the time taken and difficulty of scripting
  - Often only changing system performance or force elements



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New approach to model running

- Automated decision making
  - Allows the computer to generate scripts automatically
  - **Developed "Rapid Planner"** to test if current course of action is sensible given new information
  - **Developing "Mission Planner"** which automatically allocates forces in space and time to achieve a given effect
- Initial aim is for "not unreasonable" decision making & to improve over time
- Benefits to Analysis include:
  - Shorter set-up time for the scenario
  - Ability to conduct more variations, including changes to course of action

Human decision makers

- Human decision making is:
  - Pattern matching, built on experience
  - Imaginative
  - Perception-based
- But it is often limited by implicit assumptions
  - Some are real constraints
  - Some are failures of imagination

Human vs Computer decision makers

- The purpose of an automated planner is to represent the *outcomes* of human decision making

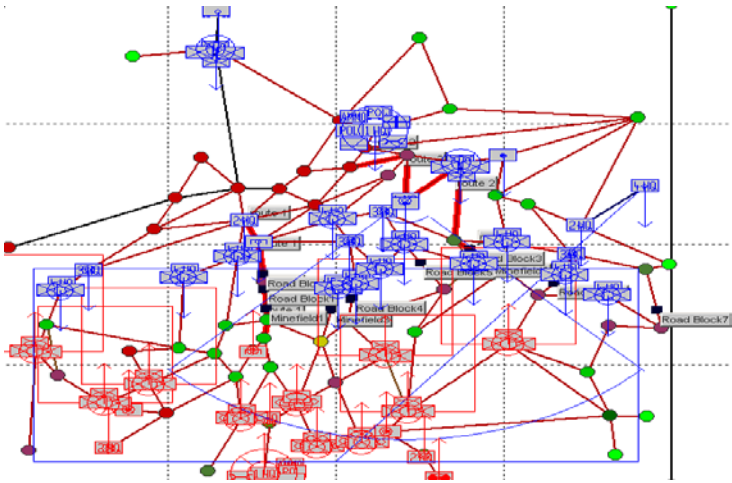
- Human decision making represented by computers:
  - Follows rules ruthlessly
  - Is information-based (not perception-based as no interpretation)
  - Has behaviour constrained by rules not perception of rules
  - Will only be as good as the information provided

What is the Mission Planner?

- The **Mission Planner** is an approach to greater automation of unit tasking in simulation models.
  - At its core is a genetic program optimiser
- It is not intended to replace humans entirely
- The **Modular Mission Planner (MMP)** is an implementation of the Mission Planner as a reusable module within our modelling framework

Mission Planner: Concept demonstration

- Used mathematical optimisation
  - Genetic Program & Simulated Annealing
- Perception-based
  - Planning only on what it “knows” about
- Can cope with uncertainty
  - Optimising against a number of potential courses of action
- Test-bed in a simple brigade-level model
- Key requirement is for a plan tester
  - What does a good plan look like?
  - How to keep run-time reasonable?



Issues with the Concept demonstration

- Plan coding
  - For example, a logistics model failed to find “obvious” solutions
  - This was caused by the way the plans were generated
- Playing the model
  - Used a HQ (which was a small and hard to observe unit) to sneak onto an objective
- Over-optimised solutions
  - Sneaking a unit behind a moving enemy unit
  - Leaving flanks open to counter attacks
- Model dependence
  - The Mission Planner implementation required individual tailoring for each model

Issues solved from the demonstration

- Plan coding
  - At least for the problems we have discovered
  - Allows shorter plans for more likely solutions
- Playing the model
  - Build a bespoke plan tester which limits the freedom of manoeuvre to the physically possible
- Over optimisation
  - **Partially** addressed by testing against multiple courses of action

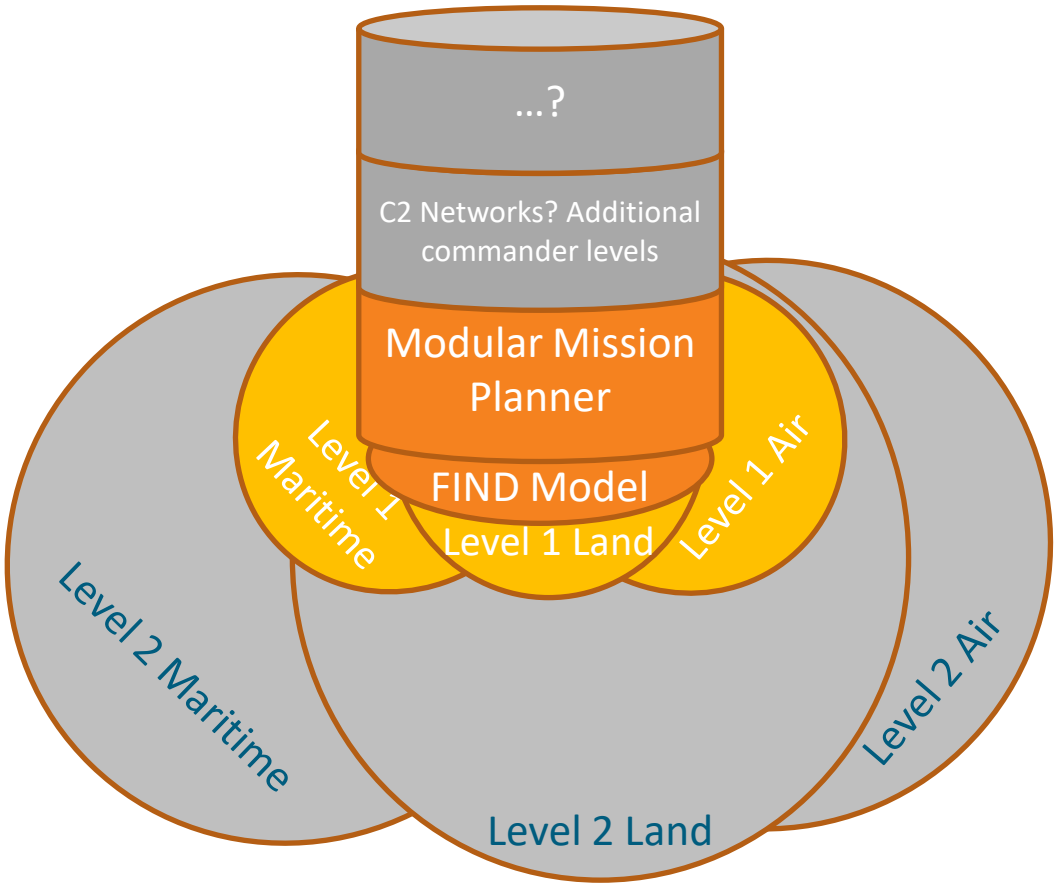
Summary of the Mission Planner Concept

- We have demonstrated that Mission Planner can produce plans for military situations
- To realise the full impact we need to embed the Mission Planner into a model
- Building a new model around the Mission Planner is simpler than trying to replace the core of an existing model

Mission Command Model

- The **Mission Command Model (MCM) is:**
  - A campaign-level model, initially focussed on the land environment, with the ***Modular Mission Planner*** embedded as core Command & Control functionality, to remove the need for scenario scripting
- It is highly aggregated and effects-based
- It can plan against multiple enemy courses of action
- It has been built iteratively, toward a complex representation of perception, including uncertainty and false information

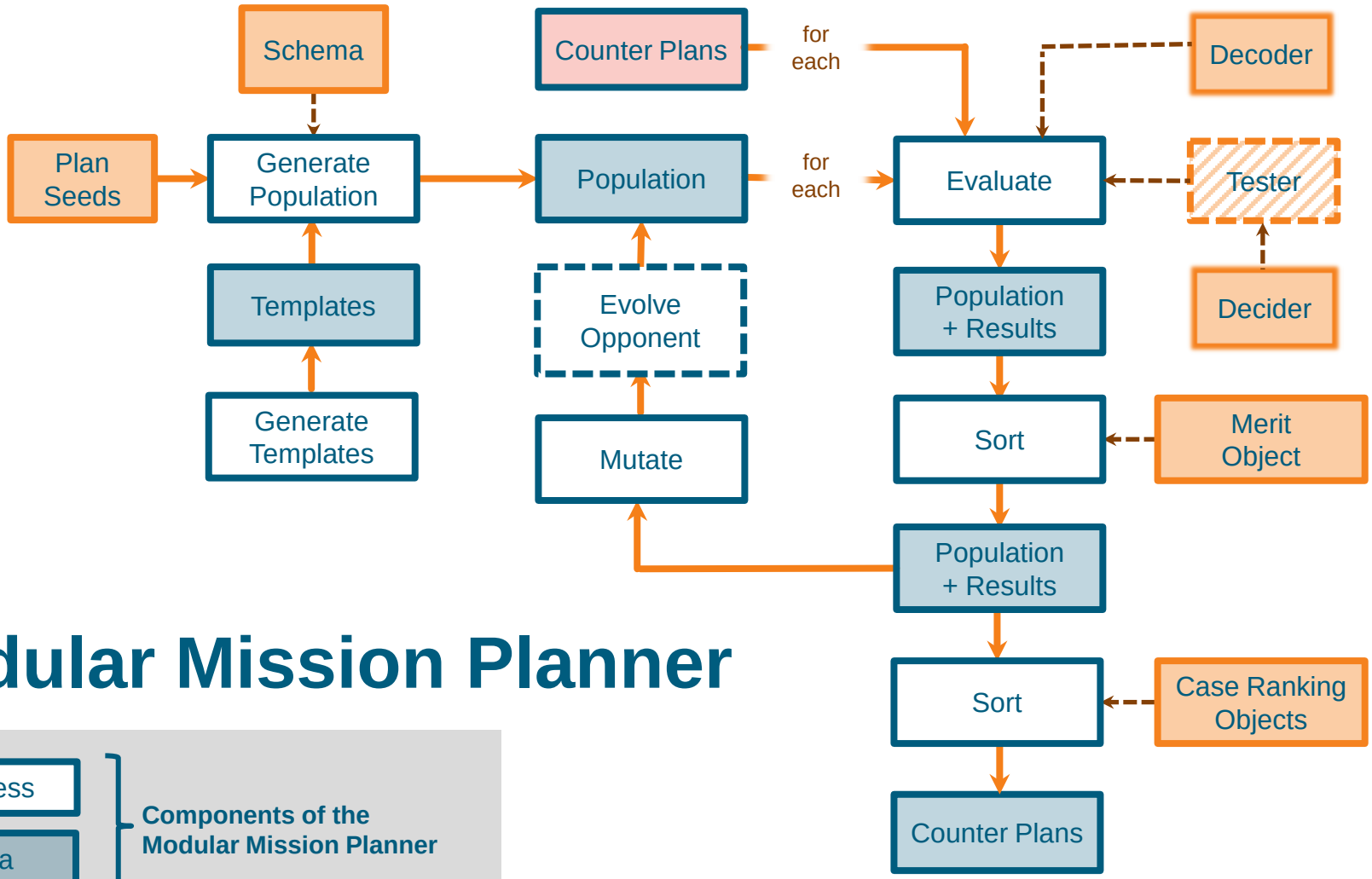
Mission Command Model



Built in stages, with useful models at each stage

Level 1: simple representations

Level 2: more detailed models of specific areas



Modular Mission Planner

Process

Data

Components of the Modular Mission Planner

Data

Model specific components

MCM – Version 1

- Single planning cycle for each side
  - Plans against multiple enemy courses of action
  - Based on their perception of the enemy's objective
- Focused on 'Find'
  - A significant problem in Force Development Analysis
  - The best test of planning
- Uses 'Block' functionality to represent the impact of combat power on the ability to conduct 'Find'

Verification & Validation

- Mission Planner demonstrated in Simple Brigade model test-bed
- Modular Mission Planner tested in isolation using a simple game
- MMP integrated into Mission Command Model
- Components other than MMP integration tested
- MCM including automated planning tested (Verification of MCM)
- MMP produces realistic plans in a given context (Validation of MCM conducted against existing UK Defence Scenario)

Where are we now?

- An external peer review was held in July 2017
  - Reviewers were drawn from Academia, MOD scrutiny & a NATO nation
- The Modular Mission Planner, embedded in Mission Command Model has been verified & produces credible plans
- MCM V1 will be used for scenario analysis towards the end of 2017
  - This will be the first time ISR planning is challenged by an automated “intelligent” opposition force in our modelling
- The next version of MCM will:
  - improve the models representation of land combat, and
  - include improvements to increase efficiency and enhance usability

Summary

- We have demonstrated the **Mission Planner** concept to automatically produce plans for military situations
- We have embedded the **Modular Mission Planner** as an innovative new C2 core within the **Mission Command Model**
- We have demonstrated that this **Modular Mission Planner** can automatically produce plans against multiple contingencies
- We will use **Mission Command Model** to analyse a scenario and continue to enhance its capability

Questions?

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