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Defence and Systems Institute (DASI)

Exploration of Conceptual Models for Agent Based Representation of Behaviour in a Simulation of the Capability Development Process

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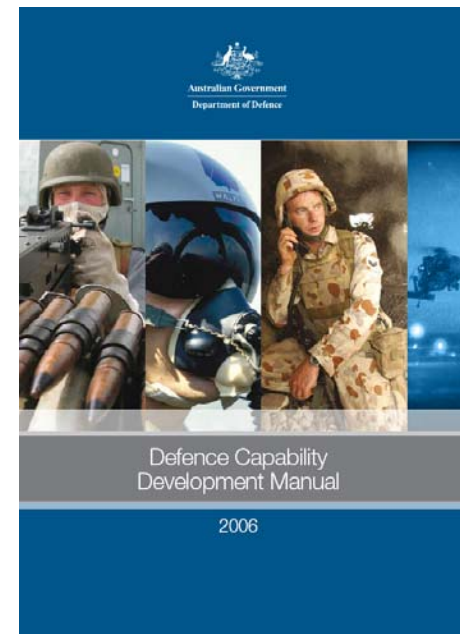
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Overview

- Capability Development Process
- Purpose and objectives
- Objects we want to model
- Actions we want to simulate
- Agents we want to simulate
- Conceptual models explored
- Summary

Capability Development Process

- Most country's defence departments have a selection process for determining which new capabilities to acquire.
- The Australian process is described in the Defence Capability Development Manual (DCDM), with 2006 being the current version.
- The Capability Development Process (CDP) aims to advise the government on preferred projects to improve and maintain Australian Defence Force capabilities.



Purpose and objectives

- We want to simulate the Capability Development Process in order to:
 - Gain an initial understanding of the CDP
 - Understand the dynamics which occur during execution of projects
 - Suggest strategies to deal with issues faced in projects

- We therefore need to establish:
 - Who participates in the CDP
 - What behaviours/characteristics they possess and
 - What actions they perform

Simulation of the Capability Development Process

Representation of Behaviour

Purpose and objectives

- We can then model these behaviours and actions using agent based modelling (ABM)
 - Various agent based modelling concepts exist
 - We will be considering three conceptual models
 - Our approach will include a process of incremental discovery, reiterative design, and development
 - We want to build a model that is
 - Flexible
 - Scaleable
 - As simple as possible
- Agent Based Representation of Behaviour**
- Exploration of Conceptual Models**

Objects we want to model

- 20+ key positions with multiple context-dependent behaviours
 - The various sub-classes of positions will initially include project manager, project team member, IPT team member and committee member
- Several committees
 - Represent committees as both single agents (initially) and a set of agents (later) that are the committee members
- Documents
 - Will need to represent documents both as unitary agents and as a collection of their sub sections
- External agents
 - As stimuli to simulation behaviour (in the first instance)
 - CIOG, Industry, DSTO, DMO, CSIG

Actions we want to simulate

- Carrying out formal processes as per the handbook (DCDM)
- Responding to real social and psychological pressures
- Resolving resource contention
 - Not enough people or time
- Responding to external issues and influences
 - Changes in requirements
 - Political decisions
 - A change in government
 - Etc....

Agents we want to simulate

- We will consider two agents as examples
- A project team member and a committee
- **Project Team Member**
 - Be appointed to the team
 - Be reassigned to another post
 - Gain knowledge about the project
 - Accept assignment of a set of activities
 - Perform activities
 - Negotiate with other team members for resources
 - Monitor own progress and report to project manager
 - Prepare sub documents
 - Attend project team meetings

Agents we want to simulate

- **Committee**

- Schedule required meetings
- Assess quality of documents submitted for approval
- Approve/disapprove documents

Conceptual models explored

- Belief-Desire-Intention (BDI) model
- Behaviour Oriented Design (BOD) with Parallel-rooted, Ordered, Slip-stack, Hierarchical (POSH) model
- Framework for Addressing Cooperative Extended Transactions (FACET) model

BDI model

- Have developed an initial BDI based model using JACK
- A way of explaining future-directed intention
- Contains representations of:
 - Beliefs - Knowledge an agent has about its environment. May not be true and may change in the future
 - Desires - The goals an agent can choose to achieve
 - Intentions - The plans that will allow fulfillment of the goal
- Addresses how the beliefs, desires, and intentions of the agents are represented, updated, and processed to determine the agent's actions
- Provides us with a clear view of what makes up an agent
- Facilitates modular and incremental development

BOD with POSH model

- BOD is a design methodology
 - Used for developing control of complex intelligent agents
- Contains two types of program structures:
 - A library of behaviour modules
 - Describe individual actions
 - Can be shared by different agents
 - A POSH plan
 - Used for organising action selection
 - Determines an individual agent's capabilities and priorities
- Aims to make agent development as easy as possible
- Provides an iterative development methodology
- Scalable
- Able to model multiple goals that are continuous and in parallel

FACET model

- Uses an agent based approach to deal with complex real-world social situations
- Consists of:
 - Steps
 - Specify instructions to be performed in the step
 - Course of Action (COA)
 - Represents sequencing of steps
- Supports modelling of
 - Cooperation among agents
 - Agents concurrently involved in multiple behaviour patterns and having to prioritize interactions among them
 - Behaviour patterns following several paths and hence becoming part of other patterns
 - Process interruption/resumption/cancellation
 - Resource contention

Summary

- We have created a first-cut model using BDI as a learning exercise in:
 - Agent based modelling
 - Representation techniques
 - Understanding some capability development processes
- We are currently in the process of investigating richer representational paradigms to inform conceptual design of the next iteration of our model. These include:
 - BOD
 - FACET
- We will not, however, be using JACK as the modelling environment in this next iteration

Questions ?



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