

Chapter 10-8 – AGENT-BASED MODELLING: EXAMPLE INSTANTIATION WITH NETLOGO

SUBJECT

The objective of this effort is to create agent-based models to compare the distribution and flow of information in a hierarchical Command and Control organisation to that of a fully networked Edge Organisation. These experiments were conducted to exercise and strengthen the SAS-050 Conceptual Model.

APPROACH

It is important to understand how the efficiency and effectiveness of an organisation's performance are affected by the structure of its communications network. Capabilities such as information sharing and collaboration depend upon on network connections. This modelling effort investigated the set of network structures illustrated in Figure 10-8.1.

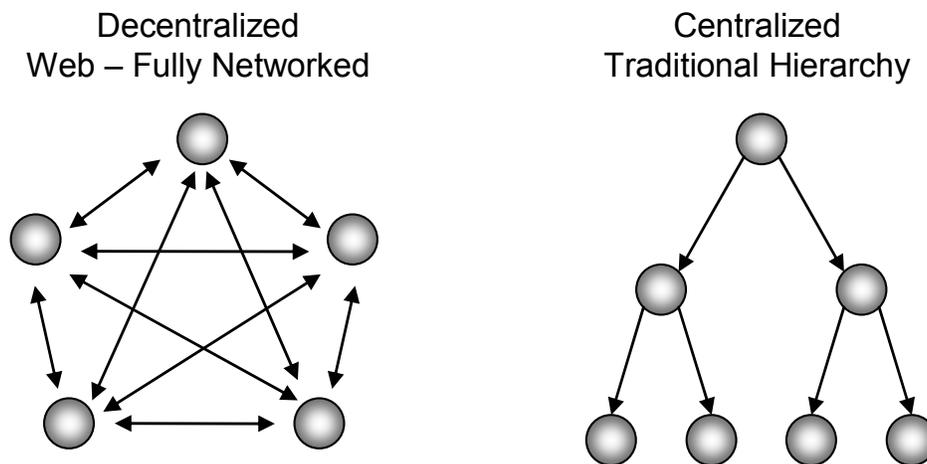


Figure 10-8.1: Four Network Topologies, Power to the Edge (p. 182).

Conducted as part of Case Study 1, the goal was to explore aspects of Network Centric Operations to support the development of the group's Conceptual Model of Command and Control.

These networks were examined in two different scenarios using different modelling tools. The first experiment focussed on the effect of a degraded communications network on an armed force under attack. The study was conducted using Map-Aware Non-uniform Automata (MANA). By data farming relevant communication parameters such as range, capacity, latency, accuracy, and reliability across a variety of network configurations, we were able to determine which communication factors are most important for a force to successfully share information. The study explored several operationally relevant scenarios ranging from the very simple setting to the complex. Primary focus will be placed on message range and accuracy, and how each affects the unit's ability to fight and win decisively. The aim of this analysis is to gain insight into the first order effects of networking on force effectiveness.

The second experiment, developed using NetLogo, models agents receiving information related to a future attack. The agents gather information related to four question areas. Collectively, the agents need to gather information facts to solve each of these questions. An organisation will have completed its task once it answers all four questions. Each organisation consists of agents and four Web sites. Agents need to share and post information in order to achieve their goal of building awareness in each knowledge area. Communication, namely the receiving, sharing, and posting of facts, is constrained by the network structure.

WHAT WE LEARNED

Agent-based modelling fills an important analytical gap in experimentation. Such models allow for rapid, repeatable concept exploration, which is an effective means of examining the impact of network technologies on a force. The use of computer simulations provides a basis for analysing and optimising the abilities of military forces in NCO. In studying the use of sensor systems, shared information, and collaboration, it was possible to determine the effects of information network structures on military situations. These experiments helped validate variables and connections illustrated in the CM.

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By conducting experiments using multiple modelling tools, we were able to investigate a broader set of variables. This detailed exploration of the variables and relationships defined by the SAS-050 group aided in identifying advantages and limitations of their conceptual model. Agent-based modelling is just one method of exercising and strengthening the C2 model.

REFERENCES

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