26th International Congress on Modelling and Simulation, Adelaide, SA, Australia, 30 Nov–4 Dec 2025
mssanz.org.au/modsim2025

An agent-based simulation model for defence workforce planning

AJ Rogers [a] and HH Turan [b]

[a] *Australian Defence Force, Melbourne, Australia*
[b] *School of Systems and Computing, University of New South Wales, Canberra, Australia*

Emails: [a] a.rowlings@student.unsw.edu.au, [b] h.turan@unsw.edu.au

Abstract: The Australian Defence Force (ADF) faces a significant workforce challenge in sustaining authorised strength while meeting its 2032 objectives. As of January 2024, the ADF was 6.9% (4,308 personnel) below authorised strength, with a projected shortfall of 5,000 by July 2025.

Addressing interconnected challenges in recruitment, retention, and mid-rank experience offers an opportunity to strengthen the ADF's capability. Nevertheless, workforce challenges are inherently multifaceted, and although reforms such as decentralised recruiting, flexible career pathways, upskilling initiatives, and targeted incentives provide partial benefits, none are sufficient in isolation. Modelling and Simulation (M&S) is an appropriate methodology for examining these complex socio-technical systems. For example, System Dynamics (SD) may capture aggregate flows between ranks, Discrete-Event Simulation (DES) may be used to replicate and test recruitment processes, and Agent-Based Modelling (ABM) may be utilized to represent individual retention behaviours.

This study particularly focuses on Army officers at the middle level ranks, with broader flows of recruitment and retention represented at a strategic level, but detailed modelling has been constrained to tactical outcomes for these ranks as depicted in Figure 1. Officers are modelled as agents progressing from Lieutenant to Lieutenant Colonel, facing annual separation or promotion decisions governed by time-in-rank distributions. Recruitment enters through Royal Military College–Duntroon graduations.

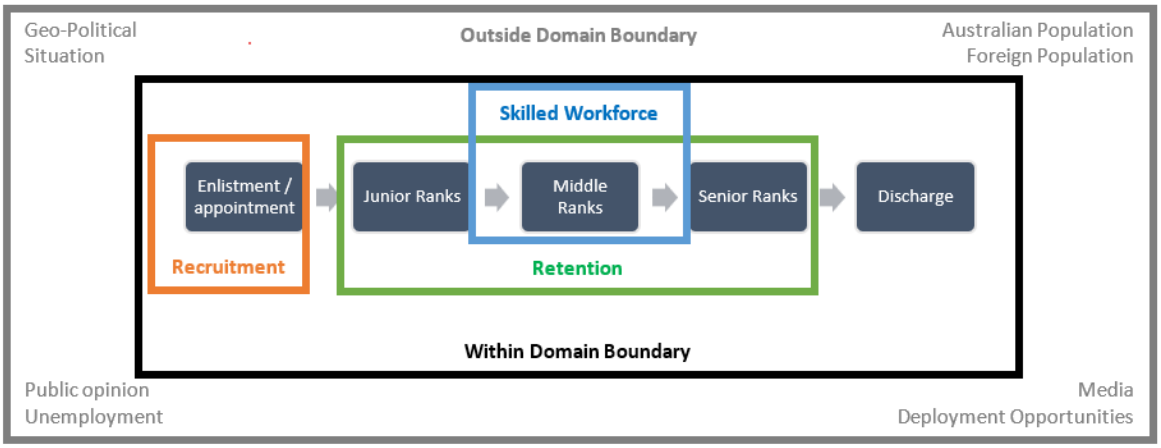

Figure 1. Army Workforce Planning Domain Boundary

Several experimental scenarios were examined. Increasing recruitment rates enabled the captain targets to be met but had limited impact on majors. Eliminating separations entirely also proved insufficient to achieve the goals. Reducing time-in-rank accelerated promotions, though it introduced trade-offs across ranks. Therefore, we coupled the developed ABM with an optimisation algorithm, namely a genetic algorithm, to explore integrated strategies.

The numerical analysis showed that mid-rank retention is pivotal, recruitment must be aligned with career progression, and optimisation requires prioritisation across ranks. These findings suggest that workforce goals can be achieved through the use of the developed simulation-optimization appraoch by investigating a wide range of policies. Future research could extend the model across services and integrate ABM with machine learning to better capture separation and retention behaviours.

Keywords: *Workforce planning, defence, agent-based modelling, genetic algorithm, simulation-optimization*