

Capability Engineering

Increasingly, defence organizations around the world have begun to focus their military planning and acquisition efforts on defence “capabilities” (frequently characterized by “system-of-systems” configurations). This conceptual shift has moved from focusing on the acquisition of a specific tool or piece of equipment, to focusing on building and sustaining an overall capability – inclusive of people, processes, and material. This new focus requires advanced methodologies to define, analyze, and measure capabilities. The CAE Professional Services team is a leader in the advancement of capability engineering as an evolving discipline. Our Capability Engineering and Design Approach (CEDA™) integrates the application of modelling and simulation in capability-level analysis and experimentation.

What Is Capability Engineering?

Capability engineering is an evolving construct that extends well-established systems engineering principles to a “system-of-systems” perspective. In defining a capability as “an ability to act”, capability-based planning seeks to optimize the capacity to “act” by considering the implications on people, process and material. Capability engineering, like the capability-based planning approach it supports, incorporates a holistic blend of people, process, and material, ensuring that capabilities are properly designed, efficiently developed and sustained with a specific focus on interoperability with government departments and defence organizations.

A structured approach to capability requirements analysis

The CAE Professional Services team of capability engineering professionals works within capability engineering teams to define and analyze capability requirements. By following capability-based planning methodologies and using systems engineering tools that support functional analysis and allocation, requirements management, network analysis, and physical design, our capability engineering team has developed a structured analytical approach to capability requirements definition for capability portfolios, which encompass broad capability-based planning domains, such as C4ISR.

Measuring capability

The gap between existing “as is” capability and the desirable “to be” capability state demand measurement both in their definition and as a key element for evaluating incremental capability attainment of the “to be” state. Our team of capability engineering experts has developed an analytical approach for clients to measure the performance and effectiveness of capability options. The CAE Professional Services team has developed value-focused metrics, including system-level measures of performance and scenario-based measures of effectiveness, which have led to integrated capability metrics suitable to link enterprise strategic guidance to an engineered capability portfolio. Through this analytical approach and simulation-based environment, client capability engineering teams understand the impact of alternative capabilities on variables such as strategic key performance parameters, operational and system performance, lifecycle costing, personnel, and training requirements and methods.





Architecture framework development

The CAE Professional Services team of capability engineering professionals works with teams in the development, validation, and application of C4ISR architecture framework analysis methodologies, using techniques such as the U.S. Department of Defence Architecture Framework (DoDAF) and various integrated architecture development tools. The team provides expertise in extending DoDAF architecture products to address specific enterprise needs, such as linking to concept development and experimentation programs, existing performance management approaches (e.g., Balanced Score Card) or other national and international architecture framework approaches (e.g., the evolving Canadian Defence Enterprise Architecture, UK MoDAF).

Using simulation to evaluate capability

The CAE Professional Services team of modelling and simulation experts design and conduct simulation-based experiments to determine and validate capability requirements. Through cost-effective constructive simulation, defence planning teams are able to evaluate the potential effectiveness of adding new tools to current capabilities, such as a new sensor to the C4ISR capability, and to compare the capability alternatives being considered for a capability portfolio, such as air versus land lift within an overall life capability portfolio. Through our simulation-based decision support services, planning teams make informed balance of investment decisions for the capability portfolios.

Predicting the impact of capability changes on personnel and training

A key component of our CEDA approach is our Human Views analysis. This extension to the DoDAF architectures incorporates the principles of human system integration (HSI) to determine the human factors engineering, system

safety, personnel, and training impact of alternative capabilities, to define the HSI requirements for a capability, and to measure the impact of capability design changes on HSI issues.

Our team has leveraged its extensive and market-leading expertise in this domain to ensure that the capability-based planning construct provides the optimized blend of people to the mix of process and material that constitutes a capability – providing the warfighter the ability to act.

Program example

The CAE Professional Services team is actively engaged in the definition and development of the capability engineering construct for the Canadian Department of National Defence supporting the defence research and development community on the \$10M, 4-year collaborative Capability Definition, Engineering, and Management Technology Demonstration Project (CapDEM TDP). Through this effort, the CAE Professional Services team supported the embryonic capability engineering approach employed on the Joint Information and Intelligence Fusion Capability (JIIFC) program during its requirements definition and analysis phase and provided guidance to the Maritime Security Operations Centre (MSOC) initiative. Although Capability Engineering is an emerging discipline and a breadth of representative applications is developing, the CAE Professional Services team is leading the definition, design, and development of the construct, realizing that our historical user-centred, simulation-based approach is significantly transferable to this integrating domain.

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