Defence Simulation: More Than a Training Technology

Definition, acquisition, operation, and support of defence systems are discussed in terms of the "life cycle." These phases follow a defence system from concept development and experimentation (CD&E) and research and development (R&D), through the acquisition process to operation by a defence unit, and eventually to disposal of the defence system.

ANALYSIS, DESIGN, EXPERIMENTATION, EVALUATION

- Concept Development & Experimentation
- Research & Development
- Acquisition:
  - ID
  - Options Analysis
  - Definition
  - Implementation

TRAINING

- Operation

DISPOSAL

Simulation has historically played a key role in the operations phase of the life cycle, primarily as a training tool. Simulation-based training has always been a part of military force preparation in the form of "live" training, where warfighters use their actual equipment in field exercises to simulate battlefield conditions. The expression "all but war is simulation" comes from this historical practice.

As technology has progressed, the fields of virtual and constructive simulation as training tools have increased significantly. "Virtual" simulation involves warfighters interacting with virtual equipment on a virtual battlefield across a range of scenarios. "Constructive" simulation involves simulated warfighters (the behaviour of the soldier, vehicle, or unit is modeled in the simulation) conducting battle on a virtual battlefield with a simulated enemy.

From a training perspective, constructive simulation was introduced to train command teams so that a group of live commanders could direct an entire simulated force, thereby training decision making and command team skills.

The business case for live, virtual, and constructive simulation-based training technologies is typically solid and includes key factors such as:

- **Cost**: Virtual and constructive simulation does not require real vehicles, maintenance, gas, bullets, and large numbers of personnel. As a result, the training experience is much more affordable.
- **Quality through realism**: Virtual and constructive simulation can introduce dangerous scenarios on foreign terrain that would not otherwise be possible to experience prior to an actual military mission. For example, teams cannot rehearse defence against improvised radiological devices in highly populated urban areas any other way.
- **Quality through instructional control**: Simulation allows the repeat of scenarios, the actual measurement of individual or team performance, and ease of instructor observation.

Today, the simulation technologies used primarily for training are also finding an equally strong role in the "up front" phases of the defence life cycle. Around the world, the field of modeling and simulation (M&S) and the use of synthetic environments are now growing rapidly through CD&E, R&D, design and development, and defence acquisition. Examples of where M&S and synthetic environments are being utilized in the Canadian defence community include:

- **CD&E Centres**: the Army Experimentation Centre, Maritime Warfare Centre, Canadian Forces Air Warfare Centre (evolving), and Joint Canadian Forces Experimentation Centre all use modeling and simulation in their evaluation of new concepts.
- **R&D Labs**: all of the Defence R&D Canada (DRDC) centres use M&S at various levels in their research programs, with full R&D sections in Toronto and Ottawa, and R&D groups at Valcartier and Atlantic dedicated to M&S and synthetic environment-based R&D.
- **Corporate development teams**: major defence system manufacturers have invested in simulation-based test and evaluation facilities to evaluate new designs and concepts. In some cases, industry/government collaboration has resulted in simulation centres at industry contractor sites, such as General Dynamics' Armoured Vehicle Test Bed or Lockheed Martin's Canadian Patrol Frigate Ops Room simulation facility.
- **Requirements analysis**: Defence procurement teams are increasingly using constructive and virtual simulation-based experiments to determine and/or validate requirements for upcoming procurements. For example, M&S experiments are used to determine what types of system configuration best meet operational requirements and these validated requirements are then used as the basis for acquisition. Simulation support is being provided to these teams by CD&E centres, operational research teams, DRDC centres, and industry contractors.
- **Bid evaluation**: This is one of the newer areas involving the application of simulation technology. Models of a bidders design are submitted to DND as part of a bid package and evaluated using simulation tools against bid evaluation criteria. A recent example of this practice is the Maritime Helicopter Project (MHP).

The application of modeling and simulation in the early phases of the life cycle increases in intensity, sophistication, and validity each year. There are numerous indications that the practice of using simulation-based technologies will increase

significantly over the next decade. A perfect example is the recently published document entitled *"The Joint Modeling and Simulation for Acquisition Rehearsal Training and Support (JSMARTS) Vision: Enabling Strategy 2020."* This document, and an associated workshop held last year, have defined a target for the "systematic integration of modeling and simulation across the business of DND."

Major capital acquisition projects currently underway, such as the Canadian Advanced Synthetic Environment (CASE) project, will start to define and deliver the infrastructure that will be required to support the effective application of M&S across a range of DND initiatives. The business case for M&S in the early phases of the life cycle includes the same factors as using simulation for training. However, there are additional benefits for the use of M&S in CD&E, R&D, and acquisition including:

- *More accurate requirements*: Studies have shown that over 70 percent of the life cycle cost of a defence system is locked in during the requirements analysis process. Simulation-based studies focus requirements and help ensure accuracy, thus saving money.
- *Less expensive engineering costs*: Re-engineering throughout development, and re-engineering following deployment, is a costly, but common practice, often due to inaccurate requirements. M&S-based studies help focus requirements and decrease re-engineering costs.
- *Lower personnel costs*: The cost of human resources is one of the largest costs in any defence system over its life cycle. Simulation-based studies early in the life cycle help to optimize the number of personnel required to operate and maintain a system, and help to anticipate any changes required to the recruitment and training system during deployment.
- *Faster acquisition*: The more that M&S is used, the more that assets, scenarios, and labs can be re-used. Re-use of simulations, personnel skills, scenarios, and measures has the potential to decrease the time it takes to evaluate concepts, conduct options analysis, validate requirements, evaluate contenders, and test final designs.

The goal of realizing these benefits is shared across DND, the Canadian Forces, and the industrial base. On the government side, a range of initiatives are hastening the maturity of the practice of simulation-based business processes, while in industry there is a growing acceptance of modeling and simulation technology. In addition, there is a small, but growing professional service skill base in Canada capable of helping to configure and apply M&S in the analysis, design, and experimentation process. The result will be that over the next decade, simulation will be much more than a training technology and will become a key enabler to the business of the DND/CF across the entire defence life cycle. FL

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