

White Paper

Synthetic Training Environments

Evolving
Simulation-
Based Training for
High-Readiness
Exercises

Developing end-to-end high-readiness training is a complex process with many steps

- 1 Design**—defining training objectives, the main events and the simulation architecture
- 2 Development**—developing the content and the connectivity to build the training exercise
- 3 Delivery**—delivering simulation-based high-readiness training
- 4 Evaluation**—measuring performance against the exercise objectives



Calian delivers high-readiness training for militaries around the world, bringing realistic, immersive training exercises to prepare militaries for operations. Military training scenarios need to reflect complex and dynamic real-world situations. Calian develops and delivers training exercises that effectively simulate operational scenarios in a safe environment. Our customers trust us to deliver when they can't fail.

We provide high-readiness training in synthetic environments for the Canadian Army through the Canadian Army Simulation Centre (CASC), through NATO at the Joint Warfare Centre, Eurocorps HQ, Joint Forces Command (Naples) and others, and through direct engagement with the militaries of NATO member nations.

Interoperability for a Common Synthetic Environment

Calian uses a system-agnostic approach to design and develop training using the right simulation tools and technology to meet training objectives. Whatever the training objectives and whoever the participants, the interoperable approach delivers a common synthetic environment.

The focus on interoperability means that nothing operates in isolation. This means Calian can develop training exercises that synchronize inputs across systems, creating a more in-depth experience for the trainee. The distributed nature of the Calian simulation-based training system is a powerful feature for delivering synchronized training at multiple locations.

Delivering an End-to-End Experience

High-readiness training is more than just delivering the exercise. Delivering immersive, realistic training exercises has four main components: 1) designing the training experience to meet the stated objectives, 2) developing exercise scenarios and content based on the design, 3) delivering the exercise, typically over multiple days, and finally 4) evaluation of the exercise performance, and identifying ways to improve the exercise experience.

Calian delivers high-readiness training with a clear focus on all four steps of the process to meet the exacting standards of military customers.

1 Design

Delivering realistic training means getting the design right from the start. Designing training means identifying the training objectives and the overall training scenario that will be presented. Defining the objectives and scenario allows developers to anchor the training experience in a context. This supports the development of events and injects. This also gives the exercise participants a frame of reference for the exercise. With a scenario established, developers identify the most suitable simulation systems to use to deliver the exercise. Taking this approach in the design phase provides a comprehensive roadmap of how all the pieces of the exercise will fit together to deliver an immersive experience. This methodical approach provides a clear, easy-to-understand design for what the exercise will look like. Presenting the design to exercise sponsors provides the baseline for discussion, allowing changes to be made during the design phase before time, effort and resources are spent in development.

In the 1990s, collective military training relied mostly on paper-based maps, wall-chart tracking, paper flipcharts and sticky notes. Analog design and delivery were the norm, with exercise control (EXCON) coordinating the timeline and inject delivery using wall-sized paper tracking charts. The process was cumbersome, with EXCON coordinating and deconflicting activities to ensure a consistent, coherent version of the truth for all exercise participants. The introduction of desktop technologies changed the approach somewhat. Email and shared file folders replaced paper traffic, though delivery was still manual. Large paper maps continued, with some digital imagery products supplementing the paper, though manual was still the default.

Calian undertook a big challenge: to develop a training tool that integrates exercise design, development and delivery of full-scale exercise into a single platform. MaestroEDE™ is the realization of that vision. MaestroEDE allows exercise designers to align the scenario and events for the exercise directly to training objectives defined by the military customer. Calian relies on MaestroEDE as a common platform that allows exercise designers to build the roadmap for exercise, and then develop and deliver training. MaestroEDE was originally developed to support CASC and national E3D

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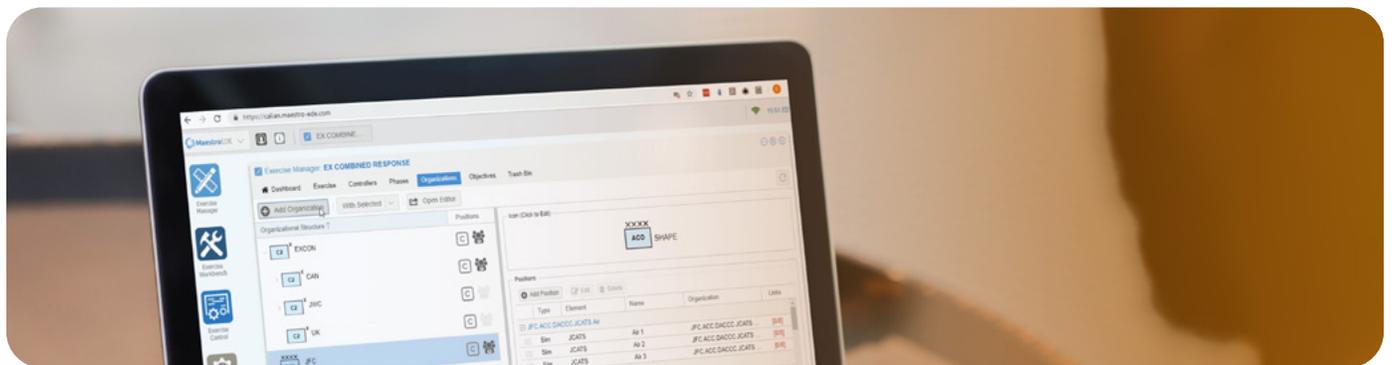
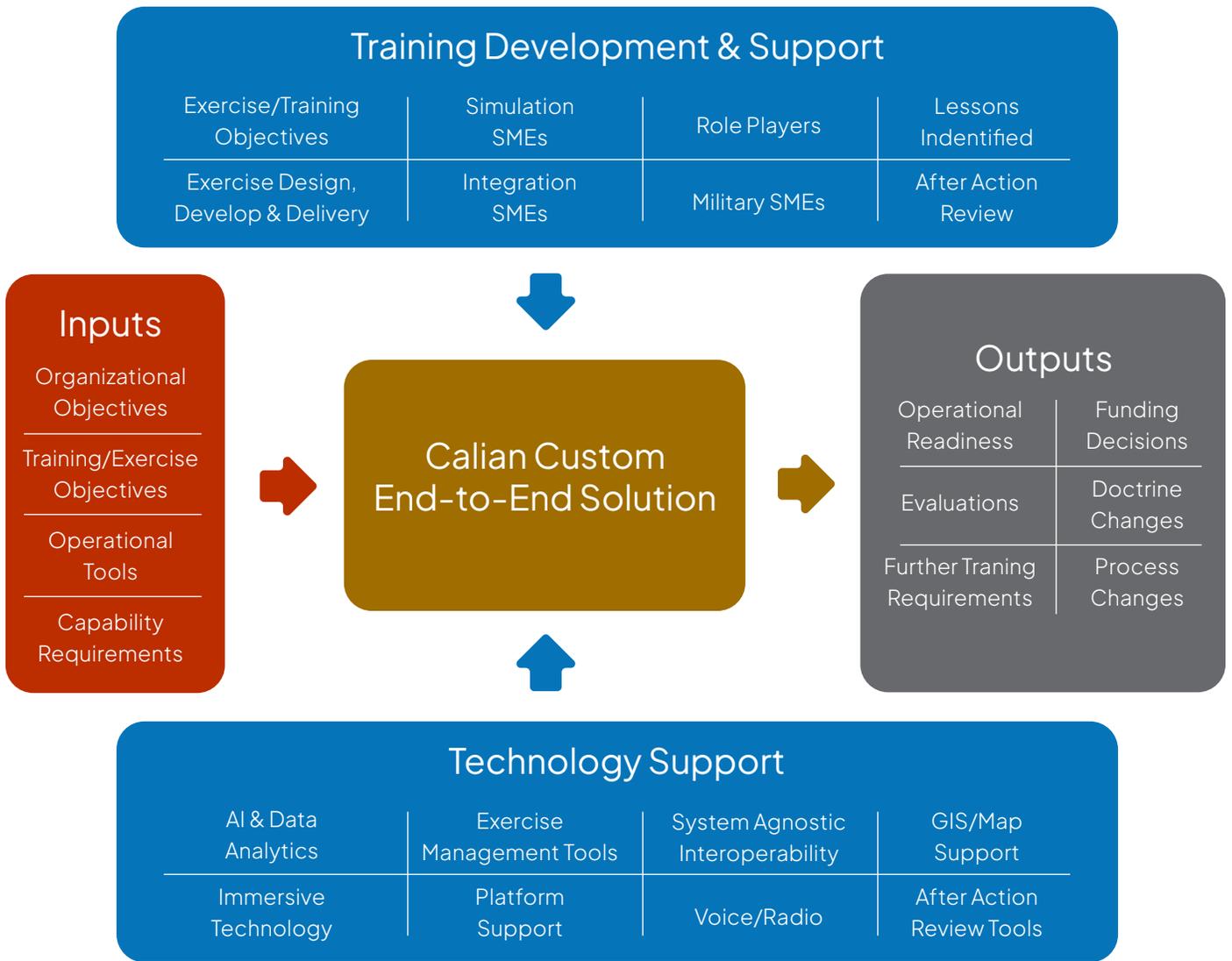
processes. The tool was designed to meet the needs of professional exercise designers who develop, deliver and report on training.

To achieve training objectives in an immersive environment, the development team needs to design and develop training to deliver the right effects. To do this, the exercise architecture is designed to make all the appropriate training systems interoperable for training delivery. Simulation system architects develop the

concept to deliver the exercise with multiple simulation systems to provide the appropriate simulated data feeds for the primary training audience to provide maximum realism. The Calian Virtual Command and Control Interface (VCCI) tool suite is system-agnostic,

allowing interoperability for simulation-based training and operational tools. Simulation and operational systems are connected as necessary using VCCI to deliver a synthetic training environment to meet the training objectives. This includes visual simulation data and audio data to create a fully immersive environment for military training. VCCI supports any scenario in a synthetic environment, including air-land operations, amphibious and littoral operations, special operations, large force-on-force naval operations, missile threat exercises and air defence. VCCI can also be extended to support unplanned or unsupported training requirements, delivering true interoperability for military training.

Calian takes a holistic approach to design and development. We start with your objectives and leverage the right technology and supporting elements to deliver a realistic, end-to-end training experience



Calian exercise development tools are user-friendly and intuitive, allowing users to develop and link events and injects to exercise objective and players to generate the desired training experience.

2 Development

The development phase involves writing the events and injects that meets the objectives outlined in the design phase and articulating how the injects will be presented in synthetic environments. Calian approaches training development and delivery with an overriding focus on creating synthetic environments that reflect real-world scenarios. Synthetic training environments are the fusion of detailed scenarios that anchor the exercise traffic in a specific context, and simulated data feeds that provide visual, audio and printed information that drive military training exercises forward. Synthetic environments provide exercise participants with a detailed context and the computer-based data to simulate real-world situations.

MaestroEDE allows exercise developers to build on the work from the design phase by generating events from storyboards and linking events and injects to training objectives. Storyboarding and event development aligns with the overall exercise scenario and objectives, connecting the specifics of execution with the specifics of the scenario and objectives. Using intuitive functionality that provides clear, consistent structures allows new users and experienced users alike to develop training content in a single platform. Content developed using MaestroEDE can be shared with other training developers, allowing for collaborative development of exercise events and injects. Throughout development, a common picture of how much progress has been made is easy to track.

During exercise development, your team can articulate a rich set of data and relationships that can be used to digitally transform your workflow and processes, end to end. A single space for all development allows for collaboration across teams working on development exercise events and injects for combat and maneuver activity, fires, engineering, logistics and sustainment, cyber, information operations, and any other domain that is part of the exercise.

The clearest advantage of VCCI tool suite for joint, combined and multi-national training, is the ability to support interoperability between simulation technology and operational tools that each participant requires to fulfil the training need. Airborne ISR, land-based ISR,



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dismounted units, armoured units and any other groups participating in an exercise, can be integrated into the synthetic environment. By combining constructive, virtual and live simulation, the VCCI experience provides versatility for high-fidelity simulation training, no matter the participants or scenario. VCCI can turn the concept of operations into a simulation-based training exercise.

The terrain for the synthetic training environment is important to providing a realistic, immersive experience. Using industry-standard tools like Virtual Battle Space(R) (VBS), and VR Forces to provide realistic terrain modelling and representation has the advantage of being interoperable with many existing simulation products like JCATS and ABACUS. Likewise, the simulation terrain can be matched to the GIS data required by the operational tools used. Integrating these systems provides the right level of fidelity for the exercise objectives, from the unit level down to individual callsigns for any scenario or exercise concept.

3 Delivery

Delivering training exercises is the culmination of the work done to design and develop training. Large, high-readiness exercises can be as large as 1,500 people at multiple locations. Delivering injects in a distributed environment allows for multiple training audiences to collaborate in real-time no matter where they are located. MaestroEDE allows the delivery team to manage the tempo of training based on a pre-loaded automated schedule, or manually to meet the needs of the exercise with dynamic writing. Exercise controllers can slow or accelerate the pace of injects if required and can manually insert new injects in near-real time if the exercise requires it or quickly reschedule existing ones. Whatever the tempo, there is full traceability across the exercise on when injects were released to the training audience.

Calian provides a common synthetic environment for military training, integrating battle management, visual simulation, constructive simulation and data evaluation. By integrating the battle management systems of the

training audiences, the actions they take based on the injects are reflected in near-real time in the synthetic training environment. MaestroEDE releases the exercise traffic, and the actions taken by the audience are reflected back into the synthetic environment.

Calian has delivered exercises for a wide range of military customers, providing scenarios in cross-domain environments. Calian has delivered joint military exercises with army, navy and air force participation for littoral environments, exercises in arctic/northern scenarios, and domestic major event security that integrates military, law enforcement, national security and local government participants. Cross-domain scenarios test the trainees' ability to respond to simultaneous challenges, identifying any capability gaps and highlighting areas where more training is needed. Providing challenging training allows the military training audience to work through challenge problems in training, not during operations where the consequences are real.



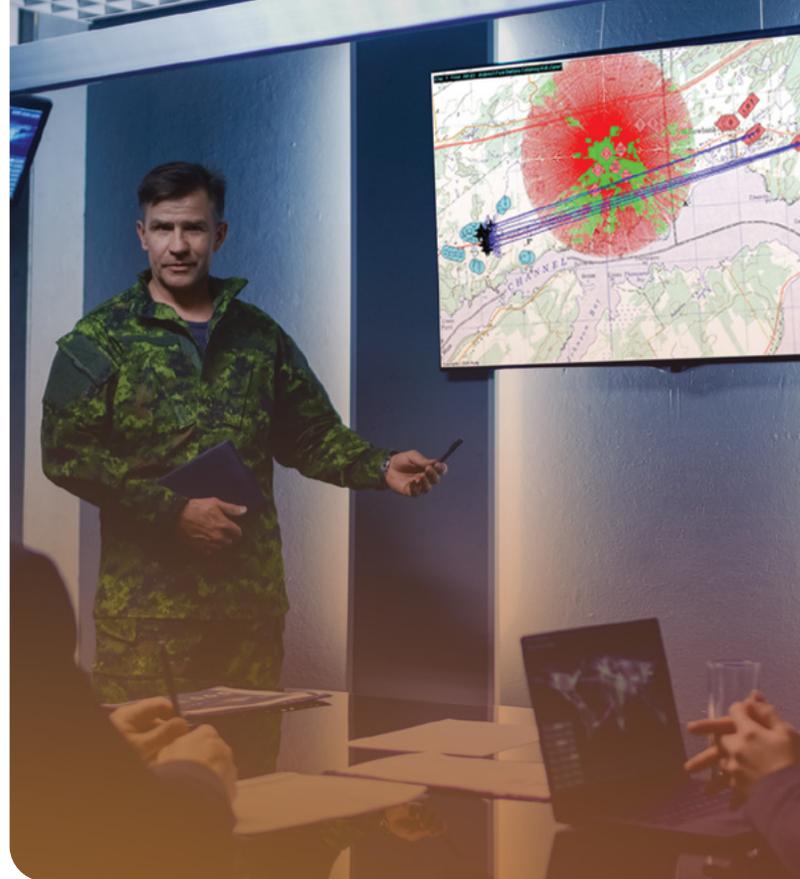
4 Evaluation

Evaluation is important to understanding where training was effective in meeting the objectives, and where there is room for improvement. Every exercise has stated objectives, and measuring performance toward those objectives is the purpose of the evaluation phase. The exercise is designed and developed with exercise objectives in mind, and MaestroEDE allows observers to plan, observe and write detailed observations throughout the delivery of the exercise and produce reports on lessons identified. Observers can also provide assessments against exercise objectives so that organizations can understand which areas, specifically, in the exercise process could use improvement or additional attention.

MaestroEDE captures data throughout the delivery of the exercise to allow for evaluation that is focused, specific, and evidence based. MaestroEDE provides training leaders and evaluators with specific data on how well the training audience performed at each step of the training journey. These outputs allow military exercise leaders to identify the specific activities and actions where the training audience has reached high readiness and identify areas where more training is required.

Calian also has ARAMIS, a dedicated military after-action review (AAR) tool that collects simulation data during the exercise. Where MaestroEDE shows the outcome of injects and observations made by the exercise controller, ARAMIS captures simulation data to provide a visual representation of specific actions to clearly show the outcomes. ARAMIS allows Calian training leaders to quickly identify where the training audience did not respond to exercise action as anticipated. ARAMIS extracts simulation data from the Paradigm Framework's data store which can include start-state data from Genesis, runtime simulation and C4ISR data from VCCI and runtime simulation to C4ISR data from the Audio Distribution Service (VCCI-Audio).

The VCCI tool suite also includes an advanced data analytic capability born out of a need to discover, interpret and communicate significant patterns in military data generated by simulations during training exercises. Military data analytics and simulation (MIDAS) provides the ability to look beyond basic AAR capabilities and provide insight into data analytics such as: combat effectiveness, control measure occupation, combat service support stocks, fratricide, rates of movement, and more. MIDAS, based on the Paradigm Framework, can also be used to integrate external data analytic solutions such as Cervus's Hive.



Aramis is an after-action review (AAR) tool that graphically represents complex simulation data captured from a military exercise. It allows the AAR analyst to quickly locate issues and specific topics from the exercise and display them in a meaningful fashion, thereby increasing the value of the event for the primary training audience.

Evolution in Approaches

Our training solutions journey started in the day of paper maps and manual wall-sized charts for delivering exercises and tracking the actions of the training audience. Since those days, we have developed new digital solutions to increase the efficiency of the training development and delivery process, have integrated other simulation tools, and can analyze the results of exercises using after-action review tools.

Calian is constantly developing new training tools to improve the experience for military customers, and to provide more versatility in the kind of training that can be delivered. Since the start of the COVID-19 pandemic, we have expanded our capability to deliver distributed training at multiple locations. Distributed-by-default is now informing all capability development. New solutions and tools must be capable of operating through local networks and cloud or distributed networks to allow for training at multiple locations.

Calian intends to utilize the future integrated training environment (FITE) concept to inform future cross-domain exercises. FITE is a concept utilized by the Canadian Army, providing simulation technology with an interoperable and multi-level training environment—a true integrated training experience. FITEs incorporate and synchronize several virtual training environments, with the eventual goal of providing a persistent, across-Canada training network of common hardware standards and protocols. Jay Ballard, Military Training and Simulation Lead at Calian, explains, “Having a common and integrated playground that can incorporate multiple levels of training is the Holy Grail of immersive environments,” and it is a goal that Calian has in its sights.



Training Exercises Delivered

Calian has delivered dozens of large-scale, end-to-end military training exercises. We have delivered for a wide range of customers, scenarios and training purposes.

Domestic/Continental Defence & Security Operations Exercises

- EX VIGILANT SHIELD—a recurring NORAD exercise with Canadian and American bi-national participation
- OP NANOOK—a recurring whole-of-government Arctic sovereignty exercise
- EX TRILLIUM RESPONSE—joint domestic emergency response exercise
- 2010 Olympics—joint exercise preparing for major event security for the Vancouver 2010 Olympics games
- EX SENTINELLE—series of exercises for whole-of-government security for the G7 Summit in 2018.

Joint Exercises & Experimentation

- EX UNIFIED RESOLVE—exercise for Canadian Army and RCAF road-to-high readiness
- JOINTEX 15/TRIDENT JUNCTURE 15—Canadian participation in NATO exercises
- EX WINGED WARRIOR—Canadian Army and RCAF for tactical helicopter integration
- Coalition Attack Guidance Experiment (CAGE)—multi-national exercise for airspace coordination, air/land coordination, targeting development, and time-sensitive targeting

Army Exercises

- Army Operations Course (AOC)—developing army leaders on operational processes and procedures.
- EX VIRTUAL RAM/VIRTUAL BEAR—Canadian Army level 6/7 exercises
- EX MAPLE RESOLVE—constructive simulation in support of live exercises
- Director Land Equipment Program Staff (DLEPS)—cyber tabletop exercises (TTX)



Air/Space Power Exercises

- Air & Space Power Command Course (ASPOC)—a recurring exercise to train prospective Royal Canadian Air Force (RCAF) ATF commanders with preparatory training
- Air & Space Power Operations Course (ASPOC)—a recurring exercise for development of RCAF officers

Development of New Features

Storyboarding

New features and applications are constantly being developed. MaestroEDE is adding a storyboarding feature to provide a simple, intuitive interface to develop the overall concept of operations for exercises. For exercise development, your team can manage workshare for developing events and injects and connect to other related events and materials to ensure everything being developed aligns with training objectives. Storyboarding will allow designers and developers to save time and effort in exercise development and connect events more smoothly.

Web API

Looking ahead, Calian expects MaestroEDE to experience significant growth as the platform continues to adapt to the needs of its users. The MaestroEDE platform sits on a robust web API which allows it to be

purpose-built to a client's specifications, or to create integrations with other software. This means that Calian can tailor the platform to customize solutions that allow clients to deliver no-fail training exercises when needed.

Terrain Modelling

Calian has also improved efficiency in changing the terrain in synthetic training environments. Calian is updating terrain in synthetic training environments in minutes. This used to take hours or days. Making rapid changes to synthetic terrain based on battle damage, weather effect or natural disaster, allows for impacts of exercise injects to be rapidly reflected in the training environment.



Improving Storyboarding for MaestroEDE

Connecting to Crew Simulators

There is interesting potential to integrate medium- and high-fidelity crew trainers into collective synthetic training environments. Integrating previously stand-alone devices into existing synthetic training environments could further enhance the realism of simulation-based training. Connecting more human operators into a common training environment puts more human interaction and decision-making into simulation-based training, with tactical creativity and errors in judgement creating effects in synthetic environments.

Virtual Reality and Augmented Reality

For individual training, the growth of virtual reality and augmented reality technology presents new opportunities. Using Microsoft HoloLens, Calian has developed individual training programs for a range of applications, including replenishment at sea while underway. A virtual reality solution was developed for directing joint fires for joint terminal attack controllers. Virtual and augmented reality technologies improve the quality of the training experience, improve knowledge retention and improve student engagement.



Virtual reality for individual training—Joint Terminal Attack Controller (JTAC)



About Calian

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