

2.4.12. EDF-2022-DA-SIMTRAIN-MSSI Modelling, simulation and simulator integration contributing to decision-making and training

Budget

The Union is considering a contribution of up to up to EUR 30 000 000 for this topic under the call EDF-2022-DA

Number of actions to be funded: Up to one action may be funded for this topic

Objectives

General objective

This proposal should lead to an enhanced EU military training and decision-making capability by connecting individual national systems through distributed solutions. Achieving the added benefit of sharing and pooling resources across EU through a shared ecosystem of simulation services. The goal of this initiative should be to establish a Distributed Synthetic Training and decision-making capability in Europe.

Specific objective

Simulation developers have produced various types of simulator and simulations. The challenge is to develop a flexible, scalable, on-demand simulation capability that can integrate legacy and new systems, a framework that integrate several simulators (of different types) or simulators' components (of different types) and should also contain command and control (C2), C4I and Tactical Data Link assets in a unique platform and to foster the interoperability among them. In particular, the solution should rely on the Modelling & Simulation as a Service concept (MSaaS), to allow deployment of national-specific as well as EU-wide federation of simulation systems across Europe.

In our rapidly changing environment modelling and simulation (M&S) solutions need to enable decision making, evaluation of course of action by providing faster and more accurate information. The complexity of today's threats is showing the limitations of today's simulation systems in terms of number of entities being simulated, resolution and fidelity of the terrain and infrastructure and domains supported as well as their interoperability.

Additionally, it must enhance the capabilities and readiness of forces in the European context.

Scope and types of activities

Scope

The scope includes Studies, the design and development of a modular common technical framework, leveraging simulation services approach, which can meet the stated challenge and demonstrate the solution for use-cases in the training domain and in the decision support domain. The proposals must investigate, validate and demonstrate the baseline architecture and the supporting tools and processes for this enhanced military training and decision-making capability.

The proposals must address studies, such as to explore the feasibility of new or improved technologies, products, processes, services and solutions and the design and development of new and integration of state-of-the-art technologies in training and decision-making using simulation systems.

A modular simulation environment, open systems-based design must allow a rapid response to new requirements, emerging cybersecurity compliance, and improved interoperability. It should support geographically separated commands/Nations and the complexity of multi-national operations that are focused on the strategic, operational and tactical levels and other operations and missions.

It must be adaptable to the different and new combat scenarios, operations and missions' environment and must support multi-domain operations, which models the conventional physical domains (for example land, maritime and air). It could as well use inputs from other new domains including space, cyber, and information, human and cognitive.

It must also facilitate the execution of analytical war-games for decision making at strategic and operational level.

It must demonstrate the capability how it could scale up to support the expected activities while modelling the behaviour of large number of entities over large areas and cooperate with a range of different simulation and real systems and platforms in a physically distributed environment.

It must study the feasibility of a simulation network, which should enable sharing and pooling of not only modelling and simulation assets, data sets and services, but also connectivity to existing legacy systems, existing simulation systems, real systems and platforms, national training and mission centres as well as operational EU or national networks like C2/C4ISR/Tactical Data Link.

The proposals must address training at the tactical level, the operational level, as well as the strategic level for support to decision-making, and the integration of different types of simulators.

Types of activities

The following types of activities are eligible for this topic:

Types of activities (art 10(3) EDF Regulation)		Eligible?
(a)	Activities that aim to create, underpin and improve knowledge, products and technologies, including disruptive technologies, which can achieve significant effects in the area of defence (generating knowledge)	No
(b)	Activities that aim to increase interoperability and resilience, including secured production and exchange of data, to master critical defence technologies, to strengthen the security of supply or to enable the effective exploitation of results for defence products and technologies (integrating knowledge)	Yes (optional)
(c)	Studies , such as feasibility studies to explore the feasibility of new or upgraded products, technologies, processes, services and solutions	Yes (mandatory)
(d)	Design of a defence product, tangible or intangible component or technology as well as the definition of the technical specifications on which such design has been developed, including partial tests for risk reduction in an industrial or representative environment	Yes (mandatory)
(e)	System prototyping of a defence product, tangible or intangible component or technology (prototype)	Yes (mandatory)
(f)	Testing of a defence product, tangible or intangible component or technology	Yes (optional)

(g)	Qualification of a defence product, tangible or intangible component or technology	Yes (optional)
(h)	Certification of a defence product, tangible or intangible component or technology	Yes (optional)
(i)	Development of technologies or assets increasing efficiency across the life cycle of defence products and technologies	Yes (optional)

The following tasks must be performed as part of the mandatory activities of the project:

- Studies:
 - o The identification of user (training) requirements for the system, by engaging prospected end users and performing background studies. Elaborate common EU training and decision-making objectives to reflect the synthetic requirements.
 - o The definition of use cases to focus the initial demonstration of the system. Concise and concrete use cases are used to eventually demonstrate the capabilities of the system, and the system of systems concept. This activity includes selection of assets needed for the use cases, such as infrastructure (networking) tools, simulators and analysis tools.
 - o The identification of required solutions and standards. Many components for a system are already available and can be composed to implement the envisioned solution. Available solutions will be identified and evaluated for their applicability. Relevant standards for (simulation) connectivity and interoperability will be identified and applied.
 - o The analysis of “use case” for training & exercises, Analysis of use cases with associated specificities for a deployment within Member States and associated countries;
 - o Analysis of requirements and functionalities for connecting in-use and future national training, missions and CD&E51 centres, analysis on how to integrate legacy simulators and mission and environment data;
 - o Elaboration and recommend a Reference Architecture for distributed ecosystem based on the relevant interoperability standards from NATO and other standardization organisations (SISO/IEEE/OGC/ISO). (e.g., High Level Architecture (HLA), NATO Reference Architectures (RA), Mission Training through Distributed Simulation (MTDS), C2 – Simulation Interoperability (C2SIM), NATO M&S as a Service (MSaaS).
 - o Elaborate and recommend the EU guidelines and business model for distributed corporation (e.g., governance), leveraging NATO MSaaS principles.
 - o Technology maturation and risk mitigation by developing technology demonstrators, especially on the following technologies:
 - Joint Forces Scenario Generator, including multi-domain computer generated forces with AI engines for realistic behaviour of OPFOR (Opposing Forces) units;
 - Cross Domain solutions that permit a Member State or Norway to access and use M&S services from another Member State with different classification domain;
 - o Analysis on how to ensure and realise IT-security and cyber-resilience capabilities: “Cybersecurity by Design” approach to minimize risks and threats associated with potential security failures and obviate risks against cyberattacks;
 - o Establish an overview of all relevant EU training and decision-making assets,

which could eventually join this EU system of systems.

- Design:

- o Design of system solution architecture and develop interoperability requirements using Modelling and Simulation as a Service concept (MSaaS), follow-on of NATO NMSG52 works, taking into account the use cases defined in the study phase, with a focus on efficiency and automation to create concurrent multi-domain and multi-service exercises; The goal is to obtain distributed simulation means for Mission Training through Distributed Simulation (MTDS) and decision making purposes whenever and wherever needed, able to run multiple simulations simultaneously by sharing and reusing resources (with efficient use of hardware), able to adapt rapidly to changing needs and able to reduce cost of employing simulation;

- o Identification, evaluation and selection of services available on the market (non-development items) and software design of services not available on the market (development items).

- o Simulation Network Design

- o Simulation Interoperability using several standards (e.g., NATO/ SISO /IEEE/ OGC / ISO standards).

- o Design for large-scale operation and interoperability. The blueprint is a system of systems and thus needs to cater for large number of participants at multiple geographically dispersed sites, and a heterogeneous collection of assets with various characteristics. This activity aims to incorporate these characteristics into the reference design.

- o Integrate EU training and decision-making assets and organisations in this system of systems

- o Development of advanced scenarios.

- o The design of a defence product, tangible or intangible component or technology as well as the definition of the technical specifications on which such design has been developed which may include partial tests for risk reduction in an industrial or representative environment. Specifically:

- The design of a reference architecture for the project and especially the area where interoperability needs to be improved and matured.

- Technology prototype, including Modelling and Simulation as a Service concept (MSaaS), which enables sharing and pooling of not only synthetic assets and data sets and services, but also connectivity to existing legacy systems, existing simulation systems at different level of security classification and qualification.

- Prototype:

- o Integration of various technology modules, system integration and relevant trials

- o System integration and deployment to prove an Initial Operational Capability.

- o Integrate decision making.

The following tasks may be performed as part of the optional activities of the project:

- Testing and qualification

- o Components and system integration

- o Test an initial EU distributed ecosystem infrastructure, including a persistent

- secure network, with MSaaS, M&S Cloud servers, Exercise Portal, and common services.
- o Advanced scenario's execution to test the environment/system
 - o Test the integration of synthetic training and exercises (Use case)

Functional requirements

The capability to be developed should meet the following functional requirements:

(1) General

- a. The system architecture shall be designed in accordance with the modularity principle in order to be expandable to future operational capabilities and to integrate modules and tools coming from multiple sources, allowing other EU Defence projects to be linked, integrated or implemented through this one.
- b. Cybersecurity aspects must be taken into account along all project phases, from requirements capture to system design and implementation, in order to ensure adequate resilience, survivability and information protection.
- c. Elaborate distributed During and After-Action Review (DAAR) to enable users to harvest the benefits of the system.

(2) Technological

- a. State-of-the-art system, with modern, intuitive user interfaces supporting operators in all their operational, technical, training and decision-making needs. Usability should be the cornerstone of the system design allowing the rapid installation, administration, operation, training and decision making.
- b. Adoption of an agile development methodology, increasing collaboration between software engineers and operational users, and exploring emerging information technology innovations to enable early delivery and continual improvement of Defence training and decision-making technical capabilities.
- c. The architecture shall be designed in such a way that a large-scale exercise can take advantage of a distributed infrastructure across participating nations considering cybersecurity aspects

(3) Integration of simulators

- a. The proposed system shall be able to create a wide variety of situations and scenarios to create new exercises to store, share and reuse simulation resources between different simulators and interoperate with others in a federation, using standard protocols.
- b. The system should be able to operate in a network that include different communication systems (e.g., WAN, SATCOM).
- c. The system shall be able to work simultaneously in different security domains and handle the information security requirements to control the information flows between these domains and the integrated external systems.
- d. The proposed system shall be based on a modern service-oriented architecture (SOA), leveraging on Modelling and Simulation as a Service paradigm, with an extensive use of open standards, allowing full compatibility with NATO and national systems, both military and civilian.
- e. Dynamic, scalable and resilient, capable of easily integrating all the actors and

nodes for each simulation scenario or application. This will be provided through Service Management & Control (SMC) services.

f. The system shall combine different kind of combat and support operations simulations (e.g., Artillery, Cavalry and Infantry, Maritime, Air, Close Air Support and logistics) with the aim to reach a full integration of them to perform computer- assisted exercises (CAX) and decision-making activities.

(4) Support to Decision-making

The proposed system shall be able to create a wide variety of situations and scenarios to create new exercises to store, share and reuse simulation resources between different simulators and interoperate with others in a federation, using standard protocols

(5) Other

a. Definition of an initial set of conventional and hybrid warfare scenarios representative of the EU operations and missions for simulation, training and decision making.

b. The system shall be able to integrate Virtual and Constructive simulation environments, including C2 systems, in order to build synthetic extension of the training and decision-making space, supporting combat preparation (e.g., Virtual Battlefield concept).

c. The system shall be open and adhere to standards to share (internal) data with Data analytics and AI

d. The system shall leverage machine learning, artificial intelligence (where possible) to support better decision making as well as generating behavioural models (civilian, military) and creating content (terrain, infrastructure).

e. Psychological, physiological and cognitive aspects, in terms of the behaviour and reactions of the personnel when facing simulated experiences (stress for instance), should also be taken into account in order to collect information and knowledge about how they will react to similar situations on the battlefield.

f. The system should facilitate the optimized data exploitation including simulation data standardisation and integration in order to facilitate AAR (After Action Review) and allow data analytics, predictive analytics and roadmap towards adaptive learning environments.

g. The system shall be able to support specified availability requirements providing an open, scalable, high availability and transparent failover architecture.

h. The development of a future simulation or integrated simulation system should take into consideration new possible technological improvements during the project, and at least (without excluding other options): simulation and communication equipment and infrastructure, in order to be able to exchange information between the Member States and Norway simulation centres and information systems. This may require the use of dedicated terrestrial networks and satellite links, hub infrastructure and terminals.

i. The infrastructure to setup dedicated simulation centres, including facilities for operators, data centres, and all the associated equipment (operators' equipment, voice / video communications, local communications, etc.)

Expected impact

The project is expected to:

- Increase of interoperability and efficient use of simulation systems thereby facilitating joint training and operations among armed forces of the EU Member States and Norway
- Deliver a prototype of TRL 6 (at least) and integrate simulation means provided by EU Member States and associated countries and reinforce interoperability between them.
- Create common reference simulation building blocks that will improve the capabilities of the European defence industry to develop and supply state of the art simulation systems.
- Reduce the cost of military missions, in particular in the training and preparation phase enabling of mission profiles that cannot be executed using conventional means or executed in areas outside MS and Norway.
- Generate an operational decision-making (constructive) environment to test and train Joint and Command Structures.
- Foster innovation and cooperation for stakeholders in the defence M&S domain and create an ecosystem to develop EU autonomous industrial segments for further industrialization phase.
- Foster exchange of datasets, scenarios and AI assets to accelerate development of capabilities of EU Member States and associated countries by promoting a collaboration network between EU Member States and Norway including academies, research centres and industries looking for synergies with civil initiatives.