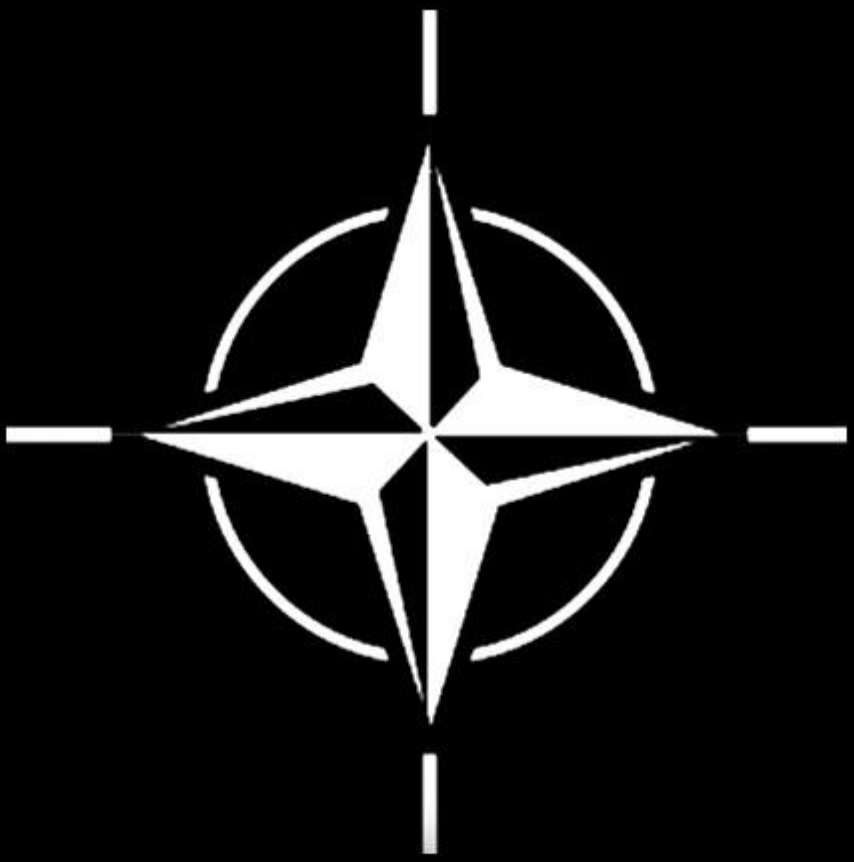
PHASE II PROPOSAL

Artificial Intelligence in Simulation-Based Learning



NATO ACT

• B & K Solutions •

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1. Section 1- Introduction

1.1. Executive Summary

B & K Solutions offers a unique and creative answer to the optimization of AI for NATO ACT training enhancement. Artificial intelligence (AI), including large language models (LLM) and AI-powered data mining, is a powerful tool that revolutionizes the educational and training landscape. Here, B & K Solutions presents the *AI-Integrated Simulations Optimization Initiative* (AISOI), a roadmap to enhance NATO's performance by designing customizable simulations that can be used anywhere, collaboratively or individually, and repeatedly with novel outcomes at each instance. The AISOI offers a design vision that utilizes the strengths of LLMs and data mining to power simulations and assist with performance analytics, serving the unique educational and organizational needs of NATO with a robust and adaptive roadmap. In brief, the AISOI solution addresses the following issues:

- **Scalability & adaptability**: This solution is not constrained to a location or device and is customizable to individual needs and contexts, allowing NATO to scale this solution to their entire organization without sacrificing relevance.
- **Accessibility**: The AISOI can be accessed from anywhere with an internet connection, with common devices such as personal computers and smartphones, in a variety of languages, and with consideration to persons with disabilities.
- **Efficiency and effectiveness**: We have adapted AI to complement the training, not the other way around. This allows for an efficient and effective personalized training solution, using NATO's existing protocols.
- **Target objective: improve decision-making skills**. We have based our solution on NATO's goal of improving decision making in high stakes and complex situations.

1.2. Why AI-integrated Simulation-Based Learning?

It is well established that simulation-based educational interventions have large, positive effects on learning (Chernikova et al., 2020). Principally, simulation-based learning is already at the core of NATO ACT, represented by the NATO Modelling & Simulation Centre of Excellence[1]. By integrating AI into simulation-based learning we bring multiple additional

[1] https://www.mscoe.org/

educational advantages, including AI-integrated virtual agents and AI leveraged in simulation-based learning for assessment (Dai & Ke, 2022). With these additions and NATO's existing training protocols and technologies, the AISOI roadmap can be integrated seamlessly and cost-effectively while also reflecting the state-of-the-art in AI learning application.

Currently, simulation-based learning is beset by several drawbacks. First, it is expensive and time consuming to plan and carry out simulations. Simulations often require expensive hardware such as virtual reality devices, or role plays that necessitate multiple, sometimes excessive, personnel. Second, simulations are only as good as they can approximate real-life scenarios. Transfer of learning and skills from the simulator to real life relies on how realistically the simulators emulate real life; role plays and software programs offer only limited authenticity. And last, simulation-based training as it is now can be difficult to deploy at a scale that can be impactful for an organization the size of NATO. AI-integration can help solve or mitigate these drawbacks.

The AISOI affords a cost-effective solution wherein simulations can be generated quickly and repeatedly from a parsimonious framework, saving time in planning and delivery. Additionally, the AISOI can be tailored to specific training needs, even down to the idiosyncrasies of individual personnel, allowing for more relevancy and a higher degree of learning transfer. This also instills a greater sense of authenticity, which can be further enhanced by the nature of AI's non-deterministic output. And to ensure this training has the widest impact possible, all simulations are delivered with standard consumer computer and mobile phone technologies.

The feasibility of this is exemplified by existing training solutions from which the AISOI draws inspiration to form a unique compilation. For instance, the work of Dai et al. (2021) and Barrett et al. (2023) demonstrates how LLMs can be trained on authentic discourse data to simulate the speech and behavior patterns of various humans, and which can be located in interactive virtual agents in 3D virtual environments. Dai et al. (2021) employ easy to use, open-source virtual worlds to create their simulation, hosted on private servers. Environments such as these provide contextualization and a higher degree of realism. Others have employed AI in complex assessment practices (e.g., Pack et al. 2024), engineering LLM prompts to apply multi-criteria performance rubrics which have performed comparatively to human assessors. These examples provide confidence in the AISOI's ability to deliver scalable, adaptable, and effective AI-based solutions for NATO's training needs.

1.3. Deliverables

The AISOI delivers an efficient, cost-effective roadmap for designing and implementing AI-integrated simulation-based training environments for NATO ACT. Our solution delivers a high-fidelity simulator which affords contextualized simulation-based training with AI-integrated NPCs and AI-powered evaluation metrics. Additionally, we deliver an AI-powered low-fidelity simulator that affords targeted skills training for individual NATO personnel addressing a wide variety of responsibilities. These simulators will be procedurally developed over five stages, each with a concrete outcome including the plan proof, design proof, alpha version, beta version, and gold version.

2. Section 2- Structured Overview

2.1. Theoretical Framework

Simulation-based learning is representative of the most important theories and principles of the learning sciences. It is ingrained in the notion that knowledge development and skills acquisition arise from learning by doing. The philosophy of John Dewey (1916), who first proposed experiential and hand-on education, and later Piaget (1964), who built on this theory laid the foundation for the future of education. This foundation allowed Kolb (1984) to formulate his experiential learning cycle, which starts with 1) concrete learning, followed by 2) reflective observation, then 3) abstract conceptualization, and finally, 4) active experimentation. Kolb's (1984) theory is the cornerstone for simulation-based learning and the AISOI roadmap.

2.2. AISOI Objectives

In light of the four objectives listed in the problem statement, we provide an alignment table that shows how the AISOI addresses these needs by leveraging AI (Table 1). To exhibit the capabilities of the AISOI, final outcomes consist of two AI-integrated, simulation-based learning systems with four example use cases. Low-fidelity simulations are text-based learning systems that teach, support, and evaluate decision-making performance in critical situations (see section 3.4.2). By enacting various conditions and event parameters, we can customize simulations that require trainees to demonstrate the multifaceted nature of decision-making in crisis communications (Heath & O'Hair, 2010; Svenmarck et al., 2018) and high-stakes negotiation (NATO, 2023). High-fidelity simulations involve computer-generated 3D virtual

environment simulations which bring a higher degree of contextualization for situations that require spatial information, such as harsh environmental challenges and urban warfare (Bodnar & Collins, 2019). These virtual environments can be rendered using open-source and internet accessible programs that are adaptable for individualized training needs (see section 3.4.3). With both low and high-fidelity simulations, NATO personnel will have their training needs met as efficiently as possible.

Table 1. *Object Alignment Table.*

Objectives	**AI applications**	**Design solutions**	**Expected affordances**
Be adaptable to diverse learning needs.	Dynamic adaptability.	Easy customization for specific situations or individuals.	Learners are provided with scenarios tailored to their roles and responsibilities.
Ensure remote, asynchronous training is accessible regardless of time or place.	AI-enhanced data mining. Application programming interface (API) utilization.	Automated performance evaluation. Simulation accessibility on personal devices.	Learners have full access to the simulations anywhere with an internet connection and using common hardware such as personal computers or smartphones.
Enhance learning efficiency and effectiveness.	Dynamic adaptability.	Program AI with existing NATO evaluation criteria	Simulations afford formative training, allowing learners to benchmark their progress along existing NATO standards.
Improve decision-making skills.	Knowledge modeling. AI-	Design non-deterministic	Learners are required to think flexibly and

	integrated virtual agents. Text-based simulation scenarios.	scenarios with novel events at each instance.	promptly to support rational decision-making.

3. Section 3- The AISOI Roadmap

3.1. Connecting the Status Quo

The AISOI can be optimized interdepartmentally across all of NATO. The core of the solution involves a team of 17, composed of a project manager, two instructional designers from B & K Solutions, nine subject-matter experts (SMEs) from the Joint Warfare Centre (JWC), NATO computer-assisted exercises (CAX), and NATO Crisis Management and Disaster Response Centre of Excellence (CMDR COE), and a scrum of five technicians to develop the simulations (henceforth referred to as 'the team').

NATO ACT, based in Norfolk, Virginia, develops and oversees various simulation-based training programs to ensure NATO forces are prepared for modern warfare. This includes the use of virtual reality (VR) and augmented reality (AR) to simulate combat environments. Their role in the AISOI is to manage the project and review the deliverables after each phase of AISOI for quality control as a primary stakeholder.

The JWC in Stavanger, Norway, conducts exercises like the Steadfast Series and Trident Series, which simulate large-scale joint operations. These exercises focus on command and control, interoperability, and operational planning. Their role in the AISOI will be to provide three SMEs who can inform designers on the most current NATO training needs reflecting international affairs.

CAX involves computer simulations that replicate battlefield conditions, allowing NATO personnel to practice decision-making and operational planning. Examples include Unified Vision and Coalition Warrior Interoperability eXploration, eXperimentation, eXamination, eXercise (CWIX). Their role is to provide three SMEs to support content creation and instruction for high-fidelity simulations which involve AI-integrated virtual agents. This will provide enhanced analytical capabilities and accuracy on AI-powered data-driven assessment of individual performance.

The CMDR COE focuses on simulation-based training for crisis management and disaster response. It uses realistic scenarios to train personnel in responding to natural disasters, humanitarian crises, and other emergency situations. They support three SMEs for providing high-fidelity simulations for environmental challenges.

The NATO Modeling and Simulation Group (NMSG) works on developing and standardizing simulation technologies across NATO member states. This group supports various training initiatives by providing advanced modeling and simulation tools. For the AISOI, they support five technicians or programmers to develop AI-powered high-fidelity simulations.

3.2. Defining Audiences

NATO is an immense organization composed of personnel with different ranks and responsibilities across multiple departments. Any training solution needs easy flexibility and adaptability so that learning is meaningful and individualized. The AISOI delivers this flexibility and adaptability with two types of AI-integrated simulation, each designed for appropriacy by NATO personnel ranks and responsibilities.

High-fidelity simulations are appropriate for training across a hierarchy of ranks. NATO is an international organization with 19 ranks. For the AISOI, we focused on the different knowledge, skills, and attitudes required for ranks, grouping them into three levels of learners. The AISOI provides customized AI-integrated simulation training for each level. NATO ranks are categorized into three levels of learners.

Level 1 learners are primarily junior enlisted personnel in the initial stages of their military careers, comprising ranks OR-1 through OR-3. These learners' primary focus is developing the fundamental knowledge and skills necessary for the basic operational decision making pertinent to their responsibilities.

Level 2 learners consist of mid-level enlisted personnel, including non-commissioned officers (NCOs) and petty officers, who are responsible for the leadership and training of Level 1 learners. This group spans ranks OR-4 through OR-9 and focuses on developing advanced tactical and leadership skills.

Level 3 learners are commissioned officers ranging from OF-1 through OF-10, encompassing junior officers to senior generals/admirals. These individuals are responsible for strategic

planning, high-stakes decision-making, and overall military operations and personnel leadership.

Low-fidelity simulations are appropriate for knowledge and skills specific to individualized responsibilities. For example, NATO personnel who are responsible for crisis communications or high-stakes negotiations will find AI-integrated training simulations for those specific tasks. For this reason, low-fidelity simulations are not ascribed to a specific rank spectrum but can be assigned or made available to targeted individuals.

3.3. Successive Approximation Model (SAM)

The AISOI roadmap is operationalized in accordance with established principles of instructional systems design. The SAM comprises three primary stages: preparation, iterative design, and iterative development. In the preparation phase, we can collect all pertinent data for building the required knowledge base that will guide the various AI-integrated simulations and research optimal data collection processes for affective computing. The savvy start stage will serve as a kick-off meeting, allowing project members to review the gathered background information and brainstorm initial ideas (Sites & Green, 2014; Jung et al., 2019). Next, in the iterative design phase, all design and evaluation occur in small, iterative steps. Prototyping is crucial in this phase as having a functioning model helps communicate to team members where conceptual and practical issues require more resources. Finally, project team members move through development, implementation, and evaluation in the iterative development phase. At the beginning of the development phase, a design proof of the product of the first cycle is created. After presenting and testing the design proof, an alpha version can be released to a subset of the learner population, which may then evolve into a beta version before finally a global rollout of the gold version.

3.3.1. Savvy Start

The roadmap initializes with a ‘savvy start’, a relatively compact needs analysis. The first deliverable communicated to NATO ACT will be the plan proof. To accomplish this, the team will hold meetings in the listed order with agendas provided by B & K Solutions (Table 2).

Each attendee is a stakeholder for NATO ACT, with three SMEs for JWC, CAX, and CMDR COE, one leading technician for NMSG, and six recent learners (two from each level). Every meeting will be recorded for future reference.

Table 2. *Meetings for 'Savvy Start'*

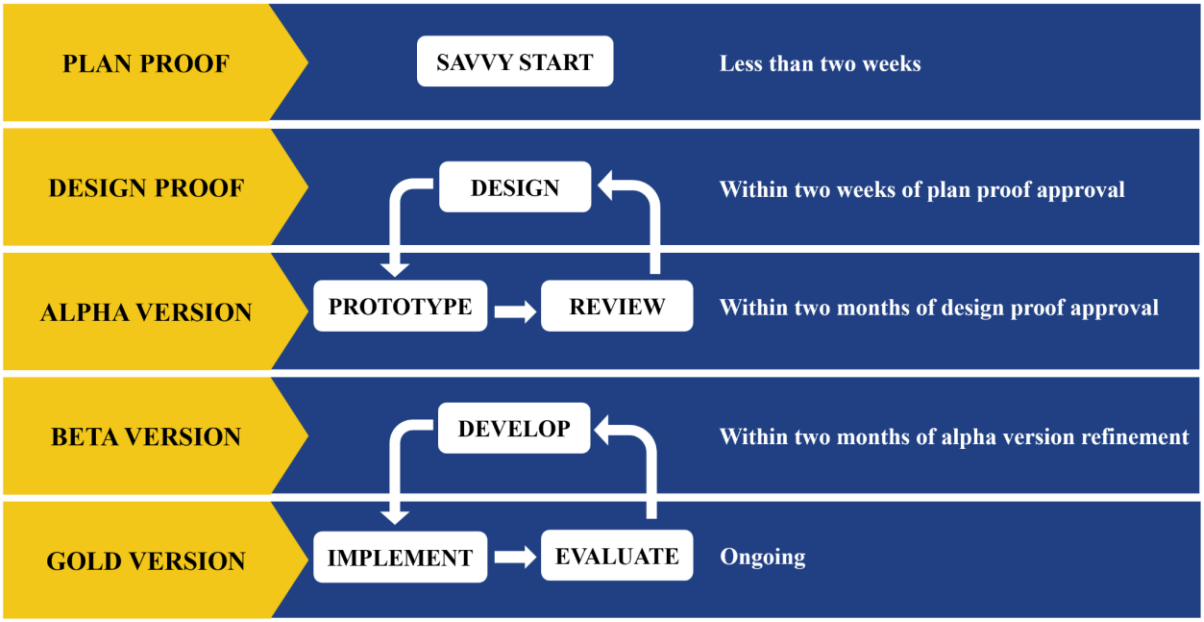
Meeting Attendees	Agenda
NATO ACT	• Confirm the overall needs of NATO ACT • Consent on the project scale (i.e., timeline, budget) • Set expectations for the next deliverable (plan proof)
JWC, CAX, CMDR COE	• Assess gaps in current scenarios • Discuss the needs and directions of new scenarios • Confirm the AI-integration functions
NMSG	• Assess the plan feasibility • Assess the amount of resources needed • Discuss action plans for data security
Recent Learners	• Assess the strengths and weaknesses of existing simulation-based training • Discuss how to loop in the learner feedback • Open discussion for additional input and ideas

A plan proof, a high-level report on AISOI strategies and details on the approach will be submitted to NATO ACT for review. It can be revised according to the stakeholder's request, and the team will move forward to design the AISOI solution once approved.

3.3.2. Designing and Developing Simulations

The design and development process of the AISOI is organized along a process with five deliverables which are produced as outcomes of each stage of the SAM model. These deliverables are outlined in Figure 1. Each stage of the procedural rollout is explained in detail, with the simulation core and extensive features outlined in Table 3.

Figure 1. *Outline of the design and development process.*



Plan Proof

The plan proof outlines the initial conceptual framework and strategic approach, providing a high-level overview of the development process. While this stage will not include detailed designs or prototypes, we will focus on high-level planning, such as goals, timelines, resources, and needs assessments. This comprehensive project plan outlines the roadmap to gradually integrate AI, starting with JWC, CAX, and CMDR COE.

Design Proof

The design proof translates the conceptual framework into detailed designs, encompassing both the visual and functional aspects of the project. This stage moves from abstract planning to concrete design, incorporating detailed blueprints, wireframes, and technical specifications. Stakeholders can expect thorough design documentation, user interface mockups, and technical specifications that guide subsequent development stages.

Alpha Version

The alpha version introduces the first functional prototype, integrating core features and enabling initial testing and feedback. This stage involves the creation of a working prototype that includes the main features but may still have bugs and incomplete functionality. Stakeholders should expect a basic but functional version of the product, focusing on core features and allowing for early user testing and iterative feedback.

Table 3. *Core and Extensive Features of the AISOI.*

Modules	Core Features	Extensive Features
High-fidelity Simulations	• High-fidelity virtual environments replicating diverse terrains for different operational scenarios. • Specialized training paths for different roles, such as leadership, logistics, combat operations, and medical response. • AI-integrated data mining to capture and interpret behaviors and interactions within the simulation.	• Summative performance evaluation and analytics. • Dynamic interactions that support non-deterministic outcomes.
Low-fidelity Simulations	• AI-driven personalization to adapt scenarios based on individual responsibilities. • Capability to create custom scenarios to address specific training needs. • Scenarios focusing on legal, social, and political issues, involving performance-based decision making. • Feedback loops to incorporate lessons learned from real-world	• Difficulty adjustment to match skill levels and learning progress. • AI-driven assessment of adherence to ethical standards and legal frameworks.

	operations and training exercises. • Automated after-action reviews (AAR) with insights on strengths, weaknesses, and areas for improvement.	

Beta Version

The beta version refines the prototype by addressing feedback from the alpha stage, enhancing functionality, and preparing the product for broader user testing. This stage builds upon the alpha version, incorporating fixes, enhancements, and additional features based on user feedback. Stakeholders should expect a more stable and feature-complete version of the product, ready for extensive testing by a larger group of users to identify any remaining issues.

Gold Version

The gold version represents the final, polished product, incorporating all necessary refinements and ready for official release. This stage delivers the final, fully-tested product, incorporating all features, optimizations, and ensuring high quality and performance. Stakeholders should expect a complete, stable, and reliable product, meeting all requirements and ready for deployment to end users.

3.4. Implementation and Explanation

3.4.1. Procedural Implementation

The systematic design model of the AISOI, the SAM, requires user testing and iterative refinement which will result in a procedural rollout of the training solution. The Alpha version will undergo testing from developers who will collect data to establish the simulators' reliability and consistency. These testers will explore the simulation features individually. The Beta version will be tested by target users. An *a priori* statistical power analysis for a comparison between the standardized performances of learners undertaking the AISOI training and learners undertaking existing, comparable training suggests a sample of 51 per group. Since NATO ACT keeps records of training outcomes for personnel, only one group of 51 will need to be recruited for the Beta version testing. These learners will explore the simulations

holistically, as intended for training. For the Gold version, another, unique sample of 51 learners will be used for testing and results will be compared to the Beta and traditional groups (see Table 4 for details).

Table 4. *Procedural Implementation Plan.*

Versions	Target users	Purpose of data collection	Types of data collected
Alpha	AISOI developers.	UI assessment, bug detection, content evaluation, fine-tuning data mining algorithms and generative AI outputs	Reliability data, performance consistency under different conditions and on different devices.
Beta	51 non-randomly selected learners across three levels.	Real-time data logging test, cloud server, extensive databases, and the intelligence connection test	Online survey, interview, performance metrics, simulation logs (e.g., chat logs, verbal commands, event logs, etc.)
Gold	51 non-randomly selected learners across three levels.	Micro adjustments on the machine learning algorithms, generative AI outputs, language, and compliance with legal and ethical standards	Online survey, interview, performance metrics, simulation logs (e.g., chat logs, verbal commands, event logs, etc.)
Global rollout	All NATO trainees	Longitudinal evaluation for both the learners and the program	Ongoing user experience surveys, learner analytics, personnel KPIs, NATO operational efficiency indicators

3.4.2. Low-Fidelity Simulations

Low-fidelity simulations are for level 2 and 3 learners. Learning objectives are to improve decision making knowledge and skills, thus, the low-fidelity simulator provides a learning environment that helps learners to consider multiple factors, make decisions, and reflect on performance.

The AISOI utilizes low-fidelity simulations for contexts that focus on verbal communications such as crisis communication and high-stakes negotiation. This solution employs transformer-based large language models (LLMs) to power a chatbot for scenario simulation, communications feedback, instructional support, and assessment. When initiating a scenario, the crisis communications simulator, for example, presents a situation randomly selected from a subset or purposefully chosen for individual training needs. The scenario provides four objectives one-by-one, each requiring the learner to undertake a crisis communications task such as writing an internal memo, posting to NATO social media, or drafting a press release (see Figure 2). The simulation scenario proceeds through four objectives, each considering crisis communications from a different angle.

After the fourth objective the simulator provides a summative assessment of the learner's performance based on a rubric with specific criteria and performance descriptors benchmarked to NATO's existing standards. Evaluation data consists of rubric scores based on NATO performance criteria, transcripts of written text (e.g., crisis communications documents such as memos and emails), and task completion times. A learner can also use the simulator to assess a communications draft or simply get information about crisis communications, all of which is designed with NATO's established training information and parameters in consultation with SMEs from JWC.

Figure 2. *Example scenario, objective, and task for the low-fidelity AI-integrated crisis communications simulator.*

Crisis Communication Scenario: Disinformation Campaign

Scenario Overview

A disinformation campaign has been launched against NATO. False information suggesting that NATO is planning an aggressive military action against a neighboring non-member state is spreading rapidly on social media and various news outlets. This misinformation is causing panic among the local population and creating diplomatic tension between NATO and the affected country.

Objective 1: Initial Assessment and Internal Communication

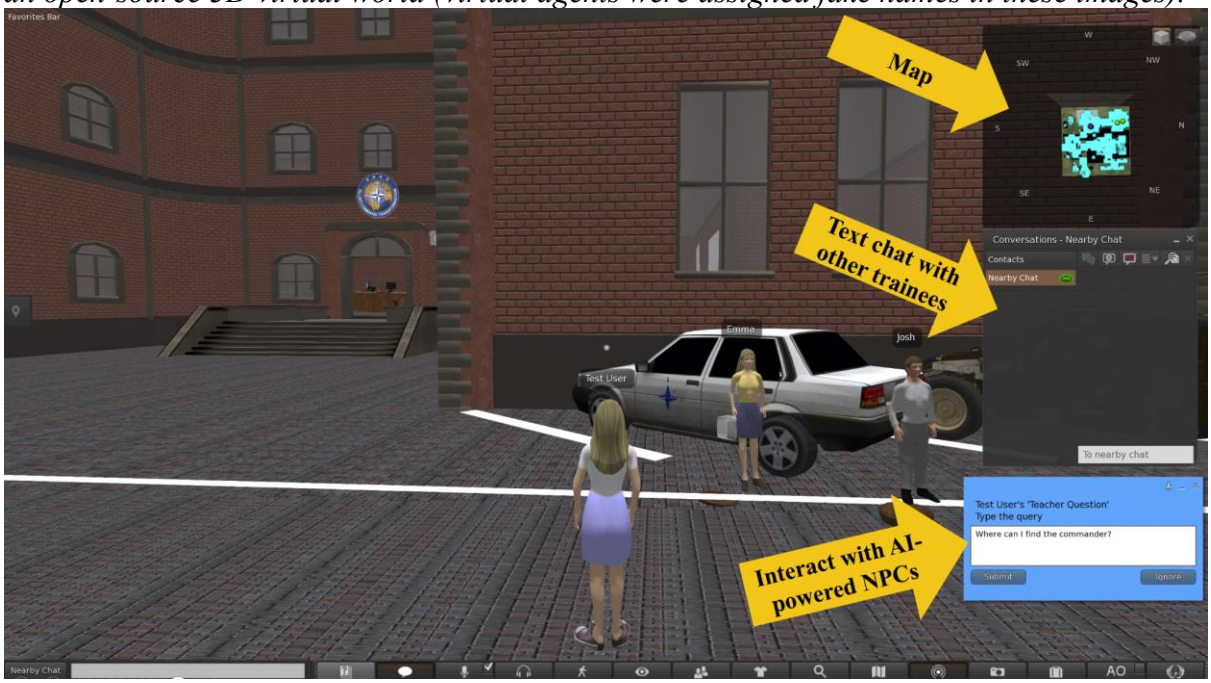
Task: Write an internal memo to the NATO ACT leadership team, summarizing the situation and proposing initial steps to counter the disinformation campaign.

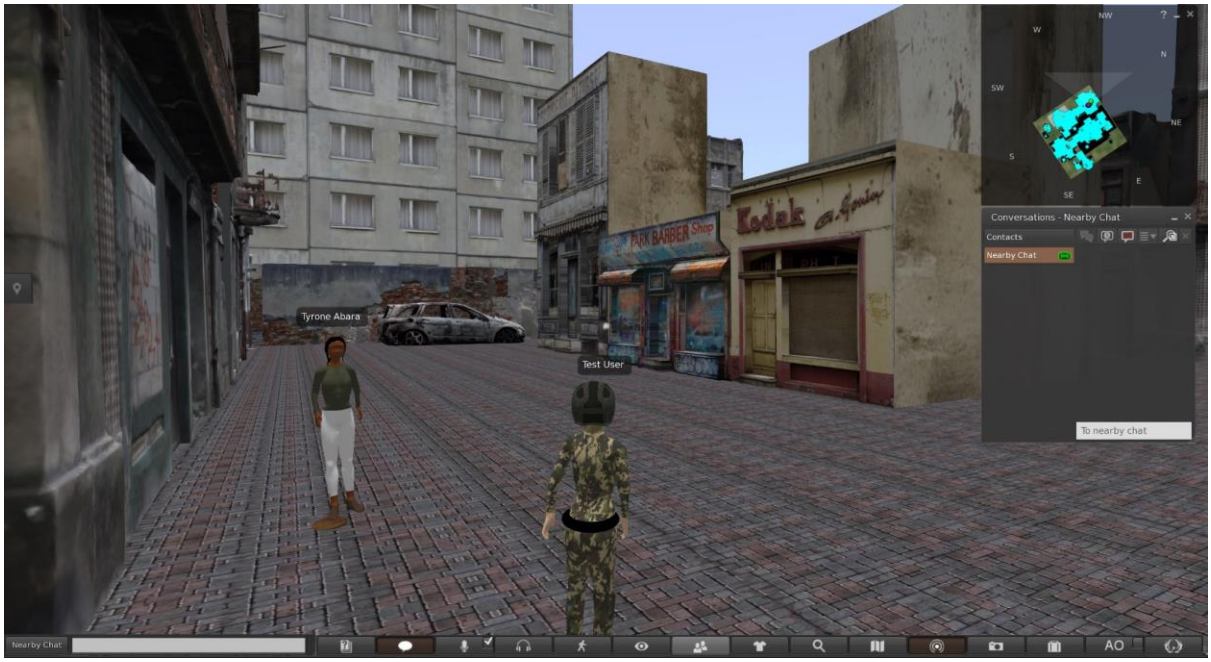
Respond to this task before moving on to Objective 2.

3.4.3. High-Fidelity Simulations

High-fidelity simulations are for level 1 and 2 learners, whose learning objectives are to improve decision making through the interpretation of environmental risks and opportunities in high-stakes situations. Thus, they need a contextualized simulation environment where they can practice decision making in a variety of situations. As shown in Figures 3 and 4, various 3D virtual environments will be simulated in coordination with the SMEs from CAX, CMDR COE, and the technicians from CAX.

Figures 3 & 4. *Examples of high-fidelity simulations with AI-integrated virtual agents using an open-source 3D virtual world (virtual agents were assigned fake names in these images).*

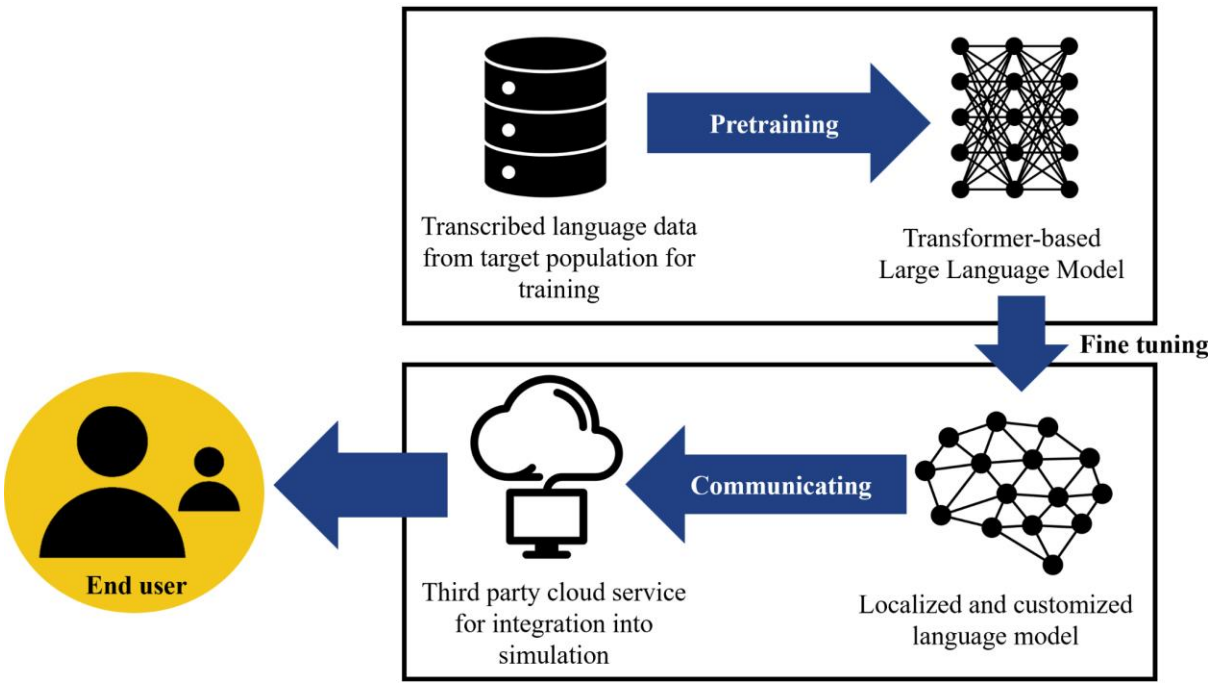




AI integration in high-fidelity simulations is realized in the AISOI through dynamic interactions and comprehensive assessment of learner behavior in the simulation. Within the 3D virtual world environment, AI can be integrated into non-player characters (NPCs) who act as virtual conversation agents allowing users to interact with them via text or voice chat (Figure 5). By using language models pretrained with target language data, virtual agents can be made to authentically simulate the language behavior of target populations. For example, the idiomatic expressions, tones, and diction of NATO personnel or a local civilian population can be emulated in the simulation. Furthermore, the behavior of these agents can easily be programmed to simulate dynamic affective states. By using a simple sentiment analysis filter that interprets user input, these agents can show a range of emotions through their linguistic behavior or through basic animations, enhancing the realism and making each simulation experience unique.

AI-powered NPCs can also be programmed with a unique knowledge base, allowing distribution of information within the simulations. For instance, a NATO personnel NPC can be programmed with expert knowledge and be used as a pedagogical agent to support learning. For another example, mission-critical information can be located within specific NPCs that the learner will need to access using negotiation skills.

Figure 5. *Workflow of the design development plan for AI-integrated agent modeling*.



The proposed simulation environment is a 3D virtual world, which is a multi-user, persistent online space where users can shape their own experiences. These environments do not have linear pathways, and instead support open exploration for accomplishing prescribed objectives. To evaluate learner performance in a non-linear environment such as this, AI can be used to compile and interpret transcripts of text- and voice-based communications, event log data of interactions with NPCs and artifacts, avatar movement patterns, response times, inventory management, and post-participation reflective self-assessments. These data can be interpreted automatically by using a prescribed rubric that an AI can apply.

3.4.4. Feasibility

Customizing pre-trained transformers (GPTs)

LLM-powered GPTs play an important role in the AISOI by generating human-like text, performing complex language understanding tasks such as interacting with the user in real-time and providing detailed responses to diverse queries. Customizing these models is quick and easy, thanks to advancements in user-friendly tools and intuitive interfaces. With minimal coding knowledge, the administrators can tailor models to specific tasks by leveraging pre-built frameworks and extensive libraries. For example, it took 15 minutes for an instructional designer in B & K Solutions to customize a GPT to demonstrate the AI-integrated functions for the low-fidelity simulations. These tools streamline the process, allowing for

efficient adjustments in behavior and output to suit the organizational needs of specific NATO programs.

Universal design

The alpha version will be in English by default, which has been the operational language of NATO since 1949. However, adaptability to additional languages is a simple process that is already designed into existing commercial GPTs. We will add French, the other official language of NATO, to the beta version to ensure linguistic felicity through use testing. The gold version will include an auto-translation function to 27 other official languages, such as Danish, Finnish, German, Italian, Norwegian, Polish, and Spanish.

Low-fidelity simulations can also be made accessible for individuals with visual impairment through the use of a text-voice conversion function. Simulated scenarios can be voiced by the machine and users can input text by speaking.

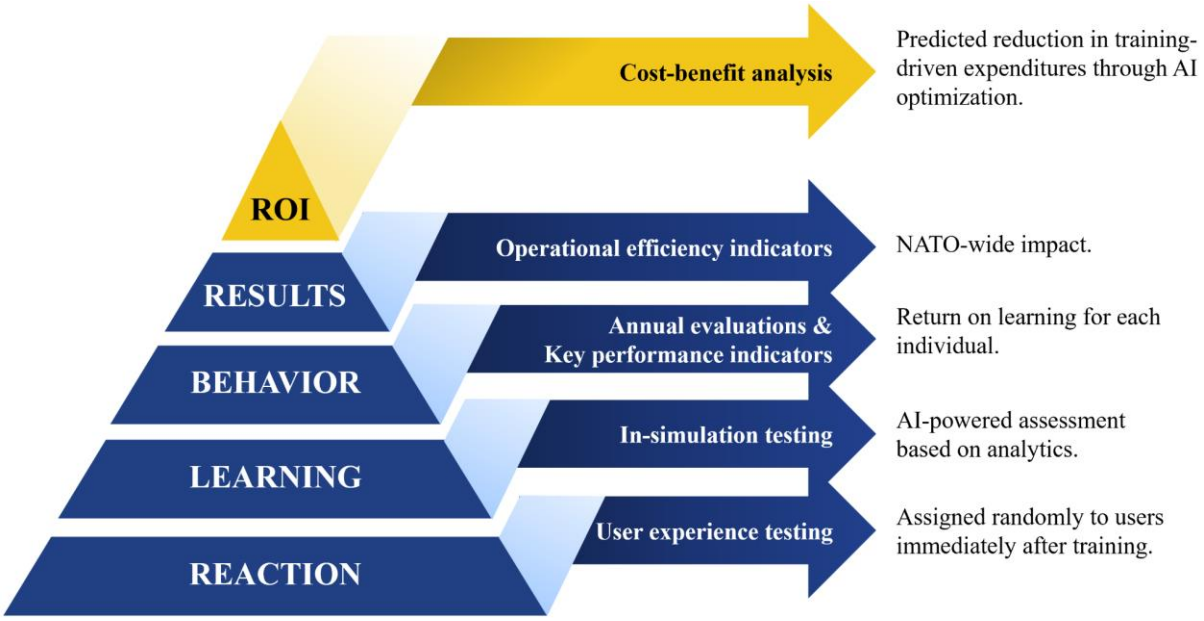
Enhancing performance while maintaining data security

One of the significant advantages of AI is that it can be continuously trained with data, refining its performance over time. This necessitates consistent data collection, which compels data and network security protocols to be strictly adhered to. One way the AI embedded in the AISOI will be secured is through anonymization and aggregation of learning data, ensuring that individual user information remains secure. Embedded machine learning algorithms will analyze patterns and trends without accessing personal data, allowing the AI to enhance its performance and accuracy. Encryption and stringent access controls will safeguard data privacy, while regular audits and updates through the network will ensure compliance with the highest cybersecurity standards. This approach guarantees that the system evolves effectively without compromising user confidentiality and data security.

3.5. Evaluation

We employ the Phillips ROI Model, which extends the Kirkpatrick model of evaluation with the addition of a fifth level: return on investment. Each stage of the model is tied to a specific metric which provides for an evidence-centered evaluation of the AISOI's impact (Figure 6). For the 4th and 5th levels of evaluation, which require long-term observation, we follow up with NATO ACT to trace the implementation of the AISOI for three consecutive years to support its success.

Figure 6. *AISOI Evaluation Plan.*



4. Section 4- Budget and Timeline

4.1. Budget

The budget is divided into project development team, equipment, and project sustainability. The project development team consists of 17 individuals (see section 3.1) and is needed for an estimated 6 months. Expenses outlined below reflect this labor, but hourly rates were estimated based on industry standards and may not reflect the payroll practices of NATO. 10 project team individuals will be provided by NATO (1 project manager and 9 SMEs), 2 will be provided by B & K Solutions (2 instructional designers), and the remaining 5 IT professionals can be independent contractors or recruited from within NATO. Labor hours are estimated based on 2080 hours annually for FTE, equipment expenses are estimated annually, and project sustainability is projected for the 5 and 10-year marks. A summary breakdown of the budget is provided below, and a detailed budget is available online at https://tinyurl.com/mw86j84s

Project development team

- 1 Project manager: $97 hourly rate for a total of 412 hours ($39,964).
- 5 Software developers: $67 hourly rate for a total of 960 hours $64,320*5 = ($321,600)
- 2 Instructional designers: $44 hourly rate for a total of 2,248 hours $98,912*2 = ($197,825).
- 9 SMEs: $44 hourly rate for a total of 8 hours $352*9 = ($3,168).

- Test users: $30 hourly rate for a total of 4,343 hours ($130,299).

Total: $692,856

Hardware and software

- Dedicated virtual servers: 32 needed (one for each member country) at $100 per month for a total of ($38,400) per year.
- Software license: Token price estimated at $7.50 for 1 million batch API tokens for premier GPT. Ten licenses per server are estimated at ($28,800) per year.
- Miscellaneous subscriptions, digital artifacts, or cloud services at ($1,000) per year.

Total: $68,200

4.2. Timeline

AISOI is divided into three phases: savvy start (2 months), iterative design and development cycle (12 months), and evaluation and maintenance (22 to 106 months). The budget and timeline will be reconfirmed and readjusted at the end of every year. We propose a detailed timeline for the first three years, which can be found at https://tinyurl.com/mw86j84s.

The current total budget is $829,936 for the first three years, however, the project can be sustained, affecting the total budget, according to the number of years the primary stakeholder (NATO ACT) agrees to. Estimated annual costs for human labor for the project's sustainability are summarized below, not including the hardware, software, and other costs. We propose a pre scheduled revisit of the budget and project sustainability at intervals of NATO's choosing to reassess the return on learning and to reevaluate the impact of the AISOI in light of future AI developments that may disrupt the budget integrity and project sustainability.

Project Sustainability

- 1 full-time instructional designer at $44/hour: 5 Years ($457,600), 10 years ($915,200).
    - The instructional designer will make adjustments to instructional contents based on the learner data and changing needs.
- 16 part-time IT technicians at $38/hour: 5 years ($3,161,600), 10 years ($6,323,200).
    - Each IT technician will support two servers.
- 4 full-time software developers at $67/hour: 5 years ($3,484,000), 10 years ($6,968,000).

    - Each software developer leads a team of four IT technicians recruited from NMSG. Four teams will take charge of North America, North Europe, Western Europe, and Southern Europe to maintain servers, perform software updates and bug fixes, and assist the instructional designers in rendering any changes to instructional content reflected in the simulators.
- 2 full-time data scientists at $72/hour: 5 years ($1,497,600), 10 years ($2,995,200).
    - Data scientists will handle data wrangling, curation, and act as a human-in-the-loop for AI analyses.

Estimated payroll budget for 5 years: $8,600,800

Estimated payroll budget for 10 years: $17,201,600

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