Dedicated to innovation in aerospace

Fit for purpose training

Royal NLR - Netherlands Aerospace Centre

Welcome to Royal NLR. Discover more about the innovative training and simulation programmes we develop for military forces and other clients. The common goal is to make training more effective and efficient.

Our vision of military training is founded on competency-based and performance-based training (PBT) concepts using integration and interoperability of live, virtual and constructive elements. Our approach focuses on a thorough process of analysis, design, development and implementation with the client.

Our staff of nearly 100 people have knowledge of training, simulation, human behavioural assessment and regulations for military forces. This knowledge is combined with applied technical research and development in simulation. NLR actively develops innovative training technologies and training media. These capabilities and our in-house research infrastructure ensure that NLR can oversee the entire spectrum and stay on top and ahead of new developments and innovations in military training and simulation.

Michel Peters, CEO
Royal Netherlands Aerospace Centre

Fit-for-purpose training environments

To assure continuous deployment and mission readiness, military forces need to make their training more effective and efficient. The time spent flying must be as effective as possible. This means more customised and less expensive training. This can be achieved through an optimum blend of live and low and high-fidelity simulated training, along with learning analytics, making it possible to keep tailoring the training to personal or broader training needs.

Royal NLR believes that a modern vision of training requires a holistic instructional design approach that is well-prepared for the high level of integration and interoperability of systems. Only then can a thorough genuine understanding of training needs and an analysis of simulation and evaluation requirements be guaranteed.

The Royal NLR design approach is based on the 4C/ID instructional design system. This is about learning complex skills in a realistic context using four main ingredients: whole-task training, part-task practice, supporting theory and just-in-time information. In addition to 4C/ID, we advocate performance-based training, in which each individual receives customised training at the most suitable moment using the best blend of training media, based on learning analytics. The design and redesign cycle is then finally closed by quality assurance, in which validation and qualification take place.

TRAINING NEEDS ANALYSIS (TNA)

Analyse operational training needs and determine the required competences through a Training Needs Analysis. The result is a competency based qualification profile that can be used as input for the training design

TRAINING MEDIA ANALYSIS (TMA)

Develop a training syllabus and select training media such as simulation, AR/VR, after-action review support tools, books, e-learning etc. Where no suitable media are available, user requirements need to be specified. The result is a fit-for-purpose training environment in which training media are well balanced and properly integrated into the competency-based training design.

TRAINING DESIGN

Produce a rough outline of the training course. Define the learner scenarios and goals in line with the training needs. Determine and assemble the required whole tasks and part tasks and insert supporting and procedural information where required. The result is a blueprint for training that can be used to develop the training syllabus and define training media requirements.

TRAINING TECHNOLOGY & ECOSYSTEMS

Assuring that training media adhere to the defined user requirement often requires technical development or improvement, for instance development of targeted fidelity VR-based simulators, interconnectivity between different simulation platforms or data collection for learning analytics are requirements that might not be available in current systems. Complex training systems for large organisations will benefit from a well-defined perspective and well-integrated components of the total system: a learning ecosystem.

LEARNING ANALYTICS

Learning analytics are critical to competency-based and performance-based training. This is the engine of modern learning ecosystems, providing a process to select, gather and analyse more detailed data on proficiencies.

ADAPTATION OF NEW TRAINING SYSTEMS

Modifying your training to include new styles of teaching, new media, learning culture or even just new types of trainees can often also entail a cultural change. Nurturing a shift in organisational culture can be a critical success factor when entirely renewing or changing your training.

Our approach consists of three main elements: stakeholder involvement, trainer and trainee mentoring, and evaluation and feedback.

QUALITY ASSURANCE - SIMULATION & DIGITAL TRAINING DEVICES

Verifying, validating, evaluating and qualifying simulation and digital training devices in any phase of the lifecycle is extremely important. The result will allow maximum advantage to be taken of the blend of simulation and digital training media within civil and military education & training programmes.

Stakeholder: Netherlands Ministry of Defence
Research partner: Royal NLR
Period: 2023 -2026

Social Media Simulator

The information environment, especially social media, plays an important role in military operations. However, within European legal and ethical boundaries, the means to train and experiment with multi domain scenarios in the information environment, are almost non-existent. It is therefore important to study and develop methods and techniques to generate the required data.

THE CHALLENGE

Recent activities in the information environment highlight the training and experimenting in Multi Domain operations. Realistic data is needed to be able to simulate the information environment. Legislation such as the GDPR prohibits the collection and analysis of online social network data for training and experimentation purposes. In order to overcome this challenge, the following set of questions must be answered:

- Which types of open source information are essential for training in Multi Domain Scenarios?
- How can we generate these types of information using techniques such as Generative AI ?
- What is the best way to set up a training and testing infrastructure for the information environment?

WHAT ARE WE DOING

NLR started by investigating which techniques and algorithms are applicable for generating realistic data. Parallel to these research efforts, a study was performed to determine approaches and architectures suitable for integrating the simulators from the various domains into a single battle lab.

The data generation research focusses on specific parts of the information environment, such as social media and other types of mass communication. The next steps are to extend our research to generate other modalities such as images, video and sound, and simulating complex behaviour of groups on online social networks.

THE SOLUTION

The current deliverable is an information environment simulator driven by generative AI models. The information environment simulator currently consists of simulated social media and news agencies. Generative AI models generate complex personalities and interactions between with respect to various subjects. Furthermore, the same AI models generate content generally expected from mass communication outlets (e.g. news agencies). The information environment simulator can communicate with other existing simulators, by parsing DIS/HLA data. The combination of these simulators allows for simulating the influence of kinetic effects carried out in physical domain on the information environment and vice versa.

Enabling Distributed Synthetic Training across different Security Domains

CDSiMS

THE CHALLENGE

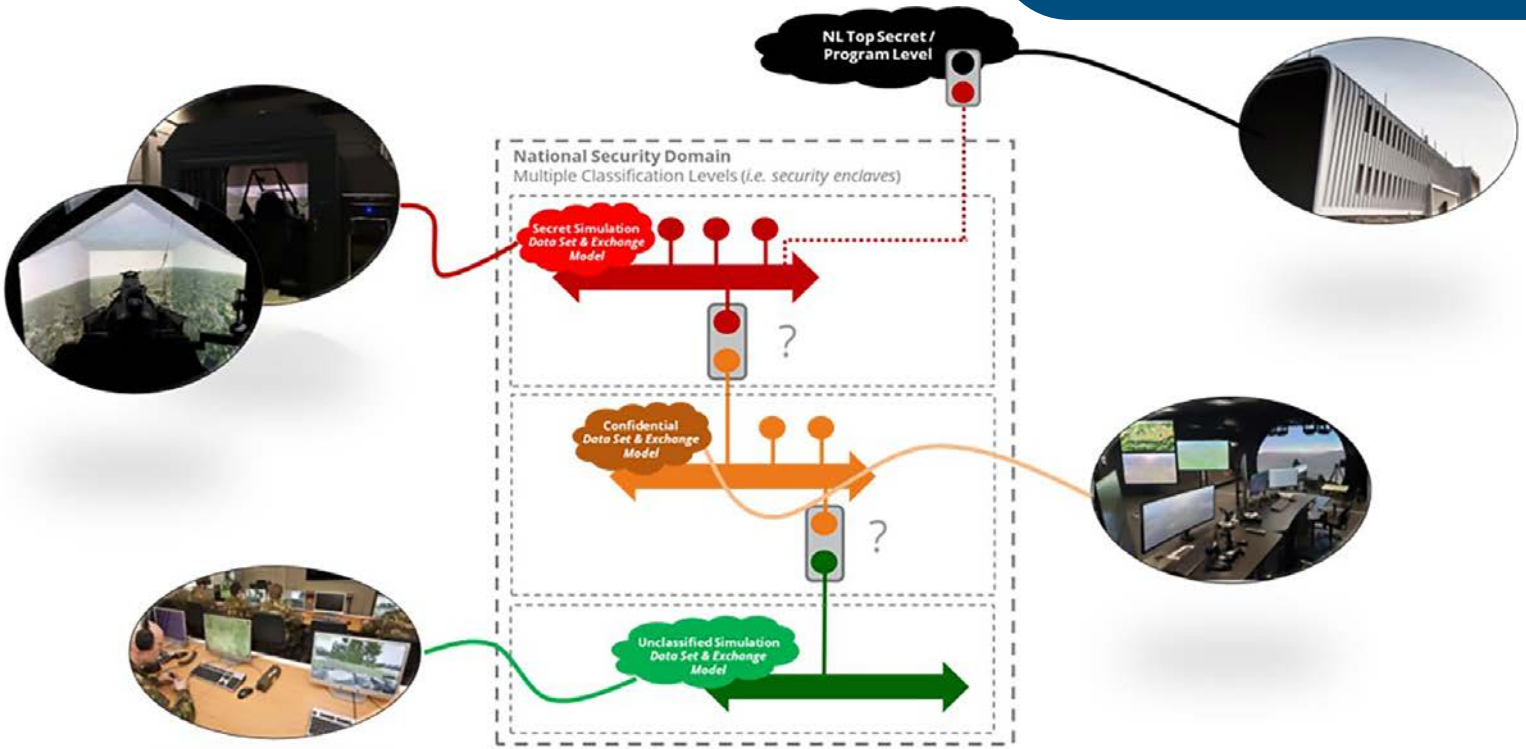
Within Distributed Synthetic Training (DST), simulation assets from different security domains must be able to interoperate within a single training environment. Cross Domain Solutions (CDS) designed for such training environments are rare. In general, a CDS prevents information leakage between different security domains and protects the overall system integrity. The key challenge is to explore how simulation data can be filtered and processed by a CDS without compromising the real-time performance and training value..

WHAT WE DID

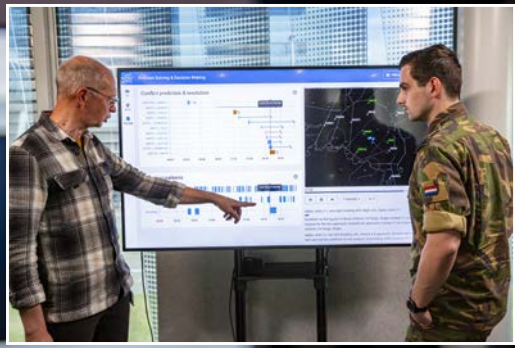
In the context of the “generic high assurance” CDS technology programme of the Netherlands Ministry of Defence (NLMoD), Royal NLR joined forces with their Technolution B.V. to develop and evaluate a dedicated CDS prototype for NLMoD DST purposes. The generic CDS platform has been extended to handle HLA, DIS and DDS data. Dedicated simulation data serialisation protocols, filter language and algorithms have been developed. Together with our partner TNO, extensive real-time performance tests were conducted on this CDS solution. A realistic RNLAF and RNLA training use case was used to evaluate the impact on training value. The use-case comprised distributed training scenarios between two NLD-Secret Apache flight simulator and NLD confidential JTACT simulators.

THE SOLUTION

This project resulted in a viable Technology Readiness Level (TRL)-6 CDS prototype that could be used in future to interoperate NLD-Secret simulators for other synthetic training devices that operate in different (inter)national security domains. Its flexible and modular design, with reusable components, facilitates easy deployment of this CDS solution for different simulators within a broad range of distributed training scenarios. The reusable components, which are pre-certified by the national security agency, also shorten the lead-time of acquiring official security Approval To Operate (ATO).



Stakeholder: Netherlands Defence: Royal Netherlands Command Material and IT (Commit), Royal Netherlands Air Force (RNLAF), Royal Netherlands Army (RNLA)
Project partners: Royal NLR, Technolution B.V., TNO
Period: 2021 - 2023



Stakeholder: Ministry of Defence
Project partners: Royal NLR, TNO
Period: Adaptive Learning Ecosystems: 2022 - 2025
INSPECT: 2023 - 2024

Adaptive Learning Ecosystems

Realising performance based training for military ATC training

With Performance-Based Training (PBT) we seek to support personalised training through enhanced performance metrics, learning analytics and support to all stakeholders in the learning and development process. The Adaptive Learning Ecosystem Programme works towards tailored concepts for Royal Netherlands Forces, providing a reference architecture and maturing advanced analytics. The INSPECT (Instructor Support for Performance Based Training) project provides an example, focusing on instructor's insight into trainees cognitive process.

THE CHALLENGE

Learning Analytics often focuses on the needs of training managers. In the INSPECT project, we aim to support the learning process itself by supporting the instructor acquire insight into trainees' cognitive process, related to:

- Situational Assessment
- Workload Mana
- Problem Solving & Decision Making

WHAT DID WE DO

The INSPECT project resulted in two prototypes to support analytics within a training session with:

- an Instructor Live Tool, which provides real-time insights into the trainees Situational Assessment
- a Debrief Tool that allows instructors to review and analyze training sessions with trainees focusing on the three cognitive competencies.

The Adaptive Learning Ecosystems Program develops predictive performance models to support personalised learning over a range of training sessions.

THE SOLUTION

An elementary learning ecosystem is needed to store and process large amounts of data from various systems within the existing training environment. The data includes eye-tracking data, audio recordings, and radar screen recordings. An analysis framework allows to calculate metrics from this data. Meaningful usage of the data requires a user-friendly and comprehensive dashboard.

LVC for Joint and Combined Air Power

Training in simulation-based environments yields cost and material reductions, though Live training will always be essential for a balanced training programme. Training with Live systems, Virtual simulators and Constructive forces in one environment really pushes the boundaries of traditional training as it offers a more realistic, immersive experience. An integrated LVC capability also facilitates testing of new training concepts for fifth generation platforms.

THE CHALLENGE

LVC incorporates Live, Virtual, and Constructive elements into one training environment. How to set up seamless and effective LVC exercises while ensuring optimal training value for all participants is not fully understood. This remains one of the most challenging issues of Modelling and Simulation for modern Air Forces. There is a lack of interoperability, limited reuse and loose integration between the Live, Virtual and Constructive assets across multiple simulation and training environments. The NLR research programme focuses on efficient and user-oriented LVC concepts for training in the Air Domain.

WHAT WE ARE DOING

NLR has identified concepts and solutions relating to LVC training development, integrated service-oriented architectures, datalink and communication technology and LVC exercise operations. Topic-specific knowledge, processes and technology - so called building blocks - are combined in an overarching Air LVC concept. An LVC architecture is determined and used to implement a specific air domain LVC capability with existing systems, networks and tools. This capability has been tested and demonstrated at the operational exercise Frisian Flag 23 where NLR investigated the technological requirements to facilitate LVC training using an operational datalink and identified the training benefits offered to pilots.

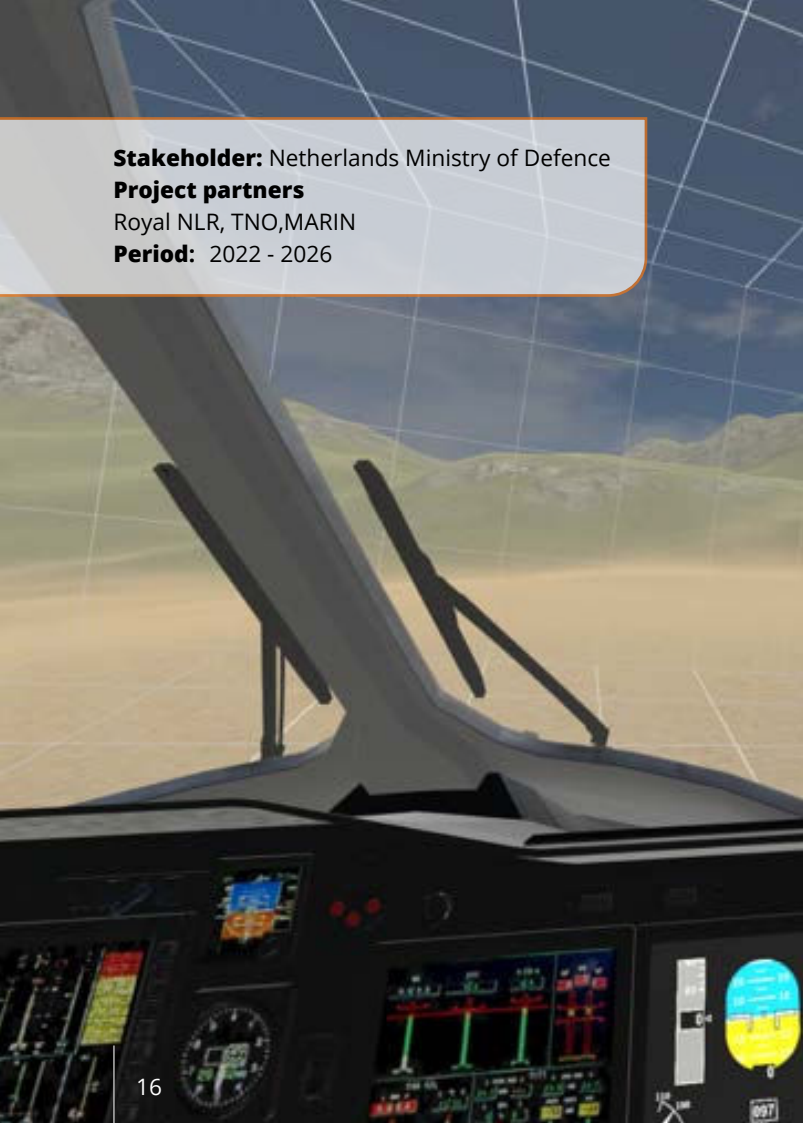
THE SOLUTION

The goal is to to determine together with the Royal Netherlands Air Force how LVC solutions can be exploited for better and more effective Air Power. This has resulted in:

- LVC concepts for flexible and scalable training in the Air Domain
- Testbeds and demonstrators of LVC technology
- Experimental tests of innovative LVC solutions connected to Live exercises
- Recommendations on how to use LVC environments for Concept Development and Experimentation

Stakeholder: Royal Netherlands Air Force
Project partners R: Royal NLR
Period: 2021 - 2025

Stakeholder: Netherlands Ministry of Defence
Project partners
Royal NLR, TNO,MARIN
Period: 2022 - 2026



Optimising training effectiveness in X-Reality

Extended Reality (XR) technologies, such as Virtual Reality (VR) and Augmented Reality (AR), are gaining popularity in the training sector due to their flexibility, cost efficiency and the level of immersion they provide.
However, the effectiveness of XR-based training is often compromised due to users experiencing adverse side effects during use, as well as lingering aftereffects that can persist for hours after training completion.

THE CHALLENGE

To fully leverage the benefits of XR technologies and environments, it is crucial to address the associated adverse side effects. Quantifying and mitigating negative side effects is essential to achieve higher training effectiveness. Key obstacles include cybersickness and the complexities of interacting with real and virtual objects. By understanding and overcoming these challenges, the full potential of XR technologies can be unlocked, leading to enhanced training outcomes.

WHAT WE ARE DOING

Two ongoing research projects investigate the negative side effects of XR environments. Human-in-the-loop experiments are employed to gain insights into these effects and evaluate mitigation techniques. The studies utilise a head-mounted display in conjunction with flight simulation, incorporating either a fully virtual cockpit or a partly physical cockpit. Careful consideration is given to the visualisation of both real and virtual environments, aiming to minimise adverse effects while preserving the user's sense of presence and monitoring the effect on its training process.

THE SOLUTION

The results of the projects are aimed towards developing technical solutions and guidelines to mitigate cybersickness and other negative effects in XR-based training. Key outcomes include a method to quantify perceptual deviations in mixed-reality interactions with real objects. Additionally, guidelines for visualising real and virtual environments for cybersickness mitigation have been established, providing a foundation for improving XR experiences and reducing adverse effects.

Project partners
Government (NL):
Project Bureau NH-90, Test Flight Office
Research organisation: Royal NLR

Start: July 2014
Duration: ongoing

NH-90 Full Mission Flight Trainer Evaluation

Evaluation of NH-90 simulation device compliance

THE CHALLENGE

The purpose is to perform evaluations of the compliance of the NH-90 simulation devices with their respective regulations and/or standards. The NH-90 simulation can be split into two separate devices that can be used separately for specific crew training and combined for full mission flight training.

- Full Flight Simulator (FFS) used for pilot training
- Virtual Sensor Trainer (VST) used for sensor operator training
- Full Mission Flight Trainer (FMFT), used for mission training with pilots, tactical coordinators and sensor operators.

WHAT WE DID

For evaluation of the FFS, the NLR evaluation team will first assess the Qualification Test Guide (QTG) of the FFS. Based on the results of this appraisement, the project team will determine if an onsite evaluation can be conducted. That will take several days during which the devices are assessed objectively by rerunning QTG tests, functionally, and subjectively as per the regulation set. The VST cannot provide objective data, so all tests performed on the VST will be subjective and functional tests. Furthermore, the military aspects of the devices are not accounted for in the civil regulations agreed between the simulator operator and the manufacturer. To gain an understanding of the military/tactical capabilities of the devices, interviews will be conducted with experts of all crew types involved in operations on the devices.

THE SOLUTION

The result of the project will be an evaluation process (including V&V reports) making it possible to determine:

- Whether the NH-90 FFS, VST, and FMFT are performing in accordance with the relevant regulations that will ensure safe operation of the NH-90 and its subsystems
- Whether devices are suitable for training pilots, sensor operators and tactical coordinators in both individual tasks and mission settings.

Multi-Ship Multi-Type Helicopter Simulation Training Capability

Acquisition & Deployment Support

THE CHALLENGE

The RNLAF is currently acquiring and deploying a unique multi-ship multi-type (MSMT) helicopter simulation training capability to support the fight, tactical and whole-task mission training of CH-47F and AH-64E crews at all operational levels. The MSMT capability will incorporate a large number of high-end simulation training devices, a tactical control centre (TCC), AAR and training mission development systems within a single flexible, scalable and easily expandable training environment that will have to cover a wide range of versatile training needs. Together with the many RLNAF stakeholders and industry parties involved in the acquisition and deployment of the capability, this makes the MSMT program a hugely demanding undertaking with many challenges and risks in achieving the envisioned objectives.

WHAT WE DID

The MSMT programme was formulated as a staged process where each phase results in a training capability with limited but clearly scoped functionality To guide the process, the MSMT training capability concept of operations (ConOps) as envisioned has been developed with the RNLAF end users along with an overarching simulation training system architecture.

Throughout each programme phase, a multi-disciplinary team of NLR experts conducted activities that include:

- Corporate and platform specific TNA/TMA
- PoR development for simulators, TCC and AAR
- RFI/RFP development and response assessment
- Engaging and challenging industry parties
- Integration testing and validation of industry deliverables
- Simulation training method and technology CD&E
- RoI analysis and decision-making assessment
- Training programme optimisation for using the capability
- Training mission development and operations support

THE SOLUTION

The project results in a full lifecycle support process that reduces the burden on both the Dutch Defence Materiel Organisation (DMO) and the RNLAF in acquiring and deploying the MSMT capability. A support process that ultimately leads to the most versatile mission simulation training environment possible with the highest level of interactivity for the RNLAF within the programme budget and timeframe. Continuous availability and direct access to a dedicated pool of NLR training and simulation experts deployable at key positions within the DMO, RNLAF and contracted industry parties.

Project partners
Dutch MoD (Defence Materiel Organisation)
Royal Netherlands Air Force Defence Helicopter Command
Research organisation: Royal NLR

Duration: 2018 - ongoing

Project partners
Defence Helicopter Command (DHC) of the
Royal Netherlands Air Force
Joint IV Commando (JIVC) of the Ministry of Defence
Research organisation: Royal NLR

Start: June 2016
Duration: 2.5 years

Redesign of helicopter training

A common, modernised approach for platform qualification training

THE CHALLENGE

The Defence Helicopter Command of the Royal Netherlands Airforce expressed a need for a common, modernised approach for qualification training on all of their platforms.

WHAT WE DID

In cooperation with subject matter experts (operational pilots/ load masters and instructors), a competency-based training needs analysis was performed. Competency profiles were identified for CH-47 pilots and load masters and for the AH-64 pilots. Idealised mission qualification training (MQT) outlines were designed that would lead to fully combat-ready pilots and load masters for a wide range of normal and adverse operational conditions. This is based on the assumption that modern tactical simulators are available, suitable live ranges are available and that there are no scheduling issues. Such ideal training conditions are important for creating and working with a clear vision of training.

With the idealised training setups in mind, actual MQT were developed, implemented and evaluated. User requirements for a multi-ship/multi-type (MSMT) simulation facility were also identified and a roadmap to a future idealised MSMT system concept was suggested.

All activities were facilitated by NLR and new, science-based approaches were applied as far as acceptable for the subject matter experts.

THE SOLUTION

The project produced actual MQT for AH-64 and CH-47 crews. Additionally, user requirements, a system concept and a roadmap for an MSMT simulation facility were provided.
The method applied is a competency-based training approach that applies the train-as-you-fight principle from the start. This primarily whole-task training setup is constructed using principles (for example gradually increasing complexity) that optimise cognitive load throughout the training.

Replacement of initial training capacity

Flexible and scalable future training

THE CHALLENGE

The PC-7 training aircraft of the Royal Netherlands Air Force (RNLAF) needs to be replaced. A Training Needs Analysis (TNA) and Training Media Analysis (TMA) were therefore done, aiming to provide a solution for the replacement of the entire initial training capacity. This training capacity needs to be flexible and scalable to meet the changing training needs in the future. As a result, the following questions should be answered clearly:

- What is the end goal of the training?
- What is the desired training concept?
- What are the most suitable training media?

THE SOLUTION

To answer these questions, NLR uses an approach called the Comprehensive Analysis Process for Aircraft Blended Learning Environments (CAPABLE). CAPABLE is a structured approach to an integrated training solution. This approach is complemented with a TMA aimed at maintaining flexibility in the long term. The TMA takes current and possible future technological developments in the field of training into account in order to arrive at an optimum training medium or an optimum blend of training media.

WHAT WE DID

NLR, in cooperation with the RNLAF and DMO (the Dutch Defence Materiel Organisation) has performed a TNA that served as input for a training design blueprint. Subsequently, the blueprint has been used in a future-proof Training Media Analysis based on user and functional requirements for training media. The RNLAF instructors then develop the actual training design using the blueprint and TMA as reference documents. Finally, the results of the TMA can be utilised by the RNLAF for Requests for Information (RfI) from Original Equipment Manufacturers (OEMs) for training resources, which will be carried out by the DMO.

Project partners
Stakeholder: Royal Netherlands Air Force, Dutch Defence Materiel Organisation
Research organisation: Royal NLR

Period: February - May 2021

Smart Bandits

Intelligent opponents in mission simulation

THE CHALLENGE

In military simulations, computer-generated forces (CGFs) are autonomous entities that represent friendly, neutral or hostile air, ground surface, or subsurface-based units, platforms or individuals. The behaviour that CGFs display in the simulations is modelled to resemble realistic human behaviour. CGFs are typically used in application areas such as training, mission rehearsal, concept development and experimentation (CD&E) or decision support. For each application, the CGFs require different behaviour models. However, traditional modelling techniques do not give scope for expression and keep modellers from quickly developing new models. New approaches to behaviour modelling are therefore required.

WHAT WE DID

The Smart Bandits project aims to explore various approaches to modelling human-like behaviour.

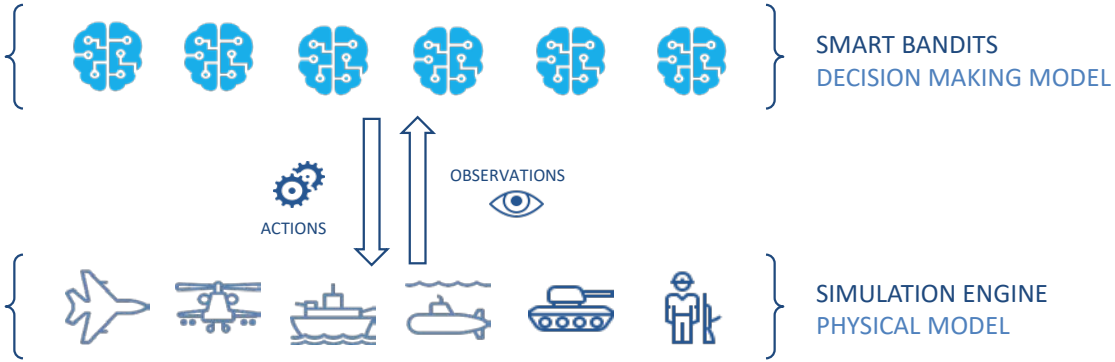
To this end, we carried out research in two main directions, namely human behaviour and computational modelling. In the former, we specifically studied situational awareness (i.e. perception of the environment) and theory of mind (i.e. beliefs, desires and intentions). In computational modelling, we studied the use of machine learning techniques for enhancing classical modelling techniques such as finite-state machines and behaviour trees. A key component of the Smart Bandits project was the evaluation of newly developed techniques in human-in-the-loop simulations, such as in NLR's Fighter 4-Ship networked F-16 simulator.

Project partners
Research organisations:
Royal NLR, VU University Amsterdam

Start: 2010
Duration: improvements ongoing

THE SOLUTION

The results of the studies have been combined in a user-friendly graphical behaviour modelling tool. The tool was named Smart Bandits (after the project). It lets modellers quickly implement behaviour models and link the new models to the CGFs in a simulation engine. While the CGFs make their observations in the simulated world, the Smart Bandits tool calculates their next actions. During simulations, the behaviour models can easily be inspected to see what the CGFs are thinking. Apart from being an intuitive modelling tool, Smart Bandits continues to be a platform for behaviour modelling research. NLR is continuously experimenting with new modelling techniques and new ways of interacting with CGFs.



BROAD RANGE OF RESEARCH AND TESTING APPLICATIONS

- OPERATIONAL AND TACTICAL DOCTRINE DEVELOPMENT
- MULTINATIONAL COLLABORATIVE DEVELOPMENTS
- 5TH GEN AIRFORCE
- INFORMATION-DRIVEN OPERATIONS
- CONCEPT DEVELOPMENT & EVALUATION FOR OPERATIONS AND TRAINING
- SERIOUS WARGAMING

Warfighter focussed CD&E

Cerebro: testing environment for research, development, testing and evaluation

All NLR simulators and tools for defence are integrated into Cerebro, a battle lab environment in which concepts for military operations developed, tested and evaluated - Concept Development and Evaluation (CD&E). It has a broad range of research and testing applications, such as investigating data-drive operations and multi-domain operations issues in a broader context.

KEY FEATURES

Cerebro integrates existing high-fidelity platform simulators and tools with additional proof-of-concept demonstrators and tools. Also, it can extent to other, external, battle lab environments, and be connected to live systems. Our facility supports both small and larger projects that require multiple simulators to work in an integrated environment. Hereby reducing costs for testing and development while enabling assessment of new functionalities concepts in a safe and classified environment.

TECHNICAL SPECIFICATIONS – SIMULATION SET-UP

The NLR CD&E infrastructure is based on a virtualisation solution. This allows for quick configuration of simulation tooling and scenarios, and rapid deployment of simulation exercises to end-users. The core services are readily integrated, such as terrain databases, scenarios, chat, and simulation backbone. Cerebro's simulators include the CDEF F35 simulator, the helicopter pilot station (HPS), the multi-UAS supervision testbed (MUST) and others. Tools include the weapon engagement simulation tool (WEST) and the threat reference manual (TRM).

BATTLE LAB BASED ON VIRTUALISATION

The Cerebro infrastructure is fully based on a virtualisation solution, enabling rapid configuration and deployment of exercises with various tools, services, and simulators: Quick configuration of simulation tooling and scenarios

- Rapid deployment of simulation exercises to end-users
- Core services readily integrated, e.g. terrain databases, scenarios, chat, simulation backbone
- Promotes quick and agile development of simulation experiments

SCOTT: Smart Controller Training Tool

Diverse and realistic scenarios for fighter controller training

Fighter controllers are essential for the safety and effectiveness of fighter pilots. They provide the pilots with a complete and correct air picture. Fighter controllers must be well trained to observe, assess and communicate in rapidly evolving situations. This includes training scenarios that are diverse and have realistic fidelity and scale in terms of the platforms involved and their behaviour.

THE CHALLENGE

Training and educating fighter controllers is often highly labour-intensive, as well designed and user-friendly tools to simulate air engagements are not readily available. Frequent training with live assets in the air is costly in terms of logistics, coordination and the number of platforms (blue and red) required. Generating realistic behaviours of constructive platforms is typically not available without human input. The challenge is to create the desired level of realism in an environment where the minimum required human involvement is low.

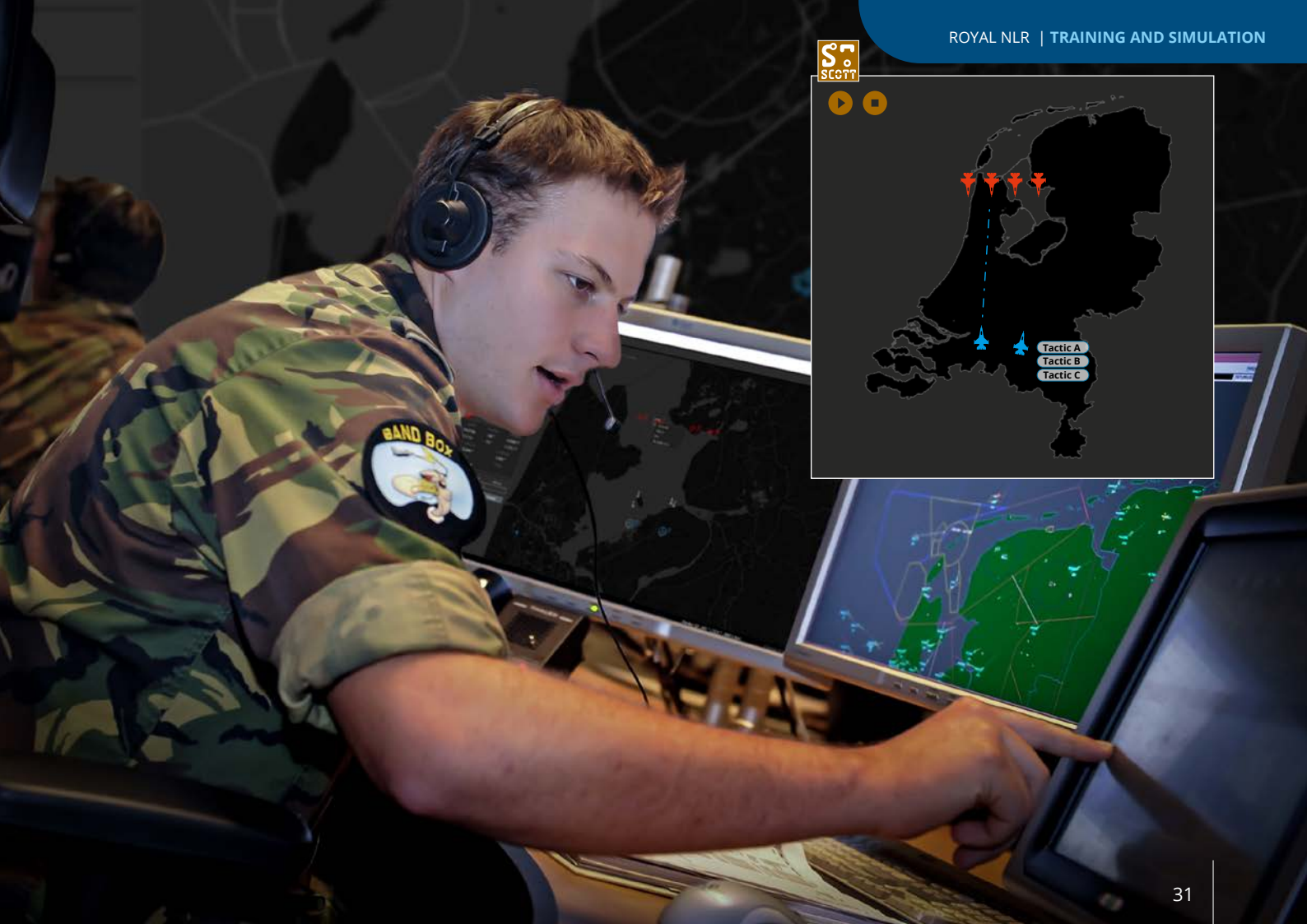
THE SOLUTION

Royal NLR designed and developed SCOTT as an easy-to-use tool for instructors and pseudo-pilots for fighter controller training. SCOTT is a tool that can create realistic tactical simulation exercises using artificial intelligence (AI), consisting of both Blue and Red air platforms. SCOTT can run air-to-air combat scenarios autonomously, but a human can intervene in the tactical decisions of the constructed air platforms. As the scenarios are easier to control, larger tactically relevant scenarios can be implemented. SCOTT presents these scenarios via DIS to the operational system for fighter controllers. Interoperability between SCOTT and other simulator systems is also possible, e.g. for LVC or MTDS exercises.

WHAT WE DID

NLR developed the SCOTT tool to allow the design and execution of air-to-air combat scenarios and contain autonomous and semi-autonomous tactical constructive entities. NLR added realistic tactics and missile performance which can be specified to national requirements.

These are based on tools that were developed in-house: Smart Bandits (AI behaviour) and WEST (missile performance). This resulted in a low-effort tool for easy control of the scenario and adjustment to the desired learning objectives.


SCOTT
Tactic A
Tactic B
Tactic C
BAND BOX

Stakeholder:
Royal Netherlands Air Force (RNLAF)
Defence Equipment Organisation (DMO)
Research organisations: Royal NLR
Netherlands Organisation for Applied Scientific Research (TNO)

Start: February 2000
Duration: ongoing

F-35 Acquisition & Operational Readiness Preparation

Design and construction of multiple training and evaluation plans

THE CHALLENGE

NLR helped the RNLAF with F-35 acquisition and operational readiness by focusing on transforming the Defence Materiel Organisation (DMO) into a smart buyer and assisting the RNLAF with a smooth transition from the F-16 to the F-35. Within this programme, multiple training & education projects have been carried out to design and improve training for pilots, maintenance staff and mission support crew.

WHAT WE DID

The training methods, tools and activities carried out by NLR throughout the F-35 programme include:

- Training Needs Analysis (TNA) for pilot maintenance staff and mission-support roles
- Design of an F-35 pilot competency profile, initial and recurrent training course content
- Training Media Selection Analysis (TMA
- Business case for a Maintainer Training Centre (MTC)
- Multi-Spectral DataBase (MSDB)
- Continuation training including Performance-Based Training (PBT)

THE SOLUTION

The activities mentioned helped to develop a variety of products and services, including:

- Initial and recurrent training course content for pilots and maintenance staff
- Design and execution of an Operational Test & Evaluation plan for Continuation Training
- Design and construction of a WLT (Weapons Loader Trainer) including augmented reality applications.

Project partners
Royal Dutch Airlines KLM
Research organisation: Royal NLR

Start: June 2016
Duration: Ongoing

Augmented reality for maintenance training

Problem-based training with increased trainee activity

THE CHALLENGE

KLM expressed the need for more innovative training media to modernise and improve maintenance training.

WHAT WE DID

To ensure properly integrated use of training media, the project started with a review of the current training design and an analysis of current training content. Subsequently, there was a study of whether augmented reality (AR) could add value for aircraft systems that are difficult to train through traditional classroom training. Requirements for the AR application and training design were defined before starting actual development. Finally, the prototype was evaluated through an experiment.

The project was carried out in a highly interactive and agile way. Bi-weekly sprints were held with experts from relevant areas such as maintenance experts, application developers, human-machine interface experts and educational experts, which ensured accuracy and acceptance of intermediate and final results.

THE SOLUTION

The result of the project is a modernised, problem-based maintenance training design that enhances understanding of the systems and system interaction. This design comprises less traditional instruction and more trainee activity through paper-based assignments and problem-based AR scenarios.

The experiments proved that trainees score better using AR when it is fully integrated into the training design; trainees retained more of what they learned, had a deeper understanding and retention time was longer compared to traditional classroom training. Important lessons learned are the importance of shared AR and a maximum of 20 minutes wearing the AR goggles.

Project partners
Armasuisse, Swiss Armed Forces
Hulleman Expertise
Research organisation: Royal NLR

Start: September 2017
Duration: 1.5 years

Note – given ratings are fictive and don't represent the Swiss Armed Forces situation

Swiss Armed Forces Simulator Portfolio Rationalisation

Formulation of training and simulation vision including a roadmap for implementation

THE CHALLENGE

Many nations are facing the question of what to do with their end-of-life simulators and how to ensure their replacements will be more (cost-) effective, efficient, and future-ready. The Swiss Armed Forces are investigating possible options for developing a new portfolio of training simulators. The options should fit the envisaged Swiss Armed Forces' future training needs and budget for 2030 and beyond.

WHAT WE DID

A corporate TNA was carried out to identify current and future demands and to review the major training facilities. A training and technology scan was carried out, together with a small benchmarking activity. This led to advice on a training & simulation vision, including measures for integrated simulation architecture and infrastructure.

Three different options were put together for realising the training demands and constraints. One option aimed for simulator replacement with limited change ('Minimise Change'), a second aimed to take advantage of the large variety of envisaged training media, including VR, AR, MR and PC-based simulation ('Richly Blended'). A third option aimed to maximise PC-based simulation ('Lean & Agile'). All options require a considerable level of integrated simulation infrastructure. The three options were compared in terms of initial investments, cost reduction and training value against the current situation ('business as usual') as the baseline.

A roadmap was outlined towards implementation of the selected option.

THE SOLUTION

The project provided guidance for a high-level outline of options for a future training simulator portfolio with a broad outline of an implementation roadmap and plan for the Swiss Armed Forces. The key to the success of the selected option is to formulate a modern vision on training and simulation.

NLR in brief


One-stop-shop
Global player with Dutch roots
100+
Since 1919
Amsterdam, Marknesse
Rotterdam, Noordwijk, Brussel
Innovative, involved and practical
For industry and governmental
For civil and defence
800+
staff
€ 127 M turnover
78% Dutch, 19% EU and 3% worldwide
Active in 24 countries
Very high customer satisfaction

About NLR

Royal Netherlands Aerospace Centre

NLR is a leading international research centre for aerospace. Its mission is to make air transport safer, more efficient, more effective and more sustainable. Bolstered by its multidisciplinary expertise and unrivalled research facilities, NLR provides innovative and comprehensive solutions to the complex challenges of the aerospace sector.

NLR's activities span the full spectrum of Research, Development, Testing & Evaluation (RDT&E). Given NLR's specialist knowledge and state-of-the-art facilities, companies turn to NLR for validation, verification, qualification, simulation and evaluation. They also turn to NLR because of its deep engagement with the challenges facing our clients. This lets NLR bridge the gap between research and practical applications, while working for both government and industry at home and abroad.

Royal NLR stands for practical and innovative solutions, technical expertise and a long-term design vision regarding their fixed-wing aircraft, helicopters, drones and space exploration projects. This allows NLR's cutting-edge technology to find its way also into successful aerospace programmes of OEMs like Airbus, Boeing and Embraer.

NLR supports military forces in solving any challenge in modelling & simulation, ensuring effective realism and cost efficiency.

Royal NLR

- defines training & simulation vision
- performs operational training needs analysis
- designs training blueprints
- defines training media in line with training needs
- supports training implementation
- carries out training evaluation

For more information:

Harrie Bohnen, Department Manager Training & Simulation

+31 88 511 36 60

info@nlr.nl

NLR Amsterdam

Anthony Fokkerweg 2

1059 CM Amsterdam

+31 88 511 3113

info@nlr.nl www.nlr.org

NLR Marknesse

Voorsterweg 31

8316 PR Marknesse

+31 88 511 4444

info@nlr.nl www.nlr.org

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