

Advanced and cost efficient - the Joint Fire Support Team Trainer of the Bundeswehr

Abstract — To fulfil the need of realistic education and training of Joint Fire Support Teams (JFST) the German Federal Armed Forces (Bundeswehr) installed a Joint Fire Support Team Trainer (JFSTT). This paper describes the different use cases, the architecture and modules and the connectivity of the simulator. Focused on how to enable training for different educational levels and reduce costs and personnel, details like scenario-based behaviour modules, C2 system integration and radio simulation control are presented. ESG internal research on how to use augmented reality for JFST training give an outlook on further developments.

1 Introduction

To fulfil the need of realistic education and training of Joint Fire Support Teams (JFST) the German Federal Armed Forces (Bundeswehr) demand a simulation system capable of exercising the collaboration between the members of a Joint Fire Support Team as well as the collaboration between up to three teams supporting a combat battalion. All relevant JFST procedures need to be trained dismounted as well as mounted on the German Army JFST vehicle Fennek. The part of the simulation system representing the air-ground component of the JFST must also be qualified for NATO standardized Forward Air Controller certification. The simulator is intended to be connected to other national and international training facilities and will be used for multinational training courses. The company ESG has been chosen to deliver the JFST Trainer (JFSTT) for the German Federal Armed Forces. The provided simulation system is flexible in regard to training level and trainee composition, realistic by using device mock-ups and integration of real C2 Systems and cost efficient by reducing the administrative staff and providing different parallel exercises.

2 System composition

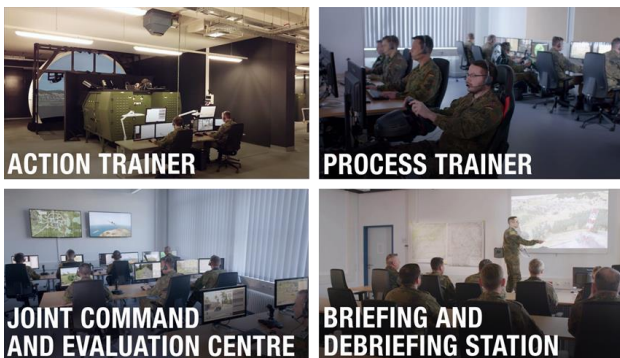


Fig. 1. Components of the Joint Fire Support Team Trainer

The Simulation system consists of two main parts, a Process Trainer and an Action Trainer. The Process Trainer is a desktop-based solution for education and training of up to two JFST. The Action Trainer is mainly

used for advanced training with device mock-ups in mountable vehicle cabin replicas or dismounted in a 220-degree dome system. The JFSTT is controlled by the Joint Command and Evaluation Centre and equipped with separate debriefing stations for the Process Trainer and the Action Trainer.

The simulator is based on VBS3, VBS IG and VBS Radio supplemented with more than 40 custom-made plug-ins created by ESG.

2.1 Process Trainer

For desktop-based training of up to two JFST the Process Trainer provides workstations for driver, operator and commander of the Indirect Fire and Forward Air Controller vehicles of the JFST. All workstations can be used for mounted and dismounted operations by providing virtual world interaction or image generation for the optical devices. Vehicle-bound and dismounted C2 Systems are also available at the Process Trainer on separate monitors.

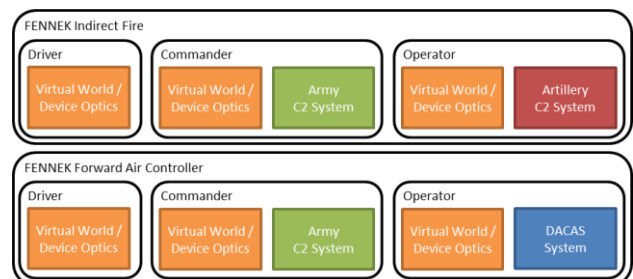


Fig. 2. Workstations at the Process Trainer

2.2 Action Trainer

The Action Trainer consists of two Fennek mock-ups and one 220-degree dome system for dismounted operations. The dome has a 7-channel visual system based on VBS IG and can be manned with a commander and an operator using the following equipment: Vector IV, PLDR II, LRTV, NYXUS (Laser Range Finder), IZLID, Compass, DAGR, Rover, SEM70 (Radio), PRC 117F, PRC 148 and a tablet for C2 Systems. The dome also provides one Head Mounted Display for 360-degree view for each person – the other equipment is shared between them.

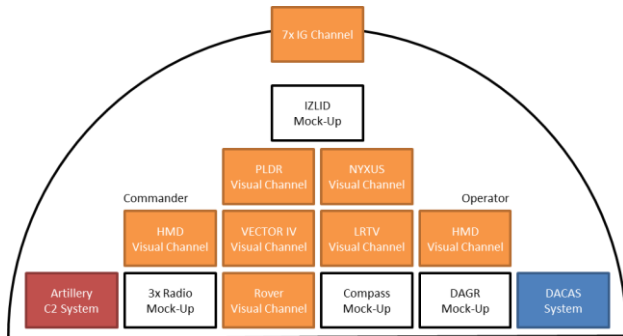


Fig. 3. Dome at the Action Trainer

The Fennek mock-up can be manned with driver, operator and commander. The three front screens present the virtual environment to the driver and can also be seen from the rear positions. The Army C2 system is assigned to the commander, the weapon station to the operator. The vehicle observation device and a second C2 system (Artillery for Indirect Fire Fennek or DACAS for FAC Fennek) are mounted on a movable console between them. A radio control panel in the back of the mock-up can also be operated by both.

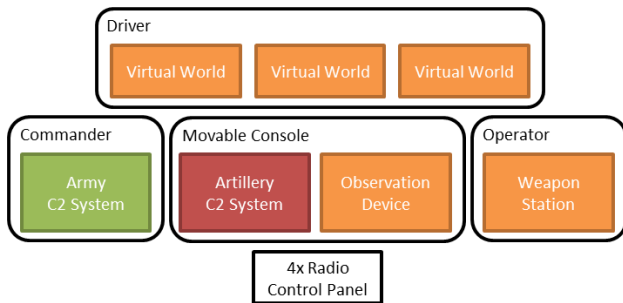


Fig. 4. Fennek mock-up (Indirect Fire) at the Action Trainer

By raising the commanders and operators seats they can turn out of the Fennek mock-up. The device connections that are located between these two hatches on top of the cabin are nearly the same as the ones used in the dome system. Equipped with HMDs and other optical training devices the turned-out trainees can observe the virtual world outside the Fennek cabin.

Additionally, for each pair of Fennek and dome an administration and a pilot station is provided. Therefore, the Action Trainer can be run independently from the Joint Command and Evaluation Centre.

2.3 Joint Command and Evaluation Centre

The main tasks of the Joint Command and Evaluation Centre are exercise planning and Exercise Control (EXCON). The Process Trainer needs an occupied Joint Command and Evaluation Centre, the Action Trainer can run independently. Up to eleven workstations for simulation control, pilot stations for fixed-winged, rotary-winged and UAV, BLUFOR, OPFOR, Naval- and Indirect Fire Control as well as C2 stations for Higher Level Command are provided. Each stations operator can occupy each role which allows to run an exercise from only one workstation. Therefore, the number of

administration personnel can be adapted to the individual training requirements.

2.3.1 Scenario-based behaviour modules

To enrich VBS mission for recurring training segments, six scenario-based behaviour modules were created. All modules are deployed on each administration workstation at the Joint Command and Evaluation Centre and the Action Trainer. Each module can be instantiated once at each exercise running on the JFSTT.

The module Escort Convoy can create automated vehicle convoys driving on roads, where vehicle positions, driving distance, stopping distance, driving speed and catch up speed can be specified. The road network can be extracted as a shapefile from VBS maps and edited afterwards, to create roads and paths not existing at the regular maps. The JFST vehicles can be driven automatically within the convoy, leave their positions to drive independently and can be reintegrated to the convoy. Predefined roadblocks / IEDs combined with convoy vehicles securing off-road positions will force the JFST trainees to react appropriately.

The IED module simulates the deployment and activation of an IED by a group of persons. IED position and position marking, appearance, approach and departure of the group as well as of a triggerman and civil traffic can be specified. The different stages of the process can be triggered at runtime allowing the simulation of different behaviours e.g. exploring the IED position by only approaching and leaving without placing an IED or burrowing non-IED items by civil personnel.

The demonstration module populates an area with predefined persons. A certain amount of the crowd then gathers for a demonstration at a predefined position. The demonstration can be escalated by thrown stones, ignited fires, visible firearms or gunshots from participants. The demonstration can also be dissolved at any time by the administrator either regularly or with fleeing protesters.

The ambush module evaluates potential ambush positions along roads based on visibility calculations between vehicles approaching from a specified direction and the possible attackers. All or a subset of these calculated positions can then be chosen to create enemy units. The calculations and unit creation are designed to be executed at runtime without slowing down the simulation and may therefore take a couple of minutes.

The amphibian landing module can place JFST on ships or landing boats, trigger preparation fire, automates the landing process and creates a bridgehead of own forces.

The mechanized brigade plugin triggers the attack of an enemy mechanized brigade on pre-recorded paths. Platoons, companies or battalions can be ordered to take different attack positions and move between them on recorded paths. Infantry can be deployed from each

vehicle. While moving the vehicles can be ordered to engage with different weapon types or to cease fire. With this module up to four battalions, each consisting of four companies with four platoons can be commanded. Each platoon can handle up to nine vehicles.

2.3.2 Radio integration

To simulate radio communication VBS Radio is used. Based on the API a plugin for admin workstations was created to define radio channels with defined frequencies. All radio devices from Process and Action Trainer can be assigned to specific radio channels via a matrix-style user interface.

The users at the Process Trainer can switch between the allowed radio channels using the standard VBS key assignment. Users at the Action Trainer must tune in the correct radio frequency at the radio mock-ups to switch radio channels. Within the JFSTT you can connect the virtual radio devices of the Process Trainer with the radio mock-ups of the Action Trainer.

3 Utilization

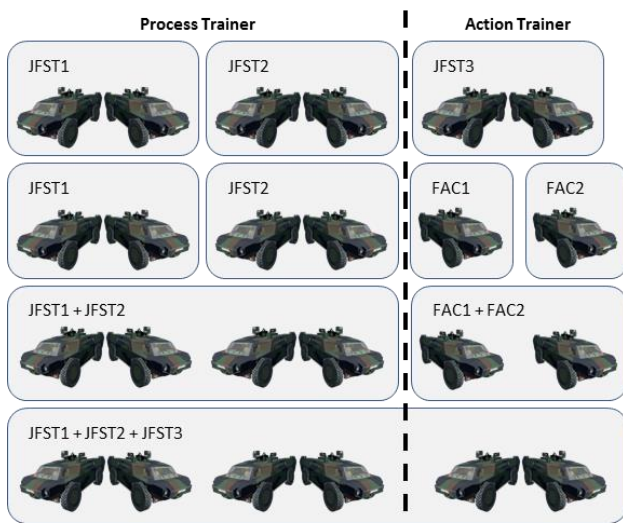


Fig. 5. Different exercise combinations of the JFSTT

For educating a multitude of Joint Fire Support Teams, up to three independent exercises for each team can be set up. To fulfil the need to train JFST while conducting as much as possible FAC certifications, the Action trainer can be set up to run two independent VBS missions with a mounted or dismounted FAC part of the JFST. At this configuration up to four parallel exercises can be executed. At this configuration a separate admin and pilot station is used for each FAC, located directly behind the vehicle mock-up.

For more challenging training the two JFST of the Process Trainer and the two FACs of the Action Trainer can work together in one virtual world. For high intense training, Process and Action Trainer can be linked together. A practiced use case for this setup is to train three JFST at a battalion level training scenario, each embedded in a combat company.

The utilization of Action and Process Trainer can be selected independently before mission start. The only restriction is to use full JFST when connecting Process and Action Trainer.

The configuration of the simulator is automated during the start of a mission. The administrator can choose free parts of the simulator the trainees will have to mount. Afterwards he assigns free administration stations and chooses a VBS mission. Until mission start all selected resources of the simulator stay reserved, in case other administration personnel is creating missions.

4 Integration of C2 Systems

In the current expansion stage of the JFSTT the ESG Digital Aided Close Air Support (DACAS) system EAGLE is already integrated. In the Process Trainer commander and operator can use the DACAS system in all FAC vehicles at mounted or dismounted operations. One instance of the operational software is running at a virtual machine and it is possible to switch the DACAS system between commander and operator workstations at their second monitor. At the Process Trainer one tablet PC with the operational EAGLE system is deployed in each Fennek mock-up, when operating at FAC mode. Here the handover between commander and operator is done naturally and when you switch between mounted vehicle mock-up and dismounted dome operation you can simply take the tablet PC with you. Each admin workstation can start an instance of EAGLE to represent higher command and each pilot station uses one instance to represent an aircraft at the C2 network.

Sensor input for both solutions is realized by a virtual GPS plugin for VBS, transmitting the virtual vehicle position to the operational GPS interface of the EAGLE software. It is also possible to transmit lasered positions from the virtual and the mock-up LRTV device. For this functionality the operational interface was also used, allowing to integrate the operational software without changes.

At the next stage the German Army C2 System FÜInfoSysH and the German Artillery C2 System ADLER will be integrated. They will get sensor integration with the virtual vehicle observation Device (BAA II) and the Laser Range Finder NYXUS. For automated fire mission a constructive artillery system simulator (VISSS) will be connected with the ADLER Artillery C2 system and the VBS3 simulation system, allowing to automate Fire Direction Centres and effectors like mortars, howitzers, MLRS and naval systems.

5 Augmented Reality for JFST training

An ESG internal research project focussed on how to use augmented reality for JFST training. Moving own and opposing ground and air forces were displayed at a military training area using Microsoft HoloLens. The AR device was also used as a laser range finder to get the

real-world coordinates of the simulated entities. Connected with a C2 system the engagement process led to visual impacts on the simulated vehicles represented at the real-world.

Benefits of the used HoloLens were high mobility of the training equipment due to wireless operations. Commercial laser-based geodata was used for the presentation, but the use of drones for generating geodata has also been successfully evaluated.

Some limitations due to the early development stage of AR equipment like limited geodata storage, disturbing effects of natural light and overall performance outside of closed rooms came up. For the next iteration newer AR hardware with the ability of (electro-)optical magnifications is planned to be constructed and to be analysed for JFST training purposes.

Author/Speaker Biographies

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