The TIGER Development Simulator

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Abstract

The efficiency of a complex weapon system is closely related to the man machine interface (MMI). Therefore, on the TIGER special emphasis has been put on this aspect testing and verifying concepts and the implementation. From the beginning the development process was supported by simulation with prototyping and off-line simulations, which have been used for part task investigations and then merged into a tool, which represents the complete system - the Simulation Cockpit (SimCo).

The TIGER SimCo is a 1:1 replica of the crew station, fully instrumented and functional. It allows to simulate helicopter, avionics and weapon system behavior in a complex mission environment. It was built up according to the development progress and used as the primary evaluation tool in several simulation sessions with the customer. Results from this campaign have been proven to be valuable inputs to the development. Requirements and definitions could be settled at an early stage and the change cycle was shortened.

Today, the simulation for the TIGER UHT version has just been finished. The SimCo was upgraded to the latest weapon system configuration, which was evaluated in complex mission scenarios.

Development approach

The MMI of a complex weapon system like the TIGER is the key issue for mission success. The intensive use of modern information techniques, the combination of different sensors and complex weapon systems requires a high degree of automation and easy operation. Therefore, Eurocopter has put a lot of effort in the development and optimization of the crew interface.

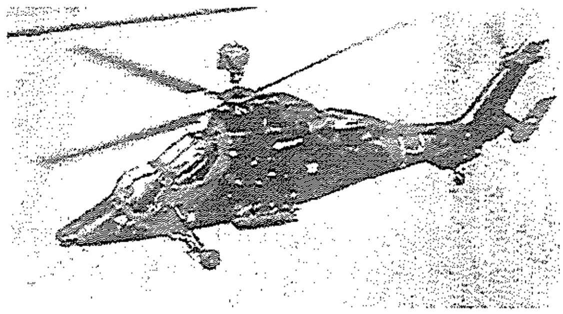

Figure 1: TIGER - UHT version

A procedure was set up to design, evaluate and validate the MMI in several steps. Since the abstraction level of a paper definition is too high, it was foreseen to present and validate the definitions in a simulation. The customer, which was represented by a Consulting Crew, evaluated the proposed MMI and gave his comments as inputs for a new definition.

Several simulation phases have been defined in the development process directly linked to design freezes of functions, MMI, SW versions and prototypes. Starting with simple tasks like flying and evaluation of new symbology, more and more functionality and equipment were added. So in several intensive simulations the basic system was optimised. Symbology, cockpit management, AFCS, HC-systems, avionics, flight/mission-management and degraded modes have been the main topics.

In a second step the Mission Equipment Package (MEP) with all sensors and weapons was integrated and evaluated in the same way. The simulation of a complete mission finalised the evaluation of the bilateral weapon system. A national simulation campaign for the UHT version of the TIGER - featuring all necessary mission equipment and weapon upgrades - was performed recently.

The initial intention of the SimCo was to make the weapon system more transparent to the customer than it could have been done by paper definitions. So the MMI was the primary target of the simulations. But soon the simulation was identified as an excellent tool to prototype the system and the objective changed from MMI- to system simulation. So the SimCo morphed from a pure MMI demonstrator to a mission system simulator, where the customer proved his ideas and the engineers could identify problems at an early development stage.

Technique

The SimCo is based on a 1:1 replica of the cockpit section. It hosts all relevant cockpit devices for pilot and gunner including the flight controls and the simulation computer. A three channel projection provides an external out of the window view for the pilot eyepoint. Equipped with wheels the SimCo can be easily moved to another location.

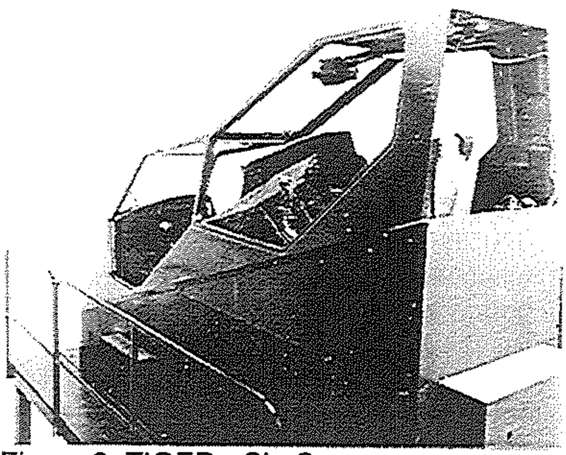

Figure 2: TIGER - SimCo

The pilot's cockpit is equipped with standby instruments, a Remote Frequency Indicator (RFI), a Control and Display Unit (CDU) and some dedicated control panels for HC-systems like engine, electric, autopilot and others. Primary display for the pilot is the Helmet Mounted Sight and Display (HMS/D), which generates flight and weapon symbology optionally overlaid with sensor information. Other symbology, digital map and sensor images are displayed on two Multi Function Displays (MFD).

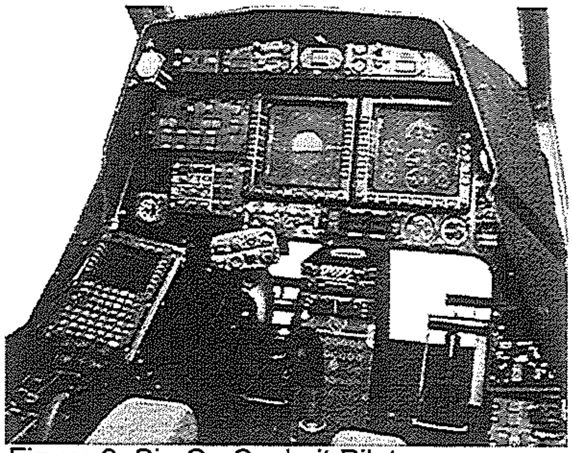

Figure 3: SimCo Cockpit Pilot

The gunner's cockpit is also equipped with two MFD's, an HMS/D, a CDU and a RFI but functionality on helicopter controls is limited. Nevertheless, the gunner is able to fly the helicopter from the backseat and take over pilot tasks. In addition to the pilot's controls and displays he has a Head In Display (HID) and two armament control grips. Sensor images from the Mast Mounted Sight (MMS), which can be controlled with these grips are displayed on the HID and allow the air to ground engagement.

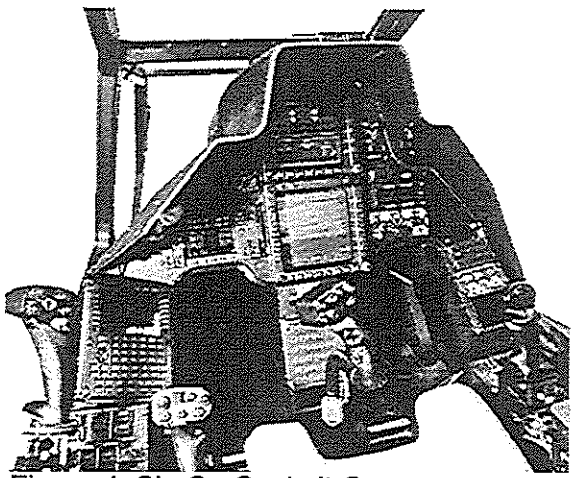

Figure 4: SimCo Cockpit Gunner

As far as possible, simulation equipment is used in order to be responsive to changes in definition and to reduce costs due to commercially available components. Nevertheless, form, fit and function has to be representative of the original components.

The functionality behind these devices is calculated by a multi-processor VME bus system, controlling all cockpit devices and calculating the simulation models. It connects also the original equipment like the HMS/Ds with their specific interfaces. Graphic workstations for each display provide the symbology, the map or the sensor images. Mixer equipment combines symbology with the sensors and distributes it in the cockpit. All computers are connected via a network with the instructor station.

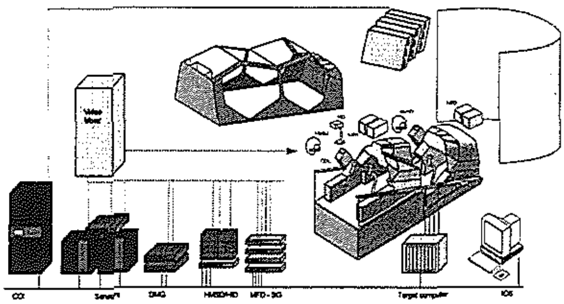

Figure 5: SimCo Architecture

Functionality

At the early stage SimCo was intended to be an MMI demonstrator showing moving symbology or principles of CDU operation. But it showed up, that such a complex system could not be defined on paper and the interdependencies have to be evaluated before rig integration or flight tests. So the TIGER autopilot was added to the flight-mechanical model to investigate its modes and performance. Basic HC systems and avionics were included to consistently animate CDU, RFI and MFD symbology. The implementation of degraded modes for the basic systems was a big issue and allowed to show reconfigurations and failure modes. After the evaluation of the basic systems SimCo was upgraded with the MEP - the sensor and weapon system - to simulate the PAH/2 and HAC TIGER versions. To fulfill the requirements for the weapon simulation, which exceed the capabilities of the used simulation facilities, it was necessary to build up the infrastructure for this demanding task. A visual system solution was needed to generate an external vision in parallel to the 3 different sensor images of the TIGER. This was solved by using commercial of the shelf components, which enables us to implement all needed functionality for the sensors, moving models and special effects.

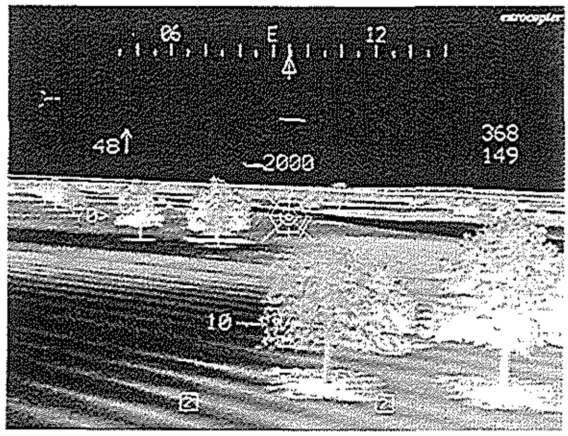

Figure 6: Sensor image

A huge database was created correlated to real terrain, which allows to fly and prepare a sortie based on existing maps. The mission equipment like sensors, target tracker and weapons was completely modelled in normal and degraded modes and allows interaction with the simulation environment. After the evaluation of single equipment, the last simulation phase covers a whole mission. Tactical scenarios were set up to have realistic conditions. A scenario could run in automatic mode or by instructor interaction, who could trigger failures or set threats. Air or ground targets had to be detected and destroyed by using the different weapon configurations. After this phase the SimCo was extended by new weapons and a digital map system to simulate the German UHT version. It enables the customer to evaluate the complex system under realistic conditions with all its interactions.

Experience

Simulation has proven to be a valuable tool in the development process. It can reduce the risk of changes in later stages of the development and allows to optimise the system and MMI definition in advance. But the use of simulation has to be carefully planned and adapted to the purpose of the investigation. Although simulation was intensively used for handling qualities or flight dynamics, the MMI simulation was new terrain. Another new subject was the high complexity of the TIGER, which makes intensive use of software-implemented functionality. In addition the customers in this binational program harmonise their idea of the common layout during the development. The plan to use the simulation as an evaluation tool for the proposed solutions therefore didn't fit these conditions. As the simulation phases were tightly coupled with development milestones and the schedule did not allow much flexibility, the goal of the simulation was hard to achieve. Means have been taken to reduce these problems. First the system know-how had to be transferred to the customer in order to have a common understanding of the functionality. As the information was spread to several documents, it was necessary to do informal meetings and produce a handbook, which summarises operation and functionality like a pilot's manual. For the last simulation phase, which covered the definition of the UHT version, the procedure was changed. Simulation was continuously involved in the development process allowing to prototype the system and eliminate problems in place. This gave also stable simulation results, while the evaluation in previous phases strongly depended on the prerequisites. So were many prior comments turned around during the mission simulation The best results were given by the last phase, the mission simulation, which is a clear confirmation, that a part-task simulation could not deliver results concerning the whole system.

On the technical side, the simulator concept proved to be right. It was wise to have an open system with nearly unlimited growth potential. Commercial of the shelf components were widely applied and when original equipment was used, it often did not give the flexibility needed for development simulation. The integration in the design process allowed e.g. to generate code out of development databases or use simulation software for symbology development.

Simulation results have been fully confirmed by flight tests and development simulation has proven to be a valuable tool for system design and integration. The experience will be applied on future projects like the NH90, where part-task simulation is already used to demonstrate systems or functional chains.

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