Training Systems for Advanced Rotorcraft- The Role of the Helicopter Manufacturer

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Abstract

This paper describes the evolution of the role of the helicopter manufacturer in the area of training systems development. The state of the art helicopters like EC135 or Tiger or NH90 comprise high level complex avionics systems to fulfil their missions. They require more extensive training of crews to ensure the mission effectiveness.

On the other hand also for helicopter simulator systems qualification standards comprising challenging requirements are under preparation to ensure a common baseline for high level training. Due to its longstanding experience in helicopter avionics system development and using the expertise from its development simulators the helicopter manufacturer is playing a more important role in the development of helicopter training systems as a partner of the simulator industry. The development of the avionics system simulation within the Tiger Aircrew Training Media project is an example, how a new co-operation between helicopter industry and simulator manufacturer could be established.

Abbreviations

ADS-33	Aeronautical Design Standard
AFCS	Automatic Flight Control System
AMC	Armament Management Computer
ASS	Avionics System Simulation (of a specific helicopter type)
BC	Bus Controller
BMS	Basic Management System
CAI	Computer Aided Instruction
CBT	Computer Based Training
CCSw	Cockpit Computer Software of the helicopter simulation
CDU	Control & Display Unit
CPDS	Central Panel Display System
DItBC	Data Item to Bus Converter SW-Module
EQSw	Equipment Software
ERASMUS	Eurocopter Rotorcraft Advanced System and Mechanic Utility Simulation
EWS	Electronic Warfare System
FAA	Federal Aviation Authority
FCDS	Flight Control Display System
FCL	Flight Crew Licensing
FMS	Flight Management System
FLIR	Forward Looking Infrared
HAP	Helicopteré Appui-Protection
HAS	Helicopter Avionics Simulation
HC	Helicopter
HID	Head in Display
HMS/D	Helmet Mounted Sight Display
HOCAS	Hands On Collective And Stick
HUD	Head Up Display
IFR	Instrument flight rules
JAA	Joint Aviation Authority
JAR	Joint Aviation Regulation
LLTV	Low Light TV
MFD	Multi Function Display
MMI	Man Machine Interface
NASS	NH90 Avionics System Simulation
NATM	NH90 Aircrew Training Media
NOE	Nap Of the Earth
NVG	Night Vision Goggles
OFRS	Operational Flight Resident SW
RTU	Remote Terminal Unit
SG	Symbol Generator
SimCo	Simulation Cockpit
TASS	Tiger Avionics Simulation Subsystem
TATM	Tiger Aircrew Training Media
TI	Thermal Infrared
UHT	Unterstützungs-Hubschrauber Tiger
VFR	Visual Flight Rules

Introduction

Helicopter operators are more and more requested to extend their mission capabilities and to perform more and more complex mission tasks with an increasing potential risk. This is true for military operations first, but also in the civil and para-military area like rescue services new missions are requested, which require all weather rescue capability and day and night operations using night vision goggles or FLIR.

The answer to these requirements is given by developing advanced rotorcraft like Tiger or NH90, which provide a lot of avionics components to fulfil the operational needs. This additional mission aids and functions increase system complexity and therefore pilots workload too. In order to reduce pilots workload extensive high level training is required to instruct the crew with the complexity of the system. Both evolutions and its influence on the work of the helicopter manufacturer will be described afterwards presenting the ECD training systems and the TATM project.

Helicopters of the 21st Century

Until the seventies rotorcraft cockpit systems were developed in a conventional way. Looking at the BO-105 Cockpit as an example, the implemented instruments indicate directly the helicopter sensor information. To get the helicopter flight state information the pilot must collect and evaluate the indicated information in his mind. Typical instruments are the artificial horizon, the magnetic indicator, barometric altimeter or airspeed indicator. All these instruments receive their data from the related sensors without any significant background signal and information processing.

Figure 1: Cockpit of the BO 105

In the early eighties the development of new attack helicopters started. A major requirement was given for these helicopters to provide improved mission functionality like visionics as helmet mounted displays and FLIR or LLTV sensors.

Figure 2: Pilot Cockpit of Tiger Helicopter

All equipment, i.e. sensors, computers, weapons, displays and cockpit controls are coupled using bus systems like Mil-Bus 1553B and ARINC429 or RS485 to realise communication. Also new equipment like digital map generators and integrated multifunction displays are developed to get additional information about the tactical environment. Also integrated display concepts and automatic route management, navigation and firing control computation were requested. As a result new sensors and main computers were established in the helicopter and cockpit instrumentation lost its direct link to the sensors.

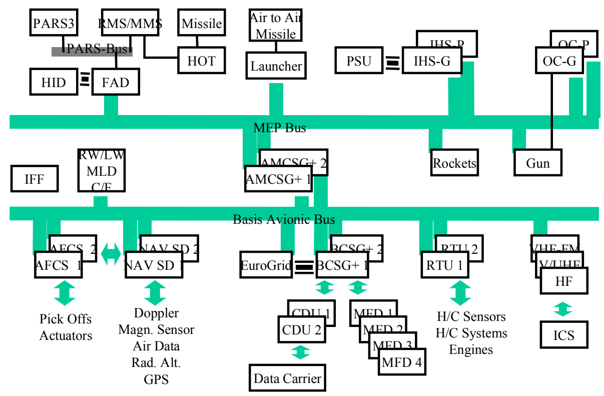

Figure 3: Principle system architecture of the Tiger Attack Helicopter

On the other hand there is a strong request of the crews to get and to use the information in different, individual ways. These requirements and the operational needs result in a new class of cockpit, which provides all the information on pilots request, but requires a lot of crew attention as well as knowledge about the systems and their background processes.

Development Simulators

In order to realise this new generation of cockpit systems simulators are built up to develop and to assess the ergonomic design of the cockpit systems and to define the functions, which have to be realised.
The Tiger SimCo is an sophisticated environment, which provides all functionality of the Tiger Basic and Weapon Avionics System including the AFCS and validated Flight Model.

Figure 4: Eurocopter Tiger SimCo Development Simulator

For the weapon system modelling also the gunner and pilot´s visionics models like FLIR, LLTV, TI as well as different weapon models are included.
Developing the Tiger avionics system and cockpit simulator Eurocopter got a longstanding detailed knowhow about the functionality and dynamic behaviour of the avionics system, and also a lot of models of the different avionics components were built.
The Tiger SimCo is not only used for development purposes. Due to its highly validated flight dynamics model, Tiger SimCo is used also for helicopter qualification activities, e.g. tail rotor loss handling, [1]. This approach is based on a close trustful co-operation with the certification authority and demonstrates a similar activity as it is established in the fixed wing community, [2].
Today Tiger SimCo is also used for training the pilot instructors of France, Germany and Australia in handling and controlling the avionics system, [3].
All this activities provided comprehensive experience in building up state of the art high quality simulators.

A similar approach was chosen for the development of the civil standard avionics system "Avionique Nouvelle", which is implemented in the EC135, 145 and 155. In this case a desktop simulation of the Central Panel Display System (CPDS) and Flight Control Display System (FCDS) was built, to develop the symbology of the displays as well as the signal and information processing behind and the control and moding.
This kind of development simulation realises the system functionality in a very cost efficient way using VAPS™ and C-software models on workstations. It also allows to assess the concepts of system reconfiguration, e.g. display fault and crew co-ordination.

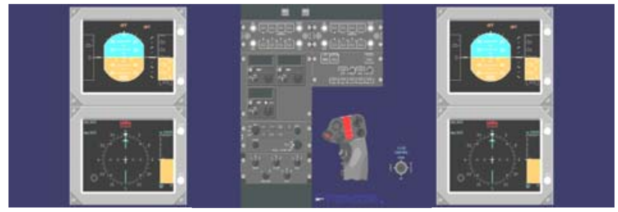

Figure 5: Avionique Nouvelle System Simulation CPDS and FCDS

Although the dynamic behaviour and time response is not exactly the same as for the real equipment it is absolutely representative in terms of displays and control and moding.

Computer Based Training Systems

Based on the Eurocopter experience in this system and considering training applications from the beginning in the system simulation, it was decided by the Eurocopter Training Center in Donauwörth to extend this system to a Computer Aided Instruction System (CAI). A CAI-System is used by an instructor to explain the functional behaviour of a system in front of a class or it is used for self studies of a single trainee.

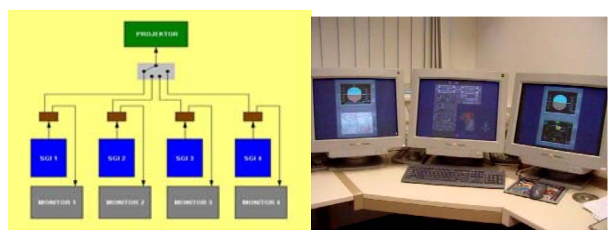

Figure 6: Eurocopter CAI Classroom Training System „ERASMUS“

For this purpose the existing simulation was extended by introducing an instructor console, which allows to configure and control the Avionique Nouvelle simulation in an appropriate way. It also provides to the instructor the ability to introduce malfunctions in order to demonstrate the behaviour of the system in such a case and to show the reconfiguration procedures. Another module was developed, called „Free Flight Scenario“, which allows dynamic system management training for IFR procedures and airport approaches. Using the free flight scenario, the instructor and the trainee can perform IFR approaches to selected airports.
The Avionique Nouvelle Cockpit Simulation is the kernel for other H/C-system simulations like the fuel system, engine system, hydraulics system or electrical system.

The training philosophy is to train first the internal behaviour of the relevant system.

Figure 7: Linked Cockpit and System Simulation

As a second step this H/C system simulation is linked to the cockpit simulation module to show to the trainees the cockpit indications and modes which are directly related to specific H/C-system states. For example the CAI allows to demonstrate the cockpit procedures during engine start up and simultaneously visualise the response of the related helicopter systems.

The training concept is to show not only the cockpit displays and modes but also to support the trainee in understanding the related system behaviour. This represents the training philosophy, which was realised by the Eurocopter Training Center in Donauwörth as part of the overall Eurocopter training concept.

This CAI-System was extended also to a Computer Based Training System (CBT), where self explanatory descriptions of a system are given. During such a lesson the trainee is also requested to perform some system control procedures by using the implemented simulation of CAI.

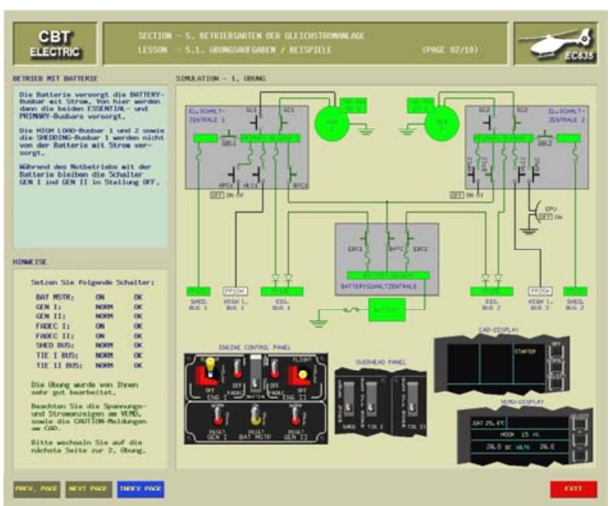

Figure 8: ERASMUS CBT-Module Electrical System

It is a typical feature of the Eurocopter CAI/CBT product line „ERASMUS“, that dynamic simulation and the transfer of system knowledge are provided in a combined way.

The development of this training system was initiated by the experience, that today helicopter cockpit systems have reached a high level of complexity and integration, which requires to train the crew and the maintenance staff to understand what is going on behind the cockpit.

Today ERASMUS is sold also to external customers and is becoming part of the basic sales of every EC135, EC145 helicopter.

Since today no certification requirements are to be considered for CAI and CBT systems, it is very cost efficient to migrate existing development simulations to such training system products.

Certification Standards for Helicopter Simulators

While rotorcraft systems of the 21st century are becoming more and more sophisticated, also the requirements for the related training simulators are increasing. Introducing the JAR-FCL 2 more formalised training requirements for flight crew licensing are set in to service. Training centres have to revise their training concepts and contents to comply with these new requirements.

On the other hand for the first time also technical requirements for certifying rotorcraft training simulators are established or under preparation.

Following the aircraft community a JAR-Std 1(H) for rotorcraft Full Flight Simulators (FFS) was established in 2001.

For Flight Training Devices (FTD) the JAR-Std 2(H) is under preparation as well as the JAR-Std 3(H) for Flight and Navigation Procedure Trainer (FNPT).

- JAR-Std-1(H) ➔ Rotorcraft Full Flight Simulator Level A-D (type specific)
- JAR-Std-2(H) ➔ Rotorcraft Flight Training Devices (type specific)
- JAR-Std-3(H) ➔ Rotorcraft Flight and Navigation Procedure Trainer Level I-III (generic)

Table 1: Rotorcraft Training Systems Certification Standards

For rotorcraft no real difference between the JAR-Std-2(H) and –3(H) seems to be reasonable, because rotorcraft systems are very type specific. As a consequence rotorcraft flight navigation procedure trainer of level II and III will be always also type specific, to get sufficient flight credits. On the other hand the efficiency of a procedure trainer is significantly increasing, if a lot of type specific features could be also trained on one device.

Especially the JAR-Std-1(H) and its equivalent the FAA AC-120/63 are becoming also applicable in the

military community. Although there are no detailed certification requirements defined for the avionics system simulation, it shall be highly representative.
To develop a representative helicopter avionics simulation is one of the common big challenges of the simulator industry and the helicopter manufacturer in the Tiger Aircrew Training Media (TATM) development project.

The TATM H/C-Avionics Simulation Development

For more than 10 years of Tiger Helicopter development Eurocopter has completely elaborated the Tiger avionics system. This experience is now introduced in to the TATM project, when Eurocopter provides the helicopter avionics simulation consisting of

- The Tiger Basic Management System
    - Basic Computer
    - Remote Terminal Unit
    - Control and Display Unit
    - MFD & Symbol Generator
    - Eurogrid
    - Navigation Sensors
    - AFCS
- The Tiger Mission Equipment Package of UHT and HAP
    - Armament Mission Computer
    - Pilot Sight Unit (UHT)
    - Elevation Slaving Unit (HAP)
    - Turreted Gun (HAP)
    - HID, HUD, HMS/D –Symbol Generators
- The Tiger flight dynamics and automatic flight control simulation
    - Flight Dynamics Model
    - AFCS
    - Engine Model
- Cockpit Panels

Table 2: Eurocopter Tiger Avionics Simulation Subsystem (TASS)

The three avionics simulation subsystems and the panels will be delivered as one pre-integrated subsystem together with the cockpit control panels.
Looking at the requirements to be fulfilled by TASS a very close link between the helicopter development and the simulator requirements definition is becoming obvious.
The TASS system specification summarises requirements derived from

- The training needs
- The operational needs
- The Tiger system performances
- The simulator requirements incl. malfunctions and specific functions, e.g. freeze, replay
- The simulator certification requirements

Table 3: TASS system requirements

On system level the operational and functional requirements allocated to the helicopter are related to TASS. From training point of view the training objectives and the simulator requirements have to be considered.
On model level the equipment related requirements called „allocated baseline" of the helicopter are also part of the requirements set of a single model.
Because the simulator certification standards JAR-Std-1(H) and FAA AC-120/63 refer most to the flight dynamics representation of the helicopter, the avionics system simulation representation is based on the functional requirements of the real helicopter.

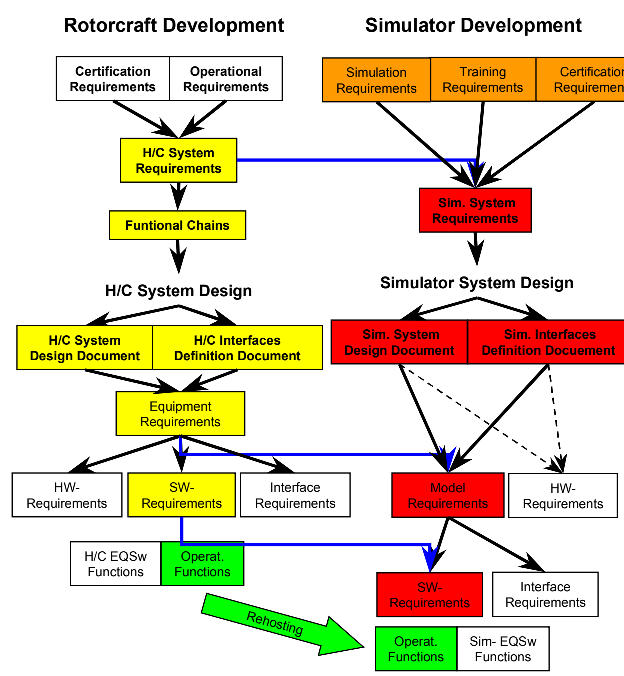

Figure 9: Requirements Tracability Flow

Comparing the system development and engineering approach for the rotorcraft and the simulator, it is obvious, that they follow in principle the same rules. Also a strong correlation between both development processes is visible on system level and equipment/model level. It is important to note, that

during simulator development simulator system requirements and rotorcraft system requirements must be taken in to account.
On equipment/model level two other aspects have to be addressed. First a software simulation model of an equipment contains descriptions of hardware functions as well as software functions. It also contains hardware interface functions described as software models.
As a consequence the separation of hardware and software development occurs one level above compared to the helicopter system development. And the separation is related to the simulator hardware environment. A software model describes hardware and software functions coincident, while its interfaces refer to the simulator hardware in terms of e.g. memory size or speed and refers the simulator software architecture in terms of e.g. data flow.

Avionics System Simulation Design Approach

The design approach of TASS is driven by ensuring a high level of system representation and reusing most of the existing knowhow and hard- and software components developed for the helicopter. This philosophy is captured by the „Rehosting Approach“.
Rehosting is understood as using existing software modules of embedded software or simulation models used for the development purposes and to implement these modules in to a training simulator architecture.
The Rehosting Approach provides some advantages compared to the classical re-engineering philosophy. First approximately 80% of the operational flight resident software (OFRS) can be reused for simulation purposes too. As a logical consequence a high level of representativity can be achieved easily. Also the same qualified development tools can be used for software development, which supports the level of quality. At last software maintenance and configuration control of the helicopter and the simulation models can be performed in a more efficient way, which is also a clear benefit for the customer.
This approach is realised for the Tiger main computers BC and AMC as well as for the Eurogrid digital map simulation and symbol generator models.
As shown in figure Figure 10, the rehosting approach allows to reuse all operational functions software modules also for the training simulation environment.

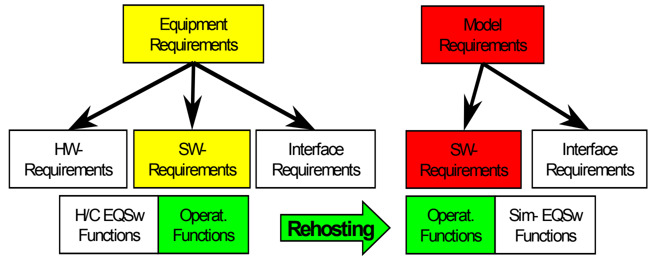

Figure 10: Rehosting - Migration of Embedded Software to Simulation

It is also obvious, that the equipment software (EQSw) must be replaced by new modules in the simulation. Referring to the MilBus and ARINC based Tiger Avionics System also this data flow and communication baseline is completely different in the simulator. On the other hand its is necessary for the simulation development to realise the same data structures as in the real system, if parts of the embedded software are used. The principle data flow architecture of TASS is given in the following figure.

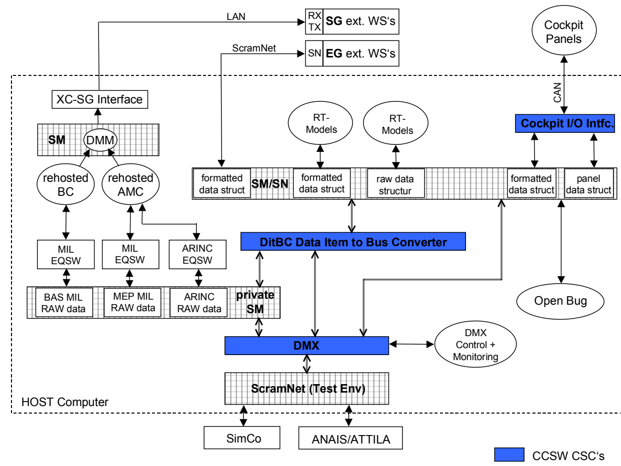

Figure 11: TATM Data Flow Modelling based on SimEQSw MilBus Control and CCSw

In TASS the EQSw comprises the Milbus1553B controller simulation in terms of time triggering and MilBus frames adressing. The communication itself is realised by a model called cockpit computer software (CCSw), which provides all data flow and exchange structures.
The MilBus frames generated by the BC and AMC main computers or the related RTUs as well as ARINC429 bus data are taken by the Data Item to Bus Converter (DItBC) Module of the CCSw. The DItBC transfers these data in formatted and raw structures to the shared memory of the simulation host computer and vice versa. The shared memory realised as SCRAMNet is the hardware and data flow interface to the simulation host computer provided by the simulator industry, i.e. THALES and STN Atlas Elektronik.

The Integration, Test & Validation Concept

The Integration, Test & Validation concept is based on the question, how to verify the representative behaviour and functionality of TASS. For this purpose an analogous approach derived from the helicopter development has been chosen. Applying the relevant requirements and test procedures of the helicopter qualification & test plan (QT-plan) and using also the qualified test tools (ATTILA, ANAIS) as well as SimCo for TASS a verification and validation of the avionics simulation can be performed.

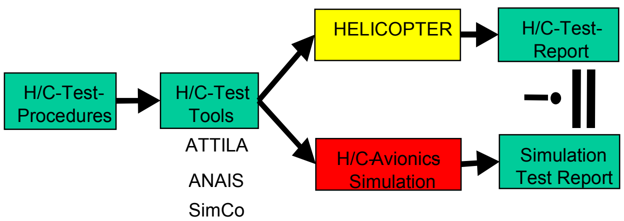

Figure 12: Verfication and Validation Concept for Avionics System Simulation

The verification of functionality is achieved when the avionics simulation test reports describe the same results as the helicopter/rig test reports, see Figure 12. The verification of the avionics systems can demonstrate the right reaction of the avionics components on dedicated control inputs induced by other components of the simulation.
The validation of the simulation system shall demonstrate, that inputs result in the same parameter values and show a very similar time response as the real aircraft. Also for the validation test procedures of the real helicopter will apply as much as possible.

Following the verification and validation approach the test concept is developed in a similar way. The helicopter and simulation functionality of a single model will be tested first on model level stimulating the different input and output parameter. As a result a functional verification of the internal model functions will be received according to the helicopter equipment functions. Baseline for this kind of tests are the equipment test procedures, except those who are related to the interfaces. In addition on this model test level also the simulation specific functions will be tested to verify the correct behaviour.
A specific situation on this level is given for the cockpit computer software, which represents mainly the data flow management of TASS. Because this software is a complete new development without any reference to the helicopter, a new test procedure and test description have to be developed. The CCSw will be tested on a functional basis. No timing performance can be test on that level.

The second level tests are dedicated to the TASS subsystem level, i.e.

- Tiger Basic Management System,
- Tiger Mission Equipment Package UHT/HAC and HAP,
- Tiger Flight Dynamics and AFCS.
- Cockpit panels

The requirements baseline for the level test is given by the Tiger functional chains for the BMS and MEP, which describe the functional and performance requirements on subsystem level. At this level a specific situation is given for the AFCS and the navigation sensor models. Because these models are linked to the BMS as well as to the MEP and the Flight Loop, they have to be incorporated in to all three subsystems for testing. With this kind of test the interactions and the data flow between the subsystem related models will be verified. As an example, within the TATM project the Tiger Basic Management System simulated by Eurocopter comprises the BC, SG, Eurogrid, Navigation, AFCS and as a new model the CCSw representing the different bus systems. Additionally the correct data flow between the cockpit panels, which are linked to the models through the CCSw will be verified for those control inputs, which are related to the BMS models. A validation of the correct dynamic behaviour of the interactions between the models will be performed at the first time, which includes especially a validation of the CCSw behaviour and the MilBus simulation within the simulation equipment software. Because the bus systems simulation is different to the real helicopter the last objective is of high importance.

At last the overall TASS will be tested according to those requirements, which are related to the overall helicopter avionics system. This level of testing will especially address the data flow between the BMS and the MEP. It will also perform tests to verify the correct interactions of all models and also all control panels of TASS. In addition the dynamic responses between models of different subsystems will be validated. It is important, that at this stage also the flight loop model is integrated in to TASS to validate the correct responses between control inputs of the pilot, necessary calculations of the AFCS, correct response of the flight dynamics and the navigation sensors. Finally the right data processing and control command generation of the BC for the symbol generator and at last the right display on the MFD must be proven. Although Eurocopter is not in charge of the final validation and qualification, which is under responsibility of THALES and STN-Atlas, it is important to demonstrate the correct representation of the integrated helicopter avionics simulation on system level.

For performing the test logic described before, Eurocopter will use the SW-test-benches of the helicopter for testing the rehosted models on model level.
Because Eurocopter will not provide the overall helicopter simulation and also some avionics models like EWS are missing, the helicopter manufacturer can not verify and validate requirements, which need inputs from these models, e.g. electrical system, hydraulics. In order to demonstrate the representative functionality, but not to validate dynamic behaviour, Eurocopter will use its development Tiger simulator SimCo for subsystem and system tests, which affords the missing models from functional point of view.

Following the test concept, the integration logic is based on setting up the simulated subsystems, i.e. BMS, MEP(UHT and HAP) and Flight Dynamics simulation.

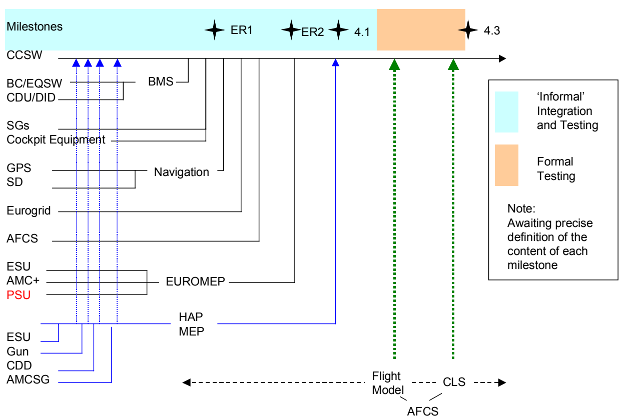

Figure 13: TASS integration concept

Within the first integration step all subsystems will be integrated and tested. Having this integration level passed successfully the BMS and the flight dynamics simulation will be linked. The final integration step will link together the BMS and Flight Dynamics simulation and the MEP simulations for UHT and HAP.

At the end of this development process Eurocopter will deliver a pre-integrated H/C avionics simulation subsystem for further integration in to the Tiger Aircrew Training Media Systems at THALES and STN-Atlas.

Some lessons learned

The Tiger Aircrew Training Media (TATM) project is one of the first projects, where simulator manufacturer and helicopter industry work together on a new basis. While formerly the helicopter industry has provided only data packages containing descriptions, drawings and sometimes flight test data, the contents of the data package has changed significantly today, due to the high complexity of the state of the art avionics systems. Today and in the future too, the helicopter industry will provide a "helicopter package" comprising a reduced set of the classical data package and an helicopter avionics system simulation (ASS). The next projects, which will follow this approach will be the development of the ARH Aircrew Training Media for the Australian Army and the development of the NH90 Aircrew Training Media (NATM).
The recent experiences from using the Tiger SimCo for development, qualification and training purposes and being a co-operative partner in training systems development to the simulator manufacturer have shown some lessons learned which should be applied in the future:
First the helicopter industry should consider the development of helicopters and simulation systems for development and training as two simultaneous processes, where the simulation requirements will affect also the helicopter system design especially in the software development.

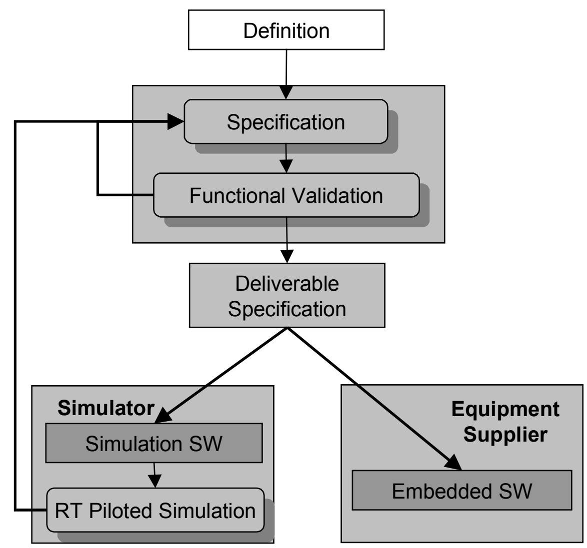

Figure 14: Avionics systems software development approach for helicopters and simulators, [8]

As described above at Eurocopter flight control and display symbology software will be developed from one source to be provided to the embedded system as well as to the development simulator. This logic needs to be extended to training specific functions like, freeze, replay, repositioning, which should be implemented from the beginning in to the software. This requirement will cause new discussions with the certification authorities about the certification of embedded software, where not all functions will be used in flight. However such an approach is necessary to make helicopter and simulator system development more efficient from economical and configuration management point of view.
On the other hand developing models for building up new development simulators in the future should take

in to account a more structured and qualified software development approach and training specific features, in order to adapt the existing software also for training simulators.
This will also improve the training capabilities of the development simulators to a certain extent. Development simulators will not replace certified training simulators but could be an efficient baseline for training systems development.
Therefore, certification requirements should be thought about also, when models will be developed for a development simulation system.
However, such an approach will cause earlier considerations about building up development simulators, and it will increase cost during the development phase of a new helicopter.
The return of this investment will be a more efficient training system development, where the helicopter industry will participate to a bigger extent. There is also a higher probability, that the adequate training media will be available right in time, when a new helicopter enters the market. The customer can train his staff earlier, which increases flight safety and mission effectiveness, and at last customer satisfaction.
Taking in to account the simulators at an earlier stage will not only affect the software development, but also industry flight test needs to be prepared. For the development of certified training systems a high quality flight test data are required. In the past a lot of additional and expensive flight test were needed to gather those high quality data, necessary to build accurate helicopter systems and flight models. Even today additional validation flight test data are needed, which must be different from the development data.
The additional cost of these flight tests can be reduced to a certain amount, if the prototype flight tests provide adequate and additional data also for simulator development. To reach this goal, the accuracy of the flight test equipment should be based on the simulator data quality requirements. It is also recommended to install a defined flight test measurement equipment on one prototype permanently. Following this approach the prototype could become a reference helicopter at an early stage, which is important for the simulator development and certification. At last validation data for the training simulator could be received from the handling qualities assessment flight tests based on ADS-33 or similar. This approach provides separate flight test data for dedicated mission tasks and control responses on single and all axes. Regarding the flight test data a return of investment could be expected by the helicopter industry, when it will provide the flight loop models of its helicopters also for training systems. Additional return of investment could be achieved, if the prototype flight tests are used more efficiently, instead of performing additional simulator related flight test later on.

A New Relation between Simulator Manufacturer and Helicopter Industry

Due to the high complexity of state of the art and future helicopters and the more challenging quality and training requirements of the associated training systems the responsibility of the helicopter industry for training systems will increase in the same way as it is observed in the fixed wing community, [4], [5]. Also the simulator manufacturer are facing new challenging requirements to realise sophisticated training systems. While the simulator manufacturer will stay as the simulator system integrator, the helicopter industry will be in charge of providing high quality helicopter avionics simulations to support simulator industry in developing high quality training systems for complex rotorcraft. This approach will reduce the simulator manufacturers risk to provide a representative simulation of a complex helicopter he has no long lasting knowledge about. The simulator manufacturer will increase his activities and competence in the areas of environment and complex dynamic mission simulations including battlefield simulation. Networked simulation will also become a big issue for the simulator manufacturer as well as further improvements of the vision systems and helmet mounted vision aids simulation.

Summary

State of the art and future rotorcraft contain highly integrated avionics systems, which the helicopter industry is developing and integrating. Due to this activities the helicopter industry has a long standing experience about these systems, which is difficult to catch up. Therefore the helicopter manufacturer will become an important partner to the simulator manufacturer in providing high quality training systems.
Development simulation at helicopter industry´s side follow this high level of complexity and sophistication.
Development simulations will be therefore a good baseline to become or to derive simplified training systems without giving credits like procedure trainers or CBT/CAI.
High level certification requirements will be established to provide high quality training systems for helicopters.
The Tiger Aircrew Training Media project is one of the first projects, where helicopter industry is in charge of the avionics system simulation.
In order to realise highly representative models an analogue approach of integration, testing and verification like in the Tiger helicopter development is chosen for the Tiger avionics system simulation.
It is obvious, that helicopter development and training simulator development are closely linked and should be considered as parallel developments in the future.

Rehosting of embedded software and adapting development models are efficient approaches to provide representative avionics models in an efficient way.
In the future simulator requirements should be taken in to account by the helicopter industry for software development and flight testing from the beginning of a new helicopter development.
A new quality of co-operation between simulator manufacturer and helicopter industry will be established, with shared responsibilities.

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