THE NEW TORNADO MISSION SUPPORT SYSTEM IN THE CONTEXT OF NETWORK CENTRIC OPERATIONS

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1. OVERVIEW

The successful accomplishment of task orders within modern air operations depends increasingly upon effective mission planning tools.

Mission preparation will be facilitated by information systems which support the crew to plan the tasked mission. Core requirements for such systems are:

- Effective data provision
- Mission oriented provision of data
- Minimising of the time critical mission planning phase
- Human machine interface, directly related to the operational processes

Within the Tornado Operational Ground Support System (TOGSS) a Mission Support System (MSS) has been developed by EADS Military Air Systems.

Designed in cooperation with pilots and weapon system officers of the German Air Force, it provides essential information, required for tactical / operational planning as well as to perform the mission. Additionally a data reduction process provide the capability to the user to filter mission relevant information for further processing.

The Tornado MSS optimally supports the complete mission cycle, pre-mission, in-flight and post- mission activities.

An interface to the C3I system of the German Air Force is implemented into the MSS. This provides the capability to the operator to access to the common information grid and therefore the prerequisite is established to support the future concept of network centric operations.

2. WHAT IS MISSION PLANNING?

There are many differente definitions about the term “Mission Planning' depending upon the objective of what is to be planned, the users, operational level and so forth. Herein the following definition is used:

Operational aspect: The process on unit (squadron) level to transform the task order received from a higher command level into an executable mission by one or more aircrafts, in conjunction with other participants, taking suplementary information, provided by other agencies, into consideration. Note: post flight activities to evaluate the mission results and to report them to the tasking agency are included.

Technical aspect: A system with implemented features to support the user to perform the operational mission planning task as defined above.

Flexible and process based access to mission planning functions including data synchronisation.

Complete data management for the import, processing and preparation and maintenance of date required to support the mission.

Use of an integarted Geographical Information System (GIS) with flexible features for route- reconnaissance and attack planning.

Perform flight performance calculation.

Provide the communication with the national command centre or other agencies.

Figure 1 shows the operational view of mission planning in accordance with the given definition.

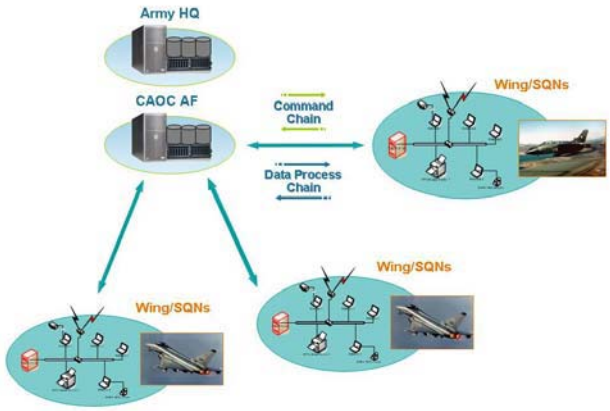

FIG 1. Mission Planning on Squadron Level

Figure 2 shows our vision of mission planning embedded into a network centric scenario.

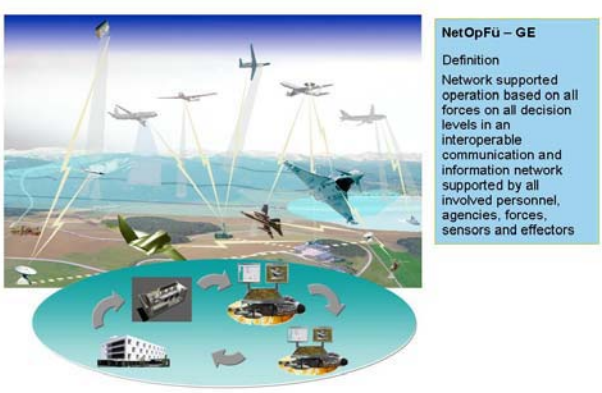

FIG 2. Mission Planning within NCW

3. MISSION PLANNING CONCEPT

The hardware configuration of the MSS in the dual display version is shown in figure 3.

FIG 3. Dual Display Configuration of the MSS

When a task order is received by the squadron, action will be taken to transform it into a mission plan using all information required and available to prepare it. After the mission has been executed by the aircrews the information gained during the mission will be analysed for de-briefing purposes and to prepare the mission report, which is provided to the tasking agency. The complete process from tasking to the submission of the final mission report is a cyclic process because it might have an influence on the tactical situation and could initiate a new task which is a reaction on the changed situation. Hence, this mission planning including the execution of the mission can be described as mission cycle. This mission cycle is shown graphically in figure 4

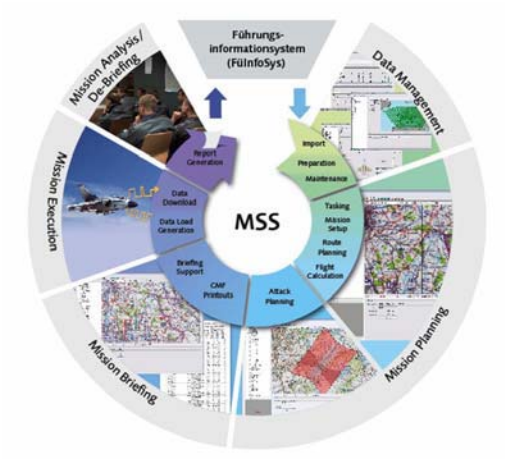

FIG 4. Mission Cycle

Making use of state of the art IT technology the Tornado MSS is designed to supports the phases data management, mission planning, mission briefing, mission execution, mission evaluation, mission analysis and de-briefing, which constitute the complete mission cycle. In the subsequent paragraphs the phase of the mission cycle are described.

3.1. Data Management

In this phase of the mission cycle the task order is received from the head quarter, which is connected to the MSS via the Command and Control Information System.

After it has been analysed all available information, required to perform the mission is collected from the data base and provided to the air crew to plan the detailed execution of the mission. This information include

- Aeronautical information
- Structure of the airspace
- Weather information and
- Threat information

Beside these task related functions Data Management provides the capability to the user to maintain the stored data.

3.2. Mission Planning

Mission Planning is performed by the air crew. The Task Order information which includes information about goals of the mission conditions to be taken into consideration as well as information about cooperative systems (like tankers involved) is used as basis for the preparation of the detailed mission plan. Supplementary information, provided by Data management are used too.

The mission planning process starts with the mission set-up to define the overall operational frame of the mission like definition of the take-off, landing and alternate places, definition of the target area including the target itself, preparation of the mission specific equipment and possible external load configuration. This is the precondition to planning of the take-off and landing procedure.

Finally the route to the target area and back to the landing place is defined.

Specific planning features are provided to the air crew to plan role, attack, and weapon specific mission manoeuvres in the target area. As an example Figure 5 shows a reconnaissance mission with sensor coverage as overlay on a map.

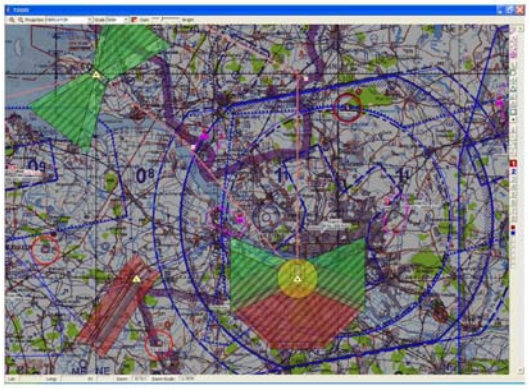

FIG 5. Reconnaissance Mission

As far as the MSS mainly supports planning of tactical missions in an hostile scenario, planning feature to analyse different types of threats and to recommend minimum risk routes to the air crew are provided. Figure 6 shows threats as red cycles as overlay on a map and an optimised route to minimise risk for the crew and the aircraft.

FIG 6. Threat Analysis

Flight and take-off performance calculation is a continuously ongoing process during mission planning, based on the mathematical model of the aircraft and the basic performance data. Taking furthermore weather conditions, configuration load of the aircraft and flight manoeuvres into consideration, the required fuel consumption will be estimated.

Rehearsal is a method to simulate the overall planned mission in advance in order check operational aspects to be considered like safety items, consistency and feasibility. The mission can be rehearsed in 2 or 3-dimentional view and different speeds.

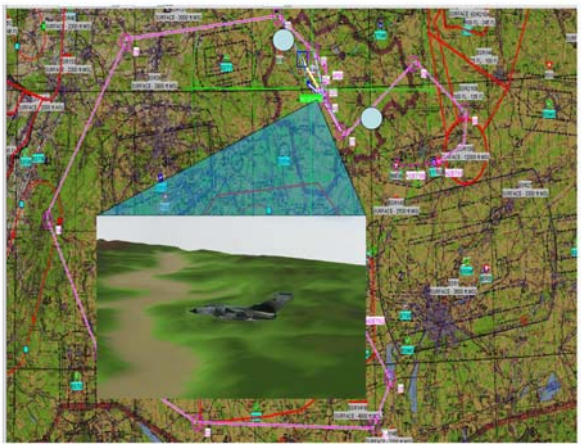

FIG 7. 3-D Mission Rehearsal

After mission preparation and before the mission will be executed, briefing takes place. During briefing the crew and other mission experts involved in the mission are informed about mission requirements and special aspect which have to be taken into consideration. The briefing document will be generated automatically during the planning process.

FIG 8. Briefing/De-Briefing Room

The Mission documentation like take-off log, flight log, sensor log and mission specific maps will also be generated automatically. Mission data used to control the avionic system of the aircraft are stored on data carrier to be uploaded into the aircraft system.

3.3. Mission Execution

The mission is executed in accordance to the mission plan, except unexpected events force the crew to deviate from the plan.

3.4. Post Flight Activities

After landing de-briefing and mission analysis take place. Mission specific data, recorded during flight will be displayed on ground. They are used during de-briefing for training purposes and lesson learned. In addition a Mission Report (MISREP) is prepared. In case of a reconnaissance mission the sensor data are evaluated within a dedicated Aerial Imagery Exploitation Station and a Recce Exploitation Report is prepared. Both, MISREP or RecceExRep are sent to the tasking agency. By this the initially mentioned mission cycle is closed.

3.5. Network Configuration of the MSS

The MSS supports different tasks allocated within the mission cycle to different cervices and responsible persons involved. The overall process require cooperation between these services. On the other hand the mission support will not only be limited to the main operation base but also at a deployment base under limited infrastructure conditions. Therefore different configurations of the MSS might be used for mission support. Figure 9 shows the network configuration which provides the capability for cooperative work between different functions allocated to different workstations. The dual display configration is shown in figure 3.

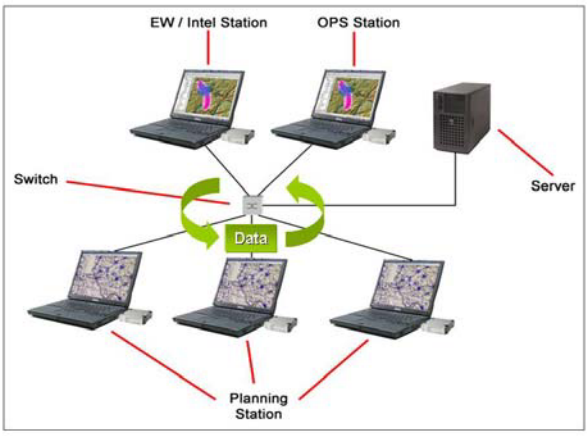

FIG 9. Network Configuration of the MSS

4. SOLUTION SPACE FOR NETWORK CENTRIC OPERATIONS

German MoD (Verteidigungspolitische Richtlinien 2003) defines ‘transformation’ as an enclosing principle to enhance the military forces to future requirements. Until now improvement projects have been performed with a well defined state of performance at the end. In contrast to that transformation designates a continuously on going adaptation process in order to maintain and improve the capabilities of the armed forces. It includes the adaptation of the capabilities to changed security situation and new military demands as well as the application of new technical innovations, improved integration, networking and synergy effects. Transformation includes as basic elements the concentration on most probable military operations, common international operations and the capability for network centric operations (NetOpFü).

In the subsequent paragraphs the concept of NCW is briefly described and the relation to the existing situation is highlighted. The aim is to identify new operational requirements, missing technical elements or procedures, required to support or realize the concept of NCW. It is assumed that NCW is not a well specified concept of operation with a complementary well defined way to reach it, but an aim which is approximated be a large number of single project steps at different sites. Furthermore it is assumed, that this transformation is not only a technical and procedural project, but needs a conversation in mind of the users too.

4.1. Definition of NetOpFü

Definition of NetOpFü in accordance with ‘Konzeption der Bundeswehr’:

Within NetOpFü command and control of military forces is based on an interoperable information network of relevant persons, agencies, units and facilities being common to all forces and command levels as well as sensors and actors. (Sensors may be radar, cameras, RECCE systems, actors may be weapons, weapon systems, or jammer.)

4.2. Basic Concept of NetOpFü

Essential ideas of NetOpFü are base on US publications concerning ‘Network Centric Warfare’. A common picture of the battlefield and a common understanding of the military situation is generated by comprehending networking of reconnaissance, command and operation, leading to an advantage in handling and combat. This means, that a lot more information and options to handle are available at all command levels. Providing an actual overview about the participating forces, time consuming reports about position and status as well as extensive explanations can significantly be reduced. The essential elements of the network are established by sensors (i.e. RECCE systems), command agencies and executing systems (i.e. weapon systems). But not until they are integrated into a network can NCW take place. This concept provides the capability to react effectively and with better use of available resources on the new military challenges.

The following figure 10 illustrates the benefit of efficiency, by relating the important NCW elements.

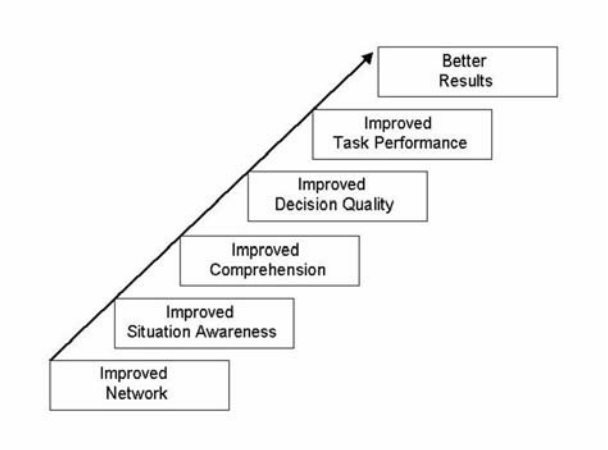

FIG 10. Expected NetOpFü Benefits

4.3. Common Relevant Operational Picture (CROP)

A central element inside NCW is the improved comprehension of the actual military situation (order of battle). On one hand it is based on a common operational picture, on the other hand on user- and command level specific presentation of the information available inside the space of operation. The term 'relevant' means that the information might depend upon the actual role and task. This is provided by the generation of a global information space (or grid) (GIG) in which the involved elements are integrated in a net. The net is integrating the agencies involved and makes the information available were ever it is required.

4.4. Features of NetOpFü

In accordance with 'Konzeption der Bundeswehr' NetOpFü provides the following operational capabilities:

- Fast and continuous reconnaissance of the order of battle in order to generate a common picture of the military situation
- Verification of possible military activities and use of the results for the assessment of the situation
- Distribution of the order of battle and the tasking information
- Continuous control of the status of the task orders
- Transformation of information superiority into command and control superiority
- Transformation of command and control superiority into combat superiority in cooperation with participating forces
- Avoidance of unintentional loss of own forces and non-involved parties by friendly fire using the common picture of the situation

The aim of NetOpFü is to perform military operations successfully, i.e. fast, flexible and precise by using a minimum amount of resources.

As a summary the following requirement can be derived:

- Improvement of the agility of the forces
- Improvement of the command and control capability by improvement of the information with respect to quality and quantity
- Improvement of the harmonisation of acting forces (synchronisation)
- Better use of resources
- Improvement of cooperation by improved interoperability

4.5. The MMS in the Context of NCW Operations

An important step towards more flexibility, which means the capability to react on unexpected events, is the qualitative and quantitative improvement of the integration of actors in these scenarios. The idea is to enable all participants to exchange information via a common network. The capability is provided to each actor within the network to access to the operational capabilities of the other participants, if this is required. Due to the fact, that a large number of functional capabilities are available, it is possible to react fast and adequate on unexpected situations. The main difference to the 'integrated systems' is the common network, which provides the capability, to define cooperating weapon systems with adequate functional capabilities similar to a user group.

The establishment of the GAF CCIS as common network for the involved players within the operational scenario is a first and important step towards the concept of NCW operations. The configuration of this network is shown in Figure 11.

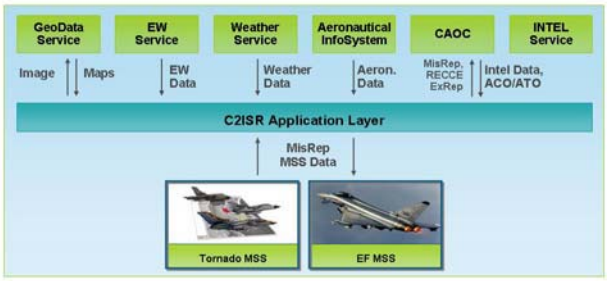

FIG 11. Interface to the National CCIS

The CCIR network is under national authority and provides services to the participants involved in common military operations.

5. SUMMARY

Using state of the art technology, a powerful tool has been developed by EADS Military Air Systems to supprt all phases during the mission cycle of combat aircrafts. This Mission Support System is embeddet into the national command and contro information system and provides the capability to support the concept of networc centric operations.