

# Status Report for HFM-078/RTG-17 Uninhabited Military Vehicles: Human Factor Issues in Augmenting the Force

**Dr. John M. Reising**  
Technical Adviser  
Warfighter Interface Division  
Human Effectiveness Directorate  
Wright-Patterson Air Force Base, OH 45433  
USA

## ***ABSTRACT***

*HFM-078/RTG-17 will complete its term at the end of 2005. Its objective is to look at human operator issues involved with uninhabited military vehicles. After some initial meetings, a crucial symposium in Leiden, Netherlands was held to frame the issues to be addressed by the TG. The results of the symposium led to the following five key issues which form basis of discussion in the final technical report: 1-Theoretical Frameworks, 2-System of Systems, 3-Cooperative Automation and Computational Intelligence, 4-Controls and Displays, and 5-Human-Automation Integration. The capstone symposium will be held in Biarritz, France in 2006.*

## **1.0 EXPLORATORY TEAM**

Initial organizational meetings were held in Amersfort, Netherlands and in Baltimore US. Following these meetings, the exploratory team prepared a proposal to form a task group. Selected subsections of the terms of reference for this task group are shown below.

## **2.0 TERMS OF REFERENCE (TOR) OBJECTIVES**

The Task Group (TG) will seek to augment the force using uninhabited military vehicles (UMV's) by leveraging the potential advantages of UMV's to act as force multipliers. Force multiplication can be achieved by addressing the issues and challenges shown below:

- Collaborative Work – Optimal Task Distribution.
- Virtual team performance.
- Manned/Unmanned collaboration.
- Interoperability.
- Flexible level of automation.
- Optimization of operator/vehicle ratio.
- Control Stations – Intelligent Operator Support.
- Operator functional state assessment.

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- Intelligent adaptive interfaces.
- Cognitive cooperation.
- Knowledge management systems.

In order to achieve the overall goals of the TG, the following specific goals and topics were listed as part of the TOR:

- **Hold a workshop** on UMV-human operator issues to identify the knowledge gaps and key thrusts of the TG.
- **Develop understanding** of the key thrusts for achieving force multiplication.
- Disseminate and **publish workshop findings** and results.
- **Develop a framework and model** for optimizing force multiplication through UMV operator interaction.
- **Hold the capstone symposium** at the conclusion of the TG's activities.
- **Collate research** relevant to the area and scope of the TG **in a report**.

After NATO/RTO approval of the TOR, the TG was formed. Seven countries agreed to participate: Canada, France, Germany, Netherlands, Sweden, United Kingdom (UK) and United States (US). The initial meeting of the TG was held in the Salisbury, UK where the purpose and action plan for TG 17 was discussed in detail. At that meeting, a decision was made to hold a symposium which would solidify relevant issues the processes used to solve them.

### **3.0 TASK GROUP PROGRESS**

#### **TOR Objective 1 – Hold a Workshop**

This first task was accomplished by holding a symposium in Leiden, Netherlands. The Executive Summary of the Leiden Symposium is shown below.

The Workshop on Uninhabited Military Vehicles (UMVs) – Human Factors of Augmenting the Force has been sponsored by the NATO RTO Human Factors and Medical Panel 078/TG 017 and held in Leiden, Netherlands from 10-13 June 2003. The workshop was attended by over 40 practitioners, researchers and subject matter experts from 7 NATO countries.

The purpose of this workshop was, generally, to review the state of the art, of research and of anticipated and needed improvements in human interaction with and control of UMVs. Specifically, the objective was to provide guidance and directions to RTO Task Group HFM-078/TG-017 in the structuring, content and preparation of their eventual report on this topic.

The workshop was structured around three separate activities: (1) presentations from participants with operational experience in human interaction with and control of UMV's, including those participating in ongoing UMV development and procurement programs, (2) presentations from participants in the research community with valuable insights and/or experience with technologies or developmental approaches pertinent to the topic, and (3) extensive interaction between workshop participants in five theme areas to

discuss and arrive at recommendations for the future structure and content of sections of the working groups final report.

Six presentations were made by subject matter experts from the operational community:

- Air Commodore Jouke Eikelboom of the Royal Netherlands Air Force. Commander Eikelboom reported on a joint UAV requirements definition effort between the Netherlands and France and stressed the importance of human control of UMVs by means of setting and manipulation effective Rules of Engagement (ROEs).
- Captain Armand Goossens, also of the Royal Netherlands Air Force provided more detail on the joint French/Netherlands UAV requirements definition and feasibility study effort, a Medium Altitude, Long Endurance UAV for use in intelligence, surveillance and reconnaissance efforts in the 2009 time frame with an operational concept described as “completely autonomous with human override” capability.
- Cpt. Matthew Esker of the U.S. Air Force reported on workload projections for operators attempting to control multiple UAVs based on current experiences with the Global Hawk.
- Lt. Commander Graham Carver of the Royal Navy, UK presented operational experience in undersea unmanned vehicles (UUUVs), specifically, the UK’s Gambit UUUV program.
- Ms. Micki Heath UK consultant, reported on an ongoing work in UMVs for land operations and the unique difficulties not only in developing working unmanned ground vehicles, but also in gaining user acceptance for them.
- Mr. John Box of the U.S. Air Force Airborne Reconnaissance Division presented lessons learned from his many years of working on the Predator program, stressing the need for easier, more flexible, modification for the UMV and its control methodology.

Common themes from these presentations were the need for the operator to remain in control and be aware of the UMV, the need for better support tools, displays and interaction modalities to accomplish the task and better visibility, better access to diagnostic information and plans, and better communication methods.

Four presentations were made by members of the research community:

- Dr. Christopher Miller described previous and ongoing work on what he termed delegation Architectures – that is, methods by which the human operator might provide tasking instructions to automation including UMVs in a manner similar to the way a supervisor can instruct a knowledgeable subordinate via a variety of styles and levels of detail. Two specific architectures, Playbook and Policy, were described in depth.
- Professor Eric Hollnagel urged a rethinking of the traditional analytic framework for human-Automation interaction, levels of automation, in favor of an alternate framework that stresses appropriate and interaction layers of control matched to the requisite variety of control input requirements for different subsystems. He provided a template, called the Extended Control Model (ECOM), for representing and analyzing these layers of control.
- Dr. Bob Stone offered an extensive review of roughly three decades of work in teleportation, telepresence, and virtual reality technologies with thoughts as to their promise and pitfalls for applications to UMV control and interaction. Specific insights for UMV applications included the observation that the availability of peripheral cues (and therefore, see-through wearable) seems important and virtual reality (which implies immersive environments) seem mostly unjustified.

- Dr. Axel Schulte provided a view of human interaction with automation not so much via the Traditional notion of supervisory control wherein humans occupy the “higher” levels of control and leave the lower levels to automation, but rather of shared and variable control where either human or automation could control various functions or tasks within an overall domain at various levels.

Common themes from these presentations included the need for a rethinking, and probably an expansion of traditional “levels of control: notion in human interaction with automation and the need for mixed initiative or variable levels of control (along with truly supporting interface technology) available to the operator on an as-needed basis.

### **TOR Objective 2 – Develop Understanding of the Key Thrusts**

The bulk of the work of this meeting was performed by five separate “theme” groups who met several times to discuss issues, current and needed research, important contributors, trends and developments, etc. within their theme or topic area. These were as follows:

- *Theme 1 – Theoretical Framework.*
- *Theme 2 – Supervisory Control, Decision Systems, Concepts and Modeling.*
- *Theme 3 – Advanced UMV Operator Interfaces.*
- *Theme 4 – Application of Levels of Automation.*
- *Theme 5 – System of Systems: Teaming Issues.*

### **TOR Objective 3 – Publish Workshop Findings**

The proceedings were published by NATO/RTO in a CD (RTO- MP-111, March, 2004).

### **TOR Objectives 4 and 6 – (6) Collate Research Relevant in a Report and (4) Develop a Framework and Model**

The framework will be contained in the report which also discusses relevant research. Progress on the report is discussed on the following section.

The primary activities of TG 17 concentrate on the development of the chapters that will go into the technical report which documents the work of the TG. The outlines of the chapters were formulated during the workshop held in Leiden, Netherlands. Following the Leiden workshop, a series of meetings were held to focus technical discussion on the major, individual themes: Denver, US, (Theoretical Framework); Are, Sweden, (Controls and Displays); Québec City, Canada, (Cooperative Automation and Computational Intelligence and Human-Automation Integration); Bath, UK (Systems of Systems). Also in Bath, the overall structure and linking themes of the report were discussed in detail, revised, and finalized.

### **TOR Objective 5 – Hold the Capstone Symposium**

The Capstone Symposium will be held in Biarritz, France in 2006. Col Dr. Jean-Michel Clere is the contact point for the meeting. The Organizing Committee for the symposium has been created.