

NORTH ATLANTIC TREATY ORGANIZATION



RESEARCH AND TECHNOLOGY ORGANIZATION

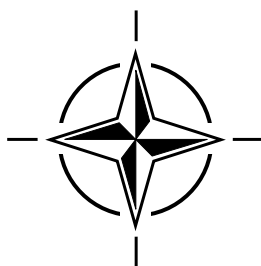
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RTO MEETING PROCEEDINGS 44

Advances in Vehicle Systems Concepts and Integration

(les Avancées en concepts systèmes pour véhicules et en intégration)

Copies of papers presented at the Systems Concepts and Integration Panel (SCI) joint symposium covering: Symposium (A) on "Aircraft Update Programmes. The Economical Alternative?" and Symposium (B) on "Warfare Automation: Procedures and Techniques for Unmanned Vehicles" held in Ankara, Turkey, 26-28 April 1999.



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The Research and Technology Organization (RTO) of NATO

RTO is the single focus in NATO for Defence Research and Technology activities. Its mission is to conduct and promote cooperative research and information exchange. The objective is to support the development and effective use of national defence research and technology and to meet the military needs of the Alliance, to maintain a technological lead, and to provide advice to NATO and national decision makers. The RTO performs its mission with the support of an extensive network of national experts. It also ensures effective coordination with other NATO bodies involved in R&T activities.

RTO reports both to the Military Committee of NATO and to the Conference of National Armament Directors. It comprises a Research and Technology Board (RTB) as the highest level of national representation and the Research and Technology Agency (RTA), a dedicated staff with its headquarters in Neuilly, near Paris, France. In order to facilitate contacts with the military users and other NATO activities, a small part of the RTA staff is located in NATO Headquarters in Brussels. The Brussels staff also coordinates RTO's cooperation with nations in Middle and Eastern Europe, to which RTO attaches particular importance especially as working together in the field of research is one of the more promising areas of initial cooperation.

The total spectrum of R&T activities is covered by 7 Panels, dealing with:

- SAS Studies, Analysis and Simulation
- SCI Systems Concepts and Integration
- SET Sensors and Electronics Technology
- IST Information Systems Technology
- AVT Applied Vehicle Technology
- HFM Human Factors and Medicine
- MSG Modelling and Simulation

These Panels are made up of national representatives as well as generally recognised 'world class' scientists. The Panels also provide a communication link to military users and other NATO bodies. RTO's scientific and technological work is carried out by Technical Teams, created for specific activities and with a specific duration. Such Technical Teams can organise workshops, symposia, field trials, lecture series and training courses. An important function of these Technical Teams is to ensure the continuity of the expert networks.

RTO builds upon earlier cooperation in defence research and technology as set-up under the Advisory Group for Aerospace Research and Development (AGARD) and the Defence Research Group (DRG). AGARD and the DRG share common roots in that they were both established at the initiative of Dr Theodore von Kármán, a leading aerospace scientist, who early on recognised the importance of scientific support for the Allied Armed Forces. RTO is capitalising on these common roots in order to provide the Alliance and the NATO nations with a strong scientific and technological basis that will guarantee a solid base for the future.

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Symposium (A)

Aircraft Update Programmes. The Economical Alternative?

(RTO MP-44)

Executive Summary

The general theme of the joint symposium held in Ankara, Turkey on 26 to 28 April 1999 was "Advances in Vehicle Systems Concepts and Integration." The Symposium (A) on "Aircraft Update Programmes, The Economical Alternative?" provided an opportunity to share NATO experience in the upgrade and update of aircraft, including rotorcraft. Focus was on three key questions: "What can and cannot be done economically?"; "What are the limitations extending useful life of aircraft?"; and "How can technological advances be integrated?". These questions were addressed from both technical and cost-effectiveness points of view at this symposium.

The symposium was structured in five sessions covering Cockpit, Sensors, Engine, Overview and Lessons Learned (Part I and Part II) and was concluded by a panel discussion. There were twenty four papers presented. Two papers addressed cockpit upgrades taking benefit of the numerous advantages of the man-machine interface and allowing optimized operational capabilities to reduce overall development costs. Six papers addressed sensors/avionics. Discussions in this session included digital terrain system, electronic warfare management, modular avionics architecture, computer symbolic generators, air-to-surface weapon delivery and multi-target air-to-air armament control.

Three papers addressed the engine upgrades which covered advanced turbine engines for helicopters and the PW150 turboprop for C-130. Thirteen papers gave overviews or addressed lessons learned covering fighters (e.g. F16 MLU), transports (e.g. Transall C-160), rotorcraft (e.g. H-1), and discussions on cost-process for deciding between a new system versus an upgrade program. One of the principal parameters on cost is aircraft commonality. Two papers and a Keynote Address on USN/USMC H-1 program highlighted the commonality of 85 percent between the AH-1Z and UH-1Y.

In summary, with regard to the symposium title, "Aircraft Update Programmes, The Economical Alternative?", the answer is a resounding YES as concluded by the panel discussion. With a new aircraft development program costing a factor of ten or more than an upgrade program, it is difficult to challenge the cost-benefit of aircraft update programmes. The shortcoming with upgrading an existing aircraft is that its useful life is extended another 20 years at most, whereas a new aircraft would usually provide double the life.

Symposium (A)

Les programmes de modernisation des aéronefs.

La solution économique ?

(RTO MP-44)

Synthèse

Le thème global du symposium qui a été organisé à Ankara, en Turquie, du 26 au 28 avril 1999 est le suivant : « Les avancées en concepts systèmes pour véhicules et en intégration ». Le symposium (A) sur « Les programmes de modernisation des aéronefs. La solution économique ? » a fourni l'occasion de partager l'expérience de l'OTAN dans le domaine des programmes d'amélioration et de modification des aéronefs, y compris les aéronefs à voilure tournante. L'accent a été mis sur trois questions: « Qu'est-ce qui est faisable dans les limites imposées par la rentabilité ? » « Quelles sont les obstacles au prolongement du cycle de vie utile des aéronefs ? » et « Comment intégrer les progrès technologiques ? ». Ces questions ont été examinées du point de vue technique et du point de vue de rentabilité.

Le symposium a été organisé en cinq sessions comprenant le poste de pilotage, les senseurs, les moteurs, un tour d'horizon et les enseignements tirés (Partie I et Partie II). Le symposium s'est terminé par des discussions sous forme de table ronde. Vingt quatre communications ont été présentées. Le sujet de l'amélioration du poste de pilotage en tirant profit des nombreux avantages offerts par les interfaces homme-machine et en réduisant les coûts globaux de développement par le biais de l'optimisation des capacités opérationnelles a été traité par deux communications. Six autres communications ont porté sur les senseurs et l'avionique. Les sujets suivants ont été discutés lors de cette session : les systèmes de suivi de terrain numériques, la gestion de la guerre électronique, l'architecture de l'électronique modulaire, les générateurs de symboles, le tir des missiles air-sol et la commande des systèmes d'armes air-air multicible.

Trois communications ont traité de l'amélioration d'un turbomoteur avancé pour hélicoptères et du turbopropulseur PW150 pour le C-130. Treize communications présentaient un tour d'horizon et des enseignements tirés concernant des avions de combat (ex : F16 MLU) des avions de transport (ex : Transall C-160) et des aéronefs à voilure tournante (ex : H-1) ainsi que des discussions sur le calcul des coûts pour permettre de décider entre l'achat d'un nouveau système et l'amélioration d'un système existant. L'identité de conception des aéronefs est l'un des principaux paramètres coûts. L'identité de 85% entre l'AH-1Z et l'UH-1Y a été mise en évidence par deux communications, ainsi que par le conférencier d'honneur dans son discours sur le programme de l'USN/USMC H-1.

En conclusion, concernant le titre du symposium, « Les programmes de modernisation des aéronefs. La solution économique ? » les discussions en fin de séance ont conclu par un OUI massif. Etant donné que les programmes de développement d'aéronefs nouveaux coûtent au moins dix fois le prix d'un programme d'amélioration, il est difficile de nier les coûts-avantages associés aux programmes d'amélioration. Le seul point faible de l'amélioration d'un avion existant est que sa vie utile est prolongée de 20 ans au plus, tandis que la vie utile d'un avion neuf est d'au moins 40 ans.

Symposium (B)

Warfare Automation: Procedures and Techniques for Unmanned Vehicles

(RTO MP-44)

Executive Summary

The general theme of the joint symposium held in Ankara, Turkey on 26 to 28 April 1999 was "Advances in Vehicle Systems Concepts and Integration". The Symposium (B) on "Warfare Automation: Procedures and Techniques for Unmanned Vehicles" provided a state-of-the-art summary on technologies used for unmanned military vehicles, their operation and their integration into mission systems and battlefield scenarios. Focus was on operational requirements for unmanned vehicles, ongoing design and development programs and experiences from laboratory testing, field experiments and real applications of unmanned vehicles.

The Symposium was structured in four sessions:

1. Operational requirements for unmanned vehicles
2. Integration aspects and mission management
3. Platform management and critical technologies
4. System concepts and mission experience.

The Symposium was concluded by a round table discussion. In total, twenty three papers were presented. Six presentations addressed operational requirements from different perspectives. Six papers described integration and mission aspects, ranging from signal processing for micro sensors to fully autonomous unmanned combat air vehicles. Five presentations addressed platform management and technology aspects. System concepts and mission experiences were discussed in six papers, covering unmanned tactical aircraft system concepts, surveillance unmanned aerial vehicles, a land vehicle and reports from field experiences with unmanned aerial vehicles (CL-289 and Predator). Round table discussions covered aspects of operational requirements, levels of autonomy and corresponding time frames, cost considerations and integration of vehicles and battlefield management.

The design studies, development programs and the field experience with unmanned vehicles (air, land and sea vehicles) provided a comprehensive picture of the requirements, capabilities and uses of such vehicles and also very useful information for future development programs. Cost and cost effectiveness aspects were discussed, but more practical experience, a much better data base and considerable analytical work will be necessary to obtain a clear picture. One other area of concern which was addressed at this symposium was the problem of the integration of unmanned vehicles into mission systems and battlefield scenarios, and their interoperability with other existing and planned "systems of systems". At this stage of the development of unmanned vehicles, the requirements for interoperability and integration probably do not yet receive sufficient attention. More work and more coordination is needed in the future in order to make sure that these systems work together properly in the NATO environment.

Symposium (B)

Automatisation du combat : procédures et technologies de véhicules sans pilote

(RTO MP-44)

Synthèse

Le thème global du symposium qui a été organisé à Ankara, en Turquie, du 26 au 28 avril 1999 est le suivant : « Les avancées en concepts systèmes pour véhicules et en intégration ». Le symposium (B) sur « Automatisation du combat : procédures et technologies de véhicules sans pilote » a fait le point de l'état actuel des connaissances dans le domaine des technologies utilisées pour la réalisation des véhicules sans pilote, de leur exploitation et de leur intégration dans les systèmes de conduite de mission et les scénarios de combat. Le symposium a mis l'accent sur les spécifications opérationnelles des véhicules sans pilote, les programmes actuels de conception et de développement et l'expérience acquise dans le domaine des essais en laboratoire, des expériences sur le terrain et du déploiement de véhicules sans pilote.

Le symposium a été organisé en quatre sessions :

1. Spécifications opérationnelles pour véhicules sans pilote
2. Aspects intégration et gestion de mission
3. Gestion de plates-formes et technologies essentielles
4. Concepts systèmes et expérience opérationnelle

Le symposium s'est terminé par une table ronde. En tout, vingt trois communications ont été présentées. Différents aspects des spécifications opérationnelles ont été traités dans six présentations. Six communications ont porté sur les aspects intégration et missions, allant du traitement du signal pour microsenseurs aux véhicules aériens sans pilote entièrement autonomes. Cinq autres présentations ont examiné la gestion des plates-formes et les aspects technologiques. Des concepts de systèmes et l'expérience opérationnelle ont été examinés dans six communications, couvrant les concepts de systèmes pour véhicules aériens tactiques sans pilote, véhicules aériens de surveillance sans pilote, un véhicule terrestre et des rapports sur des expériences sur le terrain réalisées sur des véhicules aériens sans pilote (CL-289 et Predator). Les discussions qui ont eu lieu lors de la table ronde étaient centrées sur les besoins opérationnels, les niveaux d'autonomie et les tranches de temps correspondantes, les considérations de coûts, l'intégration des véhicules et la gestion du combat.

Les études de conception, les programmes de développement et l'expérience sur le terrain avec des véhicules sans pilote (véhicules aériens, terrestres et maritimes) fournissent la description complète des spécifications, des capacités et des applications de tels véhicules, ainsi que des informations très pertinentes sur les futurs programmes de développement. Les aspects coûts et rentabilité ont été discutés, mais il faudra beaucoup plus d'expérience sur le terrain, une base de données plus complète et des travaux d'analyse considérables avant d'avoir une vue d'ensemble plus claire. Une autre préoccupation de ce symposium a été le problème de l'intégration des véhicules sans pilote dans les systèmes de conduite de mission et dans les scénarios de combat, ainsi que leur interopérabilité avec d'autres « systèmes de systèmes » existants et projetés. A l'heure actuelle, il y aurait lieu d'accorder plus d'attention au développement des véhicules sans pilote, ainsi qu'aux exigences en matière d'interopérabilité et d'intégration. Plus d'efforts et plus de coordination seront demandés à l'avenir pour assurer la synergie de ces systèmes au sein de l'OTAN.

Contents

	Page
Executive Summary (A)	iii
Synthèse (A)	iv
Executive Summary (B)	v
Synthèse (B)	vi
Theme	xi
Systems Concepts and Integration Panel	xii
Acknowledgements	xiii
	Reference
Keynote Address by M. Özsu	K1
Keynote Address by J.T. Curtis	K2
Keynote Address by U. Krogmann	K3
 Symposium (A) Aircraft Update Programmes. The Economical Alternative?	
Technical Evaluation Report by L.M. Nicolai	TA
Technology for Rotorcraft Systems Updates – The Integration Challenge by A.W. Kerr	A1†
The H-1 Upgrade Program: Affordable War Fighting Capability for the U.S. Marines by A.W. Myers and P. Davidovich	A2
F16 Mid-Life Update Program (MLU) – Maintaining Superior Operational Effectiveness by V.L. Denena	A3†
The Tornado GR4 Programme – A New Approach by T. Watkins	A4
Mirage 2000 Combat Aircraft Upgrade in Dassault Aviation Solution for NWDS System open and affordable by A. Picard and L. Madon	A5

† Paper not available at time of printing.

Tornado Upgrades – Design Criteria, Integration Concept & Experience Gained by D. Hoffmann	A6†
La modernisation des avions d’armes by G. Le Bretton	A7†
Paper A8 withdrawn	
Paper A9 withdrawn	
Aircraft Life Extension – CC130 Hercules Avionics Update by C.P. Daley	A10
Enhancing Tactical Transport Capabilities: Cockpit Evolution from G222 to C-27J by G. Evangelisti, M. Spinoni and P.F. Jones	A11
A Modern Integrated Avionics System for the Next Generation U.S.M.C. Attack and Utility Helicopters by J.A. Dowell and R.C. Wade	A12
Strategy for Long-Term Systems and Technology Advancement by E.C. Vaught and L.B. Giles	A13
Integration of Defensive Aids by P.M. Zanker	A14
Modular Avionics Upgrade: The Cost Effective Solution to Adapt Existing Fighters to the Operational Requirements of Today’s Battlefield by C. Dedieu and E. Loffler	A15
Laser Designation Pod on the Italian Air Force AM-X Aircraft: a Prototype Integration by P. Donzelli and R. Marozza	A16
Paper A17 withdrawn	
Achieving Helicopter Modernization with Advanced Technology Turbine Engines by F.W. Dickens and T. Thomason	A18
C-130 and P-3 Propulsion System Upgrade Concepts Based on PW150 Turboprop by R. Hamaker	A19†
La Modernisation des moteurs militaires SNECMA Développements récents et perspectives by M. Coquelet	A20
Lessons from the Front Line: The Role of Flight Test in Aircraft Update Programs by D.J. Hoey, M.E. Skeen and E.C. Thomas	A21
The AH-64D Apache Longbow, Affordable Evolution by H.M. Dimmery	A22
MH-53J Service Life Extension Program, A Special Operational Forces Rotorcraft Winner by C.C. Crawford and H. Mason	A23

† Paper not available at time of printing.

The Canadian Air Force Experience **A24**
Selecting Aircraft Life Extension as the most Economical Solution
 by N. Landry

Paper A25 withdrawn

Transall C-160 Life Extension and Avionics Upgrade Programs **A26**
 by P. Blumschein

Le Cougar C.SAR, un exemple d'optimisation d'un hélicoptère existant **A27**
(The C.SAR Cougar, an example of optimisation of an existing helicopter)
 by Ph. Cabrit, P. Jaillet and T. Giacino

Symposium (B)

Warfare Automation: Procedures and Techniques for Unmanned Vehicles

Technical Evaluation Report **TB**
 by D. Woodall

A Framework for the Automation of Air Defence Systems **B1**
 by S. Choenni and K. Leijnse

Les Avions de Combat Non Habités (UCAV). Le point de vue d'un avionneur **B2**
 by D. Condroyer and P. Helie

Paper B3 withdrawn

UAV Requirements and Design Consideration **B4**
 by E. Torun

An Analysis on Operability of Tactical Unmanned Aerial Vehicle Systems over Turkish Territory **B5**
 by Ö. Ertem and G. Mandaş

UK Military Requirements for Unmanned Land Vehicle Combat Engineer Support **B6**
 by H.A. Warren

UK Experience with Unmanned Land Vehicles for Combat Engineer Applications **B7**
 by P.J. Gibson

Controlling Unmanned Vehicles: the Human Factors Solution **B8**
 by J.B.F. van Erp

An Evaluation of Input Devices and Menu Systems for Remote Workstations **B9**
 by J. White, C. McCrie and C. Miles

Advances in UAV Data Links: Analysis of Requirement Evolution and Implications on Future Equipment **B10**
 by S. Baiotti, G.L. Scazzola, G. Battaini and E. Crovari

Signal Processing for Micro Inertial Sensors **B11**
 by A.R. Stubberud and X-H. Yu

Distributed Intelligence, Sensing, and Control for Fully Autonomous Agents **B12**
 by A. Moshfegh and D.S. Siegel

Command and Control System of Unmanned Surface Drones for Sea Mine Disposal **B13**
 by G. Brückner

Test and Evaluation of the Man-Machine Interface Between the Apache Longbow™ and an Unmanned Aerial Vehicle by A.G. Kraay, M.L. Pouliot and W.J. Wallace	B14
Paper B15 withdrawn	
Paper B16 withdrawn	
Flight Control Law Design and HIL Simulation of a UAV by A. Ulku	B17
Unmanned Research Vehicle (URV): Development, Implementation, & Flight Test of a Mimo Digital Flight Control System Designed Using Quantitative Feedback Theory by C.H. Houppis and S.J. Rasmussen	B18
CRECUS: A Radar Sensor for Battlefield Surveillance UAVs by H. Boucard, T. Gach and E. Sicsik-Paré	B19
Unmanned Air Vehicles for the Army - Future Concepts by J. Bäker, H. Grobecker and R. Hastedt	B20
Successful Peacekeeping Missions of a UAV. The Drone CL-289 in Bosnia and Kosovo by T.J.M. Rumpf	B21†
Paper B22 withdrawn	
Miniature Remote Eye/Ear Land Vehicle by B. Hall and J.J. Grodski	B23
U.S. Predator Operations – Update by J.C. Porter	B24
Short Range Reconnaissance The LUNA Experimental UAV Program by W. Sabarz and J. Wernicke	B25
Design Considerations for Hypersonic UAVs by E.L. Fleeman	B26†
UCAV Concepts for CAS by A.J. Chaput, K.C. Henson and R.A. Ruszkowski, Jr.	B27

† Paper not available at time of printing.

Theme

The general theme of this joint symposium was “Advances in Vehicle Systems Concepts and Integration”. Two simultaneous symposia were presented:

1. Symposium (A): “Aircraft Update Programmes. The Economical Alternative?”

This symposium provided an opportunity to share NATO experience in the upgrade and update of aircraft, including rotorcraft. Focus was on three key questions: “What can and cannot be done economically? What are the limitations extending useful life of aircraft? and How can technological advances be integrated?” These questions were addressed from both a technical point of view and a cost-effectiveness perspective.

2. Symposium (B): “Warfare Automation: Procedures and Techniques for Unmanned Vehicles”

This symposium provided state-of-the-art summary on technologies used for unmanned military vehicles, their operation and their integration into mission systems and battlefield scenarios as well as acquisition and system operating costs. Theoretical studies forecast cost reductions - “Is this supported by real experience?” Special attention is on joint missions of land/sea/air forces, in areas with highly automated and cooperative infrastructures and simple and hostile environments as well.

We believe the participants in this conference made significant contributions toward meeting the increasingly difficult challenges of the NATO nations’ defense requirements within the limitations imposed by necessary economics in military resource allocations.

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NATO forces	Integrated systems	Ground vehicles	Platforms
Cost effectiveness	Transport aircraft	Remotely Operated Vehicles	Management
Service life	Man machine systems	Human factors engineering	Critical technologies
Defense economics	Lessons learned	Man machine systems	Systems engineering
Cockpits	Commonality	Man computer interface	Missions
		UAV (Unmanned Aerial Vehicle)	Battlefields
14. Abstract			
The meeting proceedings from this joint symposium on "Advances in Vehicle Systems Concepts and Integration" contain the Technical Evaluation Reports and papers presented at Symposium (A) on "Aircraft Update Programmes, The Economical Alternative?" and at Symposium (B) on "Warfare Automation: Procedures and Techniques for Unmanned Vehicles". It was organized by the Systems Concepts and Integration (SCI) Panel of the RTA in Ankara, Turkey from 26 to 28 April 1999. Symposium (A) was structured in five sessions covering Cockpit, Sensors, Engine, Overview and Lessons Learned (Part I and Part II) and was concluded by a panel discussion. Symposium (B) was structured in four sessions covering Operational requirements for unmanned vehicles, Integration aspects and mission management, Platform management and critical technologies and System concepts and mission experience.			



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