



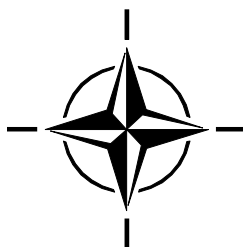
RTO MEETING PROCEEDINGS

MP-AVT-144

Enhanced Aircraft Platform Availability Through Advanced Maintenance Concepts and Technologies

(Amélioration de la disponibilité des plateformes
d'aéronefs au moyen de concepts de
maintenance et de technologies évolués)

RTO AVT-144 Workshop held in Vilnius,
Lithuania, 3-5 October 2006.



Published June 2011





RTO MEETING PROCEEDINGS

MP-AVT-144

Enhanced Aircraft Platform Availability Through Advanced Maintenance Concepts and Technologies

(Amélioration de la disponibilité des plateformes
d'aéronefs au moyen de concepts de
maintenance et de technologies évolués)

RTO AVT-144 Workshop held in Vilnius,
Lithuania, 3-5 October 2006.

The Research and Technology Organisation (RTO) of NATO

RTO is the single focus in NATO for Defence Research and Technology activities. Its mission is to conduct and promote co-operative 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 co-ordination 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 co-ordinates RTO's co-operation 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 co-operation.

The total spectrum of R&T activities is covered by the following 7 bodies:

- AVT Applied Vehicle Technology Panel
- HFM Human Factors and Medicine Panel
- IST Information Systems Technology Panel
- NMSG NATO Modelling and Simulation Group
- SAS System Analysis and Studies Panel
- SCI Systems Concepts and Integration Panel
- SET Sensors and Electronics Technology Panel

These bodies are made up of national representatives as well as generally recognised 'world class' scientists. They 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 co-operation 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.

The content of this publication has been reproduced directly from material supplied by RTO or the authors.

Published June 2011

Copyright © RTO/NATO 2011
All Rights Reserved

ISBN 978-92-837-0132-3

Single copies of this publication or of a part of it may be made for individual use only. The approval of the RTA Information Management Systems Branch is required for more than one copy to be made or an extract included in another publication. Requests to do so should be sent to the address on the back cover.

Table of Contents

	Page
Programme Committee	iv
Executive Summary and Synthèse	ES-1
List of Papers	1
Annex A – List of Workshop Participants	A-1

Programme Committee

CHAIRMAN

Mr. G.F. Eastaugh
NRC Institute for Aerospace Research
1200 Montreal Road
Ottawa, Ontario K1A 0R6
CANADA
Tel: +1-613-993-2845
graeme.eastaugh@nrc-cnrc.gc.ca

VICE-CHAIRMAN

Dipl. Ing. M. Buderath
PSCG8 Customer Support Operations
EADS Military Aircraft
81663 Munich
GERMANY
Tel: +49 (0) 89-6-07-29073
matthias.buderath@eads.com

MEMBERS

CANADA

Dr. W. Beres
NRC Institute for Aerospace Research
1200 Montreal Road
Ottawa, Ontario K1A 0R6
Tel: +1-613-993-0033
wieslaw.beres@nrc-cnrc.gc.ca

Mr. J. Bird
NRC Institute for Aerospace Research
1200 Montreal Road
Ottawa, Ontario K1A 0R6
Tel: +1-613-990-0652
jeff.bird@nrc-cnrc.gc.ca

Mr. J. Komorowski
NRC Institute for Aerospace Research
1200 Montreal Road
Ottawa, Ontario K1A 0R6
Tel: +1-613-993-0141
jerzy.komorowski@nrc-cnrc.gc.ca

CZECH REPUBLIC

Prof. J. Stodola
University of Defence in Brno
PS 13, K 252, Kounicova str. 65
612 00 Brno
Tel: +420-973-442-278
Jiri.Stodola@unob.cz

Mr. F. Tesar
VTULaPVO
Mladoboleslavská 944
197 21 Praha 9 (Prague)
Tel: +420-255-708816
ferdinand.tesar@vtul.cz

FRANCE

Mr. T. Vilain
Dassault Aviation
78 quai Marcel Dassault – Cedex 300
92552 St. Cloud Cedex
Tel: +33-1-47-11-34-30
thierry.vilain@dassault-aviation.com

GERMANY

Dipl. Ing. W. Bienenda
Secondary Power Systems
EADS Military Aircraft
81663 Munich
Tel: +49 (0) 89-6-07-24993
wolfgang.bienenda@eads.com

ITALY

Major M. Colavita
Chemistry Department
Flight Test Centre of Italian Air Force
“M. De Bernardi Airport”
00040 Pomezia, Rome
Tel: +39-06-9129-2894
mcolavita@tiscali.it

NETHERLANDS

Ir. H.J. ten Hoeve
National Aerospace Laboratory NLR
Aerospace Vehicles Division
P.O. Box 153
NL-8300 AD Emmeloord
Tel: +31-527-248672
hjth@nlr.nl

ROMANIA

Colonel (Dr.) I. Lespezeanu
Ministry of Defence
Armaments Department
7-9 Drumul Tabare Street
Sector 6, Bucharest 061353
Tel: +40 (21) 319-68-58 Ext 2815
ion.lespezeanu@dpa.ro

UNITED STATES

Mr. K. Hart
Alion Science and Technology
CTR USAF Fleet Viability Board
Wright Patterson AFB
Dayton, OH
Tel: +1-937-255-8600
karl.hart@wpafb.af.mil

UNITED KINGDOM

Dr. M. Winstone
Physical Sciences Department
Defence Sciences and Technology
Laboratory (DSTL) Porton Down
Salisbury, Wiltshire SP4 0JQ
Tel: +44-1980-658553
mrwinstone@dstl.gov.uk

CONTRIBUTORS**UNITED KINGDOM**

Wg Cdr A. March
Combat Aircraft and UA(C)Vs
Material & Structures Group (M&SG)
L107 Block L
DLO Wyton, Huntingdon
Tel: +44-1480-52451 Ext 6172
marcha560@hqicr.mod.uk

Dr. M. Mishon
Ministry of Defence
Materials & Structures Group
Fleetlands, Fareham Road
Gosport, Hants PO13 0FL
Tel: +44 (0) 23-9254-4595
cch@aim.mod.uk

UNITED STATES

Mr. R. Bondaruk
General Dynamics Information Technology
(GDIT)
Oklahoma City Air Logistics Center
Tinker Air Force Base
Oklahoma City, OK
Tel: +1-405-739-7773
bob.bondaruk@gdit.com

Mr. J. Waldman
NAVMAR Applied Sciences Corporation
65 West Street Road (Building C)
Warminster, PA 18974
Tel: +1-215-675-4900 Ext 108
waldman@navmar.com

AVT PANEL MENTOR

Prof. J. Vantomme
Royal Military Academy (RMA)
Department of Civil Engineering
Renaissancelaan 30
B-1000 Brussels, Belgium
Tel: +32 (2) 742-64-10
john.vantomme@rma.ac.be



REPORT DOCUMENTATION PAGE																					
1. Recipient's Reference	2. Originator's References	3. Further Reference	4. Security Classification of Document																		
	RTO-MP-AVT-144 AC/323(AVT-144)TP/363	ISBN 978-92-837-0132-3	UNCLASSIFIED/ UNLIMITED																		
5. Originator	Research and Technology Organisation North Atlantic Treaty Organisation BP 25, F-92201 Neuilly-sur-Seine Cedex, France																				
6. Title	Enhanced Aircraft Platform Availability Through Advanced Maintenance Concepts and Technologies																				
7. Presented at/Sponsored by	RTO AVT-144 Workshop held in Vilnius, Lithuania, 3-5 October 2006.																				
8. Author(s)/Editor(s)	Multiple		9. Date June 2011																		
10. Author's/Editor's Address	Multiple		11. Pages 496																		
12. Distribution Statement	There are no restrictions on the distribution of this document. Information about the availability of this and other RTO unclassified publications is given on the back cover.																				
13. Keywords/Descriptors	<table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">Aircraft availability</td> <td style="width: 33%;">Diagnostics</td> <td style="width: 33%;">Maintenance-free operating period</td> </tr> <tr> <td>Automatic test systems</td> <td>Inspection</td> <td>Prognostics</td> </tr> <tr> <td>Availability based contracting</td> <td>Integrated logistic support</td> <td>Readiness</td> </tr> <tr> <td>Battle damage repair</td> <td>Integrated vehicle health management</td> <td>Reliability</td> </tr> <tr> <td>Condition based maintenance</td> <td>Maintainability</td> <td>Reliability centred maintenance</td> </tr> <tr> <td>Corrosion prevention</td> <td>Maintenance</td> <td>Usage monitoring</td> </tr> </table>			Aircraft availability	Diagnostics	Maintenance-free operating period	Automatic test systems	Inspection	Prognostics	Availability based contracting	Integrated logistic support	Readiness	Battle damage repair	Integrated vehicle health management	Reliability	Condition based maintenance	Maintainability	Reliability centred maintenance	Corrosion prevention	Maintenance	Usage monitoring
Aircraft availability	Diagnostics	Maintenance-free operating period																			
Automatic test systems	Inspection	Prognostics																			
Availability based contracting	Integrated logistic support	Readiness																			
Battle damage repair	Integrated vehicle health management	Reliability																			
Condition based maintenance	Maintainability	Reliability centred maintenance																			
Corrosion prevention	Maintenance	Usage monitoring																			
14. Abstract	<p>Aircraft availability is a key component of military capability and an important measure of the readiness and effectiveness of a force. For years, NATO accepted trade-offs between reliability and technical performance in tactical systems because it was compelled to pursue technological superiority over the Soviet Union during the Cold War. There is now a need to place more emphasis on availability, together with an enduring ability to provide it in tactical deployments with a small logistics footprint. Therefore, a Workshop was held in Vilnius, Lithuania, from 3 to 5 October 2006, to identify advanced maintenance/support concepts and technologies which could help to improve aircraft availability. It was attended by over eighty invited specialists from thirteen NATO Nations and two partner Nations. The topics of the papers were individually prearranged to ensure the widest possible coverage of this large topic, and fell into four main categories: national perspectives; metrics and key performance indicators; maintenance/support management concepts and technologies; and aircraft and support equipment technologies. Most speakers provided manuscript papers, which are contained in these proceedings. The AVT-144 Technical Team has also prepared a report which blends information from the Workshop with additional research. This has been published separately as RTO-TR-AVT-144.</p>																				





BP 25

F-92201 NEUILLY-SUR-SEINE CEDEX • FRANCE
Télécopie 0(1)55.61.22.99 • E-mail mailbox@rta.nato.int



DIFFUSION DES PUBLICATIONS
RTO NON CLASSIFIEES

Les publications de l'AGARD et de la RTO peuvent parfois être obtenues auprès des centres nationaux de distribution indiqués ci-dessous. Si vous souhaitez recevoir toutes les publications de la RTO, ou simplement celles qui concernent certains Panels, vous pouvez demander d'être inclus soit à titre personnel, soit au nom de votre organisation, sur la liste d'envoi.

Les publications de la RTO et de l'AGARD sont également en vente auprès des agences de vente indiquées ci-dessous.

Les demandes de documents RTO ou AGARD doivent comporter la dénomination « RTO » ou « AGARD » selon le cas, suivi du numéro de série. Des informations analogues, telles que le titre et la date de publication sont souhaitables.

Si vous souhaitez recevoir une notification électronique de la disponibilité des rapports de la RTO au fur et à mesure de leur publication, vous pouvez consulter notre site Web (www.rto.nato.int) et vous abonner à ce service.

CENTRES DE DIFFUSION NATIONAUX

ALLEMAGNE

Streitkräfteamt / Abteilung III
Fachinformationszentrum der Bundeswehr (FIZBw)
Gorch-Fock-Straße 7, D-53229 Bonn

BELGIQUE

Royal High Institute for Defence – KHID/IRSD/RHID
Management of Scientific & Technological Research
for Defence, National RTO Coordinator
Royal Military Academy – Campus Renaissance
Renaissancelaan 30, 1000 Bruxelles

CANADA

DSIGRD2 – Bibliothécaire des ressources du savoir
R et D pour la défense Canada
Ministère de la Défense nationale
305, rue Rideau, 9^e étage
Ottawa, Ontario K1A 0K2

DANEMARK

Danish Acquisition and Logistics Organization
(DALO)
Lautrupbjerg 1-5, 2750 Ballerup

ESPAGNE

SDG TECIN / DGAM
C/ Arturo Soria 289
Madrid 28033

ESTONIE

Estonian Ministry of Defence
Estonian National Coordinator for NATO RTO
Sakala 1, Tallinn 15094

ETATS-UNIS

NASA Center for AeroSpace Information (CASI)
7115 Standard Drive
Hanover, MD 21076-1320

FRANCE

O.N.E.R.A. (ISP)
29, Avenue de la Division Leclerc
BP 72, 92322 Châtillon Cedex

GRECE (Correspondant)

Defence Industry & Research General
Directorate, Research Directorate
Fakinos Base Camp, S.T.G. 1020
Holargos, Athens

HONGRIE

Hungarian Ministry of Defence
Development and Logistics Agency
P.O.B. 25, H-1885 Budapest

ITALIE

General Secretariat of Defence and
National Armaments Directorate
5th Department – Technological
Research
Via XX Settembre 123, 00187 Roma

LUXEMBOURG

Voir Belgique

NORVEGE

Norwegian Defence Research
Establishment, Attn: Biblioteket
P.O. Box 25
NO-2007 Kjeller

PAYS-BAS

Royal Netherlands Military
Academy Library
P.O. Box 90.002
4800 PA Breda

POLOGNE

Centralna Biblioteka Wojskowa
ul. Ostrobramska 109
04-041 Warszawa

PORTUGAL

Estado Maior da Força Aérea
SDF A – Centro de Documentação
Alfragide, P-2720 Amadora

REPUBLIQUE TCHEQUE

LOM PRAHA s. p.
o. z. VTÚLaPVO
Mladoboleslavská 944
PO Box 18
197 21 Praha 9

ROUMANIE

Romanian National Distribution
Centre
Armaments Department
9-11, Drumul Taberei Street
Sector 6
061353, Bucharest

ROYAUME-UNI

Dstl Knowledge and Information
Services
Building 247
Porton Down
Salisbury SP4 0JQ

SLOVAQUIE

Akadémia ozbrojených síl gen.
M.R. Štefánika, Distribučné a
informačné stredisko RTO
Demänová 393, Liptovský Mikuláš 6
031 06

SLOVENIE

Ministry of Defence
Central Registry for EU and
NATO
Vojkova 55
1000 Ljubljana

TURQUIE

Milli Savunma Bakanlıđı (MSB)
ARGE ve Teknoloji Dairesi
Başkanlıđı
06650 Bakanlıklar
Ankara

AGENCES DE VENTE

NASA Center for AeroSpace Information (CASI)

7115 Standard Drive
Hanover, MD 21076-1320
ETATS-UNIS

The British Library Document Supply Centre

Boston Spa, Wetherby
West Yorkshire LS23 7BQ
ROYAUME-UNI

Canada Institute for Scientific and Technical Information (CISTI)

National Research Council Acquisitions
Montreal Road, Building M-55
Ottawa K1A 0S2, CANADA

Les demandes de documents RTO ou AGARD doivent comporter la dénomination « RTO » ou « AGARD » selon le cas, suivie du numéro de série (par exemple AGARD-AG-315). Des informations analogues, telles que le titre et la date de publication sont souhaitables. Des références bibliographiques complètes ainsi que des résumés des publications RTO et AGARD figurent dans les journaux suivants :

Scientific and Technical Aerospace Reports (STAR)

STAR peut être consulté en ligne au localisateur de ressources
uniformes (URL) suivant: <http://www.sti.nasa.gov/Pubs/star/Star.html>
STAR est édité par CASI dans le cadre du programme
NASA d'information scientifique et technique (STI)
STI Program Office, MS 157A
NASA Langley Research Center
Hampton, Virginia 23681-0001
ETATS-UNIS

Government Reports Announcements & Index (GRA&I)

publié par le National Technical Information Service
Springfield
Virginia 2216
ETATS-UNIS
(accessible également en mode interactif dans la base de
données bibliographiques en ligne du NTIS, et sur CD-ROM)



BP 25

F-92201 NEUILLY-SUR-SEINE CEDEX • FRANCE
Télécopie 0(1)55.61.22.99 • E-mail mailbox@rta.nato.int



**DISTRIBUTION OF UNCLASSIFIED
RTO PUBLICATIONS**

AGARD & RTO publications are sometimes available from the National Distribution Centres listed below. If you wish to receive all RTO reports, or just those relating to one or more specific RTO Panels, they may be willing to include you (or your Organisation) in their distribution.

RTO and AGARD reports may also be purchased from the Sales Agencies listed below.

Requests for RTO or AGARD documents should include the word 'RTO' or 'AGARD', as appropriate, followed by the serial number. Collateral information such as title and publication date is desirable.

If you wish to receive electronic notification of RTO reports as they are published, please visit our website (www.rto.nato.int) from where you can register for this service.

NATIONAL DISTRIBUTION CENTRES

BELGIUM

Royal High Institute for Defence – KHID/IRSD/RHID
Management of Scientific & Technological Research
for Defence, National RTO Coordinator
Royal Military Academy – Campus Renaissance
Renaissancelaan 30
1000 Brussels

CANADA

DRDKIM2 – Knowledge Resources Librarian
Defence R&D Canada
Department of National Defence
305 Rideau Street, 9th Floor
Ottawa, Ontario K1A 0K2

CZECH REPUBLIC

LOM PRAHA s. p.
o. z. VTÚLaPVO
Mladoboleslavská 944
PO Box 18
197 21 Praha 9

DENMARK

Danish Acquisition and Logistics Organization
(DALO)
Lautrupbjerg 1-5
2750 Ballerup

ESTONIA

Estonian Ministry of Defence
Estonian National Coordinator for NATO RTO
Sakala 1, Tallinn 15094

FRANCE

O.N.E.R.A. (ISP)
29, Avenue de la Division Leclerc
BP 72, 92322 Châtillon Cedex

GERMANY

Streitkräfteamt / Abteilung III
Fachinformationszentrum der Bundeswehr (FIZBw)
Gorch-Fock-Straße 7
D-53229 Bonn

GREECE (Point of Contact)

Defence Industry & Research General
Directorate, Research Directorate
Fakinos Base Camp, S.T.G. 1020
Holargos, Athens

HUNGARY

Hungarian Ministry of Defence
Development and Logistics Agency
P.O.B. 25, H-1885 Budapest

ITALY

General Secretariat of Defence and
National Armaments Directorate
5th Department – Technological
Research
Via XX Settembre 123, 00187 Roma

LUXEMBOURG

See Belgium

NETHERLANDS

Royal Netherlands Military
Academy Library
P.O. Box 90.002
4800 PA Breda

NORWAY

Norwegian Defence Research
Establishment, Attn: Biblioteket
P.O. Box 25
NO-2007 Kjeller

POLAND

Centralna Biblioteka Wojskowa
ul. Ostrobramska 109
04-041 Warszawa

PORTUGAL

Estado Maior da Força Aérea
SDFA – Centro de Documentação
Alfragide, P-2720 Amadora

ROMANIA

Romanian National Distribution
Centre
Armaments Department
9-11, Drumul Taberei Street
Sector 6, 061353, Bucharest

SLOVAKIA

Akadémia ozbrojených síl gen.
M.R. Štefánika, Distribučné a
informačné stredisko RTO
Demánová 393, Liptovský Mikuláš 6
031 06

SLOVENIA

Ministry of Defence
Central Registry for EU & NATO
Vojkova 55
1000 Ljubljana

SPAIN

SDG TECIN / DGAM
C/ Arturo Soria 289
Madrid 28033

TURKEY

Milli Savunma Bakanlığı (MSB)
ARGE ve Teknoloji Dairesi
Başkanlığı
06650 Bakanlıklar – Ankara

UNITED KINGDOM

Dstl Knowledge and Information
Services
Building 247
Porton Down
Salisbury SP4 0JQ

UNITED STATES

NASA Center for AeroSpace
Information (CASI)
7115 Standard Drive
Hanover, MD 21076-1320

SALES AGENCIES

**NASA Center for AeroSpace
Information (CASI)**

7115 Standard Drive
Hanover, MD 21076-1320
UNITED STATES

**The British Library Document
Supply Centre**

Boston Spa, Wetherby
West Yorkshire LS23 7BQ
UNITED KINGDOM

**Canada Institute for Scientific and
Technical Information (CISTI)**

National Research Council Acquisitions
Montreal Road, Building M-55
Ottawa K1A 0S2, CANADA

Requests for RTO or AGARD documents should include the word 'RTO' or 'AGARD', as appropriate, followed by the serial number (for example AGARD-AG-315). Collateral information such as title and publication date is desirable. Full bibliographical references and abstracts of RTO and AGARD publications are given in the following journals:

Scientific and Technical Aerospace Reports (STAR)

STAR is available on-line at the following uniform resource
locator: <http://www.sti.nasa.gov/Pubs/star/Star.html>
STAR is published by CASI for the NASA Scientific
and Technical Information (STI) Program
STI Program Office, MS 157A
NASA Langley Research Center
Hampton, Virginia 23681-0001
UNITED STATES

Government Reports Announcements & Index (GRA&I)

published by the National Technical Information Service
Springfield
Virginia 2216
UNITED STATES
(also available online in the NTIS Bibliographic Database
or on CD-ROM)