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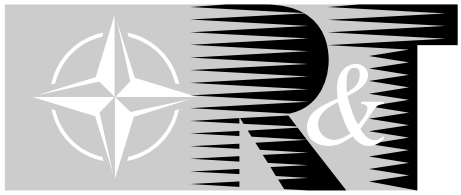

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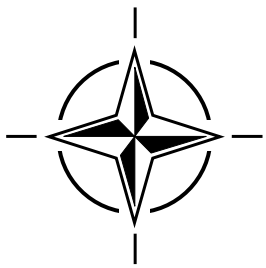
**RTO MEETING PROCEEDINGS 32**

# The Human Factor in System Reliability – Is Human Performance Predictable?

(les Facteurs humains et la fiabilité des systèmes –
Les performances humaines, sont-elles prévisibles?)

*Papers presented at the Human Factors and Medicine Panel (HFM) Workshop held in Siena, Italy from 1-2 December 1999.*



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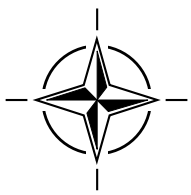

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RTO reports both to the Military Committee of NATO and to the Conference of National Armament Directors. It comprises a Research and Technology Board (RTB) as the highest level of national representation and the Research and Technology Agency (RTA), 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 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 Studies, Analysis and Simulation 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 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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# The Human Factor in System Reliability – Is Human Performance Predictable?

## (RTO MP-032)

# Executive Summary

This workshop was convened by the Human Factors and Medicine (HFM) Panel of the Research and Technology Organisation (RTO) mainly as a precursor to a new Task Group WG30 which aims to investigate and develop the role of Human Reliability Assessment within the overall design process. The workshop attracted an excellent collection of experts and practitioners across both civil and military domains and was successful in highlighting the needs of the Human Reliability community and hence providing a clear focus for the newly formed Task Group.

The workshop received eleven papers, including two keynote addresses, which tackled a gamut of issues including:

- Current Safety Assessment methods
- Limitations of existing Human Performance Models
- Cognitive Reliability Analysis techniques
- Barrier functions and their impact on human reliability
- Quantitative vs Qualitative analytical approaches
- Characteristics of high reliability organisations
- Variability of Corporate Safety Cultures
- Contextual Causal Modelling Techniques
- Cost Effectiveness Analysis techniques in Human Reliability Modelling
- Causal Database Developments
- Application of Hierarchical Taxonomy approaches to Human Error Prediction

The workshop identified and debated recent trends in Human Reliability Assessment, in particular the pressure to treat human error analysis in the same manner as hardware component analysis. The need for new techniques in data collection, data analysis and human error quantification was examined that take account of unique human attributes.

New themes that emerged included a need to focus more upon cognitive processes and the organisational context in which system behaviour takes place. The traditional focus on human error should be broadened to consider human adaptability as a safety feature and the classical concept of a human task expanded to embrace a wider work scenario. The concept of high reliability cultures and organisation was also addressed with emphasis being placed on the development and adoption of pro-active safe working practices.

In conclusion, the workshop was highly successful in sharing and debating state of the art knowledge and assessment approaches that will collectively enhance the science of human reliability within the overall design process. The valuable theoretical and practical insights contained in the presentations coupled with the lively debate on the issues raised, ensured that the workshop not only fulfilled its objectives from an educational standpoint, but also provided an enjoyable yet formative experience for the delegates.

# les Facteurs humains et la fiabilité des systèmes – Les performances humaines, sont-elles prévisibles?

## (RTO MP-032)

# Synthèse

Cet atelier a été organisé par la commission sur les facteurs humains et la médecine (HFM) de l'Organisation pour la recherche et la technologie de l'OTAN (RTO), comme précurseur au nouveau groupe de travail WG30, dont l'objectif est d'examiner et de développer le rôle de l'"Evaluation de la Fiabilité Humaine" dans le processus de conception. De nombreux spécialistes et praticiens civils et militaires ont été attirés par le sujet de cet atelier, qui a permis de mettre en évidence les besoins des chercheurs travaillant dans le domaine de la fiabilité humaine et par conséquent, d'établir une base de travail claire pour le nouveau groupe de travail.

Onze communications, dont deux discours d'ouverture, ont été présentées lors de l'atelier, qui a permis d'examiner un grand éventail de questions dont les suivantes :

- Méthodes actuelles d'évaluation de la sécurité
- Limitations des modèles actuels de performances humaines
- Techniques d'analyse de la fiabilité cognitive
- Fonctions barrière et leur impact sur la fiabilité humaine
- Approches analytiques quantitatives contre approches analytiques qualitatives
- Caractéristiques des organisations hautement fiables
- Variabilité des cultures sur la sécurité dans l'entreprise
- Techniques contextuelles de modélisation causale
- Techniques d'analyse coût-efficacité dans la modélisation de la fiabilité humaine
- Développements dans le domaine des bases de données causales
- Application d'approches basées sur la taxonomie hiérarchique à la prévision de l'erreur humaine

L'atelier a permis d'identifier et de discuter des tendances récentes dans le domaine de l'évaluation de la fiabilité humaine et en particulier la tendance de plus en plus marquée qui veut que l'on traite l'analyse de l'erreur humaine de la même manière que l'analyse des composants matériels. Le besoin de nouvelles techniques de collecte de données, de quantification de l'erreur humaine et d'analyse de données, qui tiendraient compte des attributs spécifiques à l'être humain, a aussi été abordé.

Le besoin de privilégier les processus cognitifs et le contexte organisationnel dans lequel les systèmes fonctionnent sont des exemples de nouveaux thèmes qui ont été mis en évidence pendant l'atelier. Le champ d'investigation classique de l'erreur humaine doit être élargi pour englober l'adaptabilité humaine en tant que facteur de sécurité; de plus, le concept traditionnel de la tâche humaine doit être étendu pour englober des scénarios de travail plus diversifiés. Le concept de cultures et d'organisations de haute fiabilité a également été examiné, l'accent étant mis sur le développement et l'adoption de pratiques de travail proactives sans danger.

En conclusion, l'atelier a largement permis de mettre en commun et de débattre les dernières approches de l'évaluation des connaissances, qui sont susceptibles de faire avancer la science de la fiabilité humaine dans le processus global de conception. Les précieux éclaircissements théoriques et pratiques contenus dans les présentations, associés aux vifs débats qui ont animé l'atelier ont permis non seulement aux organisateurs d'atteindre leurs objectifs pédagogiques, mais aussi à l'assistance de participer à une manifestation à la fois agréable et formatrice.

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**14. Abstract**

Human error is seen as an unacceptably high contributing factor in most military accidents and much research has been carried out over the past 50 years, to attempt to predict the probability of the occurrence of human error. Significant advances have been made within the safety critical domain areas within the nuclear and chemical industries. The aim of the workshop was to review the research carried out across multiple domain areas in order to provide a clear focus for Working Group 30 (Human Reliability in Safety Critical Systems). It was evident from the workshop that key cognitive processes and organisational contexts play an important part in shaping the overall human performance and hence the likelihood of human error. Therefore it was clear that there are new approaches to Human Reliability Assessment that take account of the unique human adaptability attributes that are not present in any other part of the overall system in which the human is an integral part. Working Group 30 will develop these approaches to provide clear guidance to the NATO community in designing and analysing human roles to quantify and qualify the likelihood of error. This will enhance future design processes to produce higher fault tolerant designs, to include mitigating strategies and aim towards a significant reduction in the number of human errors.

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