

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 2: Safety and security in air traffic management (ATM)
2.1: Safety management systems and programmes

THE HUMAN IN FUTURE AIR TRAFFIC CONTROL (ATC) SYSTEMS

(Presented by IFATCA)

SUMMARY

The Tenth Air Navigation Conference (September 1991) recognized the importance of Human Factors in future ATC systems. It was considered that automation had the potential to reduce human error. There was a recommendation that work conducted in the field of Human Factors studies relate to the use and transition to future communications, navigation, and surveillance/air traffic management (CNS/ATM) systems. Several areas were subsequently identified where Human Factors knowledge and experience would enhance system safety and security. This paper explores the role of the human in future air traffic management systems, and argues that safe systems can only exist because of the role played by the humans in it. Therefore it is essential to better understand and enhance the role of the human in future air traffic control (ATC) systems.

Action by the conference is in paragraph 4.

1. INTRODUCTION

1.1 The Fourth Meeting of the Air Navigation Commission, Consultation with Industry, held at ICAO Headquarters in Montreal, 16 and 17 May 2000, had as its theme industry's perspective on ICAO's Global Aviation Safety Plan (GASP), as it expands to include the air traffic services (ATS) sector. The objective of the Plan is to gain commitment from States and the aviation industry as a whole in a collaborative effort to enhance safety. GASP is designed to identify and prioritize tasks and programmes likely to produce the best safety dividends in terms of reducing the accident rate on a worldwide and regional basis.

1.2 Elements having potential to impair safety, such as shortcomings and deficiencies, lack of compliance with ICAO Standards and Recommended Practices (SARPs), or repetitive causes for accidents are to be identified and corrective actions recommended. States have been urged to cooperate with ICAO and each other in order to improve the capability to compile, assess and disseminate safety-related information.

1.3 When examining various proposals for air traffic management (ATM) in the future, we see there are those that would endorse the responsibility for control and separation of aircraft transferring from the air traffic controller to the pilot. Under these conditions, and in scenarios involving a degree of complexity, it could drastically alter the role of the controller from one of active participation to one of being a passive monitor of this complex system. He/she would be in the background to monitor separation, or to respond in the event of some unforeseen emergency. Detailed studies have shown that when this shift in responsibilities occurs, it has a detrimental effect on, *inter alia*, conflict detection, memory, and situational awareness. It has been shown that when controllers are removed from situations of direct authority, and are subsequently required to step back in, detection and resolution of conflicts take longer than when someone has been actively involved all along.

1.4 We believe that when considering any implementation(s) of automation, the primary focus must be on reliable, high level applications for information acquisition, integration and presentation. However, any form of automation must also assist the controller's decision making. Automation has the potential not only to advise controllers of a particular situation, but also provide a particular solution, which presents a dilemma, a possible no-win situation for the controller. If he/she follows the suggested course of action and an incident ensues, they are accountable. If the suggestion is not heeded, and another course of action results in a loss of separation they are again held accountable. The development of decision aids to conflict resolution and separation assurance is a key element for controllers. Choosing what to automate should be guided by the need to compensate for human vulnerabilities, and at the same time take advantage of human strengths. Involving users in the development of automation is considered essential and evaluation(s) must include the human-in-the-loop. Gradual introduction of automation, with attention to training and human acceptance is necessary. Systems must be capable of being modified to suit the users' requirement, rather than the other way around.

1.5 The study and application of Human Factors in ATM is one of the most important issues facing us today. Although Human Factors in air traffic control is not a novel item, the ICAO Flight Safety and Human Factors Programme has given a new impetus to the work in this area during the last decade. The result is a new appreciation for the importance of the human and Human Factors issues by the aviation industry. Automation should improve the working environment for system users, but at the same time be fail-safe, all the while providing accurate and incorruptible data. With the human as the key component, automation, with fully considered Human Factors aspects, should act in a support role. It is important to understand the role of the human, and the role of technology is vital to system safety. A human centered approach takes advantage of the strengths of both humans and automation.

2. DISCUSSION

2.1 Human-centred automation

2.1.1 When we look at aviation systems of the future we must consider the impact that automation will have on the human operator within that system. What role will it play; what authority will it have, and how will it impact upon the operator? Computers already perform many of the tasks associated with navigation so do we need the human at all? We are far from perfect. But we do have the ability to reason effectively, to think in the abstract, and conceptualize when solving problems. Humans have five senses along with common sense and

intuition. Of course, we do not use them all in every situation, but, automation does not have these capabilities, so therefore should be a tool or resource for the human operator: a facilitator of the negotiating process between aircraft and ground-based control facilities, with the operator deciding the final outcome of this process in all cases.

2.1.2 Aviation will evolve as a result of technological advances. The entire system will need to be treated as one large resource with interaction among all elements, with the human operator(s) remaining a key element. It has long been known by documentation of facts surrounding accidents, incidents and system deficiencies, that a technology-centered approach to automation does present certain concerns. They apply equally to the cockpit environment as well as the ATC environment, and include: poor interface design; motivation and job satisfaction; complacency; distrust; intimidation; workload, and loss of situational awareness. These examples of incompatibility can (and have) lead to accidents and /or incidents. Concerns for the way that humans react and interact with automation will always be a valid concern. Reliance on automated systems can result in a natural degrading of controllers' manual skills. If new controllers entering today's ATC environment are trained to accept and trust automation to a great degree, they could be prone to reduced levels of alertness and reaction response times.

2.1.3 The Human Factors Guidelines for Air Traffic Management (ATM) Systems (ICAO Doc 9758), describes three essential concepts for discussion concerning the development of ATM systems: Human-Centered Automation, Situational Awareness, and Error Management. Each of these categories is significant in that they all are grounded in the human being. In other words, people are the central figure(s) in each, and understanding their role(s) is vital to the safety issue. Some basic assumptions surrounding future developments in aviation include pilots responsible for their flights and controllers responsible for separation and traffic flow.

2.1.4 In principle pilots remain in command of their aircraft and controllers in command of air traffic. To do this both must be adequately informed, actively involved, and able to monitor the automated system. The human's task is supported by the machinery, not managed by it. To have human beings properly recognized as the integral part of ATM systems is a prerequisite for improving and maintaining safety and efficiency. For this reason, it is imperative to properly identify, and communicate human factors ideas and solutions in a way that is both uncomplicated and understandable. Management of Human Factors issues in ATM should be a normal component of processes followed by designers, providers and users of the system. The time to address Human Factors issues is during the design phase. Once technology is deployed, it may be too late to address Human Factors issues due to incompatibility of human-technology interfaces.

2.1.5 The development of a formal plan ensures that Human Factors considerations are fully incorporated into any system design. Such a plan would address the human performance and parameters for purposes of programming and design. The plan is first developed at the start of a project and updated during each subsequent phase. (As we seem to focus on the future of the system, there is also the question of introducing Human Factors issues retrospectively). It is a well-known fact among experts in the field, that when a Human Factors evaluation of a system is warranted, it should be performed by a team that includes both Human Factors specialists and operations specialists working together. They represent the users and operators (e.g. pilots or controllers), and as long as they are knowledgeable of current issues, procedures, and practices, they are the most appropriate source for information and advice. Working together, the two types of specialists can predict problems and head them off before they occur in actual operations.

2.1.6 For some years now there has been a requirement in ICAO Annex 1 – *Personnel Licensing* for air traffic controllers to have knowledge of human performance relevant to air traffic control. If we accept that the human is the central element in a system then that human is entitled to all available resources to enable him/her

to function at optimum levels. The development of a formal plan is necessary to ensure that Human Factors considerations are taken into account. It is equally important to address other aspects such as system design, understanding (changing) team roles within the ATS unit, and how new equipment will integrate with existing equipment.

2.1.7 An important factor with regard to training in any environment is the associated cost; however, human factors in itself does not cost much to implement. Perhaps having Human Factors specialists available full-time could prove to be a cost-effective way of identifying and resolving incorrect procedures and/or unsafe working conditions at the outset. The International Federation of Air Traffic Controllers' Associations (IFATCA) feels that if sufficient resources, (financial and human) are made available to guarantee the best training possible, a team approach led by Human Factors specialists could lead to better education, cost-savings, and a happier, healthier workplace.

2.2 **WORKPLACE**

2.2.1 Concerns for the implications of Human Factors issues for air traffic controllers in their working environments are not limited to automation and related equipment. Other human necessities in our work places that may have nothing to do with technology, but play a role in the well being of both the human operator and equipment, deserve equal attention. The list includes such basic considerations as the immediate surroundings. Workspace temperature, humidity, lighting and noise levels; adequate eating and drinking facilities, proper rest areas (particularly when night work is involved), and even cleanliness are all components of a good working environment and contribute greatly to the well being of workers. Among some Member Associations of IFATCA, these issues that many of us take for granted are difficult to attain, or are non-existent. We have very real concerns in these areas and will continue efforts where possible to improving working environments.

2.2.2 In contrast, things such as inconsistent shift schedules with erratic hours of work, mandatory over-time and insufficient consecutive days of rest, contribute greatly to the fatigue factor, and could, in their own subtle way, impact on safety. If the result is an increase in the burn-out rate, an increase in attrition is likely to follow and the organization becomes much weaker with a corresponding effect on safety!

2.2.3 The work environment has a significant influence on the health and well being of individual air traffic controllers. Often these more mundane issues are not taken into consideration, but information is available on the relationship between sick leave and the quality of the workplace. A poor quality workplace causes a reduction in productivity and job performance. These issues of health, comfort, and sick leave therefore, must be taken seriously.

3. **CONCLUSIONS**

3.1 IFATCA has placed the application of Human Factors knowledge high on its list of priorities. The human is the central element in our aviation system(s). As such, he/she is entitled to all available resources that will promote and facilitate functioning at optimum levels. As mentioned above, our concerns are not limited to those of a technical/human nature, but also of everyday conditions in the work environment, and scheduling issues involving fatigue management. We believe that any understanding of Human Factors issues that is limited solely to individual operators in a complex system such as aviation, whether they be controller, pilot or other vital component, is undesirable. It is paramount that all operators share the same basic understanding of how a system, or system component, is designed, and to have knowledge of human performance relevant to their function. The assurance of safety in air traffic services will govern the industry's direction. Each component of the aviation

industry must demonstrate an ability to meet, and exceed required levels of safety. To accomplish this, we must become more pro-active in our approach to safety management in ATS. IFATCA will address the issue of safety management in a separate working paper to be presented to this Conference (AN-Conf/11-WP/44 refers).

3.2 It is IFATCA's wish that service providers will take positive steps to provide training programmes for ATC staff, in the area of Human Factors. It is our view that training programmes featuring introduction of Human Factors knowledge to *ab initio* controllers, and gradual and systematic education (recurrent) to already-qualified air traffic controllers, are a necessity. Such programmes should be designed by Human Factors specialists and operational training specialists. The ICAO *Human Factors Guidelines for Air Traffic Management (ATM) Systems* (Doc 9758) is very specific in this regard. As the reliance on technological tools is increased, these people are the most appropriate source for information on user preferences, knowledge of issues, procedures, and practices. Only by understanding circumstances from a Human Factors perspective, is it possible to introduce changes making it less likely similar errors would reoccur.

3.3 Many challenges remain in the field of Human Factors knowledge and skills in the ATM domain. IFATCA is committed to an evolutionary improvement process that builds on the strengths of our existing, and proven aviation-system. IFATCA's proposed solutions for ATC Human Factors issues centre on efforts to convert practical expertise into written rules and regulations. The Federation believes this is the way of the future. The main ingredient is a culture that focuses on the human, and Human Factors. IFATCA respectfully submits that Human Factors is not a one-off exercise; it deserves continual attention until it becomes a way of life. We agree with the philosophy that the human must play an essential — and where necessary, central — role in the global ATM system; and that the human is responsible for managing the system, monitoring its performance, and intervening, when necessary, to ensure the desired system outcome. Due consideration of Human Factors must be given in all aspects of the system.

4. ACTION BY THE CONFERENCE

4.1 The Conference is invited to take steps to ensure that Human Factors considerations are fully integrated into ICAO guidance material on safety management systems for ATS.

4.2 The Conference is invited, in recognition of the importance of human performance in safe ATM systems, to task ICAO with developing requirements for re-current training for ATS staff.

4.3 The Conference is invited to task ICAO with developing guidelines that provide indemnity for all ATM system operators when following conflict resolution advisories from any automated system, including ground conflict resolution systems.

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