CONDITIONS OF WORK AND
WELFARE FACILITIES BRANCH

Working paper

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Occupational stress and stress prevention in air traffic control

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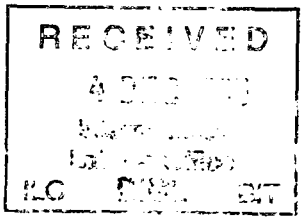

Note: Working Papers are preliminary documents circulated in a limited number of copies solely to stimulate discussion and critical comment.

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Table of contents

Preface

Occupational stress can no longer be considered an occasional, personal problem to be remedied with palliatives. It is becoming an increasingly global phenomenon, affecting all categories of workers, all workplaces and all countries. This trend — coupled with its rising cost to the individual, to industry and to society as a whole — has greatly heightened awareness of the need for effective and innovative ways of tackling stress.

Stress prevention at the workplace has proved particularly effective in combating stress, by attacking its roots and causes, rather than merely treating its effects. In line with such an approach, this series of working papers is aimed at providing concrete advice on how to prevent stress in specific occupations particularly exposed to stress. For each occupation considered, the paper indicates a number of preventive measures targeted to the elimination of the causes of stress, rather than the treatment of its effects, and how these measures can become an integral part of the necessary organizational development of a sound enterprise and eventually pay for themselves.

The series includes the following working papers:

— Dr. V.J. Sutherland and Professor C.L. Cooper,
University of Manchester, United Kingdom
Stress prevention in the offshore oil and gas exploration and production industry;

— Professor G. Costa, University of Verona, Italy
Occupational stress and stress prevention in air traffic control

— Professor T. Cox and Dr. A. Griffiths, Nottingham University, United Kingdom
Professor S. Cox, Loughborough University of Technology, United Kingdom
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— Professor M.A.J. Kompier, University of Nijmegen, Netherlands
Occupational stress and stress prevention for bus drivers

— Dr. S. Kvanström, Asea Brown Boveri, Sweden
Stress prevention for blue-collar workers in assembly-line production

As the series is intended to stimulate action at enterprise level, its primary audience will consist of managers, supervisors, workers, workers' representatives and engineers who have a concrete interest in introducing anti-stress programmes within their enterprise and an open approach to improvements and change. The series is also directed at policy-makers, as well as government officials and workers' and employers' organizations with a direct interest in this area.

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1. Introduction

1.1 What is stress?

It is not easy to properly define what stress is, although it is quite a common experience for everyone.

Stress is a part of everyday life and not necessarily a negative phenomenon, being a physiological stimulus usually connected with human-environment interactions.

However, it can become a harmful risk factor for health when it is perceived as an imbalance between an excess of demands and the individual ability to meet them. This causes a perturbation of the psycho-physical equilibrium, taxing physical, psychic and behavioural responses aimed at coping with it. If this coping fails, stress can have harmful consequences on physical, mental and social well-being, with high costs both for the individual and society.

Stress at work can be generated by job demands, environmental conditions, work organization and human relations; its impact on job satisfaction, performance efficiency and health can vary widely depending on the psycho-physical characteristics and coping resources of individuals, as well as on the social support received.

1.2 The sources of stress in air traffic control

Air traffic controllers (ATCs) are generally considered one of the working groups having to deal with a highly demanding job.

In fact, it entails a complex set of tasks requiring very high levels of knowledge and expertise, as well as the practical application of specific skills pertaining to cognitive domains (e.g. spatial perception, information processing, logic reasoning, decision making), communicative aspects and human relations.

To have an idea of its complexity, it is sufficient to mention that, according to a job analysis of en-route controllers carried out by a group of American researchers,[1] six main activities can be identified (i.e. situation monitoring, resolving aircraft conflicts, managing air traffic sequences, routing or planning flights, assessing weather impact, managing sector/position resources), which include 46 sub-activities and 348 distinct tasks. For example, the relevant cognitive/sensory attributes required for high performance levels at radar workstations are spatial scanning, movement detection, image and pattern recognition, prioritizing, visual and verbal filtering, coding and decoding, inductive and deductive reasoning, short- and long-term memory, and mathematic and probabilistic reasoning.

[1] H.L. Ammerman, L.J. Bergen, D.K. Davies, C.M. Hostetler, E.E. Inman and G.W. Jones: *FAA air traffic control operations concepts, Vol. VI. ARTCC/HOST En route controllers*, report number DOT/FAA/AP/86-01 (Washington, Federal Aviation Administration, 1987).

It is evident that the cognitive and operational processes of an ATC vary not only according to the number of aircraft under control, but also with the number and complexity of problems to be solved.[2]

The ATC must constantly reorganize his or her system of processing flight information by changing operating methods (in particular, cognitive processes, conversation, coordinating with assistants, anticipation and solving problems) as they arise and interact with each other.[3] This is carried out by means of the precise and effective application of rules and procedures that, however, need flexible adjustments according to differing circumstances, often under time pressure.

At the same time, the job includes high levels of responsibility, not only with regard to risking lives, but also for the high economic costs of aeronautical activities.

According to several surveys,[4] the main sources of stress reported by air traffic controllers are connected both to operative aspects and to organizational structures (Table 1). For the former, the most important are peaks of traffic load, time pressure, having to bend the rules, limitations and the reliability of equipment. The latter are mainly concerned with shift schedules (night work in particular), role conflicts, unfavourable working conditions and the lack of control over work.

These stress factors can affect not only job satisfaction, but the well-being and safety of ATCs. In fact, as the workload increases the ATC tends to employ more procedures which are less time consuming, together with a progressive reduction to the minimum of flight information and the relaxation of certain self-imposed qualitative criteria. It is evident that the number of decisions to be made becomes a stressful condition when the controller's decision-making capacity is stretched to the maximum; this can lead, in case of overload, to a very risky situation defined as "loss of picture".

On the other hand, it is frequently reported that, paradoxically, many errors often occur during periods of light or non-complex traffic. This points to the great effort required to regulate the psycho-physical reactions, maintaining high level of arousal and vigilance even in conditions of "underload".

[2] S. Ratcliffe and H. Gent: "The quantitative description of a traffic control process", in *Journal of Navigation*, Vol. 27, 1974, pp. 317-322.

[3] J.C. Sperandio: "The regulation of working methods as a function of work-load among air traffic controllers", in *Ergonomics*, Vol. 21, No. 3, 1978, pp. 195-202.

[4] R.C. Smith: *Stress, anxiety and the air traffic control specialist*, Federal Aviation Administration Report No. FAA-AM-80-14 (Washington, 1980); E.W. Farmer, A.J. Belyavin, A. Berry, A.J. Tattersall and G.R.J. Hockey: *Stress in air traffic control. I. Survey of NATS controllers*, RAF Institute of Aviation Medicine Report No. 689 (Farnborough, 1990).

Table 1. Main sources of stress for ATCs

Demand:

- number of aircraft under control
- peak traffic hours
- extraneous traffic
- unforeseeable events

Operating procedures:

- time pressure
- having to bend the rules
- feeling of loss of control
- fear of consequences of errors

Working times:

- unbroken duty periods
- shift and night work

Working tools:

- limitations and reliability of equipment
- VDT, R/T and telephone quality
- equipment layout

Work environment:

- lighting, optical reflections
- noise/distracters
- microclimate
- bad posture
- rest and canteen facilities

Work organization:

- role ambiguity
- relations with supervisors and colleagues
- lack of control over work process
- salary
- public opinion

Another important stressful factor is shift work, connected with the requirement of an optimum use of all mental faculties at all hours of the day and night, sometimes irrespective of the workload. It has to be taken into account that an ATC's work performance can be impaired at certain hours of the day by an excessive workload, but it can also be lowered during the night by a decline in mental and physical functions, in spite of a reduced external load. In fact, a lack of stimulation from a low workload can further increase the normal drop in physical and mental efficiency during the night hours, connected to perturbation of sleeping habits and circadian rhythms of body functions. This can be particularly harmful in emergency situations.[5]

Furthermore, air traffic controllers are among the groups of workers more exposed to "critical accidents", these being situations which cause unusually strong emotional reactions, such as in the case of air accidents with loss of life or serious injury, near collisions or loss of control due to overload. The psychic (anger, guilt, grief, anxiety) and physical (tachycardia, hypertension, headache, sweating, heartburn, insomnia) reactions cannot only hamper work performance (poor attention and concentration, impaired thinking and memory), but can also give rise to long-term post-traumatic disorders.

1.3 The consequences on health and well-being

If we consider stress as the external demands upon an individual, it is clear that stress for air traffic controllers is connected, on the one hand, with the intrinsic characteristics of the job and, on the other hand, with the work organization and conditions in the workplace. It is important to bear in mind that the psycho-physical responses of individuals also depend on their resources, defined both in terms of personal characteristics and coping strategies.

According to the "demand/control/support" model on stress at work,[6] high stress levels and consequent troubles and illnesses are more likely to develop in work activities where there is high psychological demand, but low decision latitude and inadequate social support at the workplace ("high strain job"). On the other hand, jobs having not only high psychological demands, but also a high decision latitude and adequate social support, are likely to determine an active behaviour that stimulates learning, motivation and labour productivity.

As far as air traffic control is concerned, it is evident that the job entails, on the whole, high psychological demands while being subjected to a considerable degree of external control. This feeling of lack of personal influence that ATCs often complain of can be a powerful stressor, also taking into account that the job requires high levels of responsibility.

[5] S. Folkard and T.H. Monk (eds.): *Hours of work: Temporal factors in work scheduling* (Chichester, John Wiley, 1985); and G. Costa: "Shiftwork and circadian variations of vigilance and performance", in J.A. Wise, V.D. Hopkin and M.L. Smith (eds.): *Automation and systems issues in air traffic control*, NATO ASI Series, Vol. F73 (Berlin, Springer-Verlag, 1991), pp. 267-280.

[6] R. Karasek: "Job demands, job decision latitude, and mental strain", in *Administrative Science Quarterly*, Vol. 24, 1979, pp. 285-308; and J.V. Johnson and E.M. Hall: "Job strain, work place social support, and cardiovascular disease: A cross-sectional study of a random sample of the Swedish working population", in *American Journal of Public Health*, Vol. 78, No. 10, 1988, pp. 1336-1342.

However, both "demand" and "control", as well as "social support", can vary widely according to several factors dealing with different working situations, e.g. work environment, equipment, work planning and procedures, workload distribution, team composition, working hours, rest pauses, shift schedules and human relations.[7]

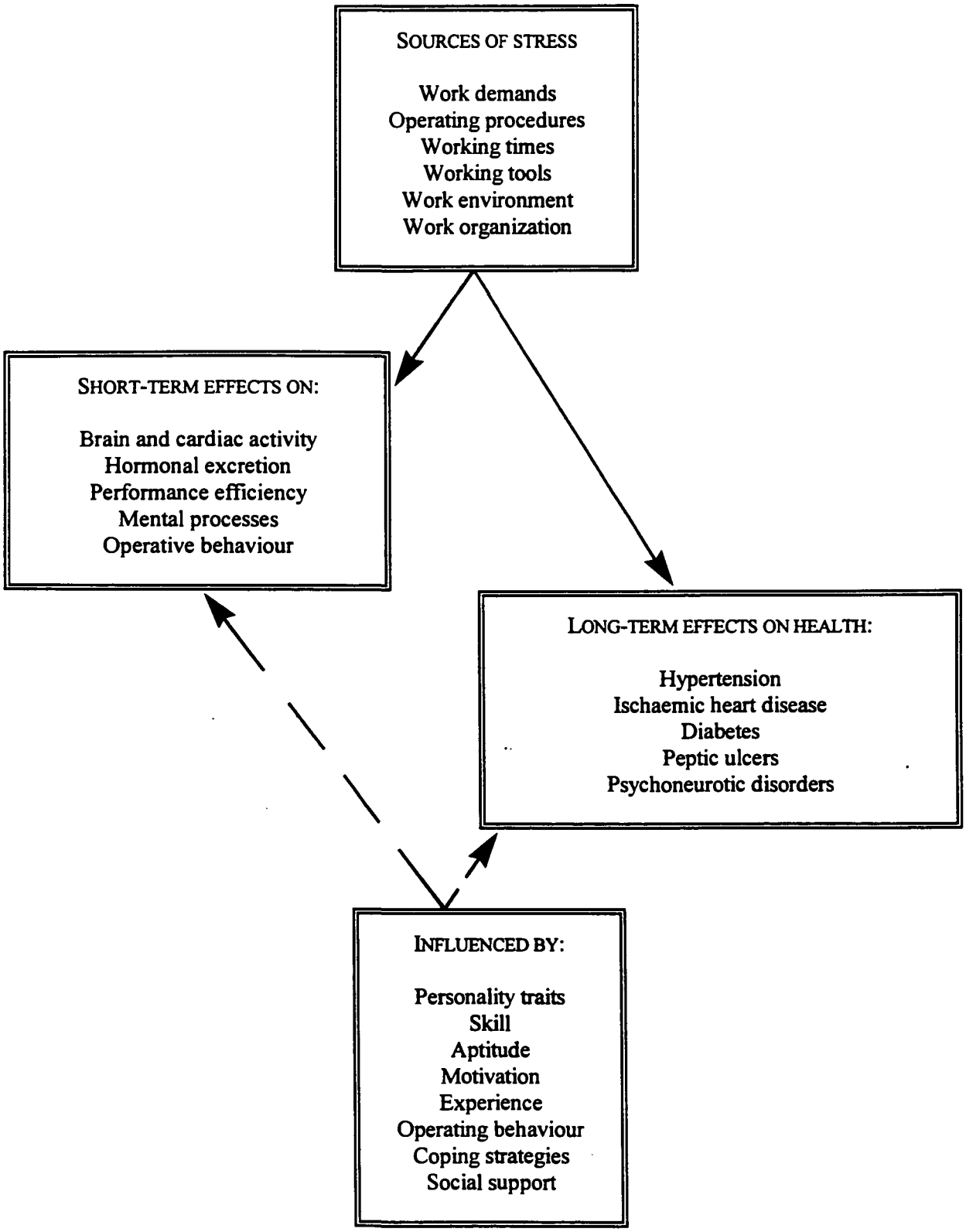
Furthermore, the consequences on an ATC's performance and well-being may differ widely among individuals in relation to many factors dealing with age, life styles, life events, work experience, personality traits (introversion, anxiety, type A), behavioural characteristics (mood, sleeping habits, morningness), attitudes, motivation, and physical and mental health. Moreover, many other factors related to social conditions can play an important role in this respect, e.g. socio-economic status, housing conditions, commuting, family attitudes, social support and integration.[8]

Therefore, all these aspects can have more or less influence on an ATC's job satisfaction, health and well-being according to different circumstances (Figure 1). They can interact and interfere with each other, giving rise to not only possible additive or multiplicative, but also subtractive effects, so that it is often very difficult to evaluate and compare the effective stress and strain in different groups and individuals. This is the reason why many studies on the stress of air traffic controllers reported apparently contradictory findings.

[7] V.D. Hopkin: "The measurement of the air traffic controller", in *Human Factors*, Vol. 22, No. 5, 1980, pp. 547-560; C.E. Melton, R.C. Smith and J.M. McKenzie: "Stress in air traffic personnel: Low density towers and flight service stations", in *Aviation, Space and Environment Medicine*, Vol. 49, No. 10, 1978, pp. 724-728; and R.B. Stammers: "Human factors in airfield air traffic control", in *Ergonomics*, Vol. 21, No. 6, 1978, pp. 483-488.

[8] M.W. Hurst and R.M. Rose: "Objective workload and behavioural response in airport radar control rooms", in *Ergonomics*, Vol. 21, No. 7, 1978, pp. 559-565; J.W.H. Kalsbeek: *Some aspects of stress measurements in air traffic control officers at Schipol Airport*, working paper presented to the Symposium on Stresses of the Air Traffic Control Officers, University of Manchester, Department of Postgraduate Medical Studies, 1976, pp.39-42; S. Karson: "Some relations between personality factors and job performance rating in radar controllers", in *Aerospace Medicine*, Vol. 40, 1969, pp. 823-826; and J.H. Crump: "Review of stress in air traffic control: Its measurement and effects", in *Aviation, Space and Environment Medicine*, Vol. 50, No. 3, 1979, pp. 243-248.

Figure 1. Main consequences of stress for air traffic controllers



With regard to the short-term effects, an ATC's responses can be documented in terms of changes in hormonal secretion (e.g. adrenaline, non-adrenaline, cortisol), heart rate, blood pressure, muscular activity, cerebral waves, work performance (errors) and behaviour (sleeping, smoking, eating and drinking habits). These can indicate a normal, physiological adaptation of the individual to external stimulation, as well as an excessive strain due to an imbalance between demands and resources.

Most research indicates that these responses are in some way related to the workload, which can be evaluated in terms of the number of aircraft under control or expected to come under control, peak traffic counts, duration and type of communications, tight work schedules, and number and complexity of problems to be solved. However, big differences among air control centres can be recorded, mainly in relation to air traffic density.

On the other hand, they appear to be greatly influenced by subjective factors, such as personality traits (anxiety, introversion), aptitude, skill, ability, motivation, experience and operating behaviour.[9]

In the long term, some studies indicate that this demanding occupational activity may be a risk factor for stress-related symptoms, such as headaches, chronic fatigue, heartburn, indigestion and chest pain, as well as for serious illnesses, such as hypertension, coronary heart disease, diabetes, peptic ulcers and psychoneurotic disorders.[10]

It is quite easy to foresee the high costs from both the existential and the economic point of view that these negative consequences of stress can have, not only for the single person, but also for companies and society.

Therefore, prevention and control of stress becomes a compulsory target for employees, in order to safeguard their physical, mental and social health; for companies, in order to improve the efficiency and reliability of the service; as well as for society as a whole, in order to guarantee the highest levels of safety and comfort for all included and affected by this very important work activity.

[9] Karson, op. cit.; R.C. Smith: "Comparison of the job attitudes of personnel in three air traffic control specialties", *Aerospace Medicine*, Vol. 44, 1973, pp. 918-927; G. Costa: "Evaluation of work load in a group of air traffic controllers", in *Ergonomics*, Vol. 36, No. 9, 1993, pp. 1111-1120.

[10] C.F. Booze: *The morbidity experience of air traffic control personnel*, Federal Aviation Administration Report No. FAA-AM-78-21 (Washington, 1978); S. Cobb and R.M. Rose: "Hypertension, peptic ulcer and diabetes in air traffic controllers", in *Journal of the American Medical Association*, No. 224, 1973, pp. 489-492; J.D. Dougherty, D.K. Trites and J.R. Dille: "Self-reported stress-related symptoms among air traffic control specialists (ATCS) and non-ACTS personnel", in *Aerospace Medicine*, Vol. 36, 1965, pp. 956-960; M.G.P. Fisher: *Stress and illness in air traffic controllers*, Report to the Committee on Regulation of Air Traffic Controllers' Hours (London, Civil Aviation Authority, 1989); R.M. Rose, C.D. Jenkins and M.W. Hurst: *Air traffic controller health change study*, Federal Aviation Administration Report No. FAA-AM-78-39 (Washington, 1978); and M. Singal, M.J. Smith, J.J. Hurell, J. Bender, R.S. Kramkowski and S.A. Salisbury: *Hazard evaluation and technical assistance report: O'Hare International Airport*, National Institute for Occupational Safety and Health Report No. TA 77-67 (Cincinnati, 1977).

2. How to prevent stress at work

An effective strategy aimed at reducing stress should address both the causes and the consequences of stress, thus acting upon all factors involved concerning work organization, as well as the personal resources and social conditions of the controllers.

The possibility of making changes and improvements in job demands is determined mainly by technical factors related to the development of scientific knowledge with regard to air flight and control systems. Implementing new methods of automation in air traffic control activities, for example, could profoundly change job demands and characteristics. One result of such changes could be a modification in conditions which are known to cause stress.

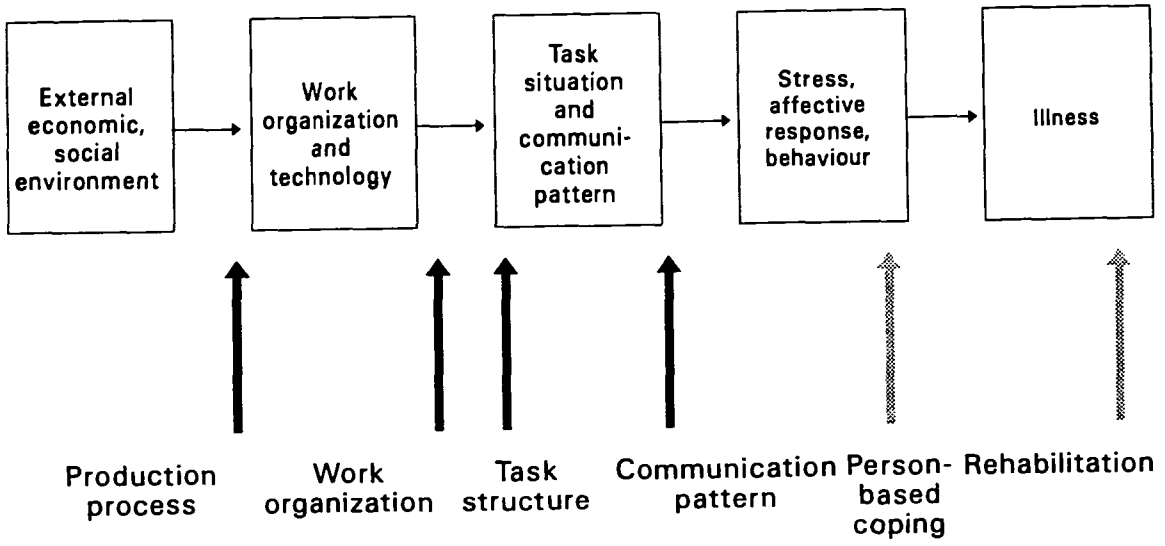
On the other hand, specific arrangements of work organization and careful attention to the psycho-physiological conditions of ATCs are just as important tools capable of reducing stress and improving the comfort and well-being of operators.

In order to have an understanding of the possible practical interventions for stress prevention and attenuation, we can refer to the model of the stress development process reported in Figure 2.

As can be seen, we have several possibilities of intervention at different levels, which can have a different impact and effectiveness in relation to the causal factor they deal with and to their congruence with the specific environmental and personal conditions.

With respect to the particular aspects of an ATC's job, we will examine the possibilities at the different levels according to the following scheme, also giving some examples of programmes or interventions carried out by some ATC companies, agencies or institutions.

Figure 2. A model of the work stress development process and interventions[11]



Intervention on the external socio-economic environment

Legislation, international and national directives
Social support

Intervention on technology and work organization

Improving job planning and reliability of the work systems
Reduction of working times and arrangement of working teams and rest pauses in relation to the workload
Arrangement of shift schedules according to psycho-physiological and social criteria
Participation in decision making

Intervention in working place and task structure

Improving the work environment
Lighting
Noise
Microclimatic conditions and indoor air quality
Arranging workplaces according to ergonomic criteria
Workstation design
Working with visual displays units
Sitting postures

[11] R. Karasek: "Stress prevention through work reorganization: A summary of 19 international case studies", in ILO: *Conditions of Work Digest — Preventing stress at work*, Vol. 11, No. 2, 1992, pp. 23-41.

Intervention to improve individual responses and behaviour

Individual ways of coping with stress
Selection and training
Counselling and other supporting measures at company level

Specific intervention for health protection and promotion

Appropriate medical surveillance

3. Intervention on the external socio-economic environment

3.1 Legislation, international and national directives

The Air Navigation Commission of the International Civil Aviation Organization (ICAO) has formulated the following objective for the task: "To improve safety in aviation by making States more aware and responsive to the importance of human factors in civil aviation operations through the provision of practical human factors material and measures developed on the basis of experience in States".

It is, therefore, necessary that states, organizations, companies and agencies involved in air traffic control make constant efforts for a more and more widespread exchange of know-how, expertise and guidelines to make possible a standardization and an effective integration of information services, flight data and air traffic management.

This is the main goal of the ICAO project on the Future Air Navigation System (FANS), that deals with a combination of satellite technology and the best of line-of-sight systems to provide an air navigational system which will overcome many of today's deficiencies on a global scale.

In Western Europe, for example, air traffic control is managed by 22 independent systems run autonomously by governments and agencies on a national basis. The EUROCONTROL International Convention defines, among the most prominent tasks, those concerning the promotion of common policies for ground and airborne navigational systems, and training of air traffic services staff.

In this perspective, the European ATC Harmonization and Implementation Programme (EATCHIP) is an important tool aimed at properly harmonizing the traffic services among member States in terms of airspace management, working rules and operational procedures, systems and human resources.

In the United States, the Federal Aviation Administration (FAA) has developed — with the collaboration of NASA and the Department of Defense — a national plan for integration, coordination and research in the area of human factors support, also providing a relational

database system concerning the impact of automation, human performance, selection, training and safety monitoring of ATC activities.

3.2 Social support

Social support is a crucial point in stress management. According to the Karasek and Johnson model, this is one of the three factors that concur in determining stress conditions.

It can be seen in two main aspects:

(a) the availability of social services aimed at satisfying ATCs' needs. They concern, for example, transport facilities for reducing commuting times, canteen and sleep facilities, and housing conditions;
(b) the recognition at a social level of the importance of ATCs' activities and, consequently, its appreciation by the general population.

ATCs complain that the general public do not fully understand the complexity and importance of their job, which is often considered "second class".

Michel,[12] after an enquiry on job satisfaction within a group of Swiss controllers, pointed out that "the controllers' descriptions of their own profession are very emphatic: ultra specialized, honourable, indispensable, irreplaceable, unique ... There is a shortage of descriptions to prove that this profession is *unlike the others*, and that it is one to be carried out with pride. This internal acknowledgement makes up for a *lack of external image*: the profession is little known among the general public, and is even often blamed for causing continuous traffic delays. The self-assessment is therefore indispensable for maintaining the will to work, and to work well".

This is probably determined by a scarcity of information and, therefore, the ATC companies should increase their activities in the field of public relations in order to give people adequate information about the ATCs' activities and, more generally, about the complexity of such activities, so that people can better appreciate the ATCs' job and role in modern society.

4. Intervention on technology and work organization

4.1 Improving job planing and reliability of the work systems

The passage from the old procedural methods to modern assistance, under total radar coverage of air space, is the main factor which enables a "jump in quality", not only in terms of work efficiency, but also in terms of stress levels, by reducing cognitive, memory and

[12] S. Michel: "The impact of ICWS on the 'job satisfaction' of controllers", in *SWISSCONTROL*, November 1993.

communicative loads as well as uncertainty and unforeseeability of the situations (that are, in most cases, the main sources of strain).

The further technological passage to operating under "multi-radar" assistance permits a further increase in levels of reliability and safety as well as a decrease in stress levels.

The improvement in coordinating the information flow among the centres in order to assure an increasingly safe, regular and expeditious air traffic flow is the other milestone which allows ATCs to operate safely and quietly.

This is made possible by modernizing the telecommunication and radio assistance systems and improving the efficiency and reliability of equipment, as well as by the progressive automation of the aeronautical information service, flight data processing and air traffic management.

These improvements allow for better planning of air traffic and, consequently, a more balanced workload among centres, sectors and individual ATCs. These improvements may also subsequently reduce the possibility or the seriousness of many unforeseen situations, by allowing for more reliable information and more time for solving problems and making decisions, while eliminating many stressful and risky traffic peaks.

It is clear that the introduction of advanced automated systems in air traffic control activities can profoundly change job demands and content; therefore, it has to be carried out very carefully.[13]

The goal of progressive automation is to maximize system safety and efficiency by reducing human workload and error. However, it can also increase some problems related to both cognitive processes and operative procedures. There is a justifiable concern for increased human boredom, decreased motivation, loss of situational awareness, over-reliance on and misuse of automated systems, and deterioration of skill.

Michel, after discussing with a group of Swiss controllers the impact that the new automated workstations may have on motivation and job satisfaction, pointed out some problems and the related risks that can arise.[14]

Regarding information processing, it has to be taken into account that the cognitive competence of controllers consists of simultaneously mastering part of the procedure by application and/or adaptation type. For the moment, it is the controllers themselves who "decide" about this division according to their personality and cognitive structure. With automated workstations, this division will be taken over by the machine, and the controller will then only need to apply or adapt. Some may suffer from this and gain the impression that they can no longer

[13] J.A. Wise, V.D. Hopkin and M.L. Smith (eds.): *Automation and systems issues in air traffic control*, NATO ASI Series, Vol. F73 (Berlin, Springer-Verlag, 1991).

[14] Michel, op. cit.

pursue their own logic independently, that they are losing landmarks in their reasoning and that they can no longer think in a reliable manner.

Automated systems are now able to provide aids for preventing conflicts. They will provide a "pre-processing" of situations of potential conflicts by showing the areas in which they exist (identification), the degree of urgency (classification) and even the type of solutions that can be considered. This processing carried out by the machine greatly diminishes the individual's decision power. This is certainly indispensable and unavoidable in terms of the reliability of the system, but it is also risky, having a notable effect on decision making. Indeed, what is the limit beyond which the controller will have the impression that his powers of decision are being "stolen" from him? How far can one go in letting him control the process of deciding and not simply "speaking the right information into the microphone"? The answer to the question is not an easy one, since it is difficult to find the balance between the stress alleviation by increasing the security of the man/machine system, and the reduced involvement which reduces security through a drop of vigilance.

Another example in this field comes from the utilization of the automated Traffic Alert and Collision Avoidance System (TCAS). The level of acceptance of TCAS, after more than 20 million hours of operation worldwide, has been clearly divided between pilots and controllers. From the line pilot's perspective, TCAS provides an "extra set of eyes in the cockpit" and increases overall situational awareness, especially in terminal area airspace. Overall, TCAS has been highly regarded by the pilot community, despite the operational shortcomings that have been identified during the TCAS Transition Programme in the United States.

Air traffic controllers, however, have complained about TCAS operation because of its incompatibilities with existing ATC procedures alerts, and that aircraft are leaving assigned clearances without ATC authorization and knowledge. These deviations are disruptive to a controller's plans, they increase workload and are often the cause of a great deal of unnecessary anxiety on the part of the ATCs involved.[15]

4.2 Reduction of working times and arrangement of working teams and rest pauses in relation to the workload

The mental effort, required to maintain the highest level of attention and vigilance, as well as to safely and effectively face the task in terms of cognitive and memory load, can vary widely in relation to air traffic density and connected problems.

Therefore, to guarantee the best level of performance efficiency avoiding excessive mental stress and fatigue, particular attention has to be paid to arranging duty periods.

In relation to the peculiarity of the job and the characteristics of the demands, it is worth stressing that one of the most important aspects in this domain is flexibility, which should be used

[15] *The Controller*, March 1994.

in scheduling duty periods and arranging working teams and sectors according to the air traffic density.

For example, the Committee on the Regulation of Air Traffic Controllers' Hours in the United Kingdom, after a wide survey on workloads, hours of duty, sleep, performance and fatigue, concluded that the regulation of working hours should be aimed at ensuring, as far as reasonably possible, that controllers' fatigue does not endanger aircraft, and thereby to assist controllers in providing a service safely and effectively.

(a) *Duty periods*:

— the length of the duty period should not exceed ten hours (extendable to 12 hours in special circumstances), and should be adjusted according to the workload;
— an interval of no less than 12 hours should be scheduled between the conclusion of one period of duty and the commencement of the next period of duty;
— within a 30-day cycle (720 consecutive hours), the aggregate of periods of duty should not exceed 200 hours, and not fewer than three intervals of a minimum of 60 hours each should be allowed between the conclusion of one period of duty and the commencement of the next period of duty;
— consecutive periods of duty should not exceed 50 hours in a seven-day cycle. After that, an interval of a minimum of 60 hours should be allowed before the commencement of the next period of duty;
— overtime should be an exception.

(b) *Breaks during operational duty*:

— no operational duty shall exceed a period of two hours without there being taken, during or at the end of that period, a break or breaks totalling no less than 30 minutes;
— during periods of high traffic density, the possibility of having more frequent short breaks (ten minutes) should be provided;
— a sufficiently long break for meals should be allowed, providing adequate canteen facilities to assure hot and good quality meals.

(c) *Holidays*:

— during any consecutive period of 365 days, no fewer than ten days of total holiday entitlement shall be taken in periods of no less than five consecutive days.

4.3 Arrangement of shift schedules according to psycho-physiological and social criteria

Shift work, in particular night work, is a further stress factor for the ATCs due to its negative effects on various aspects of their lives, in particular as concerns:

(a) disturbances of the normal biological rhythms, beginning with the sleep/wake cycle;

(b) changes in work performance and efficiency over the 24-hour period, with consequent errors and accidents as potential outcomes;

(c) negative effects on health and well-being, including troubles with the digestive function (disturbances of appetite, gastro duodenitis, colitis, peptic ulcers), nervous system (sleep deficit, anxiety, depression) and cardiovascular systems (ischemic heart diseases);

(d) social problems, resulting from difficulties in maintaining the usual relationships both at the family and social levels, with consequent negative influences on marital relations, children's education and social contacts.

Recent studies and research have resulted in some recommendations for the design of shift-work systems aimed at avoiding or reducing dangerous effects on health, well-being and efficiency of shiftworkers.[16] They can be summarized in the following points:

1. Adopting a rapidly-rotating shift system, changing work shifts every one or two days instead of every week (or longer), in order to cause less disturbance to the normal circadian rhythm of body functions, including performance.
2. Reducing the number of consecutive night shifts as much as possible (one or two at most), and having a day's rest after the night-shift period. This prevents accumulation of sleep deficit and fatigue, and allows a quicker recovery.
3. Delaying the beginning of the morning shift (e.g. at 07:00 or later) to allow a normal amount of sleep and to ensure the "REM sleep".
4. Preferring the forward rotation (e.g. morning-afternoon-night) to the backward one (e.g. afternoon-morning-night) to allow a longer period of rest between shifts. The forward rotation also parallels the "natural" tendency of body functions to lengthen the circadian rhythm over 24 hours when in "free-running" conditions (without external synchronizers).
5. Adjusting the length of shifts according to the physical and mental workload: day shifts should be shorter, whereas night shifts could be longer if the workload is reduced and there are sleeping facilities.
6. Giving the possibility of a short sleep or naps during the night shift, arranging proper sleep facilities. This has been found to have favourable effects on performance, physiological adjustment and tolerance of night work.
7. Keeping the shift rotation as regular as possible, so that the shift cycle will not be too long and will include some free weekends. This allows a better organization of personal, family and social life.
8. Arranging a sufficiently long pause (45 to 60 minutes) for meals during the work shift, and providing hot meals.

Individuals should also adopt some personal strategies, in particular as concerns their sleeping and eating habits, such as:

(a) Keeping to a tight sleeping schedule while on shift and night work and, as much as possible, avoiding disturbances (e.g. arranging the bedroom so that it is as silent and dark

[16] A. Wedderburn: *Guidelines for shiftworkers*, Bulletin of European Shiftwork Topics (BEST) No. 3 (Dublin, European Foundation for the Improvement of Living and Working Conditions, 1991); and P. Knauth: "The design of shift systems", in *Ergonomics*, Vol. 36, Nos. 1/3, 1993, pp. 15-28.

as possible; using ear plugs; making some arrangements with family members and neighbours).

(b) Avoiding the use of sleeping pills, save in exceptional cases, and only under medical control.

(c) Trying to adhere to the usual meal times, which can act as a good synchronizer of body functions.

(d) Eating light meals no later than two hours before going to sleep; avoiding caffeinated drinks and alcohol; relaxing before going to sleep (light exercise, reading, watching television, listening to music).

(e) During the night shift, having the main meal preferably before 01:00; thereafter, consuming only light snacks with a high carbohydrate level and soft drinks (fruit juices, milk).

According to these guidelines, the Italian ATC company, ANAV, has adopted for many years a fast-rotating shift schedule on a six-day cycle, as follows: first day: afternoon (13:00-20:00); second day: morning (07:00-13:00); third day: night (20:00-07:00); fourth day: rest after the end of the night shift; fifth day: off; sixth day: off.

The length of the work shifts is inversely associated with the traffic load, the morning and afternoon shifts being shortened to seven hours, in relation to higher air traffic loads, and the night shift being longer (11 hours) in relation to lower air traffic loads. Moreover, during the night shift, controllers are allowed to have long rest pauses alternatively, during which they can take naps in properly arranged rooms.

This has been found to be very helpful in overcoming sleepiness and maintaining alertness and performance efficiency. In fact, in a study concerning their psycho-physical reactions, the examined controllers were shown to be maintaining a normal circadian synchronization of body rhythms, and high levels of awakeness and alertness (documented by mood and physical fitness rating scales, as well as by tests of performance and hormonal excretion) also during the night, in spite of the external understimulation.[17]

Furthermore, the Committee on the Regulation of Air Traffic Controllers' Hours in the United Kingdom, has recently proposed that:

— no more than two night shifts may be worked in immediate succession;
— upon the conclusion of two night shifts in immediate succession, there shall be an interval of a minimum of 54 hours before the commencement of the next period of duty;
— delaying shift systems should be preferred to advancing systems.

4.4 Participation in decision making

Participation of the controllers in decision making appears to be necessary to increase perceived influence, motivation, job satisfaction and performance efficiency, as well as to

[17] Costa, 1993, op. cit.

decrease stress and relative negative consequences, not only for the individual, but also for the organization (role conflicts and role ambiguity, job-related communications, exasperated criticisms, strikes, etc.).

This aspect is becoming more and more important as long as automated and expert systems are being introduced. The effect of automation can be very complex: some tasks are eliminated, others modified, and still others created. The adaptation of the controllers to such changes depends greatly on their involvement in the process, particularly as concerns the man-machine cooperation and the utilization of skill and creativity in an apparently more normal and passive role, that otherwise can give rise to frustration and alienation.

Increased participation in decision making is one of the four main suggestions given by Farmer after a survey on British ATCs.[18] Responses to job satisfaction items indicated that, although the controllers were satisfied with the intrinsic content of their work, they were rather dissatisfied with other aspects of the job, such as organizational design and structure, the value placed upon their efforts, internal processes within the organization, and personal relationships. The focus of such responses, together with numerous criticisms of management styles, suggest that more attempts should be made to foster more "democratic" decision making.

5. Intervention in working place and task structure

5.1 Improving the work environment

Particular attention has to be given to ensuring that environmental conditions in the control centres are suitable and comfortable as concerns, in particular, lighting, noise and microclimatic conditions.

5.1.1 Lighting

Taking into consideration that the ATC's task is performed almost exclusively in front of a visual display unit, particular attention should be paid to providing lighting conditions which favour an optimal visual performance.

Lighting conditions are completely different inside the regional centres and the towers.

In the radar centres, dim light (under 200 lux) is usually used to favour the visual contrast on the screen. It has to be considered that the introduction of modern screens are brighter and in colour, allows an increase of the illumination levels in the control room (up to 500 lux), thus avoiding excessive (and troublesome) luminance contrasts between central and lateral visual fields, making the environment more stimulating, thus increasing vigilance and alertness.

[18] Farmer et al., op. cit.

The lighting should be indirect, obtained preferably by mixing natural and artificial light directed onto the ceiling and the walls and thus reflecting into the room. This gives a diffuse lighting in the work environment without shadows and glare. Each artificial lighting unit should contain two or more phase-shifted tubes to avoid flickering, which is extremely annoying, causes visual discomfort and makes the reading of the different traces on the screen more difficult.

Inside the towers, the opposite is the problem. It is necessary to avoid excessive illumination levels due to external bright light using both anti-reflection glass and curtains; it is also important to have the possibility of positioning and shielding the visual display units to avoid indirect glare due to bright reflections on the screen.

5.1.2 Noise

The noise levels recorded inside control rooms are usually under the risk level for loss of hearing, but can have significant effects in terms of interference with speech communication, the disturbance of mental concentration and annoyance.

It is worth considering the peculiarity of verbal communication, carried out in a foreign language for most of the pilots and ATCs, and containing many unfamiliar, technical and cipher words.

The main sources of noise are represented by conversations, manual operations (e.g. manipulations of strip supports) and office machines (printers, telephones, photocopiers, etc.).

Therefore particular attention has to be paid in order to stop background noise from exceeding 45-50 dB by installing quieter office machinery, arranging work sectors in order to have better sound protection from each other, and installing more insulating headsets and more sensitive microphones.

5.1.2 Microclimatic conditions and indoor air quality

A comfortable working temperature is another important factor supporting the maximum efficiency of performance. It is well-documented that conditions of thermal discomfort favour loss of concentration and efficiency of mental tasks with a consequent increase of errors and irritability.

Microclimatic conditions must be maintained within the range of thermal comfort, that is air temperature between 20 and 24C, humidity between 30 and 70 per cent, and air velocity between 0.05 and 0.5 m/sec.

To ensure these conditions, it is necessary to install adequate air conditioning systems which must be maintained efficiently to guarantee a good indoor air quality.

Indoor air, in fact, can be polluted both from human activities (odours, exhaled carbon dioxide, smoking) and by environmental contaminants (chemical substances, microbes). Therefore, it must be periodically changed (at least three times per hour) and purified (passing

through adequate filters) in order to avoid people complaining of symptoms related to the so-called "sick building syndrome" (lethargy, tiredness, headache, blocked nose, dry eyes, sore throat, wheeziness, cough, general itchiness) that cannot only disturb work performance, but also cause sickness and absenteeism.

5.2 Arranging workplaces according to ergonomic criteria

5.2.1 Workstation design

Particular attention has to be paid to the configuration of the workstation, in particular as concerns the console layout in terms of the positioning of radar screens and auxiliary displays, the disposition of commands and controls, and the design of the keyboard and other interfaces.

Further standardization of the panel layout is required. Information and controls must be easy to understand and input devices easy to operate, according to logical processes of mental reasoning: delays and errors may occur because of confusing, misleading or excessively confusing documentation and information, poorly located knobs and levers, or lack of proper coding causing mismatches and mistakes.

Data displays containing flight information should preferably be located beside the radar screen, whereas the auxiliary displays showing maps or other complementary information can be placed above it.

High resolution and multi-colour displays are preferred; keyboards, rolling balls or joysticks should be movable to accommodate individual preferences; headset jacks must be positioned on both sides of the table and should not protrude.

It is also important to arrange the layout of the workplace in order to avoid glare caused by excessive brightness contrasts between different objects and surfaces; it causes discomfort and hampers the comprehension of the information. The displays should be shaded and the surfaces matte, avoiding the use of reflective materials and bright colours on table-tops and consoles. The luminance contrast between the screens and surrounding surfaces (plan-table, console frames, documents, keyboards, strips) should not exceed the ratio of 1:10.

The most advanced display systems allow for better performance with greater comfort because of their greater width, more favourable visual contrast, higher reliability, greater possibility of storing and retrieving information, and a better control layout.

On the other hand, particular attention has to be given to software ergonomics that can offer great possibilities for improving presentation, comprehension and processing of information. With regard to this, it has been proved that an appropriate use of colours, symbols, line shaping, windows and figures facilitates and hastens data recognition and extraction.

However, it is worth mentioning that drastic changes in workstation design and man-machine interfaces, often made possible by technological improvements, should be adopted very

carefully, as they can cause excessive stress and decreased performance due to difficulties in the adaptation of mental processes and operating procedures.

For example, according to a group of Swiss controllers interviewed by Michel,[19] the system of windowing raises the question of what should be on screen permanently and what should not, bearing in mind that even permanent presence does not mean total security. The excess of information forces the controller to perform a mental "sort" and he only consults that which he considers useful. Therefore incidents/accidents are very often due to misrepresentation of what is useful.

With automated workstations, the controllers have less to do with telephoning, listening and passing on information. These interpersonal communications can have an influence on the method of work and the search for solutions. Reduction of verbal and non-verbal communication might lead to a feeling of isolation and a poorer internal atmosphere; therefore, greater emphasis should be placed on the development of adequate levels of communication.

The abolition of paper strips should also be carefully considered. For most controllers, they fulfil a structuring role at a cognitive level and, in addition, they play an extremely important psychological role of reassurance (particularly in case of unforeseen breakdowns). There is nothing to prove that these psychological functions will be fulfilled by electronic strips, even though the technical functions will certainly be perfectly assured.

On the other hand, the four ODID (Operational Display and Input Development) simulation projects, carried out in the last seven years by EUROCONTROL, have pointed out some very interesting developments in the use of new technologies in human-computer interface. The successive steps looked at the use of colour electronic data displays (ODID I and II), the use of the mouse in combinations of graphic displays (ODID III), and the replacement of the strips and radar displays with a composite picture of graphic images and on-screen input mechanism (ODID IV). The latter is programmed to present the controller with the most likely input order as a default value so that, in most cases, it is sufficient to point at a data field and press the mouse button to insert the data and the controller's intentions into the system. The input system is intuitive and logical, which makes it easy to use, easy to learn, and faster than the voice command over radio or telephone. Although the paper strips are replaced by an electronic display of data, the system has carefully maintained the working methods currently practised by controllers. An analysis of controller needs has led to a display system with which the controller will carry out his work in a similar manner as today. A Medium Term Conflict Assistance (MTCA) function has also been developed, which scans all flights for the controller and presents the results of this conflict detection for his inspection and action.

5.2.2 Working with visual display units

The interaction between the ATC and a visual display terminal are mainly characterized in terms of data acquisition and interactive communication. The ATC has a continuous dialogue

[19] Michel, op. cit.

with the radar-computer system by calling up information, scanning traces, inputting, reading and deleting data. The controller concentrates mainly on the radar screen and periodically glances at the side displays and keyboard.

The radar screen should be placed in the centre of the visual field and should be adjustable in height, distance and angle to give the operator the possibility of arranging the best working position in order to avoid, on the one hand, prolonged contraction of the neck muscles and, on the other hand, an excessive effort of visual adjustment with consequent visual discomfort and fatigue. Therefore, it is recommended that the screen be placed within a viewing angle of 5° above and 30° below the horizontal plane of sight, and that the eye-screen distance is between 50 and 70 cm to facilitate visual adjustment.

To give the operator the possibility of coming closer to the screen in order to focus better on traces in moments requiring particular attention, it is necessary that the table-top be not overly large but, at the same time, able to support the arms without interference with the keyboard.

5.2.3 Sitting postures

The ATC usually remains seated in front of the console, changing position slightly according to the working conditions. The ATC normally sits in the middle of or forward on the chair with his or her arms on the table-top when he or she is actively operating and needs precise control of the radar screen, and leaning on the backrest when he or she is on stand-by.

A prolonged, constrained sitting posture causes musculo-skeletal discomfort and pain, particularly at the level of the neck, the shoulders and the lumbar tract.

In order to avoid or alleviate such disturbances, it is important to use suitable chairs which allow a comfortable sitting posture while working, as well as useful muscle relaxation while on stand-by or resting in front of the screen.

A good chair should be designed for a forward and reclining sitting posture, adjustable in height and angle, rotating on a five-legged base. It should also have user-friendly controls, have wide arms and a high backrest, a pad for lumbar support and a head-rest. The seat should be made of a sufficiently resistant padding of foam rubber covered with non-slip and permeable material, and it should also have a slight hollow and a rounded front edge turned upwards about 4 to 6 degrees above the horizontal plane.

The break periods between operational duty should also be used as "postural pauses", the controller should stand and walk around, stretching his body.

Moreover, a programme for improving physical fitness should be planned, aimed at preventing lower-back pain by providing gymnasiums to be used by the ATCs during their relief periods. There should also be technical guidance aimed at showing the most appropriate exercises that should be done for the most effective "postural pause".

6. Intervention to improve individual responses and behaviour

6.1 Individual ways of coping with stress

Managing stress properly also requires that the individual learn how to cope effectively in terms of personal lifestyles and behaviours.[20]

A. First of all, people should **avoid ineffective ways of coping**, which can have an apparent short term positive effect but, in the long run, can cause further problems in health and well-being. We refer, in particular, to smoking, alcohol drinking and drug consumption.

Increasing **smoking** (for smokers) and/or **alcohol intake** is sometimes seen as a way of obtaining a sense of relief and calmness. Of course, apart from short-term relief, there are many adverse effects both on performance efficiency, due to interference with the upper nervous system activities, and on health, due to increased risk of lung tumours and chronic bronchitis from smoking, and of stomach and liver diseases from alcohol.

For example, in the study of Farmer among 618 British ATCs,[21] "the average level of alcohol consumption was related primarily to personality: those who drank more were likely to be extroverts, tough-minded, and relatively unambitious, and to have low behavioural control". The association between this last personality variable and drinking was mediated by use of alcohol to cope with the pressures of the job.

The consumption of **drugs** (e.g. stimulants, tranquillizers or anti-depressants) can have a positive effect only if they are used — under medical supervision and attention is paid to their negative effects on vigilance and performance! — as auxiliary and temporary support for the organization of effective strategies aimed at removing the causes of stress. In any other case, they become a dangerous masking factor of the stress condition that is more likely to become chronic and cause dangerous drug dependence and addiction.

For example, as far as the delicate problem of alcohol and drug abuse is concerned, the Canada Air Traffic Control Association, jointly with Air Traffic Services and Civil Aviation Medicine, has developed a programme called Working Together, aimed at (a) helping controllers who have a chemical dependency (alcohol or drug) problem get back to work earlier after initial treatment; and (b) increasing awareness of existing resources for the prevention, early identification, assessment and rehabilitation of chemical dependency problems.

Also, Transport Canada personnel licensing medical standards normally require a two-year waiting period before the return of a Licence Validation Certificate after loss due to alcohol or

[20] J.M. Atkinson: "Analysis of mental processes involved in air traffic control", in *Ergonomics*, Vol. 14, 1988, pp. 565-570; C.L. Cooper, R.D. Cooper and L.H. Eaker: *Living with stress* (Harmondsworth, Penguin, 1988).

[21] Farmer et al., op. cit.

drug dependency problems. The programme facilitates a much earlier reinstatement of the licence by providing a structured rehabilitation framework that includes a peer support network. It also encourages controllers to seek help early before their licence is potentially affected.

It features a *voluntary follow-up support programme.* Controllers with a chemical dependency problem who wish to participate agree both to enter into a *compliance agreement*, which sets out the relicensing requirements of Civil Aviation Medicine and to enlist the help of a *follow-up support team.* This team, chosen by the recovering individual, consists of a physician and one, or preferably two, other trained support team members (controller and/or manager). Team members are knowledgeable in the area of chemical dependency. They are selected from a roster and trained for their role within the follow-up support process. Each support team member understands the nature of a chemical dependency problem and is supportive during the rehabilitation process.

Each follow-up support team member, who is personally selected by the individual, is required to keep all information regarding the participant's follow-up programme confidential, except in two specific instances: (1) the physician member of the support team is required to submit confidential periodic reports regarding the participant's progress to the regional aviation medical officer to facilitate LVC reinstatement and to assess continuing medical fitness for ATC licensing; and (2) only with prior written consent provided by the participant will information be shared with specific people considered mutually essential and directly involved in the participant's recovery.

Furthermore, controllers concerned about potential personal problems related to chemical dependency have access to CATCA Controller Advisors, ATCIH Health and Lifestyle Consultants and Physicians, plus Transport Canada Regional Counsellors for information relating to chemical dependency prevention and rehabilitation; assistance in seeking referrals for assessment, counselling and treatment; and advice on other related issues.

B. Secondly, **maintaining good physical fitness and emotionally stable psychic conditions** are the best aids in fighting and overcoming stress.

To stay in satisfactory condition, people should pay particular attention to physical exercise, eating habits, sleeping patterns, relaxation techniques and leisure activities.

There is no doubt that **physical exercise**, if carried out regularly and in a non-competitive way, is beneficial for all the body functions improving both physical and psychological well-being.

However, particular attention should be given by the controllers to secondary occupations and/or sport activities which could hamper proper relaxation or adequate sleep, thus leading to greater tiredness or reduced alertness while on duty.

Proper **eating habits** are also important in keeping the person fit. A balanced diet, having light and easily digested meals before and during work, can support work performance during duty periods, avoiding drops in mental efficiency and drowsiness that generally occur after heavy

meals. A diet with a low-fat content and the right amount of calories, aimed at maintaining an ideal body weight, also has a strong influence in preventing degenerative processes for chronic digestive and cardiovascular diseases, for which both stress and obesity are important risk factors.

Preserving **sleep** both in terms of quantity (for recovering from physical fatigue) and quality (for psychic well-being), is a very important anti-stress measure. Sleeping troubles, in fact, can be an early symptom of stress, but can make the person more vulnerable to stress as well. Should these troubles arise, the person should not use sleeping tablets (or only as a last resort), but try behavioural methods, such as taking more exercise to become more tired before going to bed; adopting stricter times for going to bed and getting up; avoiding eating before going to bed; having a light dinner with a prevalent content of carbohydrates rather than proteins; not taking stimulants, such as alcoholic beverages, tea, coffee and soft drinks containing caffeine; having a warm bath before going to bed; arranging a comfortable bedroom protected from disturbing noises; listening to relaxing music or reading before sleeping.

Relaxation techniques are becoming more and more popular among people who feel to be under stress. Massage, yoga, meditation and autogenous training are all useful exercises which help to control restlessness, anxiety, muscular tension, inability to concentrate, insomnia and other symptoms of stress.

Leisure time activities may help fight stress provided that they have a recreative aim and are not taken too seriously, in order to avoid them becoming another stressor. Depending on personality characteristics, some people prefer individual activities (such as fishing, painting, listening to music, reading and do-it-yourself); others need group activities (such as team games and social groups).

Educational activities concerning all these important aspects are provided by many ATC companies. They are carried out by means of printed materials (newsletters, brochures, posters) as well as by seminars and periodic meetings. Lifestyle consultants work with employees and managers to help them become aware of lifestyle practices that promote physical and mental health by providing lifestyle assessment and programming, such as good nutrition, physical fitness, relaxation, medication and prevention of illnesses.

Some companies provide gymnasiums inside the centres to be used by controllers during work pauses to relax both physical and mental tension, as well as to maintain good physical fitness.

6.2 Selection and training

Improvements in selection procedures are desirable.

The Swedish Civil Aviation Administration, in close cooperation with Uppsala University, implemented an integrated training programme in 1974 that lead to positive results by reducing the average failure rate of applicants by almost 20 per cent (it passed from 54 per cent during the 1970s to 66 per cent during the 1980s and to 74 per cent during the 1990s). The expert group reported that an important prerequisite for a successful training result is an efficient selection

procedure based on a well thought-out chain, consisting of an information-introduction-skill test, assessing in substance the most important groups of the key behaviours derived from a work analysis based on the critical incident technique, such as decision making in a dynamic process; self-confidence; information gathering and processing; social relations; and communication. Moreover, it became clear that efforts have to be made in order to continually pin-point key behaviours in changing technology. In fact, if a new technology or system is to be introduced, it is important and fundamental to be assured that operators accept the new technique and that the new technique will create opportunities for them to improve their performance. They must also be informed in advance of how to be trained to achieve this new standard of performance. Furthermore, the results of trying to apply modern training techniques, for example programmed skill-training and to teaching the instructor to become a mentor and a coach, is now believed to be the most promising measure taken to improve the outcome of basic ATC training.[22]

Personality variables (e.g. conscientiousness, trait anxiety, neuroticism/emotional stability, type A, non-assertive behaviour) also play an important role in flight safety and may be associated with many stress effects.

For example, in a large study concerning 1,790 students of the FAA Academy,[23] it was shown that the proportion of students who passed at the Academy decreased as a function of increasing levels of anxiety, and that the proportion of students who either failed or were in the withdrawal/incomplete category increased as a function of increasing levels of anxiety. On the other hand, a higher proportion of ATCs with lower anxiety scores were successful in field training compared to the group of trainees with high anxiety scores.

Therefore, greater emphasis on these factors during selection and training may increase both the performance efficiency and the level of resistance to stress of ATCs.

Periods of training are also of crucial importance for the education of ATCs in terms of stress prevention. An effective training programme aimed at understanding the needs and capacities of the individual, and balancing individual needs with organizational needs, is able to improve not only technical learning but also motivation, job satisfaction and human relations.

Training should also aim, in particular, at teaching occupational and specific coping strategies in order to improve the capacity of event appraisal and problem solving, so that ATCs learn how to cope with emotional effects of stressful events and improve the capacity of control.

Air traffic controllers should be trained to develop action-oriented and problem-focused coping abilities. Positive acceptance and reappraisal of stress situations, active coping, seeking social support for instrumental and emotional reasons must be strengthened, while inclination towards restraint coping, behavioural and mental disengagement should be restricted.

[22] *The Controller*, No. 4, 1993.

[23] W.E. Collins, D.J. Schroeder and L.N. Nye: "Relationships of anxiety scores to screening and training status of air traffic controllers", in *Aviation, Space and Environmental Medicine*, March 1991, pp. 236-240.

An important part of the training should also be devoted to improving interaction between controllers and pilots, promoting meetings aimed at increasing a mutual understanding of each other's work tasks, problems and operative behaviours.

Periodical refresher courses on the English language for non-native speaking people are also important for improving self-confidence and avoiding stressful and risky misunderstandings while communicating.

6.3 Counselling and other supporting measures at company level

Psychological support and counselling given by psychologists appears to be an important aspect of the coping strategies that can be activated at company level. This should be carried out periodically and, in particular, on occasions of high emotional stress and anxiety due to conflicts or errors that can lead to burn-out.

This should be concerned with improving self-control, developing a more effective capacity of choosing among alternative modes of action and behaviour, and to gaining more information about reactions by monitoring self-behaviour, emotions and thoughts.

For example, the Transport Canada Counselling Service has set a specific programme for critical incident stress management (CISM). It consists of both pre-incident education and post-incident support services, managed by teams of mental and occupational health professionals. It is aimed at increasing awareness about critical incident stress (CIS) and post-traumatic disorders, teaching effective techniques for managing and reducing strain, and giving support for a defusing and/or debriefing process of the event to help alleviate the immediate stress reactions and to promote a quick return to routine activities.

The "debriefings" are structured group meetings that emphasize educational and informational elements which are of great assistance for emergency personnel in understanding and dealing with stress generated by the event. The support process is ideally conducted within 24 to 72 hours after the incident and generally lasts two to four hours in length.

The "defusings" are a shortened version of the debriefing. They are usually 20 to 90 minutes long in an ATC environment. It must be done within eight hours of an incident.

"Follow-up services" are always necessary after a defusing to ensure that the personnel are adequately managing stress. This may be done in several ways, e.g. by telephone, by direct contact with the person or, in extreme situations, by providing debriefing to family members as well. The maintenance of confidentiality is vital to the success of these services.

Their introduction is of paramount importance, considering that approximately 86 per cent of individuals experiencing CIS will have some cognitive, physical or emotional reaction within 24 hours after the incident. If unmanaged, 22 per cent will have symptoms six months to one year after the event, and approximately 4 per cent run the risk of developing post-traumatic stress disorders.

The following guide booklet given to controllers, concerning critical incident stress management, is reproduced by kind permission of the Transport Canada counselling services.

CRITICAL INCIDENT STRESS MANAGEMENT

About CIS

Sooner or later, most people involved in the field of transportation have critical incident stress (CIS).

> A *critical incident* is any line of duty situation that causes employees to experience unusually strong emotional reactions that could interfere with their ability to function, either at the scene or later; e.g., a serious personal injury, the death of someone you work with or being involved in a transportation accident.
>
> *Critical incident stress* is a term describing all the typical reactions that employees may experience when they are involved in these kinds of traumatical events.

Many Transport Canada employees are at risk for CIS simply because of the kind of work they do. In this booklet you will learn what CIS is. How to manage it and how Regional Counsellors can help you and your co-workers deal with it.

Use the booklet as a personal guide. Think about the questions in it and write your thoughts and ideas in the space provided. You may wish to share your thoughts and feelings with a close family member, friend, co-worker or counsellor. Keep in mind that most people who experience CIS are sensitive about their reactions to it and want to keep discussions confidential.

The first step is recognizing a critical incident.

Can you remember a specific event or situation when you felt an overwhelming reaction that interfered with your ability to do your job or get on with life in general? If so, chances are you have experienced CIS.

A critical incident may be a major disaster involving many people or a smaller incident with one or two people. Typical critical incidents experienced by Transport Canada include:

- the death or severe injury of a co-worker in the line of duty
- the suicide or traumatic death of a co-worker
- an incident where people are killed or badly injured, e.g., air crash, marine disaster
- prolonged rescue or recovery operations, especially when children are involved or where the person is known to rescue personnel
- a hostage taking
- a violent incident at work
- exposure to toxic materials
- situations involving intense media attention
- a serious operational error

Critical incidents happen to the best of us:

- firefighters
- radio operators
- operations personnel
- search and rescue crews
- security personnel
- dispatchers
- air traffic controllers
- maintenance crews
- secretarial or administrative personnel
- duty managers

People react to critical incidents in different ways.

Most employees involved in air, surface or marine disasters or other traumatic events will experience strong emotional and physical reactions. These predictable and normal reactions are known as CIS.

By recognizing and understanding when you are experiencing CIS you can make choices that will protect your health and how well you do your job.

Typical reactions include:

— exhaustion and sleeplessness
— disturbing flashbacks related to the event
— nightmares
— withdrawal
— anger, feeling impatient and irritable
— a need for recognition
— a preoccupation with negative thoughts
— a loss of self worth and confidence

Which of these reactions have you noticed following a critical incident?

Keep in mind that

— CIS is not the same as everyday stress; it is more intense and is tied to a specific event
— what is stressful for one person may not be stressful for another
— a person's reaction may change form one incident to another
— CIS reactions may occur immediately after an incident, they may occur several weeks or months later, or they may accumulate over a period of time and be the result of several incidents
— a strong reaction is a normal reaction; very few people remain unaffected by critical incidents

Managing CIS

There are four keys to managing CIS:

— recognize your reactions
— analyse the incident
— choose your options
— make some changes

When you experience CIS, you can protect your health and feel good about yourself at work and home by using these four keys.

1. Recognize your reactions

Read each list of common CIS reactions below and check (√) the items that apply to you. Some items in the lists may trigger immediate responses; be sure to take enough time to think about the ones that don't come as quickly — they are often valuable sources of information.

Feel free to add your own items at the bottom of each section.

Physical reaction	Cognitive reactions	Emotional reactions	Behavioural reactions
_ exhaustion	_ blaming attitude	_ anxiety	_ emotional outbursts
_ nausea/vomiting	_ confusion	_ anger	_ change in activity level
_ weakness	_ reduced attention span	_ sense of loss	_ disturbed sleep
_ difficulty breathing*	_ flashbacks	_ feel strongly for victims	_ increase smoking
_ chest pains*	_ poor concentration		_ startle easily
_ rapid heart rate	_ loss of confidence	_ numbness	_ antisocial behaviour
_ headaches	_ negative self-talk	_ guilt	_ change in appetite
_ thirst	_ decreased awareness	_ fear of loss of control	_ difficulty relaxing
_ elevated blood pressure	(e.g., feeling dazed)	_ irritability/agitation	_ feeling hyperactive
	_ troubled thoughts	_ depression	_ easily distracted
- fainting/dizziness	_ easily distracted	_ feeling overwhelming	_ increased use of
		_ feeling isolated	alcohol or other drugs
		_ strong need for recognition	_ changed sex drive

(* these reactions require immediate medical attention)

People respond to this checklist in different ways. Some people can check off a lot of items and others only a few. The more symptoms you are aware of, the better you will be able to deal with them. Some of the most common reactions are exhaustion, frustration and the need for recognition about what you have just gone through.

Review the items you checked. Which three are the strongest indicators of how you respond to a critical incident?

Your reaction is unique to you. It depends on your emotional makeup, your level of fitness and general health, other stressors in your life, experience on the job, the incident, the amount of time spent at the scene, how well you have learned to deal with stress in general, and so on.

2. Analyse the incident.

Think about the same event you used to complete the previous activity. What was it about this event that made it a critical incident from your point of view?

The more you understand the incident and your reactions to it, the better prepared you are to do something constructive about it.

3. Choose your options

The old saying, "Different strokes for different folks" sums up how to choose solutions that will work for you, your co-workers and your family.

> Many solutions are simple and free, but that doesn't make them easy to do while experiencing CIS. Eating and sleeping, being physically active, listening to restful music and doing breathing exercises are all fairly simple solutions. But they can be next to impossible to do if you are feeling exhausted, frustrated or out of control, or if you have lost your appetite.

If you want to be successful in dealing with CIS, choose options that make sense to you, are interesting and convenient, and will give you the benefits you want. Check the following suggestions that apply to you.

Before a critical incident, think preparation: The potentially harmful effects of CIS are easy to prevent with immediate and proper intervention.

Keep your immune system strong by focusing on a healthy lifestyle:

- eat regularly and well
- sleep 7 to 8 hours
- enjoy your work
- be physically active on a regular basis
- spend relaxing time with friends
- laugh a lot
- avoid excessive use of alcohol, caffeine and nicotine
- attend a Canada Transport pre-incident educational session to help you and your co-workers prepare for CIS. To request a workshop or presentation, contact your Regional Director of personnel. If you would like a confidential personal session, call your Regional Counsellor for an appointment.

During a critical incident, think protection: Focus on ways to manage the stress and protect yourself and others around you from further harm.

Take care of yourself:

- use positive "self-talk", such a "I'm doing fine" and "I'm using the skills I've been trained to use"
- eat frequently and in small quantities
- be as physically active as possible, take frequent short walks, stretch regularly
- keep your sense of humour; reduce "disaster humour", it may offend more than help
- take short breaks if you feel your work is suffering, or your supervisor suggests you do so

Take care of your team:

- make an agreement with your co-worker to watch each other for stress symptoms during critical incidents
- support those who seem to be under the most stress — be positive in your approach; be accepting of co-workers for how they feel or function shortly after the incident
- show appreciation and positive feed-back for work done well during an incident
- talk about your feeling with someone you respect
- keep those *once-upon-a-time-someone-went-through-something-worse* stories to a minimum; they tend to play down the real stress of the moment
- remember that anger is a normal response in stressful situations — try not to take it personally if it gets directed at you; avoid directing your anger at your co-workers
- listen actively to co-workers who are experiencing CIS; assure them that their feelings are normal
- keep what you hear confidential
- participate in both informal and organized team debriefings

Take care of your home: knowing that things are under control at home is a good way to reduce the normal stress in your life during critical periods at work.

— talk with your family and close friends about CIS and the challenges of your job
— set up a family response for dealing with critical incidents that cause a break in your normal home routines, e.g. make sure you have a quiet place to rest.

After a critical incident, think renewal: Downshifting when your engines are racing is an important part of managing CIS. Returning to your usual life patterns after a critical incident requires a shift into a more normal pace and routine.

— keep your expectations about returning home realistic; anticipate where problems might develop and prepare for them, e.g. negotiating your need for rest, changing routines, etc.
— accept that you need to rest; it may take several days to get back to normal
— if you have young children, make an effort to help them understand your situation; think carefully about how to describe what happened without frightening them
— balance your need to talk about the incident with other people's need not to talk about it; try not to take it personally when others are not as interested as you are in talking about the incident
— balance your need to work through the incident on your own with other people's need to understand what has happened to you
— participate in a critical accident stress debriefing (CISD) offered by your Regional Counsellor

Transport Canada offers CISDs where you can discuss your reactions to an accident in a safe, non-threatening environment and learn CIS management techniques. CISDs are not operational critiques nor are they therapy. They are confidential educational opportunities to assist you and your colleagues.

Because CIS is a normal reaction to an event that is outside the range of what you usually experience, it often takes a special effort to get your life back to normal. Both research and practical experience have shown that dealing with CIS as soon as possible following a critical incident helps to minimize the negative impact of stress reactions.

Throughout, be good to yourself: By taking care of Number 1, you're in better shape for yourself and everyone else. Set aside some time each day when you can do something just for you. This might involve vigorous exercise, a "power nap", a walk outside, some stretching exercises, a hot bath, meditation, an entertaining TV programme, a deep breathing pause or a phone call to a supportive friend. When taking time alone, focus on slowing down, thinking positive thoughts and tuning into your own needs.

4. Make some changes

As a result of thinking about CIS and your own experiences, what could you do to improve how you manage CIS?

I could start

_____

I could stop

_____

I could continue

_____

If you are reading this booklet, you have already made a good start. The rest depends on following through.

Good luck!

7. Appropriate medical surveillance for health protection and promotion

Because of the specific requirements of the task, it is necessary that operators not only possess high intellectual and operative skills, but that they are also in good health (both physical and mental) in order to guarantee the highest levels of vigilance and performance at all times.

Therefore, good medical surveillance is essential to ensure that operators are in good health and are able to carry out their job without unnecessary stress. In fact, the fear of losing their licence (and the accompanying economic benefits) because of health problems is often a further stress factor for the controllers.

Consequently, the application of the precise norms and recommendations, defined by the International Civil Aviation Organization (ICAO)[24] for the medical certification of licence holders, must be regarded as a preventive measure rather than a fitness programme.

At present, the controllers are submitted to a periodic check-up, at least every two years for those under 40 and every year for those over 40. These check-ups consist of a general medical examination supplemented by blood and urine analysis, electrocardiogram, visual and auditory tests and, if necessary, further medical checks by specialists.

During these medical checks, doctors should pay particular attention to specific complaints or illnesses, as well as to personality characteristics and coping strategies, with the aim of defining possible stress-related disorders and suggesting further preventive measures.

Therefore, medical surveillance should be converted from the predominant aspect of formal certification of "fitness for work", derived from the lack of evidence of significant troubles and illnesses causing a decrease in medical fitness, into a more positive approach aimed at preserving the controller's health and well-being at best.

This deals with the above-mentioned guidelines and education programmes on preventive health measures (e.g. sleep, diet, smoking, physical fitness, rehabilitation), as well as to positive personal behaviours which are able to enhance job satisfaction and the psycho-physical condition.

Taking into account the different factors that can influence resistance and tolerance to stress, constant attention has to be paid to give social support to those controllers who may be expected to encounter more difficulties in coping with stress on the basis of their psycho-physiological characteristics, health situation and living conditions.

For example, in a study among 618 British ATCs,[25] "the level of self-reported physical ill-health, although fairly low in absolute terms, exceeded that reported by other occupational

[24] International Civil Aviation Organization (ICAO): *Manual of civil aviation medicine* (Montreal, 1985).

[25] Farmer et al., op. cit.

groups. Reported ill-health was higher among both who were trait-anxious and those who had low behavioural control; the effect of low behavioural control was mediated by decreased use of task strategies to cope with job demands".

In a recent epidemiological survey on the health condition of 572 Italian air traffic controllers, it was found that sixteen of them were judged unfit to work and transferred to administrative jobs because of health impairments, due to severe diseases of the nervous, gastro-intestinal and cardiovascular systems. Such disorders, as well as musculo-skeletal ones, were mostly reported present in active controllers. Beside age, some personal characteristics appeared to influence health and well-being. In particular, neuroticism was correlated with chronic fatigue, minor psychological disorders, cognitive and somatic anxiety, and digestive and cardiovascular complaints.

Taking into consideration that the above-mentioned disorders are, in most cases, a manifestation of chronic-degenerative processes (for which medical therapy has little, if any, effect) and that stress is one of the main risk factors, it is clear that preventive health measures and proper medical surveillance have a basic role to play in preserving well-being and performance efficiency of air traffic controllers.

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