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Human Factors in the Aircraft Cabin

Inflight safety and efficiency depend upon a proper balance of highly interactive factors that include aircraft interior design, operating procedures and passenger-cabin crew considerations.

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In everyday speech, the phrases "human factors" and "the human factor" frequently refer to individual quirks of behavior which may be irrational and difficult to explain and which can be called upon, in the absence of any hardware failure, to account for unfortunate events such as accidents. Implicit in this everyday usage is the notion that behavior is unpredictable and that the addition of a human being to an otherwise smoothly-operating system will inevitably result in human error at some time or another.

Even when there is some recognition of the requirement to accommodate the human within the system, the idea of the need for expertise to optimize this accommodation is often rejected on the grounds that it is all a matter of common sense. In fact, common sense has serious limitations when decisions have to be made about integrating humans into systems. A more satisfactory approach would be to utilize the technology of human factors, which has as its subject matter the capabilities and limitations of people which have to be taken into account when designing or managing any system which has a human as a component.

Human Factors in the Aircraft Passenger Cabin

In contrast to the flight deck, where only one fairly homogeneous group of people must be considered, the passenger cabin must accommodate the needs, limitations and capabilities of two different groups of people. These are the passengers who are the system users, and the cabin crew members who are the system operators. When the requirements of these two groups conflict, an informed compromise must be devised.

Considering the Passengers

For the passengers, the cabin is an extension of their living space. Their requirements are for comfortable seats, adequate toilet facilities, the provision of food and beverages appropriate to the length of the flight, and the confidence that they will arrive at their destination without mishap, or, if a mishap occurs, that they will be taken care of by the cabin crew.

Passengers come in all shapes and sizes, in a wide range of ages, and in various states of health including some quite serious disabilities. An aspect of the cabin that has an immediate impact on a passenger is the seat. Tall people will experience more discomfort from a low seat pitch (short distance between rows) than will their average-sized neighbors. Obese passengers will have problems with narrow seats. Both groups are also likely to have particular difficulties in getting in and out of their seats, especially when they are not on the aisle. Obese passengers and those who are wheelchair-bound may find it impossible to make use of the toilet facilities.

The design of seats and toilet compartments can be optimized by taking into account various relevant bodily dimensions and, in the case of wheelchair-bound passengers, the dimensions of wheelchairs and the spaces into which they must fit. It is a mistake to assume that average values are sufficient in relation to the design of seating.

For some dimensions, such as the height of the the seat, the shortest person should be accommodated; for others such as the pitch of the seats, the tallest.

Other features of the cabin of consequence to the passengers are the level of the lighting both in general and in an individual's immediate vicinity, the ambient noise, and vibration. Recently, the quality and impurities of the cabin air and their effects on people have caused some general concern, particularly in relation to tobacco smoke. However, it is arguable that aspects other than tobacco smoke in the cabin air pose more serious problems for human well-being. These include the effects of reduced air pressure in the cabin which, even in healthy individuals, places greater demands on the respiratory system than are experienced at sea level. In those passengers with gastric, cardiac and even dental problems, the reduced pressure can have harmful effects. Low levels of relative humidity in the cabin environment and the presence of atmospheric hazards such as ozone and cosmic radiation must also be considered in terms of their effects on passengers.

Design for Safety

The design of the cabin interior must not only provide the passenger with comfort, it must also ensure safety in the event of an accident. This implies that the pitch of seats, the size of exits, and the width of aisles should not present a hazard to rapid evacuation and that emergency exists should be readily operated. As with comfort, so safety considerations center on the passenger seat. The strength of the seat and restraint system, and its ability to withstand at least as much acceleration force as can the human body, is a critical element in safeguarding passengers in the event of an impact. The issue of matching human acceleration tolerance to seat strength persists in spite of recent changes in regulations.

Items of specialized safety equipment such as oxygen masks and life vests, if they are to be effective, must be located so that they can be readily accessed when they are needed. They must also be designed so that they can be donned quickly and easily.

But, however well-designed the equipment, it will have no survival value unless it is used correctly. This, in turn, depends on the adequacy of the instructions associated with the use of the equipment. The design of information presentation requires more than a simple common sense approach. Features of the cabin concerned with the transmission of information and instruction include the passenger briefing cards, the illuminated signs indicating "no smoking" and "fasten seat belts," the signs denoting the location of exits and the placards associated with emergency equipment.

In order to transmit information effectively, a number of aspects of the message must be considered. These include the language that is used; whether more than one language is required; whether or not diagrams are included; and the use of symbols and the meaning these may have for particular cultural or national groups. In addition, the use of color, the size and the style of lettering must all be considered in relation to intelligibility.

In addition to these physical elements in the cabin, the cabin crew will also have an impact on passengers. Passenger evaluations of a flight, and by extension, of an airline, are influenced considerably by the behavior of the cabin crew, by the extent to which they feel that their needs have been met by the cabin crew, and by the degree of professionalism with which they perceive that the flight has been conducted.

There is very little expectation of a role for passengers beyond the passive acceptance of the goods and services provided by the cabin crew. However, in the event of an emergency, the passive recipient role is not the most functional for survival. There is a strong argument for training passengers to help themselves. Safety training for emergencies is likely to have an effect on normal flight also, with the result that passengers would be more ready to comply with the rules such as not smoking in the toilet compartment and not bringing excessive hand baggage into the cabin.

Taking the Cabin Crew into Account

For the cabin crew members, the cabin is their workplace. Their requirements center on the need to do their job efficiently and effectively, and to reduce the incidence of fatigue, stress, injuries, and the emotional costs associated with interactions with the public.

In the same way as the seats and the toilet facilities are important for passengers, so galleys, ovens, service carts and the space available for resting (should time allow) are important for the cabin crew. Consideration should be given to human dimensions in the design of working spaces, such as the galley. By taking account of the postures demanded by the location of equipment such as ovens and storage units, much can be done to reduce the incidence both of accidents and of cumulative damage to crew member posture.

Cabin crew members have to carry out their tasks in the face of numerous sources of stress. One source of stress for crews engaged in long-haul operations is the disturbance of the body rhythms, popularly known as "jet lag." Sleep disturbance and deprivation lead to the interruption of many bodily functions such as digestion which show a natural circadian rhythm. It is easier to recognize the problem than to prescribe a solution. Flights cannot readily be scheduled such that working hours coincide with normal waking hours. One commonly used method of coping with the effects of sleep disturbance is to take tranquilizing drugs. This is not an acceptable solution either in the short- or long-term. Instead, education and training in sleep management can be used to assist cabin crews to cope with the conditions of long-haul flight. This includes advice on diet, on the need to drink sufficient fluids and on the scheduling of leisure time to benefit maximally from rest periods. Most important, cabin crews can be taught relaxation techniques to help them to sleep at the times when the schedule requires it, and also to help them to cat-nap when this is appropriate.

Dealing with Problematical Passengers

Another source of stress for cabin crew members is the need to cope with difficult passengers. Such difficulties can arise for a number of reasons: passengers may be ill, they may suffer from air-sickness, they may be fearful of flying or preoccupied with other anxieties. The most problematic passengers are those who are over-demanding, drunk or rowdy.

The individual flight attendant interacts not only with the passengers, but also with the other members of the cabin crew and, to a greater or lesser extent, with the flight crew. The relationships among all these individuals can be significant both for the conduct of the flight and for the well-being of the individual crew member. A smooth operation characterized by coordinated teamwork, particularly when unexpected incidents take place, is the product of thoughtful management, which recognizes the special problems of the work situation and enlists the appropriate expertise to help solve them.

For the individual team-member, the source of much work-related stress is found in relationships with other people, and this includes not only passengers but also the other members of the team. The stress arising from interpersonal relationships within a team may be alleviated by means of organization change related to the design of work, or by means of personal counseling, possibly including assertiveness training.

Two types of activity are concerned with the preparation of personnel to carry out crew functions. The first of these, personnel selection, can assist in selecting those most likely to succeed in a particular job. Secondly, the recruits must be trained. Training for cabin crew members consists of training for safety and training for service.

Training technology has developed considerably over recent years and there is an increasing appreciation of the complexity of the processes involved. These include the development of the curriculum in response, for example, to changes in the aircraft or in the characteristics of the trainees; the design of the training program, which must be based on a careful task analysis; the implementation of the program, which may first involve a training program for the trainers; and finally, and very importantly, the evaluation of the training program to ensure that its goals are being achieved.

There have been many developments in the sophistication of training aids and devices, including the most recent cabin simulators. These can be used very effectively to enhance the quality of training. However, the disadvantage of such hi-tech training aids is that they may be seen as a substitute for a carefully considered real-life training program.

Considering the Cabin as a System

The application of human factors to the aircraft cabin clearly covers a wide range of topics and it may be helpful to consider these within a systematic framework. One such system is provided by the SHEL model (software, hardware, environment and liveware). Although this model is applied here to the cabin, it is a general system model equally applicable in other fields.

As shown in Figure 1, the SHEL system comprises three types of resource that exist within an environment. The **hardware** in the cabin includes such items as seats, galleys, toilet facilities, luggage bins and emergency equipment. The **software** includes all the rules, regulations and procedures associated with the management and operation of the cabin. The **liveware** in the cabin includes the passengers and cabin crew. The lines linking the system components represent the interfaces through which energy and information are interchanged. It is at these interfaces, rather than within the components themselves, that problems typically arise. For example, seats must be considered in terms of how they relate to the shape and size of the human body and procedures must be designed in relation to easy learning. These serve respectively as examples of L-H and L-S interfacing. Unless the appropriate expertise is employed in the design of these interfaces, problems may arise.

In a real-world system, there will be a number of components of each type and these, too, must interface together smoothly. A simple example of H-H components are a plug and socket which, to be of any use, must fit precisely together. The L-L interface concerns the relationships between the individuals which form the teams and groups within the system.

The SHEL model demonstrates the highly interactive nature of the system. Changing one part of the system is likely to demand change in another part. For example, change in the design of a piece of equipment (H) has implications for change in the design of the procedures for operating it (S). These changes may sometimes lead to a requirement for different abilities among the people who use it (L).

All three types of resources are selected and deployed by system designers to achieve the optimal operation of the system. Furthermore, as the figure indicates, these resources exist within an **environment** which, although beyond the control of system designers, nevertheless exerts major constraints on their activities. Some aspects

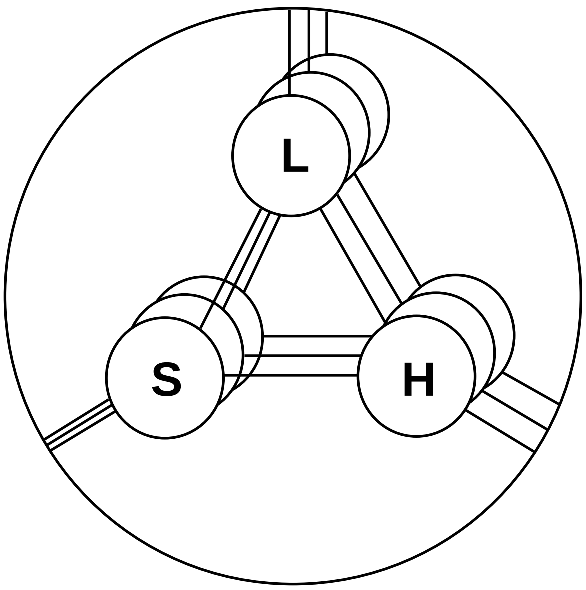

Figure 1

of the environment are highly visible. For example, the rules of the regulatory authorities require compliance; and the hostile physical environment in which an aircraft flies makes demands which cannot be ignored. In addition, there are more subtle constraints within the environment which system designers must recognize and accommodate. These include, for example, the effects of local conflicts for the supply of fuel; the demographic trends showing an aging population (potential passengers) and a reduction of younger echelons (potential cabin crew); and the consequences of political decisions such as deregulation. All these have implications for passenger-carrying aircraft and their cabin crew members.

It is clear from the outline given here that human factors is central to the design and operation of a safe and efficient aircraft cabin. ♦

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About the Author

Mary Edwards, graduated with honors in psychology with philosophy from the University of Bristol, U.K. She taught courses in business psychology and held an appointment as psychologist within a government program for occupational rehabilitation. Following research into organizational structure and function, she was awarded a Ph.D. from Loughborough University of Technology.

Subsequent research projects conducted by Edwards in the area of human factors have included studies of robot ergonomics, accidents in the home, industrial safety systems and the design of public transport road vehicles.

In 1985, Edwards was joined by her husband, Elwyn Edwards, and established their consulting company, Human Technologies.

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