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**Human Factors in
Cabin Safety**

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FOREWORD

Safety of the civil aviation system is the major objective of ICAO. Considerable progress has been made, but additional improvements are needed and can be achieved. It has long been known that less than optimum human performance underlies the majority of aviation accidents and incidents, indicating that any advance in this field will have a significant impact on the improvement of aviation safety.

This was recognized by the ICAO Assembly, which in 1986 adopted Resolution A26-9 on Flight Safety and Human Factors. As a follow-up to the Assembly Resolution, the Air Navigation Commission 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, and by developing and recommending appropriate amendments to existing materials in Annexes and other documents with regard to the role of human factors in the present and future operational environments. Special emphasis will be directed to the human factors issues that may influence the design, transition and in-service use of the [future] ICAO CNS/ATM systems.

One of the methods chosen to implement Assembly Resolution A26-9 is the publication of guidance materials, including manuals and a series of digests, which address various aspects of Human Factors and their impact on aviation safety. These documents are intended primarily for use by States to increase the awareness of their personnel on the influence of human performance on safety.

The target audience of Human Factors manuals and digests is the managers of both civil aviation administrations and the airline industry, including airline safety, training and operational managers. The target audience also includes regulatory bodies, safety and investigation agencies and training establishments, as well as senior and middle, non-operational airline management.

This digest is an introduction to the latest information available to the international aviation community on relevant Human Factors considerations for aircraft passenger cabin safety.

OVERVIEW

Chapter 1 describes how cabin crew training is geared towards the development of emerging competencies in support of the establishment and maintenance of high team performance standards. This has been achieved with the development of a CRM-based team approach to solving complex operational problems.

Chapter 2 addresses the fact that critical safety briefings are usually ignored by passengers. The safety briefings content and procedures need to be enhanced to optimize their potential safety benefit.

Chapter 3 presents the numerous issues surrounding aircraft exit and evacuation. There are several aspects of aircraft exit and evacuation that can help mitigate the risk of severe injuries. The completion of a safe evacuation is highly dependent on the usability of safety equipment. It also depends on a relevant Human Factors aspect which is the competent management of passenger behaviour (e.g. disruptive passengers) for the safety of others. Disruptive, competitive behaviours have been reported in studies of evacuations with monetary incentives and in accident reports where evacuations have taken place during a cabin fire.

(i)

Chapter 4 highlights several central organizational considerations, such as culture, policy development and implementation, and error management, all of which directly impact the attainment of operational objectives. These organizational factors need to be carefully considered so that they can support a human-centred safety and security culture throughout an organization. A brief overview of error management elements is also presented.

Appendix A lists Annexes to the Convention on International Civil Aviation that include Human Factors Standards and Recommended Practices. Appendix B describes human strength limits in the creation of design guides. Appendix C provides information on Human Factors audit elements for cabin crew training. Appendix D contains the Bibliography.

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INTRODUCTION

GENERAL

1. The broad application of Human Factors knowledge contributes to decreasing accidents and incidents in civil aviation as well as to mitigating the impact of those accidents and incidents. Human Factors knowledge can be applied to cover the myriad interactions among people, technology, organizations, cultures and the environment. Increasing awareness of the importance of Human Factors in civil aviation and the application of its principles presents the international civil aviation community with a significant opportunity to make it both safer and more efficient.
2. ICAO has been proactively pursuing this objective and introduced Human Factors in the training and licensing requirements of Annex 1 (1989) and in the operation of aircraft requirements of Annex 6 (1995). In addition, largely through the work of the ICAO Flight Safety and Human Factors Programme, the awareness of Human Factors opportunities and challenges present in civil aviation has increased steadily and markedly across the international civil aviation community since 1990.

DEFINITION OF HUMAN FACTORS

3. The human element is the most flexible, adaptable and valuable part of the civil aviation system, but it is also the most vulnerable to influences that can adversely affect its performance. With the majority of accidents and incidents in the civil aviation system resulting from less than optimal system performance, there has been a tendency to attribute them to human error. However, the term “human error” is of little use in accident prevention and mitigation. Although it may indicate where in the system the breakdown occurred, it provides little indication as to why it occurred. An error attributed to the human component of the system may have been design-induced or associated with inadequate or inappropriate training, badly designed or implemented procedures, or a poor layout of checklists or manuals (see the *Human Factors Guidelines for Safety Audits Manual* (Doc 9806)). In contemporary safety thinking, human error is the starting point rather than the end point in accident prevention and mitigation.

Human Factors is concerned with people in their dynamic working environments; about their diverse relationships with the technological elements, with procedures, and with the environment of the civil aviation system; and also with their relationships with other people. These include human behaviour; decision-making and other cognitive (i.e., mental) processes; the design, learnability, maintainability, and usability of controls and displays; flight deck and cabin layouts; communication and software aspects of computers, maps, charts and documentation such as aircraft operating manuals, standard operating procedures, checklists, etc.

A FRAMEWORK OF HUMAN FACTORS

4. Given the multi-faceted nature of Human Factors, it is helpful to use a framework in the description and understanding of Human Factors concepts. One such basic framework, the SHEL, uses blocks to represent some of the different components of Human Factors. The SHEL framework (see Figure 1) with the name being derived from the initial letters of its four components: Software, Hardware, Environment and Liveware was first

developed by Edwards (1972) and later modified by Hawkins (1987). Each component of the SHEL framework represents one of the building blocks of Human Factors. The following interpretations are suggested: Liveware (human), Hardware (technology), Software (policies, procedures, processes) and Environment (situation and culture within which the L-H-S interactions occur).

5. The liveware, or the human element, is the centrepiece of the framework representing the most critical and flexible component. This component does have limitations most of which are predictable in general terms.

6. Errors in human performance are cited as causal or contributory factors in the majority of civil aviation accidents and incidents. Experience has shown that most incidents and accidents that occur in operational environments are not due to the catastrophic failure of single components within a system but to the mismatches at the interfaces of different system elements. Thus, while it is possible for a crew member to suffer a sudden and complete incapacitation, or for a hardware element in the system to fail with disastrous results, it is far more likely for errors causing incidents and accidents to arise from individuals and errors in the system. From the perspective of dealing with unsafe conditions, errors arise from the incorrect allocation of tasks due to poorly designed procedures.

LIVEWARE — THE INDIVIDUAL

7. The core of the model is comprised of human operators, the most flexible and critical component in the system. However, humans are subject to considerable variations in behaviour and performance limitations that are predictable in general terms. The limits of the human component in the system are not clearly delineated, so the other components of the system must be carefully matched to it if stress in the system and eventual breakdown are to be avoided. Modifications through Human Factors need to start with the identification of where mismatches between components exist and contribute to an accident or incident.

8. In order to optimize matching components, an understanding of the characteristics of the central component is essential. Some of the more important characteristics (Hawkins, 1975) are described as follows:

- *Physical size and shape.* In the design of most equipment, a vital role is played by body measurements and movements, which will vary as a function of age, ethnicity and gender groups. The data for such design decisions are available from anthropometry and biomechanics.
- *Physical needs.* Humans' requirements for food, water and oxygen are available from physiology and biology.
- *Input characteristics.* Humans have evolved a sensory system for processing information from the world around them, enabling them to respond to external events in completing goal-directed behaviour. But all senses are subject to degradation and error, and the relevant sources of knowledge are available from physiology, psychology and biology.
- *Information processing.* These human functions have limitations. Poor instrument, warning system and interface design have frequently resulted from a failure to take into account the capabilities and limitations of the human information system.
- *Output characteristics.* Once information is sensed and processed, messages are sent to the muscles to initiate the desired response, whether it be a physical control movement or the initiation of some form of communication. Acceptable control forces and direction of movement must be known, and biomechanics, physiology and psychology provide such knowledge.
- *Environmental tolerances.* Temperature, pressure, humidity, noise, time of day, light and darkness all impact performance levels and well-being.

9. The interfaces among the different system components must be thought out carefully.

Human-technology interactions (liveware-hardware (L-H) interface)

10. This interface is the one most commonly considered when speaking of human-machine systems: designs of seats to fit the characteristics of the human body, of displays to match the sensory and information-processing capabilities of the user, of controls with proper movement and low force requirements, coding and location. The human operator may never be aware of a deficiency in the liveware-hardware (L-H) interface, even when it may lead to an accident, because the human operator can adapt to L-H mismatches masking any deficiencies, but cannot remove its existence.

Human-procedures interactions (liveware-software (L-S) interface)

11. This reflects the relationship between the individual and supporting systems found in the workplace. It can span subjects such as regulations, policies, standard operating procedures (SOPs) and processes, which include manuals, checklists, publications, symbology and instructions.

Human-human interactions (liveware-liveware (L-L) interface)

12. This is the interface between people. Cabin crew, flight crew, air traffic controllers, maintenance engineers and other operational personnel function as teams, and team influences play a significant role in determining behaviour and performance. In this interface, we are concerned with leadership, crew coordination and cooperation, teamwork, attitudes and cultural diversity interactions. Staff and management are also within the scope of this interface, as organizational culture, corporate climate and operational constraints can significantly affect human performance.

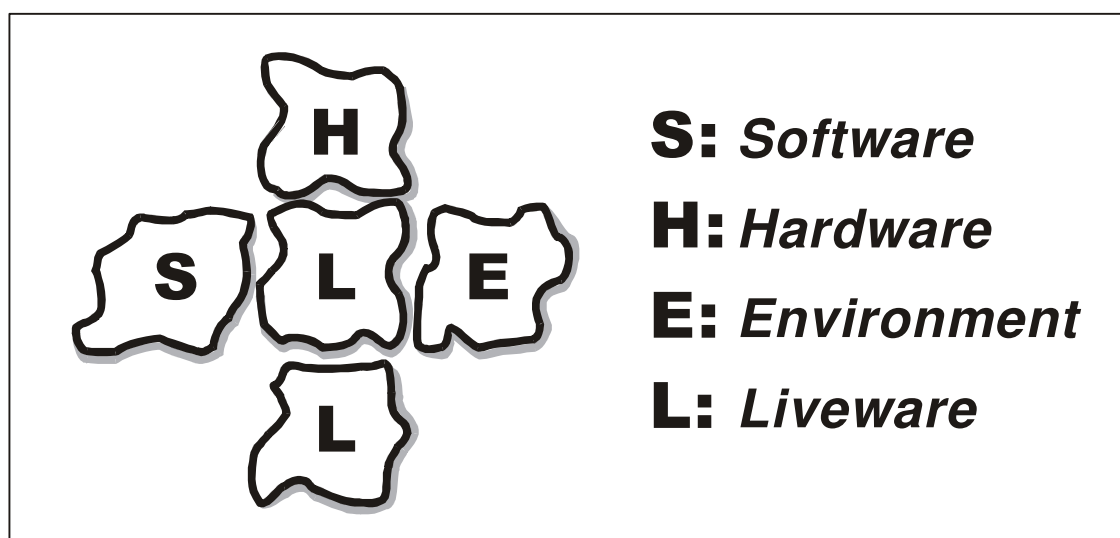


Figure 1. Graphical representation of the SHEL framework (Hawkins, 1987)

Human-environment interactions (liveware-environment (L-E) interface)

13. This interface involves the relationship between the individual and both the internal and external environments. The internal workplace environment includes such environmental factors as temperature, ambient light, noise, vibration and air quality. The external environment (for pilots) includes such things as visibility, turbulence, terrain and illusions. Increasingly, the work environment for flight crews includes disturbances to normal biological rhythms such as disrupted sleep patterns. Since the aviation system operates within a context of broad political and economic constraints, which in turn affect the overall corporate environment, such factors as the adequacy of physical facilities and supporting infrastructure, the local financial situation and regulatory effectiveness are included here. While the crew's immediate work environment may be creating pressures to take shortcuts, inadequate infrastructure support may also compromise the quality of crew decision-making.

Human error

14. Human error is cited as being a causal or contributing factor in the majority of aviation occurrences. All too often these errors are committed by highly trained, qualified, experienced (i.e. skilled) and motivated personnel. Human error is a natural outcome of output from the human brain that uses predefined scripts and other shortcuts to complete goal-oriented behaviours. These shortcuts sometimes lead to errors.

15. Errors may be the consequence of either intentional or unintentional behaviour. They may be further subdivided into slips, lapses and mistakes depending on the degree of intention preceding them.

- *Slips* are unintentional actions where there is a lack of appropriate attention (inattention or overattention) due to distractions, misordering of sequences or mistiming of actions.
- *Lapses* are unintentional actions where there is a memory failure due to forgetting an intention, losing one's place or omitting planned items.
- *Mistakes* are intentional actions resulting from errors in planning, but there is no deliberate decision to contravene established rules or procedures. Mistakes are based on the application of rules drawn from our knowledge; they may result from the application of a rule that, while good, is inappropriate for the current situation, or from the application of a flawed rule.

16. Slips and lapses are essentially automatic responses with little, if any, conscious decision-making — they are errors in execution. On the other hand, mistakes involve deliberate decision-making and evaluation based on knowledge, experience and mental models that have worked well in the past — they are errors in planning.

- *Violations* are related to mistakes. Although slips, lapses and mistakes may all lead to technical breaches of regulations or company operating policies and procedures, they are considered to be errors since they are not based on a deliberate decision to contravene the established rules. Like mistakes, violations involve intentional planning, often based on knowledge and the mental model acquired through daily experience; but violations are deliberate decisions to contravene established rules or procedures and are often a result of having to adapt procedures.

17. As presented earlier, within the SHELL framework the irregular surfaces on the various elements depict the imperfect matches in interfacing humans with the other elements of their environment. Therefore, each of the imperfectly matched interfaces has a potential for initiating or exacerbating errors, for example:

- In the human-technology interactions, knobs and levers that are poorly located or lack the proper coding may create confusion leading to slips or mistakes.
- In the human-procedures interactions, delays and errors may occur while seeking vital information from confusing, misleading or cluttered documentation, leading to slips or mistakes.

- At the human-environment interface, environmental factors (e.g. noise, temperature, lighting and vibration) or a disturbance in biological rhythms may affect an individual's attention and response levels, the ability to reason or communicate, and attitude towards fellow crew members and the flight itself, any of which could facilitate slips, lapses or mistakes.
- Poor human-human interactions at all levels of the system may reduce operational effectiveness and efficiency through lack of teamwork and leadership and through reduced communication and coordination, and could cause misunderstandings and slips, lapses or mistakes.

SUMMARY

18. This introduction attempts to highlight the multi-faceted and pervasive nature of Human Factors in civil aviation safety. Readers interested in more detailed information should consult the *Cabin Attendants' Safety Training Manual* (Doc 7192, Part E-1) and the *Human Factors Guidelines for Safety Audits Manual* (Doc 9806). To assist in understanding the complex interactions of Human Factors and the multi-disciplinary nature of its study, the SHEL framework is briefly described. Since human errors are cited frequently as being causal or contributory in aviation occurrences, an error classification system is presented. Since error is an integral part of all human endeavour, eliminating it completely is an unattainable objective. This highlights the need to manage and control errors as well as to mitigate their negative consequences through a systematic error management system (further details are provided in Chapter 4).

19. A growing number of Annexes contain Standards and Recommended Practices (SARPs) that require a demonstration of knowledge of human performance and limitations. Operational personnel must be able to demonstrate such knowledge under actual job conditions. Some SARPs identify specific skill requirements with respect to human performance. Others specify that particular documentation and programmes should be prepared and implemented in accordance with accepted Human Factors principles and knowledge. The list of Annexes to the Convention on International Civil Aviation that include Human Factors SARPs is found in Appendix A.

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Chapter 1

HUMAN FACTORS IN TEAMS

TEAM PERFORMANCE

1.1 Within many operational settings team performance issues are becoming more predominant. Knowledge about teams has been evolving for decades, and significant progress toward understanding teams has been achieved. More is now known about team cohesion, team leadership, team communication, team decision-making, team competencies and teamwork than ever before.

1.2 Accordingly, individual, team, task and work characteristics influence team processes, which in turn influence team performance. Team performance requires more than individual performance; even qualified cabin crew may perform poorly as a team. When crew perform well together, they work in synergy. When in synergy, the performance of a team of people working together is higher than the sum of each individual's performance (Salas et al., 2000).

1.3 The cabin crew structure, with clearly defined roles and responsibilities for each crew member should contribute to increased synergy. Within the aircraft, the pilot-in-command is the flight crew commander. The senior cabin crew member reports to the pilot-in-command for any operational or commercial problem. The pilot-in-command informs the senior cabin crew member about operational or technical problems, who then informs the rest of the cabin crew. The senior cabin crew member interacts with a crew of up to ten or more.

1.4 To generate synergy among cabin crew, certain conditions need to be met:

- task allocation (i.e. Who does what?)
 - the senior crew member allocates positions and roles in the cabin
 - the safety training manual specifies to the cabin crew what has to be done, when, how and by whom
- authority allocation and leadership, since every team needs a leader
- a friendly and professional environment

1.5 The measurement of team performance has recently been receiving increased attention. Critical aspects of team performance are: which type of behaviours to measure and the level of analysis at which to measure, that is the measurement of team processes (e.g. communication and coordination) as well as team outcomes (e.g. correct decision) and the evaluation of individual or team competencies. Tools that can be used to measure team performance in terms of process include:

- observational scales
- critical incidents analysis
- expert ratings
- communication analysis

1.6 Team characteristics, such as cohesion, and team competencies also affect team performance. Team cohesion is affected by factors such as commitment to the task and the team's standards of acceptable performance. Cohesion has a stronger effect on teams in real-world settings and the commitment to the task appears to be the most important component of cohesiveness (Salas et al, 2000).

Team leadership

1.7 To be an effective and efficient team requires a leader. The leader's role consists of:

- building the team
- explicitly stating expected results
- coordinating and monitoring activity
- managing workload and time
- preventing and addressing conflicts
- listening and implementing team member inputs
- making decisions

1.8 Leadership sometimes is associated with a recognized hierarchical position in an organization providing authority. The status of pilot-in-command and cabin supervisor is assigned by the airline. Leadership is also supported by characteristics such as personality, attitudes and values. Leadership is sometimes provided by someone who is not in a position of authority but because of particular competencies required by the situation (i.e. situational leadership).

1.9 A good leader has relevant technical knowledge, communicates effectively to diverse audiences in diverse circumstances, coordinates activities, manages the team, deals with conflict effectively and has superior listening skills. A leader also provides support to the team members by contributing to their development in delegating appropriate-level challenges in order for them to acquire autonomy. It is important that organizational policies support these leadership competencies and that selection tools assess them effectively and training programmes support their continued development.

TEAM PERFORMANCE IN DIFFERENT AIRCRAFT TYPES

1.10 The requirements of some cabin crew members working on numerous aircraft of different types subject them to a mass of information necessary to apply many different procedures. When personnel are confronted with a severe abnormal situation, they confuse equipment type, location and utilization. Frequently during evacuations, cabin crew confuse the handle for inflating slides with the handle for slide separation from the cabin (Edwards & Edwards, 1990; Flight Safety Foundation, 2001; Hynes, 1998). These events have provided impetus for regulatory activity. The Joint Aviation Authorities' regulations (JAR-OPS 1.103) state that:

Each cabin crew member does not operate on more than three airplane types except that, with the approval of the Authority, the cabin crew member may operate on four airplane types, provided that safety equipment and emergency procedures for at least two of the types are similar. Variants of airplane type are considered to be different if they are dissimilar in emergency exit operation; location and type of safety equipment; and emergency procedures.

1.11 The joint requirements for emergency and safety airborne equipment of the European Civil Aviation Conference (ECAC Doc 18) state that “for all types of aircraft having more than 19 seats, the number of required cabin crew is one for each unit of 50 passengers; and that the minimum number of cabin crew shall not be less than half the total number of Types A, I or II floor level exits” (see Table 3-2). They also state that “the number of aircraft types in which cabin crew are qualified at any particular time should be limited.”

1.12 Recently, ICAO undertook a census of Contracting States to determine which regulations are in place to frame the operation of more than one aircraft type or variant by cabin crew. Half of the 69 States that responded to the census allow cabin crew to fly on multiple aircraft types but had not developed any specific regulatory requirements.

1.13 States also varied from two to no precise limits on the maximum number of aircraft types on which cabin crew can operate. There is a significant number of States that allow cabin crew to operate on more than one aircraft type and have no regulations governing conversion, differences or recurrent training for cabin crew on the operation the different types of aircraft. Consequently, States lack the capacity to regulate and oversee cross-crew qualification and mixed-fleet flying programmes involving cabin crew.

CREW RESOURCE MANAGEMENT AND TEAM PERFORMANCE

1.14 To improve aviation safety and security, flight and cabin crew need to communicate, cooperate and work as a team. This is the role of crew resource management (CRM). ICAO has defined CRM as “the effective utilization of all available resources to achieve safety and efficiency.” Furthermore, ICAO has adopted the concept of CRM as an error management training tool. The Federal Aviation Administration’s (FAA’s) definition is the following:

CRM can be broadly defined as the utilization of all available human, informational, and equipment resources toward the goal of safe and efficient flight. CRM is an active process by crewmembers to identify significant threats, to communicate them, and to develop, communicate, and carry out a plan of actions to avoid or mitigate each threat. CRM also deals directly with the avoidance of human errors and the management and mitigation of those errors that occur.

1.15 Resources can refer to individual competencies, fellow crew members, aircraft systems, procedures, manuals, regulations, time, flight crew, passengers and other professionals. Resource management is the coordinated use of the available resources in attaining strategic and operational objectives.

1.16 CRM training is but one practical application of Human Factors. CRM is an on-going process that should occur throughout the flight and during pre- and post-flight activities. It involves planning, awareness of conditions and pre-flight communication, and includes all personnel performing those activities. Although CRM training can be approached in many different ways, there are some essential features. CRM training can be viewed as a family of instructional strategies that seek to improve error management and mitigation through teamwork in the aircraft by applying well-tested training tools (e.g. simulators, lectures, videos, role-playing) targeted at specific content (i.e. teamwork knowledge, skills and attitudes). CRM training focuses on the functioning of crew members as a team, not simply as a collection of technically competent individuals, and should provide opportunities for crew members to practise their skills together in the roles they normally perform in flight.

1.17 The CRM training programme teaches crew members how to use their interpersonal and leadership styles in ways that foster crew effectiveness and error management. The programme also teaches crew members that their behaviour during normal, routine circumstances has a powerful impact on how well the crew as a whole functions during high-workload and stressful situations. Similar situational experiences during training increases the probability that a crew will handle actual stressful situations with greater effectiveness and efficiency.

1.18 Pre-training factors, such as organizational, situational and trainee characteristics, can influence training effectiveness. A number of factors related to supervisory behaviours influence training effectiveness. The appropriate knowledge and commitment of senior management are the first step in the development of CRM training.

1.19 The literature suggests that incorporating known principles of practice and feedback into the design and delivery of training programmes can strengthen CRM training. CRM training that is consistent with theories of learning and provides relevant information about CRM behaviours, active practice and remedial feedback has a high probability of success (Salas et al, 2000).

1.20 Over the past several years, a wealth of knowledge has been generated with respect to teamwork, all of which is applicable to the design and delivery of CRM training. This knowledge can be used when analysing crew task requirements, observing crew, designing learning objectives, establishing feedback protocols, building scenarios for practice and evaluating crew performance.

1.21 Research indicates that culture can impact the effectiveness of CRM training. Cultural differences often impede the implementation in one State of off-the-shelf CRM programmes developed in other States. Four types of cultures have been found to influence CRM: the national culture of the crew member, professional culture, organizational culture and the organization's safety culture.

CULTURAL DIVERSITY

1.22 Cultural differences have been recognized as an issue where Human Factors knowledge can be effectively applied. Helmreich and Merritt (1998) have provided the following description of culture :

Culture fashions a complex framework of national, organizational and professional attitudes and values within which groups and individuals function. The power of culture often goes unrecognized since it represents 'the way we do things *here*' - the natural and unquestioned mode of viewing the world. However, the reality and strength of culture become salient when we work with a new group (whether in a new country, a new organization or a new profession) and interact with people who have well-established norms and values.

1.23 Cultural diversity among cabin crew and between cabin crew and passengers is an inevitable part of the operational and organizational environment. Awareness of cultural differences is necessary to minimize misunderstandings that may arise among crew members of differing cultural backgrounds and result in breakdowns in communication and coordination. Such issues can also be addressed with respect to the cultural diversity of passengers. Flight crew, especially those destined to operate in multinational crew, must be made aware of the significance of cultural diversity and the importance of understanding each individual's culture.

SUMMARY

1.24 Team performance issues are becoming increasingly relevant in many operational settings. CRM is a standard method that is used in civil aviation to support team performance. CRM establishes a team approach to solving complex problems that can arise within the aircraft's work environment. The necessary leadership competencies are redefined within a team environment. Novel aspects for training are also present with the increase of culturally diverse crew as well as newly designed aircraft. Such newly emerging competencies may require a recasting of the frameworks underlying cabin crew training programmes.

1.25 Two issues of importance may also impact team performance: cultural diversity and aircraft type. Raised awareness among cabin crew of cultural diversity can enable and support strong team performance. With respect to differences in aircraft type, it may be necessary to determine the impact of working on diverse aircraft on cabin crew team performance levels.



Chapter 2

COMMUNICATION AND COORDINATION

GENERAL

2.1 Central to team performance and CRM are competencies in communication. Communication takes place when information is transmitted from one or many senders to one or many receivers. Communication among flight crew, cabin crew and passengers plays a vital role in the performance of procedures concerned with aircraft operations under normal and abnormal operating conditions. The conditions and constraints of communication vary according to the people with whom the cabin crew must interface. Crew members communicate to exchange information, to build and reinforce common goals, action plans and expectations, to compare the understanding of a current situation, to monitor activity, to transmit the organizational culture (e.g. in creating a professional yet friendly work environment) and to avoid and address conflict situations. Joint training exercises on evacuations for flight and cabin crew have proved effective in resolving communication and coordination issues.

CABIN AND FLIGHT CREW COMMUNICATION

2.2 Certain accident reports tragically demonstrate the criticality of timely and effective communication between the cabin and flight crew. The report on the Dryden accident¹ revealed, in a significant way, that such communication is not automatic and may be impossible due to differences in professional and organizational cultures. The Dryden investigation found that cabin crew did not communicate critical safety information (wet snow on the wing) for a number of reasons. Among reasons cited were professional respect, an assumption that the pilots were aware of all pertinent information and a reluctance to second-guess the pilots. Hesitation on the part of the cabin crew to transmit to the flight deck information that they considered critical for flight safety was noted. An examination of accident and incident reports has led Chute and Wiener (1994) to suggest five basic factors that influenced the differences between the two cultures and perpetuated the division and the problem as follows:

- *Historical background* — origins of the jobs and their influence on personal attributes and attitudes today
- *Physical separation* — lack of awareness of other's duties, responsibilities and problems, each influences by lack of physical proximity
- *Psychological isolation*² — personality differences, misunderstanding of motivations, pilot skepticism and cabin crew ambivalence about chain of command
- *Regulatory factors* — sterile cockpit confusion and licensing issues
- *Organizational factors* — administrative segregation, training differences and schedules

1. Moshansky, V.P. Commission of Inquiry into the Air Ontario Crash at Dryden, Ontario (Canada). Government of Canada, 1992.

2. It is important to note that security procedures designed to seal the flight deck, as currently proposed, can exacerbate the physical separation and psychological isolation among crew members.

2.3 The source of such hesitation may reside in the fact that the cabin crew may be “put in their place” by the pilot-in-command or fear that they are not respecting the “sterile cockpit”. The notion of the sterile cockpit comes from the Federal Aviation Regulations FAR 121/542 as a result of controlled flight into terrain (CFIT) accidents. The FAR regulates that non-essential communication (i.e. not directly related to the actual conduct of the flight) to the cockpit is prohibited below 3 050 m (10 000 ft). This is associated with the fact that in many situations the flight crew are intensely preoccupied with the task of handling the aircraft and cannot focus on non-essential communication. Although the rule is useful in a wide range of circumstances since it protects the flight crew from potentially unsafe interruptions, it restricts cabin crew communication by discouraging them from reporting potentially vital information to the flight crew.

2.4 It is important that the extent of communication with the flight crew be regulated by the phase of flight and the completion of tasks. There are phases of flight where pilots are particularly busy and in those high workload phases, communicating with the cabin crew imposes additional demands on the flight crew. Consequently, communication should be kept to safety-critical information during the following phases:

- before and during take-off, because of workload and potential technical problems and counter-measures required to cope with them
- prior to and during landing
- ATC calls, because they require pilots’ attention
- navigation or weather problems, since they require problem-solving and decision-making from the flight crew
- during emergencies

2.5 During an emergency evacuation, communication between the cabin crew and the flight crew consists of ensuring that the evacuation order has been given and transmitted, identifying usable exits and directing passengers so as to permit a rapid evacuation. During abnormal operations it is important that communication be clear so as to render evacuation easier and faster.

2.6 Aboard an aircraft, flight and cabin crew pursue the same objectives: flight safety, effectiveness and efficiency. However, the cabin and flight crew often have evolved within two distinct technical cultures. In most organizations, these two categories of personnel are managed by two separate departments. This organizational separation has resulted in discrepancies in training, manuals and procedures. It is important that the differences between the two professional cultures do not hinder optimal communication. Standardized training of certain procedures, such as emergency evacuations, is one way in which each group is exposed to the other’s professional culture. Each must learn more about the other to ensure good communication during a flight.

2.7 Additionally, the cabin and the flight deck are physically very distinct and are separated by a locked door. This is especially true on wide-body aircraft, where this separation prevents contact between the flight crew and the cabin crew. The work environments are not only separate, they are also different. The flight deck is a relatively quiet and confined environment, and pilots remain seated. In contrast, the cabin is a spacious and relatively noisy environment. The cabin crew are in direct contact with passengers and have to move around the cabin. Therefore, the communication consideration for both flight and cabin crew is distinct.

Crew briefings

2.8 Communication is also important for crew briefings and procedures to optimize coordination. Crew briefings are used to share common objectives, develop a common understanding of the situation and a common action. All crew need to know is who is doing what, when and how. Briefings are performed before every flight. Briefings should focus on the points that might diverge from routine and expectations. To be effective, briefings must be concise yet comprehensive.

2.9 ICAO has implemented Amendment No. 11 to the *Procedures for Air Navigation Services — Aircraft Operations* (PANS-OPS) (Doc 8168, Volume I, Part XIII, Chapter 3) with the recommendation that pre-flight crew briefings given by the pilot-in-command should involve all crew members. Where joint briefings are not held, the pilot-in-command should brief the senior cabin crew member who will then brief the other cabin crew members prior to each flight. Briefings should adhere to the following principles:

- a) crew briefings should be short, including not more than ten items. If more than ten items are necessary, consideration should be given to splitting the briefing into sequential phases of the flight;
- b) crew briefings should be simple and succinct yet sufficiently comprehensive to foster understanding of the plan of action among all crew members;
- c) crew briefings should be interactive and where possible should use a question-and-answer format;
- d) crew briefings should be scheduled so as not to interfere with, and to provide adequate time for, the performance of operational tasks; and
- e) crew briefings should achieve a balance between effectiveness and continual repetition of recurring items.

2.10 Crew briefings that become recitations do not refresh prior knowledge and are ineffective. Pre-flight briefings should focus on crew coordination as well as aircraft operational issues and include but not be limited to:

- a) any information necessary for the flight, including unserviceable equipment or abnormalities that may affect operational or passenger safety requirements;
- b) essential communication, emergency and safety procedures; and
- c) weather conditions.

2.11 Cabin crew briefings should prioritize all relevant conditions that exist for the departure and include but not be limited to:

- a) assignment of take-off and landing positions;
- b) review of emergency equipment;
- c) special attention passengers;
- d) silent review process (i.e. the self-review of individual actions in the event of emergencies);
- e) review of applicable emergencies;
- f) security or service-related topics that may impact passenger or crew safety; and
- g) any additional information provided by the operator.

2.12 Briefings should also refresh all relevant procedures, especially if the aircraft is different from the one cabin crew typically work in, and crew should review how to evacuate, how to open the doors, the location of handles to inflate slides and the locations of fire extinguishers. Such briefings on procedures provide for a review of predefined action plans.

Communications systems

2.13 Communication within an aircraft is typically completed through communications systems. Public address (PA) systems are typically used to convey messages to the passengers from the flight deck and/or the cabin. Intercom systems are used for communication between individual crew members. When such communications systems are out of order, communication between the cabin crew, the flight crew and the passengers is hampered. Consequently, the timeliness and reliability of the information to be transmitted can be negatively impacted. There are instances of failures of such systems documented in accident investigation reports.

Safety briefing messages and signs

2.14 Other forms of communication used to transmit safety messages and coordinate activities in the case of an emergency are safety announcements and written or pictorial information to all passengers. Training prepares cabin crew to use additional comments and instructions to passengers in conducting evacuations. In particular, there is a requirement for briefings to passengers who are seated in an exit-row. Research studies demonstrate that passengers who receive exit-row briefings are more effective in evacuating the aircraft.

2.15 National regulations require all airlines to provide a safety briefing and demonstration to all passengers. Individual safety briefings should be given by cabin crew to special needs passengers. This includes passengers who may need the assistance of another person to move expeditiously to an exit in the event of an emergency.

2.16 The safety of passengers is enhanced if they know what to do in the event of an emergency. Laboratory studies have demonstrated that individuals perform better when they have received instructions about the use of emergency equipment (Flight Safety Foundation, 2001). There is also evidence from accident reports that survivors are frequently those who have prepared themselves for an emergency. This is a minority.

2.17 Surveys show that less than 10 per cent of passengers review the briefing card while on board (FSF, 2001). Results derived from responses to a questionnaire distributed to passengers who were obliged to evacuate a B747 after an accident involving fire demonstrate that information on the card contributes to mitigating the potential for injury. Of 165 passengers, 144 responded to a question concerning the briefing card. Of the 63 per cent who had not read the card, 56 per cent were injured in evacuation-related causes whereas of the 37 per cent who had read the card, only 17 per cent were injured due to evacuation-related causes (see Hynes, 1998; FSF, 1998; 2000).

2.18 There are several factors contributing to the minimal attention paid by passengers to the safety briefing. These include the fact that the risk level is so low that they do not believe that an accident can happen to them; frequent travellers assume they know everything and they believe that if an accident happens, the chances of survival are nil, so the safety briefings are considered superfluous. Consequently, there is a critical need for the industry to develop methods that encourage the passengers to pay attention to the safety briefings.

2.19 The oral briefings before and during the flight are usually given on the aircraft PA system. It is extremely important, in the event of an emergency, that the cabin crew communicate quickly and clearly to all passengers on board. The PA system provides the standard means of achieving this objective. In the event of failure of the PA system, an alternative method of communication is necessary. During the evacuation, megaphones may be used to direct passengers once they are outside the cabin. These should be stored near doors and within reach of the shortest crew member, from a seated position where possible. One accident report found that some of the emergency equipment, which included two megaphones, was stowed in overhead bins in the cabin and not near the cabin crew stations. Consequently, during the emergency evacuation the cabin crew found it impossible to reach this equipment as passengers moved towards the exit.

2.20 Safety briefings that are provided following boarding tend to be long, often monotonous and when passengers are inattentive. In fact, the anticipation of departure, the typical long waits to check in, the noise and