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Regulatory Study on

Emergency Evacuations.

Final Synthesis and Recommendations

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Introduction

An emergency evacuation is an event that seldom occurs at the scale of airlines and that is extremely rare at that of individuals. However, it is under such circumstances that the role of the Cabin Crew Members will be preponderant and with many consequences on the rates of injured people and survivors after an air crash.

A survey by the European Transport Safety Council (1996) assesses that 40% out of the 1500 persons who die every year in air crashes (that is 600 persons) die in a technically “survivable” accident. A little more than half of them (330 persons) die from the direct result of the impact, the others (270 persons) die because of fire, smoke or problems that arose during the evacuation itself.

Among the causes of the worsening of injuries or the increase of the amount of passengers and crew members who die after a “survivable” air crash, some are directly caused by inadequately executed evacuation procedures from the plane and “erratic” actions by some Cabin Crew Members. This, of course, puts forward the problem of the efficiency of their training and practice. It must be understood that there is a difficult problem on two aspects. The rarity of the actual emergency evacuations can in no case allow an adequate “in line” practice. All therefore relies on the training and practice out of line, which raises, as we will see, genuine challenges of realism and frequency and therefore a heavy financial involvement. But at the same time, this very rarity of actual emergencies generates a feeling of low usefulness as far as such a training is involved, all the more than its added value is blurred. It was therefore most important to try and clarify this reality. And to begin with, the economical justification of the Cabin Crew Members safety function should be mentioned here even roughly.

In 1995, the USA Office of the Secretary of Transportation assessed that the value of an avoided death amounted at least up to 2,7 million dollars. This figure of 2,7 million dollars is a value based on the American society and economy and is, of course, not valid everywhere in the world. But on another hand, for reasons that need not be discussed here, the average price that the airlines are ready to pay for to save human lives in aviation is much higher than the average cost of a death. Therefore if one takes as a basis the above-mentioned value, the annual 270 “avoidable” deaths in matters of evacuations would cost have a price of about 730 million dollars. The question is therefore to know whether investing each year such a sum to improve emergency evacuations could produce a significant improvement. In other words, can the efficiency of the Cabin Crew Members be significantly improved in emergency evacuations with an investment of about one thousand dollars a year per individual? It does not seem unreasonable to think so.

In the same way, an analysis of the accidents shows that the management of emergency evacuations remains a possible item of improvement. That is why, the Research department of the French « Service de la Formation Aéronautique et du Contrôle Technique (SFACT) » carries out, in the scope of the European Cooperation (Joint Aviation Authorities) a study schedule on cabin safety and especially on the training of the Cabin Crew Members to emergency evacuations.

The hereby report is the synthesis of the study carried out in this frame by Dédale and made in France from September 1998 to September 1999¹.

The questions that were the guidelines of this study come directly from the problematic mentioned formerly and is built up around the following themes:

- what is the actual efficiency of the action of the Cabin Crew Members as it appears from the feedback of experience and what is the responsibility of training in this record ?
- do the existing regulations meet the needs and do they cover all the aspects of training?
- can the administrations check that the rules are properly understood and enforced by all the airlines and in the same way?
- is the training the Cabin Crew Members get adequate to enable them to deal with emergency situations?

To answer these questions, we gathered and analysed different types of information:

- information based on feedback of experience: incident and accident reports,
- information based on enquiries addressed to Cabin Crew Members: interviews, questionnaires,
- comparative and cross analysis: European and foreign concerns in the area of aeronautical safety as a whole and of emergency evacuations in particular (regulatory texts, conferences, safety bulletins),
- examination of the emergency intervention training in areas related to aviation.

The synthesis of all the pieces of information gathered was meant to meet a double aim:

- from the critical analysis of what exists, to identify the points of convergence that make up the great axis on which improvements can be made on emergency evacuations,
- formulating recommendations aiming to improve the training conditions of the Cabin Crew Members on emergency evacuations and safety as a whole.

From the chronological point of view, the study was built around three main stages. The first one was dedicated to a literary review (French and European regulations, accident or incident reports with evacuations, synthetic studies). The two following stages consisted in an in depth investigation in order to feed a comparison of the existing state (visit of training centres, gathering of accounts by Cabin Crew Members through questionnaires and interviews of Cabin Crew Members having undergone emergency evacuations) and the state of art as far as emergency evacuations in aviation and related areas (that is firemen and merchant navy) are concerned.

For logistic and budgetary reasons, the analysis and especially the assessment on the field of the means and practices implemented for the training of the Cabin Crew Members was centred on France. We have also chosen to focus this study on the events and the recent evolution in the area of Cabin Crew Members training, and in average over these 5 last years.

¹ For logistic and budgetary reasons, the assessment on the field of the means and practices implemented for the emergency evacuation training was carried out in France only. However, it sounds realistic to assume that many arguments developed in this report have a European scope.

Even though practices may differ from one country to another, the results of this study should remain valid for everything related to regulations whence the reflection centred on the JAR-OPS. Several recommendations aim at reinforcing the latter in order to clarify its interpretation and its implementation and to avoid the current weaknesses. The recommendations issued for the other interlocutors of the area (such as airlines), valid for France, could probably be extrapolated by the reader from outside the French borders.

Chapter 1 – Synthesis of the Research Carried Out

1. The Regulatory Frame

The first stage of this study consisted in a review of the regulatory frame ruling the training for emergency evacuations of the Cabin Crew Members.

1.1 French Regulations

In France, the regulations related to the safety functions of the Cabin Crew Members is found in the Order of November 5th, 1987. A specificity of the French regulations, compared to the JAR-OPS or ICAO regulations, is the requirement for each Cabin Crew Member to hold a French Certificate of Safety and Rescue (CSS – paragraph 6.3.3.7 of the appendix of November 5th, 1987). The preliminary related training is carried out in several training centres in France. The graduation for this certificate is made through a State examination set up by the French « Service de la Formation Aéronautique et du Contrôle Technique (SFACT) ».

This requirement might disappear with the enforcement of the JAR-OPS. The basic knowledge of Safety and Rescue would then become the responsibility of the airlines, that up till now mainly hired persons already holders of this certificate.

The Safety and Rescue Certificate, title of acknowledgement of the professional Cabin Crew Members, is however still in force in France and wholly applies as far as the training and issue of the title by the authority is concerned. A European project of a “certificate of professional proficiency” is however being studied.

In order to be able to ensure the Safety and Rescue function, especially in the frame of emergency evacuations, the Cabin Crew Member must have been taught and trained. Chapter 6 and Appendix X of this order set the required skills and titles, but also the rules to preserve, update and check these skills.

The initial training and skill preservation programmes are filed by each airline and are submitted to the approval of the Civil Aviation Authority. These practice programmes include, among others, a theoretical part related to the materials and procedures especially for emergency situations and a practical part including individual and collective exercises.

As far as these practical exercises are concerned, a note at the end of Appendix X (order of November 5th, 1987) states that the practical exercises must be made in conditions that best repeat the environment that might be found in operation, that the collective exercises of emergency evacuations are carried out on board of the aeroplane itself or in a model having at least one exit of a comparable geometry of those of the aeroplane, respecting best the existing volumes of the cabins: galleys, lavatories, seats, etc. The text also specifies that the materials must be arranged to be obstacles to the evacuation with a possible restoration of the sensorial environment (dimmed light, sound, ...).

1.2 JAR-OPS European Regulations

With the arrival of the JAR-OPS (Subpart 0 – Paragraph 1.990 Number and Composition of Cabin Crew), the minimal number of Cabin Crew Members will depend on the number of seats in the aeroplane. For instance, for a 300 seats plane with 225 passengers on board, the minimal number of staff which is now of 5 Cabin Crew Members in France will be brought up to 6. However, the JAR-OPS make provisions that under exceptional circumstances the number of Cabin Crew Members can be reduced.

Another operational aspect that might bring changes for the European airlines (especially the French ones), is the appearance of the regulatory flight and duty time. Following to the discussions that aimed to incorporate this aspect in the JAR OPS (JAR-OPS Subpart Q – Flight and Duty Time Limitations and Rest Requirements), it would seem that Flight and Duty Times will eventually be regulated at the European Union level.

The JAR-OPS formalise a use that already existed in France but that was not mentioned in the order of November 5th, 1987: the need for hierarchy within Cabin Crews (Subpart O –Section 1.1000 Senior Cabin Crew Members). A specific training (IEM OPS 1.1000(c) Senior Cabin Crew Training) is required to become a Senior Cabin Crew Member. This includes several subjects such as pre-flight briefings, co-operation within the crew, crew resource management.

The JAR-OPS bring, among other things requirements concerning the subjects of the CRM (Crew Resource Management) and crowd management (JAR-OPS, Appendix 1, Section 1.1005/1.1.1010/1.1015/1.1020) and this for any Cabin Crew Member. As far as the Human Factors are concerned, the JAR-OPS also stress the need to use the right words on board to enable good co-ordination and communication among Cabin Crew and Flight Crew Members (JAR-OPS AMC to Appendix 1 to JAR-OPS 1.1015 and JAR-OPS Temporary Guidance Leaflet N°6).

The JAR-OPS also require that at the end of a specialisation training course on a new type of aircraft that a familiarisation flight should be made either under the supervision of a Cabin Crew Member in charge of instruction or as in the order of 1987, a display of the plane.

To finish with, the specifications related to the features of the models used during the training that are found in the Interpretative and Explanatory Material of the JAR-OPS but that do not have a regulatory value (IEM OPS 1.1005/1.1010/1.1015/1.1020 Representative Training Devices). The IEM state that the model should reproduce exactly the configuration of the cabin regarding the exits, the galleys, the storage of the safety devices, the types and positioning of the passenger and crew seats as well as whenever possible the operation of the exits (especially their weights, the moment of inertia and the strength to be applied).

1.3 ICAO Regulations

Regarding the ICAO recommendations, the chapter 12 (On board commercial staff) of the ICAO Appendix 6 is not very developed. As for training, it is stated that each Cabin Crew Member should follow at least once a year a training programme. This programme, established by the airline, must be approved by the State in which the airline is based. The purpose of the training is that each Cabin Crew Member:

- a) “should have the required skills to carry out his/her allotted functions should there be during the flight an emergency or a situation requiring an emergency evacuation;”
- b) should be trained to use the safety and rescue equipment whose transport is required.”

The ICAO points out that this training is all the more critical than the emergency situations in which they will have to be put into practice seldom occur.

The tendency within the ICAO is clearly to reinforce the safety side of the job of the Cabin Staff. Still recently (Cabin Safety Update, Vol. 4, n°10, 1998), to show the importance of this safety function, it was decided to replace the English name used up till now “Flight Attendant” by “Cabin Crew”. This change is meant to stress the fact that the Cabin Crew Members fully belong to the crew and are responsible for the safety as well as the Flight Crew Members.

On another hand, the ICAO (1996), in its Instruction Manual for the Cabin Crew Members safety training, enhances the duality of the Cabin Crew Members’ job, the service side on one hand and the safety side on another. The ICAO points out that if the safety function is often relegated to a position of secondary importance by the airlines, it is not only due to their commercial policy but also to the criteria used for the selection of their Cabin Crew Members.

The ICAO (1996) goes further than the European regulations by suggesting that the Cabin Staff should gain some fundamental aeronautical knowledge in order to have a better understanding of their working environment. The aeronautical terminology mentioned in the JAR-OPS would then only make up one of the subjects of this training session, the others being theory of flight and air operations as well as regulatory provisions (ICAO, 1996 Chapter 3).

As far as the emergency procedures training is concerned (amongst which are the emergency evacuations), it is advised that the practical training should be carried out either on life-size models or in real aeroplanes. Among the established aims, there is the co-ordination between the crew members, the crowd management with the recognition of different types of behaviours of passengers and time management.

To finish with the ICAO (1996) advises to include a human factors facet in the training sessions of the Crew: “The human element is the more supple, adaptable and precious part of the aviation system, but it also is the most vulnerable to the influences that might negatively affect the performance” (pE1-27 paragraph 7.2.1). A number of human factors aspects must be taken into account during emergency evacuations such as communication (between Cabin Crew and Flight Crew Members, with the passengers or with outside contributors), awareness

of the situation, decision making, stress management, synergy and leadership. All these items are part of the syllabus recommended by the ICAO in its instruction manual.

2. *Feedback Experience*

2.1 **Enquiries on Accidents and Incidents**

Several Civil Aviation or organisations of enquiry on accidents regulatory authorities have issued studies on emergency evacuations. They mainly are the Federal Aviation Administration (FAA), the National Transportation Safety Board (NTSB), the Bureau de la Sécurité des Transports du Canada (BST), the Japan Civil Aviation Bureau (JCAB), the Civil Aviation Authority (CAA). As a whole, they deal with all the problems linked to this type of event, that is to say the passengers' behaviour, the problems related to the difficulties of operation of communication systems (public address, megaphones, intercoms), the difficulties in using safety materials and the failure of some of these materials.

The consulted reports give a rather negative result. In a number of cases, the enquiry boards have established that the actions of some Cabin Crew Members led to the aggravation of the consequences of the accident. The same factors are nearly always found: gaps in knowledge and skills or difficulties in implementing them in a practical way.

In its NTSB report of February 1992 (NTSB SIR 92.02) dedicated to emergency evacuations during 27 accidents that occurred in the USA, the NTSB are very critical in their analysis because it is written that “the actions of some Cabin Crew Members contributed to increase the number of injured people among the passengers and that some of these Cabin Crew Members did not know how to open the doors or how to use the evacuation slides. (NTSB, 1992, p.2). More generally, the reports show that among the causes of injuries aggravation or increase in the number of passengers' and Cabin Crew Members' deaths after an air crash, some are directly linked to the inadequate execution of the evacuation procedures from the plane and the erroneous actions of some Cabin Crew Members. Among these erroneous actions, some are caused by stress. Others can be attributed to gaps in the training, which is either insufficient or ill adapted.

A more recent study on 519 emergency evacuations in the USA (Human Factors Research on 519 recent air carrier evacuation events, Michael K. Hynes, 1998) gives a very interesting complimentary light. Mainly dedicated to evacuations *without* any accident, it shows that most of the evacuations must be classified as “precaution evacuations”. They were initiated either by the Flight Crew Members, or by Cabin Crew Members, despite the fact that there had been no real accident. They took place either during engines start up or during taxiing. This study carried out with the help of the CAMI and the FAA shows that there are actually four to five air accidents a year in the USA followed by an evacuation from the aircraft. On another hand, there is an average of one said “precaution” evacuation every five of six days! Thus between January 1st, 1988 and December 31st, 1996, passengers and crew members have performed an emergency evacuation from a plane nearly 500 times without it taking place after a real accident. And out of all these “precaution” evacuations, 75% were regarded as useless or avoidable.

The analysis of these precaution evacuations mainly suggests the three following questions:

- How to feel when the decision of an emergency evacuation should be made? Which is the right compromise between the principle of precaution and the risks linked to the evacuation itself and to its indirect effects (costs, disturbance of flights)? Who initiates the evacuation? How can the training be maximised on this point?
- What is the impact of these evacuations on the training and practice of the cabin crew members?
- What are the fundamental differences between an emergency evacuation (after an accident or in case of danger e.g. a fire) and a precaution evacuation? Between an evacuation after an accident and a precaution evacuation aren't there indeed very different surroundings that would justify a specific training, with in the first case the aim to learn and control under intense stress the spontaneous movements of passengers (panic) and in the other case to learn how to make them move (refusal to leave their seats, refusal to jump)?

It happens that the poorness of the pieces of information available today do not really allow to answer the questions asked.

Fire, toxic gases and smokes disturb the evacuations very much, because besides the facts that they reduce the visibility, they limit the communications and reduce the number of usable emergency exits. These points disrupt the passengers' or cabin crew members' behaviour by affecting their mental abilities (BST, 1995).

Seven out of the fifteen evacuations studied were considerably slowed down because the Cabin Crew Members were unable to open the doors properly, to spread out the slides or because the slides did not spread out properly.

The passengers seated near the emergency exits sometimes have unexpected reactions and may disturb considerably the evacuation operations or sometimes generate anticipated evacuations.

A poll carried out in 1989 with Canadian travellers showed that only 29% of them had read or at least glanced at the leaflets of safety guidelines put into the pockets of the seats (BST, 1995, p.4).

During emergency evacuations, communication problems between the crew members has created an important source of delay or of hindrance in the evacuation phase. A bad coordination between the crew members can especially be caused by an inaccurate terminology, misunderstandings, lacks of transfer of information between the Flight and Cabin Crew Members or among the Cabin Crew Members or problems linked to the ill operation of systems.

Following to some evacuations, the Japan Civil Aviation Bureau implemented a special bureau that gave guidelines to the airlines on a number of aspects regarding air safety and especially the improvement of the training of the Cabin Crew Members for emergency situations (Tomita, 1998).

Some Cabin Crew Members flying on several planes of different types receive so much information and have to apply so many different procedures, that when they are in front of a serious event, they confuse the materials, the storage places of these material and their operation.

During evacuations, it often appeared that the Cabin Crew Members confused the emergency inflating handle of the slides with that of the separation of the slides with the threshold of the door which could have caused the falling down of passengers jumping in these slides.

The human factors stand for many of these sometimes incomprehensible reactions from professionals having a great experience. The human being has a remarkable intelligence but does not fully know himself and his reactions are not always those one should expect. Several regulations and procedures rule the Cabin Crew Members, but it must be noted that things are not basically improved.

2.2 Results of Existing Studies

We examined the studies carried out in the area of training to emergency evacuations. A great number of studies are related to purely technological aspects such as the width of the doors and the materials used to avoid the propagation of fire. Another very active area of research is that of evacuation tests and computer based evacuations.

But while a considerable volume of research in Human Factors is dedicated to the “operation” of pilots in a cockpit, it is not the same for the cabin. There are very few studies, as far as we know, that are dedicated to the specificity of the training of the Cabin Crew Members on emergency evacuations or on the passengers’ behaviour. It results in a poor number of passenger behaviour patterns and a poor performance of the cabin staff in situations of emergency which fuels in return the poor quality of the feedback of experience: the right questions are not asked when thinking with poor models. It seems therefore important, if one wants to go ahead with the safety of evacuations, to build a feedback experience worth its name on this area with the aim of knowing the real behaviour of the Cabin Crew Members, the contexts of intervention, the nature of the difficulties met and the mechanisms of their successes.

This pessimistic introduction was meant to draw the attention on the necessary complementary research in the area. In no case, it is meant to underrate the quality of the work of those who got interested in the matter, on the contrary. If there are few of them, there is at least a number of quality studies on the matter whose problematic and results will be summed up around the following themes: the passengers’ behaviour and particularly crowd management in emergency situations, communication, management of the duality of the functions business/safety, understanding the situation, synergy, stress, decision making, risk management, computer modelling of emergency evacuations, training of the Cabin Crew Members to emergency evacuations and impact of new technologies on training whether it involves a moving model or Computer Based Training (CBT).

2.2.1. The Factors Related to the Passengers

There are numerous problems related to the passengers which do not only depend on the quality of the training given to the Cabin Crew Members. Among the factors that help for the survival of the passengers (Snow & al. 1970), there are: the “configuration” factor: structure of the aircraft, number of seats, of emergency exits, the “procedure” factor: efficiency of the crew to lead the evacuation, the “environment” factor: heat, presence of smoke, light, meteorological conditions, the “behaviour” factor: behavioural answers of the passengers according to their personalities, their health, cultures and experiences.

During an evacuation, there can therefore be multiple behavioural answers of the passengers whether involving evacuations on take-off or during a violent landing or after a crash (BST, 1995). In the first case, the passengers are alert enough to panic and go beyond the instructions of the crew. And in the second case, the crew and the passengers are tired and find it difficult to have the strength to evacuate the plane quickly. Furthermore, at that time of the flight, the safety guidelines given during the departure are forgotten. Muir and Cobbett (1996) have compiled several types of reaction: fright, anxiety, disorientation, inaction, aggressiveness. Panic behaviours can be observed as soon as life seems threatened. The evacuation is then made in a non cooperative and even a competitive way.

The factors of panic are fire, smoke, the lack of clear and precise orders and the contagion of panic reactions among the passengers (Muir & al., 1996). A means of action on the passengers' behaviours should therefore be found so that they remain willing to cooperate.

The factors “multiple anti-panic” (Muir, 1994) are: the assertiveness of the Cabin Crew Members in the way orders are given and the number of Cabin Crew Members in the plane. Thus, lots of articles, among which that of Koenig (1995) point out the necessity of training the Cabin Crew Members to crowd management. The mastering of crowd phenomena that might take place during an emergency evacuation goes through the authority of the Cabin Crew Members. They should be able to direct the passengers towards all the possible exits. To do so, they should be able to be heard and to communicate with all the crew members to know the available exits.

The literature of reference offers no pedagogy, nor any teaching programme on this matter.

A real taking into account of the “passenger” factor for emergency evacuations must go through the definition of a policy of awareness of the elderly and handicapped people, of a policy of information, of preparation of the passengers in the cabin and by the improvement of the technical design of the cabins (this last aspect goes beyond the stage of our study and will not be mentioned).

As far as the pieces of information for the passengers are concerned, a study carried out in the United Kingdom with people having travelled by aeroplane in the weeks before the enquiry, gives us some figures that are interesting to quote (Cabin Safety Update, Vol. 3, n°11, 1997): nearly 40% of the persons interviewed believe that less than 50% of air accidents leave a possibility of survival. However, in 90% of the accidents, a well carried out evacuation can save lots of lives, even all the persons still alive after the crash (if there was any crash) 73% of the persons interviewed do not want to know more on the safety of the aeroplane (feeling that the more they know the more they are afraid), 27% require more information (feeling that the more they know the more they will be able to survive). This figure is similar to that of 29% mentioned by the study of the BST (1995).

This figures show that the problems related to the passengers bear on the difficulty of informing them properly without scaring them. Besides the consciousness raising campaigns that may be carried out by the airlines, the Cabin Crew Members can play an important part in reaching that aim.

2.2.2. Communication

All the studies consulted agree that communication is a momentous concept for the preparation and the carrying out of emergency evacuations. The conditions and constraints of communication change according to the interlocutors that the Cabin Crew Members have in front of them.

2.2.2.1. Communication With the Passengers

The way of addressing the passengers has an influence on the speed of execution of the emergency evacuations (Muir&Cobett, 1996). According to the authors, addressing the passengers in a firm and authoritarian manner is a good means of limiting panic and getting an organised evacuation. However speaking in this way to the passengers is a contradiction with the service practices of the cabin flight hostesses and stewards. This problem of tasks and even of contradictory assignments sends back to the discussion related to the duality of the parts played by the Cabin Crew Members.

2.2.2.2. Communication With the Flight Crew Members

Some accident reports prove in a tragic manner the importance of communications between the cockpit and the cabin. The most famous of them, the accident of Dryden in 1989 (Mohanski, 1992) reveals in a significant way that communication of this sort is not automatic and even sometimes impossible for cultural reasons.

There is a special difficulty of communication between the two jobs: the hesitation of the Cabin Crew Members in transmitting the Flight Crew Members pieces of information they believe to be critical for safety (Chute & Wiener, 1995). The reasons for this reluctance lie in the doubt the crew members entertain as to the actual consistency of information, the dread of being sent back or “being sent away” by the pilot or the dread of not respecting the rule of the “barren cockpit”.

The training of the Cabin Crew Members should enable them to understand and know (ability to name) the basic items of the plane that can be seen from the cabin and critical for the safety of flight (Chute & Wiener, 1996). This training should also enable the Cabin Crew Members to become aware of the pilots’ workload for each phase of the flight and especially the inside and the duration of the procedures during an emergency evacuation.

So that the difference of culture between the two jobs should not be a bar to communication (Merritt, 1993), the joint training of some procedures such as emergency evacuations could be a means for each one to get impregnated of one another's culture. Both populations should know one another better to ensure proper communications during the flight.

On another hand, when the systems of intercom are out of order, the communication between the Flight and Cabin Crew Members is broken. The use of megaphones is not always audible enough. As a consequence the set of information goes from mouth to ear, but that type of communication is very poorly reliable, the messages are transformed, misinterpreted and the times of transmission are dramatically increased.

2.2.2.3. Communications Between the Cabin Crew Members

During an emergency evacuation, communications between the Cabin Crew Members will mainly consist in making sure that the order of evacuation was given and passed on, in identifying the available exits and in splitting up the passengers to enable a quick evacuation (Muir & al., 1996).

In some situations (cabin safety Update, Vol 4, n°1, 1998), a Cabin Crew Member may find himself/herself isolated from the rest of the crew (cabin and flight ones). The Cabin Crew Member must then decide alone: to evacuate or not to evacuate? Only one thing may help him/her in making this decision: a good understanding of the situation (Cf. Understanding of the situation).

2.2.2.4. Communications With Ground Teams

Some articles (Cabin Safety Update, Vol.3, n°2, 1998) and incident reports quote the communications between Cabin Crew Members and ground teams (firemen for instance) as a determining factor for the good progress of the evacuations. But do both populations know one another, do they have any opportunities to meet and to discuss the actions carried out by each of them?

2.2.3. Duality of the Safety & Service Roles

This conflict between the two roles originates difficulties for the Cabin Crew Members (Focus on Commercial Aviation Safety, Autumn 1995) because they are sometimes felt as contradictory. It is important to enable the Cabin Crew Members to solve this conflict by giving them a better sensitivity to their safety parts and by helping them to identify the situations where the change from the service role till that of security is required. This is on another hand part of the suggestions expressed by the Cabin Crew Members we have consulted by questionnaire (refer to this section).

Of course, during an evacuation, this passage is most likely to take place. But three reasons may change its scope and efficiency:

- The Cabin Crew Member regards his/her job more as a commercial job, the situations requiring a safety role being very rare. They seldom have the opportunity to implement these specific skills.
- The situations are sometimes blurred. The triggering of a “safety” phase can be felt as a trauma by the passengers. Therefore the Cabin Crew Member hesitates.
- The passengers believe they deal with commercial agents and are very amazed to see them turning into personals in charge of safety. There is therefore a risk of not be taken seriously (referring to safety skills) and therefore not to be listened to by the passengers.

2.2.4. Understanding the Situation

As we point it out in the section related to communication, when the intercom systems are out of order, a good understanding of the situation is necessary to ensure a good evacuation. According to the article "Who should initiate an evacuation?" (Cabin Safety Update n°1, vol 4, 1998), the most important for the Cabin Crew Member in such a situation is to be able to work alone at his/her post, to identify quickly a threat endangering the passengers' lives. The Cabin Crew Member must then be able to work individually. We no longer are in a context of team work.

The Cabin Crew Member need to think of the right questions and have the necessary general knowledge to think of the right questions and decide of an action. A good understanding of their working surrounding and the evidence to take into account (fire, smoke, running engine) in case of an emergency evacuation that could help them in making individually the right decision should the situation require it.

2.2.5. Making a Decision and Managing Risk

These two concepts are linked: when a Cabin Crew Member makes a decision (evacuating the plane, using any exit, putting any person beside the emergency exit, etc.) he/she takes a risk. To make a good decision, the Cabin Crew Member needs to have a good understanding of the situation and to be able to appraise the risks relevant to his/her decision (Cabin Safety Crew, Vol.3, n°2, 1998).

Some professional tools such as procedures or check-lists are helpful. But in some cases, they are not enough because the situation is out the scope of the anticipated frames.

In most cases, the decision will have to be made collectively. The matter of the quality of the communication between all the members of the crew is then momentous. This communication of information relevant to the situation of each Cabin Crew Member in the plane, will enable a process of collective decision making that will take into account each one's constraints, under the lead of a senior cabin crew (or having the highest rank).

We have seen that the Cabin Crew Member is involved in some extreme cases in making an individual decision (cf. §5.3). Thus, in such situations, the Cabin Crew Member may feel helpless in front of an important choice (To evacuate or not to evacuate? By which exits?).

The training should take into account the different cases.

2.2.6. Synergy

Crew synergy is not natural: it is built up (Amalberti et col. 1996), mainly under the impulse and responsibility of the Captain. For the crew members to be able to follow this "policy" of team management and keeping an attitude of support to the leader, a training course on the rules of synergy is essential.

Synergy can be helped by communication and cooperation procedures between the cockpit and the cabin (Cardosi & Huntley, 1998). The most current problem in emergency situations lies in the communication of the type of the emergency by the cockpit to the rest of the aeroplane and the communication by the Cabin Crew Members of the state of the cabin to the Flight Crew Members. We see here the narrow relationships between good communications and the setting up of synergy with the implementation of a common project.

The concept of synergy is part of the human factors training courses of the Flight Crew Members. For the Cabin Crew Members, the JAR-OPS regulations will require the airlines to set up such a training. Some airlines have already anticipated these rules.

2.2.7. Stress

Stress is no doubt the most present and strenuous factor during emergency evacuations. Barayan's study (1991) shows that stress factors of the Cabin Crew Members are mainly the fear of an accident, an inadequate training and the lack of self confidence. The training must act on these three aspects by the acquisition of skills, of knowledge or attitudes enabling them to reduce their perception of the stress associated to the carrying out of an emergency evacuation.

Well dominated, stress can have positive effects on performance. But for that, it is important to have a good knowledge of its mechanism (origin, knowledge of stress factors and their effects both on psychological and physiological levels) and to have a good knowledge of oneself in emergency situations (through situation exercises). Training is a stress reducer because it enables the automation of the gestures and the actions to do which improves the know-how and self confidence.

2.2.8. Digital Patterns of Evacuation

The current regulations require for the certification of new aeroplanes that it should be demonstrated that the evacuation of all the passengers is possible within 90 seconds. This test is a reference of comparison for all the types of aeroplanes. The cost of a nature sized evaluation test may reach on jumbo jets 2 million dollars. Even though this figure is relatively low compared to the cost of developing a new aircraft, nevertheless it isn't a negligible figure.

On another hand, this test is not without any risks: about 6% of the persons taking part in this certification tests were injured (OTA, 1993). One of these persons even remained paralysed after the first certification test of the MD11 in 1990. The financial cost and the problem of the people injured by these tests do not however question their necessity. These factors are nevertheless arguments in favour of the digital modelling of human behaviour during evacuations.

There are different patterns of human behaviour (for instance Court & Marcus, 1996). Some take into account the special situation of evacuations whether in an aeroplane or in a building. The pattern airEXODUS of Galea and its colleagues (1998) was developed with the aim of providing some help for the certification of cabins of aeroplanes.

Today, there is a great debate on the possibility of using this kind of patterns for certification. On one hand, the supporters of this use put forward financial and ethical arguments (participants might be wounded), on another hand the opponents attack the validity of such patterns. It depends on the reliability of the parameters used. These parameters come from accident extracts for which information could be obtained from the survivors. The data collected by the constructors during certification tests make up the other source of information. All these data are kept in the AASK (Aircraft Accident Statistics and Knowledge) database (Galea & Owen, 1998).

It was anticipated in the frame of this study, to carry out an analysis of the AASK database developed by the University of Greenwich in the United Kingdom to deepen the understanding of the needs of Cabin Crew Members training. Only a presentation of this base could be obtained. Its software is being renewed and the updated release was not finalised when this report was written out.

On examining the release 1.0 of the database, it happened that the information kept (data related to the accident, the Cabin Crew Members, the dead and the passengers) mostly favoured the understanding of the technical environment (intervals between the seats, location of the exits...) as well as the invariants in the passengers' behaviours. A release 2.0 is being developed now. It could, if the designers oriented more the gathering of information on the performance of the Cabin Crew Members during the evacuation, turn out to be useful to show the possible difficulties met by the Cabin Crew Members in different scenarii of emergency evacuations, to ease the development of more adapted training syllabi, even though to be used as a pedagogical tool for demonstration.

Another argument from those who have developed this pattern is that it can be an assess in the emergency evacuations training. However, it does not seem that today this model is still used for such training sessions. The use of this tool would certainly bring a lot to make the Cabin Crew Members aware of the different evacuation scenarii as well as the possible behaviour of the passengers. The fact that it is a computer pattern makes it easily incorporable in a training of the type computer based training where the Cabin Crew Members could interact with the system to discover the consequences of such or such configuration.

3. The Answers of Cabin Crew Members' Training on These Subjects

3.1. The Regulatory Frame

Whether it is a matter of French regulations (orders of November 5th, 1987 and July 5th, 1984), of JAR-OPS, of FAA regulations (FAR 121-417) or of the CAA (CAP 360 31-16), the theoretical and practical teaching are more or less clearly defined. To be able to be in compliance with regulations, the airlines copy exactly their general or analytical programmes on these rules.

The implementation of the JAR-OPS will undoubtedly lead to normalise the basic training of the Cabin Crew Members in Europe. It is sure that training will never be able to reproduce all the emergency situations that the Cabin Crew Members might encounter during their career. To become a professional of safety, the ICAO recommends that the Cabin Crew Members should receive some specialised and detailed training (ICAO, 1996).

The Cabin Staff require authority and sound knowledge as regards safety but also in depth knowledge in aeronautics, meteorology, physiology related to flight (ICAO, 1996). For the training to be efficient and the level of skill required high, the instructor must himself be selected, trained and checked at a good level. However, today's regulations do not mention the skills required for these instructors. No study consulted makes any reference to this subject as far as Cabin Crew Members are concerned. On the regulatory point of view, only the CRM trainers for the Flight Crew Members must fulfil some requirements before being able to give this type of training (Order March 8th, 1995, JAR-OPS Temporary Guidance Leaflet n°5).

As far as the Flight Crew Members are concerned on another hand, a study carried out by the French "Académie Nationale de l'Air et de l'Espace" (ANAE, 1987) issued "recommendation on the desirable evolution of the training of young pilots of civil aviation of transport". One of the recommendations is related to the training of the trainers. The Academy regards this matter as essential: "The intensive use of simulation and its incorporation in the teaching system make the improvements to be brought in the sector of trainers urgent."

The faults noted in the study are as follows: insufficient basic pedagogical training (a good technician or a good pilot is not necessarily a good instructor); lack of homogeneity in the way of teaching the trainees; standing by of the 'corporation', with a difficult management, nearly impossible checks and recycling and a frequent lack of motivation in the search of pedagogical efficiency.

And the report concludes: "a thorough reflection on the roles and objectives of the trainers, their recruitment, their training, their checking and recycling is to be lead in depth. The success or failure of the implementation of a system of instruction is up to them. It is therefore necessary to look seriously after them and to motivate them..."

Couldn't these formulated records and recommendations for the trainers of young pilots also address the safety trainers of the Cabin Crew Members?

3.2. The Pedagogical Tools

Simulators able to display realistic simulations of emergency situations are now widely available and they are used to train with efficiency the Cabin Staff trainees to the emergency safety procedures.

For the training to be efficient, it is necessary to have at least one model of a life-size representation of the inside of the fuselage [...] to allow to simulate with realism the functions of onboard commercial staff" (ICAO, 1996).

For many years, the pilot population benefited from the contributions of technology for their training. The Full Flight Simulators giving back the feelings of a genuine aeroplane cockpit allow the airlines to avoid using aeroplanes to train their Flight Crew Members. This technology also exists for the Cabin Crew Members (CAT, Vol. 5, n°3, 1994). Some airlines already use these tools (ANA, British Airways, China Southern, Emirates, Finnair, Lufthansa, Swissair, ...). The advantage of these simulators is to be able to train the crews to evacuations in unusual configurations (for instance with front landing gear retracted) in adverse

environments while having them undergone a simulation of the flight phase before evacuation as realistic as possible (aborted take-off, emergency descent, etc.).

But these simulators remain very expensive tools and some airlines cannot afford them. On another hand, it would be thoroughly unjustified to carry out all the Cabin Staff training in these simulators. Other pedagogical means, much less expensive, can allow the acquisition of given knowledge during evacuations (door module, cabin filled with smoke, fire simulation,...).

The use of the computer tool for the training warranties a standardisation and allows some flexibility either in an individual way, allowing every one to progress at their own rhythms or collectively with the help of an instructor.

As far as the limits of Computer Based Training are concerned, as pointed out by the ICAO: "the use of leading training devices should never be an excuse to overlook carrying out practices and exercises/role games on all the aspects of emergency procedures" (1996).

4. The Enforcement of the Regulatory Frame by the Airlines

During the second phase of the study several point were analysed: the procedures of emergency evacuation defined in the operation manuals and the Safety and Rescue Manual (MSS) of the airlines, the methods of basic and recurrent training as well as the realism of the training to emergency evacuations, the realism of the scenarii of the exercises and their credibility compared to the airline and the means of training of the Cabin Crew Members of the small airlines.

In order to meet the objectives, three major actions were taken during this second phase of the study: a visit and a study of three training centres during emergency evacuation exercises, carrying out, sending and analysing a questionnaire meant for a sample of the French Cabin Crew Member population (all airlines put together) and the meeting with a Cabin Crew Member having undergone an accident with an evacuation.

4.1 Visit of the Training Centres of Three Airlines of Different Sizes

We visited the Cabin Crew Members training centres of three airlines of different sizes to have a better knowledge of the different cases as far as training centres are concerned.

4.1.1. Big Sized Centre

This centre located in the Parisian area shelters the premises meant for the Safety and Rescue training of crew members from a big French airline.

In report n°2 a description of the configuration of this centre in terms of equipment and training modalities of the Cabin Crew Members will be found. We will remind here that it has fixed models of heavy and small carriers with slides as well as genuine modules of door on which the Cabin Crew Members can exercise to their opening in deteriorated conditions. Furthermore, two models filled with smoke are used to train to wearing the respiratory protective masks and moving in such an environment.

A mixed Cabin and Flight Crew Members situation exercise is carried out there which is called "simulated flight", whose aim is to stress the problems of crew management in a crisis. It takes place in four phases: former briefing for the Cabin and Flight Crew Members acting as the crew, progress of a scenario (that might change from one instruction season to another), video taping of the exercise and debriefing of the exercise from the video.

The important points of this formula are the presence of the Cabin Crew Members, the pedagogical tools available and the size of the model. It must be noted that the instructors are not Cabin Crew Members. Regarding the other bad marks, let's quote the apparent lack of motivation from the Cabin Crew Members in the practical exercises (their aim being, apparently, to succeed in the annual test of knowledge check at the end of the training session) and the fact that crowd management is only seen from the theoretical point of view, without any practical exercise.

4.1.2. Middle Sized Centre

This centre, located on a Parisian airport, shelters the premises meant for the Safety and Rescue training of the Cabin Crew Members and some rooms meant for the Flight Crew Members training.

As far as the Safety and Rescue training of the Cabin Crew Members is concerned, the centre has a model hall available equipped with a small carrier model and a jumbo jet model section with an evacuation slide, with door modules of a limited realism (all the opening and closing handles are represented and operate to simulate their handling but do not cause the doors to open or to close) and of a very realistic fire space especially as far as the toilet compartment is concerned.

The instructors are Senior Cabin Crew Members in activity. There is no test after the practical exercises.

The exercises are carried out heartily on a sustained rhythm. The other good points are the hearing of the instructors and the partaking of the trainees. Regarding the weak points, the lack of participation of the Flight Crew Members is noted, the lack of realism of the environment simulating a jumbo jet and the fact that the crowd effect is not reproduced. The overall realism of the emergency evacuation exercises is therefore limited.

4.1.3. Small Sized Centre

This centre located in the provinces, is split into two parts: one reserved for the Flight Crew Members with flight simulators and the other for the Cabin Crew Members for training to Safety and Rescue.

The centre has now available a "generic" model simulating the different aircraft in use in the airline and is meant to stand for the doors and exits of these aircraft, whereas it is planned to set up a model with a slide to represent an F100.

The capacity of the model is rather limited, but the duration of the training dedicated to emergency evacuations is important (three and a half hours). The instructors are Senior Cabin Crew Members in activity. There is no test after the practical exercises.

The main strong points are the realism of the exercises (sound effects, smoke), the variety of the scenarii, the very strong authority of both instructors, the advice adapted to small carriers to face the passengers disturbing the evacuation. The method is especially active: scenario, muscled evacuation, debriefing and exercise done all over again if it was not deemed satisfactory. The trainees are "jostled" and jostle one another during the evacuation as would happen during a real situation. They especially have the opportunity to train on a rather realistic "maritime" evacuation exercise. After the exercises, trainees and instructors gather in a room to work on studies of recent cases in the airline. The main weak points are the absence of Flight Crew Members and the lack of realism of the physical environment (hall model and premises).

4.2. Enquiry by Questionnaire

It was important to ask the Cabin Crew Members on the emergency evacuations, their ability to manage such a situation, the quality of their training and their suggestions of improvement in this area.

1750 questionnaires (concerning about 13,6% of the French Cabin Crew population) were handed out at random in the most significant French airlines : scheduled airlines, charters and third level. All the airline companies asked took spontaneously part in this enquiry but one.

The questionnaire is anonymous and confidential. It includes 42 questions that cover several aspects of the Cabin Crew Members' practical training and tackles the reactions and the preparations of the Cabin Crew Members to an emergency situation. We asked the Cabin Crew Members to formulate a judgement on their own know-how and therefore on their training and to put forward improvement hints.

The questionnaires were issued from mid February 1999 with a « validity period » of one and a half months (return asked by end of March 1999). On April 2nd, 1999, Dédale had 356 questionnaires filled in available. This stands for a return rate of 20,34%, that is to say a questionnaire back out of five sent. This figure on another hand stands for 2,7 % of the French Cabin Crew population (12 844 people).

The good rate of answers to the questionnaire, the richness of the suggestions made let us believe that the Cabin Crew Members are very aware of their roles in safety. The Cabin Crew Members asked were rather critical as to the training to emergency evacuations they get now : training deemed too theoretical, not very realistic conditions, timeworn material, not very serious modalities. As a consequence, is the outlined fear is expressed very clearly for some of them not to be able to face if need be.

The main results are presented hereafter :

- The elderly and most experienced Cabin Crew Members, particularly the Senior Cabin Crew Members felt more involved in this enquiry.

- The Cabin Crew Members estimate as rather good the safety part in their training whereas the quality of the training dedicated to emergency evacuations is often felt as insufficient. The lowest note is related to the realism of exercises.
- The Cabin Crew Members prefer smaller aeroplanes they feel as more « human », more practical, easier to manage in case of problems. Their preferences are also for the aeroplanes in which they fly most.
- The multi specialisation is often felt as a hazard for safety.
- The most experienced Cabin Crew Members take their roles of safety a little more seriously which especially appears in the biggest frequency in which they review the emergency procedures between the safety training sessions.
- Most of the questioned Cabin Crew Members underrate the survival chances in case of an emergency evacuation. This underrating is more important with the less experienced.
- As a whole, the discourse of the Cabin Crew Members on their collaboration with the Flight Crew Members is not alarmist. Improvements are however wished, especially as far as pre-flight briefings are concerned. The Cabin Crew Members believe that the Flight Crew Members do not regard them enough as safety specialists but more as commercial staff.
- Most of the Cabin Crew Members seem rather confident in their abilities to face the situation during an emergency case, which in comparison with the other items of the questionnaire denotes a certain degree of over confidence.
- More than 50% of the Cabin Crew Members questioned, whether experienced or not believe that the beginners' training wants improvement.
- Even if the utility of the CRM is as a whole recognized in safety matters, this awareness to human factors is not adapted enough, in its actual state, to the specific treatment of emergency situations.
- In terms of self assessment, the questioned Cabin Crew Members regard themselves as not prepared enough to react against a number of situations among which there is sea landing forecast or not as well as the unforecast crash landing. The item that receives the lowest score is the capacity to react in front of a *beginning of panic among the passengers*.
- The emergency evacuations are rare events: only 16 out of the 365 persons having answered stated having seen one.

Three flight hostesses having each lived an emergency evacuation spontaneously offered to talk of their experience and to comment some items of the questionnaire. A report of these interviews is shown in section 4 of report n° 2. To give a synthesis of these testimonies, it will remain that:

- the involved persons think they were not prepared enough to meet emergency situations,
- the exercises lack realism and the training sessions are too theoretical,
- in particular, it should be taught how to manage crowds,
- the daily activities lead to forget that accidents exist and may happen to anyone (losing the awareness of risk).

The questionnaire also suggested that the Cabin Crew Members should express hints of improvement regarding their training to emergency evacuations. Three themes are strongly outlined:

- the improvement of the realism of the evacuation exercises.
- The improvement in which the training courses are carried out.
- And the use of more concrete training supports.

As for the training wishes, they can be organised around four objectives:

- the acquisition of automatic reflexes that many of them think not to have received at this stage of their training for the following reasons: insufficient initial training, insufficient training sessions in number and duration and carried out in not very realistic conditions, multi specialisation generating confusion between the aircraft. The Cabin Crew Members regard the automatic reflexes "resisting" best in case of stress rather than the more theoretical training they are receiving now.
- **the acquisition of more general, transversal skills, complimentary of the automatic reflexes: team work, management of a panicked crowd, stress management, decision making, knowledge of the aeronautical terminology and the aircraft parameters.**
- **The improvement of the collaboration with the Flight Crew Members.**
- **And to finish with, the revalorisation of the safety aspect of their job versus the commercial aspect.**

Reaching these objectives means favouring all that might help the Cabin Crew Members in representing themselves the requirements of reality and understanding their role to be able to train themselves and to be proficient on the day an incident occurs: realism, credibility and concrete things. To benefit from real-life experiences is also a means of approaching the reality of a job: the exchanges with colleagues implied in these events and the feedback of experience seem still insufficient and are related to a genuine need.

Incidents seldom occur most luckily. The need of realism for these trainings has therefore an increased importance because they make up the main occasions for the Cabin Crew Members to challenge their reflexes in matters of emergency.

5. Practice in Related Areas

We took an interest in the practices and skills in other areas than aeronautics. The terms and conditions of this study made provisions that the problems of evacuation would be studied in such areas than the Navy, tunnels (Eurotunnel), civil protection or public buildings (e.g. Stade de France). In this study, only the areas of the Navy and Civil protection (firemen Brigade of Paris and airport firemen) were investigated. We made an on site visit in these two areas, with for the Navy an observation of exercises of training to safety and especially to emergency evacuations.

As far as Eurotunnel is concerned, no contact could be obtained, in spite of the efforts made. The catastrophe of the Mount Blanc Tunnel unfortunately caused the closing of the access to information that could have been expected. As far as the public buildings are concerned, the safety is ensured by the firemen.

5.1 The Firemen

Even if there are many differences - and more especially this one : for a fireman, an emergency intervention is a daily professional act, for a Cabin Crew Member it is a dreaded and exceptional event - it was interesting to draw a parallel on the training sessions and exercises of both professions.

In this parallel, some points that could apply to the safety training of the commercial crew can be pointed out. The strength of the training of the firemen lies first of all in the discipline of the team, the physical fitness, the frequency of the training.

- The team:

In fact, it is the solidity of the team that is built behind the principle of discipline of the firemen. It is a remarkable point during the training sessions for emergency evacuations. A lot of importance is given to individual exercises for the cabin crew. You open your door, you use your mask, your oxygen bottle, you extinguish "your" fire and outside the exercise of evacuation, there is no group training even though the cabin crew is part of a crew.

- The physical fitness:

The notion of physical fitness is an important factor regarding firemen. The success or the failure of a daily physical exercise allows or forbids active service for the day. On the other hand, the physical fitness is far from making up a job value for the cabin hostesses and the stewards, even though the acts carried out in case of an emergency evacuation are demanding on that point: opening a door against gravity in an inclined aeroplane or against the wind, control of excited individuals, acceleration of the evacuation, etc.

- The frequency of the training sessions:

Daily training at the fire brigade, annual training for the Cabin Crew Members: there is clearly a gap between the two worlds. This is aggravated by the fact that the daily activity exposes the firemen to a repetition of the professional gestures that alone allows to acquire accurate and reliable gestures whereas the Cabin Crew Members very seldom undergo emergency situations.

As a conclusion of this comparison, it clearly appears than a yearly training of a short duration, carried out in conditions of realism often very low, with a motivation (understanding of the need) of the staff that is very relative, and a physical strength often limited regarding the professional acts to be carried out, ill prepare the Cabin Crew Members to emergency evacuations.

The interviews carried out with the firemen of Aéroports de Paris CDG bring another light. In the case of an emergency evacuation on an airport, which is the most frequent case, the role of the firemen begins at the plane when the passengers have already begun the evacuation. But, the firemen ignore indeed what happened inside the cabin when the evacuation was initialised, if they can climb on board to help the cabin crew. Indeed, the problem of a bad knowledge between the jobs arises again, between the crew members in the aircraft and the airport firemen.

The airport firemen would like to take part from time to time in joint evacuations. The probable arrival of very heavy carriers will no doubt require a better coordination between ground assistance and the crew in the case of an accident on an airport and subsequently a conjunction of the jobs.

5.2. The Merchant Navy

There is an area rather close to aeronautics in matters of training to emergency evacuations. It is merchant navy and the crew on board of passenger ships. Modern ships are equipped with evacuation slides and safety lifeboats that are very similar to those that equip the planes (same principles and same manufacturers). Furthermore, the actual implementation of these material for the training of the crews would be very expensive. That is why, the training of the staff has a particularly important aspect.

We contacted an important French shipping company whose fleet is mainly made up of ferry boats whose passenger capacity averages 2000 passengers and the responsible for safety rescue training for the company received us at Saint-Malo.

As for aeronautics, the allotment of the safety and rescue function to the personal serving on the ships carrying passengers as well as their training programme and their practical exercising underwent regulatory arrangements. The content of the training programmes is approved by the maritime authorities. It can be found in the intermediary report n°3 a description of the characteristics of this job related to the regulatory arrangements, the training to safety, the training to fire fighting, the rescue plan and the safety complimentary training sessions (monitoring of crisis situation, stress, crowd management).

The staff whose job is the closest to the Cabin Crew Members' on a ship is the ADSG personal (help to general service), that is to say mainly hotel staff. Like the Cabin Crew Members, they also have in common both the service and safety roles and therefore live a similar difficulty in being able to put themselves quickly as safety responsible ones with passengers they were close to a few moments before at the bar or at the restaurant of the boat.

Even though the allotted times to the emergency evacuation of a plane (one to two minutes) and of a boat (about twenty minutes) are not of the same order, many points are similar but there also are divergences in the safety training of the personals and the devices implemented.

- The similar points can be found in the subjects tackled during the training sessions (especially as far as the human factors are concerned), and the use on board of safety instructions, of evacuation plans and according to the boats, of safety video projections in the cabins.

- The divergence is especially found at the level of the frequency of the trainings: annual for the cabin crew of the airline companies, and weekly in the navy, a part of the weekly exercises being dedicated to the gestures required for the implementation of real material and the other to video training. Other exercises are scheduled at different intervals: a general exercise with the simulation of an escape from a ship and the gestures required for the implementation of the materials every three weeks on quay and an annual general safety exercise with the real use and putting into water of the abandoning means.

As a conclusion, a great rigor in the training, an evident awareness of the staff on their safety roles, a great discipline and an important frequency of the exercises are perceived by the responsible ones as the warrants of a maximum safety.

5.3. In Short

Strict respect of the procedures, great discipline, repetition of the gestures are all the more common points we have noted in the professions we have studied regarding emergency evacuations.

The acquisition of this know-how undoubtedly enables a better stress management and subsequently a better performance of the teams. The professionals of safety struggle justly by any means against improvisation. As far as safety is concerned, all the research works carried out in matters of evacuations, the evacuation patterns, give valuable indications related to the reactions of the passengers and crew members in such conditions. But, up till now, it seems that there is a real discrepancy between this knowledge and the practical training of the cabin crew. We believe it particularly important to bring closer these two axis, to show the companies that whatever their size may be, the quality of their safety training involves a permanent training of the personal and to make the staff as well as the managers realise that an accident does not choose its company.

The difficulty, for commercial crew members is putting into practice the knowledge acquired. Luckily, accidents seldom occur and unlike firemen or emergency medical staff who have to deal everyday with dramatic situations, the commercial crew members are not able to "live" evacuations and therefore are not able to assess their skills.

The increase in the frequency of the training sessions and the introduction of new training sessions should make up for the lack of practice. This is true for small capacity planes as well as for very big carriers where the coordination of the crew members put under the authority of a recognised leader seems indispensable.

6. The Matter of the Size of Aeroplanes

The Cabin Crew Members' job and further more its 'safety' component, changes considerably according to the size of the plane taken into account. At one end of the scope, it is a solitary function. On the other it is the work of a big team. It is clear that the objectives and the constraints of training and exercising are then considerably affected. To incorporate this aspect in the reflection, we will deal in this chapter with the case of small capacity planes and on the other extremity with that of the very high capacity future planes.

6.1 Small Capacity Planes

The planes with a capacity of less than 50 passengers require the presence of only one Cabin Crew Member. On those of less than 20 passengers, no Cabin Crew Member is required. In both cases, the Flight Crew Members have an important role to play in case of an emergency evacuation either to assist the only Cabin Crew Member, or to carry out the evacuation themselves.

For instance, a recent accident of a French ATR in Italy illustrates well the case of a single Cabin Crew Member on board during a rather dramatic emergency situation. One of the pilots was killed and the other very seriously wounded. The Cabin Crew Member had then to make alone the decision to evacuate the passengers.

This example shows the importance in implementing training modules to decision making for the Cabin Crew Member of airlines operating small carriers with only one Cabin Crew Member. Because the fact of being alone requires special abilities to carry out successfully an emergency evacuation. However, very often small capacity plane is often synonymous with a young Cabin Crew Member without much experience.

6.2. Very Big Capacity Planes: A3XX

The study also anticipated a meeting with Airbus to debate safety problems and more particularly emergency evacuations and the needs in Cabin Crew Members training on their future very big capacity A3XX. However the successive delays of the launching mean that the project is still in its phase of specification. We were not communicated potentially interesting information because it still remains either undefined or confidential. We shall therefore limit ourselves in discussing the general problematic created by this new dimension of aircraft.

Straightaway an important contradiction takes place between the commercial argumentation and safety. The manufacturer already boasts that in such an aircraft, bars, gymnasiums, relaxation and playing areas will be available for passengers. There are certainly advantages that can be easily imagined on a ship but that in an aircraft will no doubt encourage the passengers to unfasten their safety belts and to get around to use these services. The turbulence will certainly neither choose the type of aircraft nor the moment. This will add further difficulties to the supervision task of the Cabin Crew Members.

On the passengers side, a huge crowd sensation, perceptible as early as the embarking halls will have to be taken into account. This might increase the worry and panic at the least incident.

Should there be an evacuation, the impressing height of the upper deck could provoke an important hesitation from the passengers when they have to jump in the slides. For this reason, Airbus Industrie limited the slope of the slides at 33°. As an indication, the slope of the slide of the upper deck of the B747 is of 38°. It should however be noted that the upper deck of the A3XX-100 is meant for 205 passengers (in the 3 classes version, practically 250 passengers for the A3XX-200 in the 3 classes version) whereas that of the B747-400 only accepts about 40 ones (in the 3 classes version). Even if the slope of the slides of the upper deck of the B747 is bigger than that anticipated for the A3XX, the number of passengers involved is not comparable.

Two flights of stairs are anticipated to link the main cabin to that of the upper deck. The stairs should be wide, straight (and not in spiral) and with a double way. This design which was chosen to help the evacuation of injured people on stretchers will allow the passengers to pass in the case of an evacuation of precaution as well as the easy circulation of the Cabin Crew Members and passengers during the flight.

The important number of passengers in the upper cabin lead Airbus Industrie to regard the two cabins (lower one and upper one) as independent in case of an evacuation. This means that the evacuations of the two cabins should take place in a separate way while being simultaneous. In this case, the stairs are not to be used.

During emergency evacuations, either in aeronautics or in other areas, the passengers have a tendency to evacuate by the door used when entering to the detriment of nearby emergency exits. The upper deck passengers will therefore also have a tendency to use the front stairs by which they entered. This might cause congestions at the front doors of the main cabin, that might provoke a panic. It will be the role of the Cabin Crew Members to canalise these passengers in order to avoid their climbing down to the lower deck. This point will be subject to a particular attention during the Cabin Crew Members training. Crowd management becomes with the A3XX an important training matter. But the teaching will also have to develop in an in depth manner the concepts of synergy, of decision making, of communication and stress management.

Regarding each deck as a different plane is not without raising a number of questions as far as safety training is concerned. To evacuate independently indeed, but how to be sure of the right coordination of both crews? With over 200 passengers on the upper deck, it would not be surprising for the Cabin Crew Members to actually feel as if they were moving about in two different planes. Then is raised the problem of coordination between the crew members especially because the Cabin Crew Members will not necessarily only fly in the sole type of aircraft. It is precisely in emergency cases that a team needs a leader because the temporal pressure is strong and the decisions often irreversible. This type of situation also requires a strict enforcement of the procedures by Cabin Crew Members at first not very at home with this type of plane. But the evacuation procedures are today either nonexistent or being elaborated, or not officially available. Whatever the case the need of a specific training is felt.

Chapter 2 – Discussion

This section is about the discussion developed around the four questions asked at the beginning of this report.

1. What Are Now the Concerns Associated to the Regulatory Frame and How is It Enforced by the Airlines ?²

The European regulations (JAR-OPS Sub-part O) mark an improvement regarding the Cabin Crew Members training to the safety functions with more accurate specifications especially as for the realism of the models and practical exercises. This trend is confirmed in international regulations (ICAO : Instruction Manual, 1996) Cabin Safety Update, Vol 4 n°10, 1998), that require that the Cabin Crew Members should acquire both the knowledge related to their safety attributions as well as the necessary authority and self-confidence necessary to their enforcement. However, neither the ICAO recommendations nor the indications provided in the AMC & IEM of the JAR OPS (Acceptable Means of Compliance and Interpretative/Explanatory Material - sections 1.1005/1.1010/1.1015/1.1020 - Representative Training Device) *are required* in the practical implementation of the regulations by the airlines.

In France, the implementation of the JAR-OPS sub-part O will start the following changes in relation with the Order of November 5th, 1987 (modified in 1988 and 1993) :

At the operational level - making up the crew : number of Cabin Crew Members defined according to the number of seats and no longer according to the number of passengers (O - section 1.990), and a hierarchy among the Cabin Crew Members is made official (O - section 1.1000)³,

At the training level - CRM compulsory for the crucial themes of crowd management⁴, of a terminology common to the whole of the crew (Human Factors and technical) in order to improve the coordination and communication,

At the training level - More precise requirements related to the environment of simulation and the modes of operation.

To be able to work as a Cabin Crew Member, it is required to get either a Certificate of Safety and Rescue in France and some European countries, or a certificate acknowledging the training.

The regulations state that it is required to be physically fit to be able to work in this job. In France specific medical visits can be undergone in specialised centres.

The medical criteria are also defined in the JAR OPS 1.995.

² We only made our observations in the French airlines.

³ The French regulations make no hierarchy among the Cabin Staff and only mention the positions of senior cabin crew member and head of cabin in jumbo jets. The JAR-OPS do mention a particular training for Senior Cabin Crew Members.

(JAR OPS 1.1000).

⁴ the JAR OPS requires a method of crowd management training favouring the swiftness of an evacuation (JAR-OPS 1.1005 f(2)).

The French regulations point out that after having attended a specialisation training for the aircraft on which they will have to fly, the Cabin Crew Members will have to follow every year a training to maintain their skills during which the emergency procedures will be recalled.

The JAR-OPS require a greater frequency for some exercises which can reach three years (Appendix 1 to JAR OPS 1.1015 paragraph c), while the ICAO advises in its instruction manual a yearly training for the Cabin Crew Members.

On the other hand, compared to the French regulations, the European regulations never mention the sensorial environment. The note of the Appendix X (Order of 1987), has the credit to mention it even if it is only means a possible restitution.

On another hand, the French regulations anticipate an annual check of knowledge regarding safety and emergency procedures, but give no precision as to the way of carrying out this check. This test may be in written or oral form, on board of planes or after skill maintenance training courses under the form of MCQs by computer or not.

The regulations provide objectives and prerequisites in matter of content and training and exercising modalities. The instruction programmes that are filed by the airlines with official organisations are rather faithful to the spirit of the regulations. However, it is noted that beside very accurate specifications, the choices for the practical enforcement (model, course material, training and exercising modalities) are left to the interpretation of the airlines.

On this subject, it is rather paradoxical to note that the centres that have less means are those who offer the most realistic exercises. Together with this record, the Cabin Crew Members that follow the trainings in these centres seem very motivated and follow their trainings paying a lot of attention. The joint exercises with the Flight Crew Members occur still too seldom and when they take place they do not meet with the requirements of the Cabin Crew trainees that is, on one hand a better knowledge of what really happens in the cockpit during an incident and on the other hand the expectations of the Flight Crew Members regarding the action of the Cabin Crew Members in the cabin.

Very often, the situations simulated are not very realistic and therefore that do not enable to represent crowd management, the feelings of stress or the flow of evacuation of a great number of passengers.

Life size models, mobile and representing an environment close to the reality are really a major asset. But without a realistic scenario, a solid preparation and a nearly life size simulated situation, the models are certainly not enough.

2. *What Is the Teaching of What Exists : What Can Be Learnt From the Facts and First Line Actors ? What Needs and Priorities Come Out in Terms of Training and Exercising ?*

The comparison of the regulatory trends with the accident reports of the NTSB and the BST as well as with some French data only reinforces the need for integration of safety human factors within the training sessions in their design as well as in their realisation. An inadequate execution of the evacuation procedures is in fact identified as one of the causes of worsening the injuries or the increase in the number of dead passengers and Cabin Crew Members following an air accident.

Some common factors come out from the analysis of accidents notwithstanding the type of carrier, the nationality of the aircraft and the culture of the crew:

- the performance of the individuals in an emergency situation is directly linked to the possibility of implementing automatic actions based on skills.
- the multi-specialisation may be a spring of confusion during emergency situations,
- the stress changes notably the perception of difficulties in the progress of actions, alters decision making and disorganises the activity both on individual and collective planes.
- obscurity, toxic fumes, crowd reactions are conditions for which the cabin crews claim to be insufficiently prepared,
- the communications among the crew members whether between the pilots and cabin staff or among the cabin staff are often made very difficult even impossible either because of a malfunction of the communication devices or because the stress caused a very degraded communication situation or because the cabin was broken during the accident.

An emergency evacuation is a particularly stressing event because in addition to its rarity and the effect of surprise, it endangers the actors' lives. It is known that an acute stress alters the performance with a risk of blocking the reasoning, decision making and action. The basic arms against acute stress are training, a strong team spirit, a well defined structure of decision and the recourse to procedures. The procedures provide stocks of adapted answers that simulated situations allow to automate both for the individuals and the crew. The uncertainty is limited and there is less improvisation. Limiting stress also implies anticipating it mentally - to be ready for potentially critical phases. But that is not enough. It is known that stress results from the unaware comparison between the requirement felt from the situation and the inner image of one's own know-how. There is therefore a phenomenon of amplification. If the training is insufficient, the intimate certitude of not being up to the situation destroys the poor existing know-how. If the training is of a good level, the stress can be checked and the potential know-how is turned into acts.

Regarding the research carried out in matters of safety and more particularly in the area of evacuations, all the works and evacuation patterns give valuable hints as to the reactions of the passengers and crew members involved into such conditions.

Up till now, it therefore seems that there is an actual gap between this knowledge and the practical training of the cabin staff. We believe it particularly important to put side by side these two axis and to show the airlines that whatever their size the quality of the safety training goes through the permanent training of the personal in maximised realistic conditions.

3. *Do the Training Programmes in the Airlines Meet the Training Needs Linked to Emergency Evacuations ?*

The conclusions that come out both during the analysis of incidents (phase n°1) but also from the questionnaires and the interviews (carried out in phase n°2) point out lacks that partly come from either an insufficient or an inadequate training, bringing about gaps in knowledge and skills or difficulties in implementing them practically.

As we pointed out in the synthesis, the accident reports read give a rather negative record: the actions of some Cabin Crew Members aggravated the consequences of the accident. There are nearly always the same factors: gaps in knowledge and skills or difficulties in implementing them practically, particularly as far as the opening of the doors or the use of slides are concerned. Physical factors (fire, toxic fumes and smokes) hinder furthermore the progress of the evacuations because besides the fact that they limit visibility, they limit the communications and reduce the number of emergency exits that can be used.

Furthermore, the passengers seated near the emergency exits sometimes have unexpected reactions and contribute to hinder considerably the evacuation operations or sometimes cause anticipated evacuations. Panic movements can then follow. An improvement in crowd management is a need deeply felt by the Cabin Crew Members themselves.

The difficulties are therefore expressed in terms of progress of emergency evacuations but also before in making the decision of evacuating for the cases in which it belongs to the Cabin Crew Members to decide. Some testimonies gathered during our study (interviews and questionnaires) thus evoke clearly the difficulty of making a decision. Intrinsic difficulties linked to the alteration of the process of decision making under stress and to the stakes and risks linked to the evacuation.

Improving training in this point looks therefore like making up a necessary axis of improvement for the Cabin Crew Members but it is not enough. This training should then undergo the proof of varied and realistic scenarii.

The problem of the training frequency also arises. In front of daily interventions, training and exercising are fanned out accordingly, frequently and in realistic conditions. In front of rarity, the reasoning can be more complex and it becomes difficult to rule the training level answering the requirements of reality. The event "safety intervention in an emergency situation" remains the same, independently of its frequency of occurrence. The requirements to be performing in front of this event are important: it is necessary to acquire and maintain automatic reflexes to be able to work in an automatic manner. The way one answers these requirements can after be balanced by the frequency of the events:

"It often happens therefore it is absolutely necessary to know how to face it". The frequency justifies then the birth of a special qualification, a full part job to answer it and an intensive training to acquire the skills and the necessary automatic reflexes. And as a feedback this daily practice reinforces these abilities.

"It very seldom happens and one should be able to face it, but by ensuring all the same other functions, the daily ones". In this case, the training should be a point all the more crucial and critical than the situations requiring a practical implementation seldom occur. But in front of the rarity of emergency situations, even if in terms of safety, some "sound" training is obviously necessary, the economic arguments can lead towards less ambitious solutions.

To finish with the distinction of the type of evacuation according to the context (after an accident or a precaution one) leads us to reflect on the role of the cabin crew members and the operating modes underlying each of them. Rather than an overall training approach, specific training sessions would allow to answer better the operating needs of the Cabin Crew Members, (for instance to monitor, under intense stress, the spontaneous movements of the passengers or to have them move in case of refusal).

4. *What Are the Practices in Other Areas that Aeronautics and What Lessons Can Be Learnt From Them?*

Parallels between different jobs involving safety interventions were drawn (navy and civil protection). There are similarities in the training syllabi. But important deviations can be noted regarding practical exercises and the training of the staff.

Among the training modalities that are different, one can find:

- discipline: an integral part for firemen and seamen, it is only relative for the Cabin Crew Members. Regarding the training sessions, rigour is yet a determining item for the solidity of the team, giving it a greater resistance to stress and more resources in front of the management of a panic stricken crowd;
- the physical fitness: it is in no way a prerequisite for the Cabin Crew Members;
- the training in teams using as a minimal unit the binomial and not the individual;
- and which is the most important gap, the frequency of the training sessions, annual for the Cabin Crew Members, weekly for the seamen and daily for the firemen.

The result is, the nature and frequency of the Cabin Crew Members training infer lesser requirements. A direct consequence: the lesser the requirements, the less obvious the motivation and comprehension for the Cabin Crew Members. This linked to the conditions in

which the training sessions are carried lacking realism do not lead to an efficient preparation of the Cabin Crew Members to face emergency evacuations.

But the duality of the work of the Cabin Crew Members do not necessarily exist in other jobs of safety intervention. It is the case with the firemen: the exclusive role of safety justifies a training accordingly. Without advocating equivalent training modes for the Cabin Crew Members, one can however learn from the teachings of this guild as for the acquisition of automatic reflexes through the repetition of gestures in realistic conditions. One can also transpose rigour principles in the team during the trainings.

On another hand, in Merchant Navy, a part of the personal meets the same constraints than the Cabin Crew Members: ensuring a double role of service and safety. The training programme implemented for this personal stands for a good example of to what one could wish for the Cabin Crew Members.

Chapter 3 – Synthesis of the Criticisms

To be proficient in front of an emergency evacuation requires a quick analysis of the pieces of information, decision making and the fulfilment of an action with accurate and adapted gestures, both on individual planes and in a team.

As a consequence, the intervention in emergency situations must rely as much as possible on smooth running skills with minimal costs on the cognitive side. This implies to build and maintain automated and reliable routines, stress proof and to the different cases.

Yet, all the actions taken in this study, such as the visit of training centres, the interview of personals, the analysis of accident reports, etc. lead us to note in a rather homogenous way that the training and exercising now implemented are out of step regarding the requirements of an emergency evacuation. In other words, it seems rather important to develop actions taking into account the finality towards which one should tend. This report can be broken down into five criticisms corresponding to different conditions of progress in reaching this finality.

These criticisms represent convergence points identified between the different approaches adopted in this study. They imply either the content of the training of the cabin crews – realism and crucial subjects to be tackled during the training – or the process of training itself – frequency, credibility, trainers. The critics are made from arguments put forward in the section Synthesis of Research which is built on all the intermediary reports.

1. Frequency of Training Sessions

The JAR-OPS make provisions for an annual review of skills with, for some exercises a periodicity that could reach three years (real fire in recurrent training). On this point, the French regulations echo the European regulations.

However, as a whole, the interpretation that is made by the airlines of these regulations remain limited to the strict respect of the prescribed frequency, which leads to a minimum.

The different sources of information explored during this study converge to the fact that it would be useful to increase the frequency of the training sessions:

- during visits of some training centres, we noted in the course of exercises that mistakes and hesitations were made during the handling of materials,
- accident reports on another hand point out inappropriate automatic reflexes by the Cabin Crew Members during the evacuations. The consequence is a delayed evacuation even worsened by these manoeuvres,

- the Cabin Crew Members themselves do not seem satisfied with this periodicity because they claim that it does not allow them to acquire and maintain the automatic reflexes required for emergency evacuations (result of an enquiry by questionnaire, refer to report n°2),
- the low frequency of the training of the Cabin Crew Members contrasts strongly with the more regular training sessions undergone by other professionals of emergency intervention,
- to finish with, the combination of the multi-specialisation with a low frequency of training creates a factor of increasing difficulties for the Cabin Crew Members in the implementation of the evacuation procedures (risks of confusion).

It therefore appears rather clearly that, from the point of view of safety, a training session once a year and by plane happens to be insufficient referring to the performance level required by an emergency evacuation.

To sum up

We believe it difficult to develop and maintain automatic reflexes on various types of aircraft with a yearly training for one situation, a fortiori, seldom met. To review the training sessions schedule therefore appears as a priority.

2. Realism

As far as the realism of the training exercises is concerned, the regulations put forward some items of physical specification of environments. Even if the European regulations are on some points more accurate than the French ones, the margin of interpretation left to the airlines remains still rather important.

From the pieces of information gathered during this study, three axes of improvement come out:

- an improvement of the realism of the material itself: mainly simulators and models,
- an improvement of the credibility of the scenarii of evacuation,
- an improvement in the realism of the modes of use of this material: the reproduction of the sensorial environment but also of the psychological (in particular the cognitive one), social and operational ones. When speaking of realism for a training tool, one sometimes stops to the physical dimension. It is convenient to note here that this dimension, although necessary, is not enough. The psychological realism is all the more important. The training must take place in a context reproducing faithfully the activities of the Cabin Crew Members. A great variety can be noted in the implementation on this point by the airlines. Ideally, the content and the context of the training should be rich and operationally representative. Each scenario should be felt by the trainees as believable. This requires that the training sessions should be inscribed in operational and technical representative contexts. That is why integration in a same programme of training should take into account the crew resources management aspects and the passenger management in a situation of crisis (see further).

To sum up

Today, it is not guaranteed that the conditions of physical realism (models, sensorial environment, obstacles in the cabin, actors playing the role of passengers, etc), and that the psychological and operational realism are enough to ensure the credibility of the trainings for the Cabin Crew Members and to involve them as much as possible. Particularly, if there are simulation tools available with a high degree of physical realism they are an asset that can only be fully exploited if the overall realism of the simulated situation compels the trainees in fully involving themselves in the training session.

3. Consistency of the Overall Qualification Scheme

But for one exception⁵, in the training sessions we witnessed, we noted a sort of lack of enthusiasm from the trainees taking part to the exercises of evacuation and their low involvement in scenarii that they themselves deem too "poor". We believe that there is a sort of "self-demotivation" from the cabin crew regarding its safety role.

It happens that motivation is capital for any performance. Motivation is the result of interactions between inner factors linked to the person (deep psychological springs and aware projects), and to external factors (stimulating role of the environment, gratification and social recognition). The observed demotivation can therefore be linked to the conjunction of several factors that it is difficult to choose from. Nevertheless, it seems that a basis factor can be isolated: many Cabin Crew Members are not convinced of the importance of their role in safety and this representation is reinforced by all the messages sent on this matter by the great system. To fight against this lack of motivation we therefore believe it essential **to increase the value of the safety role played by the cabin crew** and that in different ways:

- At the regulatory level, first. The selection of staff and the modes of control of the safety skills acquired during the training session are subjects that ideally should not come from regulatory obligations but from rules of the know-how of the job. However, taking into account nowadays practices within the airlines, the regulations could formulate recommendations in these areas, underlining thus their importance related to safety.
- Next, for the airlines, by allowing more investments for safety training and particularly to emergency evacuations. The ratio of allotted time to the safety trainings compared to the commercial one is a good example of the implicit message decoded by the Cabin Crew Members: *"If this safety role were really important, it would appear during our training sessions!"*. We have just tackled two other key evidence in the former criticisms: frequency and realism of the training. In this area, beyond the strict application of the regulatory frame, the different options taken come from the choice of the airlines.
- To finish with, by a circular effect, the Cabin Crew Members themselves: *with stronger above requirements, the motivation and understanding of the need by the Cabin Crew Members is all the more improved.*

⁵ Training course given in the training centre of a small sized airline.

- To be motivating, a training session a fortiori a practical one in the area of emergency evacuations, should mainly be credible. For a training to be credible, many aspects should be taken into account:
 - a) intrinsic aspects that will determine the quality of the training itself: we said so, realism is a key element of this credibility,
 - b) but also extrinsic aspects related to the way in which the training is implemented and operated in the broader circuit of the Cabin Crew Members qualification, especially:
 - at a very high level, during the selection of the staff,
 - and in terms of control of the acquisitions.

The first point (a), related to the training itself is the object of the former criticisms. In this section, we focus on the formulation of the criticisms related to the second point (b).

As far as this second point is concerned, an important side for safety is not taken into account now, neither during the selection of staff, nor during the competence checks : it is a matter of **physical fitness** of the cabin crew :

- **Regarding the selection side**, except for the CSS requirement in some European state members (Portugal, Greece, France) and a license for Italy, there is no regulatory specification of the selection criteria of the cabin crew for their hiring. More particularly there is at no moment a reference to criteria of *physical strength* or to other fitness to exercise during an emergency evacuation. Regarding this matter, studies carried out at Cranfield (Great Britain) by Professor H. Muir, clearly show that the strength expended by a man during the opening of a partially blocked exit and in emergency situation is in average more than twice more important than the strength expended by a woman in the same conditions. But, nowadays, over than 50% of the population of the cabin crew is made up by women. The cabin crews themselves go to the end of the reasoning by suggesting an application on the higher levels of this safety orientation as early as the recruitment tests.
- **Regarding the maintenance and control of skills side**, no formalised system aims today the maintenance and control of physical fitness required for an emergency evacuation.

To sum up

If physical strength and other physical skills play a role in safety, this criterion is not used today for recruitment ends. But taking safety into consideration, especially of the action to be implemented by the cabin crew members during an emergency evacuation begins as early as the selection. Ideally, the feedback of experience coming from the field should be used to define above the criteria to be taken into account at this stadium included the physical criteria. On this plan, if nothing is made at the level of the selection nothing is either made referring to the maintenance and control of skills.

More generally, as far as the **control of acquisitions** are concerned, the JAR-OPS stipulate that a test must be carried out after each training session, without pointing out the practical modalities of this control. Regarding the frequency of the training sessions in this area, the French regulations are consistent with the JAR ones because they advocate an annual check of knowledge, without accuracy in methodological order however. As a consequence, there is no homogeneity between the airlines : the practices are different as well as the means and levels of requirement.

To sum up

Because there are no accurate regulatory specifications on this matter, the systems of control and validation of skills change from one airline to another. In all the possible options, some evacuation systems may happen to be little motivating even to discredit the training sessions. For instance, not to carry out a control on the emergency evacuation practical exercises, do not encourage the Cabin Crew Members to fully involve themselves and to regard their safety role with seriousness.

4. Trainers and Training of Trainers

The way a training is carried out is part of the extrinsic factors that may have an influence on its credibility in the opinion of the trainees. That is why, we could have put this paragraph in the former section. But it is also and before anything a matter of efficiency for the training session. It is the reason why this aspect undergoes a full criticism.

Even though the regulations refer to the persons enabled to carry out checks and clearly define the criteria, these same regulations in no place mention the criteria required for the *trainers*. Whether it involves the JAR-OPS, the ICAO instruction manual (1996) or the 1987 order, there is no paragraph to be found related to this subject. The role and the skills required for the instructors in charge of teaching safety and emergency procedures are nowhere clearly defined nor regulated, no more than the training modes of these instructors.

Paradoxically, the JAR-OPS mention that the instructors should be « appropriately qualified », with no further details. According to the ICAO, for the training to be efficient, the instructor himself must be selected, trained and checked at a « good level », without defining what must be understood then.

Given the lack of precise rules, the airlines call either instructors belonging to the Cabin staff, or to ground personal who do not necessarily have enough knowledge of the job of Cabin staff. In both cases, the *pedagogical* skills are neither clearly defined, nor clearly controlled.

Here, the criticism is met regarding the selection of the cabin crew members. Some efforts could be made to select and train the staff furthermore on operational criteria. This principle also applies to the *instructors* as well as to the *trainers of these instructors*. On another hand, to chose trainers among the Cabin Crew Members is a means of capitalising valuable information on everyday reality, that may be missed by contributors from other jobs.

To sum up

Regulations define today a level of quality for the instructors (for instance, « be appropriately

qualified »). On another hand, the skills required to get this level are nowhere clearly defined, no more than the modes of training of the instructors. Furthermore, when there are no regulatory indications, the instructors may come from different jobs, which does not warranty an in depth knowledge of the specificity of the Cabin Crew job. Moreover, whether there are or not Cabin Crew Members instructors, we believe that it would be useful to better define their pedagogical skills as well as the way of getting them and controlling them.

5. Themes Not Always Dealt With During Training Sessions

We felt that some important points could be incorporated or when they already are, better dealt with during emergency evacuations training:

- **the cooperation between the Flight and Cabin Crew Members,**
- **the crowd management during emergency situations.** This management comes both from the ability to recognize signs of panic and to check its expansion and some leadership to have the firmness of command required in this type of situation,
- **making decisions alone**, when one or two crew members find themselves in a physically isolated cabin (fire, smoke, etc.) or following to a rupture of the cabin or when there is only one Cabin Crew Member on board (case of the small carriers).

Cooperation between Flight Crew Members and Cabin Crew Members

The JAR-OPS and the ICAO recommend to practice whenever it is possible emergency exercises and joint debriefings. The French regulations today do not mention this dimension. Some airlines try to implement such a joint training. However, the difficulties of planning training courses, the imperatives of operation and operational constraints are brakes to such initiatives.

The Cabin Crew Members ask yet a lot for such training sessions that are most useful to ensure a good crew synergy in case of an emergency evacuation.

To sum up

Endeavours of joint training and exercising taking place today is a point that must be underlined. However, one can believe that when such initiatives take place the interactions between the two populations can be improved, that one could get a better benefit of the joint presence of the Cabin and Flight Crew Members. To do so, one could especially improve the realism of the scenarii (everyone playing their own roles, with operational constraints and in an environment representative of an emergency evacuation), which as we have seen, would increase the involvement of the Cabin Crew trainees and would reinforce their perception of their safety role. A better training of the instructors, especially in areas of communication and synergy of the crew, make up another way of improvement.

Crowd management

The JAR-OPS require a training for a crowd management method favouring the swiftness of the evacuation (JAR-OPS 1.1005 f (2)). Now, the French regulations do not explicitly refer to a crowd management training during an evacuation.

This study enabled us to make an appraisal regarding these aspects :

- the airlines make endeavours in this area, but the lack of realism of the training sessions, the difficulty of creating again stressing situations and the little conviction of the actors limit their efficiency. The nature of the scenarii, the lack of effect of surprise, the exiguity of the models, the low number of participants acting as passengers, the fact that those participants are themselves very often cabin hostesses or stewards (their reactions are therefore different from those of real passengers), and the lack of specific information of the trainers make up as many axis of improvement. On another hand, the Cabin Crew Members clearly expressed both their fears on their abilities to manage a panicked crowd and their needs in terms of feedback (sound real life information from colleagues) and training sessions relying on this feedback of experience.
- As an example, the studies carried out by H. Huir and Cobett brings out well the necessity of avoiding that the panic should gain the passengers. In this frame it is essential to learn to detect the first signs of panic to limit its progress. It was also shown that the Cabin Staff should display a great firmness in the formulation and the carrying out of safety orders in an emergency situation.
- All the Cabin Crew Members are involved in this training. But the need is even more blatant as far as cabin heads are concerned. An ill prepared team to the requirements of an emergency evacuation with a leader that has only his experience to make up for the possible weaknesses of his team... The caricature is a bit strong but it allows a good synthesis of what we learnt in this study through different sources, whatever the questionnaires, the interviews or the incident reports may be.

To sum up

Crowd management is a crucial aspect in emergency evacuations. It requires some specific fitness from the Cabin Crew Members such as stress management, passenger control, detection of panic outbreaks and management of panic. The management of the passengers in emergency situations requires a great self confidence and the implementation of gestures and firm commands and not ambiguous ones. The acquisition of these skills requires an improvement of the training contents as well as the modes of situation simulation and training. A valorisation of the group is also desirable. It goes through an improvement of training to crew synergy. All the Cabin Crew Members are concerned but the need is even more obvious as far as cabin heads are concerned because they are led to exercise a strong command and be reassuring in the case of an evacuation.

Decision making

It is here a matter of defining the frame in which a Cabin Crew Member could have to initiate an emergency evacuation.

Three situations can lead such decision making :

- the pilots are no longer physically able to play a part,

- a Cabin Crew Member is entirely isolated in a part of the cabin without any communications with the rest of the crew.
- there is only one flight hostess or steward on board (case of a small carrier) and she/he is isolated from the pilots⁶.

Today, there is no European or French regulation on the matter. However, procedures were defined in each company. They appear in the operation manual and as such were therefore set down and approved by the authorities.

As far as we know, the captain remains responsible for the initiation of the evacuation. For the three cases mentioned before, there is a doubt in the mind of the cabin staff regarding their prerogatives to initiate an evacuation.

To sum up

In the cases when the flight crew can no longer fulfil their role (dead pilots or in a state of incapacitation), when a Cabin Crew Member is isolated from the rest of the team or when there is but one flight hostess or steward on board, there remains a doubt regarding their prerogatives to initiate an evacuation. This doubt can be a source of indecision or to lead to a wrong decision, factors that are often mentioned as aggravating in the accident reports. It would therefore be desirable to precise this point in a training session and to train the cabin staff to the different cases mentioned here.

⁶ Here the case when there is no Cabin Crew Member on board is not anticipated. The decision, as well as the carrying out of the evacuation belongs then to the Flight Crew Member. Awareness and training actions in this area would certainly be desirable.

Chapter 4 - Recommendations

1. Recommendations Related to the Frequency of the Training Sessions

Summary of the criticism :

We believe it difficult to develop and entertain automatic reflexes on several different aircraft with an annual training to a situation, a fortiori, seldom met in the exercise of one's job. We believe that reviewing the schedule of the training sessions is therefore a priority.

In order to really develop and maintain relevant automatic reflexes for emergency evacuations, we recommend :

To the authorities :

- to reinforce the regulations so that the training sessions for emergency evacuations take place at least every three months.

Economical aspects :

In order to avoid too great a number of immobilisation of the cabin staff and subsequently important costs, it should be convenient to study with the professional organisations slots enabling to gather this activity with other ground or in flight activities. It is not essential for this training session to take a long time : it could, for instance, be limited at one hour.

To the airlines :

- to enable the Cabin Crew Members to liven up their memories by viewing short videos before their flights. These videos should show, on one hand the main phases of an evacuation (materials, implementation and evacuation sequence) and on another hand, the particularities of the aircraft on which they are going to fly.

Economical aspects :

Because video systems are rather cheap now, each departure or debriefing room should be able to be equipped (possibly progressively) with this type of material.

- to put at the disposal of the Cabin Crew Members specialised on various types of aircraft a specific room equipped with simulators representing the systems to open the doors and the implementation of slides of the different types of aircraft.

Economical aspects :

In order to limit the expenses, it may not be necessary for these simulators to be very sophisticated. What is important here is to enable the Cabin Crew Members to liven up their memories regarding the operating mechanisms of the different systems and the associated hand movements.

- to restore the importance granted to safety training compared to commercial training.

Economical aspects :

Without encroaching on the commercial aspects or increasing in an exaggerated way the number or the duration of the training sessions, the aim here is to restore all its value to the safety role of the first line actors that are the Cabin Crew Members.

2. *Recommendations Related to Realism*

Summary of the criticism :

It is not sure today that the conditions of physical realism (models, sensorial environment, obstacles in the cabin, actors playing the act of the passengers, etc.), or that the psychological and operational realism are enough to ensure the credibility of the training sessions for the Cabin Crew Members and to get from them a maximal involvement. Particularly, if having simulation tools with a high degree of physical realism is an asset, this cannot be fully exploited unless the overall realism of the situation simulated fully involves the trainees in the training session.

In order to make the training sessions more credible for the Cabin Crew Members, we recommend :

To the authorities :

- to modify the regulations to take into account the criteria of realism, as much at the level of the model than to that of the scenarii used. To do so, it should be pointed out, in addition to the strictly technical criteria, the operational and social criteria of the evacuation exercises.

Accidents seldom occur in « ideal » conditions, the exercises should be able to reflect the reality of these situations, that is :

- plane in unusual position, gear up (main or front),
- degradation of the means of communication (failure of public address or intercom),
- doors difficult to open because of the position of the aircraft or the weather conditions (for instance the wind),
- obscurity,
- sound restitution of the plane noises, shouts from the crowd,
- pungent smoke (harmless or slightly irritant),
- fire or other hostile outside environment that can be simulated (videos shown on screens in front of the windows),
- alleys obstructed with luggage and other materials (cars out of their housings, blankets, etc).
- passengers on board (act played by actors), reacting in a realistic way.

Economic aspects :

The airlines could group themselves together in order reduce the purchase costs of modern and sophisticated training materials, such as mobile models.

To the airlines :

- to increase the awareness of the Cabin Crew Members to the realities of an evacuation by the projection, during training sessions, of videos showing real accidents or evacuations.

Refer the following of this section.

- to enable the Cabin Crew Members to view the passenger flow in the cabin during an emergency evacuation by a more practical use of the « evacuation patterns » such as those developed by Professors H. Muir or E. Galea.

This approach would require a computer support or a video support.

3. Recommendations Related to the Consistency of the Qualification Scheme

3.1. Physical Fitness

Summary of the criticism :

If physical strength and other skills play a role in safety, this criterion is not used today for recruitment. Yet, the taking into account of safety and especially of the actions to be implemented by the Cabin Crew Members during an emergency evacuation, begins as early as the selection. Ideally, the feedback from experience coming from the field should be used to define at the beginning the criteria to be taken into account at this stage. On this plan, if nothing is done at the level of selection, nothing is either done as far as the maintenance and control of skills are concerned.

To be holder of a CSS (which let's remind it, is not the case for the Cabin Crew Members from all the European countries) does not ensure enough physical fitness to face an evacuation, especially after some years spent in an airline. We believe then it important to recommend :

To the authorities :

- to introduce in the regulatory texts minimum physical fitness criteria to be taken into account during the selection as well as all along the career of the Cabin Crew Member.

To the airlines :

- to systematically plan a safety test during the selection tests, such as an exercise of opening the door of a plane and a wing exit, in conditions simulating a failure of the system of help for opening. A failure during this test would be taken into account in the decision of recruitment.
- to ensure a minimum physical potential compatible with the actions and safety gestures to be made during an emergency evacuation. These requirements go beyond the CSS. They are expressed in terms of selection criteria but also in terms of training to keep this physical potential.

3.2. Checking the Acquisitions

Summary of the criticism :

Because there are no precise regulatory specifications on the matter, the systems of control and validation of the skills change from one airline to another. Among all the possible options, some evacuation systems may turn out to be not very motivating and even discredit the training sessions. For instance, not to carry out a control on the practical exercises of emergency exercises, does not incite the Cabin Crew Members to fully involve themselves and to take seriously enough their safety roles.

We recommend :

To the authorities :

- to point out methodological aspects at least on the great principles
 - it should especially be convenient to require practical tests for a practical training,
- to detail the requirements for each type of training and exercising,
- to require the success for the tests, both the theoretical and practical ones to be able to go on flying.

To the airlines :

- to act in a way that the Cabin Crew Members know by heart some simplified emergency procedures (sequence of evacuation, opening of the exits, etc.),
- to manage that in each of the tests are important questions to be found, compulsory and eliminatory (unsatisfactory answers would ban the Cabin Crew Members from flying and would lead them to take the test again after a minimum period to be determined).
- to implement, in the same spirit, a system of notation for the practical exercises (with a requirement of success to be allowed to fly).
- to deploy flight controllers having the role to check the knowledge of the Cabin Crew Members and their behaviour in front of very practical and concrete situations related to the aircraft on which they fly. These checks would be related to hand movements, the ability of reacting in front of a string of situations (e.g. emergency descent followed by an evacuation, depressurisation followed by an emergency descent and an evacuation), and on the practical implementation of the concepts.

4. Recommendations For the Trainers

Summary of the criticism :

The regulations define today a level of quality for the instructors (e.g. « be suitably qualified »). On another hand, the skills required to reach this level are nowhere clearly defined, no more than the training modes of the instructors. On another hand, because there are no regulatory indications, the instructors can come from different jobs, which does not ensure an in depth knowledge of the specificity of the Cabin Crew Member job. Furthermore, whether they are Cabin Crew Member instructors or not, we think that it should be useful to better define their pedagogical skills as well as the way of getting them and controlling them.

In order to ensure a maximum of quality and homogeneity in the training sessions made, we recommend :

To the authorities :

- to put forward selection and training criteria of the instructors and a scheme to control the skills and to carry out recycling.

Ideally, the instructors should :

- have a very good knowledge of the Cabin Crew Member job,
- having followed a pedagogical training, completed by a training on the subjects to be dealt with including the human factors (this training would especially help them in making a better debriefing of what they notice with the trainees during evacuation exercises).

To the airlines :

- to call on, whenever it is possible, to Cabin Crew Member instructors to give the training sessions. Specialists of emergency evacuations, like firemen, could also give these training sessions, provided they have a good knowledge of the Cabin Crew Member job and pedagogical skills equivalent to those of the Cabin Crew Member instructors.
- to make systematic observation flights when it is a matter of instructors coming from the ground personal.

5. *Themes Not Always Dealt With During the Training*

5.1. Flight and Cabin Crew Members Co-operation

Summary of the criticism :

The fact that endeavours of joint training and exercising take place today is a point that should be underlined. It can however be thought that when these initiatives take place the interactions between the two populations could be improved that one could get the best benefit from the joint presence of cabin crew members and flight crew members.

Being understood that the regulations anticipate a training session on emergency exercises both for the Flight and Cabin Crew Members, we recommend :

To the airlines :

- to do everything so that the planning services should be able to program these two populations together and in a regular way on safety training courses,
- to develop the scenarii stressing the co-operation between the two populations,
- to train the trainers to debrief what they observe during such joint exercises.

Economical aspects :

Both populations should all the same be programmed for safety training courses, this recommendation should be able to be implemented by an adapted planning without creating further immobilisation costs.

5.2. Crowd Management

Summary of the criticism :

Crowd management is a crucial aspect in emergency evacuations. It requires specific skills from the cabin crew members, such as stress management, supervision of the passengers, detection of panic outbreaks and mastering the panic. Directing the passengers in emergency situations requires a lot of self confidence and the implementation of gestures and firm and clear commands. The acquisition of skills requires an improvement of the training contents as well as the modes of simulated situations and training. A team valorisation is also desirable. It goes through an improvement of the training to crew synergy. All the cabin crew members are involved, but the need is still more flagrant as far as senior crew members are concerned, because they are supposed to exercise a strong command and be reassuring in case of an evacuation.

Ensuring the acquisition of these skills requires an improvement of the training contents as well as of the simulated situations and training modes, that is why we recommend :

To the authorities :

- to implement an annual evacuation exercise of a jumbo jet (like the SAMAR and SATER exercises that allow to test at a national level the efficiency of the rescue of an air crash), using military or administrative staff with flight and cabin crew staff acting as passengers and the role of the crew in function should be held in turn by the Cabin Crew Members from different airlines using the type of aeroplane chosen ;
- to carry out a general briefing of this exercise that should have been filmed from the inside and the outside. This film could then be used as a support for the coming training sessions.

To the airlines :

- to train the senior cabin crew members to exercise a reassuring and strong command in case of an evacuation. This leadership aspect should be integrated during the training for the function of senior cabin crew member (especially in the senior cabin crew member CRM) and reinforced during the training sessions for emergency evacuations.
- to include in each of the safety training sessions (both for the flight crew members and the cabin crew members), in the section dedicated to emergency evacuations, films made up from videos made from evacuation models of technical or university laboratories, films made by the manufacturers during certifications or particularly realistic epic film extracts,
- to use modern video means to make films made in models and that would give the feeling of a crowd,
- to benefit, at least once a year, from the technical check of an aeroplane in the maintenance services to carry out a real emergency evacuation.

Different staff members should be invited to act as passengers by using all the seats of the plane and a flight and cabin crew would act their own roles. This exercise could then be filmed and operated at a great scale within the airline, the aim being to improve the respective knowledge of the different jobs and to increase the synergy, not only among the crew members but also between the ground personal and the flight crew members.

Economical aspects:

We are aware of the difficulties involved in materializing this aim of practical crowd management training. However, there are intermediate solutions such as those put forward by the cabin crew members themselves during the enquiry by questionnaire:

- simulation of situations of an intermediary realism level relating to emergency scenarii, in the way: "*What should be done in case of...?*",
- the use of videos, whether they are the reconstitution of real cases or of realistic fictions. Let's use on this matter, the proposal of a cabin crew member gathered during the enquiry by questionnaire: "*Hand out a safety cassette to each cabin crew member showing some emergency evacuations: images mark far more than words. And it can be viewed and reviewed as many times as one wishes*".

5.3. Decision Making

Summary of the criticism:

In the cases when the technical crew are no longer fit to do their jobs (dead pilots or in a state of incapacitation), when a cabin crew member is isolated from the rest of the crew or that he/she is alone on board, the cabin crew member entertains a doubt in mind related to his/her prerogatives in initiating an evacuation. This doubt can be a spring of indecision or lead to an inadequate decision, factors that are often quoted as aggravating in accident reports.

It would therefore be desirable to point out this item during training sessions and to train the cabin staff to the different cases mentioned. We recommend:

To the authorities:

- to define more precisely the circumstances in which the cabin crew members are lead to initiate an evacuation.

To the airlines:

- to remind during the emergency evacuations training sessions the human factors principles related to decision making, studied during the CRM training sessions,
- to elaborate for the cabin crew members clear procedures that are not ambiguous related to the initiation of an evacuation, in accordance with the flight crew members' procedures,
- to make the cabin crew members aware that there might be some delay between the time the aircraft is immobilised and the evacuation signal given by the pilots (it is important that the scenarii should also be realistic on the matter).

To the manufacturers:

- to study the implementation of a stand alone communication system between the crew members that do not work from the aircraft systems and that is more effective than megaphones.

Chapter 5 – Widening the Prospect: Other Axis of Improvement

The recommendations exposed in the previous section refer to the major axis of improvement identified during this study and centred on emergency evacuations. It is however difficult to limit our thoughts to these sole recommendations. On one hand, in order to respect a consistency of action, some axis of recommendation would imply corollary measures. More widely, the consideration of an overall system in which is involved in an emergency situation leads us to deal with some complimentary aspects.

1. Passenger Information

In terms of overall efficiency, it would be interesting to reconcile an improvement of the emergency evacuations training of the cabin crew members with educational measures of the passengers.

Some emergency situations are caused by the imprudence of passengers unaware of the risks involved in their behaviours that might lead the pilot to carry out an emergency manoeuvre that may end in an evacuation. On another hand, not to respect the safety guidelines sometimes leads to accidents (seat belts not fastened during turbulence, alleys encumbered, too heavy luggage, etc.).

The lack of attention of the passengers during the safety demonstrations by the cabin staff is an important factor of the lack of respect of the rules and the ignorance of the instructions. That is why all the following recommendations could be addressed to the airlines:

Referring to the safety regulations themselves:

The safety regulations that are given after embarking are long, often monotonous and especially broadcast at a time when the passengers are not necessarily "ready" to listen to them. The excitement of the departure, sometimes a tedious wait during the check-in and necessary procedures, noise, sustained attention to listen to the airport announces, long lobbies, etc., are factors that do not lead people to listen attentively once on board. For many passengers, once installed, it is but the time to relax.

On another hand, many emergency evacuations happen during landing. According to an ICAO source (Bureau de la Sécurité des Transports du Canada SA 9501) out of 156 evacuations that happened between 1970 and 1993, 55 of them took place during landings. Some elements can come and aggravate the conditions of evacuation. For most passengers, landing means the end of the trip and a sort of relaxation (or a last phase of tension for stressed passengers). For the long carriers it is the time when tiredness, an awakening often difficult and a sort of apathy reign in the cabin. The safety instructions that were given at the beginning of the flight, sometimes several hours before, are often forgotten.

These records lead us to anticipate to:

- replace the safety instructions in a more favourable context for the passengers,
- make easier the memorization of these instructions and to favour the activation of the right safety procedures should there be an incident.

All these reflections lead to the recommendation of breaking down the demonstration by phase of flight, that is to deal with the safety specific themes when they happen to be most relevant, that is:

- on departure: belts, luminous track, emergency evacuations,
- when crossing 1000 feet: demonstration on how to use the oxygen masks,
- in cruise, recalling the no smoking advice and the risks associated,
- before a sea crossing: life vests,
- during descent: safety regulations related to a possible evacuation (luminous track, positioning of the exits, use of the slides).

Referring to the modes of displaying the safety regulations:

- Using, during the cabin crew members training sessions, appropriate techniques for the voice, the tone, the gestures of the staff making safety announces to sound differently from commercial announcements.
- On the aircraft equipped with video material use films showing the cabin crew members training sessions but also explanations on the hazards involved in disregarding the safety instructions. It is however important that in spite of the video broadcast of the instructions, the physical presence of the cabin crew members should be maintained during the demonstrations so that they can be identified by the passengers.
- So that the pieces information should be understood by most passengers: give the safety regulations in the languages of the country of departure, the country of arrival and in English.

Referring to the realisation by the passengers of the importance of the safety regulations:

- Giving to the passengers when they purchase their tickets, attractive booklets on the risks related to the lack of respect of the safety rules on board and the importance of the cabin staff.
- To show explicitly on board magazines, the essential role played by the crew especially the cabin staff in matters of safety and the stakes linked to the respect of these instructions.

2. *Cabin Luggage*

Cluttering a cabin by too much, too heavy or too voluminous hand luggage to fit in the lockers are a factor of hindrance and subsequently of risk during an emergency evacuation. If the

excesses of the passengers in the matter are linked to a lack of awareness of the underlying safety stakes, they are on another hand allowed by the system of filtration of luggage during check-in. A reinforcement of the above safety measures would mean a prevention axis by limiting as much as possible the factors of risk linked to cabin luggage.

All these recommendations bearing on the passengers' information (sequencing of the safety regulations by phase of flight, videos of emergency evacuations...) and the prevention of the cabin cluttering (filtering of hand luggage) happen to be even more crucial in the prospect of the technological evolutions announced by the manufacturers toward very high capacity planes.

3. *Experience Feedback System*

The importance of experience feedback is known for any system: knowing one's own operation and identification of axis of improvement. A system of experience feedback also means a way of reaching the reality of the job, a crucial point in the area of emergency evacuations where it is known that the occasions of approaching this reality seldom happen.

Yet, from the investigations led during this study it appears that experience feedback remains an under exploited dimension (either nonexistent or not informed enough either suffering from a deficient movement of information).

The poorness of the available information both related to evacuations linked to an accident and to precaution evacuations do not allow today to answer easily to the questions asked regarding the training needs of the cabin crew members specific to these situations.

It therefore seems important, if one wants to progress in matters of the safety of evacuations to build a wide spanned experience feedback in this area, with the aim of knowing the real behaviour of the cabin crew members, the contexts of intervention, the nature of the difficulties met, the causes of failure and the mechanisms of success.

Well documented, the experience feedback would especially allow to know the course of actual evacuations and to reintroduce these data in the specification of training scenarii and video supports meant for the crews and passengers.

Conclusion

This synthesis gives a state of all the works led to answer the double aim of this study: making a critical analysis of what exists and offering improvement tracks regarding the cabin staff regarding emergency evacuations. The aggregation of the information gathered describes a complex system with circular effects. As a consequence it is difficult to identify the entry points to improve the whole of the system, exercise that is the object of the conclusion.

An emergency evacuation is an event that seldom occurs at the scale of the companies and extremely rare at that of individuals. However, it is during such circumstances that the role of the cabin crew members happen to be preponderant on the rate of survivors to an air crash. According to the enquiry of the European Transport safety Council (1996) quoted in the introduction of this report about 40% of the 1500 persons who die every year in an air crash die in a technically survivable accident. A little more than the half are victims of the direct result of the impact whereas the others die of the suites of the accident especially during the evacuation itself.

To improve the factors of "survivability" as a whole and to put forward measures meant to improve the probabilities of survival, it is indispensable that all the actors of the aeronautical system, whether the authorities, the airlines or the manufacturers, cooperate and combine their endeavours at both levels European and worldwide.

Among the causes of aggravation of the injuries or increase in the number of deaths of passengers and crew members that happened after a said "survivable" air crash, some are directly related to the actions of some cabin crew members. This raises of course the problem of the efficiency of their training and their exercising.

This study showed that it was a double difficult problem. The rarity of the emergency evacuations in no case allows to keep an adequate in line training. Everything therefore lies on the training and out of line training, which raises, as we saw, problems of realism and frequency, with strong financial implications. But at the same time, it is this same rarity of the evacuations that generated a feeling of low utility of such a training or more particularly of the financial investments to be granted to prepare the staff.

Most of the recommendations that we formulated would imply expenses in matters of safety. What can be expected from such an investment? Let's recall that in 1995, the Office of the Secretary of Transportation) assessed that the value of an avoided death was at least of 2,7 million dollars. This figure of 2,7 million dollars is based on a value related to American society and economy and of course is not valid everywhere in the world. But on the other hand, the average price that the societies are ready to pay to save human lives in aviation is well over the average cost of a death. If now the value mentioned above is taken as a basis, the 270 "avoidable" annual deaths in the scope of evacuations have a price of about 730 million dollars. The question is therefore to know whether investing each year such a sum for the improvement of the emergency evacuations could produce a significant improvement. In other words, can the efficiency of the cabin crew members be significantly improved as far as matters of emergency evacuations are concerned with an investment of about one thousand dollars a year per individual? Some of the recommendations expressed in this study, by their included costs show that it is possible.

In the area of emergency evacuations, the most striking need for improvement regards as we said, the training of the cabin crew members. It should be supplemented, be made more practical, more realistic and their frequency should be increased. But an improvement of the overall consistency of the device is also desirable, which goes among other things through a better taking into account of the safety criteria as soon as the selection as well as all along the cabin crew members' career, and by an improvement of the training of the instructors. On another hand, it is also important to implement an experience feedback system really efficient that could be used as a basis to the specification of the training scenarii and of pedagogical supports such as videos.

But these actions will undoubtedly not be enough as long as the system as a whole do not further believe in the safety role of the cabin crew members. Today an unbalance is felt between the commercial aspect and the safety aspect in the cabin crew member function. This unbalance is translated as soon as the selection begins and is kept all along the career. It is reinforced by the nature of the information that the system sends to the actors, especially as far as the preparation for emergency evacuations is concerned: the exercises are rare and lack realism, the validation system implemented can be perfected (nature of the evaluation tests, low consequences related to a failure, etc.), and the means released are counted. The situation is such that the cabin crew members themselves do not really believe in it: what the actors decode as a lack of consideration for their safety role do not lead them to fully involve themselves in this role.

Thus the setting of the cursor between the commercial and safety aspects influence not only the chain of decisions and investments consented, but also the degree of involvement of the actors themselves. Without a strong and clearly displayed will to better regard the importance the role of the cabin staff in matter of safety by the related authorities and the management boards of the airlines, it therefore seems difficult to want to improve the efficiency of the cabin crew members during emergency evacuations.

A number of problems on board (aggressive passengers, luggage, etc.) also result from this priority given to the commercial aspect. Because the research of a maximal and immediate satisfaction of the passengers can bring in the cabin out of standard luggage that may risk to create problems in the case of an evacuation. Serving alcohol on board is another instance. This practice is part of the commercial policies of all the airlines, even though it is known alcohol may make some passengers aggressive and therefore endanger the flight.

To conclude, so that the improvement measures put forward in this study be really efficient, it would be convenient to inscribe them in a systemic prospect where safety would be more valued. Taking into account this systemic approach also implies to anticipate and to prevent the problems rather than managing a crisis. A proposition in this way was formulated concerning the filtering by the staff who check in cabin luggage.

Behind this instance, at least appears the necessity of improving the cooperation between the different trades as well as the knowledge of the assignments, the tasks and the respective constraints. In this prospect, the management of the emergency evacuations begins well before the flight outside the space and time in which an evacuation takes place.

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