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POSITION TRANSFERS IN EN ROUTE AIR TRAFFIC CONTROL: ASSESSING FLAWED MENTAL REPRESENTATIONS OF THE TRAFFIC SITUATION

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Purpose

To address air traffic control (ATC) operational errors (OEs) that occur early on position, past OE reduction efforts focused on developing improved position relief briefing checklists and analyzing the content of the recorded verbal briefings. However, the verbal briefing, by itself, does not ensure that either the incoming or outgoing controller had an accurate mental representation of the traffic situation. If there are inaccuracies in either of their mental representations, then the position relief process is flawed. We examined an archival OE database to determine whether en route OEs that occur as the result of a problematic position transfer were due, in part, to a flawed mental picture by either the incoming or outgoing controller. The degradation of the mental picture was analyzed using situation awareness variables. **Data Extraction.** 455 en route OEs were extracted from the Federal Aviation Administration's (FAA's) OE database for the period June 1, 2001 to June 1, 2004. These OEs were marked in the data base as being associated with a problematic position transfer. Included in the extraction were: a) three position relief briefing (PRB) items (checklist not used, controller gave incomplete briefing, and controller did not use briefed information), (b) three Situation Awareness (SA) items used to measure the mental representation (did not detect, did not comprehend, and did not project future traffic status), and c) final summary of incident reports.

Results

Of the 455 position relief OEs, 318 were associated with a lack of SA (70%). However, only 24 (8%) were supported by additional information (i.e., the marked PRB and SA items). For those 24 OEs, 13 were associated with the outgoing controller and 11

were associated with the incoming controller. Because of multi coding, the 13 outgoing controller OEs consisted of 21 marked SA items and the 11 incoming controller OEs consisted of 20 marked SA items. When the outgoing controller gave an incomplete briefing or failed to use the checklist, 33% of the time it was associated with a lack of detection, followed by a lack of comprehension (33%), and a failure to project (33%). When the outgoing controller did not use the briefed information, 50 % of the time it was associated with a failure to project followed by a lack of detection (25%), and a lack of comprehension (25%). **Conclusions.** Despite limitations of the study due to missing data, the results suggest that both the relieving controller and the one being relieved have particular vulnerabilities at the time of the position transfer. For OEs involving the controller being relieved, all aspects of SA are equally involved. In contrast, the relieving controller appears to be especially vulnerable to inaccuracies due to a failure of projecting the future traffic status. It would be interesting to determine, under experimental conditions, whether the relieving controller has more difficulty than the relieved controller in understanding the future ramifications of the current traffic situation shortly following a transfer of position.

THE INCIDENCE OF PSYCHOLOGICAL ASPECT IN BRAZILIAN AIRCRAFT ACCIDENTS FROM 1997 TO 2002

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The research on the incidence of psychological aspects of human factors in aircraft accidents, was developed by the Aeronautical Institute of Psychology, aimed the identification of critical areas and the proposition of controlling actions. The proposed actions approach ways to favour the development of attitudes and behaviours, aiming the consolidation of a safety culture in the organizations. This work fills a great gap by making it possible to base the preventive activities on data that reflect the Brazilian reality. The ergonomic approach, wich considers the accident as a breakdown on the balance between individual, psychosocial and organizational conditionings of the man-task-machine relationship, was used as support to group and analyse the data and identify critical areas. The date raised in this research detaches the attitude and the decision making process as the most critical areas of the psychological aspects in the occurrence of the accidents. It can be observed that these areas are linked and directly influence the flying activity in terms of the planning of the flight and capacity of judgment of the pilot, compromising, in this way, the safe operation of the aircraft.

Introduction

The greatest challenge of aviation has been to avoid human error and control its incidence. Despite the technological progress and high resources destined to safety, which have made the rate of accidents in the Brazilian aviation decline equaling to the countries considered more advanced in the aeronautical world scenery, the accidents are still occurring, bringing incalculable material and human damages.

The flying activity has developed in a complex social – technical system, where the human being, with its characteristics of creativity and adaptability, f occupy a prominent place in the operation of aircrafts, elaboration of projects, production and maintenance of equipments and administration of the system. However, the existence of biological, psychological and social limitations is part of the human nature and can affect negatively people's performance, invalidating the most sophisticated methods and devices of prevention of accidents.

Human Factor's studies show that the estimated involvement of human error in the collapses in technological systems that present risk in its operation, such as: aviation, control room and nuclear power stations, increased four times in the period among the 60's and 90's, passing from 20% to 80% (Reason et al., 1995). World statistics reveal that, the technical crew is mentioned with more frequency than the material failures. Researches in that area indicate that among 70% to 80% of the aeronautical accidents can be attributed, at least, partly, to human error (Shappel and Wiegmann, 1996).

The presented data show the necessity of obtaining a greater comprehension about the capacities and human restrictions to apply and diffuse that knowledge more thoroughly, so that it would be possible to reduce the influence of human error in the occurrence of the accidents.

The research developed by the Aeronautical Institute of Psychology about the incidence of the psychological aspect in the occurrence of aeronautical accidents in the civil aviation, in the period from 1997 to 2002, is the continuity of a previous work that studied the same segment, for the period from 1992 to 1996, and it has the objective of identifying the critical areas and propose measures to make its control possible.

The study of the psychological aspect, in this research, is based on the understanding of the human performance as resulting from a series of factors: internal and peculiar of human being and external, situational, which condition the result of his/her performance. In this work, the ergonomic approach was used as theoretical base for collecting and analyzing the data, by understanding the accident as a rupture in the balance of the individual, psychosocial and organizational conditionings, of the relationship man-task-machine.

Methodology

The analyzed data refer to accidents happened in the civil aviation, in the period from 1997 to 2002, in which the psychological aspect was contributory. The Table 1 presents the numbers of occurred accidents in the cited period and the contribution of the

psychological aspect, information obtained from the Center of Investigation and Prevention of Aeronautical Accidents (CENIPA), a sector of the Air Force responsible for managing the System of Prevention and Investigation of the Air Force (SIPAER) in Brazil.

Table 1: Contribution of the psychological aspect in the period from 1997 to 2002.

Type of Aviation	Total of Accidents	Psychological Aspect
Civil	377	184

The sample of the analyzed accidents was constituted by 151 (82,0%) of the accidents occurred in the civil aviation in which there was the contribution of the psychological aspect.

The conditionings of the psychological aspect that contributed to the accidents were extracted from the final reports made by CENIPA. The frequency and the percentage of each attribute/conditioning was established in relation to the accidents/answers, as it is illustrated in the Table 2.

Table 2: Conditionings of the psychological aspect in the accidents in the period from 1997 to 2002.

Conditionings	f	%
Individual	465	79,8
Psychosocial	49	8,4
Organizational	69	11,8
Total of Answers	583	100,0

Because of the great number of extracted data, they were divided in areas, as follows: the individual conditioning (attitude, decision process, emotional state, attention, motivation, professional experience, personality, perception, memory and motive response); the psychosocial conditioning (relationship in the work environment, the crew's dynamics, situations outside the work atmosphere, communication), and organizational conditioning (organizational environment and system of support). The frequency and percentage of the areas were calculated based on the total of answers in each conditioning of the psychological aspect.

Aiming a greater comprehension of the identified areas, it was necessary to subdivide them in attributes. So, the frequency and percentage of each attribute in its respective area were also calculated.

The frequency and percentage of the contributory operational factors were highlighted, in order to

identify possible relationships between these factors and the psychological ones.

Presentation of the Data

According to the collected data, it can be verified that the contribution of the psychological aspect for the occurrence of accidents concentrated mainly on five areas, which are distributed in their respective conditionings. In the individual conditioning, the attitude and decision process stood out. In the psychosocial conditioning, relationship in the work environment and crew's dynamics were highlighted. At last, in the organizational conditioning, the organizational environment was the main area (Table 3).

Table 3: Areas of the psychological aspect that contributed to the occurrence of accidents in the period from 1997 to 2002.

Areas	F%	%
Individual Conditionings		
Attitude	200	43,0
Decision Process	77	16,6
Emotional state	34	7,3
Attention	33	7,1
Motivation	32	6,9
Professional experience	31	6,7
Personality	29	6,2
Perception	15	3,2
Memory	12	2,6
Motive response	2	0,4
Total of Answers	465	100
Psychosocial Conditionings		
Relationship in the environment of working	20	40,8
The crew's dynamics	19	38,8
Situations outside the environment of working	7	14,3
Communication	3	6,1
Total of Answers	49	100
Organizational Conditionings		
Environment organizational	63	91,3
Systems of Support	6	8,7
Total of Answers	69	100,0

Regarding to the attitude area, it was observed that the excess of self-confidence was the attribute that most contributed to the occurrence of accidents in the analyzed period (35,5%), followed by indulgence (22,0%) and disregard with operations and procedures (21,5%).

According to the area of decision making process, the attributes wrong decision (62,3%) and deficient

judgment (26,0%) were the ones that presented larger incidence.

In the area of working environment, the pressure of the employer / superior (50,0%) and working group culture (15,0%) were the attributes of larger contribution. The crew's deficient integration (5,79%) was the attribute of greater relevance in the area of the crew's dynamics.

At last, it was observed that less developed organizational culture (68,3%) was the attribute of the organizational area that more significantly contributed to the occurrence of accidents in the civil aviation.

Regarding to the operational factor, deficient judgment (15,7%), planning (14,0%) and supervision (13,2%) were the aspects of greater incidence in the referred period (Table 4).

Table 4: Contribution of the operational aspect in the aeronautical accidents in the period of 1997 to 2002.

Operational aspects	f	%
Deficient judgment	127	15,7
Deficient planning	113	14,0
Deficient supervision	107	13,2
Indiscipline of flight	84	10,4
Uncertainty	81	10,0
Deficient application of commands	57	7,1
Adverse meteorological conditions	40	5,0
Deficient coordination cabin	37	4,6
Small flight experience or in the aircraft	34	4,2
Deficient instruction	33	4,1
Other aspects	30	3,7
Deficient maintenance	27	3,3
Influence of the environment	13	1,6
Deficient infrastructure	11	1,4
Operational aspects	9	1,1
Deficient judgment	4	0,5
Deficient control of air traffic	1	0,1
Total of Answers	808	100,0

Analysis of the Results

The analyzed period highlighted a great incidence of individual contributors in comparison to the psychosocial and organizational conditionings, which, at first sight, show a less expressive contribution to the occurrence of the accidents. However, considering the most recent theories on causality of the accidents, it can be verified that this first impression is not confirmed.

Reason et al., (1995) classify as active failures the errors and violations that happen in the operation of

the system, provoking an immediate adverse effect. The mistakes and violations can be related to the environment where the task takes place or to the physical and mental state of the operators that, in this research, is revealed in the high incidence of individual aspects.

The active failures make it possible to identify the latent failures related to decisions taken in the managerial sphere, by people not directly involved in the operation, which can stay occult for long periods. The latent failures represent the fragility of the defenses of the system, and they include, for instance: inadequate training and supervision, bad selective process, no standardization of procedures, undeveloped safety culture, etc.

In this sense, the high incidence of aspects related to the individual area suggests that the organizational defenses, which constitute the processes and practices developed to minimize or to remove the risks involved in the operation, are not accomplishing, in an effective way the objective of reducing the occurrence of errors in the activity. This supposition is corroborated by the data related to the operational factor, where the deficient supervision is verified as the third aspect of greater incidence in the total of occurred accidents.

The relationship among the individual, psychosocial and organizational aspects will be better understood, starting with comments related to the areas and attributes of larger incidence that will be presented next.

The concept of attitude is used to describe the individual's tendency to answer in a certain way to objects, people and situations.

For the prevention of accidents, it is fundamental to know the personnel's attitudes regarding to his/her work, the organization and safety activities, which allows the elaboration of programs to strengthen attitudes considered appropriate and modify those that are unfavorable to a safe flight activity. The excess of self-confidence, exhibitionism, indulgence, improvisation and the disregard with operations and procedures are attitudes considered incompatible with flight safety.

The excess of self-confidence was the attribute that most contributed to the occurrence of accidents in the period and it refers to the exaggerated belief in the own operational capacity. This belief can interfere in the capacity of the pilot's judgment, through a deficient critical analysis of the situation, in his

process of decision making and in the planning of the flight. In aviation, pilots with a lot of experience but that don't live critical situations for a long period in flight are supposed to develop this attitude. On the other hand, the organizations that don't possess a system of effective supervision and tolerate incompatible attitudes with the safety of flight activity reinforce the high self-confidence and other attitudes that increase the risk of the operation. It is supposed that the excess of self-confidence is related to the aspects deficient judgment, supervision and planning, that were the attributes of the operational area that most contributed to the occurrence of accidents in the analyzed period.

The formation and maintenance of attitudes that favor a safe flight can be obtained through training programs, effective supervision activities and a flight safety culture well developed.

In the development of his/her activity, the pilot is submitted to a great variety of incentives, which should be selected in function of his/her relevance to the situation in that he/ she is. This process is fundamental to the elaboration of judgment, the decision process and actions that should be implanted during the flight (Bond *et al.*, 1968).

The process of decision, such as in routine or emergency situations is also influenced by aspects related to the individual characteristics of who decides (self-confidence, emotional control, sleep, fatigues, operational knowledge, experience) as well as it suffers influences of external aspects provoked by other people and the surrounding environment.

The influence caused by third parties in the decision process occurs, especially, when the other occupies a leadership position, when the group strongly influences the person who decides, or when there is fear or concern related to the consequences of the decision. This kind of influence can be observed in the present research, in the attributes: pressure of the employer/superior and culture of the working group, of the psychosocial area.

The surrounding environment influence the making decision process, mainly if it contains elements which mobilize stress such as: high level of noise, risk level involved in the operation, excess of information, innovation and complexity of the situation, lack of elements of information and time. In this sense, the crew's inadequate dynamics, in terms of definition and division of tasks, as cited, can favor this overloaded environment.

The mentioned internal and external aspects can contribute to a deficient judgment of the flight situation and, consequently, to a wrong decision process, which was the attribute, of the area of making decision process that presented larger incidence.

The making decision process involves cognitive (gathering and analysis of information), affective (feelings that are mobilized by the situation) and motors (actions undertaken after the choice of an alternative) components, and it can suffer influences of several orders. It is important that the procedures adopted to improve the pilots' decisions not only involve technical and operational aspects for routine and non-routine situations, but also the application of strategies to solve problems and emotional control.

It is important to point out that the performance in the flight activity results not only from the individual characteristics of the operator, in terms of professional experience, motivation and personality, among others. The characteristics of the group where the individual is inserted and the rules, politics, working conditions and culture of his/her organization are also considered.

In the current research, the less developed organizational culture attribute was the one with the highest evidence in the environmental organizational area.

According to OACI - International Organization of Civil Aviation, culture is defined as group of beliefs and values shared by almost all the members of a group. It defines values and predisposes to attitudes and behavior, causing influences on the behavior of a certain group.

Turner et al. (1989) state about culture of safety: "scenery of beliefs, rules, attitudes, roles, technical and social practices inside the organization, which objective is to minimize the exposition of people to conditions considered dangerous, inside or outside the organization."

It can be verified that the attributes of the individual and psychosocial conditionings (disregard with operations and procedures, indulgence, improvisation, pressure of the employer/superior) and deficient supervision, of the operational factor, are indicative of the presence of a culture of less developed safety culture silted in the organizational environment.

The maintenance and strengthening of a safety culture is a complex and expensive process. It involves actions directed towards the increasing of the individual competences, not only in the technical/operational/interpersonal sphere, but also in relation to the improvement of the policies and managerial practices and the compromising of the high direction with the flight safety. According to Coelho and Magalhães (2001), "a solid flight safety culture has great probability of reducing to the minimum the influence of personal or psychosocial aspects because interfere in the attitude of the people and groups towards the prevention of accidents."

Conclusion

The aeronautical accident is a multifarious phenomenon resulted from complex interactions among physical, biological, psychological and social factors.

The data highlighted in this research constitute a contribution to show the psychological aspects that influenced the flight safety in the period from 1997 to 2002. After examining the data, it can be observed that the excess of self-confidence, indulgence, disregard with operations and procedures, the process of wrong decision, pressure of the employer/superior, the crew's deficient integration and less developed organizational safety culture were the attributes of the Human Factors - Psychological Aspect that most contributed to the occurrence of accidents in the civil aviation, especially in the general aviation, that concentrated the majority of the analyzed accidents.

The effects of those variables, which are typical of the human being, in the flight activity can be minimized through organizational practices based on the valorization of flight safety culture, which allows the organization to reach its objectives with a minimum risk for the equipment, people and the environment. In relation to the Psychology field, besides the accomplishment of specific researches, it can highlight the activities of personnel selection, performance evaluation and follow up, as well as the psychologists' inclusion in safety inspections, operational and development of teams trainings as important tools to control the human errors in the performance of the flight.

Flight safety is not an isolated activity, it depends on the knowledge of professionals in several areas, as well as leaders, supervisors and operators. In this sense, the results reached with this research, integrated into studies and practices accomplished in

other fields of knowledge, can contribute to produce effective results in the field of accident prevention.

References

Barreto, M., Fonseca, C. and Coelho, E. (2006) *Investigation of Psychological Aspects in Aircraft Accidents: an Ergonomic Approach*. 16th World Congress on Ergonomics, IEA. Maastricht.

Barreto, M. and Magalhães, F. (2003) *La Contribución del Aspecto Psicológico en los Accidentes Aeronáuticos en el Periodo de 1992 a 1996*. Primeras Jornadas Iberoamericanas de Seguridad e Instrucción en Aviación Civil. OACI. Madrid.

Coelho, E. and F. Magalhães (2001) *Os Vãos da Psicologia no Brasil: Estudos e Práticas na Aviação*. Departamento de Aviação Civil, Rio de Janeiro.

Cacciabue, P.C and North, C.J. (1995) *Human Factors, the Next Technological Advance? Issues and Needs: a View from the CEG in Applications of Psychology to the Aviation System*. Avebury Aviation, Aldershot.

Coelho, E., Magalhães, F. and Barreto, M. (1999) *Investigação do Aspecto Psicológico – Orientações Básicas*. Centro de Investigação e Prevenção de Acidentes Aeronáuticos, Comando da Aeronáutica, Brasília, DF.

Magalhães, F. and Barreto, M. (1999) *Modelos de Análise de Fatores Humanos - Shell e Reason*. Centro de Investigação e Prevenção de Acidentes Aeronáuticos, Comando da Aeronáutica, Brasília, DF.

Cardella, B. (1999) *Segurança no Trabalho e Prevenção de Acidentes: uma Abordagem Holística*. Editora Atlas S.A, São Paulo.

OACI (1998) *Manual de Instrucción sobre Factores Humanos*. Organización de Aviación Civil Internacional, Montreal.

Reason, J., Maurino, D., Johnston, N. and Rob, L. (1995) *Beyond Aviation Human Factors - Safety in High Technology Systems*. Avebury Aviation, Aldershot.