Crew Resource Management

FLIGHT OPERATIONS

SUBJECT

Flight Operations

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Crew Resource Management

1. Introduction

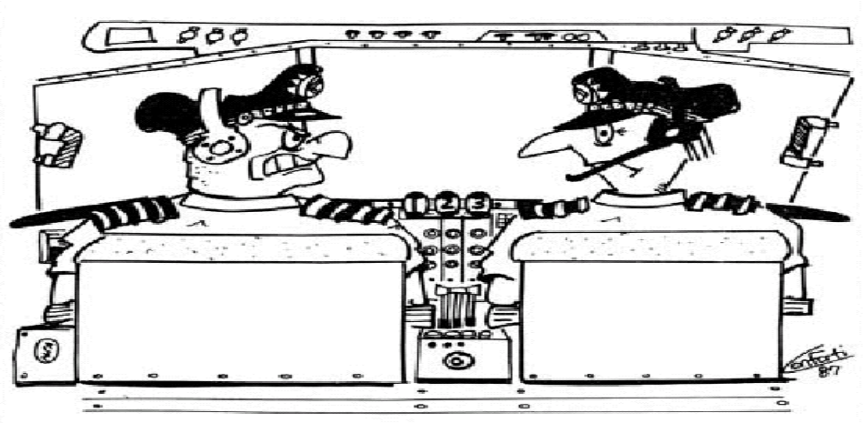
Crew Resource Management (CRM) was developed as a response to new insights into the causes of aircraft accidents which followed from the introduction of flight recorders and cockpit voice recorders into modern jet aircraft. Information gathered from these devices has suggested that many accidents result not from a technical malfunction of the aircraft or its systems, nor from a failure of aircraft handling skills or a lack of technical knowledge on the part of the crew; it appears instead that they are caused by the inability of crews to respond appropriately to the situation in which they find themselves.

In an attempt to remedy the apparent deficiency in crew skills, additional training in flight deck management techniques has been introduced by some airlines. Following a period of experimentation and development, the techniques embraced by the new training became known collectively as CRM. The importance of the CRM concept and the utility of the training in promoting safer and more efficient aircraft operations have now been recognized worldwide.

2. What is CRM?

CRM can be defined as a management system which makes optimum use of all available resources - equipment, procedures and people - to promote safety and enhance the efficiency of flight operations.

It is concerned not so much with the technical knowledge and skills required to fly and operate an aircraft but rather with the cognitive and interpersonal skills needed to manage the flight within an organized aviation system. In this context, cognitive skills are defined as the mental processes used for gaining and maintaining situational awareness, for solving problems and for taking decisions. Interpersonal skills are regarded as communications and a range of behavioral activities associated with teamwork. In aviation, as in other walks of life, these skill areas often overlap with each other, and they also overlap with the required technical skills. Furthermore, they are not confined to multi - crew aircraft, but also relate to single pilot operations, which invariably need to interface with other aircraft and with various ground support agencies in order to complete their missions successfully.



3. Principles of Crew Resource Management

CRM is defined as the effective utilization of all available resources--equipment and people--to achieve safe, efficient flight operations. Resources include autopilots and other avionics systems: operating manuals; and people, including crew members, air traffic controllers, and others in the flight system. Therefore, the concept of effective CRM combines individual technical proficiency with the broader goal of crew coordination, thus integrating all available resources to achieve safe flight.

The following principles are fundamental to the CRM concept:

a) Effective performance depends on both technical proficiency and interpersonal skills.

b) A primary focus of CRM is effective team coordination. The team encompasses the flight crew (cockpit and cabin), dispatchers, air traffic controllers, maintenance and others.

c) CRM focuses on crew members' attitudes and behaviors.

d) Effective CRM involves the entire flight crew. CRM is not simply a responsibility of the captain, nor should CRM training be viewed as captain's training. All crewmembers are responsible for effective management of the resources available to them.

e) The acquisition of effective CRM skills requires the active participation of all crewmembers. Effective resource management skills are not gained by passively listening to classroom lectures, but by active participation and practice, including the use of simulations such as Line-Oriented Flight Training (LOFT).

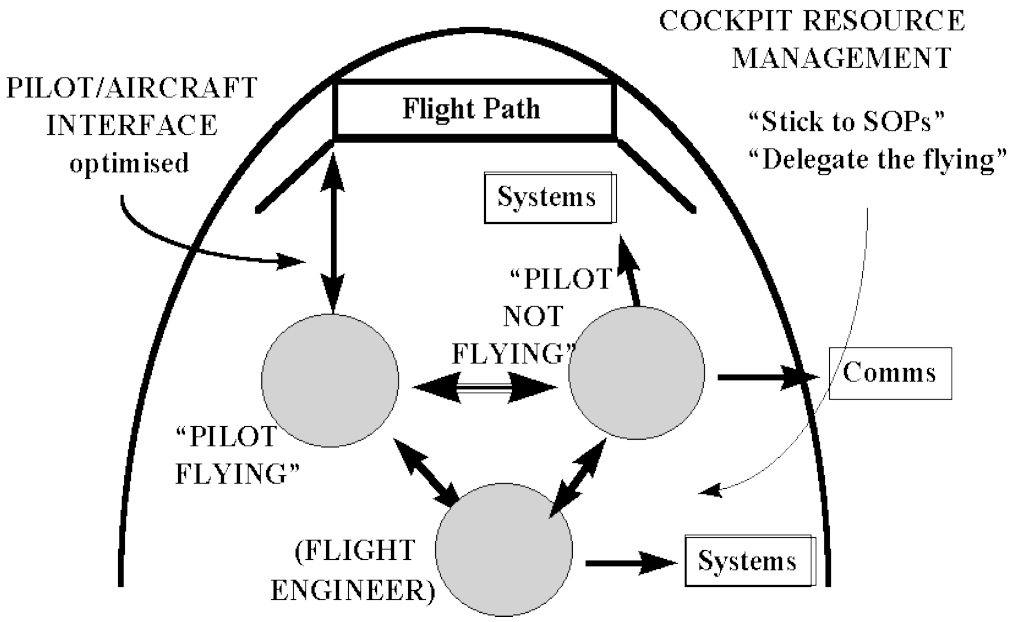
f) CRM training should be blended into the total training curriculum, including initial, transition, upgrade, and recurrent training.

CRM encompasses a wide range of knowledge, skills and attitudes including communications, situational awareness, problem solving, decision making, and teamwork; together with the entire attendant sub-disciplines which each of these areas entails.

In the next rows a short description of some of the CRM training concepts are presented.

1. Cognitive skills

1. Situational Awareness- involves conscious recognition of all the factors and conditions operational, technical and human - which affect the safe operation of an aircraft.
2. Planning and decision making- a central aim of CRM is to ensure that high quality decisions are taken across the whole spectrum of flight operations. In this context, thorough pre-flight planning will not only provide a yardstick against which in-flight decisions can be made but will also allow all members of the crew to manage their own specific areas of responsibility successfully.



2. Interpersonal skills

1. Communications-effective communication between crew members is an essential prerequisite for good CRM. It not only helps the crew to develop a shared mental model of the problems which need to be resolved in the course of the flight, thereby enhancing situational awareness, but it also allows problem solving to be shared amongst crew members by enabling individual crew members to contribute appropriately and effectively to the decision-making process.
2. Teamwork- Successful teamwork is achieved when the output of the team is greater than that which could be developed by the sum of the efforts of the individual crew members acting in isolation - a process known as synergism.

3. Factors affecting individual performance

1. Emotional climate- refers to the way that people in the team feel about themselves and each other during flight operations.
2. Stress- a factor which can quickly undermine the emotional climate in which the crew is operating is stress - defined as a state of highly unpleasant emotional arousal associated variously with overload, fear, anxiety, anger and hostility - all of which threaten both individual performance and teamwork.
3. Commercial, Organizational Pressures and Morale-although stress has been mentioned earlier, commercial and organizational pressures are worth presented whether short

term or long term, since these are often cited as being stressors, and can have an effect on morale.

4. Fatigue- is a factor which can affect individual performance and hence, CRM. The more fatigued you are, the less able you will be to cope with stress and workload.
5. Incapacitation-An extreme case of performance decrement is incapacitation of one, both or all flight crew members.

Safe and efficient flight operations depend for their success not merely on the acquisition of sound technical knowledge and skills but also on the mastery by aircrew of the cognitive and interpersonal skills which form the basis of good CRM. Cognitive skills not only allow for the development and maintenance of good situational awareness but also underpin high quality problem solving and decision making techniques. In addition, interpersonal skills, which depend for their effectiveness on good communications, encourage the creation of synergy and the development of successful teamwork. Both cognitive and interpersonal skills are enhanced by a good emotional climate amongst the crew, but they are also easily degraded by stress, so management of the emotional climate and stress becomes an integral and important element of good CRM.

4. Crew Resource Management – Pilot Training

1. ICAO and EASA Regulations

ICAO

An operator shall establish and maintain a ground and flight training programme, approved by the State of the Operator, which ensures that all flight crew members are adequately trained to perform their assigned duties. The training programme shall: include training in knowledge and skills related to human performance including threat and error management. (Annex 6 — Operation of Aircraft).

EASA

Crew resource management (CRM) training: Before operating, the flight crew member shall have received CRM training, appropriate to his/her role, as specified in the operations manual. (Part-ORO).

A flight crew member shall receive initial and recurrent CRM training.

2. Content of the CRM

A CRM Training Course for Pilots should cover at least the following subjects:

1. Information Processing. An overview of mental human performance characteristics which flight crew use, the way in which information gathered by the senses is processed by the brain. The limitations of the human information processing system. The basic theory of decision making.
2. Human Error, Reliability and Error Management. Human error is inevitable, what is important is to ensure that human error does not result in adverse events such as air accidents. This can be addressed in two ways: reducing errors in the first place, and controlling errors such that they, or their immediate effects, are detected early enough to allow remedial action. CRM addresses both types of mitigating strategies, but concentrates particularly on error detection, especially in the multi-crew situation.
   Human reliability is the science which looks at the vulnerability of human beings to make errors (or less than perfect performance) under different circumstances. One could argue that it is more of an art than a science, since it is very difficult to predict, in quantifiable terms, human reliability in different situations, and from individual to individual. However, there are certain conditions under which humans are more likely to make errors (e.g. during circadian lows, when stressed, when overloaded, etc.).
3. Fatigue and Workload Management. Deals with 'readiness to cope' in some sense, in terms of an individual's physical and mental ability to cope with work demands, and how he manages those work demands. The ideal would be for flight crew to be at peak fitness and alertness all the time, and to be able to manage the workload such that work demands never exceed ability to cope. However, life isn't like that, and there are times when individuals are fatigued, or stressed, and workload sometimes exceeds ability to cope. CRM aims to help flight crew to plan their workload as far as they are able, making best use of the team, and taking into

account the fact that some individuals may be performing below peak levels (e.g. due to fatigue, etc.). It is also important for managers to be aware of such human performanceissues when planning, e.g. rosters.

4. Situation Awareness. Situation Awareness (SA) is knowing what is going on around you, notice the big picture and is fundamental to correct decision making and action.
   Information processing tends to be the term used for the psychological mechanism of receiving and analysing information; situation awareness is a description of an individual's,or team's, understanding of the aircraft state and environment, based on perceived and processed information.
   SA is more than just perception - it is understanding the meaning of what you perceive, how it might change in the future, and the implications.
   Decision making is based on situation awareness; therefore if you have poor SA, you arelikely to make poor decisions. SA has sometimes been referred to as "perception of reality" anditis quite possible for different crew members to have different perceptions of reality.
   The aim of SA training should be to ensure that all flight crew members have good SA and a common (and correct) perception of the state of the aircraft and environment. This can be achieved by good team working and communication.
   Breakdown of situation awareness is the root cause of so many aircraft incidents that eliminating it would dramatically reduce the accident rate.SA is, therefore, an important element of CRM.
5. Communication & Management. One of the basic underlying premises of CRM is that a team can, and should, perform better than two (or three) individuals in the cockpit. The aim ofCRM is to ensure that 1+1>2, as opposed to 1+1<2 (in a two pilot cockpit), and that team performance takes precedence over individual performance.
   Good CRM is getting the balance right as a team, whilst recognising that the Captain has the final say and responsibility for the safety of the aircraft.
   In order to be effective, team members must be able to talk to each other, listen toeachother, share information and be assertive when required. Commanders should take particular responsibility for ensuring that the crew functions effectively as a team.
   Whilst the emphasis in CRM is primarily upon the cockpit crew, and how they work as a team, it is also important to look at wider team effectiveness, namely the whole flight crew.
   CRM principles may also extend to situations where ATC, maintenance, company experts,etc., are considered to be part of the team (especially in emergency situations or in a single pilot environment).
   A UK based study of 249 co-pilots reported that nearly 40% of them had on several occasions failed to communicate to the Captain their proper doubts about the operation of the aircraft. The most common reason being the desire to avoid conflict and deference to the experience and authority of the Captain.
6. Automation. Automation in the aviation domain has been increasing for the past two decades. Pilot reaction to automation varies from highly favourable to highly critical depending on both the pilot's background and how effectively the automation is implemented.

Modern aircraft feature a variety of automation technologies to help the pilot with such things as checklist execution, navigation, descent planning, engine configuration, and system monitoring. Older aircraft can be retrofitted to incorporate many of these features by replacing older radios with modern units, replacing traditional gauges with computer monitors, and linking everything with computer processors.

One of the goals of automation is to improve the pilot's situational awareness. A related goal is to decrease the workload required to maintain a given level of awareness.

Technologies assist the pilot with awareness of position, terrain, traffic, fuel usage and remaining aircraft range, engine operating characteristics, etc. Pilots have various reactions to automation. They may find it superfluous (the real pilots don't need an autopilot perspective), helpful (the autopilot can fly an approach much more accurately than I; a real plus in bad weather), or confusing.

It is believed that to make automation helpful, it needs to fulfil a pilot's need, fit seamlessly into the flying tasks, and be easy enough to understand to earn a pilot's trust.

CRM in highly automated aircraft presents special challenges, in particular in terms of situation awareness of the status of the aircraft.

7. CRM for Single Pilots. Single-Pilot Resource Management (SRM) is an adaptation of Crew Resource Management (CRM) training to single-pilot operations. Although GA is often regarded as a lesser component of the aviation industry, this perception is incorrect. In the United States GA accounts for 96% of aircraft, 60% of flight hours, and 94% of fatal aviation accidents. Airline and military aviation estimates of the number of accidents caused by pilot error range from 70-80%.

   Single Pilot operations can be less complex with respect to certain aspects of CRM compared to Multicrew operations. There is no inter-crew communication and there are no flight deck issues involving authority and leadership. However, in other areas such as error management, decision making and planning, the lack of an additional crewmember can make the situation more demanding. The single pilot does not have the advantage of learning from the experience of other crewmembers on the flight deck and often has to learn from his own mistakes. The only debriefing and evaluation available to the single pilot during normal operations is self-evaluation.

   The content of SRM is similar to that of CRM training, except the topics relating to pilot crews are excluded (ex. captain and co-pilot communication). Examples of topics included in SRM training are situation awareness, workload management, automation management, and aeronautical decision making.

5. Crew Resource Management History

1. NASA

The origin of Crew (or Cockpit) Resource Management (CRM) training is most often traced to a NASA workshop in 1979 that focused on improving air safety by reducing human error. The workshop was convened to consider NASA research which indicated that the majority of aviation accidents were caused by failures of interpersonal communication, leadership, and decision making in the cockpit.

Training which derived from this workshop was initially titled Cockpit Resource Management, but this title was soon replaced by Crew Resource Management as study in the field soon concluded that flight safety was under the influence of all crew, and indeed all personnel in the aviation system, not only those on the flight deck.

2. CRM and Aviation-The Tenerife crash

The 27th March 1977 at 17:06, an KLM Boeing 747 collided with a Pan Am Boeing 747 on Tenerife Airport killing 583 people of 647. This accident was a wake up call to the Aviation Industry. After this accident KLM began their work with Crew Resource Management.

Accident Summary

After a bomb exploded at Gran Canaria Airport, many aircraft were diverted to Tenerife. Among them were KLM Flight 4805 and Pan Am Flight 1736 – the two aircraft involved in the accident. The threat of a second bomb forced the authorities to close the airport while a search was conducted, resulting in many airplanes being diverted to the smaller Tenerife airport where air traffic controllers were forced to park many of the airplanes on the taxiway, thereby blocking it. Further complicating the situation, while authorities waited to reopen Gran Canaria, a dense fog developed at Tenerife, greatly reducing visibility.

When Gran Canaria reopened, the parked aircraft blocking the taxiway at Tenerife required both of the 747s to taxi on the only runway in order to get in position for takeoff. The fog was so thick that neither aircraft could see the other, nor could the controller in the tower see the runway or the two 747s on it. As the airport did not have ground radar, the only means for the controller to identify the location of each airplane was via voice reports over the radio. As a result of seve ral misunderstandings in the ensuing communication, the KLM flight attempted to take off while the Pan Am flight was still on the runway. The resulting collision destroyed both aircraft, killing all 248 aboard the KLM flight and 335 of 396 aboard the Pan Am flight. Sixty-one people aboard the Pan Am flight, including the pilots and flight engineer, survived the disaster.

As the accident occurred in Spanish territory, that nation was responsible for investigating the accident. Investigators from the Netherlands and the United States also participated. The investigation revealed that the primary cause of the accident was the captain of the KLM flight taking off without clearance from Air Traffic Control (ATC).The investigation specified that the captain did not intentionally take off without clearance; rather he fully believed he had clearance to take off due to misunderstandings between his flight crew and ATC.Dutch investigators placed a greater emphasis on this than their American and Spanish counterparts,but ultimately KLM admitted their crew was responsible for the accident, and the airline financially compensated the victims' relatives.

The accident had a lasting influence on the industry, particularly in the area of communication. An increased emphasis was placed on using standardized phraseology in ATC communication by both controllers and pilots alike, thereby reducing the chance for misunderstandings. As part of these changes, the word "takeoff" was removed from general usage, and is only spoken by ATC when actually clearing an aircraft to take off. Less experienced flight crew members were encouraged to challenge their captains when they believed something was not correct, and captains were instructed to listen to their crew and evaluate all decisions in light of crew concerns. This concept was later expanded into what is known today as **Crew Resource Management**.

CRM training is now mandatory for all airline pilots.

6. CRM Aspects in Accidents

Case Studies

The following accident emphasizes the relationship between arousal and performance. Crucial elements identifiable in this excerpt include the importance of unbroken attention to instrument scan and the insidious role of distractions.

EASTERN AIRLINES 401

Accident Summary

On December 29, 1972, an Eastern Airlines Lockheed L-1011 crashed In the Everglades about 18 miles west-northwest of Miami International Airport MIA). There were no major mechanical problems, severe weather phenomena or crew Incapacitation. The flight diverted from its approach because the nose landing gear position Indicating system of the aircraft did not indicate that the nose gear was locked in the down position. The aircraft climbed to 2,000 feet MSL and followed a clearance to proceed west from the airport at that attitude. During that time the crew attempted to correct the malfunction and to determine whether or not the nose landing gear was extended. Unfortunately, during that period, workload management in terms of flying, navigating and communicating was totally ignored due to fixation on the relatively minor failure.

The flight was conducted in clear weather conditions with unrestricted visibility. However, the accident occurred in darkness with no moon. The flight was uneventful until the approach to MIA. The landing gear handle was placed in the "down* position during the preparation for landing, and the green light, which Indicates to the crew that the landing gear is fully extended and locked, failed to Illuminate. The captain recycled the landing gear, but the green light still failed to illuminate.

The National Transportation Safety Board determined that the probable cause of this accident was failure of the flight crew to monitor the flight Instruments during the final four minutes of flight, and to detect an unexpected descent soon enough to prevent Impact with the ground. Preoccupation with a malfunction of the nose gear position indicating system distracted the crew's attention from the Instruments and allowed the descent to go unnoticed.

Event History

Eastern Airlines Flight 401 was a scheduled passenger flight from the John F. Kennedy International Airport in Jamaica, New York to the Miami International Airport in Miami, Florida.

1. At 2334:05, EAL 401 called the MIA tower and stated, "Ah, tower, this Is Eastern, ah, four zero one, It looks like we're going to have to circle, we don't have a light on our nose gear yet."
2. At 2334:14, the tower advised, "Eastern four oh one heavy, roger, pull up, climb straightahead to two thousand, go back to approach control, one twenty eight six."
3. At 2335:09, EAL 401 contacted MIA approach control and reported, "All right, ah, approach control, Eastern four zero one, we're right over the airport here and climbing to two thousand fest. In fact, we've just reached two thousand feet and we've got to get a green light on our nose gear."
4. At 2336:04, the captain instructed the first officer, who was flying the aircraft, to engage the autopilot. The firs officer acknowledged the instruction. Subsequently, the captain tookover the flying responsibilities. The first officer successfully removed the nose gear light lens assembly, but it jammed when he attempted to replace it.
5. At 2337:01, the captain instructed the second officer to enter the forward electronics bay, below the flight deck, too check visually the alignment of the nose gear indices.
6. At 2337:48, approach control requested the flight to turn left to a heading of 270 degrees magnetic. EAL 401 acknowledged the request and turned to the new heading. Meanwhile,the flightcrew continued their attempts to free the nose gear position light lens from its retainer, without success. At 2338:34, the captain again directed the second officer to descend intothe forward electronics bay and check the alignment of the nose gear indices.
7. At 2340:3e, a half-second C-chord, which indicated a deviation of +/- 250 feet from the selected altitude, sounded In the cockpit. No crewmember commented on the C-chord. No pitch change to correct the loss of altitude was recorded. A short time later, the secondofficer raised his head into the cockpit and stated, “I can’t see it, its pitch dark and I throw the little light, I get, ah, nothing." The flightcrew and an EAL maintenance specialist who was occupying the forward observer seat then discussed the operation of the nose wheel well light. Afterward, the specialist went into the electronics bay to assist the second officer.
8. At 2341:40, MIA approach control asked, "Eastern, ah, four oh one how are things coming' along out there?” This query was made a few seconds after the controller noted an altitude reading of 900 feet In the EAL alphanumeric block on his radar display. The controller later testified that momentary deviations in altitude Information on the radar display were not uncommon; and that more than one scan on the display would be required to verify a deviation requiring controller action.
9. At 2342:05, the first officer said, "We did something to altitude," The captain's reply was "What?" The first officer asked, "Were still at two thousand, right?" The captain immediately exclaimed, “Hey, what’s happening here?”
10. At 2342:10, the first of six radio altimeter warning "beep" sounds began; they ceased immediately before the sound of initial ground Impact. The aircraft crashed while in a left bank of 28 degrees. The aircraft was destroyed. There were 163 passengers and a crew of 13

aboard the aircraft. Ninety-four passengers and five crew members received fatal Injuries.All other occupants received Injuries which varied from minor to critical.

The distraction shown in this accident report was an operational one. Ironically, the distraction itself was not serious. The crew's mismanagement of the distraction caused it to be fatal.

Distractions can also come from outside the cockpit in the form of traffic, weather, unexpected rerouting, etc. The keys to dealing with distractions in order to avoid catastrophic consequences lie in the crew's ability to focus on aircraft control and hazard avoidance.

The crew should be prepared to avoid distractions. The captain can fly the aircraft and delegate tasks that might interfere. Or vice-versa. While the distraction in the L-1011 accident demanded immediate attention, it was the captain's responsibility to set priorities and to delegate responsibilities or make work assignments. Tragically, the entire crew became absorbed in the distraction at the expense of aircraft control.

US AIRWAYS 1549

The following accident ilustrates how the principles stated in the CRM can make the differece between life and death.

Accident Summary

On January 15, 2009, about 1527 eastern standard time (EST),1 US Airways flight 1549, an Airbus Industrie A320-214, N106US, experienced an almost total loss of thrust in both engines after encountering a flock of birds and was subsequently ditched on the Hudson River about 8.5 miles from LaGuardia Airport (LGA), New York City, New York. The flight was en route to Charlotte Douglas International Airport (CLT), Charlotte, North Carolina, and had departed LGA about 2 minutes before the in-flight event occurred. The 150 passengers, including a lap-held child, and 5 crewmembers evacuated the airplane via the forward and over wing exits. One flight attendant and four passengers received serious injuries, and the airplane was substantially damaged. The accident flight was the last flight of a 4-day trip sequence for the flight and cabin crewmembers and the second flight of the day in the accident airplane. The flight crew flew from Pittsburgh International Airport (PIT), Pittsburgh, Pennsylvania, to CLT on a different airplane and then flew the accident airplane from CLT to LGA. The flight crew reported that the flight from CLT to LGA was uneventful.

Crew resource Management Implications

US Airways provided training on crew resource management (CRM) during basic indoctrination training, CQT, and distance-learning modules. In addition, US Airways integrated CRM and TEM into all aspects ofits training, including ground school and flight simulations. During postaccident interviews, the captain was asked to describe the crew coordination between him and the first officer during the accident event. The captain stated that he thought that the crew coordination was “amazingly good “considering how suddenly the event occurred, how seve re it was, and what little time they had. The captain indicated that, because of the time constraints, they could not discuss every part of the decision process; therefore, they had to listen to and observe each other. The captain further stated that they did not have time to consult all of the written guidance or complete the appropriate checklist, so he and the first officer had to work almost intuitively in a very close-knit fashion.

For example, the captain stated that when he called for the QRH, about 17 seconds after the bird strike, the first officer already had the checklist out. The captain credited the US Airways CRM training for providing him and the first officer with the skills and tools that they needed to build a team quickly and open lines of communication, share common goals, and work together. During postaccident interviews, the first officer stated that he and the captain each had specific roles, knew what each other was doing, and interacted when necessary.

7. Conclusions

Commercial aviation is one of the safest forms of transportation, with a safety record that is excellent by any standards. The number of commercial jet aircraft in service worldwide has climbed steadily over the past three decades to a total of 9,530 in 1990,while annual departures have increased to13,298,000 for 1990 (Boeing, 1991).Remarkably, over this same period, the total accident rate has declined from over 60accidents per million departures to about 2.5-- less than one twenty-fourth the accident rate in 19591 (see Figure 1) This fortunate trend can be attributed to advances in equipment technology, to a high level of individual technical proficiency, and to improved operating procedures. Despite the record, one challenge has not been met: Breakdowns in crew performance have remained the primary factor in commercial jet accidents. Two out of three accidents are attributable to flight crew error.

In the early years, when equipment reliability was the biggest problem, the aviation community responded with ingenuity and resolve. Engines and other aircraft components became more reliable, and related accidents declined. Today, with crew performance the most significaat threat to aviation safety, the industry has responded with an ambitious program to support effective crew coordination and performance: Crew Resource Management training.

One aviation observer has projected that this industry focus on crew performance has the potential to double system safety. Data on the effectiveness of existing CRM programs indicate that this challenge is being met.

8. References

1. ***SKYbrary* Aviation Safety**
2. National Transportation Safety Board Reports www.ntsb.gov
3. ***EASA - European Aviation Safety Agency***
4. ***International Civil Aviation Organization (ICAO)***
5. Wikipedia www.wikipedia.com