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A Plan to Integrate Cockpit Resource Management Into Training Programs of Non-Automated, Transport Category Aircraft

C. H. Meyerholtz Jr.

A PLAN TO INTEGRATE COCKPIT RESOURCE MANAGEMENT INTO TRAINING PROGRAMS OF NON-AUTOMATED, TRANSPORT CATEGORY AIRCRAFT

C.H. Meyerholtz Jr, B.S.

An Abstract Presented to the Faculty
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ABSTRACT

Pilot error has been listed frequently as the probable cause of aircraft accidents. In most cases this does not refer to an error in piloting skills, but rather an error in judgment or inept use of resources available to the pilot. Researchers found that the skills required to effectively use all resources and encourage a team spirit in the cockpit had not been sufficiently developed. Further, according to the National Transportation Safety Board and the Federal Aviation Administration, these resource management skills are just as necessary as flying skills in order to effect safe flight. In the mid-1970's, cockpit resource management, CRM, was developed fill this void.

This project provides ideas for integrating cockpit resource management training into existing transition training programs, specifically that of older, non-automated jet transport aircraft. To that end, the paper:

* Lists and defines key components of cockpit resource management;
* Provides evidence of the effectiveness of cockpit

resource management training;

* Establishes a need for the training based on empirical research and the statistical realities of aircraft accidents;
* Introduces specific objectives which incorporate key components of cockpit resource management;
* Develops strategies to integrate cockpit resource management issues into existing training programs;
* Offers an example of an integrated syllabus, and
* Discusses selection and training of instructors and check personnel.

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A Culminating

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Assistant Professor Daniel W. Kemper
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INTRODUCTION

Overview

There exists among academics, bureaucrats, and industry, a plethora of information on cockpit resource management, CRM. It has been defined, explained, developed, researched, nursed, rehearsed, and in certain ways, which relate to specific training programs, even implemented. There is irrefutable evidence that using CRM has saved lives by preventing accidents attributed to pilot error. In a world where a full 80 percent of all airline accidents are ascribed to pilot error, that evidence takes on immense importance (Freeman and Simmon 1-3).

With all of the existing information concerning the effectiveness of cockpit resource management, why is there not a gigantic push to integrate CRM into all levels of airline, commuter, and corporate flight training? The Federal Aviation Administration has published a special regulation allowing airlines to develop such an integrated program. This regulation establishes the existence of an Advanced Qualification

Program or AQP. Some airlines are working on this new approach, while others are not. At this time it is up to the specific airline to decide whether or not it will adopt AQP.

Since the early days of cockpit resource management in 1978, this author has attended initial training, as well as many upgrade and recurrent training assignments, with four different airlines. The most recent of these was completed in May of 1993. Although there was mention of CRM and its importance, CRM concepts were not successfully integrated into the training environment in any of these courses. In the most recent case, three hours of classroom lecture were given and a follow-up three-day CRM seminar was accomplished during the first year of employment.

In all cases, the aircraft training syllabus emphasized flying skills while the more subtle skills associated with good cockpit resource management were glossed over or not mentioned at all. The academics, simulator, and line instructors working from a traditional syllabus, did not stress CRM.

Cockpit Resource Management

Dr. John Lauber describes cockpit resource management as the task of actively managing all assets available to the pilot of an aircraft (Foushee and Orlady 9). Practicing good cockpit resource management includes: managing hardware; i.e., actually flying the aircraft; managing software; i.e., charts, operations bulletins and other paper work, and getting the most out of the "liveware," i.e., other pilots and crewmembers. Cockpit resource management, then, is the process of bringing all of these assets together in such a way as to achieve a safe and expeditious flight.

Most airlines today have established some type of cockpit resource management training. The Federal Aviation Administration issued Advisory Circular 120-51 on the subject in December of 1989. The purpose of the Advisory Circular was to "present guidelines for developing, implementing, and evaluating a cockpit resource management training program" (1). As a result, some airlines have spent millions of dollars to establish CRM training, while others have done very little. The spectrum of training programs is quite large, from elaborate initial seminars with follow-up training, to no initial seminar and only one classroom training session per year.

Although CRM is generally accepted to mean cockpit resource management, conventional wisdom in the aviation industry now includes all aircraft crewmembers as assets; therefore, flight attendants or other persons who are not part of the working cockpit crew are brought under the umbrella of cockpit resource management. The best recent example of this use of extended resources is the case of an instructor who happened to be riding on United Airlines Flight 232. Captain Al Haynes used the expertise of this non-working crewmember to help accomplish the impossible when they nursed a DC-10, which had lost power to its flight controls, on to an Iowa airport, in the process saving a great many lives (Haynes 10).

Background

During the mid 1970's, NASA was engaged in a research study to find answers to some complex questions concerning accidents attributed to pilot error. One constant theme which surfaced during the pilot interviews that NASA was conducting, was dissatisfaction with the training which the pilots had received. The concerns expressed, for the most part, were not associated with the technical training, but rather with the lack of training in areas such as decision-making, command, leadership, and communications skills (Foushee and Orlady 6).

Analysis of accidents which happened during that period also shed some light on the "pilot error" question. Preoccupation, diverted attention, poor communication, and the lack of situational awareness seemed to pop up during the accident investigations (7).

Studies using full mission simulation (the simulating of a normal flight including paper work, ground delays, and passenger problems) confirmed that there was indeed a problem with crew coordination and cockpit communications. Pilots involved in the full mission simulation studies commented that they wouldn't have believed that they were capable of making the kinds of mistakes that they had, in fact, made. Another very interesting point was that all the pilots said that the insight gained during the simulation was potentially of great benefit to them (Orlady and Foushee 8).

For most pilots, who for years had used only their stick and rudder skills as a measurement of success, it was like a revelation from on high. It became apparent that no matter how good a "stick" a pilot is, his or her ultimate survival and the survival of passengers and crew, may very well depend on how well available resources are managed.

Slowly the concept of CRM was evolving. Probably the most significant data in shaping CRM, as it is known today, came from a study by H.P. Ruffell Smith in 1979. During this study, it became clear that applying classical business management concepts to cockpit operations could increase the overall effectiveness of flight crews (15-18).

Subsequent analysis of the data from the Ruffell Smith study by Clay Foushee and Karen Manos shed further light on the issue and established a direct correlation between the effectiveness of intracockpit communications and performance of the flight crew (Foushee and Manos 67-70).

Considerable research has been done since the early days of CRM. As a result, many improvements have been made in the training airline crews receive.

Specifically, full mission simulation, also known as line oriented flight training, or LOFT, was developed as a direct result of research done by NASA and others in the late 1970's and early 1980's. Federal Aviation Regulations provide for a LOFT session with upgrade and transition training. LOFT training during annual recurrent training may be given by an airline if it chooses (121.427).

Research has awakened the aviation community and alerted it to such hazards as windshear, mid-air collision, and controlled flight into terrain. Research has defined problems and presented the industry with various possible solutions. The formula for a successful cockpit resource management training program is still being debated. As long as cockpit resource management is treated as a separate part of an approved training course, CRM will never achieve the lofty goals set down by its architects. The Federal Aviation Administration recognized this and published Advisory Circular, AC:120-51, titled Cockpit Resource Management Training. The advisory circular calls for at least three distinct phases of training: the awareness phase, practice and feedback phase, and continual reinforcement phase (3). Academic courses on CRM concepts should be taught during the awareness phase. Communication, decision-making, and leadership skills must be woven into the fabric of each unit of training during the practice and feedback phase. The advisory circular sums up the reinforcement phase with the statement that "CRM should be embedded in the total training program. It should be continually reinforced, and it should become an inseparable part of the organization's culture" (5).

Definitions And Principles

John Lauber of NASA's Ames Research Center, and a member of the National Transportation Safety Board, made the opening remarks at a 1986 symposium on Cockpit Resource Management Training. The precepts presented in that opening statement are the core of CRM. According to the FAA Advisory Circular, these principles must be integrated into all levels of instruction if CRM training is to be successful. The following is a synopsis of the precepts gleaned from Dr. Lauber's remarks.

1. Task Delegation and assigning of Responsibilities

Distribution and management of workload is an essential element of CRM. To be an effective manager, the captain must be aware of the workload being placed on the crew and assure that it is distributed in such a way that no crew member becomes overloaded.

2. Prioritizing

Human beings do not do well when faced with multiple and conflicting tasks. The more demands placed on an individual, the higher the chances of that individual making a mistake; therefore, it is necessary to constantly assess the priorities of competing demands and place them in a logical order.

3. Monitoring and Cross-checking

The constant evaluation of information through cross-checking from independent sources is a critical component of effective cockpit resource management. Information from sources such as air traffic control, maintenance, dispatch, and operations must be monitored and independently cross-checked for accuracy.

4. Use of all Available Information

Familiarization and complacency lead to accomplishing tasks based on incomplete information.

The best example of this is landing on the wrong runway or even worse, at the wrong airport. Simply using all available navigation aids can prevent this mistake.

5. Problem Assessment and Avoidance of Preoccupation

Management of distractions is the best way to accomplish this. It is important for flight crews not to become involved or preoccupied with minor problems. The prime example of this type of preoccupation is the Eastern Airlines L-1011 that was flown into the Everglades while the flight crew was absorbed with changing a light bulb.

6. Communications

Communication within the cockpit and with outside resources is one of the main ingredients of CRM. The requirement to successfully communicate with fellow crew members is paramount. Successful CRM training program must have, at its nucleus, a cluster on effecting good communications.

7. Leadership / Followership

Like the other items discussed above, good leadership is an important part of the CRM formula. The pilot in command must exercise his authority over the flight, but must also foster an atmosphere where subordinate crewmembers are encouraged to advocate a different position. Good followership skills help the copilot or flight engineer to know how and when to advocate that different position (Orlady and Foushee 9).

Summary

Pilot error is a term listed all too frequently as the probable cause of an aircraft accident. In most cases this does not refer to an error in piloting skills, but rather an error in judgment or inept use of resources available to the pilot. The professional pilot has demonstrated his flying skills hundreds of times and continues to do so at least once a year on required FAA checks. These skills are cultivated over the years with much study and hard practice; however, researchers agree, and accident statistics reveal, that the skills required to effectively use all resources and encourage a team spirit on the flight deck and among other crewmembers have not been sufficiently developed (Freeman and Simmon 1-3). According to the NTSB and the FAA, these skills are just as necessary as flying skills in order to effect safe flight. These are the skills that need to become an integral part of an airline, commuter, or corporate training program.

This paper provides ideas for integrating cockpit resource management into an existing training program. The thoughts presented in this paper are in no way intended to replace or satisfy the FAA's Advanced Qualification Program. Airlines and other interested parties are continuing to make progress on that front; however, AQP, at least for now, is a choice. Airlines may or may not adopt it. Commuter airlines and corporate aviation are not required to even consider AQP. The concepts presented in this paper are meant to provide meaningful CRM training by combining CRM methodology with existing training programs.

In order to establish a clear set of objectives, the specific goals of this document are listed below:

1. To list and define key components of cockpit resource management.
2. To provide evidence of the effectiveness of CRM training.
3. To establish a need for the training based on empirical research and the statistical

realities of aircraft accidents.

4. To introduce specific objectives which incorporate the key components of cockpit resource management.
5. To develop strategies to integrate CRM issues into existing training programs.
6. To offer examples of an integrated syllabus.
7. To discuss selection and training of instructors and check personnel.

The true effectiveness of cockpit resource management may only be known by those who, through its use, are able to cope with what could be an otherwise disastrous situation. Safety service and scheduled departures and arrivals are what customers expect. Service and on-time performance are judged and graded by customers every time they fly. Safety and dedication to enhancing safety are not tangibles customers can evaluate, other than knowing how many accidents or incidents are reported in the press. It is left to the aviation industry, then, to use all means available to increase safety, so if the consumer could grade it, it would receive top marks. Integrating cockpit resource management is a step in that direction.

Chapter II

LITERATURE REVIEW

With the introduction into service of jet aircraft, the airline industry gained a great deal of mechanical reliability over older, piston-powered airplanes. In addition, jets offered much more operational flexibility. This tended to make problems such as poor weather a little easier to handle. As a result, the number of major accidents, ones which involve a death or a hull loss, decreased dramatically in the decade of the sixties (Sears 2).

Accident data for worldwide commercial jet transport operations show a relatively constant rate from the early 1970s through 1989 (Freeman and Simmon 1). For the ten year period of 1980 to 1990, the rate of major accidents is about 1.4 per million departures. This rate equates to an average of approximately 15 major accidents per year worldwide. The accident rate in the United States is somewhat lower, equal to approximately five major accidents per year. Excluded from the list are those accidents resulting from sabotage, hijacking or military action and those incurred by the former Soviet Union.

There are several interesting conclusions which may be drawn from these data. One is based on the assumption that airline operations will increase in the coming years. The International Air Transport Association forecast for worldwide departures of commercial jet aircraft predicts an increase from the 10 million actual departures recorded in 1980 to an estimated 18 million departures in 2005 (Freeman and Simmon 2). That's good news for the airline industry, but based on the previously discussed accident rate, very bad news for the traveling public. If the accident rate remains the same, the amount of hull-loss accidents will increase with the increased departures. Based on the International Air Transport Association figures, in 1995, 21 hull losses can be expected; in the year 2000, 23 losses, and by 2005, 25 hull losses (Freeman and Simmon 2). Without taking aggressive action to lower the accident rate, one must deal with the reality that the number of major accidents will increase significantly in the next 10 to 12 years.

Another occurrence which will affect these statistics is the likely inclusion of hull-loss accident data of Aeroflot, the national airline of the former Soviet Union. The addition of these data will most certainly have an effect on the worldwide accident rate.

The statistical information indicates increasing numbers of hull losses in the coming years. This should set off an alarm within the aviation industry; however, it is easy to be lulled into a sense of false security if accident data are looked at on a year-to-year basis. The uneven nature of the accident record over the short term may be deceiving. In the U.S. in 1984, there were no hull losses, and in 1985 there were six. This points out the low confidence factor for statistics consisting of such a small number of events (Sears 1). Commercial jet transport accidents do not discriminate and are unpredictable.

If the industry continues on with business as usual, it is conceding to the notion that no more can be done to improve safety. If this concept is true, then every time someone flies in a commercial jet aircraft, a business jet, or light airplane, fate really is the hunter and not just the title of the Ernest Gann novel. Leaving to chance the future safety record of the air transport industry is simply unacceptable.

Probabilities

Over the last ten years, the air transport community has examined accidents, attempted to determine the causes, and taken steps to correct and improve the system. Still, the accident rate has stayed almost constant. The most pressing question then becomes, "How will the industry reduce the accident rate?"

One method suggested by Richard L. Sears, a safety engineer for Boeing, attempts to isolate causal factors in the chain of events which precede an accident (2-3). His logic is that elimination of any one of these events in the chain could prevent the accident or at least lower the probability of its occurrence. He uses the following example to illustrate his logic: On a night approach over unlighted terrain, the captain becomes somewhat confused as to his exact location. Even though confused, he continues the approach without reference to any approach aids and strikes hilly terrain as he turns to intercept the final approach course.

According to Sears, some significant contributing factors might have been:

1. Pilot did not use available approach aids.
2. Inadequate crosscheck by other crew members.
3. Air traffic control failure or error.
4. Pilot unresponsive to ground proximity warning system commands.

Any of these factors may be eliminated by establishing certain standard operating procedures and practices. Consider the following:

1. Nighttime visual approaches to certain airports could be prohibited.

2. The pilot not flying must independently check the navigation of the pilot flying.

3. Insure the installation of available air traffic control equipment which warns controllers when aircraft are below a minimum, safe altitude.

4. Flight crews must be trained to respond positively to ground proximity warnings.

Using this simple example, Sears was able to illustrate the probability of this accident occurring if one or more of the contributing factors are removed, or the interval of occurrence is increased or decreased. If each of the four causes in the above example occurs once in each 1000 flights, the probability of all four occurring on the same flight is 1 in $(1000)^4$ which is 1 in 10^{12} flights. From 1959 to the mid-1980s, commercial jet airplanes completed approximately 1.7×10^8 flights. Based on the above data, the type of accident discussed here would only occur once in 5000 additional equivalent time intervals of 25 years, or approximately 125,000 years.

At the other end of the spectrum, it is estimated that the captain becomes confused once in every 1000 approaches. The copilot does not monitor the approach once in every 100 approaches. Air traffic control has no warning equipment or the controller does not monitor the approach closely once in every 10 approaches. Finally, suppose that only one in every two crews is trained to properly respond to the ground proximity warning system. The probability of an accident occurring under these conditions is one in (1000)x(100)x(10)x(2) flights, or once every 2,000,000 flights. The current fleet of jet aircraft makes about 10 million flights per year; therefore, under these circumstances, expect this accident to happen five times each year (Sears 3).

This example demonstrates how a change in just one of the causal factors of an accident can have a very profound and positive effect on the probability of occurrence of a certain type of accident. Taking the example one step further, suppose the ineffective response to the ground proximity warning system could be changed from once in every two events to once in every 100 events. The frequency of the accident now becomes once in every 10 years. This example serves us well because, in the last two years, airlines have been tasked with increasing the awareness of flight crews concerning controlled flight into terrain. Responding to ground proximity warning devices has been a big part of that effort.

Using the same logic, if the pilot not flying the aircraft monitors the approach every time, the probability of this type of accident happening is significantly reduced. The assignment then becomes to establish a training objective of monitoring and cross-checking essential instruments and systems during all approaches. This is, by the way, one of the primary objectives of cockpit resource management training (Lauber 23). Once this objective is incorporated into a training syllabus, it should have a positive effect on accident probabilities.

<u>Causal Factors</u>

In order to determine a list of causal factors, Sears researched 126 hull-loss accidents. Ninety-three of the accidents studied were identified as having enough information documented to allow significant causal factors to be identified. One of the criteria Sears used in defining these significant causes was, "A definitive solution or remedy can be envisioned for the elimination of the factor" (5).

A list of 24 significant contributors to accidents was developed. Of these, 14 were flight crew related. For the purposes of this paper, only those items which can be considered to be related to cockpit resource management will be considered. The following list represents those items along with their percentages of presence in the 93 major accidents Sears studied (6):

1. 33% Pilot deviated from basic operational procedures.

2. 26% Inadequate crosscheck by a second crew member.

3. 10% Captain did not respond to crew inputs.

4. 10% Complete absence of approach guidance.

5. 4% Pilot incapacitation.

One third of all accidents studied by Sears were at least partially caused by pilots deviating from basic operational procedures. Perhaps as many as 31 accidents could have been prevented if that link in the accident chain had been broken. One thing is for certain; operational and training practices, specifically CRM training, can impact the probabilities and, consequently, have a significant effect on the reduction of future accidents.

CRM Training

Research accomplished over the past 15 or so years by various individuals, groups, and government agencies has done much to reveal the nature of accidents attributed to "pilot error." A direct result of this work are the many different cockpit resource management training programs in use today around the aviation industry.

United Airlines emerged as an industry leader in this area when they introduced their CLR (Cockpit Leadership and Resource Management) program in the early 1980's. Other examples of programs in use today are Alaska Airline's ICE (Integrated Crew Experience) program, United Parcel Service's Cockpit 2000, and TWA's Cockpit Resource Management program, to name a few (Ford; Murray; Willis 56).

Most of the studies concerning cockpit resource management address two distinct areas. The first deals with the non-psychological aspects of CRM; for instance, establishing a procedure which requires the pilot to use all available approach aids regardless of the weather or to address communication problems in the cockpit (Lauber 22). The second area considers the psychological aspects of cockpit resource management such as small group dynamics, personality, and leadership styles (Hackman 23-38).

According to the Federal Aviation Administration Advisory Circular which addresses cockpit resource management training, some of the CRM skills which should be taught are: communication, situational awareness, problem-solving/decision-making/judgment, team management, team review, and interpersonal skills (6).

CRM training programs, then, according to the FAA, should cover both psychological and non-psychological factors. Items such as communication and situational awareness, parts of which may be presented by management as policy or procedure, may be taught in a classroom, cockpit procedures trainer, simulator, or airplane. The psychological portion is more suited to a classroom or seminar atmosphere where discussion, group exercises, and role playing can take place (6-7).

Another valuable tool is a videotaped line-oriented flight training (LOFT) session. The training period is a complete trip in a state-of-the-art simulator. It includes not only the high-workload periods such as takeoff, landing, and operation in the terminal area, but also operation in the low-activity, enroute environment. The scenario generally includes "emergency situations which require the coordinated actions of all crew members for success" (Foushee and Helmreich 192).

The session proceeds with no interruption from the instructor. The entire flight is video taped. Following the session, the instructor reviews the tape and helps the crew evaluate its technical and team performance.

This review accomplishes two important functions: first, it serves to help the crew "recognize and remediate deficiencies in crew coordination" and second, it serves to "reinforce superior performance" (Pettitt 36)

The Captain As A Manager

In January of 1979, H.P. Ruffell Smith published the results of his study titled, A Simulator Study Of The Interaction Of Pilot Workload With Errors, Vigilance, And Decisions. The research consisted of a full mission simulation of a typical airline journey. The trip contained two segments, one domestic and one international. The first segment was designed to be uneventful, while the second was fashioned to produce an increased work-load and require several decisions to be made by the flight crew concerning irregular operations.

Twenty fully qualified, three-man crews took part in the study. The actions of the crews, including all communications as well as the basic aircraft parameters, were observed and recorded. Crew members' heart rates were recorded and used to investigate the correlation with any errors, vigilance or decisions made during the scenario.

Results of the study showed that the number of errors was quite variable among crews, but the mean of the errors increased as workload increased. The decision time and order were also measured and, according to the study's summary, they "seemed related to the abilities of captains to manage the resources available to them on the flight deck" (1). It seems that the more the captain was able to "unload" himself, delegate and manage his resources, the fewer mistakes he was apt to make.

Although the study was designed to look at the interaction of pilot workload with errors, vigilance, and decisions, it turned up some other very interesting data. The decision-making process, and the amount and type of errors, appeared to be associated not solely with the captain's ability to fly the airplane down, and then land "on a wing and a prayer," but rather his ability to manage the non-routine situation.

Dr. John Lauber emphasized the significance of the data gained from the Ruffell Smith study. According to Lauber, "...it was literally during this study that the idea of applying classical business management concepts to cockpit operations came to us (at NASA)" (Orlady and Foushee 7). Dr. Lauber summarized the results of the Ruffell Smith study with the following succinct statement:

> Those (captains) who made effective integrated use of cockpit resources performed well; those who did not display effective management skills also committed large numbers of operational and technical errors, some of which were potentially catastrophic (Orlady and Foushee 7).

Accidents analyzed in light of the results of the Ruffell Smith study revealed many common aspects, many of the same types of management errors, links in a chain which when fully formed resulted in loss of property, injury or death.

It has been suggested that one reason for some of these management errors is the perceived compelling need for pilots to demonstrate that they have complete mastery, or the "right stuff," when it comes to their flying skills (Pettitt 2). Indeed, some findings concerning pilot personality types seemed to fit quite well with what Ruffel Smith observed in at least some crews which made major mistakes during the scenario.

R. L. Christy, in a 1975 study, observed that pilots as a group are prone toward mastery, prestige, and control (310). Alkov and Borowsky found that pilots are oriented toward demonstrating strength and competency (861). Ursano characterized the pilot as self-sufficient, direct, and unemotional (1247).

If the self-sufficient, direct, and unemotional pilot could choose a specific personality type for a flying partner, what type of personality would he or she choose? Not surprisingly, J.L. Wheale's 1984 study found that pilots would rather fly with someone who is task oriented and technically competent; i.e., has the "right stuff." In an interesting turn of events though, the study also discovered that pilots would prefer their flying partners to have a personality which allows them to deal with job stress and human relations issues. According to the study, the preferred flying partner is "characterized by both instrumentality, or goal orientation, and expressivity or interpersonal orientation" (88).

These studies give credence to Foushee's findings which assert that both task and relationship orientation are important in a pilot's make-up. Foushee further contended that both task orientation and interpersonal orientation are necessary for the effective management of all situations (887). The effective captain-manager should have good technical skills as well as good interpersonal skills.

The Captain As A Communicator

One large source of errors in the cockpit comes from glitches in communication. Communication between the pilots on the flight deck plays an important part in the overall safety of a particular flight. Using the Ruffell Smith study as a basis, Clayton Foushee and Karen Manos were able to demonstrate that crews who communicated effectively had fewer errors than those crews who did not communicate well.

The taped communications data generated by the Ruffell Smith study were broken down into 10 categories. Examples of these categories are: observations, commands, and inquiries. Each category of communication was defined and a tally was kept of the number of times each type of communication was used. The overall results of the study showed that crews who did not perform well tended to communicate less

(Foushee and Manos 66).

The researchers found a strong inverse relationship between operational errors and acknowledgement of commands. Acknowledging commands, questions, and observations was a common thread which wound its way though low-error crews. Foushee and Manos further concluded, "communication acknowledgements serve an important function of validating that a certain piece of information has been transferred" (66). Simply repeating a command or restating a clearance provides opportunity for the other crew member to recognize and correct a potential error.

In the mid-1980's, the Aviation Safety Reporting System, ASRS, was instituted. This program allows pilots and air traffic controllers to report incidents, where regulations may have been broken, without the fear of reprisal from the FAA (Orlady and Foushee 6). Over the years the ASRS has been operating, thousands of reports have been filed with NASA which administers the program. Many of the incidents described in the reports can be blamed on communication errors of some type.

In one example, an actual report filed with ASRS in the early 1980's describes how, while enroute to Boston, the flight failed to level off at an assigned altitude. Of course, this transgression can be very dangerous because of the proximity of other aircraft.

The first officer was flying the airplane and the captain happened to be making a PA announcement. The flight received a clearance to cross 10 miles south of a specific navigational fix at an altitude of 14,000 feet and an airspeed of 250 knots. The first officer incorrectly interpreted this as a clearance to cross 14 miles south of the fix at 10,000 feet and 250 knots. It so happens that 10,000 feet and 250 knots is a very common altitude and speed restriction issued to aircraft entering the terminal environment. The first officer did read back the 10,000 foot clearance to air traffic control but was not corrected. As the aircraft was passing through 13,000 feet, air traffic control asked where the aircraft was going and stated that a clearance to 14,000 feet had been issued.

The writer of the report goes on to say he felt at least three communications mistakes were involved in causing this incident. The first was that the captain took himself out of the communication loop during a high workload period. The second was that the first officer assumed he had been issued a clearance to 10.000 feet and did not verify it. Finally, air traffic control failed to catch the error when the first officer read back the clearance (Meyerholtz).

Similar mistakes are reported in a study of information transfer between air traffic control and aircraft, done by Ralph L. Grayson and Charles E. Billings. The researchers used The Aviation Safety Reporting System as the main source for their study. The study concluded that only a small number of communications problems was associated with breakdown of communications equipment, frequency saturation or other system factors (60). They further state that, "...the problems observed in this study constitute a threat to the integrity and safety of the aviation system" (60).

Many other investigations have been done on the roll of effective communication. It is beyond the scope of this paper to include research on the intricacies of interpersonal communications; however, the above information points toward poor communications as a cause for violating air traffic control clearances and other incidents. This would seem to validate the Foushee/Manos study. It is sufficient to note that using standard phraseology and restating commands and instructions have been shown to reduce the tendency for error in the cockpit. It must also be said that too much "chatter" in the cockpit does not necessarily translate to better performance. The type and quality of communications are the important elements, not the absolute frequency (Foushee and Manos 70; Grayson and Billings 51). In any case, the captain is the catalyst for cockpit communication. If he or she uses standard phraseology and repeats commands, the rest of the crew will generally follow suit.

Flight Crews As Teams

Cockpit crews generally consist of two or three crew members. On some flights, normally longer, over-water flights, an additional pilot is required to relieve other crew members.

The structure of the cockpit team is defined by the position each crew member occupies, as well as by the specific duties associated with that position. Captain, first officer, second officer or flight engineer, and if required, international relief pilot are integral parts and have specific roles to play within the structure.

Richard Hackman of Harvard University described this pre-existing structure as a shell, or "a collection of features which are already in place prior to the first meeting of the crew" (4). A crew member may be placed into this shell and is able to function because he or she accepts as givens such things as: basic flying tasks and cockpit technology, the roles of other crew members and the general characteristics of the people who occupy those roles, and the basic norms of conduct that regulate crew member behavior (4).

According to a study on the formation of airline flight crews by Robert Ginnett, a closely knit team is formed when a crew comes together to occupy a shell. Initial information presented to the crew in the form of a briefing by the team leader was found to have a great impact on how the crew performed over the period of time it was together (28).

In his research, Ginnett was able to identify four types of team leaders or captains based on how they affected the shell. The best captains elaborated the shell by affirming the positive expectations about how crews should function. A second group consisting of most captains in the study, simply validated the shell by making sure the members were aware of the boundaries of the team and the roles of its members. A third group abdicated responsibility for building a team. People in this group showed no interest in developing any continuity within the group. The last type of captain actively undermined the pre-existing shell by blatantly ignoring standard operating procedure and other established norms. Fortunately this was a very small group (226-245).

Team formation and the affirmation of the shell play an important part in how well the team performs. Dr. Hackman in his research identified three areas which impact crew effectiveness. The first is how well the crew meets the performance expectations of the groups which have a stake in that performance; i.e., did the crew go from point A to point B and satisfy the customers, the company, and the FAA, or did they do their job in such a way that was safe, but left the customers with a bad taste in their mouth? The second has to do with the experience gained as a team. Did the team gain ten hours of experience or one hour of experience ten times? The last contributing factor seems to be the individual enjoyment of contributing to the overall productivity of the crew; i.e., that satisfying feeling one gets when he or she is part of a successful project (2-3).

Another study by Dr. Robert Helmreich defines crew efficiency as the overall effectiveness that a particular crew achieves in the pursuit of a safe and expeditious flight. How well a crew or team performs is based, at least in part, on how well the knowledge, judgment, decision-making, and communications skills of all the crew members are utilized (Orlady and Foushee 15).

To summarize, performance or efficiency of a flight crew depends on very different people pulling together to complete the assigned task of getting an airplane from point A to point B safely and expeditiously with the highest amount of customer and crew member satisfaction.

Pilot Performance

Researchers have identified three broad categories of characteristics which relate to pilot performance. Number one is the pilot's technical ability; the second is personality, and the third is the individual's attitude about cockpit management.

Technical Ability

As used in the following discussion, technical ability consists not only of the ability to physically pilot an airplane but also the knowledge of flight manuals, policy, documents, and regulations pertaining to the job.

Ability is an attribute which may be cultivated; however, training cannot normally provide an individual with raw ability he or she does not possess. Fortunately, by the time an individual reaches the position of airline or corporate pilot, his or her ability to fly an airplane is pretty well established.

A pilot's technical ability is the most noticeable aspect of his or her piloting performance. If piloting skill or technical knowledge is not up to par, it is readily apparent to a check airman or another pilot. The technical aspects of piloting are also the easiest to teach. From a cockpit resource management perspective, technical ability encompasses the non-psychological aspects of resource management, such as using all available navigation aids or having the non-flying pilot monitoring the approach. This technical knowledge may be incorporated into company procedures, and pilots could be evaluated on how well they know and abide by those procedures.

Dr. Helmreich suggests that poor technical ability may have an indirect effect on the psychological portions of resource management. The example Dr. Helmreich uses is one of a captain who is below par technically and who tends to be very defensive in order to preserve a self-image of competence. If the captain presents this image through maintenance of unrealistic and self-deceptive attitudes of his expertise, then he or she may shun needed support and coordination from other crew members (Orlady and Foushee 16; Sellards 295). This person pretends to be confident and independent when, in reality, the opposite is true. This type of behavior is hardly conducive to good crew coordination.

To review, technical ability consists of piloting skills and knowledge of regulations and company procedures. A lack of "hands-on" piloting skill is relatively easy to spot, and in most cases can be corrected with additional training. A pilot's technical ability also encompasses the non-psychological factors of CRM; i.e., those parts which can be proceduralized. Finally, a lack of technical ability may affect the psychological factors of CRM because of an individual's attempt at image preservation.

Personality

For years, researchers have attempted to determine what effect personality has on job performance in general and pilot performance in particular. During their investigation into the subject, Helmreich and his associates studied research that A.W. Melton had conducted during World War II. Melton's work suggested personality factors had an effect on flying performance (Orlady and Foushee 17). Some later studies, however, disagreed with those findings. In a study of attrition in Naval aviation, G.R. Griffin and J.D. Mosko maintained that there were inconsistent or weak relationships between personality and flying performance (Orlady and Foushee 17). This left many to wonder if personality should even be an issue when considering pilot performance.

Studies done outside the aviation community indicate that ability, personality, and motivation do play an important part in learning, retention, and transfer to a job situation (Baldwin and Ford 68-69).

In their research, Noe and Schmitt indicated that characteristics consisting of ability, personality, and motivation play an extremely important part, not only in generalization and maintenance of skills, but also in learning and retention during training. It was shown that there was a relationship between training effectiveness and trainees' attitudes concerning their jobs, careers, and participation in the training program. In fact, the higher the participation factor in their jobs and careers, the more motivated they were to undergo a training program, and the more successful they were in generalizing that training to the job context (517).

In another study Helmreich and his colleagues followed a newly-hired employee through training and then observed him during months of daily performance.

The results of their research were quite interesting. Helmreich and his team found that personality factors did not predict performance in training, which disputes the findings of Noe, Schmitt and others. Personality factors, however, did become increasingly good predictors of actual performance on the job (Helmreich, Sawin, and Carsud, 187). A person would try hard to do the best he or she could during training and while on the job for the first few weeks. As the euphoria of the new job wore off and the work became more routine, however, underlying personality traits began to have an influence on job performance. This tendency was dubbed the "honeymoon effect" by the researchers.

Commenting on his research, Helmreich noted that "the facade of cooperativeness and eagerness to learn of the pilot trainee may crumble during line operations, revealing a hostile, arrogant, interpersonally insensitive individual who cannot work effectively with fellow crewmen" (Orlady and Foushee 17).

Dr. Robert Sellards of U.S. Air states that his research "indicates the problem pilot can and should be identified through standardized psychological and physiological tests, peer review, and past incidents" (291). Dr. Sellards goes on to say that pilots who make excessive and insistent demands on crew members or other co-workers exhibit neurotic, distorted behavior. Like Dr. Helmreich, Sellards asserts that this type of behavior is initiated by extreme insecurity and is used to preserve a self-image of competence (295).

Historically, performance during training or the simple completion of training has been the yardstick by which pilot performance was measured. More recently, however, research which used ongoing line performance as the standard has been much more revealing concerning the effects of personality on total job performance. In a paper entitled <u>Pilot Selection and Training</u>, Dr. Helmreich explained that a person who combined a high level of achievement and was sensitive to the reactions and concerns of others was likely to have superior line performance (Helmreich, R.L 583).

Personality issues can be a gigantic stumbling block to effective cockpit resource management. Not even the best CRM training program can effect a substantial change in personality; therefore, to the extent that resource management and crew performance are determined by personality, little progress should be expected in this area (Foushee and Orlady 18). The pilot with the reputation for being hard to get along with because he is hostile or aggressive will most likely continue to maintain that reputation.

Attitude

A change in personality may come about as a result of intensive psycho-therapy or a religious conversion experience. Aside from that, personality is pretty much "set in stone." Piloting ability is an attribute that the crew member should already possess. Normally, only the sharpening of certain skills which are not ordinarily practiced during line operations would be required to assure his or her technical competence. This leaves the attitude as the only area researchers believe they "can achieve substantial change in observable behavior" (Foushee and Orlady 18).

Early in the development of cockpit resource management, Dr. John Lauber and some of his NASA colleagues developed a set of crew member attitudes relevant to flight deck behavior and crew interaction. Using that work as a stepping stone, Dr. Helmreich developed a questionnaire which measured performance related attitudes. Attitudes which were associated with responsibilities, roles, crew interaction, and reaction to stressful events were gleaned from the questionnaire and placed in a data base (Helmreich, R.L. 584). The questionnaire was revised in 1988. More pilots completed the instrument and more data were added to that already held (Gregorich, S.E., Helmreich, R.L. and Wilhelm 682).

The data revealed a generally supportive attitude toward cockpit resource management. Because the data were gathered from several different airlines, and from pilots who flew many different types of aircraft, it was suggested by the researchers that the questionnaire might be a good measuring device of attitudes, both within and across existing organizational lines (Gregorich, S.E., Helmreich, R.L. and Wilhelm, 689).

In addition, by completing an instrument both before and after initial CRM training it might reveal the effects of ongoing CRM training over a period of time. This, in fact, was done by Helmreich and his colleagues in their research. Analysis of the results indicated a significant change in attitude in the desired direction (684). The question still remains: Will the impact of formal CRM training over a substantial period of time be as positive as the researchers' initial findings?

Another indicator of a supportive pilot attitude toward cockpit resource management may be drawn from an informal study accomplished by this author in December of 1990. A relatively small group of pilots from a major airline was surveyed concerning attitudes towards cockpit resource management. The survey contained questions like: "How effective do you feel CRM techniques are in increasing safety of flight?" The crew members were captains, first officers, and second officers, male and female, and assigned to several different types of aircraft within the airline's fleet. Based on the Likert scale, the respondents indicated a 48% very positive attitude toward the survey questions, 43% responded with a positive attitude, while only 9% responded in a neutral, negative, or very negative manner (Meyerholtz 16-17).

The large data base investigators have developed clearly indicates areas where training would be beneficial. Some of the areas where CRM training may achieve an observable change in attitude include decision-making, interpersonal communication, leadership, and leader responsibilities. These aspects of cockpit resource management are a vital part of any CRM training program.

The long term success of a cockpit resource management program must ultimately hinge not only on changing attitudes but also on maintaining that change. As in any training program, transfer of the new information is an important consideration. For the new information to be properly internalized, the trainee needs to be personally involved and actively participating in the process (Baldwin and Ford 92-95). Instructors and evaluators must be carefully selected and specially trained (FAA Advisory Circular 6). Finally, the organization must provide its unwavering support to the training effort,(Foushee and Orlady 18-19) a difficult thing given the financial losses in the airline industry over the past three years. This last element of a successful training program, management support, is very important and may be compared to the life of a new religious convert: "Life in a world of sin and temptation without constant reinforcement leads to backsliding" (Foushee and Orlady, 19).

The State Of CRM

Based on a telephone interview with Robert Helmreich who heads the NASA/UNIVERSITY OF TEXAS/FAA Aerospace Crew Research Project, it was found that most major airlines, worldwide, have instituted some sort of CRM training program. In addition, the U.S. military requires CRM training for pilots of transport type aircraft.

Although it would be inappropriate to compare the programs of the various airlines within the framework of this paper, there are, according to Helmreich, several airlines which have made progress in specific areas. For example, in the area of special training for instructors and evaluators, Federal Express, Delta, Southwest, Quantas, and Cathay Pacific have taken a leadership role.

When asked specifically about how the industry was doing in regards to CRM training during upgrade and transition courses, Dr. Helmreich stated that CRM issues were not being included to the extent he believes is necessary. He went on to say that Southwest

Airlines has recently instituted a program which involves not only pilots but also flight attendants, dispatchers, maintenance personnel, and gate agents in a seminar setting within an upgrade/transition syllabus. Southwest's top management was so excited about the new program that they took the time to participate. Helmreich feels this type of training could be very rewarding.

For cockpit resource management to realize its goal of continued reduction of "pilot error" type accidents, there must be continued commitment on the part of management to development and training; however, the financial state of the airline industry stands in direct opposition. Airlines world wide continue to loose billions of dollars a year, and cost-cutting programs designed to return the airlines to profitability tend to stem the development and implementation of new and innovative CRM programs. At one airline, the manager of CRM, a very qualified pilot with a background in CRM research, was sent back to flying and replaced by the company psychiatrist. Airlines must regain profitability if CRM is to flourish.

Summary

A considerable amount of literature has been written concerning aircraft accidents and accident prevention. The term "pilot error" has been assigned all too often as the probable cause of many aircraft accidents. In 1990, the International Air Transport Association data attributed 80% of all accidents to flight crew causes. When researchers began to look into the whys behind pilot error accidents, one thing became quite clear: Pilots were not using all the resources available to them when operating their aircraft.

As the airline industry continues to expand, and business aircraft continue to find wider acceptance with large corporations, the amount of aircraft departures will continue to increase. At the current accident rate, the number of accidents will increase. This is an unacceptable trend. To reverse the trend, the accident rate must be lowered. To do this, specific areas of cause must be addressed in airline and corporate aviation training programs.

In the late 1970's, researchers were able to show that pilots who did a good job of managing the resources available to them in the cockpit did better during a full mission simulation that was fraught with failures of various aircraft systems. These failures required a series of decisions not generally associated with a normal flight. The study results encouraged other researchers to delve into the management of flight deck resources and other related items.

What has evolved is cockpit resource management or CRM. CRM is the term used to describe the task of actively managing all assets available to the pilot of an aircraft. Cockpit resource management may be thought of as having two parts. One part contains the non-psychological aspects of CRM and refers to procedurally related items and other things such as specific cockpit communication techniques. The other part of cockpit resource management deals with the psychological aspects such as small group dynamics, personality and attitude.

The literature has provided evidence of unacceptable accident rates, probable reasons for those rates, and a possible solution to the problem. Although much research remains, cockpit resource management is probably the best conduit for creating a safer cockpit environment.

<u>Problem Statement</u>

In at least some cases within the industry, cockpit resource management is receiving little attention during initial, transition, and upgrade training (Helmreich; Murray; Ford). This seems to be especially true of the more operational oriented, non-psychological aspects. Except within the framework of standard operating procedures, items such as crew briefing, establishment of priorities, communication techniques, or monitoring and cross-checking are not specifically included in simulator lesson plans.

As new, automated airplanes enter airline fleets, behaviors associated with cockpit resource management seem to be more evident in the crews flying these newer aircraft. Items such as communications, decision making, crew self-critique, preparation, planning and vigilance are all noticeable to a greater degree in pilots of newer generation aircraft. Researchers believe that more of these behaviors are required in the operation of automated aircraft, and thus exhibited more by crews who fly automated aircraft (Helmreich, Butler, Wilhelm 53). They do admit, however, that the quality of the training program shares some credit for this.

Crews of older, second generation jets fared worse in all observed categories during the research. Using the researcher's logic that flying automated aircraft calls for more of the "desired behaviors," then operating older, non-automated aircraft requires fewer of the "desired behaviors." It would seem then that a greater emphasis on these "desired behaviors" must be required during training on non-automated aircraft if the end product is to be the same.

The plan, which is contained in Appendix A, is meant to provide meaningful CRM training to pilots of older, non-automated aircraft by combining CRM methodology with existing training programs. The plan will concentrate on non-psychological aspects of CRM such as briefings and communications techniques, and integrate them into an existing syllabus of a typical, non-automated, second generation jet transport. The goal is to elicit some of those behaviors which the researchers did not find in flight crews of older, non-automated aircraft.

Chapter III

METHODS AND EVALUATION

Materials

Materials and facilities required to implement this CRM integration plan consist of the types of training resources found at most major U.S. and European airlines or contract training companies such as Flight Safety or Simuflight. Required equipment is state-of-the-art simulators capable of providing realistic LOFT scenarios, briefing rooms, and suitable chalkboard or other demonstration media. One of the most important elements of the project, and one which is not addressed in the syllabus, is training of instructors and check air staff. The assumption is made that qualified instructors and check pilots are available to accomplish the training and checking.

In its simplest form, the project may be described as an attempt to provide a method by which cockpit resource management is integrated into initial, transition, or upgrade training on older, non-automated jet transport aircraft. The medium is a simulator syllabus for a typical, non-automated, jet transport aircraft. The syllabus is similar to those currently used by major airlines. The difference is that the syllabus contained in Appendix A has cockpit resource management issues woven into the fabric of the lessons.

The seven period syllabus addresses aspects of cockpit resource management which are non-psychological in nature. For this project, psychological issues such as personality and attitude are assumed to have been discussed within a seminar setting. Each period is broken down into a briefing session, a simulator session, and a debriefing period. In the briefing, the instructor discusses, among other things, the CRM topic for that lesson. (Period four, for instance, pertains to prioritizing and task delegation.) Each CRM topic has several teaching points outlined in the lesson plan. In addition, there is an actual incident from the files of the aviation safety reporting system, ASRS, which serves to illustrate the importance of the teaching point. Each simulator period underscores the CRM briefing topic by providing instructor emphasis on that specific topic or an express CRM exercise.

The CRM topics discussed in the syllabus are as follows:

Period 1. Crew Briefing

Period 2. Communication

Period 3. Monitoring / Cross-checking/ Using All Available Data

Period 4. Prioritizing and Task Delegation

Period 5. Problem Assessment / Preoccupation

Period 6. Leadership and Followership

Period 7. Review

Normally, after seven periods, students receive a proficiency check or aircraft rating ride. The check is followed by a line oriented flight training, or LOFT period.

The syllabus contained in Appendix A does not present the check or LOFT period. The reason for this is that each check airman is free to develop his or her own check ride scenario provided it meets FAA guidelines; therefore, a syllabus for checking is not required.

Most LOFT scenarios in use today incorporate opportunities for pilots to exercise their CRM skills. Everything learned in the seven periods of simulator training can be used in the LOFT period. This would normally be an excellent time for the instructor to critique CRM skills learned during the seven period simulator syllabus.

Because existing LOFT exercises, which meet FAA guidelines, contain CRM opportunities, a specific LOFT plan was not developed for this project. The extent to which CRM opportunities are exploited is almost entirely dependent upon the instructor.

<u>Subjects</u>

The two project evaluators each bring a different prospective to the job of evaluating the syllabus. Lloyd Murray is an airline captain and manager of his airline's cockpit resource management training program. Sharon Irving is an educator with a background in aviation and human factors research.

Captain Lloyd Murray is employed by a large, international airline. He has been flying airplanes for over 30 years, 25 of those with his present employer. As the manager of CRM training at his carrier, Captain Murray is responsible for the development and promotion of CRM training at the airline. Among his accomplishments are the development of videotaped cockpit scenarios which promote active participation of trainees, and combined flight attendant and pilot CRM training during yearly recurrent training. Captain Murray brings an instructor background as well as CRM expertise to the job of evaluator.

Sharon Irving is an educator with a background in research. Her most recent project, for which she received a grant from the FAA, was to develop, then measure the results of a computer-based training program for operation of the flight management computer, FMC, on an automated aircraft. This training program was designed for pilots with no previous automated airplane experience. Ms. Irving is currently working on another FAA-funded study, and is in the process of completing her Ph.D. in educational psychology at the University of Colorado.

Instrument

The instrument consists of a formal questionnaire which is different for each evaluator. In this manner, the specific expertise of each reader is fully exploited. The questionnaire is designed to probe areas where there may be controversy. An example of this might be the extra time required to address CRM subjects during a briefing period. One of the inquiries in the Murray questionnaire addresses this issue.

In addition to a "yes" or "no" reply on the questionnaire, the respondents are required to expound upon their answers, providing explanations as to why they agree or disagree with the question. A follow-up interview of both participants is planned to clarify any inconsistencies.

Copies of the questionnaires and associated cover letters may be found in Appendix B. Letters requesting the assistance of Captain Murray and Ms. Irving are found in Appendix C.

Procedure

The evaluators received the questionnaire along with the cover letter explaining the procedure for completion. They answered the questions by circling the "yes" or "no" responses, and then detailed the reason for the response in the area provided.

After given instructions to complete the questionnaires at home or the office, the evaluators were asked to return them as soon as possible. Upon receipt, the author conducted a telephone interview to clarify any areas of misunderstanding. Results were then compiled, and the information presented in Chapter IV.

Chapter IV

RESULTS

Results of the questionnaires are presented individually starting with Captain Murray. Each question is stated along with the responses from the evaluators.

Evaluator Murray

Question 1. Did the syllabus meet the basic criteria for transition training on a typical, non-automated jet transport aircraft?

Response: Yes

Comments: Add certain training maneuvers which are used to increase the pilot's instrument scan capability.

Question 2. Are the CRM teaching points used in the syllabus applicable, given the current state of CRM at your airline?

Response: Yes

Comments: Here, Murray added some changes in terminology and as expressed points of emphasis throughout the syllabus. Some specific areas and comments are as follows:

Briefings: Cockpit and cabin crew briefings should be discussed from a "teambuilding" prospective. Murray emphasized the need for captains to listen and encourage input from others during briefings.

Communications: There were many general comments on communication techniques. One specific comment was related to misunderstanding a clearance to an altitude. Murray asserts that pilots should not ask air traffic controllers a question like: "Was Global 123 cleared to 10,000 feet?" Rather, they should ask controllers to "restate the altitude to which Global 123 was cleared." Murray feels that this technique reduces the possibility of errors because the controller must reconfirm the altitude in his own mind.

Monitoring and Cross-checking: Murray adds that when setting a course in aircraft navigation instruments, it may be better to use the airway name as opposed to the actual number of course degrees. In this manner a true cross-check is obtained when the airway is checked for the correct course on the navigation chart. Example: Do not say, "set up the 081 degree course outbound," but rather, "set up J130," then cross-check the navigation chart to make sure that 081 degrees is the correct course for the J130 airway.

Question 3. Is there enough time to adequately cover the subject matter within the allotted two-hour briefing sessions, four-hour simulator sessions, and one-half-hour debriefing?

Response: Maybe

Comments: For periods 1 and 2, it would be difficult to cover all the briefing material.

Question 4. Is there any non-essential information or wasted time in the syllabus?

Response: No

Comments: The plan appeared to be more or less standard. Added CRM issues fit.

Question 5: Is there an area where more information is required to adequately convey a CRM teaching point?

Response: Yes

Comments: Murray made suggestions in the areas of crew briefings, communications, monitoring and cross-checking, prioritizing and task delegation, and leadership and followership. The comments were made within the syllabus and consisted of terminology changes and additions to clarify a point. No substantive changes were recommended.

Question 6: Do you feel that incorporation of a syllabus similar to the one you reviewed would improve CRM awareness during transition and upgrade training at your airline?

Response: Yes

Comments: No comment included; however, in the post-questionnaire interview, Captain Murray stated that the syllabus would be more suited to a transition course. His thought was that new-hire pilots would have their hands full with learning the aircraft and procedures, and that initial CRM training should be provided in a different venue.

Question 7: Do you feel that incorporation of a syllabus similar to the one you reviewed would improve CRM awareness and skills of pilots receiving initial new-hire training?

Response: Yes

Comments: The syllabus would need to be rewritten from a flight engineer/second officer prospective on some points such as: Heavier on how a crew operates, aggressive versus assertive behavior, etc. Note: Murray feels some initial CRM training would be required before this type of syllabus could be effective.

Question 8: General comments and suggestions for improvement.

Comments: In general, Murray feels that there should be a move toward using terms which are more industry-wide so that everyone is speaking a common language; i.e., "Situation Assessment" vs. "Problem Assessment," etc. In addition, Murray would like to see an accompanying "Line Guide" to provide further explanation and discussion for CRM topics.

Evaluator Irving

All of Evaluator Irving's comments will be presented verbatim.

Question 1.

Did the syllabus meet the stated objective of introducing the trainee to basic CRM skills?

Response: No

Comments: "Is the simulator/simulator briefing the proper place to *introduce* the trainee to basic CRM skills? (No). The simulator, is a place to *practice* skills that have been introduced/taught in other, less expensive, less distracting environments. As *practice*, the syllabus provides good experience even if it is mainly limited to communication skills. More time could spent on group decision making, workload management, information gathering, and information sharing skills."

"Tying the briefings and the training scenario to the ASRS reports, is an excellent way of giving the lessons relevance. The training scenario should be carefully crafted to reinforce the lesson of the ASRS report. It seems that the debriefing would be even more important than the briefing. The instructor must find instances (either positive or negative) in the trainees' performance that support the stated lesson and tie back to the ASRS report. The instructor must show the trainee (by playing back videotaped segments of the simulator period) how their performance was desirable or undesirable under CRM guidelines. Crew members must be given the time to critique the performances of other crew members and point out occasions where the crew either worked well together or had problems working as a team. In light of all the additional requirements, briefing and debriefing times should be expanded over presently allocated times."

"More practice/training needs to be devoted to information gathering and dissemination to other crew members prior to making decisions. Decision making and its effect on CRM needs to be expanded."

"In your overview, you state "getting the most out of "liveware," or other pilots and crew members." Does this go far enough? How about the resources that are not on the aircraft but on the "team," the controllers, dispatchers, and maintenance support people. With present communication systems, these people and the resources that they represent are important assets that must be utilized by the crew to solve problems and keep the flight running smoothly. Significantly, there is very little in the syllabus that brings the cabin staff into the communications/decision making loop."

"There is very little stated practice in workload management in the syllabus. It is implicit, in many of the maneuvers (single engine approach/missed approach, loss of pressurization, loss of all hydraulics), but it is not stressed in the syllabus nor are techniques to handle it presented."

Question 2: Based on a previously qualified crew member undergoing transition training, how would you rate the effectiveness of the CRM portion of the syllabus?

Response: Good

Comments: "If by "previously qualified" you mean a crew member that has been through previous CRM training, then the syllabus is good."

"If the crew members have not been exposed to CRM prior to this transition training then the syllabus is poor. More time must be allocated to introduce the crew members to the principles and meaning of CRM. Prior to starting the simulator training, crew members must be convinced that CRM training is meaningful and has worth to them. If they do not have a feeling of conviction then the training will have no value, the crew members will simply do what is required to get through the transition program."

"The simulator is a device to integrate knowledge, to bring a wide range of knowledge and skills together to accomplish a task - safely fly passengers from point A to point B. The simulator is full of distractions and can easily overload a person's ability to cope. Is this the proper time and place to introduce training in CRM skills?"

"How the syllabus is implemented will be the key. Management must buy into the training and use the principles of CRM throughout their own interactions. Instructors must be carefully selected and very well trained to support the CRM aspects of this syllabus."

Question 3. Is there too much information in the syllabus? Does the training require too much from the trainee in too short a period of time?

Response: Maybe

Comments: "If the training is done before the simulator periods and the briefing/debriefing is a review then no, there is not too much information in the syllabus. If the briefing/debriefing periods are the primary training in CRM, then yes, there is way too much."

"How much is required of the trainee is highly dependent upon how well versed the trainee is in CRM skills prior to entering the syllabus. A person who has good communication skills, understands workload management and can foster an atmosphere that gets the crew to work together efficiently will have no problem with the training. Someone who is deficient in one or more of the stated skills may very well be overloaded."

Question 4: Is there a better method of teaching basic, non-psychological CRM skills than that presented in the syllabus?

Response: Maybe

Comments: "To answer the question you ask implies that there is an objective method of evaluating/grading the CRM skills of an individual. If there were an objective way to measure CRM skills we could then compare various experimental teaching systems and then chose the best one. But as far as I know, there is no such evaluation/grading system; thus, what is the basis of any claim that one system is better than another?"

"An alternative (that might work as well and surely would be cheaper) would be to carefully craft scenarios for use in a classroom setting. Use discussion between the crew members under the supervision of a well trained instructor to achieve an awareness of communication, leadership, and information gathering skills. But again the question "how do we know if it is better or worse," by what measure, or should I say in *whose opinion,* is it better or worse?"

"What we are really talking about is a change or enhancement of attitude. The simulator is not the best environment in which to teach positive attitudes. As mentioned above, the simulator should be where already learned skills are *practiced* and integrated into the multi-dimensional environment."

Question 5: Would you advocate adding training time and expanding the syllabus to allow for "total skill training," that is, add personality and attitude issues to the syllabus?

Response: No

Comments: "How does one teach "personality and attitude issues?" How do you evaluate "personality and attitude issues?" What are good/bad "personalities and attitudes?" Who decides what is good and bad - based on what criteria?"

Question 6: If the training set forth in the syllabus is successful in providing the learner with a conceptual understanding of CRM, will proficiency develop once the trainee is in the operational setting?

Response: Maybe

Comments: "Again, it depends on how well the concept is supported by management. If a supportive environment is maintained by management, then the crew members are more likely to respond positively to CRM training. If the time and money is spent to train flight instructors, create realistic scenarios, and develop basic training in CRM principles, then crew members are more likely to respond positively."

"Foushee and Orlady tell us that little progress can be expected if a crew member's personality stands in the way of progress (p.42), but attitudes can be changed. If one can show the difference between good and bad communications, decision making/judgment and information processing, one should be able to change attitudes. Accomplish this and crew members will become more proficient (during their line flying) in the CRM skills they have learned while in training."

Question 7: Would the instruction be more effective if a different sequence were used to present the components of CRM training?

Response: Maybe

Comments: Comments made on question 4 apply.

Question 8: In its present form, will the syllabus provide meaningful CRM training? Will it work?

Response: Yes

Comments: "It will, in my opinion, provide meaningful practice and guidance in communication and leadership skills. It will give feedback to the crew members concerning their communication and leadership skills, and that alone would be beneficial."

"Will it work? Well that depends on a great many things outside of the syllabus: management support, the attitudes of the individual crew members, and the instructor's ability to "decouple" the CRM training from the stress of preparing for the checkride, which promotes an attitude of, "Just tell me what I need to know to pass the checkride!"

"The training would be next to useless if it were the only CRM training provided during a pilot's career.

If, rather than a "disembodied" experience, this syllabus is one training event in a continuing training curriculum in CRM, then it will provide meaningful CRM training. CRM training must be reinforced regularly to be truly effective."

"There is, of course, the bigger issue of how do we define success? To say it has or has not worked requires some kind of rigorous (valid, reliable) method of evaluation. The problem with all training in the aviation community is the difficulty in determining whether it is "good" or "bad," how much is enough, and how efficient it is.

Question 9: What are your general comments and suggestions for improvement?

Comments: "CRM must be integrated not only into the training that the flight crews receive but *into the very fabric of the corporate culture at all levels.* It does little good to teach pilots all about CRM if the corporation does not practice it outside of the cockpit. If managers do not communicate well; if they make decisions by fiat: if they do not gather information to make informed decisions in their departments, how can they expect pilots to do any differently in the cockpit?"

Each period in the syllabus could stress one element of CRM; communication, workload management, situational awareness, decision making/judgment, etc. The final period(s) could be in a LOFT environment that ties together all of the training which has been received."

"Finally, the typical simulator instructor will need a great deal of training to effectively implement this syllabus. In addition to being an expert in the operation of the aircraft and simulator, the instructor must now be well versed in the far more complex field of psychology! Without developing an instructor training program which targets the extremely important (i.e., sensitive and critical) role of the trainer, this syllabus is incomplete."

Chapter V

Discussion

Questionnaires sent to the evaluators attempted to ascertain if the training syllabus contained in Appendix A would meet the cockpit resource management objective of providing the trainee with the opportunity to learn basic CRM techniques while in a simulator training environment. The type of aircraft on which the plan is based is a typical first or second generation, non-automated jet transport (the syllabus is for a Boeing 727 aircraft).

The evaluators' comments were generally favorable toward the syllabus and its ability to accomplish the stated CRM training objective. Each, however had his or her own thoughts on how to improve the training through changes in and additions to the syllabus. The following is a brief discussion of the results as presented in Chapter four. The author's comments are included and will hopefully provide insight into the discussion.

Evaluator Murray

Captain Murray felt that adding certain training maneuvers which are used to increase a pilot's instrument scan would be beneficial to the syllabus. It would seem appropriate that the instructor should have an array of maneuvers which might be used if a student is having difficulty. If one specific exercise does not work, then perhaps another one will. All the different exercises an instructor might use do not necessarily need to be documented in the syllabus. If all these many different drills were listed, the instructor might be tempted to spend time working on unneeded maneuvers.

In answering question 2 concerning CRM teaching points, Captain Murray suggested some changes in terminology and added points of emphasis in such areas as briefings, communications, and monitoring and cross-checking.

In the area of briefings, Murray suggested a "teambuilding" approach. Research done by Ginnett and others supports this concept. The syllabus could be changed to reflect this style without adding training time. Murray also emphasizes the need for the captain to listen and not just talk during briefings. Once again, this is consistent with Ginnett's findings of captains who exhibit strong leadership and are able to form closely knit working groups in the cockpit and cabin.

The next area Murray addressed was that of communication. There were many general comments on communication techniques. Although subscribing wholeheartedly to most of Captain Murray's suggestions, the author feels that it would be inappropriate to include large numbers of specific communication techniques in the syllabus. Specific communication techniques should either be published as standard operating procedures or taught as techniques by the instructor.

In the area of monitoring and cross-checking, once again Captain Murray provides some excellent guidance in the form of techniques. The same reasoning, however, must apply here as with the communication techniques. If they are to be taught as part of the lesson plan, they should be incorporated into the airline's standard operating procedures. If not, they should be taught only as technique.

In Questions 3 and 4, the matter of syllabus time is addressed. Murray asserts that, in periods 1 and 2, it would be extremely difficult to cover all the briefing material. This is probably a sound assessment and could be a very real limitation of this syllabus. One solution might be to add one hour to each of the first two briefing periods.

Question 5 asks if there is more information needed to adequately convey a CRM teaching point. Captain Murray's suggestions consist mostly of terminology changes which made the CRM teaching points more explicit. Language like, "monitor the progress of the aircraft" is changed to "fly the aircraft." The term, "workload management" replaces the phrase "priortizing and task delegation." This author is in agreement with Murray's assertion that the syllabus should reflect "industry wide" terminology. The phraseology being used in NASA CRM research would presumably set the standard.

Question 6 asked Captain Murray if the syllabus would improve CRM awareness at his airline, while Question 7 asked if the syllabus would work for new-hire training. Murray answered affirmatively to both questions. He did add that if used for new-hire training, the syllabus should be rewritten from the prospective of a second officer. This is a valid observation and could be done without difficulty if the syllabus were to be used for second officer training.

Under general comments and suggestions for improvement, Captain Murray recommends that a "Line Guide" be written to accompany the syllabus. This is an extremely important suggestion, and one which must be given serious consideration.

Evaluator Irving

The first question, which asked if the syllabus met the stated objective of introducing the trainee to basic CRM skills, was answered negatively. Ms. Irving feels that basic CRM skills should be introduced in an environment that does not contain the distractions of the simulator. This is an excellent point. Before any training can be done in the simulator, it is imperative that new pilots have a working knowledge of CRM concepts. The syllabus was written as a transition syllabus, and the assumption was made that students coming to the simulator would possess a working knowledge of CRM issues.

If the syllabus were to be rewritten and used in the training of new-hire second officers, some type of prerequisite CRM training would be required. This training would normally be provided during new-hire indoctrination and would familiarize the new pilot with CRM issues before he or she would begin began simulator training.

Ms. Irving also stated that the use of video tape would be valuable in allowing the instructor to point out positive or negative aspects of the trainee's performance and then relate that performance to the stated CRM objectives. There is no question that video tape is an effective teaching tool, but realistically, there is not enough time to evaluate the entire simulator period within a debrief of a half-hour. Video tape is an extremely useful medium, but unless simulator debriefing times are increased significantly, it would be difficult to incorporate it into a transition syllabus except during a LOFT period at the end of the transition training.

Another point made by Irving was that communication with the cabin crew as well as other resources the company provides, such as dispatch and maintenance, should be included in the training. This is an excellent point, and this type of communication is part of the problem-solving equation and should be added to the syllabus. The instructor could play the part of dispatch during a problem solving exercise such as an engine failure with a diversion to an alternate airport.

In Question 2, which concerns a qualified crew member undergoing transition training, Irving reiterates her statement that crew members must be exposed to CRM prior to training, or the syllabus will not work. Once again, the assumption is that the student is familiar with CRM concepts prior to entering training, so this should not present a problem.

Ms. Irving goes on to state that, "Prior to starting simulator training crew members must be convinced that CRM training is meaningful and has worth to them." This statement focuses a very sharp beam of light on the willingness of management to fully embrace CRM and commit the resources necessary to make it successful.

Question 3 deals with the amount of information in the syllabus and the amount of time the student has to internalize it. Irving repeats her concern that prior CRM training is essential. If prior CRM training has been provided, Irving believes there should be enough time to cover the CRM teaching points in the syllabus. If the trainee has no prior CRM training, then she feels there is way too much information for the student to assimilate. The author is in agreement with this assessment. The syllabus is designed for students who have completed some basic training in CRM skills.

In Question 4, which asks if there is a better way of teaching non-psychological CRM skills, Irving restates her conviction that the simulator (during transition training) is not the place to learn CRM skills, but rather, a place to practice them. She suggests that, perhaps, role-playing in a classroom setting might be an alternative. She admits though, that there are no data available which would allow the trainer to determine the best method. The evaluators comments are excellent and point to a need for further research in this area.

Question 5 asks if training time should be expanded and the syllabus re-written to allow for "total skill training?" Total skill training would add psychological issues to the syllabus. Irving believes that dealing with personality and attitude issues in the simulator would be a bad idea. The author agrees that this type of training should definitely be left to a different venue. Classroom or seminar settings are much better suited for this type of training.

Question 6 addresses proficiency issues. Does the syllabus provide the trainee with enough information and practice so that he or she might become adept at CRM skills upon returning to the line environment? "Maybe" is Irving's response. She feels that the only way proficiency can develop is if CRM becomes an inherent part of line training; flight instructors receive special training in CRM techniques, and management supports and promotes CRM. If all this is accomplished, she believes crew members stand a good chance of gaining proficiency. All the research supports Ms. Irving's beliefs. The author is also in total agreement. Management must make CRM a part of the training culture.

Question 7 asks about syllabus structure; namely, would it be better to arrange the syllabus in a different way? Irving responds, once again, with the thought that CRM training might be done better in a different setting. This thought is based on the trainee's having no previous experience with CRM. This is not the case, the assumption is that the trainee is familiar with CRM issues. The type of response this author had hoped for might have suggested a change in the order of the syllabus which may have made it more effective or "user friendly."

Question 8 simply asks, "Will the syllabus work?" Irving says "yes," but stresses that this must not be the only CRM training provided during a pilot's career. Rather, this should only be a small part of the total CRM package.

Ms. Irving ponders another point; she is not sure how she would define the success of CRM training. In the introduction of this paper, there is a statement which says that, perhaps, the only person who will be able to grade the success of CRM training is a pilot who, through the use of CRM, was able to cope with a potentially disastrous situation. Time will probably be the best judge of whether or not CRM training programs are successful.

Under Question 9, general comments, Irving continues to make a case for a total CRM training package. In so doing, she addresses a real, potential problem, instructor training, or the lack thereof. She warns that, without developing an instructor training program, the syllabus is incomplete. The author is in complete agreement with this statement and feels that development of a comprehensive instructor training program should be the next step in the evolution of CRM training.

Summary

For the most part, the evaluators' responses either confirm or repudiate the ability of the syllabus to achieve the CRM objective; however, the evaluators' comments move well beyond just answering the questions and provide the reader with a glimpse into what the evaluators feel would be suitable CRM training. The question of syllabus workability and efficiency has been weighed, and the evaluators' concerns have been considered. The following is an attempt to condense some of these concerns and present them in a way which might improve the syllabus and the CRM training it represents.

1. CRM must be a part of the corporate culture: The most persistent issue in evaluator Irving's remarks concerns pre-existing CRM knowledge. Time after time she echoes the recurring theme that the simulator is not the place to learn CRM, but rather the place to practice it.

Without a total CRM training program to support it, the syllabus in Appendix A will not work very well. CRM must permeate every aspect of training, or CRM training in general will not be effective. If the syllabus is utilized within a corporate culture which embraces CRM as a total concept, it should be very successful.

2. Time and financial considerations: These two items go hand in hand. Airline management is continuously looking for a way to do a given amount of training in the least amount of time. The fewer days a pilot spends in training, the more productive he or she is. It is difficult to weigh the need for additional training against keeping a pilot on the line and as productive as possible. Both evaluators stressed the need for total commitment to CRM training and the extra time it may involve, but evaluator Irving was the more passionate concerning that commitment. The experts agree that total dedication on the part of management will reap benefits in terms of fewer accidents and incidents.

The syllabus presented in Appendix A should work well within the timeframe of a normal, seven-period transition course. No extra time should be required if trainees are familiar with CRM concepts.

3. Instructor training: CRM is a relatively new

concept. As such, there are not a lot of instructors who have undergone any type of special CRM teacher training. This author has worked as an instructor for two major airlines in the recent past. Equipment and procedures knowledge was a must, and time was allotted to observe teaching technique and to learn how to operate the simulator, but alas, no training was ever provided on how to teach CRM skills.

If the CRM training provided by this syllabus or any syllabus is to be successful, then it must be accompanied by an instructor training course and manual. In addition, training for line instructors should be developed along with a line guide, as suggested by Captain Murray.

Flight instructors are asked to teach something that most of them have been intimately familiar with for at least ten years, namely, how to fly airplanes. Asking that same instructor to teach CRM without special training is like asking a university professor who has done nothing more than ride on a Boeing 727 to teach someone how to fly that Boeing 727.

Based on the input of the evaluators, the training syllabus in Appendix A should meet the goal of providing meaningful CRM training to pilots of older, non-automated aircraft. The concept of combining CRM methodology with an existing training program is the most logical method to accomplish this goal.

The syllabus in Appendix A concentrates on non-psychological aspects of CRM such as briefings and communications techniques, and integrates them into an existing training program of a typical, non-automated, second generation jet transport.

This plan should serve as a model for CRM training, specifically for non-automated aircraft during transition and upgrade training. With some changes, the syllabus could be used in new-hire pilot training.

Limitations

There are several limitations associated with this paper. The first is the amount of time that has been required to complete it. The field of cockpit resource management is very dynamic. Many changes have taken place since the start of this project. The basic concepts have not changed though, and the goals and methods remain valid.

Questionnaires sent to the evaluators spawned responses which were unexpected. Evaluator Irving seemed to evaluate that the syllabus as a stand alone training program for pilots having no previous CRM training. Evaluator Murray was more on track but became somewhat preoccupied with certain techniques and technical aspects of the plan, although not to the point of distracting from his CRM input.

There are two reasons the evaluators responded the way they did. One was the design of the questionnaires; the other was the wording of the cover letters. In retrospect, there should have, perhaps, been more questions on the instrument, and the questions should have been more specific, covering smaller parts of the plan. The cover letters needed to provide better guidance for completing the questionnaire.

Suggestions for future CRM development

The next work which should be done is the development of an instructor training program with accompanying study guide. This is extremely important as there are few, if any, such courses in existence. Additionally, development of a Line Guide would be helpful. The Line Guide could be used as a learning tool for the pilot as well as an evaluation guide for the check airman.

APPENDIX A

B-727 SIMULATOR SYLLABUS

TRANSITION TRAINING

<u>CRM Objective:</u>

The objective of this syllabus is to provide the trainee with the opportunity to learn basic CRM techniques while in the simulator training environment.

The syllabus introduces several non-psychological areas of CRM and incorporates them into the lessons.

At the completion of training, the student will have a good practical knowledge of the CRM issues included in the syllabus. This knowledge should transfer to the next phase of training, LOFT, and then line training.

Simulator Period One Briefing

I. Simulator safety briefing
   A. No smoking policy
   B. Fire and evacuation signals
   C. Emergency shutdown switches
   D. Emergency egress and building exits
   E. Use of seat belts with motion on

II. Simulator Stability
   A. Simulators reproduce actual aircraft flight control pressures and responses but do not, in the present state of the art, adequately reproduce the "seat of the pants" feeling pilots depend on to control the aircraft.
   B. Lack of feel in pitch is most noticeable
   C. Feel of acceleration with use of throttles is noticeably missing
   D. In simulator, rely on flight instruments to confirm control input. (SCAN)
   E. Stabilizer trim always relates to airspeed. In stable flight for a given configuration, airspeed above or below that desired should be the only reason to use pitch trim
   F. Don't attempt to fly the simulator with pitch trim

III. Basic Instrument Flying Review
   A. Control instruments
      1. ADI
      2. Thrust setting instruments
   B. Performance Instruments
      1. Airspeed/Mach indicators
      2. Altimeter
      3. IVSI
      4. HSI (heading)
   C. Navigation instruments
      1. HSI (course deviation)
      2. RMI (ADF and VOR needles)
   D. Attitude + Power = Performance
   E. Scan and cross checking techniques
      1. ADI is scan center
      2. ADI - AS - ADI - IVSI - ADI - HSI etc.

F. Target attitudes (ANU) and fuel flow settings at aircraft weight of 150,000 pounds
   1. 250 kts., clean, level flt.......5 & 2500#
   2. 150 kts., 15 flps, level flt.....9 & 3500#
   3. Target, 30 flps, gear dn, 3^0 GS..3 & 3000#
   4. Target, 40 flps, gear dn, 3^0 GS..1 & 4000#

   For Non-precision approaches
   5. Target, 30 flps, gear dn, level..6 & 4400#
   6. Target, 30 flps, gear dn, dsnt...0 & 2200#

IV. Cardinal rules for flight
   A. On takeoff and landing, maintain direction with rudder and level wings with ailerons
   B. Control airspeed with throttles when thrust is variable and flight path fixed; i.e., Level flight or ILS approach
   C. Control airspeed with elevator when thrust is not variable; i.e., Climb or descent
   D. While airborne with asymmetrical thrust, maintain wings level and apply rudder so as to center the yoke

V. Review policy for setting airspeed bugs for normal takeoff and landing

VI. Review Standard Operating Procedures and Flows
   A. Preflight setup
   B. Normal pushback and start
   C. Taxi
   D. After landing
   E. Parking

VII. Normal Takeoff (Use chalk board to illustrate normal takeoff profile)
   A. Flying pilot advances throttles to 1.4 EPR. Check engine instruments. Release brakes and advance throttles to takeoff EPR setting. Non flying pilot trims takeoff thrust. Captain then keeps hand on throttles until V1
   B. Maintain slight forward pressure on control yoke. Maintain directional control with rudder pedal steering
   C. V1 and Vr. Discuss V1 callout 5 knots below Vr.
      1. Decision to abort is made no higher than V1

D. At Vr, rotate at 2 degrees per second to 15 degrees. Adjust pitch attitude to maintain V2 plus 10 kts. Maximum pitch is 20 degrees.
E. With positive climb, and V2, call "positive climb gear up"
F. If clearance requires a turn, start turn by 400 ft. Use 15 degrees bank.
G. Climb at V2 + 10 knots to 1000 ft. AFE. Lower nose to 8 to 10 degrees. Maintain 500 to 1000 FPM rate of climb and accelerate
H. Retract flaps on speed schedule
I. At clean maneuvering + 20 knots, pilot flying moves throttles toward climb thrust and calls "climb thrust" and "After Takeoff Check List"
J. Climb at clean maneuvering speed plus 20 knots to 3000 ft. AFE then accelerate to 250 knots.

VIII. Area Departure to 10,000 ft. AFE

IX. Specific Flight Characteristics
A. Turns with and without spoilers
B. Aircraft stability
C. Speed and flap effect
D. Slow flight
E. High sink rate/missed approach

X. Approach To Stalls
A. Maintain altitude
B. Trim to stick shaker, or above approximately 18,000 to 20,000 ft, buffet
C. Firewall thrust, roll wings level, maintain configuration
D. Recover at maneuvering speed for flap configuration.
E. If altitude lost during maneuver, regain lost altitude when maneuvering speed is reached.

XI. Steep Turns
A. 45 degree bank, 4 to 5 degrees ANU in turn and approximately 500 lb more FF when beyond 30 degrees of bank. (about 1 throttle knob width more)

XII. Approach Familiarization
A. Always obtain latest weather info to determine approach legality

B. Review approach and set altimeter and airspeed bugs. Complete Approach Descent Check List
C. Review the following types of approaches and associated minima. Review MDA/DH bug settings
   1. Raw data ILS
   2. Flight director ILS
   3. A/P flight director ILS
   4. Non-precision approaches
      a. NDB
      b. VOR
      c. ILS (glideslope out)
   5. Visual approaches with 30 and 40 flaps
      a. FAF crossing altitude and 3 degree glideslope to TDZ
      b. First strobe of ALS disappears at 200 to 300 ft. - 1000 ft. bar disappears at 100 to 150 ft. Altitudes are lower with 40 flaps
      c. If apparent runway length and distance to horizon are equal, aircraft on a 3 degree glideslope
D. Review flying and non-flying pilot(s) callouts
   1. 2500 ft. light
   2. Final Approach Fix
   3. 1000 ft. AFE
   4. 500 ft. AFE
   5. Approaching (100 ft above) DH/MDA

XIII.Normal Landings
A. Flare at approximately 30 ft.
B. Normal touchdown attitude approx 5 to 6 degrees
C. As soon as main gear touches down, extend spoilers, fly nose wheel to ground and apply reverse thrust (1.8 EPR max).
D. Non-flying pilot calls 80 knots. Flying pilot comes out of reverse by approx 60 knots

XIV. Taxi in and Parking
A. Two engine taxi
B. First officer after landing flow
C. Parking check list

XV. Cockpit Resource Management - Crew briefing.

Discuss the requirement for a crew briefing and the importance of establishing an atmosphere which will encourage inquiry and advocacy from subordinate cockpit and cabin crewmembers. In the initial meeting, the captain sets the tone for the rest of the trip. It is important for subordinate crewmembers to know that their input is not only accepted, but encouraged.

Use the following expanded crew briefing guide as a basis for discussion:

Explain that, during the initial crew briefing, it is important for the captain to express his intention to operate the flight based on Flight Handbook and Flight Operations Manual standard operating procedures. Additional briefing items should be accomplished using a list. This establishes consistency and credibility in the briefing procedure. Examples of briefing items are listed below for both the cabin crew and the cockpit crew:

* = Brief on first leg with a new crew

CABIN CREW

* 1. Emphasize communication is a two way street and that the cockpit crew is there to help and support the cabin crew in any way they can.

2. Flight time, altitude, and anticipated delays.

3. Any expected turbulence or other weather related problems.

4. Sterile cockpit requirements.

5. Cockpit entrance signal.

6. Keep captain informed of any passenger or logistics problems. Captain will help and support cabin crew.

COCKPIT CREW

* 1. Emphasize communication is a two way street and the importance of speaking up if anything out of the ordinary is noticed by any crewmember.

* 2. Requirement to operate using standard operating procedures.

* 3. Read back all clearances and restate all commands. If this is not done, the assumption is that the clearance or command has not been heard.

4. Weather: Requirement for any special procedures such as deicing, takeoff alternate, captain only takeoff, etc.

5. Maintenance release: Any MEL items which may require special procedures or performance calculations.

6. Performance: Desired flap settings. Use of max or reduced thrust. Optional V1 speeds. Clutter calculations, etc.

7. Takeoff: Who flies, engine failure before V1 and abort duties, engine failure after V1, and any special engine failure procedures.

8. Departure: Review departure clearance, SID, and any terrain or obstructions, associated with the departure.

FIRST ENCOUNTERS

Research on crew briefing during initial crew formation was accomplished by Robert Ginnett, a Yale graduate student. Ginnett's research centered on group behavior and touched on how different types of crew briefings affected the group over the course of a typical airline flight.

Ginnett asked three questions in his research:

1. What do captains actually do in the first few minutes of their crew's formation?

2. Do captains who are known for their abilities in effective crew management behave differently than their less effective peers during crew formation?

3. Is there any consistency between the formation process and what happens in subsequent line performance?

Ginnett's research established how important a good crew briefing is during initial crew formation. The answers to questions two and three were consistently "yes." In most cases, captains who delivered thoughtful and professional crew briefings were observed to be thoughtful and professional in the conduct of the rest of the flight. Those captains who felt that the initial crew briefing was of little use, or disregarded it altogether, were observed to be less effective leaders.

Simulator Period One

1. Cockpit Preparation and Start

   * CRM exercise - Crew briefing: The captain will conduct a through briefing of the cockpit crew. Instructor will critique this first briefing.

2. Taxi Procedures

3. Normal Takeoff (VFR)

4. Area Departure

5. Airwork

   * Use of Speed Brakes
   * Roll Rates, Turns with and Without Spoilers
   * Power and Pitch Relationships
   * Slow Flight
   * High Sink Rate Maneuver
   * Approach to Stalls

6. Area Arrival

7. Autopilot ILS Approach & Landing (VFR)

   * Freeze simulator at key points during approach for slot visualization

8. Normal Takeoff

9. Raw Data ILS Approach - Touch & Go (VFR)

10. Flight Director ILS - Full Stop (500/2)

11. Taxi and Parking

12. Debriefing

Simulator Period Two Briefing

I. Review performance problem and weather for takeoff
   A. ATIS "A" CLR 15+ 60/50 0210 010

II. Pushback procedures and proper communications with the ground crew
   A. Emphasize use of proper phraseology
   B. Special care should be taken when contract labor is doing pushback

III. Review holding patterns
   A. @ 14,000 ft. and below 230 kts. 1 min legs
   B. Above 14,000 ft. 265 kts. 1 1/2 min legs
   C. Discuss entries: direct, parallel & teardrop

IV. Review non-precision approaches. Specifically the approaches which will be flown in the lesson
   A. Obtain weather (ATIS)
   B. Each pilot individually review approach and set altitude and airspeed bugs
   C. Approach Descent Check List
   D. Pilot flying briefs approach
   E. Tune and identify all nav aids
   F. Fully configured at least 3 miles from FAF
   G. Review appropriate attitudes and power settings to accomplish descent to MDA
   H. Review concept of the Visual Descent Point and how to estimate the VDP
   I. Review requirements for descent below MDA

V. Missed approach and rejected landings
   A. Pitch to stop sink
   B. Power to maintain speed
   C. Trim considerations
   D. Inform ATC of missed approach
   E. Maintain flaps 15 till reaching missed approach altitude
   F. Turns at 15 degrees bank

VI. Review precision approaches
   A. ATIS / Review app / Brief app / Tune & ID
   B. Category I & II ILS approaches
   C. Monitored approach
   D. Review requirements to descend below DH

VII. Engine inoperative familiarization
   A. Appropriate check list: "Engine Fire Severe Damage" or other depending on engine indications
   B. Engine inoperative landing
      1. Trim
      2. Power requirements

VIII. Loss Of All Generators
   A. Review check list

IX. Cockpit Resource Management - Communication

Communication between pilots in the cockpit plays an important part in the overall safety of a particular flight. Research has established a strong relationship between operational errors and non-acknowledgement of commands. Acknowledging commands, questions, and observations can validate that a certain piece of information has been transferred. Additionally, repeating a command or restating a clearance provides opportunity for other crewmembers to recognize and correct potential errors.

Use the following to establish rules for cockpit communications:

A. In communication with air traffic control, use the terminology suggested in the Airman's Information Manual.

B. In the cockpit, the flying pilot will repeat all ATC clearances. Example: ATC clears the flight to turn right to a heading of two seven zero degrees, intercept J-55, and climb to one seven thousand. The non-flying pilot reads back the clearance to the controller. The flying pilot restates the clearance to the non-flying pilot. In this manner, there is agreement as to the specific clearance. If there is disagreement, clarification can be obtained from ATC.

C. If the flying pilot does not restate the clearance, it is assumed that he or she did not hear or understand it.

D. Non-flying pilot repeats all commands. Example: Flying pilot calls "positive climb gear up," the non-flying pilot calls "gear up" then raises the landing gear. In this way, a command which is misunderstood can be caught and corrected. Example: Flying pilot says "have a good time, cheer up." When the non-flying pilot responds with "gear up," the flying pilot can gently tell him of the misunderstanding.

E. Second officer repeats all commands. Example: Captain calls for the "Before Takeoff Check List" The second officer replies, "Before Takeoff Check List" then reads the check list. This is especially important for Emergency Check Lists such as the Loss Of All Generators check list.

F. During an emergency, when the immediate action items of the appropriate check list have been accomplished, the captain will call for, and the second officer will read, the immediate action items and response from the appropriate check list. The non-flying pilot will then repeat the response. Example: (Second Officer) "Throttle.....Idle" (non-flying pilot) "Idle" and so forth.

G. Emphasize that the captain sets the tone for cockpit communication. If the captain uses proper terminology, repeats commands, restates clearances, acknowledges questions, and accomplishes check lists appropriately, the rest of the crew will generally follow his or her lead.

ASRS:

F/O flying, Captain working radio, Center clearance to cross 10 DME east of a fix at FL 240. Captain was distracted, F/O set 10,000 in altitude alert and started down. At 19,200, Center advised we should be at FL 240. Captain advised he had received a clearance to 10,000 ft at 24 DME. Center then had us maintain FL 180.

If the clearance had been restated by the first officer, the captain would have had the opportunity to correct his mistake. Ask students what other mistakes might have been made by this crew? (Flying pilot should not set altitude alert. Possibility of captain not reading back clearance. Include flight engineer in communications loop).

Simulator Period Two

* CRM Exercise - The instructor should correct non-standard radio phraseology. Encourage the students to repeat commands, restate clearances, and acknowledge questions.

1. Preflight Inspection
2. Irregular Starts (Hot Start, Hung Start, No Ignition, Start Valve fails to close)
3. Taxi Procedures
4. Takeoff and Area Departure
5. Wheel Well Fire
6. Holding
7. Loss Of All Generators
8. Non-precision Approach (NDB) (600/2)
9. Touch and Go, or Rejected Landing
10. Published Missed Approach Procedure
11. Non-precision Approach (VOR or LOC) (400/2)
12. Rejected Landing
13. ILS Flight Director Approaches
14. Engine Inoperative Familiarization - Fail engine # 3 with the aircraft in a non-critical situation
15. Landing Engine Inoperative
16. Taxi and Parking
17. Debriefing

Simulator Period Three Briefing

I. Review performance problem and weather for takeoff
   A. ATIS "B" CLR 15+ 80/50 0215G25 985

II. Taxi techniques
   A. Airplane geometry
   B. Use of power
   C. Adverse weather ops
   D. Two engine taxi

III. Takeoff
   A. Review normal takeoff
      1. 30 second review; eng fail, etc.
   B. Rotation technique and tailskid strikes
   C. Crosswind technique
      1. Consideration of # 2 engine compressor stall
      2. Use of aileron
      3. Track and heading considerations

IV. Landing
   A. Review normal landing
      1. Stabilized approach
      2. Visual slot identification
   B. Crosswind technique
   C. Tailskid/wingtip/flap strikes
      1. Use chart to demonstrate pitch/roll angles which cause tailskid/wingtip/flap to contact runway
   D. Touch and go landings in the simulator

V. Engine Failure on takeoff, review profile
   A. Directional control
   B. Rotation technique
   C. Climb to cleanup altitude
   D. Flap retraction
   E. Climb to 1500 ft. AFE
   F. Use of appropriate check list
   G. Communication with ATC, company, F/As & pax
   H. Other considerations
      1. Declaration of emergency
      2. Weather and where to land
      3. Fuel dump
      4. Loss of another engine

VI. Landing with engine inoperative
   A. Configuration same as 3 engine landing
   B. Use 30 flap Vref but target is 15 flap maneuvering speed
   C. Use of rudder trim
   D. Asymmetrical thrust considerations on approach
   E. Review target attitudes and fuel flows
   F. Rudder trim on landing

VII. Specific Approaches
   A. Back course approach
   B. Flight Director only to CAT II minimums

VIII. Low fuel procedures, landing with low fuel

IX. Cockpit Resource Management - Continuously monitor and cross-check essential instruments and systems. Use all available data to conduct an operation.

Continuously monitoring and cross-checking instruments and systems is one of the best ways of combating complacency and promoting cockpit discipline. Becoming non-attentive can be hazardous to one's health. For example, with the aircraft on autopilot, inattentiveness could lead to a decay of speed causing stick shaker or worse. This particular scenario has occurred several times. The most celebrated being the China Air 747 approaching the west coast of the U.S. Not cross-checking INS nav data had disastrous results for KAL 007. Other areas such as identifying nav frequencies and checking and crosschecking course selectors should be stressed.

Using all available data to conduct an operation may be illustrated by pointing out how many aircraft have inadvertently landed at the wrong airport. Embarrassing!

The following should be stressed during simulator and line training:

   A. Identify all navigation aids. If a student does not identify a particular aid, fail the aid at some point on the approach.

B. During autopilot operation, the captain should assure that someone is monitoring airspeed, altitude and position at all times.

C. All crewmembers should cross-check course selections in cruise and for approaches.

D. The non-flying pilot should always monitor an approach by selecting the nav aid appropriate to the final approach segment.

E. During visual conditions, pilots should always use all nav aids available to them for a particular approach. This includes ILS, VOR, and NDB aids.

ASRS

The captain was flying the aircraft. A holding clearance was received and the captain selected the frequency of the VOR where we were to hold without checking the chart. While proceeding to the VOR, center called and asked where we were going. At that point I checked the frequency and found that we were headed to the wrong VOR.

Always check the appropriate chart; frequencies change.

Simulator Period Three

* CRM Exercise - The instructor should insure that one pilot is monitoring the progress of the aircraft at all times. All nav aids should be identified and all courses cross-checked. The non-flying pilot should monitor all approaches. The pilots should use all available nav aids for a particular approach.

1. Cockpit Preparation
2. Irregular Starts (Hot Start, Hung Start, No Ignition, Start Valve Fails to Close)
3. Two Engine Taxi
4. Takeoff and Landings (Visual)
5. Takeoff and Landings (Crosswind)
6. Takeoff (RVR 600)
7. Area Departure
8. Steep Turns
9. LOC Backcourse Approach (300/1)
10. Missed Approach
11. LDA Approach (400/1)
12. Full Stop Landing
13. Engine Failure on Takeoff
14. ILS, Flight Director, 2 Engine
15. Taxi and Parking
16. Debriefing

Simulator Period Four Briefing

I. Review performance problem and weather for takeoff
   A. ATIS "E" WX 3 OVR 1/2 SF 29 25 3505 982 1/4" slush on all ramps, taxiways and runways.

II. Review cold weather operating procedures
   A. Cold weather starting
      1. Hung start
      2. Start valve fails to open
      3. Low/High oil pressure or filter bypass light on
   B. Anti Ice and engine runup requirements
   C. Fuel heat
   D. Deicing
      1. Type of fluid used
      2. Holdover times
      3. Wing check prior to takeoff, clean wing requirement
   E. Ground operations considerations
      1. Taxi speeds
      2. Use of reverse thrust
      3. Flaps
   F. Performance considerations
      1. Takeoff
      2. Landing

III. High altitude stalls

IV. Mach buffet

V. Loss of yaw damper(s)
   A. Speed limits
   B. Altitudes

VI. Dutch Roll
   A. Recovery

VII. Rapid Depressurization / Emergency Descent
      1. Oxygen and communication requirements
      2. Determine structural integrity
      3. Descent configuration/speed/rate
      4. Level off altitude, crew/pax oxygen considerations

VIII. Electrical Smoke or Fire

IX. Review precision and non-precision approaches

X. Cockpit Resource Management - Prioritizing and task delegation

At any point in time, pilots are faced with concurrent, multiple, and conflicting demands for their attention. Human beings generally are not effective parallel processors. Normally, demands must be processed serially, one at a time. In order to do this, it is necessary to constantly assess the relative priorities of competing demands and order them accordingly. For example, ASRS reports are replete with examples of pilots attempting to climb or descend to a new altitude while making a P.A. announcement. The number of altitude busts involving this combination of events is quite large. Once a priority has been established, if another task requires immediate attention, reassess the priority or delegate that task to another crewmember. By appropriately delegating certain duties, the captain can avoid task saturation. This is extremely important during normal operations and is even more critical during abnormal and emergency situations.

Have students consider the following:

A. The highest priority is <u>always</u> to fly the aircraft.

B. Establish a hierarchy of tasks and attempt to stick with it.

C. Don't sweat the small stuff. Don't let yourself become distracted by an event of minuscule importance.

D. The captain should assign tasks and responsibilities consistent with the experience level of his or her crew; however, the captain must remember that he or she is <u>always</u> the final authority as to the operation of the aircraft.

E. In abnormal or emergency situations, it is extremely important to take steps to prevent task saturation. Delegation is an important part of this process. Assigning the first officer to fly the aircraft while the captain works with the second officer to resolve a problem is an example of this type of delegation.

ASRS

As I was slowing down with brakes and reverse thrust, the Tower instructed us to turn right and hold short of runway 32R. I missed the instructions to hold short and taxied across the runway. My copilot had taken the instructions from the Tower, then got busy with the checklist, and didn't see that I was crossing the runway. The Tower said to call on the phone. I realized then what I had done wrong. It was a good example of poor crew coordination...

Workload management during taxi is one of the most crucial tasks performed by crewmembers. Two things happened that should never happen: 1. The first officer was not paying attention when he should have been (establishment of priorities). 2. A critical piece of information was not relayed to the captain.

What other CRM technique may have prevented this incident? Restating all clearances. If the captain does not restate the hold short clearance, the first officer must assume the captain has not heard or understood the clearance.

Simulator Period Four

* CRM Exercise - The captain should assure that someone is flying the aircraft at all times. For example, during normal operations if the captain's attention is diverted away from flying the aircraft, he should always assign the flying duties to the first officer. During abnormal or emergency situations, the captain must determine who is to fly the aircraft, and then verbalize that decision.

During abnormal situations, the instructor should attempt to overload the captain by making non-essential ATC requests and cabin crew inquires. The captain should be able to prioritize, acting on the most critical elements of the scenario first.

1. Cockpit Preparation
2. Starting Problem
3. Taxiing, Icing Conditions
4. Takeoff, Icing Conditions
5. Area Departure - (Anti-Ice Problem)
6. Mach Buffet
7. High Altitude Stall Recovery
8. Rapid Depressurization / Emergency Descent
9. Electrical Smoke Or Fire
10. Area Arrival
11. Non-Precision Approach / Rejected Landing
12. Non-Precision Approach To A Landing
13. Takeoff / Engine Failure After V1
14. CAT II Flight Director Approach And Landing
15. Debriefing

Simulator Period Five Briefing

I. Review Performance problem and weather for takeoff
   A. ATIS "F" CLR 15+ 80/50 27025 985

II. AC power loss (Loss of all generators) at altitude

III. Review Dutch Roll and recovery techniques

IV. Hydraulic system abnormal
   A. Loss of hydraulic system A or B
   B. Loss of hydraulic system A and B (Manual Reversion)
   C. Landing with 15 degrees of flap

V. No flap approach and landing
   A. Aircraft weight / speed
   B. Reverse thrust, braking
   C. Review possibility of hot brakes, fuse plug melt, and wheel fire

VI. Review engine inoperative CAT II approach

VII. Review engine inoperative missed approach

VIII. Two engines inoperative
   A. Review appropriate check lists
   B. Required thrust on remaining engine
   C. Flaps up
   D. Electrical load reduction
   E. Dump fuel if required
   F. Assess hydraulics (Manual gear extension and alternate flap if required)
   G. Get the aircraft on the ground ASAP

IX. Cockpit Resource Management - Problem assessment / avoiding preoccupation.

This dimension of CRM may be thought of as distraction management, and is closely related to establishing priorities and task delegation. Any number of things may distract a pilot's attention away from the progress of the flight. High workload as a result of bad weather, heavy traffic, or some irregular situation may cause pilots to become focused on what is going on in their little cocoon, this to the exclusion of all else going on around them. Distraction can also be caused by personal problems, complacency, or fatigue.

The classic case of preoccupation in the cockpit is illustrated by the L-1011 which crashed in the Everglades because the flight crew became preoccupied with changing a burned-out nose landing gear indicator lamp. The key is to maintain situational awareness at all times.

Stress the following:

A. The captain should assure that someone is monitoring the progress of the aircraft at all times.

B. Complacency must be recognized and dealt with. Duties which seem mundane, flight plan log, engine readings, etc., help to keep the flight crew involved and should not be overlooked.

C. A crewmember who is ill or noticeably preoccupied with a personal problem should be encouraged to stay on the ground. The old notion of being able to "compartmentalize" does not necessarily work. Trying to fly a trip before one goes to court to settle a messy divorce is probably not very smart.

D. Follow standard operating procedures. Well-defined SOPs are the result of a synergistic approach to problem solving/assessment with the influence of time removed. In a difficult situation, SOPs are an effective means of assessing and resolving problems in a reasonable amount of time, thus helping to avoid preoccupation.

ASRS

> *The first officer removed himself from the loop and concentrated on trying to build the LDA DME runway 18 approach in the FMC. He was having trouble programming the FMC, and I was answering*

the phone, flying the airplane, and trying to read the approach chart. I overshot the approach course slightly, and while concentrating on getting back on course, went below the published altitude at the FAF. It was entirely my fault for momentarily losing control of a major resource, the first officer.

Even though this example is from an automated aircraft, it is a good illustration of how any crew member may become preoccupied and affect the outcome of a flight. Here is another:

We were issued holding instructions at ABC intersection....A few miles before reaching ABC, a distraction arose in the cockpit (a very large bug crawling up the inside of the wind-shield). I became involved with removing the insect as I didn't want a distraction during approach - the weather was W1X1/4F and we were expecting an ILS.....Shortly after I removed the problem insect, the approach controller called us and asked if we had started our entry into the hold at ABC. I then looked at the DME and noticed that we had passed the holding fix by 4.5 miles. I let an insect distract me, and I flew through a holding fix...

Simulator Period Five

* CRM Exercise - After take off, under IFR conditions attempt to vector students into high terrain while the crew is attempting to resolve an irregular situation. If the crew has maintained situational awareness, they should request a climb or vectors away from charted terrain hazards.

1. Cockpit Preparation And Engine Start
2. Normal Taxi Takeoff And Area Departure
3. AC Power Loss (Loss Of All Generators) Above FL 310
4. Dutch Roll Recovery
5. Hydraulic System A Failure
6. Manual Gear Extension / Alternate Flap Extension
7. Non-Precision Approach To Missed Approach
8. Hydraulic System B Failure
9. Manual Reversion
10. Alternate Brakes
11. Visual Approach And Landing
12. Takeoff / Engine Failure After V1
13. Fuel Dumping
14. CAT II ILS Approach To A Missed Approach
15. Loss Of Second Engine (Engine Fire, Flameout etc.)
16. Two Engine Inoperative Approach And Landing
17. Normal Takeoff
18. No Flap Landing / Taxi In And Parking
19. Debriefing

Simulator Period Six Briefing

I. Review performance problem and weather for takeoff
   A. "X" CLR 15+ 80/40 08025 001

II. High gross weight takeoff
   A. Engine failure before and after V1

III. Rejected takeoff
   A. RTO performance data based on max braking and spoilers, no reverse thrust. 1 second engine fail recognition time and 4 second reaction time
   B. Close throttles - Max braking - Spoilers - Max reverse thrust. First officer, communicate with tower, tell them who you are, where you are, and what assistance needed. Second officer when instructed by the captain, make PA announcement to remain seated or evacuate
   C. Complete appropriate abnormal or emergency check list
   D. Consult brake cooling chart and consider possibility of a brake fire and melted fuse plugs

IV. Fuel Dump Review
   A. Aircraft weight verses fuel to an alternate
   B. Overweight landing and performance considerations

V. Two engine ILS to CAT II minimums with missed approach - second engine failure and single engine landing, no electronic guidance.

VI. Jammed stabilizer
   A. Maintain trim speed if feasible
   B. 15 degree flap approach

VII. Emergency evacuation

VIII. Windshear training
   A. Recognition and avoidance
   B. Shear encounter during takeoff
      1. Before rotation
      2. After rotation
   C. Shear encounter during approach

D. Recovery / Survival procedures
   1. Max power
   2. Maintain configuration
   3. Fly to attitude which equals max performance

E. Always inform ATC of any encountered shear

IX. Cockpit Resource Management - Leadership / Followership

The captain who is a good leader is able to establish an atmosphere that leaves no doubt that he or she is clearly in command of the flight, but which encourages other crewmembers, both cockpit and cabin, to participate is the process. On the other hand, knowing how to be an effective subordinate crewmember requires the development of followership skills. There is no magic formula which when taken in pill form will make every person an effective leader or follower, but the items listed below, as well as those discussed in previous lessons, will help enhance leadership / followership skills:

A. Defining problems: Continuously discuss and confirm problem definition with other crew members. Evaluate all available data on an ongoing basis to reconfirm a problem.

B. Inquiry: Collect and validate data. Be suspicious, continuously reevaluate by asking questions of yourself and other crewmembers. The term "Do you agree" is a good way to affirm the decision you are going to make is the best possible one under the circumstances

C. Advocacy: If uncomfortable, speak out in support of a course of action that is different than that currently being planned or followed.

D. Decision-making: Place a high value on arriving at sound decisions. Seek understanding and agreement of other crew members based on objective consideration of all available information.

<u>The captain makes the final decision on matters involving his or her aircraft</u>. By defining problems, asking questions, and resolving any conflict, he or she is able to make a completely informed and well thought out decision. It is the duty of subordinate crew members to ask questions and advocate a different position if they are uncomfortable with the current situation.

Simulator Period Six

* CRM Exercise - No specific exercise is scheduled for this simulator period. The instructor should make note of areas during the period where better use of available resources would have been beneficial to the captain. Identify any areas where inquiry and/or advocacy could have been used by the first or second officer to enhance crew coordination efforts.

1. Pushback and engine starts. (Two engine taxi if desired.)
2. Rejected Takeoff at max weight
3. Engine Failure after V1 at max weight
4. Fuel Dump
5. ILS, Flight Director Approach to CAT II minimums
6. Missed Approach (Capt.) Landing (F/O)
7. When Flaps Up, Second Engine Failure - Single Engine Approach and Landing (No Electronic Guidance)
8. VFR Cross Wind Takeoff - 25 Knots
9. Jammed Stabilizer
10. Jammed Stabilizer Landing
11. Windshear Training Using Takeoff and Approach scenarios
12. Emergency Evacuation
13. Debriefing

Simulator Period Seven Briefing

I. Review performance problem and weather for takeoff
   A. ATIS "E" W-X1/8F 31/30 CALM 2982

II. Review considerations for takeoff in icing conditions.
   A. Start problems
   B. Anti Icing and engine runup requirements
   C. Fuel Heat
   D. Deicing
   E. Ground ops considerations
   F. Ops Specs / FAR visibility and equipment requirements

III. Review required air work
   A. Approach to stalls
   B. Steep turns
   C. Dutch roll recovery

IV. Review heavy weight takeoff and RTO

V. Review Non-precision approaches

VI. Review engine failure procedures

VII. Review engine inoperative CAT II approach

VIII. Review no flap landing

IX. Review CRM techniques in relation to check ride
   A. Crew briefings
      1. Brief crew according to SOP
   B. Communications
      1. Use correct terminology when talking to push-back crews, company, and ATC
      2. Repeat all clearances
      3. Share your thoughts with your crew
   C. Monitoring / cross checking
      1. Ask non-flying pilot to cross check altitudes and provide distance/altitude calls on approaches, especially non-precision approaches
   D. Prioritizing / task delegating
      1. Make sure someone is flying the airplane at all times

E. Problem assessment / avoiding preoccupation
   1. Use the crew, ATC, company and any other available resources when working through an abnormal situation
F. Leadership / followership
   1. Inquiry
   2. Advocacy

Simulator Period Seven

1. Cockpit Preparation and Start
2. Taxi (Icing Conditions)
3. Rejected Takeoff
4. Area Departure
5. Steep Turns
6. Stalls
7. Slew Simulator To Altitude, Dutch Roll
8. Non-precision Approach (Minimum Vis., Minimum Ceiling + 50 Ft.
9. Missed Approach (Published Missed Approach Procedure)
10. Holding
11. Non-precision Approach (Minimum Vis., Minimum Ceiling + 50 Ft.
12. Landing
13. Engine Failure On Takeoff (600 RVR)
14. Fuel Dumping
15. ILS, Flight Director Approach (One Engine Inop) CAT II minimums
16. Missed Approach
17. Engine Failure, Two Engine Inoperative Approach And Landing
18. Crosswind Takeoff And Landing. (No Flap Landing)

APPENDIX B

LETTER OF INSTRUCTION TO EVALUATORS &

CRM QUESTIONNAIRES

November 1, 1993

Captain Lloyd Murray

Dear Captain Murray,

Enclosed is the syllabus mentioned in our last correspondence. Please take time to review it, then complete the enclosed questionnaire. It is imperative that you include your thoughts on how the syllabus may be improved.

After receipt of the completed questionnaire, I will conduct a follow-up telephone interview at your convenience. Any questions or further suggestions may be conveyed at that time.

Thank you for taking your valuable time to be part of this project.

Respectfully,

C.H. Meyerholtz Jr.

Encl.

COCKPIT RESOURCE MANAGEMENT

QUESTIONNAIRE (MURRAY)

1. Did the syllabus meet the basic criteria for transition training on a typical, non-automated jet transport aircraft? Circle one: YES NO

Explanation required.

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2. Are the CRM teaching points used in the syllabus applicable, given the current state of CRM at your airline? Circle one: YES NO

Explanation required.

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3. Is there enough time to adequately cover the subject matter within the allotted two-hour briefing sessions, four-hour simulator sessions, and one-half-hour debriefing? Circle one: YES NO

Explanation required.

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4. Is there any non-essential information or wasted time in the syllabus? Circle one: YES NO

Explanation required.

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5. Is there an area where more information is required to adequately convey a CRM teaching point?

Circle one: YES NO

Explanation required.

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6. Do you feel that incorporation of a syllabus similar to the one you reviewed would improve CRM awareness during transition and upgrade training at your airline? Circle one: YES NO

Explanation required.

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7. Do you feel that incorporation of a syllabus similar to the one you reviewed would improve CRM awareness and skills of pilots receiving initial new-hire training? Circle one: YES NO

Explanation required.

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8. General comments and suggestions for improvement.

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November 1, 1993

Ms. Sharon Irving

Dear Ms. Irving,

Enclosed is the syllabus referred to in our last correspondence. Please take time to review it, then complete the enclosed questionnaire. It is necessary that you include your thoughts on how the syllabus may be improved.

After receipt of the completed questionnaire, I will conduct a follow-up telephone interview at your convenience. Any questions or further suggestions may be related at that time.

Thank you for your cooperation; I very much appreciate your being a part of this project.

Respectfully,

C.H. Meyerholtz Jr.

Encl.

COCKPIT RESOURCE MANAGEMENT

QUESTIONNAIRE (IRVING)

1. Did the syllabus meet the stated objective of introducing the trainee to basic CRM skills?

Circle one: YES NO

Explanation required.

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2. Based on a previously qualified crew member undergoing transition training, how would you rate the effectiveness of the CRM portion of the syllabus?

Circle one:

VERY POOR.....POOR.....AVERAGE.....GOOD.....VERY GOOD

Explanation required.

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3. Is there too much information in the syllabus? Does the training require too much from the trainee in too short a period of time? Circle one: YES NO

Explanation required.

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4. Is there a better method of teaching basic, non-psychological CRM skills than that presented in the syllabus? Circle one: YES NO

Explanation required.

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5. Would you advocate adding training time and expanding the syllabus to allow for "total skill training," that is, add personality and attitude issues to the syllabus? Circle one: YES NO

Explanation required.

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6. If the training set forth in the syllabus is successful in providing the learner with a conceptual understanding of CRM, will proficiency develop once the trainee is in the operational setting?

Circle one: YES NO

Explanation required.

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7. Would the instruction be more effective if a different sequence were used to present the components of CRM during training?

Circle one: YES NO

Explanation required.

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8. In its present form, will the syllabus provide meaningful CRM training? Will it work?

Circle one: YES NO

Explanation required.

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9. General comments and suggestions for improvement.

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APPENDIX C

EVALUATOR LETTERS OF REQUEST

November 12, 1992

Capt. Lloyd Murray

Dear Capt. Murray:

I am writing this letter to solicit your help. I am working on the culminating project which will allow me to complete my post-graduate work in Human Resource Management. My project consists of incorporating cockpit resource management techniques into a transition / upgrade syllabus of a typical, non-automated, transport category aircraft such as a B-727.

Your task would be to evaluate the effectiveness of such an integrated syllabus within the framework of current industry standards.

Please respond at your convenience, and thank you for your kind consideration in this matter.

Respectfully,

C.H. Meyerholtz Jr.

November 15, 1992

Ms. Sharon Irving

Dear Ms. Irving:

I am writing this letter to solicit your help. I am working on the culminating project which is the last step in completing my post-graduate work in Human Resource Management. The project consists of a syllabus of a typical, non-automated, jet transport aircraft which incorporates cockpit resource management issues.

Your task would be to evaluate the effectiveness of the syllabus and to share your thoughts on how it might be improved.

Please respond at your convenience and thank you for your consideration in this matter.

Respectfully,

C.H. Meyerholtz Jr.

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