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CRM FOR PART 91 AND 135 OPERATIONS

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INTRODUCTION

Every flight is characterized by constant change. It is the way each individual crew responds to that change that determines how effectively they will be able to manage their flight deck. In this paper we would like to first present the concepts of Flight Deck Management (FDM). We feel that the principles we are dealing with are applicable to every flight, and that the occurrence of change in the conduct of every flight is a given. Nothing remains as it is initially perceived.

We will then show how SimuFlite accomplishes training in these concepts. Finally we will discuss the challenges which we face as an industry to make FDM more effective.

We will lead off with an issue, which in the two and one-half years we have been providing training to the FAR 91 and 135 operator, we have found critical to the study of cockpit resource management, which to date none of us in the industry has dealt with very successfully. We do this by posing a question which is closely akin to, "do you know where your kids are tonight?"

The Question

Most of us have at least one crew in the air right now. Each of those crews is facing changes that they didn't anticipate. How comfortable are you that your crew is able to recognize those challenges and how confident are you that they will respond to them effectively?

In considering this question and thinking about your pilots' potential ability to deal successfully with the unexpected you can feel confident that they understand and accept the criticality of the aircraft's operating envelopes. These envelopes are precisely defined by the laws of physics, relating to g-forces, airspeed, and altitude. But we submit that there is another envelope which many pilots don't understand, and more importantly, don't accept as important to safe, successful flight.

The pilot's own Safe Operating Envelope has not been adequately defined up to this point, and only recently have we begun to realize its significance. In addition, the individual pilot's psyche may reject its existence through his drive for survival, dominance, and uniqueness. These drives deny the thought that he is susceptible to the consequences of exceeding *his* limits.

We want to say up front that we don't have a suitable solution for this issue, nor do we know anyone who has. We do know that cockpit resource management faces several crucial challenges. These include:

- How do we get the average pilot's acceptance of his limitations?

- How do we train the pilot to accurately understand these limitations?

The Needed Skills

This rejection of human limitations is sometimes known as the "silk scarf" syndrome. The individual pilot perceives himself as courageous, self-reliant, capable, and even invulnerable.

His focus is on developing and maintaining his individual abilities. He strives for a high level of proficiency in his flying skills and places great importance on his understanding of the intricacies of his machine. He recognizes his need to be able to plan and navigate accurately while coping with the environment. As our aircraft and the ways we use them have become more complex, we have put several of these self-focused pilots together to form crews. Our focus on the individual is so imbedded in our aviation culture that even today we only check our pilots' proficiency on individual skill criteria.

Our job in Flight Deck Management training is to expand the pilot's skill set, enabling him to interact effectively as part of a team. Effective use of standard operating procedures (SOP's) is the foundation of the flight crew's team orientation, yet it often runs counter to the individual pilot's self-image. The skills, which allow the individual to interact with other human beings around him and to manage his flight deck in a constantly changing environment, require the same dedication and hard work to master as the more traditional skills have.

Among the "laws of the flight universe" (along with the aircraft and pilot's envelopes) there is another principle of successful flight which relates to the performance of the human in the cockpit. In a sense, the issue in Flight Deck Management relates to the crew's state of mind at all times in relation to this law. SimuFlite has defined this principle as the FDM Cycle.

The Flight Deck Management Cycle

The FDM Cycle is as fundamental to a successful flight as any of the physical cycles relating to flight. The FDM Cycle is represented by a triangle. The base of the triangle represents the crew's development of an accurate and comprehensive concept of how the flight is going to be successfully accomplished. This process develops the *plan*.

As the crew conducts the flight, they remain alert for events which conflict with the *plan*. Once these *challenges* are recognized and validated, the crew must generate an appropriate *response*. On the basis of the changed situation, the crew then returns to the base of the triangle, revising their *plan* for the successful completion of the remainder of the flight.

Flight Deck Management trains crews to develop the state of mind to recognize where they are in the FDM Cycle and to maintain the integrity of the cycle without

allowing a breakdown. Let us look at the three steps of the FDM Cycle in detail, and examine the crew skills necessary for high levels of performance in each step.

The Plan

As we look at the first step of the process, establishing a plan, we need to do so as if through a pair of bifocals. Through half of the lens, we see company management's foundation, or plan, for how all flights are to be conducted. This foundation layer consists of policies, procedures, and the company culture. It represents a considered resolution of the sometimes conflicting demands of safety versus the mission objective. This foundation is laid well before the flight is scheduled.

Through the other half of the lens we see the crew establishing a plan for this specific flight. The plan represents a common, collective concept of the flight, from block-out to block-in. (Figure 1)

Skills to Develop the Plan

The crew's use of it's Flight Deck Management skills begins with development of a plan for conduct of the flight. This process requires sound knowledge and application of the standard operating procedures, as well as other policies and regulations. Skill at accessing all available resources ensures development of suitable options and evaluation of the relative risk of each. Effective communication provides each crewmember with input opportunities in the decision-making process. The pilot holding command responsibility for the flight must communicate the selected plan to each crewmember, making certain that each of them shares a common image of how the flight will be conducted. At SimuFlite, the crew is taught a communications model which deals with how people interact, how information is processed, and how decisions are made.

The model places emphasis on the recognition of other crewmember's normal communications "style" and develops the ability to self-adapt to those differences which exist.

The Challenge

The second and inevitable step of the FDM Cycle is that there *will be* a challenge to the initial perception of how the flight will proceed. This is often the source of the flight operations manager's nagging concern:

- Will the flight crew notice the change?
- More importantly, will they see it properly?

So, Flight Deck Management's training objectives are to develop the crew's state of mind for constant vigilance to challenges (Figure 2), and to allow the crew to properly validate those challenges. (Figure 3)

Skills to Recognize and Validate Challenges

The search for challenges as the flight progresses requires various skills as the crew monitors events both on the flight deck and in the world outside. The pilot in command must ensure that his resources are used effectively so the crew may detect events which do not match the commonly-shared plan. Each crewmember holds an obligation to communicate with the others anything that may constitute a challenge, without allowing it to be colored by individual bias. Individual perceptions can then be combined as the challenge is verified.

The Response

Though safety of flight depends upon a high level of performance by the crew in each step of the FDM Cycle, the third step of *response,* it seems, is where the crew is most likely to drop the ball. The first cardinal sin in dealing with change in a multi-place aircraft is the failure to fly the aircraft. In a list of inappropriate responses to any challenge, this single critical failure is at the top of the list.

The crew's response to a challenge depends heavily on the time element:

o Time-soft situations do not immediately threaten the aircraft's or crew's envelopes, and provide the opportunity for analysis and discussion of the situation. (Figure 4)

o Time-critical situations allow little or no time for delay or trouble shooting. This type of situation requires knowledge of SOP and emergency procedure memory items in order to deal with them effectively. (Figure 5)

The crew is always obligated to select a conservative response. This means the one which best moves the aircraft or the crew away from the edge of the envelope.

Skills to Make a Response

To effectively respond to a challenge, the crew must exercise the full range of their flight deck management skills. With time-critical challenges, the ability to accurately follow SOP and immediate action checklist items enables the crew to stabilize critical situations. Given a challenge which is less demanding, the crew distributes workload to allow effective use of all applicable resources. Analysis of an ambiguous problem may be undertaken, requiring well-developed decision-making skills to select an appropriate course of action from those which may be available. The control of stress within the crew is essential to optimizing their collective effectiveness.

The Chain of FDM Cycles

Once the crew has properly responded to a challenge with a clear picture in their collective minds as to where the aircraft is in the envelope and relative to the mission

objective, the crew then moves back to the base of the triangle. They establish a new plan, and in doing so, form a new concept of how the flight will proceed to a successful conclusion. (Figure 6)

Having shared their new flight concept, the crew now remains alert for new challenges. Successful flight crews are able to deal soundly and effectively with each step of the FDM Cycle. Those crews who fail to perform adequately during a cycle, however, set themselves up for an incident or accident.

In keeping with SimuFlite's premise that there are not any pilot-error accidents, but rather pilot-preventable accidents, we find that virtually all accidents are the result, not of a catastrophic, sudden failure of one step in a cycle, but rather of poor performance by the crew in several subsequent series of cycles. Thus, in an approach and landing accident there may have been a critical failure of the crew to perform somewhere much earlier in the flight profile. As an example, an analysis of several wind shear accidents reveals challenges which were not recognized or for which inappropriate responses were generated well before the actual encounter with the violent shear.

To summarize the objectives of Flight Deck Management training, SimuFlite endeavors to:

- o Obtain the pilot's "buy-in" to his vital role in the application of sound management to complete the flight successfully.

- o Develop understanding of the FDM Cycle--the process so important to dealing with constant change in aircraft operations.

- o Exercise the skills required to successfully implement the FDM Cycle.

A safe flight operation, then, incorporates two vital links:

- o The crew's faithful adherence to the published SOP as a basis for effective management of the flight deck.

- o A high degree of performance as the crew encounters each step of a series of FDM Cycles during a mission or flight.

FDM Training at SimuFlite

At SimuFlite, we have infused the principles of Flight Deck Management throughout all of our activities. A 3-day interactive workshop on Flight Deck Management skills is available to all clients, and is required for those participating in the Upgrade program. In all other facets of training activity, including ground school and simulator, Flight Deck Management is one of the primary instructional objectives. In initiating the attempt to get pilot buy-in on the importance of training in the Flight Deck Management skills, emphasis is placed on the high percentage of accidents which are crew-preventable.

Three-Day FDM Workshop

During the 3-day Flight Deck Management Workshop, the crew explores the various skills which are used when functioning at peak effectiveness on the flight deck. Activities include multi-media presentations on past accidents and incidents to provide insights into how proper use of the Flight Deck Management Cycle can break a developing chain-of-events before the situation becomes critical.

Crews also have the opportunity to practice using their skills with carefully-developed scenarios. One scenario, for example, builds a situation in which the crew is under considerable self-induced pressure to complete a multi-leg flight. The flight progresses toward its ultimate destination where weather in the vicinity of the airport is questionable. A building chain-of-challenges, which began early in the day, culminates on an approach into La Guardia where the crew encounters wind shear.

FDM Training in Aircraft Programs

As we look at the techniques which SimuFlite uses to infuse Flight Deck Management into it's aircraft training programs, think about management's role in that first step of the Flight Deck Management cycle--that of supplying established, published procedures for use by the flight crew. In practice, many of SimuFlite's FAR 91 and 135 clients do not provide such written procedures. To fill this gap, we have developed a consistent set of procedures and information resources across all aircraft programs as part of SimuFlite's commitment to effective Flight Deck Management. These materials are designed to enhance operational efficiency, and include:

o Reference Handbook, containing limitations and technical information about the aircraft.

o Operations Handbook, which include checklists and tabulated performance data.

It should be noted that the Reference Handbook has one section which is procedural in nature. This is the standard operating procedures section. If a client already has developed an SOP which he uses in his flight operations, then we train in accordance with his own SOP. If he does not, then we suggest that he use the SimuFlite SOP as the basis for developing his own. We also use this document for basic callouts during training and evaluation.

In the classroom, the crews participate in the dynamics of the Flight Deck Management Cycle. Activities include instructor pilot-conducted interactive discussion of a representative mission scenario. Each instructor is an ATP-rated pilot, who is also rated and experienced in the aircraft type, and thus able to present operationally believable situations. The crews are given aircraft, mission, and weather information to build their concept of the flight, and the instructor then introduces challenges to alter that concept.

An example of a typical scenario would be a crew that is holding short of the runway for takeoff. The runway comfortably exceeds the required field length requirement under the existing conditions. The instructor then informs them that the planned takeoff runway has been closed due to a gear-up landing by another aircraft.

With the aircraft heavy, and the weather marginal for use of the remaining runway, the crew is now presented with some ambiguous challenges requiring them to communicate effectively to achieve agreement and validation of what the challenges are.

Next, the crew must access resources other than the tabulated data located in their operations handbook. In order to facilitate a response in this case, the aircraft's second segment climb charts are required in order to resolve flap configuration questions. After the crew formulates an appropriate response, they brief the new concept for the takeoff and climb. As the flight continues following takeoff, the instructor introduces repeated challenges. This activity requires that the crewmembers use proper callouts and communicate how they would validate or confirm what the challenge is, resolving any ambiguity.

Depending on the amount of time available, the crew gives their response based first on their SOP, and then on an exercise of their other crew skills. Through well-placed open probes, the instructor leads an interactive discussion and practice of all of those skills. When the response is considered complete, the crew members complete the cycle by moving into the first step of the succeeding cycle--they establish a revised plan. They develop a new concept of how the flight will proceed based upon the revised aircraft configuration or flight conditions. In one case, the crew has limited pressurization capability and must consider the alternatives for proceeding with their flight. They must agree upon and ensure a mutual understanding of a new plan. In the classroom, crews practice going through this cycle to understand the skills necessary to complete it successfully.

FDM in the Simulator

All flight simulator training at SimuFlite uses the Line-Oriented Simulation (LOS) or mission-oriented format. Even during the so-called batting-practice sessions, crews are carefully put into a frame-of-mind which enhances their ability to respond to challenges as they would in the aircraft. During the one-hour briefing, the crew plans the flight as if it were to be conducted in the aircraft. This activity includes sharing of the flight concept through a thorough crew briefing.

Integral to the effective presentation of Flight Deck Management training is the integration of the company-specific SOP into the training. This information is provided to the instructor as a part of the crew records, and becomes a topic for evaluation of the crew's performance.

The scenarios presented to each crew are designed to take maximum advantage of SimuFlite's Phase II-certified simulators. Each scenario includes carefully selected challenges which exercise the full range of Flight Deck Management skills, while providing the individual pilot with the appropriate progressive check in most courses.

The instructor acts to maintain the realism of the training flight, intervening only to provide remediation. The instructor is aided in his role as air traffic controller by SimuFlite's unique Air Traffic Audio Simulation System (A-TASS) which provides realistic background communications, instructor voice modification, and Automatic Terminal Information Service (ATIS) capabilities.

Low-light-level video cameras and strategically-placed microphones allow the crew to receive valuable feedback on their performance and to compare their self-image with reality during the debriefing. All instructors are trained intensively on interactive techniques to help promote self-debriefing by the crews.

An additional tool available to improve crew awareness of their performance is the ability to produce computer-generated maps and approach profiles of all phases of flight.

When evaluating the crews' performances, their ability to effectively use Flight Deck Management skills is given high priority, as demonstrated by the operational qualification items on the first page of each crew member's performance record. The items evaluated include planning, use of SOP, decision-making, and use of resources.

Line Oriented Flight Training (LOFT) is the last simulator flight in all courses, including transition and recurrent. The charter for the Instructor Pilot is to "set the stage" in the crew's mind for the operational flight or mission, after he has briefed them on the objectives of the flight--to exercise all of their management skills as effectively as possible.

The two-leg LOFT flight is structured carefully to follow NASA and FAA guidelines and incorporates carefully-controlled workload with believable weather, air traffic, aircraft malfunctions, distractions, subtle coercion, and other embedded challenges.

It is here that our 2-month Instructor Pilot Training Program in Flight Deck Management communication skills, delivery skills, and operation of SimuFlight's Phase II simulators pays off. In order to continuously maintain the flight's realism, the instructor must be an accurate and credible air traffic controller. He must successfully orchestrate all of his instructional resources to keep ahead of the crew and set up realistic conditions in response to the crew's selection of options. LOFT realism also requires an extensive airways network and a large number of airport databases.

The effectiveness of LOFT, and concurrently some measure of the crew's regard for Flight Deck Management training are indicated on the last page of SimuFlite's Client Feedback Critique. The first is where they evaluate the realism and usefulness of LOFT on a scale of 1 to 5. Ratings in this area are consistently 4s and 5s, with the average at 4.8. In the overall evaluation of training, our program effectiveness is confirmed by their feeling of completing a satisfying total training experience. A common comment is: "I learned more about myself as a pilot in this session than in all my previous training...."

Scope of SimuFlite Training

Training operations which SimuFlite is currently conducting include training for corporate and FAR Part 135 jet and turbo-prop operators, U.S. Navy and U.S. Marine pilots, FAA, and foreign government agency inspectors.

This same training will be integrated into our support of the Singer Company's new roles at training centers in Totawa, New Jersey with large transport-category aircraft and at Marietta, Georgia on the C-130 "Hercules."

CONCLUSION

In summarizing, we must revisit the opening question of this paper and ask ourselves if we are confident that our crews are successfully dealing with the changes which they are encountering? If not, then our discomfort lies not in our failure to know what skills they need. There is *common* agreement on what those skills are, we have just given them different names. Rather, that discomfort comes from our uncertainty over whether the flight crew member has "bought-in" with us that he *can* have deficiencies in those skills, and over our knowledge that the training process needs improvement.

There is a nugget of training wisdom which has been referred to several times during this workshop which can be phrased this way:

- o Tell me and I'll forget,
- o Show me and I'll remember, but
- o Involve me and I'll understand.

Understanding is the vital goal of Flight Deck Management because only when the pilot reaches this training level does he behave as an effective crewmember. At SimuFlite, we have designed a Flight Deck Management course, classroom scenarios, and simulator training under this premise.

As we have seen by the client feedback critiques, we feel we are doing something valuable, but we see opportunities for improvement in this emerging area of training:

- o First, how do we do a good, consistent job of getting pilot "buy-in" up-front for Flight Deck Management training (in other words, his acceptance of his own envelope of human limitations)?
- o Second, all of industry must commit to training CREWS on multi-place aircraft vs. individual pilots. Rating and proficiency checks must verify acceptable proficiency in crew skills.
- o Finally, we need to clearly define criteria which can be used to measure crew performance.

We are pleased to be able to participate in this workshop, and look forward to working with each of you to continue the development of Flight Deck Management training.

Figure 1

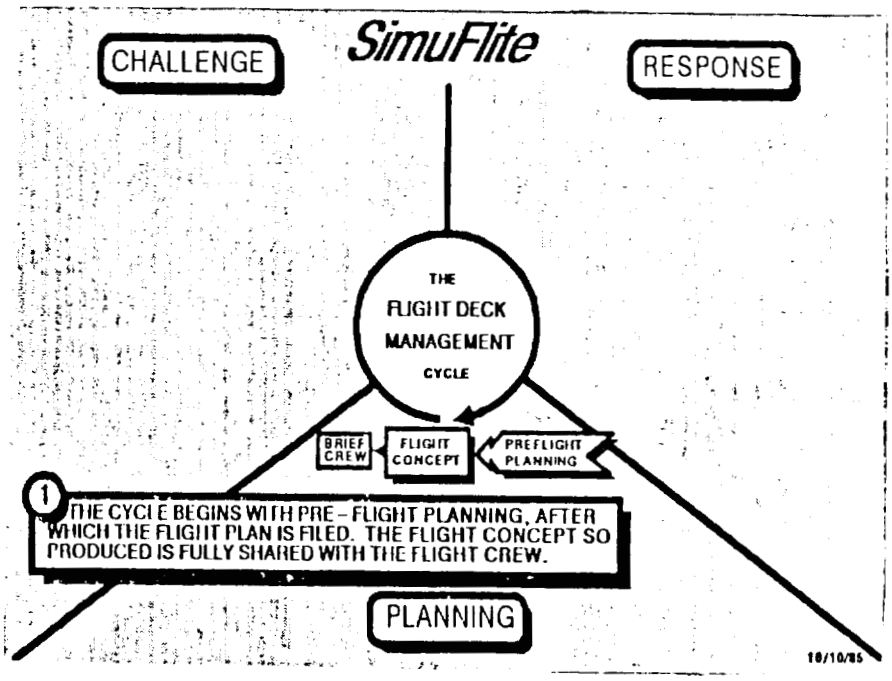


Figure 2

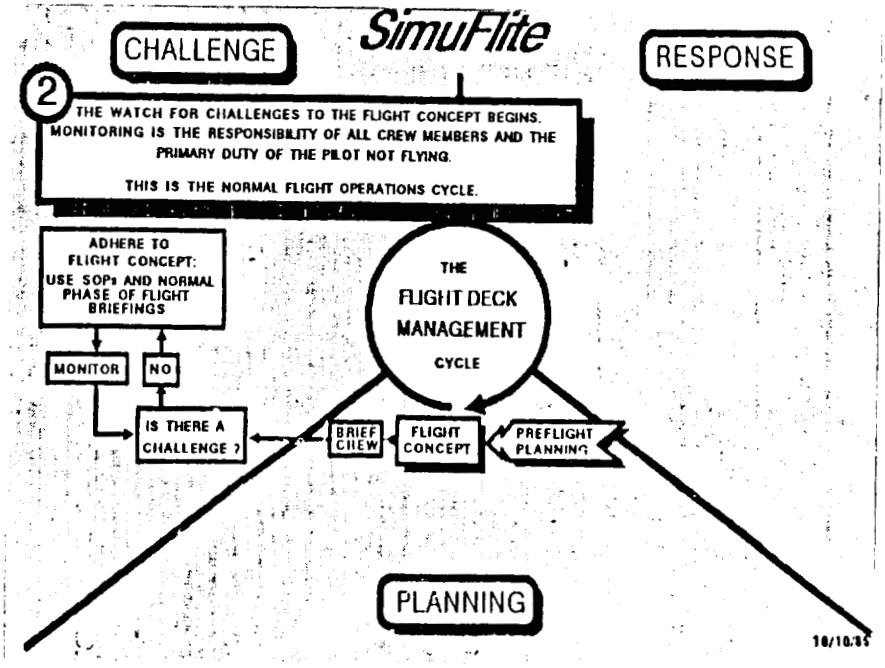
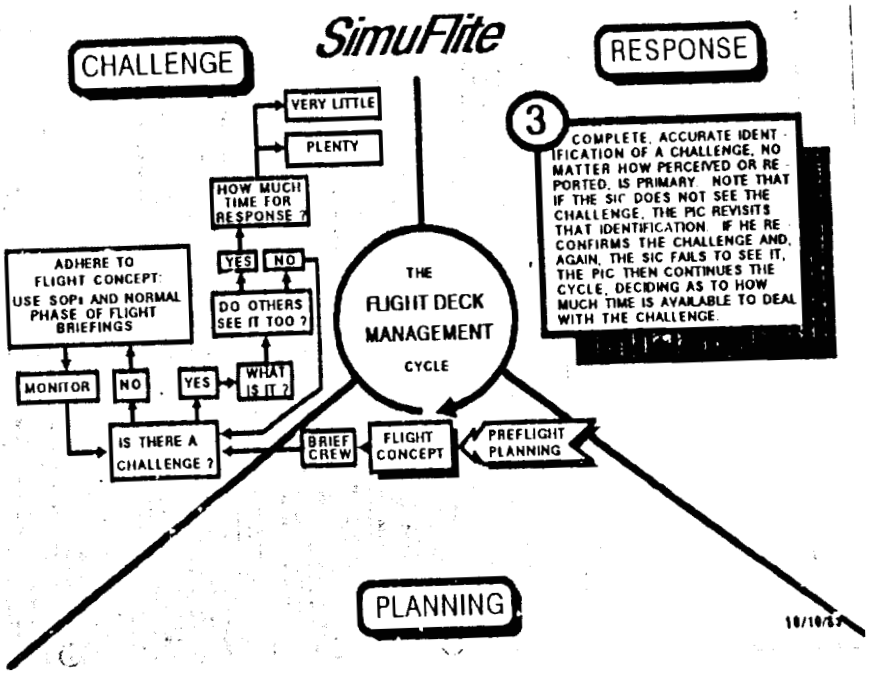


Figure 3



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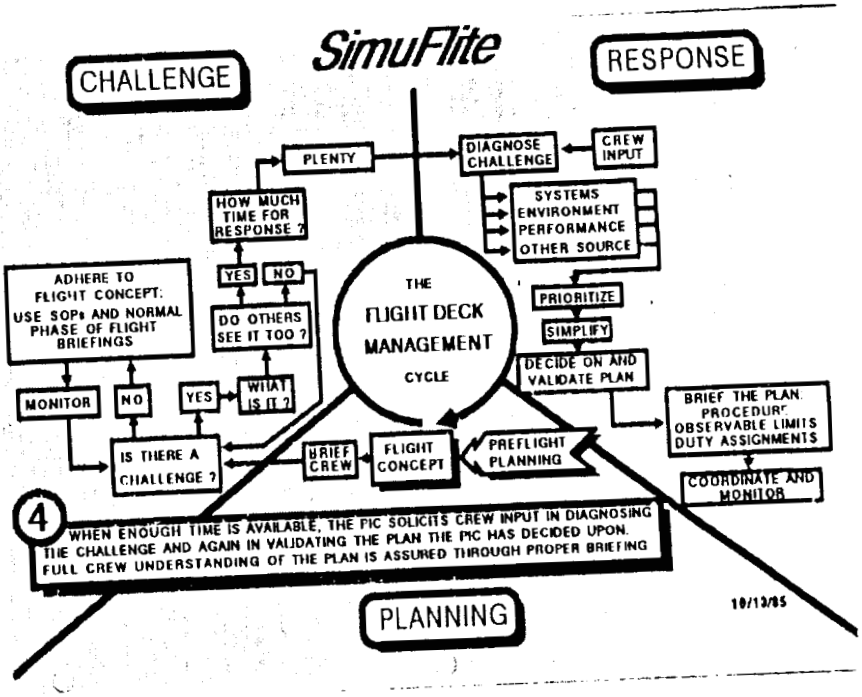

Figure 5

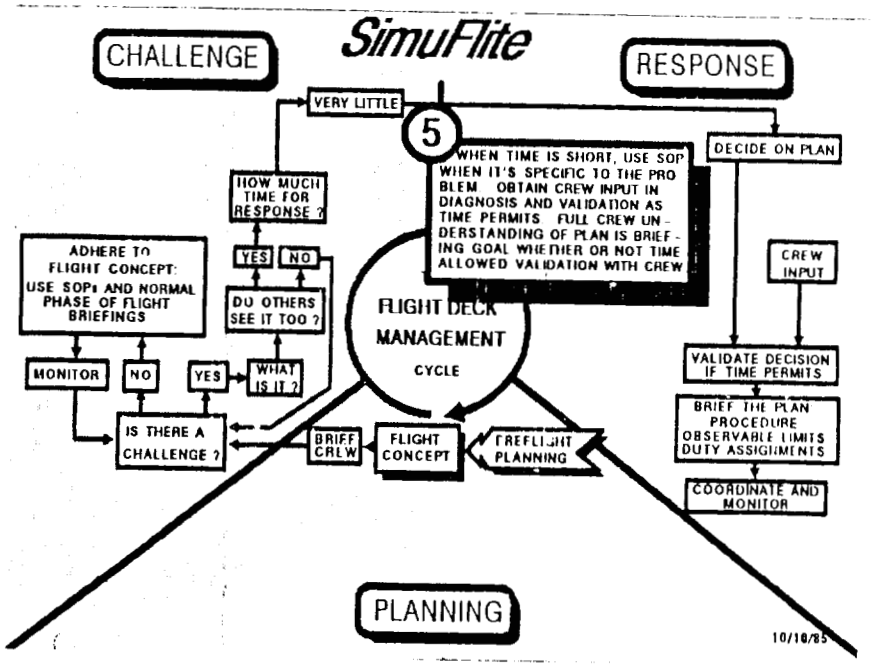

Figure 6