Flight Advisor Corner by Hobie Tomlinson

April 2011 **Human Factors, Part V**

This month we will continue our series on **Human Factors** by looking at **Crew Resource Management (CRM)** and **Single-Pilot Resource Management (SRM).**

Crew Resource Management (CRM) and **Single-Pilot Resource Management (SRM)** is the ability of the crew (or pilot) to manage all available resources effectively in order to insure that the outcome of the flight is successful.

Single-Pilot Resource Management (SRM) is most often used in general aviation and it is focused on single-pilot operation. SRM recognizes the need for pilots to seek adequate information from many available sources in order to make valid choices. Pilots must continue seeking this knowledge until they have obtained the proper information to make the best possible decisions under the existing circumstances. Once a pilot has gathered all pertinent information and made the required decisions, the pilot must then continually asses the actions taken in order to insure that they continually yield the desired outcomes.

Single-Pilot Resource Management (SRM) integrates the following disciplines:

- **Situational Awareness (SA)**
- **Flight Deck Resource Management**
- **Task Management**
- **Aeronautical Decision-Making (ADM)**
- **Risk Management**

Situational Awareness (SA) is the accurate perception of operational and environmental factors that affect the flight. It is a logical analysis based upon the aircraft, available external support, the operational environment, and the pilot. In plain language, it simply means ~ "knowing what is going on."

Proper Situational Awareness is not simply just having a mental picture of the aircraft's location; but rather, it is the continual mental maintenance of an overall assessment of all the elements which comprise the current flight environment and how each affects the flight. A pilot who maintains good situational awareness is knowledgeable of all aspects of the flight and consequently is able to be proactive in his decision-making process. Conversely, a pilot who has poor situational awareness is typically missing several important pieces of information and is thus forced to regress into a reactive style of decision-making. A pilot with poor situational awareness lacks a vision of potential future events and is thus forced into making decisions quickly when unexpected events occur, often with very limited options. An example of poor situational awareness and reactive decision-making would be a pilot who does not adequately keep track of his

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flight's progress (or the destination weather) and suddenly finds himself faced with destination weather which is below landing weather minimums ***and*** inadequate fuel to reach his filed destination alternate! (This accident actually happened to a Cessna Citation crew in Wilmington, NC.)

During a Typical IFR Flight a pilot usually operates at several levels of situational awareness. For an example, a plot may be in cruise toward his destination with a high level of situational awareness when air traffic control (ATC) issues a revised routing consisting of an unexpected **S**tandard **T**erminal **A**rrival **R**oute (STAR) due to traffic volume. Because the pilot was not expecting that particular STAR and is not familiar with it, situational awareness is temporarily reduced. However, after becoming familiar with the STAR and resuming normal navigation on the new routing, the pilot again returns to a high level of situational awareness.

Factors which Reduce SA include the following:

- **Distractions**
- **Unusual or Unexpected events**
- **Complacency**
- **High Workload**
- **Unfamiliar Situations**
- **Inoperative Equipment**
- **Fatigue**

Lack of Situational Awareness (SA) is almost always a precursor to an aircraft accident. The lack of situational awareness can be identified by the occurrence of one or more of the following events:

- **Failure to Stay Ahead** of the operation by anticipating upcoming events.
- **Ambiguity ~** when two or more independent sources of information do not agree.
- **Fixation or Preoccupation ~** when the focus of attention is only one item at the exclusion of all others.
- **Confusion ~** the feeling of uncertainly, anxiety, or puzzlement about events.
- **No One Overseeing** the task
- **Uncertainty** about the current state of the task
- **Use of Undocumented Procedures** (i.e. Shortcuts)
- **Departure from Standard Operating Procedures (SOPs) ~** either intentional or unintentional.
- **Violating Task Limitations** (or Standards)
- **Failure to Meet Task Targets** (or Goals)
- **Unresolved Discrepancy**
- **Incomplete Communication**

In some situations, loss of situational awareness may be beyond the pilot's control. As an example, a vacuum pump failure (or Primary Flight Display - PFD- screen failure for

you technically advanced aircraft – TAA – types out there) and the associated initial loss of the heading and attitude indicators could cause a pilot to suddenly find his aircraft in an unusual attitude. If this situation occurs, established and trained procedures must be immediately used to reestablish aircraft control and restore situational awareness.

Pilots should be aware of the loss (or reduction) in situational awareness anytime they find themselves in a reactive mindset. To regain situational awareness, immediately reassess your flight situation by seeking additional information from other sources such as your flight and navigation instruments, air traffic control, uplinked weather data or flight service.

Flight Deck Resource Management (CRM or SRM) is the effective use of all available resources which include the following:

- **Human**
- **Equipment**
- **Information**

Flight Deck Resource Management focuses on ***communication skills***, ***teamwork, task allocation***, and ***decision-making***. While **C**rew **R**esource **M**anagement **(CRM)** usually concentrates on pilots who operate in crew environments, the elements and concepts also apply to pilots who operate in single-pilot environments (**S**ingle-Pilot **R**esource **M**anagement ~ **SRM**).

Human Resources include all personnel routinely working with the pilot(s) to ensure the safety of the flight. These people include, but are not limited to, the following: dispatchers, schedulers, weather briefers, flight line personnel, fuelers, maintenance and/or avionics technicians, pilots and other crew members, and air traffic control personnel. Pilots need to effectively communicate with all of these people. This communication is best accomplished by using the three key components of the communication process. These three key components are as follows:

- **Inquiry**
- **Advocacy**
- **Assertion**

Pilots must recognize the need to seek enough information from the above resources to make valid decisions. Once the necessary information has been acquired, the resultant decisions of the pilot must be passed on to the individuals who are affected by those decisions. These individuals may include air traffic controllers, passengers, other crew members, fixed base operators and/or people awaiting arrival of the flight. The pilot may need to request assistance from others in implementing these decisions and in some situations this may even require assertiveness for all issues to be safely resolved.

Equipment Resources in many of today's **T**echnically **A**dvanced **A**ircraft (TAA) include automated flight and navigations systems. While these automated systems provide relief from many of the routine flight deck tasks, they present another set of

problems for pilots. The extensive programming required by automated systems tends to increase pilot workload during the least "structured" (and often rushed) preflight phase of the flight operation. It is imperative that pilots allow adequate time to correctly program their autoflight systems before beginning to taxi the aircraft and avoid any "heads down" time while taxiing. This is one of the most important steps for preventing runway incursions and/or other taxi deviations.

While Flying Enroute the automation, which is intended to reduce pilot workload, essentially removes the pilot from the task of managing the aircraft, thereby reducing the pilot's situational awareness and promoting complacency. It is important for pilots to continually monitor the information provided by the flight, navigation and weather displays of **T**echnically **A**dvanced **A**ircraft (TAA) in order to assure that they maintain proper situational awareness. Pilots must be thoroughly familiar with the operation of, information presented by, and correct management of all systems used (automated or otherwise). It is essential that pilots remain fully aware of both their equipment's full capabilities and all its limitations in order to manage these systems effectively and safely.

Information Workload and automated systems (such as autopilots) need proper management to ensure the safety of the flight. A pilot flying in **I**nstrument **M**eteorological **C**onditions (IMC) is often faced with multiple, simultaneous tasks, each with a different level of importance in ensuring a safe outcome to the flight operation. A high workload example of this occurs during the initial stages of an instrument approach to an airport. The pilot must be able to obtain the **A**utomatic **T**erminal **I**nformation **S**ystem (ATIS) or **A**utomatic **W**eather **O**bserving **S**ystem (AWOS) weather, review the applicable approach plate, properly plan his descent in order to be able to slow and reconfigure the aircraft by the Final Approach Fix, correctly program the communication and navigation radios - including all required automation systems - communicate with Air Traffic Control and complete all the required checklists.

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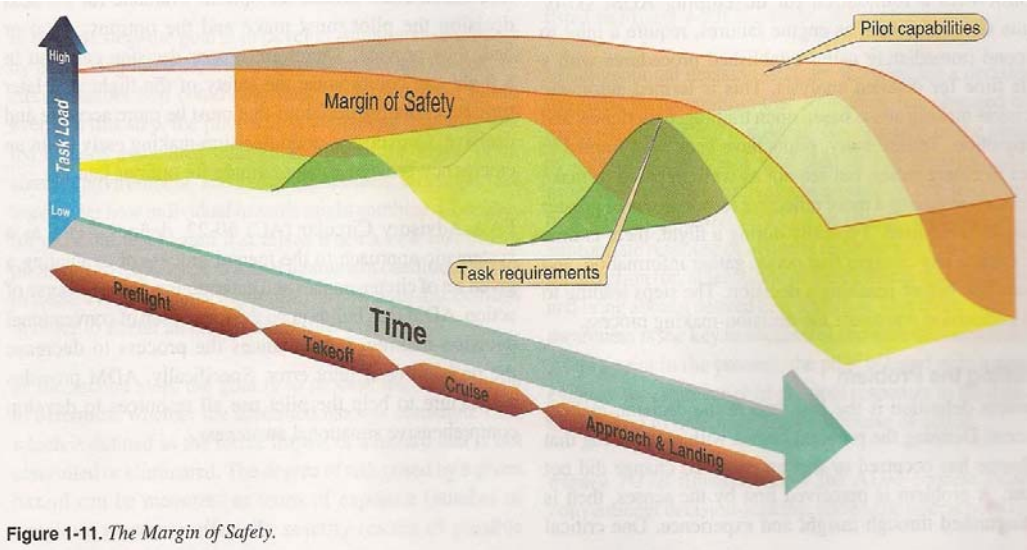

Figure 1-11. *The Margin of Safety.*

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The Pilot who is able to effectively manage his workload will be able to complete as many of these tasks as early as feasible in order to eliminate the possibility of task saturation (becoming overloaded) caused by last minute ATC changes and communication priorities during a later and more critical stage of the approach.

Figure 1-11 (above) shows that the margins of safety are at their lowest point during this stage of the flight operation. This is where the majority of accidents occur. A large part of the reason for the high accident rate during this portion of the flight is that ***when a pilot delays (or forgets) routine tasks until the last minute, there is a large possibility of the pilot becoming task saturated and stressed.*** This task saturated condition will result in a large erosion of the pilots performance capabilities and probably even produce a negative safety margin!

Proper Task Management is a requirement for preforming safe flight operations. Because humans have a finite (i.e. limited) capacity to absorb information, once the data stream exceeds the pilot's ability to mentally absorb and process all the required information, task saturation results. When this data stream (information flow) exceeds a pilot's ability to mentally process the information, any additional information will become unattended and/or displace other tasks and information already being processed. Once a pilot's task saturation (officially called "channel capacity") level is reached only the following two alternatives exist:

- **Shed the unimportant tasks**
- **Perform all tasks at a less than optimal level**

Automatic Task Shedding is a natural event during which the brain rejects incoming data in order to reduce its processing load. This prevents the brain from "locking up" as a computer will do when its processing capacity is exceeded. Because the brain is trying to reduce incoming data during "automatic task shedding," it will always reject (dump) the most complex task first. ***The problem with allowing automatic task shedding to occur is that the most complex task which the brain automatically deletes will also be the most important task!*** This is why a pilot experiencing automatic task shedding will start ***"majoring in minors."*** This is evidenced by the pilot performing some totally irrelevant minor task while a critically important, major task is being completely ignored.

New Flight Instructors are taught to identify task saturation in situations such as when observing a task saturated student concentrating on a minor task (such as resorting their approach plates) while a major event (such as the aircraft rapidly departing controlled flight and entering the very unusual attitude phase) goes completely unnoticed. (Another sure sign is the "glazed over" eyes.) A task-saturated pilot will also be relatively unresponsive to instructional input until his task load is significantly reduced. Just as in an overloaded electrical circuit, either the (information) consumption must be reduced or a circuit failure (automatic task shedding) will be experienced. During flight instructor training, they are taught to remember that a student-in-training is like a violin string ~ ***"They can only produce good music when they are kept under the proper tension!"***

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Circuit Failure (Automatic Task Shedding) is prevented by learning to ***always prioritize tasks*** (from most important to least important) and to ***recognize the signs of impending task saturation*** (an apparent sense of "time compression" accompanied by elevated stress levels). When these signs of impending "task saturation" appear, the pilot needs to implement "manual task shedding" to prevent automatic task shedding from occurring. This is done by working the prioritized task list from the top down (most important to least important) while simultaneously discarding tasks from the bottom up (least important to most important). This process is continued until the task list is completed or the available time expires. Sometimes it is possible to increase the available time (i.e. requesting a delaying vector from ATC) when vital tasks (such as abnormal or emergency check lists) require additional time to complete before attempting a landing.

The pilot who is able to effectively manage his tasks and properly prioritize them will have a successful flight. (For example, do not become distracted and fixate on some minor problem - such as an irrelevant system malfunction.) This unnecessary focus is a sign of impending task saturation and any irrelevant focus further displaces a pilot's capability, thus preventing his ability to undertake tasks of greater importance. By planning ahead and properly managing cockpit workload, pilots can effectively reduce their workload during the critical phases of flight.

This is a good place to break for this month. Next month we will use our annual May Safety Issue to discuss ***Aeronautical Decision Making (ADM)*** and ***Risk Management.***

The thought for this month is **"Let us watch well our beginnings, and results will manage themselves." ~ *Alexander Clark* –** *American Clergyman***.** So until next month, be sure to **Think Right** to **FliRite!**

KBTV "Snow Mountain" on 07March, 2011~ Heritage Aviation Ramp / East Side ~ Heritage Avn. Image

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