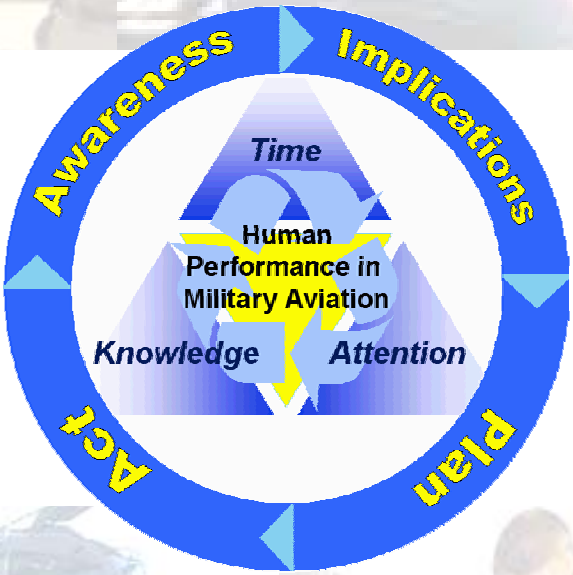
National Defence / Défense nationale

A-PD-050-HPM/PT-001

Human Performance in Military Aviation (HPMA)



Handbook

Canada

Issued on the authority of the Chief of the Defence Staff **2004-10-01**
OPI : CFS

LIST OF EFFECTIVE PAGES

Insert latest changed pages; dispose of superseded pages in accordance with applicable orders.

NOTE

On a changed page, the portion of the text affected by the latest change is indicated by a vertical line in the margin of the page. Changes to illustrations are indicated by miniature pointing hands, or black vertical lines.

Dates of issue for original and changed pages are:

Original……0……2004-10-01	Ch……..3……
Ch……1…… 2005-06-06	Ch……..4……
Ch……2……	Ch……..5……

Zero in Change No. column indicates an original page. Total number of pages in this order is 193, consisting of the following:

Page No.	Change No.	Page No.	Change No.
Cover	0		
A	1		
i to vi	0		
1 to 5	0		
1 to 17	0		
1 to 20	0		
1 to 15	0		
1 to 16	0		
1 to 12	0		
1 to 23	0		
1 to 22	0		
1 to 18	0		
1 to 14	0		
1 to 11	0		
1 to 14	1		

FOREWORD

1. A-PD-050-HPM/PT-001, Human Performance in Military Aviation Handbook, is issued on authority of the Chief of the Defence Staff.

2. The staff of the Human Performance in Military Aviation Flight *(formerly the Operational Training and Human Factors Flight)* of Central Flying School developed the HPMA Handbook. This handbook contains material drawn from a variety of sources, and represents an enormous amount of research in the field of aviation human factors. Wherever possible, sources have been cited. It would be impossible to formally recognize each and every contributor to this program but HPMA would not have been possible without the support of a large number of individuals in various organizations. In particular, CFS would like to recognize Defence Research and Development Canada (DRDC) Human Factors Section for their outstanding contributions to the program. To all the additional personnel who helped make this program possible, we extend our sincere appreciation.

3. Questions or suggestions for improvement shall be forwarded through normal channels to the OPI, Attention: Central Flying School, Human Performance in Military Aviation Flight Commander (AVN: 257-6678).

Electronic copies of this handbook are available on the HPMA DIN site at http://winnipeg.mil.ca/cfs

RECORD OF CHANGES

Identification of Ch.		Date Entered	Signature
Ch No.	Date		

Table of Contents

PART 1 – HPMA CORE CONTENT

MODULE 3 - INDIVIDUAL HUMAN FACTORS 1 - NUTRITION & STRESS

MODULE 4 - INDIVIDUAL HUMAN FACTORS 2 - FATIGUE

MODULE 5 - RULES, REGULATIONS AND SOPs

MODULE 6 - COMMUNICATIONS

MODULE 7 - SITUATIONAL AWARENESS

MODULE 8 - TASK & WORKLOAD MANAGEMENT

MODULE 9 - TEAM PERFORMANCE

CONCLUSION

PART 2 – HPMA TIER 1 & 2 TRAINING INTEGRATION

PART 3 – HPMA TIER 3 OPERATIONAL REINFORCEMENT

To be promulgated

PART 4 – HPMA TIER 4 ORGANIZATIONAL PERFORMANCE

To be promulgated

Human Performance in Military Aviation

PART 1 – HPMA CORE CONTENT

Introduction

"We are what we repeatedly do. Excellence, then, is not an act but a habit."
- Aristotle

Aviation training programs have historically focused primarily on the technical aspects of our jobs, with particular emphasis placed on individual performance and problem solving capabilities. In the past, it was considered a sign of weakness for someone to seek the input, or assistance, of other team members. However, over time, attitudes have evolved and people have started to realize that performance depends on much more than just one individual's ability to get the job done. True effectiveness relies on both individual and team performance. The integration of our people into a cohesive team is considerably more important than focusing solely on individual performance. The aim of the Human Performance in Military Aviation (HPMA) program is:

"Increased operational effectiveness through individual and team performance training"

The HPMA program plans on achieving this aim by:

- Providing you with the knowledge to improve performance in yourself and others;
- Providing you with some useful skills (tools) that will enhance human performance; and
- Promoting a professional attitude committed to continuous improvement.

What is HPMA?

Many of you may have already participated in Crew Resource Management (CRM), Human Performance in Maintenance (HPIM), or Team Resource Management (TRM) training. These programs originated out of a desire to reduce "human error" in aviation. HPMA is not a radical departure from these programs and utilizes many of the same concepts. In fact, in some instances, HPMA goes even further than these traditional programs by developing observable behaviours that can be learned, practised, and evaluated. Unlike many of these earlier programs, HPMA finally establishes a common standard of human factors training for all aircrew, maintenance, and aerospace control personnel involved in Air Force operations. The principles and concepts of HPMA are universal, yet allow considerable room for customization to fit operational needs. Here are some of the main points to help people understand what HPMA is all about:

- HPMA focuses on the entire aviation system, not just the individual. HPMA involves continuously evaluating our ever-changing environment and realizing that performance can only ever be optimized, not perfected. Change and error

are inevitable in our environment. The HPMA program teaches people to rely on feedback from the environment to adapt to the situation at hand. Instead of simply focusing on one particular issue, HPMA looks at relationships within the aviation system to see how they affect one another.

- ✈ It is our desire that HPMA become part of everything we do. HPMA should be integrated into all aspects of training and day-to-day operations. To facilitate this process, HPMA will be introduced to personnel at the basic occupational level, and reinforced as an individual progresses through training. Ultimately, HPMA will become part of our military culture…the way we do business!

- ✈ HPMA walks parallel to Flight Safety. The intent of HPMA is to improve operational effectiveness through individual and team performance training. Therefore, as performance increases, we should expect to see increased safety as well. It is our hope that improved Flight Safety will be a by-product of HPMA. While we see these two programs as being of different focus, they are highly complementary.

HPMA Course Content

The material presented in the HPMA program is by no means all-inclusive. The material presented in this course is simply a starting point for future training and education. This portion of the HPMA program focuses on fundamental concepts. More specialized material will be produced to meet the needs of the training and operational communities. The basic "core" of the HPMA course includes the following topics:

- ✈ Threat & Error Management - both are inevitable in military aviation. In order to optimize performance, we must actively try to AVOID, TRAP, or MITIGATE (reduce the severity) the consequences of threats and errors.

- ✈ Decision Making Process - The decision making process will be broken down into it's basic components and a practical decision making tool will be reinforced throughout the course. The aim is to improve decision-making in yourself and others.

- ✈ Individual Human Factors - Some of the basic individual human factors most prevalent in the military will be discussed. People will learn the importance of these factors, as well as learning countermeasures, to help deal with this barriers to effective performance.

- ✈ Rules, Regulations, and Standard Operating Procedures (SOPs) - This module will highlight the importance of rules, regulations, and SOPs and how they support effective performance.

- ✈ Communications - Communication will be tied back to the decision making process. Individuals have to communicate to make sure other team members

share the share goals, perceptions, etc. Essential communication skills will be presented, as well as, a practical communication tool that can be used by peers, subordinates, and superiors.

- Situational Awareness (SA) - A keen understanding of what is going on around us is a vital to effective performance. Situational Awareness will be broken down into its basic components, making it easier to observe and evaluate. This module will also provide some tools that will help us to develop and maintain SA, as well as what to do if situational awareness is lost.

- Task & Workload Management - Performance is most likely to be compromised when there is some sense of urgency (real or perceived). Time management is critical to effectively handling multiple, or complex tasks. Knowing how much time is available will determine how in-depth you can go into the decision making process.

- Team Performance - The importance of building an effective team is highlighted throughout this course. This module will focus on Leadership/Followership and how to build effective teams.

"Why am I here?"

Risk is inherent in everything we do. This is particularly true in the field of military aviation. On any given day, we face a number of challenges, making our jobs more difficult. The fact that you are reading this right now means that you have managed to deal with those difficult situations up to now. So why do professionals like us need "Human Performance" training? After all, we don't make mistakes…Sound familiar? History is full of examples of the most experienced personnel making fatal mistakes that could have been avoided. HPMA is designed to provide you with some essential tools that will make you better at your job, and also reduce the chances that you will make a fatal mistake.

Military aviation has come a long way since the early days. It used to be common to hear of accidents involving military aircraft. Over the years, we have learned from the past to become safer and better at our jobs. Today, we have a remarkably low accident rate. Despite the low accident rate, one factor continues to remain fairly significant. Personnel are still the single greatest cause of accidents and incidents in our Air Force. This is fairly typical across the entire aviation world. Most accident statistics show that personnel account for anywhere from 60-80% of all accidents and/or incidents. HPMA addresses this issue by targeting the "weakest link" in the system…the human. If we can become more effective at our jobs, we should see a reduction in these astonishing figures. There is no 100% cure, but HPMA is a start.

The Basic Concepts of HPMA

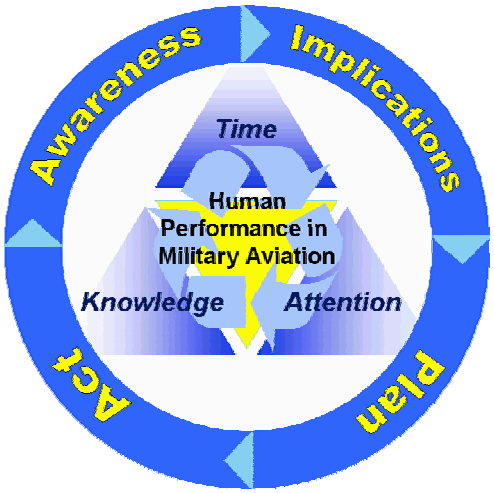
Human performance requires humans to manage three critical resources:

- **Time** – The amount of time available;
- **Attention** – Where our attention is focused, or should be focused; and
- **Knowledge** – The knowledge we possess as well as our understanding of the current situation.

The HPMA program attempts to teach people the importance of carefully managing these three resources in any given situation. HPMA helps people to…

- Maximize awareness of their surroundings, potential hazards, and goals.
- Think through the implications of the situation and the possible choices.
- Formulate a plan based on the first two steps (revising/adapting as necessary).
- Act on that plan.

Put it all together…and you get the "AIPA" Model



This image represents the logo for HPMA and also serves as your decision-making tool. It represents having to manage the three critical resources (in the middle) in order to employ the decision-making process (the outer ring). Throughout the HPMA program, you will see this tool over and over again so you become comfortable employing this methodical approach to decision-making.

As you look at this model, you may find that it isn't that different than what you are already doing. This model simply formalizes the process a little, making it easy to develop as a habit, allows us to communicate effectively, and also enables us to troubleshoot the decision-making process.

How does "AIPA" Work?

In every situation, we have to accurately assess the time available in order to attend to the right information. Attending to the right information gives personnel the knowledge they need in order to make an effective decision.

You will also notice that the circle keeps going around. The reason is fairly straight forward…the situation is always changing – we have to adapt! It is always an on-going process.

- We must be aware of the situation;
- We think of the implications of the situation;
- We devise a plan of action; and
- We act based on our plan.

Once we have "Acted", we need to return back to the Awareness step and reinitiate the process…By returning to AWARENESS, you are seeking feedback to determine whether or not your decision is working. The presence of feedback (monitoring) makes AIPA a simple error-correcting model that can be used in almost any situation. That is one of the most important aspects of HPMA, obtaining feedback to "close the loop". We will discuss this in greater detail in the decision-making module.

Your Mission

As you go through the HPMA Handbook, try to identify opportunities in your daily life that could benefit from the tools that HPMA has to offer. These opportunities are all around us, and we should be constantly seeking to improve performance in ourselves, and others.

Human Performance in Military Aviation

Module 1

Threat and Error Management

Introduction

The underlying theme of HPMA is “Threat and Error Management”. Simply put, threat and error are inevitable in military aviation. It’s one of the things that make our jobs exciting. In order to optimize performance, and reduce the potential for mishap, we must learn how to recognize and manage the threats and errors that we face on a daily basis.

This module is largely based on the works of Dr Bob Helmreich (University of Texas), a pioneer in the field of threat and error management, and the Human Factors section of DRDC. Dr. Helmreich’s work has lead to an entire revolution in Human Factors training that we intend to continue. The threat and error management tools provided in this module will assist you in virtually all aspects of your job. Since the foundation of this module is largely based on a number of works from Dr. Helmreich, academic references will be minimized.

The following quote emphasizes the fact that even the most experienced people make mistakes.

> When anyone asks me how I can best describe my experience in nearly forty years at sea, I merely say, uneventful. Of course there have been winter gales, and storms and fog and the like. But in all my experience, I have never been in any accident ... or any sort worth speaking about. I have seen but one vessel in distress in all my years at sea. I never saw a wreck and never have been wrecked nor was I ever in any predicament that threatened to end in disaster of any sort.
>
> - *Edward John Smith, 1907, Captain of the RMS Titanic*

It is our feeling that HPMA training should help reduce the chance that you, or any part of the Air Force team, makes a critical error that becomes their legacy…

Module Objective

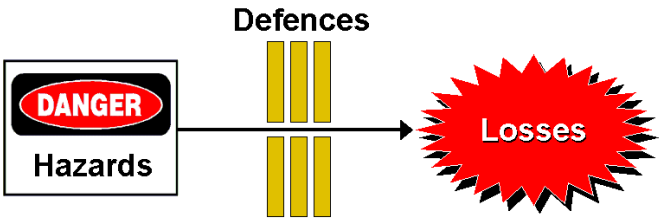
At the completion of this module, you will be able to employ basic principles that will help you recognize and manage threat and error in military aviation.

Module Content

1.1 The Challenges of Military Aviation

Military aviation is characterized by complex tasks, often with severe time constraints. The nature of our work environment means that we must deal with a variety of hazards on a daily basis. In order to prevent these hazards from affecting performance, or becoming losses (mishaps), we must develop and employ effective system defences. These defences come in a variety of forms: rules, regulations, standard operating procedures, training, supervision, etc. Some of these defences may seem redundant, but there is a simple reason for that - very seldom will one "magic bullet" be the solution to all our problems. We must have additional defences in case a hazard makes it past the first line of defence. Multiple layers, or defences, will ultimately help ensure hazards do not result in losses. This is where HPMA really becomes important. No matter how effective the defences are…WE are the last line of defence. Regardless of the defences in place, you must be alert to problems and intervene when required to prevent a degradation of performance, or a mishap from occurring.

Figure 1.1[1]



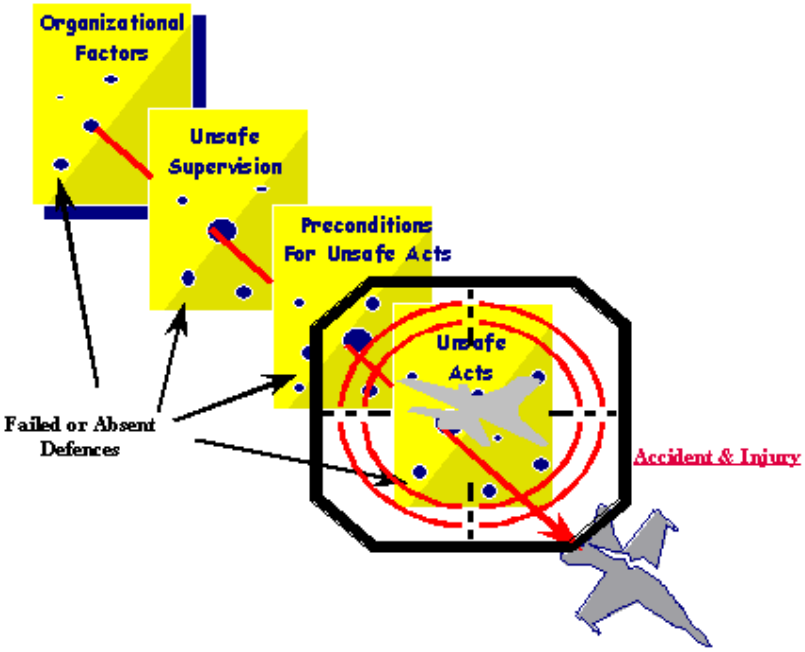
1.2 Reason's "Swiss Cheese" Model

Like dominoes stacked in sequence, mishaps are the end result of a series of errors. A professor from the University of Manchester, Dr. James Reason, developed the "Swiss Cheese" model to explain this concept. According to Dr. Reason, we must develop a

[1] James Reason (1997). *Managing the Risks of Organizational Accidents*. Aldershot: Ashgate.

system that recognizes that there will be “holes” in our defences. In some circumstances, adding another layer may be all that is required. Dr. Reason contends that there are a number of “latent” and “active” failures lurking in our midst. It is important to identify these potential failures and develop barriers to eliminate, or reduce, them if possible. Latent defences typically include things such as: organizational factors, unsafe supervision, and preconditions for unsafe acts. These errors often lay dormant for a long time, perhaps years. Active failures are the actions or inactions believed to actually cause the incident/accident. These are the things that we typically focus our attention on: the UNSAFE ACTS. These failures are often referred to as “pilot error” or “human error”, and traditionally receive the most attention because they often end in immediate, and sometimes, tragic consequences. While active failures are usually the last piece of the puzzle, they are rarely the first or only piece. The various “layers” of Reason’s Swiss Cheese model are as follows:

Fig 1.2 Reason’s Swiss Cheese Model[2]



HPMA training attempts to address all the elements of this model with focused training at the various levels of the organization. Tier 4 of the HPMA program specifically targets some of the deeper organizational issues (latent failures). Tiers 1-3 of HPMA training are specifically aimed at helping reduce the active failures (unsafe acts) that people are likely to commit. HPMA will attempt to plug the holes that exist in the various levels of our organization, before they result in serious degradation of performance, or worse…. The HPMA program takes a *proactive* approach, training people how to recognize the potential for these failures and how to take the appropriate measures *before* anything happens. If we can train our personnel to recognize problem areas as

[2] OPNAV 3750.6R (Appendix O). *Human Factors Analysis and Classification System (HFACs)*: A Human Error Approach to Accident Investigation.

they are developing, then we will become less reactive. Rather than simply responding to problems that have already occurred we want to avoid problems before they occur!

1.3 Threat and Error Management

Military aviation requires a cohesive team, in the air and on the ground, to accomplish its goals. Like machines, human performance has thresholds and upper limits beyond which performance is compromised (errors). The two primary reasons that HPMA focuses on Threat and Error Management are as follows:

1. Both are inevitable in military aviation; and
2. Everyday you face a variety of risk caused by threat and error.

Before we go any further, let's define "threat" and error."

- Threat – Originates outside our influence but requires active management to prevent them from having negative consequences on performance and safety.

- Error – An action or inaction that leads to deviation from crew, team, or organizational intentions or expectations.

Threat and error are everywhere, coming from a variety of different sources. They usually serve as a pre-cursor to more serious events. Errors in the operational context tend to reduce the margin of safety and increase the probability of incidents or accidents. We are most likely to see errors occurring when the expected level of performance cannot be achieved because:

1. The mind is not actively engaged in the process, for a number of reasons;
    a. Fatigue;
    b. Stress;
    c. Work underload;
    d. Distractions; and
    e. A variety of other factors.

2. The expected level of performance is too high.
    a. Excessively high workload;
    b. Inadequate training;
    c. Unrealistic performance goals; or
    d. Excessive amounts of information to process.

Interestingly enough, traditional human factors programs like Crew Resource Management (CRM) and Human Performance in Maintenance (HPIM) were originally developed to reduce human error in the aviation arena. Over the years, the understanding of these original goals has faded. Many people have come to view this type of program as "teamwork" training. While effective teamwork is clearly important, it

is not the primary goal of HPMA. If we focus on learning to identify threats and errors, it will also help us to identify effective countermeasures. If we can learn how to detect, or recognize threat and error, we can learn how to combat it. This will result in improved operational effectiveness and, ultimately, increased teamwork, better communications, etc. As we begin the HPMA program, it is important to remember…"To err is human."

Getting people to admit that they make errors is the most important step towards effective error management. "Human beings by their very nature make mistakes; therefore, it is unreasonable to expect error-free human performance".[3] It is hard to dispute the universality of human error. It is everywhere. HPMA focuses on this limitation, and tries to ensure that the safest and most effective people are working in the system. Here are some things to remember about "Error"...

- We all make errors (mistakes).
- There are different kinds of errors.
- There are different solutions.
- Being proactive is much better than reactive.
- **Everyone** must do his or her part to combat error.

1.4 Types of Error[4]

Research by the University of Texas has shown that the errors people make can usually be classified into one of five categories. These errors are important because they have the potential to adversely affect performance, or cause a mishap. The five error types are as follows:

1. Procedural Errors
   - These types of errors are usually slips, lapses, and mistakes where the individual/team intended to follow procedures but made an error in execution (of regulations or procedures).
   - These errors may include incorrect entries in a flight management computer, unintentionally skipping an item on a checklist, or forgetting to do a certain step in a procedure.
   - In these cases, the intention is correct but the execution is flawed.
   - May indicate poor workload management skills and/or poor procedural discipline.

2. Communication Errors
   - Any error in the communication process.
   - May include missing information or some type of misinterpretation.

[3] Shappell, S. A., & Wiegmann, D.A. (1997). A human error approach to accident investigation: the taxonomy of unsafe operations. *The International Journal of Aviation Psychology, 7(*4), 269–291.
[4] Klinect, J.R., Wilhelm, J.A., & Helmreich, R.L. (1999). Threat and error management: Data from line operations safety audits. In *Proceedings of the Tenth International Symposium on Aviation Psychology* (pp. 683-688). Columbus, OH: The Ohio State University.

- This may reflect inadequate HPMA training (monitoring and challenging) or it may indicate complacency. It may also highlight a need to clarify the terminology to be used.

3. Proficiency errors
   - Reflected in events where one or more team members lack the knowledge or skill to perform a needed action.
   - This type of error usually suggests a need for better instruction, higher standards, or better monitoring by supervisors.

4. Operational decision errors
   - These errors reflect situations that are not covered by SOPs.
   - Faced with a situation, the individual/team made a decision that unnecessarily increased the level of risk.
   - This may indicate need for dedicated HPMA training focusing on decision-making and risk assessment.

5. Intentional non-compliance errors
   - These are conscious violations of rules, regulations, or SOPs.
   - Examples would be intentionally skipping items in a maintenance procedure or checklist. These are often considered "short-cuts".
   - Errors of this nature may indicate poor procedures, weak leadership within a team, and/or a culture of non-compliance.

Although the five error types were identified from observations of aircrew, parallels in the maintenance and aerospace controller environment are almost immediately evident. Generally, we can say that these 5 types of error occur in the aviation environment. If you can learn to recognize these errors, you will also be able to take measures to reduce their frequency.

Of particular interest in this study was the extremely high number of intentional non-compliance errors observed. In fact, 54% of the total errors observed were intentional non-compliance. These errors ranged from the trivial to more important. This raises the question, "Why would these errors occur so frequently?" The most probable answer is that people generally feel they can cut corners or take short cuts because of their level of experience. In essence, people often feel they can "get away with it" because they know what they are doing. While it is true that people can often get away with small issues, it does breed non-compliance within the organization, and potentially more serious problems. Less experienced people may feel justified to take these same short cuts without a true understanding of the severity of the consequences. Intentional non-compliance can also cause an individual to push the system, because they have been successful in the past. This is a very dangerous attitude to have. Procedures serve a very specific purpose, and are only effective when followed.

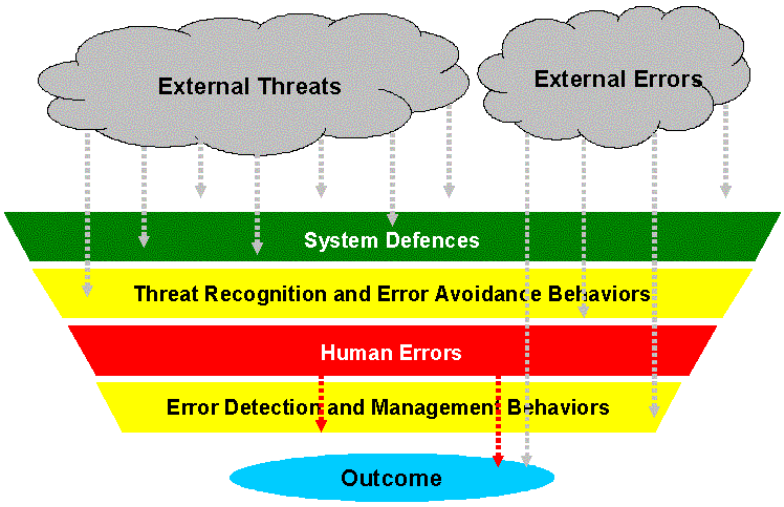
This same study also uncovered another very interesting point. Proficiency and decision-making errors were the least often observed of all the error types. However,

the results indicate that they are also the most difficult to manage. Decision-making and proficiency-related errors were more likely to lead to "something bad" than any of the other error types. While only 5% of the errors were proficiency-related, 69% of these errors led to some type of negative consequence. Decision-making errors accounted for 6% of the total errors, yet 43% of these errors led to negative consequences. This shows us that we need to pay particular attention to these errors.

What this tells us is that the importance of developing the highest level of technical skill cannot be overemphasized. As professionals, we should take every opportunity available to hone our skills. In order to address the decision-making issue, HPMA places a great deal of importance on providing you with an effective process, rather than one magic solution, to help overcome the problems you will encounter on the job.

1.5 The Rain of Threat and Error

Everyday we face a variety of internal and external threats and errors that can potentially impact our performance. Some of these threats and errors occur more than others, and often, they are beyond our control. For example, another person's error may be a threat to you! We rely on system defences (i.e. SOPs, supervision, training, etc.), to "catch" these "rain drops" so they don't adversely affect your performance. As we discussed, defences are not failsafe, and there is the potential that some "drops" will make it through the first line of defence. As a result, we must learn to recognize threats, and how to avoid errors. We may also make the situation worse, by committing our own errors. The trick then, is to be able to detect, and manage these errors before they have any negative consequences. Any "drops" that make it through this last line of defence will affect our performance. HPMA will prevent this rain of threat and error from adversely impacting our performance.



We must have a sound understanding of the risks we face in order to prepare for them. One of the best ways to do that is to identify what are called "Windows of Risk", areas where the level of risk that you may face on the job goes up. Each job consists of "windows of risk," and you may encounter several of them during any one task, shift, or mission. For example, an aircraft operating close to the ground, repairing a complex aircraft problem, or a controller handling an emergency while there is a lot of traffic to coordinate. All of these situations represent a window of risk. [See a detailed description of aircrew (Annex A), maintenance (Annex B), and aerospace controller (Annex C) windows of risk located at the end of this module.] We must identify the

threats and errors that may occur within a window of risk and be prepared for them. In order to operate safely in the window of risk we need to prepare by reducing the number of decisions that must occur. For example, planning and briefing activities prior to commencement will help ensure everyone understands what will happen if something goes wrong with the task. If you plan for the expected, and the unexpected, it will make things much easier if things go wrong, and you need to act swiftly to reduce the risk.

Your Challenge is to:

- Actively identify potential threat and error;
- Communicate these threats and errors;
- Develop and carry out a plan to AVOID, TRAP and MITIGATE threat and error.

The AIPA decision-making model provides you with a mental tool to recognize and manage threat and error.

1.6 Threat and Error Management Strategies

Since error is inevitable, HPMA can be seen as a set of threat and error countermeasures, with three lines of defence. The three lines of defence are as follows:

1. Avoid
   - First and foremost! Attempt to eliminate the threat and error through the application of HPMA skills, such as effective planning, training, etc.

2. Trap
   - Catch and correct threats or errors before they have an operational impact.

3. Mitigate
   - Reduce the effects of threat or error once they have occurred.
   - Essentially, this step involves recovering from an earlier error.

Effective threat and error management skills do not differ greatly between the three levels. The main difference is simply the time in which the actions are taken. We try to "Avoid" threat and error from happening (before) if possible. If that fails, and it will at some point, we must identify and "Trap" the threats and errors before they lead to something undesirable (at the time of the error). Lastly, we may have to take action to "Mitigate" the consequences of a threat that cannot be avoided or an error that has already happened

When an error does occur, there are essentially three typical responses:[5]

1. The error is trapped
    - The error is detected, and actively managed.
    - Occurs approximately 31-36% of the time.

2. The error is exacerbated
    - The error has been detected, and then mismanaged (action or inaction).
    - Occurred in approximately 5-11% of the time.
    - The result is an additional error or a condition that could be worse than it was to begin with.

3. There is no Response
    - Occurred the most frequently, approximately 53-64% of the time.
    - Interestingly, 36% of these errors had negative consequences.

It is particularly interesting to note that the majority of errors were not actioned! It is true…"What you don't know CAN kill you!"

Error Avoidance Strategies

The first step in managing threat and error is to develop effective avoidance strategies. The following are some suggestions that will help maximize your barriers/defences and minimize your vulnerabilities:

- Team Building;
    - Effective Leadership – Someone who is in command, decisive, and encourages participation.
    - Effective Communications – Communication channels are clearly established and maintained. Team members are encouraged to be assertive, speak up and ask questions. This is particularly important during the team formation phase (i.e. briefing).

- Effective Planning
    - Briefings – High quality briefings help align goals and allocate duties.
    - Plans Stated and Acknowledged – Make sure that all parties understand the goal.
    - Workload Assignment – Roles and responsibilities well defined. Gather your resources before the task and maximize redundancies. Establishing priorities at the onset will help keep people focused on the goal; and
    - Contingency Management – Strategies to anticipate and manage potential threats – "what ifs?"

[5] NOTE: Percentages determined during University of Texas LOSA.

- Follow Policies and Procedures (SOPs)
  - If you *must* deviate from SOPs, then very carefully work through the decision – maximum awareness, work through implications, plan thoroughly, act, maintain feedback and adapt.

- Automation
  - The ability to automate functions can help reduce the potential for error as well as freeing up our attention for focusing on other things. Unfortunately, it comes at a price. It may mean that you are more likely to make different types of errors (namely monitoring and supervising the highly reliable system). Employ it wisely.
- Proficiency
  - Develop the highest level of personal skill. This will enable you to carry out your duties easier, with less formal concentration, freeing up your valuable attention resources (able to attend to different things).

- Learn from the past…
  - There is no sense trying to make all the mistakes yourself. Take advantage of the experience of others to build your own error avoidance strategies.

Trapping Strategies

No matter how prepared we are for threat and error, we will still encounter them. Therefore, we need to develop effective countermeasures to prevent them from adversely affecting our operations. Here are a few strategies that will help "trap" threat and error before it has any negative consequences:

- Follow the rules, regulations, and standard operating procedures.

- Remain ahead of the curve.
  - Always look to the future. Ask yourself, "What is coming next?" Anticipation is vital to effective performance.

- Stay vigilant.
  - Be aware that certain activities will challenge your ability to stay focused on the task at hand. Plan accordingly, and try to stay mentally engaged in the process.

- Monitor yourself and others.
  - Look for the potential for error in yourself and others. For example, if something unexpected occurs, recognize that your plan has to be

modified. Remember that threat and error are lurking in many places.

- Actively seek and provide feedback!

The most important tool in Error Management is FEEDBACK. FEEDBACK closes the loop, builds situational awareness, and allows you to adapt to the changing situation. The newfound knowledge you gain through feedback will help you to AVOID any additional errors. Always look for feedback from your surroundings - people, equipment, environment, etc. Ask the right questions, speak up when necessary, and make your decisions based on a process.

Mitigating Strategies

It should be clear to you that the best strategy for mitigating the consequences of threat or error is to avoid them all together. This isn't always possible so we need to establish ways in which to trap the error when it occurs so it doesn't make the situation worse. Unfortunately, even the most professional aircrew, groundcrew, and aerospace controllers will be forced to deal with serious situations that could adversely impact performance, or result in a mishap. Here are a few important strategies to keep in mind that will help mitigate the consequences of threat and error:

- Always have a back-up plan!
  - It is important to recognize that threat and error are inevitable, and that we must always be ready.

- If you notice a problem or see something wrong, speak up!
  - Make sure that everyone working with you has a clear understanding of the problem and then use the "AIPA" model to ensure everyone shares a common mental model of the situation.

- If possible, remove the danger!
  - Give yourself some time. Create some space between yourself and the threat. If things are going bad, try to give yourself enough time to deal with the situation (slow down, stop, etc.).

- Assess your time available.
  - Determine how much time can be allocated to the task. Where must you focus your attention? What critical pieces of information do you require to make a sound decision? Can you sacrifice accuracy to reduce the time pressure or can you increase your time available?

- Evaluate and adapt to the situation using the AIPA model (discussed in depth in next module).
  - Awareness: What's going on? What is happening?

- Implications: What does it mean to us? How will it affect us?
- Plan: What are our options? Is the goal still possible or must it change?
- Act: Duties are clearly allocated and the plan is put into action. Make sure to obtain and maintain feedback (awareness) to determine if the plan is working as anticipated. Adapt accordingly.

1.7 Conclusion

In summary, threat and error management is an important part of our lives in military aviation. Threat and error are always around us, waiting for an opportunity when all the failures in our defences line up. Ultimately, it comes down to a question of time - before, during, and after a threat or error occurs.

Our first priority should always be to try to avoid threat and error all together. We do this by developing the highest level of skill, developing a strong team that communicates freely, and by anticipating “windows of risk” and being prepared for them before entering. If we have been unable to avoid threat or error, we must be able to trap them before they become consequential. This is accomplished by watching for signs of degraded performance in yourselves and others, speaking up when something is wrong or out of the ordinary. All the planning in the world cannot guarantee that you will not be faced with some form of threat or error. When a threat or error has gone undetected, it is still our responsibility to react appropriately to prevent the situation from worsening and resulting in negative consequences. We can do that by always leaving a way out. That requires you to have a back-up plan that identifies what you will do if things go wrong. Try to reduce the number of decisions that you make within a window of risk, be flexible and ready to adapt to the ever-changing situation.

Remember the three levels of threat and error management and what each level represents:

1. Avoid – Be prepared;
2. Trap – Watch for errors; &
3. Mitigate – Always have a back-up plan! Adapt quickly.

Become familiar with each level and start applying it to your job. Look for areas where there is room for improvement and ask yourself if there is anything else you could be doing to promote threat and error management within your particular organization.

Annex A – Aircrew "Windows of Risk"

(Source: Flight Safety Foundation Controlled Flight into Terrain (CFIT) Course

One of the most obvious windows of risk for aircrew is the take-off, landing, and approach phase of flight. In particular, the risk is further elevated when aircraft operate in that window, and are below 2000' Above Ground Level. To further investigate this phenomenon, the Flight Safety Foundation embarked on a study of 40 civilian accidents that occurred between 1986 and 1990. The research revealed some interesting facts. While this research is based on civilian accidents, there are many parallels with the military track record as well. Of particular interest is to note the percentage of accidents during the various phases of flight, along with their respective percentage of typical flight time (i.e. the average amount of time spent in a particular phase). Here are the results of their research:

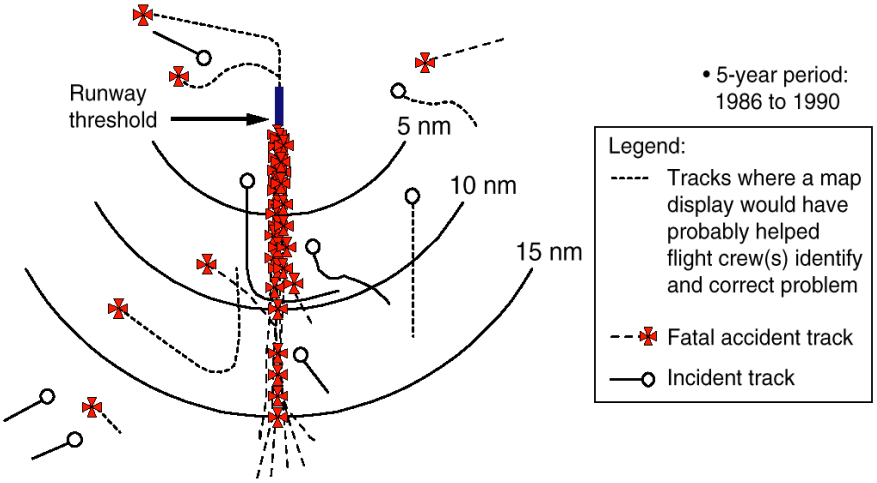
Phase of Flight	% of accidents	% of total flight time
Landing	**16.6%**	**1%**
Final Approach	**24.8%**	**3%**
Initial Approach	12.3%	11%
Descent	7.2%	10%
Cruise	4.5%	60%
Climb	18.1%	14%
Takeoff	**14.5%**	**1%**

Note: Total number of accidents investigated – 40.

From this research, we can see the definite window of risk that exists around aerodromes, accounting for more than 55% of the accidents in the entire study. More disturbing is the fact that these three phases (takeoff, landing, final approach) accounted for only 5% of total flying time! This should serve as a warning for all of you. You must exercise extreme vigilance when operating in this window of risk, as the potential for error is extremely high.

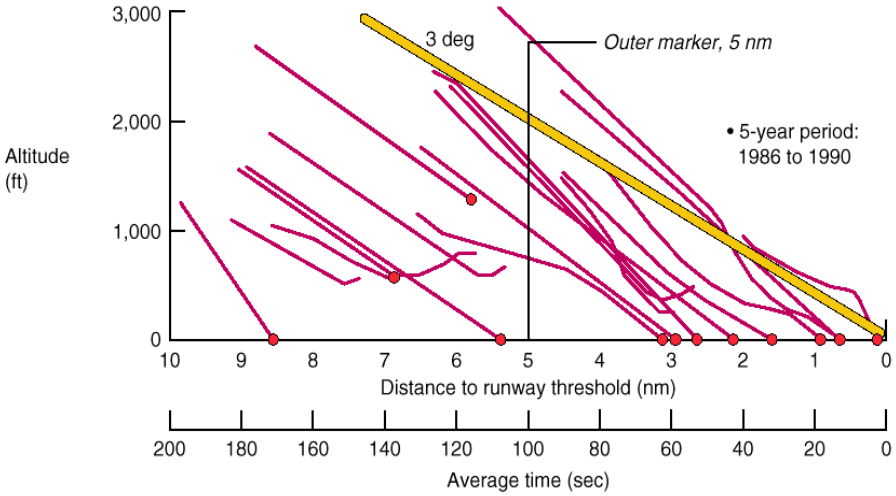
During this study, the Flight Safety Foundation was particularly interested in identifying any trends in these Controlled Flight into Terrain (CFIT) accidents. CFIT accidents involve a flyable aircraft being flown into the ground (or water) because the flightcrew failed to properly monitor the aircraft's flight path. Essentially, no one is flying the aircraft. If we go into greater depth, we can look at the actual accident plots so we can identify the trends.

Horizontal View – CFIT Accidents



Did you notice any trends? There are two of them. First of all, the accidents are highly concentrated along the extended centreline of the runway. For the most part, these aircraft appeared to be established on the approach path. Secondly, the number of accidents increases in frequency as they get closer to the runway. Now, let's have a look at the profile view from the same accident study.

Profile View – CFIT Accidents



Do you notice any trends in this graphic? Notice the angle of the flight paths? It is fairly safe to say that the flight paths resemble a 3 degree glideslope/descent profile. Knowing that, which instrument approach do you think presents the greatest risk of CFIT? Did you say ILS? That is what most people would tend to think. Actually, the VOR/DME (or TACAN) approach is the #1 "CFIT killer." The Flight Safety Foundation found that VOR/DME approaches accounted for more than 70% of these CFIT accidents. The reason lies in the actual elements of the approach. Non-precision approaches usually consist of multiple step-downs, and a large number of CFIT

accidents are the result of aircrew forgetting to level off at one of the step-downs. The reason? It likely has something to do with the way we typically fly an approach. Most aircrew usually trim the aircraft for a nice controlled descent between step-downs. This descent profile often resembles a 3 degree descent profile. The problem is further complicated at night, or during instrument meteorological conditions (IMC). Aircrew must realize that when you conduct a non-precision approach into an unfamiliar airport, at night, or in clouds, you have not stacked the odds in your favour. Be aware of the dangers when you enter this type of window of risk, and make sure you have taken the appropriate precautionary measures.

While this study was based on civilian accidents, the CF has experienced some similar trends as well. From 1988 to 1997, the CF had a total of 46 CFIT accidents, accounting for 42% of the 110 air accidents that occurred during that time frame. These accidents resulted in 31 fatalities and the loss of 20 aircraft.

Phase of Flight	% of accidents
Approach/Landing	**47.8%**
Cruise (enroute)	8.7%
Operational	**32.7%**
Takeoff/Departure	**10.8%**

Source: CFIT Presentation by Maj. Gibbs (former WFSO, 19 Wing).

Both these studies clearly highlight the window of risk that typically surrounds an airport. The take-off, landing, and approach window of risk has been responsible for far too many losses. Unlike our civilian counterparts, we face a variety of additional windows of risk, such as tactical flying, ASW operations, SAR, AAR, dipping at night, CAS, and a lot of others. In the study conducted by Maj. Gibbs, the operational phase accounted for more than 30% of CFIT accidents during the 10-year period mentioned above. We must maintain a healthy respect for any, and all, of these windows of risk. We must be as prepared as possible prior to entering a window of risk, in order to minimize decision times while operating within one of these windows. For example, plan and brief the sequence while still at altitude. Brief the expectations and what to do if things don't match those expectations. When things go wrong inside a window of risk, you should be able to act swiftly, relying on an earlier decision (while outside of the window). Another good example is an ILS approach. Before you shoot the approach, you have already established that if you are not visual at minimums, you will overshoot. The same approach can be applied to a variety of situations. It is also important that any crewmember capable of monitoring the flight path keeps an eye on what is happening while working in one of the windows of risk. It's your life too!

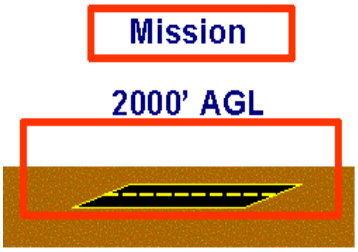
Annex B – Maintenance "Windows of Risk"

The working environment of a technician is full of risk. As you approach any situation, or task, you should attempt to identify the "window of risk." Here are a couple of windows of risk. Can you identify the areas of concern in each of these windows of risk? What hazards exist in each of these windows of risk?

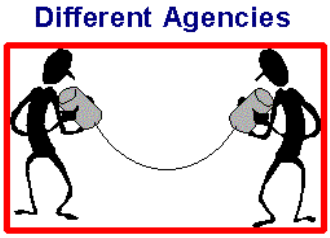
From the above examples, we can identify such hazards as jet intakes, jet blast, weapons, ejection seats, chaff/flares, AMSE, turning rotors, downwash, propellers, prop blast, etc. Even the environment can change the window of risk. For example, there are distinct concerns when operating in the heat, cold, desert, at night, unprepared surfaces, etc. The maintenance environment is also full of less obvious "Windows" such as installations of engines, functional inspections, etc. They all present a certain potential for threat and error that must be identified. Your challenge is to identify the potential for threat and error, communicate those threats and errors to the rest of your team, and devise a plan to avoid, trap, or mitigate the consequences of those threats and/or errors. It is important for you to remember that preparation is the key to avoiding threat and error. If you take a few crucial minutes before entering one of these windows of risk, you will be better able to deal with problems that arise. You should try to minimize the amount of decisions that must be made while operating in a window of risk. Then, when something happens, you will be better prepared to deal with that problem, reducing the amount of time necessary to react.

Annex C – Aerospace Controller "Windows of Risk"

In the aerospace controller role, there are also a variety of windows of risk that exist. There are some obvious ones, and some less obvious. Much like aircrew, aerospace controllers must also be concerned about the traditional windows of risk that exist around an airport, as well as those that exist in the operational role (see Annex A). In both of those instances, aerospace controllers have the unique ability to directly monitor the performance of the aircraft, and can alert, or provide direction as required, to ensure an acceptable level of performance.

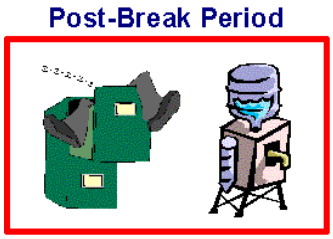


In addition to the window of risk identified above, controllers should be alert for the potential for threat and error in other, less evident aspects of their job. Whenever one agency has to coordinate with another, there is a potential for degraded performance. Controllers must be alert to the fact that some agencies may not be familiar with military aviation, or the intricacies or our operations. Some terminology may differ, presenting an opportunity for confusion or misunderstanding. All personnel must recognize this potential before making contact with another agency, and planning their message to help ensure understanding among all parties.



It is also extremely important for controllers to ensure that handovers to other controllers are adequate. Handovers should: include a thorough briefing of the current situation; confirm the other controller understands the situation; and ensure that the controller is managing the situation effectively prior to leaving the new controller by themselves. This clearly implies a period of monitoring to ensure that the oncoming controller does, in fact, have control of the situation.

The last potential window of risk that we will discuss is one that is very typically overlooked. When you, or anyone else, begins a shift, or comes back from a break period, it will take some time for you to build your situational awareness. Be aware of the potential for error during these instances, and make sure that you receive a proper handover, and exercise additional caution until you are fully "up to speed."



These are simply a few of the windows of risk present in the aerospace controller environment. There are a great deal more windows that exist, and it is up to each of you to identify the potential for threat and error. Develop countermeasures that you can apply on the job, and rely on the concepts and skills that you have learned during your HPMA training.

Human Performance in Military Aviation

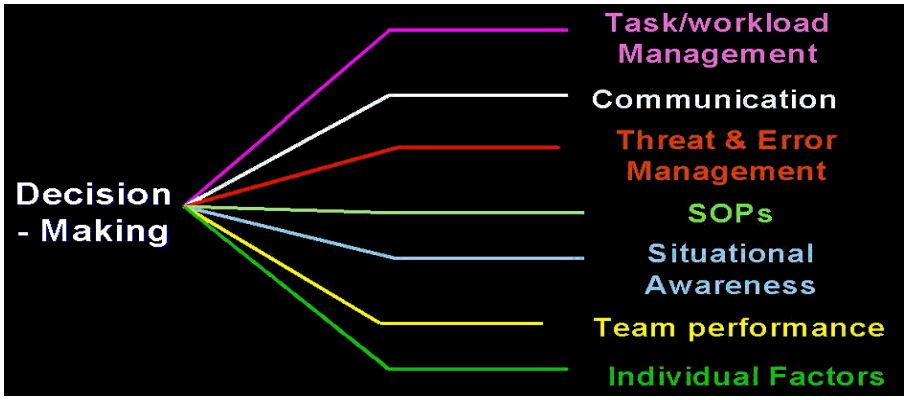
Module 2

Decision- Making

Introduction

Decision-making (DM) effectiveness at all levels – strategic, operational, and tactical – has more impact on performance than any other factor. To illustrate, research has shown that "over 50% of accident-related human errors in the military and civil aviation industry were decisional errors."[1] That is significant! In our jobs, we are constantly making decisions – deciding to do or not to do something, to say or not to say something, etc. So, we can say that decision-making is the critical underlying skill that supports all competent performance and skills. Figure 2.1 shows how each of the elements on the right hand side influence the decisions we make. For that reason, the HPMA program will focus a lot of time and effort on decision-making, and how it can be enhanced in an operational setting. Your task is to develop strategies to overcome the challenges that each situation presents, as you strive for enhanced performance.

Figure 2.1 – Factors that affect Decision-Making



In this module, we will show you *that decision-making is a mental skill that can be analyzed, practiced and improved.* The more you use effective, systematic decision-making practices the more effective your decision-making will become. The AIPA model that has already been introduced will form the basis of this module, and much of the content of this section comes from research conducted by the Human Factors section of Defence Research and Development Canada (DRDC).

[1] Orasunu, J. (1993). *Decision-making in the cockpit.* In Wiener, E. et al (Eds.). Cockpit Resource Management. Toronto: Academic Press.

Module Objectives

The objective of this module is to:

- Highlight the importance of goals in the decision-making process;
- Provide you with tools to effectively manage the time, attention and knowledge aspects of the decision-making process;
- Demonstrate how the decision-making process can be used to analyze and troubleshoot errors; and
- Provide you with a systematic approach to decision-making.

Module Content

2.1 Fundamentals of Decision-Making

We have all made "bad" decisions at some point in the past. Often, we ask ourselves how we could have made such a poor decision in light of the facts that were present. For example, the true story of a technician who decides to check the ground power unit's fuel level using his lighter… All the signs were there but for some reason, they were missed. It's very easy to identify errors in the decision-making process after they occur, but effective threat and error management is about trying to prevent them in the first place. That's the real challenge!

Important tasks are almost always approached in a logical step-by-step manner (i.e. checklists, SOPs, etc.). This reduces the potential for error, increases the quality of the work, and, in the long run, reduces the time involved in arriving at a successful conclusion. The same applies to mental tasks, like decision-making. In fact, most highly effective performers use a systematic approach to decision-making, even though they may not consciously be aware of it.

"Conventional wisdom used to hold that judgment was something you were born with, it couldn't be taught. Although judgment is difficult to put into concrete terms, the elements that go to make up decision-making can be taught to enable [an individual] to render decisions in a rational manner even under stressful conditions where workload is high."

Alkov, R, (1991). *The Naval Safety Center's Aircrew Coordination Training Program*

We are going to present you with a systematic approach to decision-making that uses a logical step-by-step fashion – a "*PROCESS*". By adopting a common decision-making model, or process, it will allow us to:

- Use a common language when discussing decision-making with others;
- Breakdown the decision-making process into observable components, so that instructors, supervisors, peers, etc., will be able to identify where decision-based errors may have occurred, and how to correct them; and
- Improve our own decision-making by making this logical approach a habit.

As you go through this module, try to look for similarities in your own decision-making process. You should also be asking yourself whether or not you are doing everything you possibly can to ensure that your process optimizes the critical ingredients that we are going to discuss. We all have room for improvement, and this module will try to help you make better decisions under a wide range of situations. Remember…

"Always use your superior judgment…
so that you don't have to use your superior skills."

2.2 Goal-setting

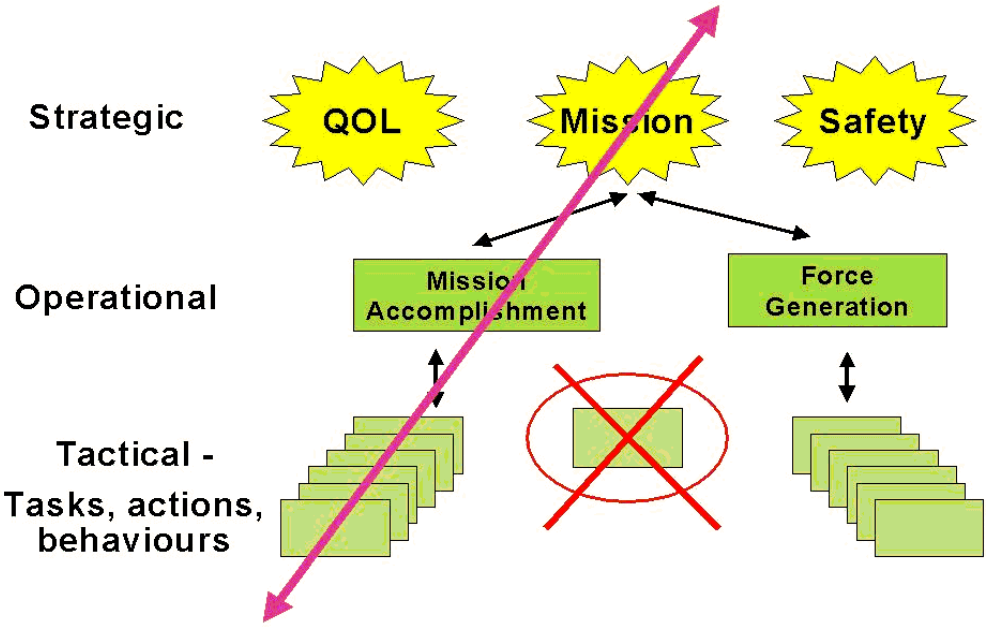
Perhaps the single most important element of effective decision-making is a clearly defined goal. Goals are the reference point, or compass, for the entire process. They give direction and reason for any action. Although having clear goals may seem somewhat obvious, a great deal of research states: "*mistakes in decisions about goals are the greatest single cause of human incompetence."*[2] Most often, people get caught up in their short-term goals, and lose track of the larger, overall objective. Sometimes, we must force ourselves to sit back and re-align our "compass". The following statement describes this phenomenon very well.

[2] Gilbert, T. (1996). *Human Competence*. ISPI: Washington, D.C. P. 109.

> *It is incredibly easy to get caught up in the activity trap. … It is possible to be busy – very busy – without being very effective. If the ladder is leaning against the wrong wall, every step we take just gets us to the wrong place faster. We may be busy, we may be very efficient, but we will also be truly effective only when we begin with the end in mind.*[3]

The first, and most important, step to effective decision-making (and therefore effective performance) is to clearly define, or communicate, the highest-level strategic, or long-term, objectives. When people understand the big picture, they are more likely to realize which subordinate tasks align with the strategic level goals, and require attention. Clearly defined goals help keep people focused on the task at hand. Once strategic level goals are defined, all subordinate goals, tasks, and activities should be aligned with these objectives. It is important to verify whether or not these subordinate tasks and activities do in fact support the higher-level goal. Otherwise, you may be wasting valuable time and energy. The model below illustrates the concept of aligning and prioritizing goals. It also shows tactical level tasks or actions that may draw your attention from the higher-level goal of operational effectiveness (the X'ed out box). If the task or activity cannot be aligned with higher-level goals, perhaps you shouldn't be doing them. However, it can sometimes be difficult to recognize these activities, so be on the lookout.

Figure 2.1 Managing Multiple Goals/Tasks



For each strategic level goal there will be a number of operational level goals/tasks, which in turn provide direction for a variety of tactical level goals. Every sub-goal and task should support some identified higher-level objective and eventually a strategic level objective. Goal alignment is critical - both up and down the chain. We can avoid some of these traps, or dead ends, by challenging ourselves, and the organization

[3] (Stephen Covey, The Seven Habits of Highly Effective People).

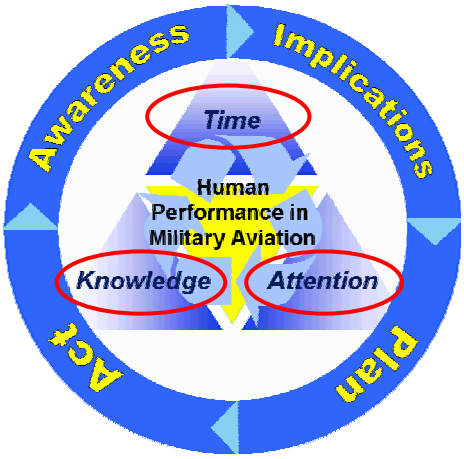
sometimes, to clearly respond to questions such as, “What are we really trying to accomplish here?” “Why are we doing this?” “What is the strategic goal?”

> "There’s no use running if you are on the wrong road."

2.3 The three Critical Mental Resources (Knowledge, Attention and Time,)

In any decision-making scenario, we must manage three critical resources:

1. Knowledge;
2. Attention; and
3. Time



If you can learn to effectively manage these three resources, you are well on your way to effective decision-making.

2.3.1 Critical Resource #1 - Knowledge

Our ability to make effective decisions depends very much on the accuracy of our understanding of the current situation (sometimes called our ‘mental model’). There are two critical aspects of the “knowledge” resource:

- ✈ Long-term knowledge.
  - The ‘expertise’ or experience we bring with us into a situation. This expertise comes from experience, training, education, etc. and should be considered the starting point of effective performance.
  - It includes our knowledge of facts, concepts, procedures, etc. and particularly our goals - what we are trying to achieve.
  - Obviously, the greater our expertise, the more likely we are to make sound decisions. The development of professional knowledge and skill is something we have a great degree of control over. Ensure that you always bring the highest possible level of knowledge about your job to every situation. Always strive to improve.

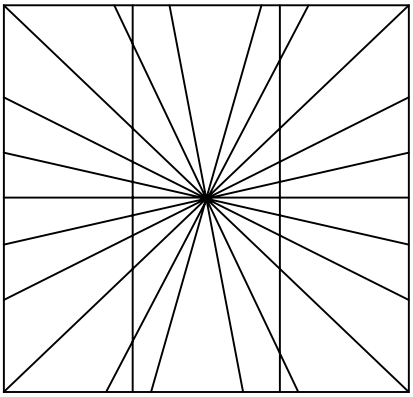
- ✈ Situational knowledge.
  - Situational awareness revolves around perception, or how you interpret what is happening around you.
  - Our situational knowledge is largely determined by the second critical resource that we are going to discuss – ATTENTION.
  - If you are attending to the critical information, you will be better able to make effective decisions. Likewise, if you are not attending to the

important information, your decision-making process will be based on incomplete data and will likely lead to less than optimal decisions being reached.

- Your long-term knowledge also has a great impact on situational knowledge. As people gain expertise and experience, they quickly learn which information is important and which information can be disregarded. This results in effective decisions being made with less time pressure than novices would typically experience.

It is important to realize that we all see the world through our own set of "filters". The way we see the world or our "perception" of reality is never 100% accurate. We never see absolutely everything going on around us, and even then it is simply our interpretation of the surroundings. Human perception is a tricky phenomenon. It is defined as the act of making sense, or developing meaning, from all the information being received by our 5 senses. What we <u>think</u> is happening around us is very much influenced by what we already know (or think we know), what information we are attending to (because this is what we think it is relevant), and what information we are missing (because it is outside of our range of hearing, sight, etc, or we just missed it because we were paying attention to something else perhaps). In short, our brains are always interpreting information from the environment.

<u>An Optical Illusion</u> The radiating spokes create an optical illusion, demonstrating the effects of our perception. Do the vertical lines appear curved? They aren't…



"The eye is not a camera!"

What we perceive to be true, or factual, is not always so. Our perceptions may even "lie" to us. You should consider this when you find yourself in a situation when one or more persons feels strongly about a certain course of action that you do not feel comfortable with. They may see something completely different from you, and therefore their situational knowledge is different than yours. Always strive for a common level of awareness among your team. Actively seek additional information and feedback available from the outside world, and make sure people understand what you are seeing, and vice versa. Remember that your actions will be influenced by your perception of what is actually happening. Errors in knowledge can lead to errors in perception. Errors in perception will quite possibly lead to errors in decisions.

In the early days of aviation, failure to maintain proper spatial orientation when the ground was obscured was originally thought to result from a lack of diligence or an avoidable pilot error, which could be overcome if the pilot tried harder. One pioneer of military aviation was convinced that pilots could not possibly maintain their orientation when the ground was not visible, and was sent to a hospital on two separate occasions to see if he was sane. We now know that reliable spatial orientation in an aircraft when the ground is not visible is an impossible task if pilots must rely exclusively on their senses.

Herschel Leibowitz. From *Human Factors in Aviation*

2.3.2 Critical Resource #2 - Attention

Attention is one of the most important mental resources and in many ways it is also one of the most limiting in regard to effective performance. In simple terms, if we are not attending to a goal or task, it is not being controlled. If it is not being controlled, error is virtually inevitable, and the task is almost certain to fail.

Generally speaking, we can only consciously 'attend' to, or control, one task at a time. At first this statement might seem odd, because our jobs usually require that we manage several tasks – none of us only doing one thing. What is actually happening, however, is that we are 'juggling' tasks – it is rather like trying to keep several balloons in the air with one hand. We can do it, but we must concentrate on each balloon, one at a time, turning our attention to the next, then the next and so on. This simple example highlights the requirement to carefully prioritize; otherwise you will drop the balloons. The result will also be the same if you are to become distracted while trying to concentrate on the most critical balloon. The same thing can happen on the job. Ensuring attention is focussed on the priorities and avoiding distractions is applicable for all performance situations, on and off the job.

This is of course highly dependent on a number of variables such as: How many goals are we juggling at any one time? How complex are the tasks involved in accomplishing the goal? How good are the strategies we have developed to deal with these tasks? How much time is available to us?

Under certain circumstances it can become very easy to overload our attention capacity. High levels of workload can bring us to the saturation point. At some point we all reach our threshold.

Low levels of workload can also be a problem. Complacency, or inattention, can occur when there is not enough going on to fully occupy us. In those circumstances, our

attention may wander away from the immediate task as we start to daydream or doze off. For example, an aerospace controller who is watching a radar scope for long periods of time when there is little activity. It will likely be very hard for that individual to stay focused on the task for any length of time.

Still another attention problem can be described as 'fixation'. This occurs when someone's attention becomes fixated on one task, and they fail to monitor and control other important tasks. The Eastern Airlines Flight 401 crash is a classic case of attention fixation, where three aircrew became absorbed with a malfunctioning light bulb. No one was attending to the primary task of flying the aircraft, and this aircraft slowed descended into the Florida Everglades with three aviation professionals staring at a light bulb... This phenomenon has accounted for a number of accidents, both in the air and on the ground. You must not lose sight of what tasks are really important. Remember your priorities!

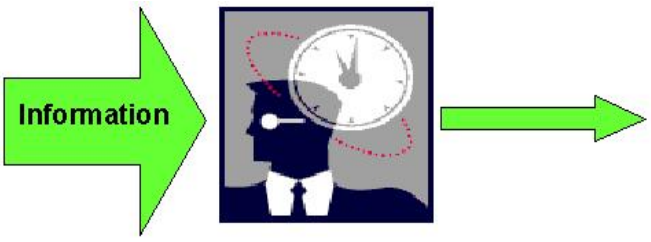
People get into trouble when they stop attending to important goals/tasks, poorly prioritize goals/tasks or get into situations where there is not enough time to deal with all important goals. Their mental models (knowledge) are simply not adequate to handle the tasks required of them, or they do not have enough time to deal with all the goals/tasks that require dealing with. Training, practice and experience can improve attention management.

2.3.3 Critical Resource #3 - Time

Time is the third critical mental resource. If you have lots of time, and only small amounts of information to process, the decision-making process can be quite easy. The decision-making process becomes much more difficult if there is only a short amount of time available, and/or, a lot of information to process. Again, it comes down to a question of priorities. Since attention is a limited resource, we must carefully determine how much time is available, in order to select which items to attend to. If time is critical, you must focus your attention on the most important information and you will have to let some information go unattended.

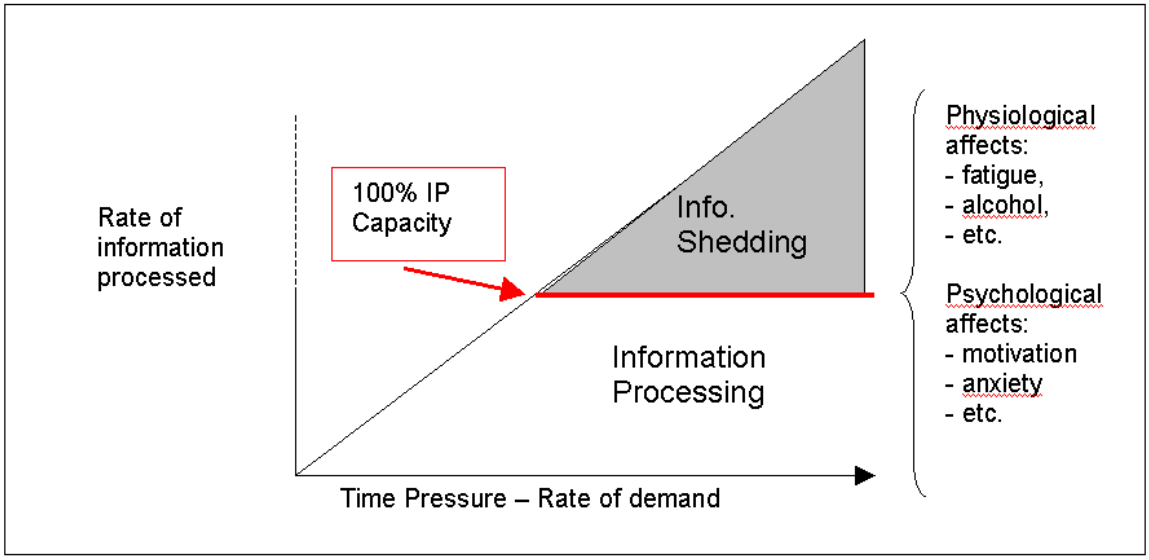
<u>Time pressure results from the amount of time available to make a decision in relationship to the amount of information that has to be processed.</u>

As time pressure increases, it becomes increasingly difficult to make effective decisions. If we are in a situation where there is more information to process than we can possibly manage in the time available, we will begin 'shedding' information. It won't get processed. Hopefully, in this case we are processing the most critical data.



Defence and Research Development Canada (DRDC) uses the Information-Processing (IP) model shown below to illustrate this concept.

Figure 2.2 - The Information Processing (IP) Model[4]



As shown in Figure 2.2, each of us has finite information processing rate or capability, which is relatively consistent.[5] Each person may have different limits, but either way, if that limit is exceeded (i.e. too much information to process), we must either ignore the new information or "shed" (discard) existing information. The potential for error and degraded performance increases drastically as we move beyond our processing limitations and start to shed information.

As you may imagine, certain physiological and psychological states can affect your information processing capacity. Factors, such as fatigue, drugs, anxiety, depression, etc., may decrease your information processing rate. Other factors, such as excitement or motivation may actually increase an individual's information processing rate to some extent.

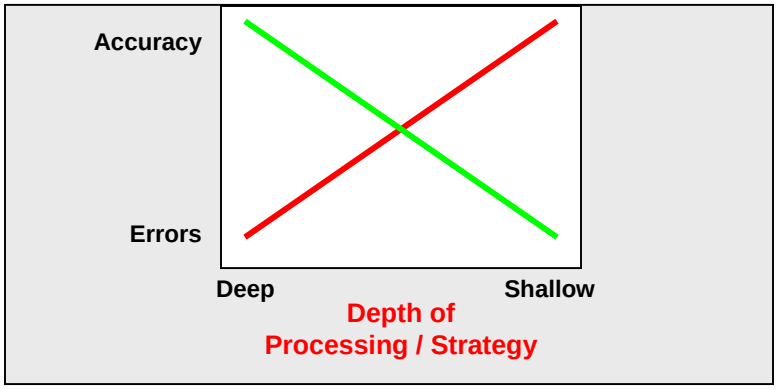
The amount of information to process and the time available are the critical elements of information processing and decision-making. We cannot process more information than our capacity will allow. You may be able to process a great deal of information given an unlimited amount of time, however, if your time is very limited, such as in an emergency situation, the amount of information you can process can be severely limited. In

[4] Hendy, K. et al (1998). *Human Factors of CC-130 Operations*. Defense and Civil Institute of Environmental Medicine: Toronto. (Syllabus, p.6).
[5] Hendy, K., and Lichacz, F. (1999). Controlling error in the cockpit. In R.S. Jensen (Ed.). *Proceedings of the 10th International Symposium on Aviation Psychology*. Columbus, OH, USA: The Aviation Psychology Laboratory, The Ohio State University.

addition new information is constantly demanding attention. Therefore management of this resource is critical to effective performance.

The practical question becomes: "What can be done when there is too much information to process in the time available?" As illustration below shows, in certain situations we may have to work with a trade-off between speed and accuracy. We might accept certain errors in the interest of speed or we might increase accuracy at the expense of increased time to reach a decision. Judgement must be applied to find the optimum balance between speed and accuracy of decision-making when there is significant time pressure.

Figure 2.3 - The Speed/Accuracy Trade-off[6]



Sometimes, however, there are other options available to us, which can be used to reduce time pressure. We tend to think of time as something that is frequently beyond our control, external to us or imposed on us. In fact there are things we can do to reduce and deal with time pressure. When you feel under time pressure, you should consider whether one of the two options may apply to you:

1. We may be able to reduce the amount of information to process; or
   - We could delegate certain tasks, utilize standard operating procedures, pre-plan, or memorize procedures.

2. We might also be able to increase the time available.
   - You may have a couple of options to increase time available, such as asking for an extension to finish a task, slowing down the aircraft, etc.

These and other techniques will be discussed in depth in later modules. For now, we will leave the discussion of time pressure with one final thought. After numerous discussions during HPMA Coordinator training, many course members are quick to point out that frequently time pressure is self-induced. Quite often, when bad things happen, or almost happen, it is because people are rushing to do something when they could have given themselves more time. If you think back to the case of the technician

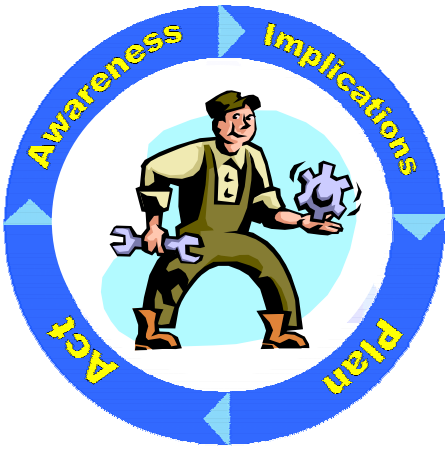
[6] Hendy et al. (Syllabus, p.8)

who almost burnt his face off, introduced at the beginning of this module, you will see an example of self-induced time pressure.

2.4 Controlling the Decision-Making Process – The "AIPA" Model

We have already discussed the importance of using a systematic approach to decision-making. There is less chance for error, and it can often help reduce the amount of time required to reach the "right" decision. However, our situation is constantly changing, and we must adapt to the always-changing environment. In order for us to be effective, we must "control" the decision-making process. We achieve this control through FEEDBACK. The presence of feedback in a system inevitably makes it error correcting (threat and error management). After all, we need to adapt all the time. The only way we will know whether to adapt or not is by carefully monitoring the effect of our actions, and decisions, in a particular situation. Feedback is what tells us whether or not things are working as planned, or if we must do something different if we wish to accomplish our goals.

The circular nature of the AIPA represents an error-correcting model of decision-making. By utilizing the process over and over again, it will help you adapt to surroundings. The AIPA "systematic' approach consists of 4 steps:



1. Maximizing awareness;
2. Work through the implications;
3. Devising a plan and contingency plans; and
4. Acting out the selected plan.

Step 1: Maximize **Awareness**: The more we know about what is happening around us the better. "Ignorance is not bliss and what we don't know can hurt us." We can begin to increase awareness right from the preparation stage of any mission/task. We also need to be very clear about what we are trying to accomplish. Knowing what we are trying to accomplish helps us know what to look for, and knowing how we are doing in relation to our goals. In order to maintain maximum awareness we must continually **update** our awareness as the situation evolves. Maintaining feedback from the environment is critical to maximizing awareness. Some questions to ask:

- "What are we trying to accomplish?"
- "What is happening…?"
- "What is working? What isn't working?"
- "Who is doing what?"
- "What do we know and what don't we know?"

Step 2: Work through the **Implications**: It is, of course, not enough to simply be aware of situational things and events. We also need to know what they mean to us and how these things might potentially impact the goals we are trying to achieve. As new information comes in (building awareness), we need to continuously **re-assess** the implications of this new information. As you work through implications, here are some questions you should consider:

- "What does it mean?"
- "How is it going to affect us?"
- "How could this affect our mission?"
- "Does this increase the risk? If so is the risk level acceptable?"
- "How does this impact on the higher level goals?"

Step 3: **Plan**: Explore your options. Develop a plan to accomplish the goal based on the most information you can get hold of in the time available. Develop contingency plans to cope with a variety of possible or critical situations. Develop short-term plans to deal with immediate situations, but also have a long-range plan. **Revise** the plan and review contingency plans as new information becomes available from the changing situation and environment. Some questions to guide the process:

- "What are the goal/task priorities?"
- "What do we need to do to achieve these goals?"
- "What are the options available?"
- "What is the best option?"
- "What contingency or back up plans do we need? What if….?"
- "How can we best allocate resources?"
- "Who is responsible for what?"

Step 4 – **Act**: Execute the plan! Using your resources available, put your plan into action. Make sure that everyone understands their role in the execution of the plan. You should also try to establish and maintain feedback mechanisms. This will enable you to **adapt** to the changing situation and environment – Control the process!

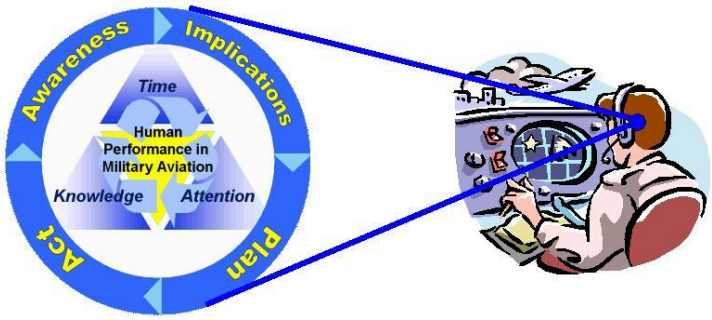
Decision-making does not have to be a passive, mysterious event that just happens. People may be born with natural decision-making abilities, but we all can control the decision-making process using AIPA. It is a systematic approach. Remember the story mentioned at the beginning of this module, about the technician who decided to check the ground power unit's fuel level using a lighter. Do you think that would have happened if that technician had taken a few seconds to informally use the AIPA approach to decision-making? Do you think he truly considered the implications of his actions? Probably not. Unfortunately, even the most experienced people fall victim to momentary lapses in judgement. The key is to try and make AIPA a habit. Use it in your day-to-day operations, and continually refine the process. The more effective you become at using the process, the easier it will be to use it during times of high stress, or workload.

Notice, that at each stage of AIPA, we talk about updating awareness, re-assessing implications, revising plans and adapting to the situation. These actions are critical to effective, adaptive decision-making. The presence of feedback is absolutely critical, and without it, you no longer have an error correcting system – there is no control! That is why the AIPA is presented as a continuous circle. Effective decision-making requires that we "keep the loop closed" to catch and correct error and to adapt to changes in the situation.

2.5 Troubleshooting Decision-Making (Potential Sources of Error in DM)

There is no such thing as a "perfect" decision. Life isn't like that. We can only try to make the best decisions under the circumstances with the knowledge we have. Sometimes the decisions are good ones and sometimes they aren't. All decisions have some elements of error. What we want to do is minimize the amount of error in our decisions. Obviously, the fewer the errors made in our decision-making, the more effective our performance will be.

The AIPA model is an excellent tool for troubleshooting errors in decision-making. Use the model to review your own decision-making process and look for areas to improve. AIPA is particularly valuable for supervisors, instructors, mentors, and peers because it provides a common methodology to decision-making, making it possible for people to identify and communicate any problems in a person's decision-making process.



2.5.1 Process Errors

There are a variety of process-based errors that will affect the decision-making process.

- **Poor Goal-setting**
  - The first question to ask is whether or not the goals were clearly identified. What was the individual *trying* to accomplish?
  - Proper selection of goals is essential to effective decision-making. Goals provide the direction, or the reference point, for making decisions.
  - For this reason it is important to clearly understand and articulate the highest-level strategic goals and prioritize sub-goals. Tieback to higher-level goals is often all that is required to resolve a conflict.

- **Lack of Awareness**
  - There is no such thing as 100% completely accurate awareness of any given situation. There will always be a certain level of information that is

missing, or inaccuracies of interpretation; therefore, we must speak about maximizing awareness.
- "Was everything that could be done to maximize awareness, done?"
- At critical junctures - the completion of a sub-task, recovery from an emergency, etc. – "Did the individual update their awareness?"
- Perhaps the second question to ask is, "Was the individual aware of all the important information?" There may be several reasons why they may not have been aware. Here are two of the main reasons:

    - *Detection* of information. Some information may simply not have been detected – we don't hear what is said, we are looking away when the gauge spikes, etc. - "Could the individual have detected the information if they were paying attention? Could they have detected the information if they were doing things properly (e.g. positioning, equipment setup)?"

    - *Selection* of important elements from all the masses of data available through our senses. A lot of information we simply do not pay attention to because we think it is unimportant. – "Was the information dismissed because they did not understand the importance of it?" Try to identify reasons.

✈ **Failure to consider the implications**
- Sometimes we are aware of particular events or information, or the changing environment, and we just fail to properly consider the implications that they may have.
- We call people "impulsive" when they seem to act without thought to the consequences or implications. Young people in particular may have a tendency to act without thought given to the implications and possible outcomes. Children may run into the street after a ball. Teenagers dive into lakes and rivers without verifying water depth or absence of obstructions. They ignore the potential implications and consequences. Sometimes, as in our initial case we used to introduce this module – "The Technician, the Lighter, and the Explosion" – it sometimes appears as if individuals fail to consider the implications at all.

✈ **Poor planning**
- Failing to apply all relevant information. Failing to explore options; simply taking the first proposed solution rather than the taking the optimum solution.
- Planning only for the short-term, and failing to account for potential long-term issues.
- Failing to revise and update plans when warranted by feedback and the changing situation.

✈ **Failure to act**

- Failure to follow through is a common error in the decision-making process. It is much more likely to occur under conditions of high stress, or workload, when the outcomes are very uncertain, and/or when the stakes are high. People sometimes hope that a problem will resolve itself without their intervention, if they can just avoid making a decision long enough. Some people allow themselves to become caught up in "analysis paralysis". They want all the information before they act – this is of course impossible and they delay making the decision long past the point when it should have been made.

✈ **Failure to control the DM process**

- Another type of failure occurs when an individual fails to adapt to a changing situation. Effectively adapting requires that the DM loop be kept activated by maintaining feedback – maximizing awareness, re-assessing the implications, revising and updating plans and acting to adapt to the situation and achieve the goal.

2.5.2 Resource Errors

In addition to the process-based errors, it is also possible to have resource errors:

✈ <u>Lack of knowledge (including skills – procedural knowledge)</u>

- The more we know about a situation the more effectively we can deal with it. Without adequate background knowledge or skills we are much more likely to make serious errors in DM. There is no such thing as "perfect" knowledge or skill so there is always the potential for some error, even from the most experienced, competent performers.
- Biases are an interesting subset of knowledge errors. *ALL* of us have biases to some extent. For example, two common biases that apply to everyone are Confirmation Biases and Probability Biases:

    - *Confirmation bias* indicates that people - all people - have a tendency to look for and accept information that confirms their beliefs, opinions, etc, and reject information, which does not support their beliefs;

    - *Probability bias* indicates that people - all people - have a tendency to make errors in accurately assessing probability. There is a tendency to over-emphasize the probability of positive outcomes (win the lotto) and under-emphasize the negative probability (hit by lightning). People have a tendency to choose the Uncertain High Risk loss (fly into bad weather) vs. the Certain Low Risk loss (turn around and delay flight) - "It won't happen to me."

- Failure of attention
  - If you are not paying attention to a task, you cannot control it. It is very important to manage your attention and ensure that the most important tasks are always being attended to.
  - If you do not pay attention to a task, it might as well not exist - it will not be included in the decision-making process and will likely result in errors.

- Failing to manage time-lines
  - As we have already pointed out, in many cases (but not always) excessive time pressure is something that is self-induced. Likewise, in many cases time pressure can be managed to some degree. Try to take control of your task timeline.

2.6 When Things Don't Seem Right!

You're in one of those situations where things just don't seem right. You've got a bad feeling about what's going on but don't quite know how to identify the problem. What do you do? You use the AIPA model to systematically analyze the situation, of course.

The first step, particularly if safety is involved, is to give yourself as much time as possible. If necessary, stop any potentially unsafe activities, or try to reduce time pressure by slowing down the activity.

- Maximize awareness to determine:
  - "What is happening?"
  - "What are we trying to accomplish?"
  - "What are the goal/task priorities?"
  - "Who is doing what?"

- Work through the implications:
  - "What does it mean?"
  - "How does it affect the short-term goals/tasks?"
  - "How will it affect the strategic level objectives?"
  - "What is the implication in terms of safety margins?"

- Develop a plan:
  - "What are we going to do?"
  - "Who is responsible for what?"
  - "What if…?"

- Act:
  - "Is the plan working?"
  - "Is it being implemented correctly?"
  - "What needs to be revised?"

2.7 Prescription for Performance and Effective Decision-Making[7]

- Take responsibility for developing individual and team knowledge and skills. The highest level of proficiency is always the starting point for effective performance. The most competent performers are "self-regulating" – they show initiative to learn how to self-analyze and self-correct. Teams need to develop common understandings and protocols (including SOPs, checklists, actions on…, what ifs?, etc.). Use standard operating procedures. Direct attention to ensure that all team members are in the loop. Allow all members to contribute to the shared core knowledge, as appropriate for their roles. Make communications concise and unambiguous. Train realistically to help ensure transfer. Practice and rehearse in a variety of situations so that time pressure is reduced in real situations. Ensure goals are clear, aligned at all levels and understood. Teams will function much more effectively when they share the same understanding of what they are trying to accomplish, how to go about it, and what is going on.

- Control the DM process – Use AIPA. Excellence is a habit and it comes from practicing good techniques consistently. Concentrate on using the AIPA model to make decisions in a conscious, systematic manner. It will become a habit. Concentrate on developing situational awareness and working through the implications. To have adequate situational awareness you must be able to answer these questions: "What are you trying to accomplish? What are the priorities? What are the implications?" Explore options and select the optimum course of action. Plan for contingencies. Execute the plan and monitor: Continue to maintain feedback to maximize awareness. Revise the plan and adapt as required to achieve the goals.

- Challenge your goals, assumptions, perceptions, and activities. Ensure that goals, at all levels, are clearly communicated, unambiguous and aligned. Ensure that all tasks and activities eventually align with a strategic level goal. Realize that our knowledge and our perception of what is occurring around us is never 100%, and can increase or decrease in accuracy rapidly depending on the situation. Challenge your assumptions and perceptions. Always seek additional information (feedback).

- Manage attention. Prioritize tasks and define roles to ensure that the most critical information is always processed, situational awareness is built, and error-correcting feedback is obtained.

- Recognize and manage excessive time pressure. Realize performance will be degraded as time pressure increases beyond your limitations, resulting in information that is "shed". Pay close attention to information that will help build

[7] Adapted from Hendy and Lichacz.

your situational awareness. Error-checking and feedback tend to decrease or be dropped in this situation - leading to increased chance for error. Sometimes trade-offs are required between the strategy selected, the performance achieved, and the time saved. Simplify strategies, approximate, reschedule, interrupt, delegate. Control the task timelines. Try to make the task self-paced rather than externally paced, or machine paced. Delegate tasks to other team members if possible. Free up or re-allocate processing time to control time pressure.

- Be proactive. Stay ahead of the curve. Pre-process information and pre-plan. If you have light workload/time pressure at one stage, use it to monitor the situation, build awareness, work through implications and plan ahead. Develop contingency plans so you are ready for possible events. Prepare in advance for stages of heavy workload and time pressure. Practice to make actions automated. Develop experience and competency so that decisions can be made quickly and easily because the situation has been encountered before. Manage time pressure proactively.

2.8 Conclusion

The quality of decision-making skills is the critical element that distinguishes highly competent performers from less effective performers. In this module, we have attempted to provide you with an effective decision-making tool that will help you become a highly competent performer. In any situation, you must carefully manage the three critical resources: knowledge, attention and time. You must use these resources effectively to reach the best possible decisions under a wide variety of situations. The important thing to remember about AIPA is that is provides for a method of systematically and logically making decisions. It can also be used to troubleshoot poor decisions by breaking the process into identifiable elements. Hopefully, this process will help you become “self-regulating”, actively analyzing and improving your own performance.

Human Performance in Military Aviation

Module 3

Individual Human Factors 1 – Nutrition and Stress

Introduction

The study of *Human Factors* is about understanding the different things that affect our performance as human beings. There are stacks of books that have been written on the subject; however, we are going to concentrate on 3 of the major factors that affect performance: nutrition, stress, and fatigue. Each of them has a real and substantial effect on, not only performance, but also our health and overall well-being. We don't have all the answers, but we can give you some practical information that you can use on the job and in your personal life.

In this module, we are going to discuss nutrition and stress, and provide you with some tools to help you manage those two human factors effectively. In the next module, we will discuss fatigue, how it affects performance, and some effective fatigue countermeasures.

Module Objectives

The objective of this module is to:

- Provide you with an understanding of how nutrition and stress affect performance on the job; and Provide you with the skills to help manage nutrition and stress.

Module Content

3.1 Nutrition

In military aviation, we often find ourselves working extremely long hours, in demanding environments. In order to be effective, we need to do everything we can to maximize performance. Nutrition plays an important part in that role. Unfortunately, most people don't understand just how much nutrition does affect their performance. While there is a lot of information regarding what you should eat to remain healthy this module is mostly concerned with what you should eat on the job in order to maintain an optimal energy level and therefore perform effectively.

The foods we eat can have a major effect on our mood and alertness. This is especially true when talking about blood sugar levels. It's also a fact that many people have terrible eating habits, particularly when it comes to sugar and caffeine intake. And our workplace environment doesn't always help. Most canteens and vending machines are largely full of foods that are filled with fat, sugar, and preservatives. For this reason, the nutrition portion of this module will largely focus on discussing how blood sugar, which is present to varying degrees in all food and drink (except water), affects energy levels.

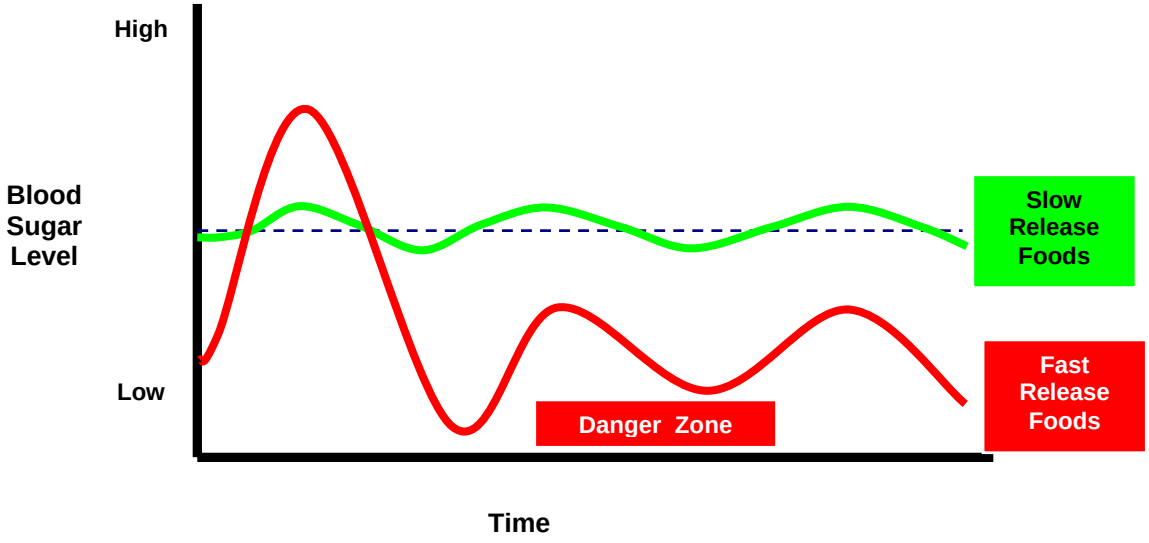
How does nutrition affect us? Most of you have felt the short-term burst of energy that comes after eating a chocolate bar or soft drink. You may have noticed that typically this "high" does not last too long, and is eventually followed by a feeling of decreased energy, or alertness. The process that occurs is a natural one. Your body is constantly trying to maintain a happy medium, so as your blood sugar level gets disrupted, your body tries to combat the excess "swing," and starts a counter-reaction. Unfortunately, this process takes time, and there is always a certain amount of lag time before the body can stabilize itself. The process is much more complicated than that but for our purposes, all you need to understand is that your body tries to counter any disruptions. Unfortunately, the process is not instantaneous, and there is always some lag. That means that your body will still be reacting even after the effects of the food have worn off. For this reason, the problem can be compounded if you were to consume additional sugar before your system has had a chance to re-establish its ideal blood sugar level. The following quote elaborates this point further:

> Within minutes after being hit by a sugar intake (such as a candy bar), insulin mechanisms react first decreasing blood sugar levels. Then as the sugar is digested (within 20 minutes), the blood sugar level is elevated abnormally high. About one hour after eating the candy bar, the insulin again overreacts sending sugar levels abnormally low. After about two hours the system equalizes and the body is back to normal. Each of the down swings in sugar is accompanied by a downward shift in the alertness and it may be very difficult for the person to stay awake.- J. R. Hackman. *New Directions for CRM Training*

The affects of caffeine and other stimulants are generally similar in nature to the effects of sugar.

In Figure 3.1, we can see the difference between foods that release sugar either quickly, or slowly, into our blood. Slow release foods provide a manageable release of sugar into our blood. The result is a relatively consistent level of blood sugar and minimal effect on our alertness and performance. However, with foods that release sugar rapidly into our blood we see wide swings both up and down because of the lag in the body's response to the increased sugar level. This can result in significant changes in our alertness and mood while the body's countermeasures respond, in an effort to stabilize our blood sugar level.

Fig 3.1 - Fast and Slow Sugar Release[1]



As you can see in the graph depicting the body's response to fast release foods, the body's system lags somewhat, which can result in our blood sugar level being driven well below the normal level. At this point, an individual may feel tired and fatigued. If an individual was to consume more fast release sugar while already low, it is likely to temporarily bring you up somewhat, however as the body again compensates it can cause your blood sugar level to plummet even lower than before – the DANGER ZONE.

We are not trying to say that fast release sugars are bad for you. The important thing to remember is that the body will exact a price for every time you 'artificially' boost it. *Therefore it is important to think strategically about how you are using food and drink as energy boosters.* Having a cup of coffee and a donut two hours before the end of your shift could give you a boost until quitting time, however it might leave you drowsy and inattentive for the drive home! Having a sugar rich meal just before sleeping may result in a bad night's sleep and leave you drowsy the next morning.

[1] Alfred T. Reed (1993). *A Shiftworker's Guide to Good Health.* Transport Canada.

Table 3.1, below, is a short list of foods categorized according to the effect on blood sugar levels. This is not an all-inclusive list by any means. It is simply intended to show you some 'good' (slow release) and 'bad' (fast release) foods. Generally, foods should be selected from the moderate and slow release groups. Some are rather surprising. Note: The chart uses the terms "good, bad, and terrible" - just remember this is only related to the concept of sugar release - not that they are "good for you" or "bad for you" (i.e. Unhealthy)!!!

Table 3.1 Slow (top), Medium (middle), and Fast (bottom) Release Foods[2]

• **Good:** Spaghetti (brown), porridge oats, pears, sweet potatoes, oranges, sponge cake, green peas (dried), baked beans, brown rice, orange juice. • **Better:** Grapefruit, haricot (white) beans, black-eyed peas, chick peas, ice cream, milk (skim/whole), yoghurt, tomato soup, apples (Golden Delicious). • **Best:** kidney beans, red lentils, fructose, soy beans (dried/canned), peanuts.
• **Not too Bad:** Shredded Wheat, plain crackers (water biscuits), raisins, beetroot, shortbread biscuits, rye crisp bread, white rice, potatoes (new, boiled), corn chips, sucrose, corn, muesli, grapes. • **Not very good:** All-Bran, digestive biscuits, oatmeal, yam, green peas (frozen), spaghetti (white), Rye bread, potato chips, bananas.
• **Bad/Terrible:** Soft drinks (glucose), parsnips, puffed rice, mashed potatoes, instant potatoes, honey, puffed wheat, puffed crispbread, rice (brown, instant), bread (wholemeal), white bread, Weetabix, turnip/swede, lima beans (lima), cornflakes, french bread, turkey with all the stuffings, chocolate bars, donuts, etc.

Remember, this strategy does not mean that you cannot eat fast carbohydrate foods, especially at strategic times. What it does mean is that it is wise to eat fast carbohydrate foods **after** shift work (*ideally*) or toward the end of your shift for a little extra energy. It's kind of similar to building a campfire. Pine or spruce will burn hot and fast. Maple and oak will burn slow and long. Both types of firewood have their uses.

Making informed choices on what foods to eat and when to eat them can have a considerable effect on your level of alertness, and performance!

3.2 Eating for Performance

There are a number of strategies we can use to optimize our energy levels including:

- ✈ **Eat smaller meals more frequently rather than occasional large meals.**
  - Eating large meals will almost inevitably cause you to experience the "slumps" mentioned earlier. A large meal will demand a lot from your body

[2] Alfred T. Reed (1993). *A Shiftworker's Guide to Good Health.* Transport Canada.

to digest. That results in energy being drained from the rest of your body. It makes you drowsy. Small meals eaten more frequently will help avoid these dangerous "slumps" and also keeps your body satisfied.

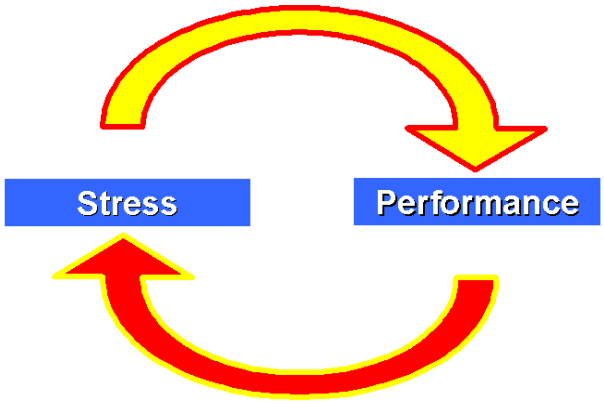
- **Stay "In the Green".**
  - Try and eat foods that are slow-sugar release. That will help you maintain a happy equilibrium.

- **Stay away from sweets.**
  - Let's face it - unfortunately they just aren't good for us! At least try to manage it carefully. Sweet foods cause large spikes in your energy level and alertness followed by a large drop. If you do feel you need a boost from something sweet, try to hold off until towards the end of your shift. They give a short burst of energy but soon it will drop off and you will have an even greater decrease in alertness. Ask your unit or squadron canteen to provide a larger selection of slow sugar releasing foods.

- **Keep yourself hydrated.**
  - Your energy and performance levels suffer when you are dehydrated. Drink lots of water. Water is just about the best form of hydration. Most people don't drink enough. Research says people should drink about 8 glasses per day. If you are involved in exercise, heavy work, working in the sun, then you will need even more. Then you should be drinking at least 10 glasses of water per day. Be careful in the winter. Because they feel cold, many people don't think they need water.

3.3 Stress and Performance

Stress is the body's response to a perceived threat. Stress and performance are tightly linked. The human being is very much like a violin string– we need some stress in order to work, but too much and we'll break. In addition, the effects of stress can permeate through a team very quickly, causing a considerable domino effect. In the worst case, excessive stress can lead to a 'vicious cycle' of worsening performance because of the relationship between stress and performance.

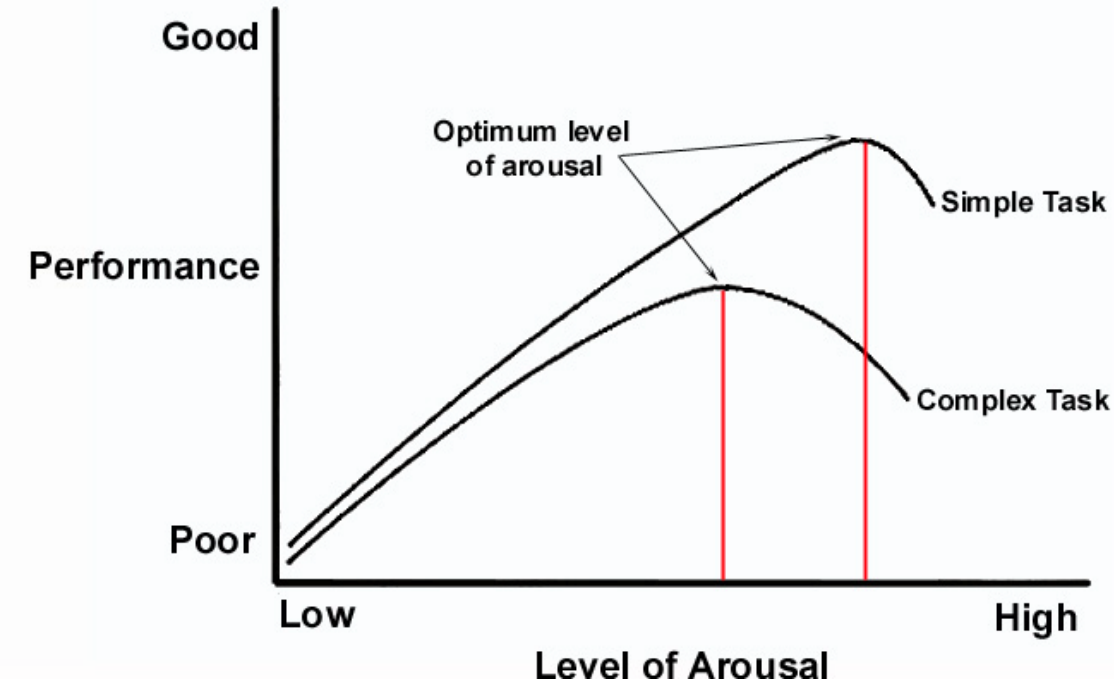


As your stress increases beyond moderate levels, you are more prone to making errors. When you make errors they cause more stress. More stress causes more errors … and so on… and so on… and the reinforcing cycle continues until something breaks it… or things "get ugly". The key is to employ effective threat and error management

strategies to prevent the cycle from building, trapping it before something bad happens. Hopefully, you won't have to intervene after something bad has happened...
As we already learned, stress, in and of itself, is not a good or bad thing – it just is. It is part of everything we do. Too much stress negatively affects performance and can eventually lead to health problems, which can also detract from performance. Paradoxically, however, too little stress also negatively affects performance. Without some stress we become complacent, inattentive and "dull". A little bit of stress "keeps the knife sharp". Either too little or too much stress can lead to a lack of situational awareness and poor decision-making!

The Yerkes-Dodson Law has been widely used to illustrate this phenomenon. Look at Figure 3.3, below, to see how stress (which in psychological terms is called arousal) relates to performance.

Figure 3.3 – Yerkes-Dodson Law[3]



You will notice performance actually increases as arousal/stress increases from low to moderate. As arousal/stress increases from moderate to high, performance starts to rapidly drop off. In fact, once you reach your limit, performance rapidly drops off as you become overwhelmed. The number and severity of errors will increase rapidly at this point. The graph also shows us that we can maintain higher levels of performance with higher levels of stress (arousal) when we are dealing with simple tasks. This is because with simple tasks we are not overloading the decision-making process as much as with complicated tasks. The graph also shows us that it is harder to maintain performance

[3] Wickens, C.D. (1984) *Engineering Psychology and Human Performance*. Boston: Scott, Foresman & Co.

levels for complex tasks under stressful situations. Therefore, complex tasks are performed better under lower levels of stress (arousal) whenever possible. The reduced level of stress frees more processing space in our mind for the complex task. Ideally you want to operate at a happy medium.

These curves represent the average person of course. The specific performance curves for each individual would be somewhat different, although the profile would not really change. Individual differences and capacities would be dependent on such things as experience, level of proficiency, and training. You must be aware of your own optimum levels. The most important thing to take away from this is the knowledge that you **will** begin to make errors once your capacity to deal with the stress is exceeded and everyone has a finite capacity.

It will be no surprise to you that stress is closely related to workload. Excessive workload can cause stress and conversely stress levels can influence *our perception* of the workload (everything seems so much harder when we are over-stressed). We tend to feel more stress and pressure, while experiencing a high workload and we tend to feel the workload is higher when we are stressed.

3.4 Causes of Stress

Stress is a natural physiological reaction. Think about early man wandering around the savannah and then he sees a sabre-toothed tiger running towards him – there is a jump in stress, which releases adrenaline to prepare the body for 'fight or flight'. Stress is simply the body's natural response to various situations.

> Stress is "**The body's response to demands placed on it**."
>
> *- Human Factors for General Aviation. pp. 7-2*

Although most people think of stress as bad and try to avoid it, some stress is actually good for us. Stress gives us the energy and enthusiasm that pushes us to grow and learn. By learning to control stress, we can maintain an effective performance level.

It is important to understand that stress is a personal thing. Some people can handle it better than others, and others are constantly over-stressed. Some people don't seem to be stressed by anything. Most people generally learn how to use effective countermeasures, but sometimes people, even well adjusted people, can be overwhelmed by stress. This can particularly happen with regard to things that *seem* to be beyond our control. For example, studies show the three most stressful events include: the death of someone close to us; divorce; moving and/or changing jobs. In the military, one thing that we do relatively frequently is move and change jobs.

Not only does stress depend on how the individual deals with it personally but also how intense, how frequent and how prolonged it is. Too much prolonged stress can lead to

severe performance problems and even health issues. Think of our caveman, surrounded by sabre-tooth tigers, several times a day, every day, for a year. His body would constantly be releasing adrenaline, working to counteract that release, then releasing additional adrenalin. He would be a physical and mental mess within weeks – if he survived that long.

Stress accumulates. Even small problems can combine to create excessive stress. Eventually those little nagging problems can add up. Stress may slowly build up over months, maybe years, or if it is significant enough it may build up quickly causing you to react right away. Problems occur when we are unable to release that stress, and it continues to build. If left unattended, it can lead to serious mental and physical problems.

Stress is as much a mental phenomenon as a physical thing. Stress can be induced by our imagination. The mind is a very powerful thing. We can make a situation much worse than it really is when we become over-stressed. When we find ourselves in positions of extreme stress our ability to process information effectively is decreased. Our decision-making ability suffers. As an example, in emergency situations people have often reverted to old habit patterns, even when it should have been clear that these actions would not work (in hindsight anyway). The HPMA program wants to try and provide people with the ability to effectively manage stress so they do not make important decisions simply based on instinct and old habit patterns. If we properly manage our time, we should be able to assess the situation and take the appropriate actions.

In this module we are primarily concerned with providing methods to manage the stressors (things that cause stress) we may find at work and that require our immediate attention. Things like: being behind schedule, interruptions, workload, friction between team-members, etc. The trick is to establish a healthy level of stress and maintain that level. We need to learn how to cope with the excess stress that can pile up and threaten our health – both mental and physical.

3.5 Categories of Stressors

We have described stress as “the body’s response to demands placed on it.” These “demands” or “stressors” may be anything internal or external that is perceived as a “threat”. These “stressors” fall into three distinct categories: physical, physiological, and psychological.

- **Physical**
  - Physical stress is associated with the environment. Think back to when you might have experienced a situation like one of these:
    - A hot, humid afternoon on the hangar floor, a noisy APU, a siren on the ground, or an engine run-up.
  - Physical stressors are typically associated with the environment: high and low temperatures; humidity extremes; noise; vibration; poor lighting; lack of oxygen; dangerous conditions, and many others.
- **Physiological**
  - Physiological stressors relate to any conditions associated with our bodies.
  - There are a number of these stressors in military aviation including: fatigue; lack of physical fitness; sleep loss; missed meals; long hours on the job; illness and many others…

- **Psychological**
  - Psychological stressors affect us mentally and include any social or emotional factors such as: mental workload, death in the family, pressure from friends/self; marriage troubles/divorce; sick friend/family member; money troubles; work-related problems; and many others…

Any of these three types of stress or various combinations can adversely affect your performance.

3.6 Types of Stress

Stress can be classified into two categories:

- **Acute Stress**
  - This type of stress is intense and short!
  - It results from demands placed on the body by the immediate task at hand.
  - Some examples that might cause acute stress:
    - Time constraints;
    - Bad weather;
    - Equipment failure during critical time;
  - Acute stress is usually very intense both mentally and physically. It invokes the “Fight or Flight” response. This type of stress is responsible for a series of effects including:
    - Adrenalin is released into the blood;
    - Metabolism speeds up - to provide energy to the muscles.
    - Blood leaves the stomach and digestive tract - to supply the muscles in the arms and legs with more oxygen;
    - Blood sugar increases (we already talked about the physiological effects of blood sugar); and
    - Heart rate, respiration, blood pressure, and perspiration all increase.

- Acute stress generally disappears shortly after the event that triggered it.

✈ **Chronic Stress**

- Chronic stress refers to stress, which is more or less constant – similar to the way arthritis pain, a bad back, or a bad knee is always with the sufferer. It is always there in the background.
- It is result of long-term demands placed on the body by life events both positive and negative. Examples might include such things as: conflict in the workplace; conflict at home; illness of a loved one; or financial difficulties.
- Chronic stress is usually the more dangerous of the two. It can cause mood swings leading to personal problems and conflict.
- Since the stress has been building up over time, it can make a normally controllable situation seem more difficult to handle.
- Chronic stress will amplify the effects of acute stress, so the stressed individual may drastically over-react at minor irritants and frustrations.
- If chronic stress lasts too long it can lead to serious health problems like illness, insomnia, irritability, ulcers, high blood pressure, etc.

3.7 Symptoms of Stress

It is important for us to be aware of the symptoms of stress so that we can identify it, not only in those we work with, but also in ourselves. Symptoms differ depending on whether the stress is turned inward (towards themselves) or outward (directed at others). The warning signs, or symptoms of excess stress usually appear in one of three ways:

✈ **Emotional Stress Symptoms**

- If turned inward – people might demonstrate depression, preoccupation, sadness, or generally be withdrawn from people.
- If turned outward – symptoms may show up as overcompensation, denial, suspicion, paranoia, agitation, restlessness, defensiveness, excess sensitivity to criticism, argumentativeness, arrogance, and hostility.

✈ **Physical Stress Symptoms**

- If turned inward – symptoms may show up as chronic headaches, insomnia, appetite changes, weight gain or loss, indigestion, nausea, vomiting, diarrhoea, and/or constipation.
- If turned outward – there are few noticeable symptoms.

✈ **Behavioural Stress Symptoms**

- If turned inward – you may see preoccupation with illness (hypochondria), self-medication, reluctance to accept responsibility, tardiness, absenteeism, and/or poor personal appearance and hygiene.
- If turned outward – symptoms include episodes of desperate "acting out" or temper tantrums (a disguised cry for attention). They may become

uninterested and unreliable at work. They may display a poor attitude towards authority. These individuals also tend to abuse alcohol and drugs, but, in addition, they may get into fights, incur numerous traffic tickets, gamble, fall into indebtedness, and may even become child or spouse abusers. Some individuals may tend to be accident-prone as their mind isn't always where it should be. Individuals may try to do too much by themselves and try to over-control others.

Sudden changes in personality, behaviour, attitudes or physical appearance may be warning signs of serious stress on an individual. Be aware of the signs in others and yourselves. The sooner stress is dealt with the better.

3.8 Stress Countermeasures

As we have discussed, some stress is good. The key is to control stress before it becomes excessive and causes your performance to drop. Here are some stress countermeasures you can employ:

- **Recruit more Resources**
  - Sometimes you can "try harder" or you may have to get some help to deal with the stressor. If you decide to try harder, you must keep in mind the speed accuracy trade-off. If you rush, things may get missed.
  - Increased effort might work in the short-term but not in the long term. For example: fatigue may set in; people may be drawn from other critical tasks, or in the long term, chronic stress may develop from always working under time pressure.

- **Remove the Stressor**
  - Although this may not be an option, it might also be as easy as turning off a noisy radio or bringing an aircraft into the hangar for maintenance on a bitterly cold day.
  - Try to see if you can eliminate the stressor. In a team setting, ask the group for ideas on how to remove the stressor.
  - This is very difficult when the stressor is internal…

- **Re-examine the Way You are Approaching the Task**
  - Sometimes the task can be accomplished with an acceptable, less demanding approach. Complex solutions are usually the most error-prone. Remember the "KISS" principle.
  - If you can't get to the "mountain", maybe there's a way to bring the mountain to you. Find another way to accomplish the task that achieves the same result.
  - For example, if a Search and Rescue helicopter can't reach a boat because of poor weather at location X, they may be able to have the boat steam to location Y where the weather is suitable. While the goal is

ultimately the same (i.e. find boat), the lower level goal changed from meeting the boat at location X to having the boat meet you at location Y.
- You can build up your own repertoire through experience and talking with others. Build your own personal human performance toolbox!
- Changing your immediate goal can be extremely difficult, especially during periods of high stress. People tend to continue with a given action or plan of action that they have used in the past. Under stress, people are much more likely to continue trying the same unsuccessful solution (the very failure of which might be the cause of increasing stress). Once again, the vicious circle continues… You can break the circle! If you find yourself, or someone else trying something and it isn't working, take a second to think about it. Run through the AIPA process to see if there is something that you have missed.

✈ **Deal with the Stressor**
- In this option, you choose to let the stressor run its course. You acknowledge it is there and try to deal with it as best you can, knowing that performance may be suffering (e.g. "It's really cold. Why don't we take a break for 10 minutes and warm up for a bit?)

It should be apparent that different people might employ different strategies. Not everyone responds to stress in the same way. Some people get quiet; some get noisy. In fact, what may be stress for one person is not stress to another.

3.9 Managing Stress

We need stress to function, but we must continually keep it in check. If we can keep our daily personal stress under control, it will reduce the potential for mishap or degraded performance on the job. Here are a few guidelines that might help you manage your stress level.

✈ **Organize yourself**
- Take control of how you spend your time and energy.
- Try to plan using a calendar (long-term), not a watch (moment to moment).
- In our lives, we routinely encounter "URGENT" items that we feel "must" be done right now. Sometimes these items are URGENT and IMPORTANT, but often they are NOT IMPORTANT, yet we still feel compelled to deal with them. We should really be more concerned about items that are "IMPORTANT" more than anything else. That should be the main force you use to set your priorities. In fact, to be truly proactive, try to focus more time and effort on those tasks that are both IMPORTANT and NOT URGENT (ex. team building, planning, etc.). By taking the time to do with these elements, you will be much better equipped to deal with those URGENT and IMPORTANT issues that inevitably appear. In fact, there will likely be less of them to deal with...

- **Change environment**
  - Control what and who is surrounding you, if possible. Try to avoid those things that cause you stress when possible. For example, an argumentative co-worker can be avoided - sometimes, or a work order can improve a poorly lighted work area.

- **Build your strength**
  - Regular exercise has been proven to reduce stress levels by approximately 30%. If you haven't already implemented a regular personal exercise program this may be the motivator you are looking for. The benefits to long-term performance and to your own long-term personal health coming from regular exercise are just too clear-cut to ignore. We can't encourage you enough to take advantage of this.

- **Listen to your body**
  - It will tell you when you are pushing too hard. Usually a little late, but it will tell you. If you are feeling continually tired, cranky, or sick something is wrong. Do something about it.

- **Learn to relax**
  - This relieves stress and tension and helps prepare you for upcoming stressful events. Find time to laugh - a great way to relieve a little stress or tension.

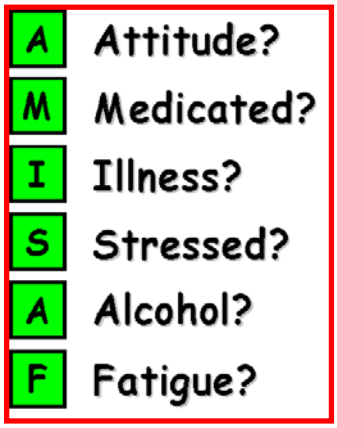
- **Develop a supportive network**
  - Good friends and supportive family members will help you forget about your stressors.

In short, if we don't manage stress, stress will manage us. Life events do not create stress; we create the stress in our minds. You can change stress into an energy source instead of an illness. The first step when dealing with negative stress is to identify it. They can then be addressed and reduced, or eliminated.

Personal Checklist

If you want to know whether or not you are prepared, you can use this simple checklist. It's pretty easy to remember. Just ask yourself:

- **A**ttitude – do I have the right attitude to do the job?
- **M**edicated – am I currently on some type of medication that could impair my judgement or my ability to do the job?
- **I**llness – am I suffering from any type of illness that could affect my work?
- **S**tressed – am I suffering from an acute or chronic stress? If yes, what can I do about it?
- **A**lcohol – have I been out drinking and could it affect the task at hand?
- **F**atigue – am I well rested? Have I had enough sleep for me to be alert enough to complete this task?
- **E**ating – have I had a good meal recently that will be able to tide me over until my next opportunity to eat?



This simple checklist can also be used to assess the people working with and around you. Instead of asking yourself the questions, you can ask yourself if any of your team members is suffering from any of them. Typically, other people are the first to notice something wrong with us. Remember threat and error management? This is your opportunity to avoid or trap an error before something happens.

"**AM I SAFE**? What about the other people working with me?"

3.10 Conclusion

Stress is a natural part of life. Some stress is good for us, and performance will normally improve with a moderate level of stress. Too little stress and we become complacent and dull. Performance degrades. Too much stress, however and we become overloaded. Our personality can change, we may even develop health problems and our performance is likely to suffer.

Learn to recognize the symptoms of stress and be aware if your own behaviour or other peoples' behaviours, health or attitude change suddenly. These may be indications of excessive stress.

Understanding the causes and effects of stress will help you identify suitable countermeasures. A proper, balanced approach to both your social and work

environment will help you cope with daily stress. Regular exercise is also one of the most important tools to manage stress – and these things are certainly within our control.

You have control!

Human Performance in Military Aviation

Module 4

Individual Human Factors 2 – Fatigue

Introduction

We have already begun to discuss how nutrition and stress can affect your performance. We will continue this discussion, turning our attention to another critical human factor that will influence performance – fatigue. The remainder of this module will focus on fatigue and some of the ways in which it affects performance.

Many people underestimate how much fatigue can impact performance. Interestingly enough, most of us will spend about 1/3 of our lives sleeping yet not many people understand the basics of fatigue. Much of the material in this module comes from exhaustive research carried out by the National Aeronautics and Space Administration (NASA). They have done amazing work in the field of fatigue in aviation environments and this module will try and impart some of their knowledge on each of you.

Fatigue is a problem that is common in the military aviation environment. The dynamic nature of our jobs makes fatigue a reality for a great number of us. Over the years, we have continued to move towards full 24/7 operations, making fatigue a significant factor that will influence our performance.

Module Objectives

Upon completion of this module you will be able to:

- Identify the main causes of fatigue;
- Recognize the symptoms/effects of fatigue in yourself and others;
- Prevent inadvertently sabotaging your sleeping habits; and
- Develop a set of personal fatigue countermeasures.

Module Content

4.1 Causes of Fatigue

Although there are a large number of small factors that contribute to our level of fatigue, it is essentially the result of two physiological causes:

1. Sleep Loss
   - Sleep loss includes disrupted sleep, as well as prolonged periods of wakefulness.
   - As you can probably imagine, if you don't sleep, you will quickly become fatigued.

2. Circadian Rhythms
   - We are all hard-wired with an internal body clock.
   - Throughout the day, your body goes through natural "highs" and "lows".
   - During the "highs," we are wide-awake, and mentally alert.
   - During the "lows," our body seeks to rest, and we are less alert.
   - Essentially, fatigue levels tend to be higher at certain periods in the day.
   - Fatigue levels tend to be higher at some times of the day than others. Any disruptions in our internal clock contribute greatly to fatigue.

Before we get deeper into the discussion of fatigue, there are a few important things that you must keep in mind.

✈ Sleep is a physical requirement
   - You cannot indefinitely deny your body of its required sleep, nor can it be substituted with anything else.
   - Some people can get by with very little sleep (3-5 hours), but most people need an average of 8 hours of sleep per night.
   - While it is possible to get by with minimal sleep, it is only temporary. Eventually your body will need sleep!

- The real key is to determine how much sleep you require each night to be at your best.
- Perhaps the best way to determine whether or not you are getting enough sleep is to compare your sleep patterns during the week with the weekend. If you find yourself sleeping a lot longer on the weekend (without alarm clock), it is very likely that you are not getting enough sleep during the week.

✈ Sleep loss is cumulative; and
- If you continue to short-change yourself in terms of sleep, you will fall into a "sleep debt."
- Most people get 1 to 1.5 hours per night less sleep than they need.
- If you routinely get one hour less sleep per night than you need, at the end of a week, you have essentially robbed yourself of an entire nights sleep.
- Because you gradually get deeper and deeper into the sleep debt, it is hard for most people to recognize.
- The only cure for sleep dept is to SLEEP!

✈ You can't "bank" sleep.
- Although you can develop a sleep debt by cutting your sleep short, the reverse is not true. Sleeping an extra hour per night does not automatically mean that you can work through an entire night.
- Conversely, you may be able to realize some very short-term benefits of sleeping earlier in the day. The general rule of thumb is that you should try to get the same amount of sleep in a 24-hour period that you would normally get. As a result, you may be able to sleep less during the night as long as you have made up some sleep earlier in that 24-hour period.

A lot of very interesting research has been done in the field of fatigue. A large study conducted by the University of South Australia demonstrated that after 17 hours of continuous wakefulness, people performed at the same level as someone who is well rested and had a blood alcohol level of .05%. After 24 hours, performance was equal to .10% (over the legal limit). They also found that beyond 24 hours, performance levels dropped even quicker.

- Handbook of Aviation Human Factors

4.2 Normal Sleep Pattern

Sleep is actually a very complex activity that is essential to life. During the night, the brain and the body alternate between periods of extreme activity and calm, that can be characterized as either Rapid Eye Movement (REM) or Non-Rapid Eye Movement (Non-REM) and is broken down as follows:

✈ <u>Rapid Eye Movement (REM)</u>
- The brain is very active during this stage, typically associated with dreaming.

- Major motor muscles of the body are paralyzed to prevent us from acting out our dreams. If awoken at this point, we may be disoriented, and can often provide vivid details of our dreams.
- REM provides regeneration for our minds. Prepares your mind for the next day.

✈ Non-Rapid Eye Movement (NREM)

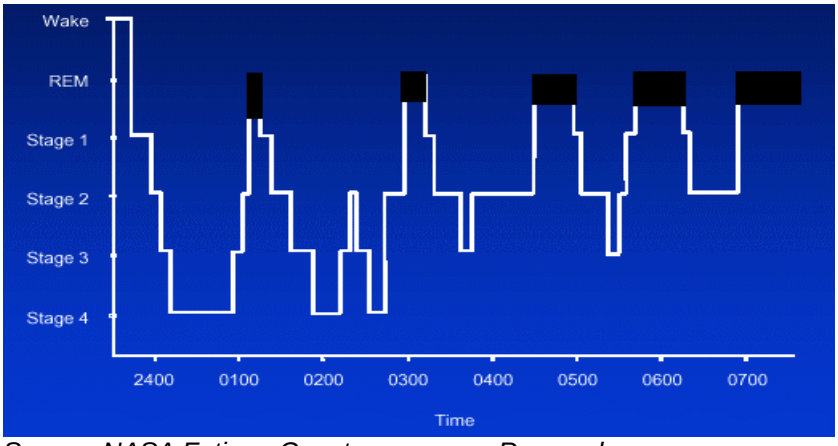
- Physical and mental activities slow down (e.g.. heart rate & breathing become slow and regular).
- NREM is rest for our bodies.
- We progress through four stages of non-REM, falling deeper and deeper to sleep.
- The NREM phase can be sub-divided into the following stages:

a. Stages 1 & 2 (NREM)
   - Light sleep.
   - Easily awoken during these stages.
   - You can be fully up to speed in a minute or two, ready to perform.

b. Stages 3 & 4 (NREM)
   - Deep sleep, the deepest sleep.
   - Very little brain activity.
   - If awakened, you will probably feel disorientated/groggy/sleep for 10-15 minutes. This is called SLEEP INERTIA.

Most people are already familiar with REM sleep. That is the period when you eyes are closed but you can see the eyes rapidly moving. This stage of sleep is typically associated with dreaming. Stage 1 is relatively light sleep, and it progresses down into stage 4 sleep which is deep sleep. The following chart depicts the various stages of sleep mentioned above.

Graph 1.1 – Typical Sleep Pattern



Source: NASA Fatigue Countermeasures Research

In graph 1.1, we see a typical night's sleep. The darkened bars represent REM sleep, which become longer and more regular later in the sleep period. Overall about 25% of sleep time is spent in REM sleep and about 50% is spent in the NREM Stage 2. The sleep pattern is fairly distinct. After approximately 1 hour after going to sleep, you will fall into deep sleep (stage 4). Typically, most deep sleep (NREM 3 and 4) occurs in the first third of the night, and REM sleep dominates the later portion of your night. If you look at the graph 1.1, you will be able to see the cycles that one experiences during the night. It is very important to actually go through the cycles. If you are awakened during the night, your sleep pattern gets disrupted. Unfortunately, you can't simply resume where you left off. For the most part, you end up going back to the beginning of the sequence. This may result in you being robbed of critical REM sleep that typically occurs during the second half of your night. That will leave you feeling considerably fatigued the next day. This is particularly important on deployments. You should take the necessary precautions to prevent unnecessary disruptions.

4.3 Circadian Rhythm

We have discussed the fact that sleep loss and circadian rhythm are major factors that contribute to fatigue. It is fairly easy to understand the significance of sleep loss, and how it will cause fatigue. However, fewer people have a real understanding of the effect that circadian rhythm has on our level of fatigue. This short section will attempt to demystify our body's natural clock that is an integral part of our human physiology. Everything revolves around this clock: sleep/wake cycles, body temperature, digestion, etc. It is also safe to say that our performance also revolves around the circadian rhythm. At certain times of the day, we are more apt to performing difficult mental tasks, just as there are other times in which our performance is highly susceptible to degradation. We need to be able to recognize these "highs" and "lows," paying particular attention to the low periods, as our performance is likely to be less than optimal.

Our "Circadian Clock" is reset primarily by an exposure to bright light.

Circa = about; Dies = day

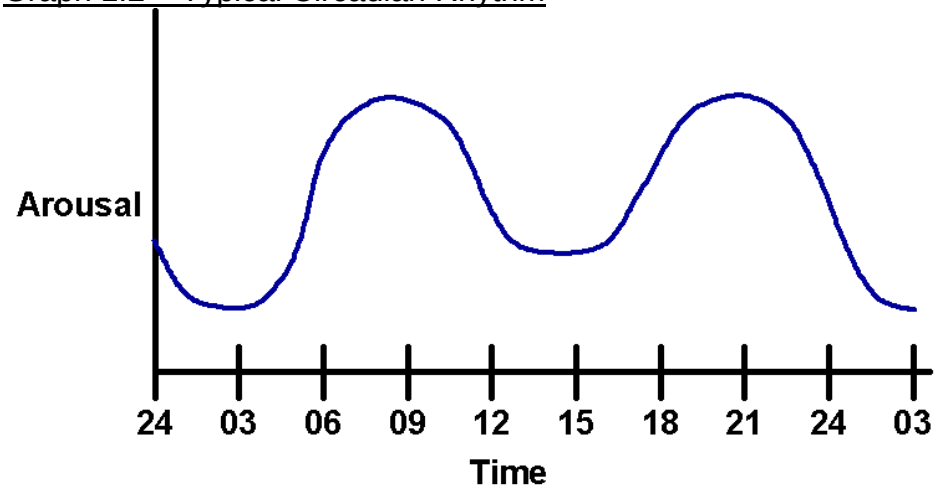
Without any timing information from the outside world, the human biological clock is actually about 25 hours. This information was derived from cave experiments, in which people were kept in caves without any source of timing information. After a couple of days, the participant's had adopted a body schedule that coincided with a 25-hour day. But, we don't live in caves…

The human is a daylight creature; in the course of evolutionary adaptation, the human species has associated its own state of wakefulness and activity (ergotropic phase) with the day/light period and its sleep and rest state (trophotropic phase) with the night/dark period.

- Handbook of Aviation Human Factors, pg. 235

This is particularly pronounced in the military environment, characterized by around-the-clock operations. Quite often, this is in direct opposition to our biological clocks. On many occasions we will find ourselves hard at work when our bodies are actually longing for sleep. This is a simple reality of our jobs. Now let's take a look at a typical 24-hour circadian rhythm (body clock).

Graph 1.2 – Typical Circadian Rhythm



Using a normal day (7 am to 4 pm), our bodies are programmed with two "low periods" (highlighted in graph 1.2). These two "lows" are periods of maximum sleepiness, and consequently, decreased alertness.

- 3-5 AM is lowest circadian point. Body temperature, heart rate, alertness and performance are all decreased.
- Around 3-5 PM, the body has a less pronounced, but significant drop in alertness, and experiences a period of increased sleepiness & decreased alertness. This accounts for the afternoon lull that many of us feel. It's not the food we ate; it's our internal clock.
- SO...if we are required to work during these periods, we should be aware that we are most prone to error during these times so use the resources available to us (e.g. other crew members) to cross check and back us up.

Now that you have a better understanding of circadian rhythm, you should be able to identify the ideal times for mentally demanding tasks, and for less mentally demanding tasks.

- Whenever possible, you should try to avoid mentally challenging tasks during a circadian low. Try to plan these types of tasks when your mind and body are most alert. Perhaps the task can be delayed until a fresh crew arrives, or until you can get some rest. If you absolutely must complete the mentally demanding task during a low, be aware that you are likely to make mistakes. You should try

to incorporate some form of redundancy (error management) to ensure that these errors are detected. An excellent way of doing that is to employ an additional person. While they may not be able to assist during the entire task, you can frequently rely on someone else to verify your work.

- ✈ These are the types of things that you should be considering. Try to do the less mentally demanding tasks, such as strictly physical work, during the "low" periods.

Making matters worse, if you are already fatigued, a circadian low will have an even greater effect on your performance.

> The combination of ***Circadian Low Period*** and ***Fatigue*** reduce performance by up to **35%.**

4.4 Operational Factors that Contribute to Fatigue

In addition to the two main causes of fatigue, there are a variety of operational factors that contribute to a person's level of fatigue. We will discuss a number of these factors, but there are undoubtedly far more than those included below.

- ✈ Erratic schedules, shift length, time of day, consecutive duty days.
  - Obviously, the longer the shift = more potential for the onset of fatigue.
  - Keep in mind that it is hard to go to sleep earlier to compensate for an early start the next day. Plan accordingly.
  - Research has shown that most crews/teams that are on the road, go to bed at least one hour later than at home. BUT…frequently they also had to wake up for duty more than 1 hour earlier than normal. TWICE THE DEFICIT!!!

- ✈ Mentally or physically demanding work.
  - The longer you have to perform (either physically or mentally), the greater the performance loss will be.
  - For example, SAR crews rotate spotters every 20 minutes because an individual's effectiveness is severely reduced beyond that. The same thinking applies to many of the tasks we face in military aviation.

- ✈ Long periods of inactivity (boredom).
  - Waiting around for something to happen will decrease your mental sharpness. Try to develop some kind of routine that will keep you busy. You need to try and stay mentally active. Do some planning, or get prepared while you wait.

- Dehydration.
  - The effects of dehydration can slowly sap your energy, causing you to feel more fatigued, ultimately resulting in reduced performance.

- Erratic eating patterns.
  - Poor nutrition does not help fatigue… While deployed, it can be very difficult to eat regular meals. Often you find your eating schedule becomes totally disorganized. We already discussed the effects of sugar release into your blood. Try and eat foods that slowly release the sugar into the blood. This will help avoid the "downs" that we sometimes suffer from after a meal.

- Uncomfortable working environments:
  - Adding stressors like noise, vibration, flicker, heat/cold, changing atmospheric pressure, sitting for long periods of time, etc. all take their toll on your body and accelerate the onset of fatigue.

- Changing time zones (Jet Lag).
  - This is a very real problem in Air Force operations. It is very common for crews/teams to cross several time zones in a short period of time. This has a very real effect on your body and fatigue levels.
  - For aircrew, it is often accompanied by the added stress of dehydration, boredom, changing pressures, sitting for long periods of time, poor nutrition. We already mentioned a couple of them above. Essentially, your circadian rhythm is being desynchronized.
  - If you are going to be away for several days, you should try to switch over to the new time zone before you actually arrive. This will make it a little easier on your body.
  - For trips of shorter duration, try to stay synchronized with your home-base time. It will be much less demanding on your body than trying to quickly adapt to a new time zone for a day or so, and then switch back to your home time zone.
  - Either way, it is important to get the same amount of sleep that you would typically need in a 24-hour period. Particularly when going east. It's easier to travel west because you can always add more hours to the day, but it is difficult to go to sleep during a "normal" awake period (daylight).

4.5 Symptoms/Effects of Fatigue

The signs of fatigue appear in a variety of ways. You should be aware of some of the typical symptoms to help recognize when you, or anyone else, are fatigued.

- Slowed mental and physical reaction.
  - As we already discussed, 18-20 hours without sleep has the same effects as drinking two or three beers. People's reaction times will gradually increase.

- Poor judgment and decision-making.
  - Fatigued people may find it increasingly difficult to make decisions.
  - It is quite common for fatigued people to recheck information several times as a result of impaired memory or inability to process information.

- Poor communications.
  - Fatigued individuals tend to "clam-up," and are less likely to close the communication loop.

- Decreased or erratic performance.
  - Errors increase despite increased effort or you may see good performance mixed with occasional drops.

- Accepting a lower standard of performance than usual.
  - Fatigued individuals tend to underestimate the performance degradation and are willing to accept more than they usually would. In these circumstances, people are more likely to blame something else for the decrease in performance.

- Decreased level of attention.
  - People that are fatigued are more likely to become distracted, fixated (channelized attention) or preoccupied. This will result in poor situational awareness, and reduced vigilance while carrying out a task.

- Short-term memory problems.
  - May appear as forgetting or ignoring checks/procedures.

- Change in attitude.
  - Withdrawn, loss of initiative, depressed, irritable, moody, lethargic, apathy.
  - The fatigued individual can become indifferent as to the outcome of the task and their operational performance. "Oh, it's good enough…"

- Prone to micro-sleeps difficult to stay awake.
  - These are the short little naps that last for only a millisecond or more. These are typically the very short "head nods" that you may experience while tired.

- Susceptible to illusions.
  - At its extremes, fatigue can cause you to imagine things that are not even there.

4.6 Sleep Barriers

There are a variety of "barriers" that adversely affect your sleep. You may already be familiar with some of these "sleep barriers" but some may be less obvious and merit discussion.

- ✈ Alcohol:
  - Alcohol disturbs REM sleep. A couple of drinks/beers can eliminate all REM sleep during the first half of the night. Withdrawal effects occur in the second half of the night and may cause disrupted or fragmented sleep. Unfortunately alcohol is the most commonly used "sleep aid."

- ✈ Caffeine:
  - Probably the most popular artificial stimulant. It can be useful just after waking up, or as a boost before the end of a shift. Continued caffeine intake will make it difficult to get to sleep. In addition, caffeine is also a diuretic and causes dehydration, which can compound the problem.

- ✈ Medication:
  - We need to be careful. A great deal of medication contains caffeine. For example, many types of over-the-counter "Acetaminophen" products contain a great deal of caffeine…Excedrin contains 65 mg of caffeine per tablet…Tylenol Regular or Extra Strength (without Codeine) contains NO caffeine.[1] Almost every medicine has some kind of side effect. Make sure you know exactly what you are taking and what it can do to you.

- ✈ Environmental Factors:
  - Noise, uncomfortable beds, hot and cold temperatures, too much light. These are all factors that can act as a barrier to sleep.

- ✈ Sleep Disorders:
  - There are a number of sleep disorders that can interrupt our sleep and cause fatigue. The most common complaint people have before being diagnosed with a sleep disorder, is persistent sleepiness. Aside from that they have no idea that their sleep is being disrupted.
  - One particular sleeping disorder that merits discussion is *sleep apnea*. This disorder is actually more common then asthma, but many people don't even know they have it. Sleep apnea is a disorder in which an individual momentarily stops breathing during the night. The result is a disrupted sleep pattern, and fatigue. Fortunately, this disorder can be diagnosed and treated at sleep disorder clinics.

- ✈ Age:
  - As you get older, sleep becomes less deep (most NREM Stage 3 and 4 disappears).

[1] Review of Caffeine Sources – Journal of the American Pharmaceutical Association July/Aug 2002 Vol. 42, No. 4.

- Stress:
  - The human mind is a powerful thing. If you are stressed about something, your brain will revert back to the concern, preventing you from relaxing and falling asleep.

4.7 Common Misconceptions Regarding Fatigue

Now that we have discussed some of the fundamentals of fatigue, and symptoms to watch for, there are a few important misconceptions about fatigue that you should know. The following are typical responses heard by people concerning fatigue:

"I know how tired I am."

"I've lost sleep before and I did just fine."

"I'm a professional, I can push through it."

These are in fact misconceptions. The reason – humans are notoriously poor at evaluating their own level of fatigue! Research has shown that people are more likely to report greater alertness than is accurate, subjectively rating themselves as more alert than is actually true. Fatigue is insidious and hard to detect because of its slow onset. You are much more likely to recognize the symptoms of fatigue in other people before you identify it in yourself. Keep that in mind. When you find yourself questioning the fatigue level of someone, you should also look at yourself. You may also be fatigued and temporarily blinded to it. Perhaps the best approach is to ask someone working with you to tell you what they think. Similar to the effects of alcohol, as we get increasingly more fatigued, our judgment becomes impaired. Therefore, we are often in worse shape than we think.

Some other misconceptions to remember…

- Fatigue is <u>not</u> overcome by:
  - Skill;
  - Increased effort;
  - Stamina;
  - Education;
  - Training;
  - Experience;
  - Will;
  - Professionalism; or
  - Motivation.

Fatigue is your body telling you to sleep. Once you are fatigued, the only true solution is sleep. You may be able to "surge" for a short period, but you must be aware of the

pending outcome of that surge. The longer you fight fatigue, the longer it will take to recover from its effects.

4.8 Fatigue Countermeasures

The NASA Ames Fatigue Countermeasures Group has spent a great deal of time and energy studying fatigue. As you might expect, they hope to minimize the effects of fatigue and to find which countermeasures work, and which do not. We will present you with several of the techniques they recommend to help maximize performance. Most of these countermeasures involve simple lifestyle or habit changes. While there are no "magic pills," there are some things that you can do to combat fatigue, or reduce the potential for fatigue-related performance problems. Some of the causes of fatigue are controllable. Don't stack the deck against yourself.

- ✈ Avoid a sleep debt.
  - If you did not get the appropriate amount of sleep during the night, make this a priority over other activities.
  - NASA studies have shown that an individual who received 8 hours of sleep was better able to carry out duties after being awake for 20 hours, than that of an individual who received just 6 hours of sleep.

- ✈ Carefully plan your work activities
  - A proper timing of work activities can be of paramount importance to ensuring high levels of performance, and decreasing the effects of fatigue.

- ✈ Plan ahead when traveling.
  - If you are going away for a short period (2-3 days)…try to stay synchronized with your home time zone. That will produce the least disruption to your circadian rhythm.
  - If you are going away for an extended time, it is wiser to force the speed of adjustment by immediate immersion in the local time and social activities.

- ✈ Develop a regular sleep routine.
  - Don't use the bedroom to work, worry, or exercise. It makes it harder for your mind to associate the bedroom with sleeping.
  - You may want to develop some physical and/or mental relaxation techniques (read a book, take a bath, etc.)
  - Try to maintain the same sleep schedule and try to average 8 hours (or as necessary) per night.

- ✈ Avoid alcohol and caffeine before bed.
  - We have already discussed the effects of alcohol and caffeine. Resist temptation…stick to water.

- ✈ If hungry, eat only light snacks.
  - Try to keep your food intake low prior to bed so your body isn't digesting food all night long. This is especially true for high protein or high fat foods.

- ✈ Avoid exercise late in the evening.
  - Your blood pressure increases, heart rate increases, and it takes a while for the body to stabilize, making it difficult to get to sleep.

- ✈ If you don't fall asleep in 30 minutes, get out of bed.
  - If you're thinking about something in particular, write it down. That will help ease your mind that you won't forget what you were thinking about. You should find it easier to get to sleep after that.
  - On of the other common problems people experience when they are unable to sleep is the habit of repeatedly looking at the alarm clock. The psychological effect of having the clock "remind" you that you should be asleep can cause significant stress. Turn the clock around, or put it on the floor, so it isn't a constant reminder to you.

4.9 Napping

One of the best tools available to overcome the immediate effects of fatigue, short of a full night of sleep, is "strategic napping." There has been considerable research demonstrating that even brief naps can improve alertness and performance. With a better understanding of the physiology of sleep, and a normal sleep pattern, strategies for napping begin to emerge. First and foremost, it is important that you plan your naps carefully.

- ✈ If not immediately prior to duty.
  - Try and get at least 1 ½ to 2 hours.
  - This should allow you to get through the first NREM/REM cycle.

- ✈ Immediately prior to duty.
  - Maximum: 45 minutes.
    - This is a safe amount without entering deep sleep. You will be able to "wake-up" quickly and get to business. If you fall into deep sleep and are subsequently awakened, you will probably feel groggy, sleepy, or disorientated for about 15 minutes or so. This is called SLEEP INERTIA

  - Minimum: Whatever you can get!
    - Even 10 minutes can be restorative in nature (although it will be short-term).

4.10 On-the-Job Fatigue Countermeasures

We don't always have the option of preparing for extended periods of work. In those instances, there are some things that you can try to help combat the immediate effects of fatigue. While there is no long-term countermeasure, the following strategies may help you counter the short-term effects of fatigue:

- ✈ Engage in some type of physical activity
  - An excellent way of maintaining alertness. It doesn't have to be complex: stretch, write, chew gum, etc. Physical activity helps keep the blood flowing, and helps combat the onset of fatigue.

- ✈ Engage in conversation
  - Obviously, you shouldn't simply waste time and just talk for the sake of talking, but good operationally focused discussion on the task at hand can help keep people focused. One technique that is often employed is that of asking, "What ifs." Some examples would be, "What if…happened right now?" or "What would you do if…?" Force yourself, and the rest of your team to stay mentally engaged in the task.
  - Aircrew can also do things like pass a Pilot Report (PIREP) to Air Traffic Control, and vice versa.

- ✈ Review emergency procedures;
  - This is another method used to keep people mentally engaged. Even if you are by yourself, you can review emergency procedures to help fight complacency.

- ✈ Ventilate your workspace (aircraft, tower, hangar, etc.)
  - The effects of fresh air on a tired person are considerable. Working in areas with poor ventilation can accelerate the effects of fatigue, so it is important to get some fresh air when you are feeling fatigued.

- ✈ Eat appropriate snacks & stay hydrated; and
  - As we discussed in the stress and nutrition portion of this program, what you eat and drink can have a considerable effect on your performance. Don't stack the cards against yourself – keep your fluid levels up and try to eat the proper balance of foods.

- ✈ Use caffeine strategically.
  - When used properly, caffeine can provide you with a short-term increase in alertness. However, once the effects wear off you typically feel even worse. Try to avoid using it when you start a shift, after a nap, or when you are already alert. It can be quite effective towards the end of a shift if you need a short burst of energy, but eventually you need to rest.

- Ensure your workspace is well lit.
  - Light plays an important role in the psychological aspects of fatigue. Light can be used to "disrupt" your circadian rhythm. The exposure to light can have some problems if employed at the wrong time. For example, trying to get to sleep after a night shift can be difficult because your body recognizes the fact that it is daytime and therefore, time to be awake.
  - You can use this effect to your benefit. If working through the night, you should keep in mind that bright light can help increase your level of alertness. For this reason, technicians should ensure that they have adequate lighting before beginning a complex task in an otherwise dark hangar. For aircrew, increasing the cockpit/cabin lights during long transits can help increase alertness as well. Of course that comes at a price while flying, but it should be weighed against the potential for a dangerous decrease in your alertness.

4.11 Using AIPA to Address Fatigue

Now that you have been given this knowledge regarding fatigue, it is time to put it into application. We must look no further than the "AIPA" Model to see how the causes, effects, and countermeasures can be brought together to make an informed decision that will help maximize performance.

- Awareness
  - We've been on duty for 12 hours, working all night long.

- Implications
  - The combined effect of no sleep (long shift) and working through the night (disrupted circadian rhythm) will almost certainly result in decreased performance.
  - Fatigue is definitely starting to set in. It will be hard to stay focused for any real length of time, and we are extremely likely to make an error.

- Plan
  - If we can't be replaced or get some sleep, we need to be extremely careful. We should try to establish some barriers that will help us accomplish our tasks.
  - Ideally, mentally demanding tasks should be avoided (if possible).

- Act
  - Every 15 minutes - stop working and clear your heads, get some fresh air. It will be much easier to stay focused for the shorter periods of time.
  - Towards the end of the shift, grab a coffee or a soda.
  - Do a couple of the less mentally demanding tasks.

The above scenario is by no means all encompassing. It simply shows how AIPA can be applied to a situation in which fatigue is a concern. It is far more important for you to

understand the decision-making process (AIPA), rather than attempting to give you one or two magic bullet solutions.

4.12 Conclusion

Most people understand that fatigue can adversely affect performance. Now you have the KNOWLEDGE regarding causes, symptoms, and countermeasures, which should help you to avoid some of the problems caused by fatigue.

Armed with this new knowledge, it should be easier for you to focus your ATTENTION on potential areas of concern. Use the TIME available to process the information you acquire, in order to make an informed decision regarding the situation and potential implications of fatigue.

It is important to remember that you can't motivate yourself out of fatigue. The mind and body need rest in order to perform effectively. The problem is compounded by the fact that military aviation may demand us to work when the body wants to sleep. This can result in severe consequences if it isn't taken seriously.

Fortunately, there are things that you can do. We have presented you with several strategies to help avoid, and deal with fatigue on the job. Unfortunately there is no simple answer to the problem of fatigue. Use your newfound knowledge to find out what works for you.

Human Performance in Military Aviation

Module 5

Rules, Regulations and SOPs

Introduction

It is important to discuss the importance that rules, regulations, and standard operating procedures (SOPs) play in military aviation. In the military, practically all aspects of our job are regulated in one form or another. We are governed by a variety of rules and regulations, which span the entire spectrum from 'should' to 'shall'. Regardless of where they fall within that range of should to shall, they have a common purpose – to enhance performance. These rules, regulations, and SOPs have been developed to assist you in the execution of your duties and to help ensure that others who work with you know what to expect from you, and vice versa. While they may not apply to every single situation, they do serve as a valuable starting point in any situation. We'll talk a little bit about rules and regulations, and then focus more on the SOPs that guide our actions every day.

Module Objectives

The objective of this module is to:

- Highlight the importance of rules, regulations, and SOPs;
- Suggest areas that should be considered when developing rules, regulations, and SOPs; and
- Provide you with a suggested process to utilize if you find yourself forced to deviate from a rule, regulation, or SOP, or if none have been written for the situation you find yourself in.

Module Content

5.1 Rules and Regulations

The old adage is true, “Many rules and regulations are written in the blood of others.” It is important to remember that rules and regulations are often the result of past experience. Rules and regulations (regs) are formal procedures. Unless otherwise specified, they shall be followed.

For the most part, rules and regs help prevent bad things from happening, and also help people do the right thing in particular situation. A lot of thought goes into the development and implementation of rules and regs. Unfortunately, sometimes we don’t have the luxury of knowing all the background behind a rule or reg. Often, the “corporate knowledge” behind a rule or regulation gets lost over time and we may start to question it. Keep in mind that you may not have all the information the drafter(s) did. Simply put, unless there are exceptional circumstances, rules and regulations must be followed. Later, we will discuss some of those exceptional circumstances, and provide you with some general guidelines to help you reach the correct decision.

As a professional, you should strive for an intimate knowledge of the rules and regulations that govern your actions. Without the proper knowledge of the rules and regs, you are charting your own course, based solely on your own experience and not the experience of those folks who wrote the procedure.

Although rules and regulations must be followed, it doesn’t necessarily mean they are always perfect. Orders can become dated, for a variety of reasons. If you think something needs to be changed, research it and make a proposal. But, be careful not to make a quick decision without thinking of the potential fallout. Use the AIPA process. It works… Do not blatantly break the rules because “you know better”. Even if it works for you, you may be setting someone else up for failure. If junior personnel see you breaking the rules, it sends a message that it is okay. That’s not the right message. If it doesn’t work, change it.

5.2 Standard Operating Procedures (SOPs)

Standard Operating Procedures (SOPs) share many of the same qualities of rules and regulations, but are generally considered “guidelines”. They typically outline what “should” be done, and can be described as “Specific procedures for anticipated situations”. Perhaps importantly, they are also “pre-determined successful solutions.” SOPs should be the starting point in your decision-making process. Someone may have already learned the lesson you are about to learn…

An effective SOP must include:

Often, procedures define the WHO and the WHAT but neglect the WHEN. If "WHEN" is not addressed, you can get into situations where people are reluctant to speak out due to a fear of conflict, etc. By including WHEN in an SOP, you are removing the personal element of the equation. It becomes simple…"the SOPs say that I am supposed to do X when Y happens. So I did." To make this even more effective, establishing the proper atmosphere from the onset is important. Personnel need to know that their inputs are going to be well received.

Many of the concepts and tools we discuss should be incorporated into your SOPs in one form or another (see Annexes A, B, and C for suggested areas of SOPs for aircrew, groundcrew, and aerospace controllers). Hopefully, after this training, you will be able to look objectively at your current SOPs and offer some suggestions on how to improve your operations.

5.3 Benefits of Rules, Regs & SOPs

Aside from providing us guidance on what to do in a situation, rules, regulations, and SOPs provide a number of benefits. Here is a summary of the main points:

- ✈ They are predetermined successful solutions;

- ✈ Reduce your information processing demands;
  - They help simplify the decision-making process by reducing the amount of time required to arrive at a decision.
  - They eliminate the need to solve the same problems over and over again. It eliminates trial and error, allowing you more time to attend to other important items.

- ✈ Risk management tool;
  - They help personnel make the right decisions based on previous successes.
  - Even if a SOP does not perfectly fit your situation, it can still assist you. You can use the SOP as the starting point and it should give you a good idea which course of action to take.

- ✈ Help to ensure consistency;
  - We know what to expect from each other. This allows us to save time trying to figure out what the other person is supposed to do.

- ✈ Encourage communication / teamwork; and

- A standard is established and each team member will know what is expected of him or her.

✈ Reduces potential for conflict
- It removes opinion from the equation. This is particularly true when dealing with "sensitive" issues. It provides the individual with an impartial source to help resolve conflict.

5.4 Making Changes to Rules, Regs, and SOPs

Rules, regulations, and SOPs often require modification to reflect changes in equipment, mission, etc. When a rule, reg, or SOP no longer applies to your job, it should be changed. While you may feel that it is an uphill battle, carefully thought out proposals can enhance performance and reduce the potential for mishap. If you feel that a change is in order, consider the following points:

✈ Do your homework.
- Find out where the procedure came from. Remember that procedures usually originate from past experience. What were the drivers (reasons) behind the procedure? Is the originator still available to discuss the issue with?

✈ Talk to the experts.
- Discuss the problem area with those in a position of influence (standards, crew chief, UFSO/NCM, etc.) You may want to consider a small working group to identify potential pros and cons. A working group is often productive because people tend to feed off other people's inputs.
- Maybe you can put the proposed amendment on circulation so people can read it and let it sink in.

✈ Let it sit for a while… Come back to it.
- Come up with a proposed solution or amendment and then let it digest.
- Set a time to revisit the issue with the necessary personnel to see if anything else has come up.

✈ Obtain agreement on a course of action.
- After a short gestation period, gain commitment from those working with you. Be sure that your amendment does no harm.

✈ Staff it up the chain!
- Send the amendment up the chain to your supervisor.

✈ Follow up to ensure closure…
- Make a note to yourself to check the status of the amendment every few weeks until you hear whether or not it has been approved.

5.5 Briefings and Debriefings

Now we will look at something that should definitely be part of any unit's SOPs - briefings and debriefings. Although the content of a *briefing* may differ greatly depending on your job, research has shown that it can greatly enhance team performance. Of equal importance is to *debrief* after a task or mission to discuss what worked well and what did not work so well.

- Briefings
  - A clear and concise briefing will help enhance the performance of everyone involved. In particular, briefings are an excellent way of:
    - Aligning goals;
    - Building awareness;
    - Allocating responsibilities:
    - Assigning duties;
    - Identifying potential hazards;
    - Clarifying any confusion; and
    - Encouraging feedback.

- Debriefings
  - Debriefings are an excellent way of:
    - Evaluating performance;
      - Provides an opportunity to find out how things worked from someone else's perspective. How often have you seen someone think that things went perfectly when in fact they didn't?
    - Improving through constructive feedback;
      - By discussing the task as a group, you are on the right path to improved performance. If someone can give you some pointers on what worked and what did not work, you will gain a better understanding of your job and how to do it better.
    - Developing your expertise;
      - Knowledge is food for the brain. Take advantage of others' experience to develop your own. Always look for ways of expanding your own knowledge base.
    - Learning from each other;
      - Adults tend to learn quicker when working with their peers. We are typically very visual people and seeing someone else execute a task can be very beneficial.

- Strengthening the team;
  - Getting together to discuss the task shows the people on the team that there is a genuine desire to improve as a group. Discussing the task as a group, and showing your ability to listen, helps build your credibility as someone who cares about the other members. If you never want to debrief, then people might equate that to a lack of interest in the group's well being.

- One thing to consider, especially for senior personnel, is that some junior members will be reluctant to ask to have a debriefing. If you were considering forgoing the debriefing, try to provide each person with an opportunity, one-on-one, to say whether or not they would like to debrief. Otherwise if you casually ask, "Does anyone want to debrief?" a less assertive person may not speak up if the rest of the group has indicated they don't want to debrief. That way, if someone wants to debrief, then you (as the supervisor/leader) simply tells the rest of the team that there will be one. This doesn't single out anyone as "having a problem". That is another misconception. Debriefs aren't always for discussing what went wrong. Take time to discuss what went right as well. That's how people learn. Especially less experienced personnel. Don't take for granted that everyone "knows" what went well and why. Put yourself in their shoes and ask that same question.

5.6 Purposeful Departure

WARNING: The information in this section is NOT intended to be a prescription for breaking the rules! It is meant to provide you with a suggested approach to handling a situation that may not, due to exceptional circumstances, suit the particular course of action outlined in orders, or SOPs. You must realize that you will likely find yourself in front of your supervisor explaining your actions, especially when it comes to a rule or regulation. Think it through wisely.

You may find yourself in a difficult situation that requires you to make a decision that is contrary to orders (i.e. combat, lives at stake, etc.). Although these situations are extremely rare, you should understand how to proceed when you find yourself in a situation that you feel requires you to do something contrary to orders or accepted procedures. In this case, it becomes increasingly important to carefully weigh the implications of the situation and your possible courses of action.

Here are some of the considerations you must account for prior to a "Purposeful Departure" from rules or regulations:

- ✈ Must I make a purposeful departure in order to prevent loss of life or serious harm?
- ✈ Would I be able to justify breaking this rule?

- Does it seem reasonable given the current situation?
- Is the situation really that serious that I must depart from the rules or regulations?

It would be impossible to cover every possible scenario. The most important thing is that you use a sound, logical process to reach a decision. Remember,

- If you depart from **SOPs**, you may have to explain yourself.
- If you depart from a **rule or regulation**, you will undoubtedly have to explain yourself. You may even initially be in trouble for breaking a rule or reg.

If you have used a proper decision-making process, and considered the appropriate factors, then the reason should be clear. Unfortunately, it can be very difficult to exercise this type of judgement. THINK IT OVER CAREFULLY!!! You should use the AIPA model to aid in your decision.

To demonstrate how AIPA could be used in this type of situation, we will simply discuss a departure from SOP. The important point is to use a systematic approach to explore your options.

- **Awareness**
  - What is going on? How serious is the situation?
  - What are we trying to achieve and how important is it?
  - Let other team members contribute to the discussion.

- **Implications**
  - If I depart from SOPs, what could happen?
  - If we follow the SOPs, what will the likely outcome be?

- **Plan**
  - Talk with the rest of the team. Get their feedback regarding the situation.
  - Plan carefully – "Set limits".
  - Brief the plan and make sure everyone understands what is going to happen.
  - Verbalize these limits so everybody knows what to expect.
    - Aircrew example: "We are going to continue flying in this direction until we reach 100 DME, then we are going to make a choice of destination."
    - Ground crew example: "We will keep going for another 15 minutes before we go inside."
    - AEC example: "We will let that traffic continue for another 15 miles, and make a decision.

- **Act**
  - Once you have reviewed the facts (Awareness), and thought of the implications, then planned choices, it's time to actually put your plan into action.
  - Make a conscious decision and go with it. Now that you've identified what is going to be done, you need to make everyone aware of how it is to be done.
  - This will start the process again of aligning goals, allocating responsibilities, etc.

Using the AIPA process should help you reach a sound decision. Of course, if the time is available, and that option exists, you should consider consulting with a higher authority if you intend to depart from the rules or regulations. If time is not an option, the decision to make a purposeful departure requires even more consideration. Think it through very carefully!

5.7 Conclusion

We have briefly discussed the spectrum of rules, regulations, and SOPs. A lot of thought goes into their development, and they are often the result of past success and failures. It is important to remember that rules, regulations, and SOPs help enhance performance and provide consistency among team members, between units, and across the Air Force. As you review and update rules, regulations, or SOPs, try to ensure that they address the WHO, WHAT, and WHEN. Use your time prior to a mission/task to brief all the parties involved, and then to follow up with a debriefing. The briefing will help people to focus on the goal and the debriefing will help your team improve their performance for the future. Lastly, we must keep in mind that rules and regulations are to be followed. If for some reason you must depart from them, we strongly recommend that you think if over carefully, and use a process – AIPA.

Annex A

Suggested SOPs – Aircrew

These are just some suggested areas that should be covered by SOPs.

- Crew briefings: Should be brief, yet thorough and structured. Every flight should begin with a pre-flight briefing. It is an important part of the team formation phase and will be discussed further in the Team Building module. Crew Briefings set the atmosphere right from the beginning by aligning team goals, establishing expectations, assigning duties and responsibilities.

- Sterile cockpit rule. The use of non-essential conversation, at inappropriate times can be distracting and may interfere with normal or operational communications. SOPs should include restrictions on the use of "non-essential communications" during periods of high workload, such as during take-off, landing, high-density traffic areas, etc.

- Standard callouts. Proper call-outs increase communication, providing for early detection of incapacitation. They are used to convey vital information with a minimum number of words that have an exact meaning to all crewmembers. Standard call-outs apply to everyone on board. Not just the pilots. In your SOPs, you should identify tolerances that are expected (for example: While en-route, pilots shall maintain ± 10 kts and ± 100 feet. Failure to do so will result in the Non Flying Pilot calling "Airspeed" or "Altitude. The Pilot Flying shall thereby respond, "Correcting" and make the appropriate corrections.).

- Two-challenge rule. Designed to combat pilot incapacitation or any situation that may compromise performance. Using the above example, this rule states: "If the Pilot Flying (PF) has not made adequate corrections after the initial callout by the Pilot Not Flying (PNF), a second callout shall be made. Failure to correct following this second callout results in the PNF assuming flying duties." This two-challenge rule does not only apply to pilots. If a Flight Engineer or other crewmember notices a problem, they should make the appropriate callouts, and the PNF would then assume control (if required).

- Altimeter setting procedures. Effective error management strategies include, the crosschecking of altimeter settings done by each individual with an altimeter. If an individual is unable to set their own altimeter, they should, as a minimum, read back their altimeter setting to confirm that altimeter settings are correct.

- Challenge and response procedures. Effective way to verify compliance. Ensures all crewmembers aware of state of the aircraft (i.e. What switches are on/off). The best example is a checklist! Checklists were created to prevent errors, but they are only useful when used. For the person who is "Challenging", they should also include "Verify" in the process. After stating the challenge, the individual should

verify that the correct switch, setting, etc. is done as the response…Challenge-Verify-Response.

- ✈ Snag reporting procedures. One of the most common things overlooked is the snag reporting process. Aircrew need to understand that the way we interact with our technicians can have an enormous impact on the overall performance of our aviation team. Respect goes both ways and they deserve a proper debriefing of aircraft snags. That may require answering a few questions to help the technicians but it is the least we can do to help the de-snagging process.

Annex B

Groundcrew/Maintenance

- Shift lengths. Aircrew have set shift lengths and similar guidelines should be established for maintenance personnel. SOPs should include guidance on when and why personnel should be tasked to work beyond normal shift lengths. It should not become a simple matter of habit, as the potential for error increases significantly when shifts are lengthened too much.

- Overnight procedures. It would be beneficial to outline general rules regarding overnight operations. The potential for error is considerably higher when working through the night, and the mind is not well suited to extremely complex mental tasks during this period. Although often impractical, whenever possible, the overnight period should be used to do some of the less mentally demanding tasks (i.e. sweep out hangars, etc.).

- Environmental concerns. Policy for leaving aircraft out over night. Policy for opening and closing doors during cold weather operations. Policy for techs working outside during cold weather. These are all items that could be incorporated into SOPs.

- Aircraft snag procedures. The sequence of events from placing an entry in the aircraft log set to ensuring that all paperwork and documentation is properly completed.

- Shift change procedures. Outlining the handover procedure. A good handover helps develop the other crew's understanding of the situation, and what has been done as well as what still has to be done.

- Establishing servicing priorities. Which aircraft missions have the highest priority? This would help supervisors plan based on operational priorities.

- Ground training requirements. The SOPs should also outline the requirement for periodic ground training sessions for maintenance personnel. Operational tempo can make it hard for them to undergo any type of professional development and this should be addressed. These sessions could be used to discuss recent performance issues – both good and bad.

- Local Tool control procedures. Should address the unit's operations at home as well as during deployed operations.

Annex C

Aerospace Controllers

- Shift lengths. How long can a controller work without a break…even if the controller feels all right? Are there rules? Are they reasonable?

- Use of standard terminology/commands. To help ensure the highest level of professionalism and to prevent misunderstandings with aircraft and other agencies.

- Terrain avoidance procedures. Personnel should be prepared with standardized terrain avoidance instructions. This type of communication must be clear and concise and leave no room for misinterpretation.

- Shift handover procedures. Is there a set time for the handover? How long does the incoming controller have to monitor the situation before they assume control? Did you know that in a large study of ATC incidents, the first 15 minutes of a person's shift, or just after a break, accounted for about 80% of the incidents? That's because it takes a while to develop a clear mental picture of what is going on. Perhaps it would be a good idea to plan at least 15 minutes overlap between shift changes to allow the incoming person to get up to speed.

- Aircraft hand-off procedures. Once again, the communication should be very structured and rely on standard terminology to expedite the process.

- Mandatory breaks. During periods of high workload, controllers should be given short breaks in order to stay mentally alert. Studies have shown that any more than 20 minutes on duty during a busy period can place enormous demands on an individual and occurs are likely to occur.

- Emergency procedures. Clear guidance on what to do in the event of an aircraft incident/accident. Who to notify, how to recall personnel, etc.

- Operational/Tactical procedures. As required to meet the operational and tactical needs.

Human Performance In Military Aviation

Module 6

Communications

Introduction

Effective communication is what makes a team perform like a well-oiled machine. It is absolutely vital for team coordination. Effective communication allows teams to build group situational awareness, share plans and provide effective feedback. It is really quite simple - effective teams communicate effectively.

Module Objectives

Upon completion of this module you should be able to:

- Apply the basic concepts of effective communication.
- Recognize the factors that affect communication.
- Apply the essential skills of communication.
- Select appropriate communication strategies under a variety of situations.
- Apply the P.A.C.E. approach to communications.

Module Content

6.1 Basic definition of "Communication".

"The process of exchanging ideas through a common system of verbal and non-verbal signals."

This definition is fairly brief but there is actually a lot to it. First communication requires that the other person(s) understands exactly what it is you are trying to share; otherwise the "idea" is not really being accurately exchanged. The communication will be incomplete or in error. Second, communication is much more than just "words". How we say something is often more important than what we say. Body language, tone and inflection, all convey meaning. In addition, we also rely on written communications, hand signals, and a host of other communication strategies ranging from actions taken in an aircraft with a radio failure to emergency fire/smoke signals in a survival situation. There are many ways of transmitting information, but effective communication is…

"Being able to communicate your information in such a way that the other person shares the same meaning you do."

The concept of effective communication goes beyond simply transmitting information. You want to ensure that the other person has understood what you said, not just received it. You can "talk" all you want but it will not be "communicating" unless all parties involved share the same ***meaning*** as you.

In a military environment, there are numerous opportunities for the communication process to break down. Do you think that these phrases might cause confusion?

- "Take-off power!"

Does this mean reduce power or set power for take-off?

- "Should I turn left?" - "Right!"

Does this mean to turn left or right? This is why proper military communication procedures utilize very specific terminology. We say "affirmative" not "right". Being disciplined in the adherence to procedures and proper terminology helps prevent confusion.

Effective communication is essential for effective team performance. Poor communication is often the root cause of poor performance. Remember, communication goes much deeper than simply our words. The way we say something has a lot to do with how it will be understood and we have to watch out for communications that could be misinterpreted based on the literal meaning of the words. Even our actions and attitudes communicate something to the people around us. Be sure that what you communicate is what the "receiver" understands. Be sure that what you understand is what the "sender" intended. Both as "senders" and "receivers" we have a responsibility to ensure effective communication is occurring in the military

aviation environment – but remember it is primarily the sender's responsibility to ensure that s/he is understood.

6.2 Modes of Communication

In a perfect world all of our communications would transpire in face-to-face conversations. This allows us to engage all of our senses in the conversation. The three primary elements of communication are as follows[1]:

- Verbal: This is probably the most obvious way in which we communicate. Verbal communication simply refers to the words we use, either orally or in writing. However, Verbal communication only accounts for approximately **7%** of the total communication process.

- Tone, Volume, Etc.: Tone, volume, pitch, inflection, referring to the way we actually say the words. Is the sender angry, scared, determined, panicked? **38%** of the communication process is the result of unconscious signals and readings, such as tone or sound of voice.

- Body Language: The way we appear to others. Are you interested? Ignoring them? Things like eye contact, posture, gestures, touch, silence, etc. Many people either don't know or realize how big a part body language plays in face-to-face conversations. Approximately **55%** of all face-to-face communication is achieved through *Body Language*.

In the military we do not always have the luxury of "ideal" face-to-face communication. We may be working in a dark environment (NVG ops), on a noisy ramp, with poor radio reception, etc. If we can't see each other (radio or darkness), then we are simply relying on our words and the way we say them. It becomes increasingly difficult to communicate effectively as we lose one or more of the modes of communication (e.g. body language). In some cases we can't hear or communicate verbally at all. In these cases we have to find alternatives such as hand signals, lights, or other methods. This is why it is so important that we establish SOPs/protocols that everyone follows. Use of standardized terminology and procedures are an excellent way of maximizing the effectiveness of the communication process. Pre-mission, or pre-tasking briefs are also very important as they help ensure that everyone is on the same page to begin with. These are some of the tools that allow us to manage the threat and error posed by hostile communication environments and continue to communicate effectively.

---

[1] *Mehrabian, Albert and Morton Wiener, 1967, "Decoding of inconsistent communications," Journal of Personality and Social Psychology 6:109-114*
Mehrabian, Albert and Susan R. Ferris, 1967, "Inference of attitudes from nonverbal communication in two channels," Journal of Consulting Psychology 31:248-252.
Daniel Druckman, Richard M. Rozelle, and James C. Baxter. 1982. Nonverbal Communication: Survey, Theory, and Research" Sage Publications 1982, pages 84-85.

6.3 The Communication Process

The objective of communications is quite simple, that the receiver understands *exactly* the information that the sender wishes to transmit. The reality, however, is that communication is never perfect - misunderstandings are common. Fortunately, communicating effectively is a skill, which can be improved with care and practice.

The communication process begins with the "SENDER" forming an idea, based on their understanding of the situation. This idea is then transmitted to another person(s) – the "RECIEVER". Unfortunately, the message frequently gets distorted. This may be due to external barriers, such as noise, or to internal barriers that exist in either the sender or the receiver, such as inattention. Hopefully the receiver will understand the message correctly the first time – HOWEVER – if the message is important, we should make sure that the communication attempt was successful.

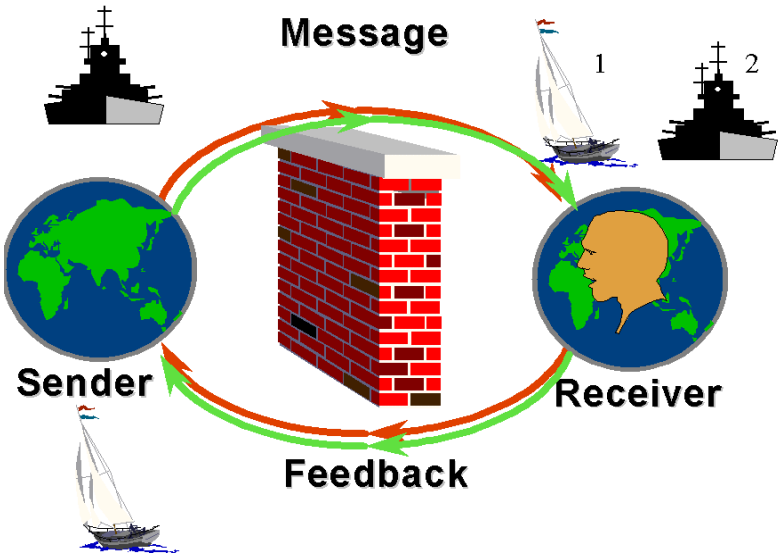


Illustration 6.1

In the scenario depicted in figure 6.1, the sender was describing a warship – "Look at that ship over there". Unfortunately because of a variety of communication barriers, the receiver thought the sender was referring to the sailboat. The only way to know if the true meaning has been understood is for the sender to obtain some form of feedback. Once you receive feedback that the message has been understood, your "mission" is complete. If the feedback you receive indicates that the message has not been understood, you must reinitiate the process again. It is feedback that allows us to correct for error. If the receiver wants to verify they have received the right information s/he might query the sender – "You mean the sailboat?" This would give the sender an opportunity to amplify the original message – "No. The warship, its at 3 O'clock, about 5 miles." Sender – "Seen!" On the other hand the sender might want to verify that the receiver has the correct information and s/he can query the receiver. Of course the best approach is to be clear about what you are trying to communicate before you "transmit" – "Look at the warship – about 3 O'clock and 5 miles out."

Remember, although the sender and receiver share some of the responsibility for ensuring effective communication, the primary responsibility lies with the sender. Some suggestions are:

Sender:

- Clarify your ideas before commencing the communication process.
- Examine the purpose of the communications (i.e. is there is hidden agenda?).
- Consider the environment, and beware of emotional overtones.
- Follow up on the communication process by obtaining feedback.
- Be a good listener…be receptive to feedback.

Receiver:

- Concentrate on the content of the message.
- Remember that body language is a very important key in the communication process.
- Be aware of internal or external barriers.
- Try to look beyond the speaker's delivery. Some people are not great communicators and it requires additional concentration.
- Listen for meaning, not just the facts.

REMEMBER…Feedback is the most important part of the communication process! It is feedback allows us to correct for error.

6.4 Barriers to Communications

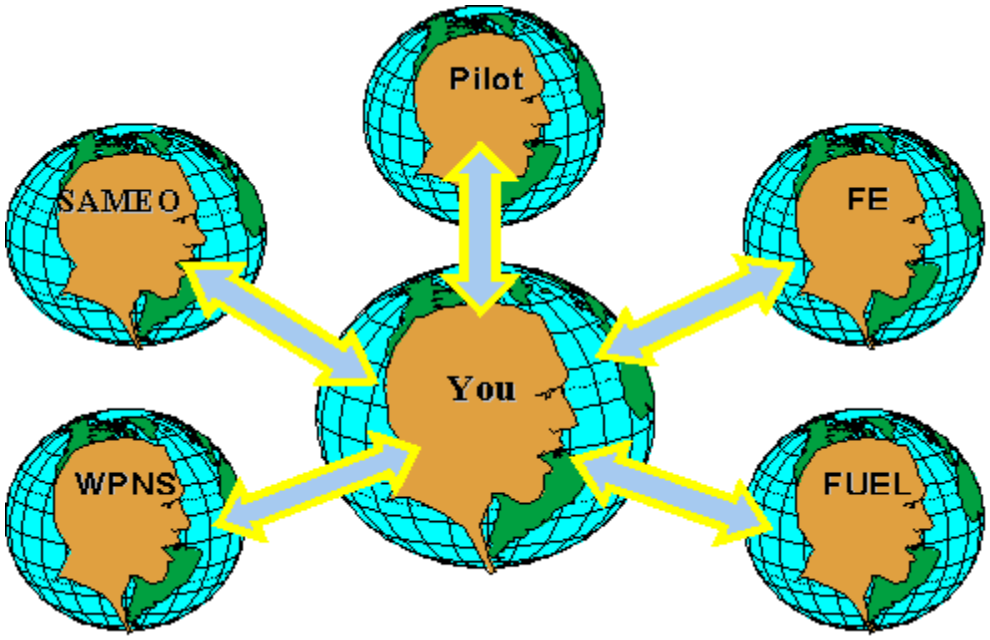
Table 6.1 identifies some common communication barriers. Some of these barriers are external – such as excessive aircraft noise. Another example might be a poorly functioning radio. These are relatively straightforward. Other barriers are internal, or mental barriers – such as attitudes. These can frequently be a little more difficult to identify and deal with because they are not always so obvious. For example, Sally may not be really listening to Sam because she feels he is always exaggerating. An example, which perhaps has elements of both external and internal communications barriers could be rank structure. It can be hard for a junior member to speak up in front of, or to, a senior member. This is why it is so important that senior members demonstrate they are receptive to input from junior members.

Table 6.1 Barriers to communications

INTERNAL	EXTERNAL
Attitudes/Ego	Rank/Crew Position
Boredom	Workload/Fatigue/Stress
Mental Distractions	Language/Culture
Health	Complexity
Emotions	Noise/Heat (discomfort)
Poor credibility	Lack of non verbal cues
Poor listening skills	Distractions

If you add several members to the team, the problem becomes even more difficult. When you look at Illustration 6.2 it is easy to see just how important effective communication can be if you want to control the inputs that you receive, process them, and make the right decisions.

Illustration 6.2 – Communication in a Team Setting[2]



It should also be easy to see why error management can be so difficult in a team setting. With a large number of variables, feedback becomes even more necessary. A feedback system provides error correction — all error correction systems use feedback.

[2] Adapted from Transport Canada Crew Resource Management (CRM) Course

In a crew or team environment, effective communications are essential to:

- Allocate of responsibilities.
- Provide timely and effective feedback.
- Direct attention.
- Establish common goals.
- Build common mental models of system states.
- Establish leadership, trust, and authority gradient.
- Establish receptiveness, attentiveness, cooperativeness, assertiveness etc.

Briefings align the team; let them know what is to be accomplished, and who is responsible for what. Debriefs are a good opportunity to share ideas and provide more in-depth feedback. Both are critical elements of effective team performance.

6.5 The Five Essential Skills of Communication

We have already seen that the communication process is a complex process. A great deal of research has been done in the field of communication. An analysis of effective communications in a team environment has identified five "essential" skills. These five skills are:

1. Inquiry;
2. Advocacy/Assertion
3. Active Listening
4. Conflict Resolution
5. Critique/Feedback

6.5.1 Inquiry

Inquiry is a tool for increasing your awareness (understanding of the situation). It is actively seeking out information and feedback from others. Our ability to make sound decisions is largely based on the quality of the information that we are able to assess

Inquiry is not always easy. You need to ask the right questions in the right way, particularly if you are communicating with someone of a higher rank, more experience, or maybe someone who is simply not very receptive to questions. In general, you should…

- Ask clear and concise questions.
- Relate your concerns accurately.
- Keep an open mind.
- Draw conclusions from valid information.
- Ask for feedback.

"Eastern Airlines Flight 401" is a classic case study showing poor use of inquiry. In this case, the crew was distracted by the landing gear indicator and inadvertently

disengaged the autopilot, commencing a slow descent. They descended until they eventually crashed into the everglades. A controller, who was watching the doomed flight on radar, attempted to warn them by asking, “Eastern 401, how’s everything going out there?” The aircrew undoubtedly assumed the controller was asking how the emergency was coming along. Their response to the controllers query was, “Fine.”

In hindsight, this question was so ambiguous that it was useless. What question or statement do you think would have got the point across? How about, “Eastern 401, what is your altitude? I show you at X and descending.”

6.5.2 Advocacy/Assertion

Advocacy

Advocacy is about suggesting a course of action. It is a tool for increasing *someone else’s* awareness, or understanding, of a situation. In order to prevent conflict, you should follow these simple guidelines when advocating your position:

- Clearly state your position.
  - Keep the focus on what’s right, not who’s right.
  - Give facts - do not be vague.

- Suggest solutions.
  - If you feel the need to advocate your position, try to have a solution ready offer. This will make you part of the solution and not part of the problem.

- Be persistent and timely.
  - If you see something out of the ordinary, speak up.
  - The longer you keep information to yourself, the harder it gets to speak up.

- Listen carefully to others.

- Keep an open mind.
  - Just remember that you are presenting your “perception” of the situation. It is quite possible that you don’t have an accurate picture of the situation. Maybe the other person has some important information that would address your concern.

Assertion

Being assertive, when required, is absolutely essential for anyone working in military aviation. Assertiveness is simply an escalated form of advocacy and is a method of getting your point across when you are very sure of your position and others do not appear to be listening. Assertiveness should not be confused with being *aggressive*.

Aggression involves emotion and anger. Assertiveness is based on rationale, not anger.

When you feel it is necessary to assert yourself, you should…

- ✈ Be persistent.
- ✈ Focus on “what’s right”, not “who’s right”.
- ✈ Treat all team members with respect and understanding.
- ✈ Use a non-defensive tone.

Assertiveness should not automatically be seen as criticism of the leader. People assert themselves based on “perception”, so it is quite possible that the concerned individual’s perception is incorrect. However, if a subordinate perceives a situation as “uncomfortable”, abnormal, or unsafe, then leaders should explain why something is being done this way - that the risk is being managed, etc. On the other hand, if the concern is warranted it should be addressed. If assertiveness on the behalf of subordinates is ‘squashed’, there is a good chance it won’t be there some day when it is really required.

In most cases, personnel will recognize a hazard together and take action. We don’t have to always be “assertive” – it would be difficult for your other team members to put up with. However assertiveness is a skill that is vital to effective performance and at some point almost surely it will be required in a serious situation. In general, it is important that you assert yourself under the following circumstances:

- ✈ **Unsure of Events:**
  - If something is going on that you are unsure of, ask questions.
  - There are many past accidents and/or incidents in which someone felt uneasy about the situation but never said anything.
- ✈ **You Have The Answer:**
  - When you have the answer, provide the information.
  - When asked, state your point clearly.
  - If you are not asked, provide feedback to other crew members in a manner that makes the point clear to everyone.
- ✈ **Perceived Danger:**
  - If you detect a problem, say something. No one person can see it all.
  - Perhaps some of the other team members’ situational awareness has degraded.
  - You can help rebuild your own, or someone else’s situational awareness (through inquiry or advocacy, depending on the situation).

- Don't sit idle while something bad is about to happen. Military aviation is very unforgiving and requires the entire team's commitment.

It is important to be assertive without appearing aggressive. When people get aggressive, conflicts will develop and people will stop listening. Here is a suggested format for an "Assertive Statement":

1. Create an Opening:
   - Call them by their name, rank, position, etc. This makes it clear and unequivocal that you are directing the conversation directly to that person. You may want to use something like "Bob, Time Out!" or "Major, Just a Second!" Whatever it takes to get their undivided attention. Don't just hang a query out to dry, for example, "Gee, I wonder what that means?", and expect someone's undivided attention

2. State the Concern:
   - Express your specific concern. Don't be vague.
   - A good tip is to use "I" when stating a concern to prevent people from becoming defensive.
   - You want to try and focus the attention on you. "YOU" are the one with the problem. "I'm getting a bad feeling about this…" or "I feel like…" or "I don't understand…"

3. State the Problem:
   - The problem may be real or perceived. It may simply be a function of inexperience.
   - "Here's the way I see it…if we do __(some action), then there is a good chance that __ (something bad) will happen".
   - You might be wrong but at least you have clearly laid out your perception of the situation.

4. Offer a Solution:
   - People don't like problems. They like solutions. Once again, use "I" if possible when suggesting something and then offer it to the group using "WE" or "US". This shifts the focus back to the entire team.
   - "Hey guys, I think that getting a couple more technicians would make it easier for **us** to do this."

5. Obtain Agreement:
   - The last step in the process is to get action. You may not have realized it but this progression reflects the AIPA process.
   - You create an awareness of the situation and potential implications.
   - You have suggested a plan.
   - You have obtained some agreement on the action to take.
   - Using the last example, you may finish the assertive statement with something like, "What do guys think?"

So, what if the assertive statement doesn't work?

If you've tried your best to get your message across, used the assertive statement, and still have been unable to convince the others that you are right, things are pretty serious! At least your perception of the situation is pretty serious. There is still a very real possibility that the problem is with you, but if you are convinced that you are right, you may have to use something else to jog the crew or other team members into awareness. Often a simple light-hearted comment will make the same point. "Hey, I don't want to become a case study, we should think about this…"

In the worst-case scenario you might have to do something drastic. Aircrew have been using the term, "This is stupid" which has been recognized as a sort of code word calling for a major timeout and reassessment. Non-aircrew might be more comfortable and better off to use another phrase less likely to cause conflict – especially for subordinates dealing with superiors. You might be better off to say something like…"I really don't like this!" or "This is wrong!" Depending on the severity of the situation, you will have to weigh your alternatives. Is it worth it? What are the potential outcomes? The "This is stupid" type of comment should only be used in an emergency situation and only as a last resort.

If you have made your case and the leader insists on going ahead, you now need to saddle up and do your part. You should make it clear that "Okay, I'm not comfortable with this but I'm going to do my best. Just so you know I'll be bringing this up with the boss…"

While the assertive statement was intended for a team environment, it is an equally effective way of making you think about your own actions. There are many individuals who are still alive because they took a second to say, "What am I doing? This is crazy!" Think of these techniques as your own "conscience". If you're not comfortable with the situation, maybe your priorities need to be revisited.

6.5.3 Active Listening

We all like to be heard and understood. For the most part, we also like to talk. The fact is that many people are simply not good listeners. The reason is that many consider listening to be a passive function. After all, you sit there, do nothing and just listen. The other guy has to do the work… Right? *Wrong*!

Active listening involves:

- A genuine desire and effort to understand the other person's message and point of view, including hidden messages, non-verbal cues, and body language. It involves making an effort to understand what is being said. That means focusing on the individual, cutting down on distractions, and allowing the other person to finish what they are saying before you add your input.

- ✈ Listening and expressing what the other person has said. Active listening means that you actually show the other person that you have understood the communication. No assumptions…

- ✈ Being sensitive to a person's thoughts and feelings. Effective listeners listen for any "feelings" in the communication process.

When you think about it, how often have you actually practised listening and tried to hone that skill? Research shows that we use the skill of listening more than speaking, reading or writing, yet we spend almost no time learning how to "listen".

How to actively listen:

- ✈ Cut down on distractions;

- ✈ Face the speaker and look relaxed.
  - This shows them that you are ready to listen and puts them at ease.

- ✈ Maintain eye contact;

- ✈ Encourage the other person to speak.
  - This shows interest in the speaker and what they have to say.

- ✈ Don't prepare your response while listening;

- ✈ Don't finish the speaker's sentence;

- ✈ Control your emotions / Be patient;

- ✈ Ask questions including:
  - Closed questions – Pointed, useful in getting specific information quickly. Be careful with this type of question as the other person may feel like they are being interrogated. Doesn't allow freedom.
    Examples: a. "How many technicians are required?"
    b. "How long will you be flying?"
    c. "You want to fly over that hill?"

  - Open-ended questions: Allows freedom of response. This type of question is useful for identifying attitudes and beliefs. The main drawback is that it can be time consuming. Some examples would be:
    a. "What's do you think about the technician's technique?"
    b. "Which other areas would you like to draw our attention to?"
    c. "What do you think we should do?"

- Probe questions - When you would like the person to clarify or elaborate. Some examples would be:
    a. "So how did you know what to look for?"
    b. "I see…any idea why that happened?"

✈ Paraphrase.
- Putting the other person's ideas or feelings into your own words. Paraphrasing has two purposes.
    a. It assures comprehension of the message; and
    b. It provides feedback to the sender.
- An example would be:
    a. "So, if I understand correctly, you've outlined two problems; double exits and the lack of a stop bar on the runway?"

✈ Stop talking.

6.5.4 Conflict Management

The first thing we all have to know about conflict is this - not all conflict is bad. Most people automatically think of conflict as a yelling or screaming match. That is rarely the case. In fact, the presence of occasional conflict means that personnel are concerned about the operation. If people weren't concerned, they wouldn't bother to raise the issue. There would be no conflict. In fact, too little conflict can be just as dangerous as too much. There is an old saying, "when everyone is thinking alike, no one is thinking." Lack of conflict often indicates 'groupthink'. Therefore the focus is not on eliminating conflict but in managing it.

Too much conflict does not contribute to operational effectiveness and is, perhaps, dangerous. Non-productive conflict occurs when the team is not working towards common goals.

Conflict may be subtle and hard to spot from the outside. For example, two people being excessively polite to each other because they really can't stand each other and neither wants to induce a confrontation. When a situation arises with the potential for conflict, the primary focus should be on…

"What is right, not who is right".

Focusing on 'what' rather than 'who' tends to reduce the emotional factor.
Example, "Nothing personal, but **I** think that course of action will put **us** in a bad position."

In any conflict scenario, there is one important question that should determine how assertive you should be.

"Does this issue have a direct impact on the safety or execution of this task/mission?"

If it is **NOT** a safety or performance issue…

- ✈ Set the issue aside and deal with it once the activity is complete.
  - Maintain a professional attitude and carry out your job to the best of your abilities.

If it **IS** a concern to safety or it could adversely affect the outcome of the task…

- ✈ Try to resolve the problem and deal with the issue.

How to Resolve Conflict.

If you find yourself in a conflict with someone, or others:

1. Maintain Control
   - If possible, suggest dealing with the issue after a short "cooling down" period. This will prevent one of the participants from reacting solely based on emotion.
   - Avoid sharing the anger. Don't allow your concern for the issue to influence your rational thinking. Use caution because you may just find, in the end, that your concerns were not justified.

2. Listen
   - Use the active listening skills detailed in this module.
   - Use open-ended questions, probing questions, paraphrasing, etc.
   - Seek first to understand before being understood. Try to see the other side. Allow the other person to explain.

3. Use a Problem Sharing Approach
   - Clarify the problem and explore ways to resolve it. "We" have a problem.
   - Define the problem. Explore alternatives and consequences – ask for and suggest options.
   - "What action should we take?" In most cases pick the safest, most conservative one.
   - Try and obtain mutual commitment to the chosen course of action.
   - Follow-up on the decision to ensure your chosen course of action is working.

4. Maintain respect
   - Avoid personal insults and put-downs.
   - Separate facts from opinion; mentally separate facts from irate expressions.

5. Avoid Hasty Responses
   - Allow time for issues (facts versus opinions) to settle. This may mean going back to the issue a little later.
   - Use the AIPA Process to analyze the situation objectively.
   - Make decisions based on facts, not emotions.

6. Seek Constructive Solutions
   - Explore the various alternatives.
   - Try to incorporate the other person's idea into the solution. It's hard to be in conflict when people accept your idea…even if only partially.
   - At this stage, you are trying to achieve some form of ownership in the situation. "Keep everyone involved and in agreement".

Depending on the severity of the situation, and time available, there are a variety of ways to get your point across. In some rare instances, you will have done your best and still conflict may result. From a human factors perspective, it is important to avoid *implying* blame or bad intentions. A properly thought-out approach will cause people to reflect, and hopefully realize the severity of the situation on their own. The key point is that you want to prevent the other person from feeling "attacked". It's not about them; it's about the action that they have selected.

Remember, focus on: ***"What's right, not who's right!*** "

6.5.5 Feedback

In one NTSB study, they found that 31 percent of the accidents involved a failure to monitor or challenge by the co-pilot.[3] It is a very real problem that is often overlooked.

Maintaining feedback is critical to effective communication. Feedback is your way of closing the loop, monitoring progress, ensuring that others have understood what you meant or that you have understood what they meant to communicate. It is the only way to know if perceptions, goals, and mental models are aligned. Feedback is what allows us to learn and improve our performance.

Unfortunately, we have a tendency to assume we have been understood and that we understand others. Don't assume that your message was understood unless you have some type of positive feedback. Watch out for ambiguous feedback like "sure…okay." or "I got it…" Try to read between the lines and look out for potential misunderstandings. *You may have a lot to lose if you don't*.

[3] National Transportation Safety Board (NTSB). 1994. *Safety study: A review of flightcrew-involved, major accidents of U.S. air carriers, 1978 through 1990* (NTSB/SS-94/01). Washington, D.C.: National Technical Information Service.

Here are some general guidelines to follow in terms of providing feedback.

- ✈ Be Descriptive:
  - Focus on observable behaviours, not attitudes, feelings, personality, etc.
  - Describe the impact of the behaviour on others in the working environment.
  - Focus on the sharing of ideas and information, rather than on giving advice.

- ✈ Be Timely and Considerate:
  - Give feedback as soon as possible but make sure there is time to fully discuss the issues.
  - Avoid asking questions for which you already know the answer.
  - Avoid interrupting the other person; let them communicate their thoughts.
  - Give negative feedback in private (if possible).

- ✈ Balance Positive and Constructive Feedback:
  - Add the word “because” to your feedback. It forces you to give the reason why…”that was a good landing…because you flew the approach well.”

- ✈ Use “I” Statements:
  - Take responsibility for what you are saying. This clarifies to the receiver that you are presenting the feedback as you see it.

- ✈ Verify Understanding and Agreement:
  - Ask the receiver to paraphrase what you have just said.
  - Ask if there are any questions or comments.

- ✈ Use Positive Words:
  - “Will you?” vs. “You have to”. Try to avoid “never” and “always”.
  - Avoid following positive feedback with “but”. Use “and” instead.

- ✈ Don’t lecture:
  - Unless you want the other person to shut you out…
  - Explore alternatives instead of offering all the answers or solutions.
  - Feedback should not be used to “get it off your chest.” It should be used because of the value it may have for the recipient.

- ✈ Be a good listener too!
  - Relax shoulders, don’t look angry.
  - Use relaxed open hand and arm gestures.
  - Make and maintain good eye contact.
  - Try to sit eye to eye, so you are not looking “down” on the other person.

6.6 Selecting a Communication Strategy

There are a number of ways and strategies for communicating with others. Depending on the nature of the problem, you should select an appropriate approach. Obviously, if the issue is something small like a different, but acceptable, technique, you shouldn't insist that someone else change his or her ways. However, it may be 'educational' for both of you if you ask why they are doing what they are doing. That will help you understand, and possibly learn, a better way of doing it. It may also make the other person wonder why they are doing it that way and ask how you would do it.

The following graph represents a natural escalation of communications strategy from inquiry to insistence.

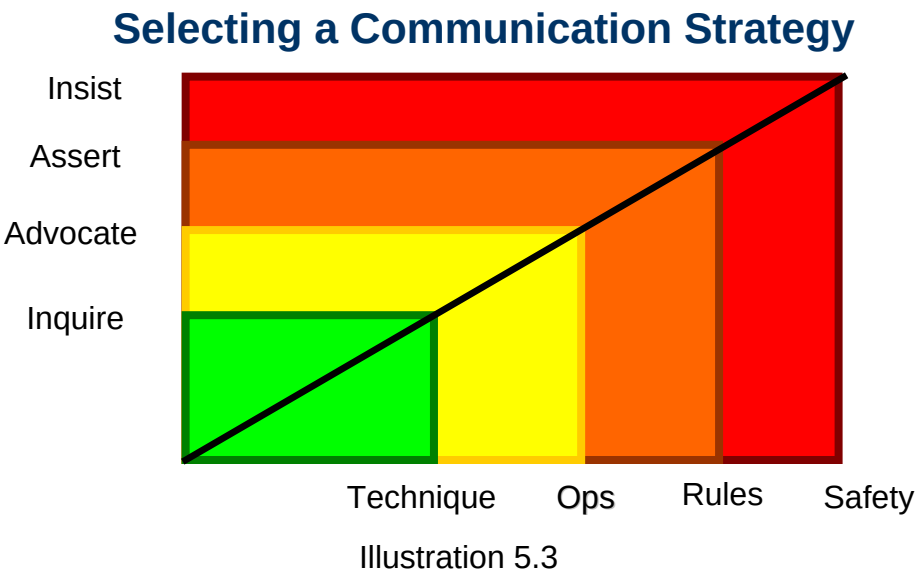


Illustration 5.3

At the lowest level, such as the example mentioned above relating to technique, you would probably **INQUIRE** to ensure you understood what is happening or to draw the other person's attention to an issue. In many cases, this is all it takes to resolve any discrepancies.

If the observation is a little more serious, such as an operational issue, you would likely **ADVOCATE** your position by stating the problem and suggesting a course of action.

If you are concerned because the problem is a direct violation of the rules, or a detriment to operational effectiveness, you should **ASSERT** yourself and inform the other individual(s) of the rules as well as the potential consequences.

If you are concerned about the safety of the team, or completion of the mission, you should **INSIST** on the proper course of action. If they choose not to go along at this point, things are very serious. You will have to make a judgement call. Should I assume control, go get a supervisor, or should I simply do my best to help accomplish

the task/mission and worry about this later. Fortunately, the odds of having to assume control from someone are extremely low. An individual will have to seriously consider the implications before taking action that extreme. On the other hand, it may be required and people may be counting on you to take that action. It is never an easy decision. In many cases, you will be able to get a supervisor involved to help resolve the situation. There is also a real potential that you are alone in your concern. Once again, you must carefully weigh the consequences. Sometimes you will have to forget your concern (temporarily) and revert back to your primary task of supporting the leader's objective. You may not like it, but it may have to be done. We don't always like what we're doing but we all have a duty to ensure military discipline is adhered to.

6.7 P.A.C.E. – A Practical Communication tool

(Adapted from material developed by Dr. Robert O. Besco, Professional Performance Improvement (PPI) Company)

Lack of assertiveness has been identified over and over again as a contributor in many incidents, accidents and performance problems. Frequently, there is someone involved who knows or suspects things are going wrong, but they just don't speak up, perhaps because they lack confidence or they feel that no one is listening. Also human beings have a natural tendency to wait-and-see in tense situations hoping it will all work out – they often don't 'close the loop.'

PACE is a practical communications tool that gives all team members a process for initiating discussion on what is happening in the current situation. PACE is a simple four-step approach that represents a non-threatening escalation of assertiveness intended on improving group awareness. Depending on the severity of the situation, and time available, PACE offers a logical progression from simple inquiry to potentially life-saving commands.

The PACE approach is:

- **P**robe for a better understanding
- **A**lert to any problems
- **C**hallenge suitability of present situation
- **E**mergency action to reduce dangers

Each step in the PACE process represents an opportunity to align team goals, ideally leading to the proper action selection. It helps groups arrive at effective decisions because it builds awareness, suggests implications and can provide a plan and course of action when things aren't going right.

Some of the key benefits of PACE are as follows:

- PACE offers a systematic approach. When all members of the team are trained to use PACE it becomes easy and natural to use it when there is indication of a performance breakdown. It is much more effective than simply trying to ad-lib on the fly. It is simple, effective, and provides a logical

progression or escalation for a team member to communicate that they are not happy with the current situation. It is clear, concise and gets to the point quickly.

- PACE is based on behaviour, not personality. PACE focuses on the substance and content of standardized communications to resolve operational issues. It provides teams with the operational skills and tools for resolving operational strategies, crew coordination and teamwork issues.

- PACE is especially suited for subordinates. If someone has a serious concern, it is his or her responsibility to inform the leader. PACE allows subordinates to do that while minimizing the potential for conflict. If, as a subordinate, your concerns are not addressed you can then carefully escalate the assertiveness of your communication strategy. On the other hand, superiors come to recognize that when a subordinate is asking questions (Probing) they are frequently trying to point out a concern, sometimes even a superior's error – but in a subtle way. Often a subordinate will not initially come out and say, "You're doing it wrong" or "That's not how you do it". Because PACE gives subordinates a way to speak up, it reinforces the value of teamwork by emphasizing the operational worth and participation of subordinate team-members.

Step 1: Probe for a Better Understanding

At this point, *"you need to understand what is happening!"*

The purpose of this step is to compare your own awareness of the situation with the awareness of the other person. Ask questions to ensure that you, and others, clearly understand:

a. The current situation;
b. Any changes to the mission/task; or
c. Any problems that might affect performance.

There may be a perfectly good reason why other members are doing what they are doing that you are not aware of. Once you know this – the problem is solved. On the other hand if there truly is a problem and you ask the right questions, you will help focus your team members' attention where it needs to be. Ideally, the other person will then realize the implications of the situation, and take appropriate measures to select the correct course of action. In most cases you will solve problems at the probing level if you ask the right questions.

- Sample probing questions:
  - "What are you/we trying to do/accomplish?"
  - "What do you think is happening?"
  - "What do you think we should be doing?"

- "What are we going to do about it?"
- "Why are we doing that?"
- "What do think could happen if we do that?"
- "Is that SOP?"

Asking the right questions is the critical element. Vague, wishy-washy, imprecise questions will not focus attention where it needs to be…

✈ Example of a ineffective probe:

- "How do you think we are doing?" – "FINE."

If you are not satisfied with the outcome of step 1, you should proceed to the next step - *Alerting*.

Step 2: Alert Others of the Problem

At this point, *"you <u>think</u> something bad is about to happen!"*

This step is still aimed at increasing awareness, making the other person(s) aware of your concern. The other person(s) apparently needs to be clearly told that there is a potential problem. The "Alerting Statement" is intended to cause the other person to reflect on the current course of action. You want to alert the leader/others to:

a. Abnormalities;
b. Deviations from the briefed mission that will reduce performance;
c. Reductions in the margins of safety; or
d. Any trends or aspects of operations that are not standard and result in reduced margins of safety and/or performance.

✈ Sample Alerting statements:
- "This course of action will not help achieve our goal."
- "The wind is blowing us off course."
- "That's not the tool specified in the book."
- "Raven 92, our radar shows that you are descending."

Avoid vague comments at this phase of the process. Communication must be clear and concise – state your concern.

If you have not been able to achieve the desired results, the situation is deteriorating and you must escalate your assertiveness (Step 3).

Step 3: Challenge the Suitability of Present Situation

At this point, *"you <u>know</u> something bad is going to happen!"*

This step represents a serious escalation of assertiveness and is especially well suited to time critical or emergency situations. The purpose of this step is to inform another person(s) of the seriousness of the situation and offer an acceptable solution. This step involves challenging the suitability of the present:

a. Strategy;
b. Tactics; or
c. Mission/task.

While this step still hopes to create awareness, the seriousness of the situation means that it is more important that an acceptable plan is agreed upon to address the current circumstances – at least temporarily until things can be worked out. Awareness becomes less important than choosing an acceptable course of action at this point.

- ✈ State your concern and reason (the why!).
- ✈ State a suitable course of action to follow!

- ✈ Sample Challenging statements:
  - "If we continue to jack this aircraft someone is going to get hurt."
  - "If we continue along this course of action, we are not going to achieve our goal. We need to select a new course of action."
  - "If we don't correct for this wind, we are going to blow dangerously close to those hills. We need to apply more crab."
  - "If you use that tool, it won't seat properly and we might damage the part. Let's go get the right tool."
  - "Raven 92, if you continue descending, you will go below the minimum safe altitude. Climb and maintain original assigned altitude."

A Challenging Statement should always include some type of consequence. Note the use of "If…Then…" statements followed by a strongly suggested course of action.

Like step 2, this step must be well thought out and should be very clear. If this step fails, there is considerable potential for loss or degraded performance and you should carefully consider using the last step.

Step 4: Emergency Action to Reduce Dangers

At this point, you have decided, *"you are not going to let it happen!"*

This step is only employed in the most serious of instances, and is the final level of escalation. It must never be taken lightly. At this point, communication is absolutely vital to safety, and your primary concern should be on taking the appropriate course of action. You are in a situation that must be addressed immediately. Emergency actions must be taken to restore margins of safety and probabilities of mission accomplishment as well as eliminating any immediate dangers.

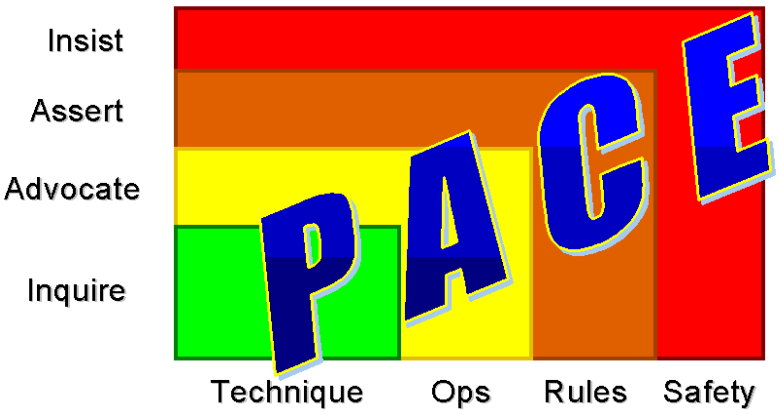
Give very specific directions or take action if necessary!

- ✈ Sample Emergency statements:
  - "We are heading for the mountains, turn right immediately and climb or I will!" or "Up, up, up!"
  - "Stop now! The pin is not in the ejection seat."
  - "I won't let you use an unauthorized tool. Someone might get killed. I'm going to get the boss to settle this one."
  - "Raven 92, climb immediately for terrain avoidance!"
  - "If we don't [action] immediately, I am going to have to take control."

<u>If this level of assertiveness is accompanied by a threat to assume control, you must exercise extremely sound judgement</u>. This can be a very difficult situation – especially when dealing with superiors. For these reasons, SOPs should include the provision for assumption of duties when performance is compromised. Regardless, this can be a very difficult decision to face. Think it over very carefully.

Whenever possible start with the "Probe" strategy and then escalate as you think is necessary.

Selecting a Communication Strategy



PACE is a tool intended to facilitate the sharing and development of awareness. In order to be effective, people must carefully think about the message they are trying to send. In some cases it will be necessary that we immediately escalate to the higher levels, for example in an unforeseen emergency situation. We may find ourselves going directly to "Emergency" and then following up using the "Probe". If there is time and opportunity, we should always try to go through the steps. If we jump too quickly to an escalated level of assertiveness, then we are unnecessarily and inevitably setting ourselves up for conflict. If personnel take the time to practise this four-step process, it will quickly become second nature. Just remember, "You set the PACE!"

6.8 Conclusion

Effective communication is essential to optimize our potential as individuals, team members and/or leaders. There will always be barriers to communication; however, the use of standardized communication techniques can minimize their impact and ensure the same message sent is received.

As we conclude this module, here are a few of the main points discussed during his module:

- Ask the right questions (inquiry);
- Speak up on a timely basis (advocacy/assertion);
- Listen actively;
- Build on info that is surfacing;
- Test assumptions;
- Work out differences;
- Make decisions based on input;
- Provide constructive feedback;
- Select the appropriate communication strategy based on your situation; and
- Never assume…always get FEEDBACK!!!

Human Performance in Military Aviation

Module 7

Situational Awareness

Introduction

One of the most important aspects of the decision-making process is our understanding of the situation. Simply put…if you don't have a good idea what's going on around you, you won't be able to make an effective decision. In this module, we are going to provide you with some tools that will help you achieve the best possible understanding of the situation, which will ultimately assist you in the decision-making process. We call this, maintaining "Situational Awareness" or "S.A."

The importance of situational awareness cannot be overstated. As you go through this module, it should become apparent why the previous topics have been covered prior to this section. Each and every element that we have discussed to this point contributes to an individual's, or team's, situational awareness. There are countless examples involving individuals, or teams, experiencing a loss of situational awareness, resulting in incidents or accidents. A loss of situational awareness, even for a second, can have disastrous results.

In this module, we are going to provide you with some tools that will help you build and maintain the highest level of situational awareness, which will ultimately help you arrive at the best possible decision.

Module Objectives

Upon completion of this module you should be able to:

- Recognize the various levels of situational awareness.
- Recognize the causes of lost situational awareness.
- Employ strategies that help build and maintain situational awareness.
- Employ strategies that will help regain situational awareness.

Module Content

7.1 Situational Awareness

In the decision-making module, we discussed the fact that our actions (behaviours) are largely dependent upon the goals we choose. It is our understanding of the situation, which we gain via feedback from the environment, which drives our actions. For that reason, an accurate understanding of the situation is absolutely critical to effective decision-making.

The concept of situational awareness is used frequently in aviation, but it has several different definitions. In its most basic form, situational awareness is often referred to as "being aware of the situation" or "knowing what's going on around you." Both of these definitions are in fact true, but situational awareness goes much deeper than that. We are going to introduce a more detailed definition of situational awareness that consists of three critical aspects that we will revisit in a few minutes.

> *"The perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future."*
>
> *- Handbook of Aviation Human Factors*

This definition ties into the deeper meaning of SA, namely the three underlined words. From this formal definition, we can say that 3 "levels" of situational awareness exist. We'll discuss this a little later. However, in laymen's terms, SA is essentially "Knowing what's going on around you" or your "mental model of the current state." It is the mental model, or, mental "picture," that subsequently forms the basis from which all decision-making and action takes place.

When someone has "good" SA, they are able to construct an accurate mental picture of reality and even project into the future somewhat to anticipate results from a number of potential courses of action. Without "good" SA, people tend to misperceive important cues (information), or worse, proceed blindly into the unknown, often with disastrous consequences. As a result, you should be able to see how situational awareness ties

back to the decision-making process. One can also say that in order to have good situational awareness, one must:

1. Know what has happened;
2. Know what is happening; and
3. Know what might happen.

Figure 1.1 – Situational Awareness

If you have a good understanding of these three items, you have a certain level of SA. As you can see, these three things are constantly changing from one minute to the next, so you must constantly update your understanding of each of them. There is one common thread that links all three of these items together. Each one of them makes reference to an aspect of time…. before, during, and after. Good SA means analyzing the past and present to help prepare for the future. Due to the dynamic nature of our environment, we need our personnel to be able to think about the situation, understand how that affects the current situation, and anticipate how it will affect the mission/task in the future. Maintaining situational awareness is a continual process of updating our "mental model" as the dynamic situation changes.

7.2 Situational Awareness Pre-Requisites

Situational awareness is perhaps one of the most critical ingredients for effective performance in aviation. In fact, SA is one of the leading causes of military and civilian mishaps. In order to develop situational awareness, there are a few "pre-requisites" that you must possess. These pre-requisites can be considered the foundation for which SA begins. Without this pre-requisite knowledge, you won't be able to have complete situational awareness at any one time. Unfortunately, even with a sound understanding of the pre-requisites, it is quite possible to lose your situational awareness. As mentioned, SA is extremely dynamic and requires a continual effort to remain effective.

In order to have situational awareness you must know:

- Your own abilities and limitations;
- Your team's abilities and limitations;
- Your equipment and resources;
- Your rules and procedures;
- Your environment; and
- Your goals!

Without these you will not be able to develop true situational awareness. You should review these items and ask yourself whether or not you have all the pre-requisites necessary for effective situational awareness. Focus additional effort on areas you feel are a little weaker, to help increase your potential level of situational awareness.

7.3 Total Situational Awareness Requirements

One of the objectives of HPMA training is to provide individuals with observable skills and tools. For many years, situational awareness has been thought of as something that people typically "had" or "didn't have." That is changing as research increases our understanding. The HPMA program identifies observable elements that can be used for feedback purposes to help address, or reinforce, the necessary concepts of the program. Research into aircrew situational awareness has identified key elements of "total" situational awareness. Although the original scope was aimed at aircrew, these elements apply to the maintenance and aerospace controller communities as well. In fact the concepts of SA can be applied in any environment. The ingredients of "Total SA" are as follows:

1. Geographical SA:
   - This aspect of SA includes anything within your vicinity. Location of your own self, others, terrain features, airports, etc.

2. Spatial/Temporal SA:
   - Includes such things as altitude, heading (direction), velocity (speed), path, deviation from plan, etc.
   - Essentially, this aspect involves knowing where you (or others) are going.

3. System SA:
   - Involves knowing the status of your systems (equipment), settings, discrepancies, modes of operation, operating limitations, impact of malfunctions/system degrades, equipment performance, etc.

4. Environmental SA:
   - Such things as weather formations, areas to avoid (danger and/or prohibited), application of rules (instrument vs. visual), flight safety, projected weather conditions, potential threats to mission execution, etc.

5. Tactical SA:
   - Knowing what task has to be completed, and who is responsible for certain aspects of the task or mission. This also involves knowing which rules apply under the circumstances, how to apply those rules, what threats present the greatest hazard, and ways to combat those threats. Much of Tactical SA is derived from the actual goal of the mission or task.

After reviewing this list of factors, it becomes clear why "Total SA" is so elusive for many people. Experience has a lot to do with the quality of SA. There is a lot to consider and it takes a great deal of effort to keep track of these important elements of SA. We can now use this list as a way of evaluating our own, or someone else's, total level of SA.

At the end of each shift, or mission, you should consider these points to see if there are any weak areas that need to be addressed. You should also remember that many people tend to focus more attention on their strong areas, because they get less enjoyment out of the others. Resist the temptation to stay solely focused on the aspects that you perform especially well. Look for areas that could be improved and focus additional effort in their direction. The end result will be a higher total level of SA.

7.4 Levels of Situational Awareness

From our earlier definition of situational awareness, we can say that three levels of SA exist. Remember the three underlined words – Perception, Comprehension, and Projection.

- Level 1 - The most basic level of Situational Awareness is **PERCEPTION OF ELEMENTS IN THE ENVIRONMENT.**
  - For example, you see a warning light that is illuminated. At this stage, you see that something is wrong, you just don't know what…

- Level 2 - The second level of Situational Awareness is COMPREHENSION OF THE CURRENT SITUATION.
  - As you can imagine, Level 2 SA goes beyond simply being aware of the situation.
  - At this level, you understand what the factors identified during Level 1 actually mean, particularly when integrated together in relation to your GOALS.
  - It should start to become clear how important these two levels are in the decision-making process. Before you act, you have to understand what "it" means to you and your goals.

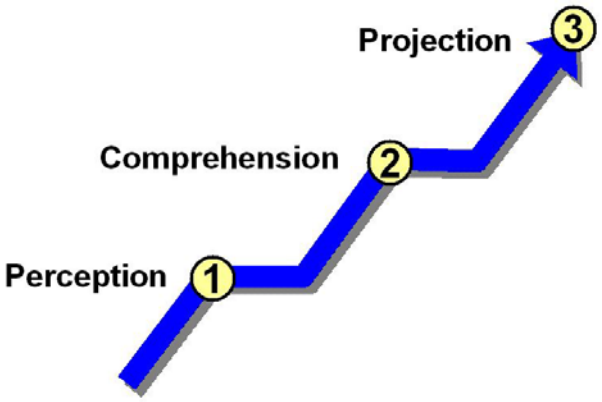
At this stage, you are putting together the data from Level 1 to form a true picture of the environment, including a comprehension of the significance of the objects and events. For example, you recognize that the warning light means something to you (ex. system malfunction).

Before we get to Level 3, let's consider a few things. Quite often, a novice will be capable of achieving the same Level 1 SA as more experienced individuals. They tend to fall short in their ability to integrate the various pieces of the puzzle, along with the pertinent goals; in order to comprehend the situation as well as more experienced individuals. This brings us to the next level of situational awareness.

- ✈ Level 3 - Lastly, the highest level of Situational Awareness is PROJECTION OF FUTURE STATUS.
  - At the third and final level, you are actually able to understand what will happen, as a result of levels 1 and 2, in the near future.
  - It is this level of SA which allows you to anticipate, and function in a timely and effective manner.
  - This level of SA is achieved through:
  - Knowledge of the status and dynamics of the elements; and
  - A comprehension of the situation (both Level 1 and Level 2).
  - Researchers have found that much of an "expert's" time is spent anticipating possible future occurrences.
  - This gives them the knowledge (and time) necessary to decide on the most favourable course of action to meet their objectives.

So, situational awareness can be seen as consisting of three distinct levels (see fig 1.2). Each one of these levels is observable and can be included in feedback sessions. You can also ask yourself whether or not you had all three levels in a particular situation. Use these levels as a way of self-improvement as well.

Figure 1.2 – Levels of Situational Awareness



If you think back to the AIPA Model, you should be able to notice how the levels of situational awareness fit into the overall decision-making process. In fact, Level 1 situational awareness equates to 'AWARENESS' in the AIPA model, forming the first step in the process. Levels 2 and 3 situational awareness involves understanding what is happening and looking to the future, to determine what might happen in the future, which corresponds to 'IMPLICATIONS' of the AIPA Model.

Therefore, situational awareness plays an integral part in our decision-making model process. With sound situational awareness, we are then able to continue the process

leading to a plan and subsequent action based on the previous steps. As we try to promote more advanced thinking, it should also show the importance of striving for a high level of collective (team) situational awareness. If someone has important information that is of concern to the rest of the team, it must be vocalized, to help ensure the most effective decisions are being made to accomplish the team's goals.

AIPA serves many purposes. It can be used as a communication tool, when discussing rules and regulations, situational awareness, and others that we are yet to discuss. The recurring theme is that we must continually strive to ensure that we, and the others working around us, are aware of the situation and the implications. That means we should be promoting Situational Awareness among all team members.

7.5 Factors Affecting Situational Awareness

Situational awareness can be easily affected by our ability to stay focused on a task (attention) and our working memory. In particular, these two limits have a greater effect on novices and people facing unknown situations.

- Human Attention:
  - Direct attention is needed to effectively perceive and process information to form situational awareness, and for action selection. This is particularly important in our complex and dynamic environment in which information overload, task complexity, and multiple tasks can quickly exceed an individual's limited attention capacity.
  - The challenge becomes trying to select which information requires your attention the most, and which items can be left unattended for a period of time. Too much attention to one particular area may result in a loss of situational awareness on other elements, ultimately leading to less effective decisions being made.
  - Be aware of anything that demands your "direct" attention. It is liable to draw your attention away from other important things!

- Working Memory:
  - Working memory capacity can also act as a limiter on situational awareness. We spend a lot of time juggling information in our working (short term) memory, and items can be dropped very easily when additional information is introduced.

Without getting into too much detail about these two limiting factors, the main things to remember are:

a. Attention is a limited resource that cannot be shared with an infinite number of elements; and
b. We are only capable of juggling a limited number of items and the addition of additional elements have considerable potential to disrupt other important information that you may require in order to make effective decisions.

There is another aspect of attention and working memory that merits discussion. Personnel that operate with automated equipment face several additional challenges that can affect their SA. While this point was specifically aimed at actual "automation," (i.e. equipment), it can be argued that any form of automation, even due to a highly developed level of skills, can have serious implications on your SA. With the growing importance of automation in our daily activities, there are a few things that we need to consider. The single greatest challenge for most people, when working with automation, is to remain "in the loop." It can be very easy to suddenly find yourself unsure of what is happening when working with automated equipment. People that find themselves "out of the loop" may be slower to detect problems and will require extra time to reorient themselves to relevant information. This occurs for a number of reasons:

- Typically, there is a loss of vigilance and an increase in complacency associated with assuming a "monitoring" role that comes with automation;
- Human beings, by their nature, are not particularly well suited to be passive recipients of information. People tend to prefer to be active processors of information. Therefore, automation can sometimes force people to assume a role that they are not ideally suited for.
- Automation typically results in a loss or change in the type of feedback that is provided to the human operator concerning the state of the system being automated.

We have shown you a few things that can greatly impact your situational awareness. Experience and training are the primary mechanism to overcome these limitations. As you become more proficient at your job, it becomes much easier to manage your attention and to remember important mission/task-related information. That does not necessarily mean that experience makes you invulnerable to a loss of situational awareness. You must always remain cognizant to the fact that even a momentary loss of situational awareness can have enormous consequences. This is particularly true when automation is involved. The human can quickly find himself or herself out of the loop, so we must be proactive to remain engaged in the process, seeking feedback to help us maintain the highest level of situational awareness possible.

7.6 Causes of Lost Situational Awareness

Now that we have discussed some factors that affect situational awareness, let us examine some of the tangible elements that can cause a loss of situational awareness to occur. When discussing situational awareness, there are a few important things to consider:

- A loss of situational awareness can occur gradually or all at once;

- Lost situational awareness seriously degrades your ability to make effective decisions; and
- There are nearly always sufficient cues available for recognition and recovery from lost situational awareness. They may not always be easy to see, but they are usually present.

Try not to build yourself into a situation in which you have to do everything right in order to escape. Early recognition of an impending loss of situational awareness is extremely important. Here are some of the main contributors to a loss of situational awareness:

- Time Pressure
  - One of the three critical resources that must be managed.
  - Time pressure can be real, or perceived, and it is often self-imposed. Regardless, it can adversely affect your ability to attend to important information. We sometimes see time pressure in our schedules, during emergencies, SAR launches, scrambles, etc.
  - It is important to recognize the potential for time pressure and identify it early in the process. Doing that will help you to recognize the pressure as it is building and to take proactive measures to mitigate the potential for threat and error.

- Misdirected attention
  - Another one of the three critical resources that must be managed.
  - If you are not attending to the important information, you will not have the appropriate knowledge to make an effective decision.

- Lack of knowledge regarding the situation
  - The third critical resources that must be managed.
  - If you are not knowledgeable about the task at hand, you will not be able to respond quickly to changes and your decision-making abilities will be greatly hampered.

- Self-imposed pressure
  - We are often our own worst enemy, putting undue pressure on ourselves to get a task done. It greatly increases the chances that ineffective decisions will be made.

- Distraction by irrelevant stimuli
  - In Controlled Flight Into Terrain (CFIT) studies involving fighter aircraft, this has typically accounted for almost 25% of the accidents.
  - This may also be an interruption from an external source (i.e. ATC, ops, servicing, etc.) and by a distraction that draws your attention away from the task at hand.

- Low workload
  - The real concern is that complacency will set in. Once that happens, SA degrades very quickly.

- High workload
  - As get busy, people tend to narrow their focus on things that are going on around them. Once people become task saturated, they will quickly lose their situational awareness and it can hard to regain.

7.7 Building and Maintaining Situational Awareness

Effective situational awareness does not happen by accident. As we discussed earlier, it is a continuous process and changes constantly. There are several things you can do to help build and maintain your situational awareness. Most of the items we will discuss directly counter the symptoms of a loss of situational awareness we identified in Annexes A, B, and C.

- Always Be Prepared / Plan Ahead
  - Always anticipate what is coming up next. Make sure everyone knows what the goal is and what your expectations are. The briefing is an ideal time to do this. - Briefings provide direction and purpose and help people to align their own understanding of the mission/task with the rest of the team.

- Follow Rules, Regulations, and Standard Operating Procedures (SOPs)
  - They all help ensure consistency by building a common understanding of what is going to happen (Level 1 & 2 SA). Once you drift away from SOPs, you no longer have a reliable frame of reference.
  - There may be times when you have to deviate, as discussed in a previous module, but it is important to recognize the benefits of effective rules, regulations and SOPs. - They should always serve as the starting point in the decision-making process.

- Resolve Discrepancies
  - If something doesn't make sense, get it sorted out. It may just be you, but it should be fixed.

- Focus on your goals
  - Don't get caught trying to react solely based on incoming data. Remember to stay focused on your goals! Let your goals dictate which information you must attend to. - Resist the temptation to become data-driven.

- Manage Distractions
  - Be alert to subtle and obvious distractions that take you away from your primary duties. Proper assignment of responsibilities is an effective tool in combating distraction.

- ✈ Manage Workload
  - Delegate duties during high workload to avoid task saturation and resist complacency during low workload. Use low workload times to plan for contingencies, stay mentally involved in the activity.

- ✈ Trust Your Gut Feelings
  - If something doesn't seem right…it probably isn't.

- ✈ Set and Meet Targets
  - These will become your benchmark to determine whether or not you have a good grasp of the situation. (Could be things like timings, estimates, job progress, fuel checks, ETAs vs. actual arrival times, etc.)

- ✈ Practise Effective Feedback
  - Try to learn from each other by asking questions like:
    - "What was the original plan?"
    - "What caused it to change?"
    - "Was crew SA maintained? If yes – How? If no – How come?"
    - "When did the individual/crew become confused or lose it?"
    - "How did you recognize it and regain SA?"
    - "What lessons can be applied to the next time?"

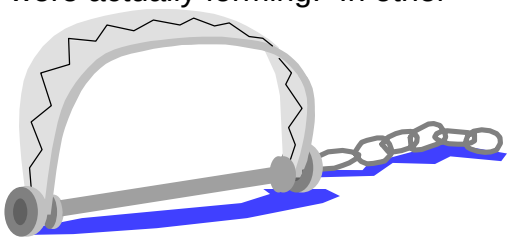
- ✈ Communicate Effectively
  - You should ask questions or voice your concern when you aren't sure of the goals, the situation, or the suggested course of action. Basically you should be communicating whenever there is a change in your understanding of the situation.
  - Be aware of the Danger Phrases:
    - "No Problem."
    - "I'm not sure…"
    - "We're a little rushed."
    - "Looks like we're behind or late."
    - "Where are we?"
    - "That's not normal."
    - "Where are we going?"
    - "Trust me!"
    - "Is this safe?"
    - "Was that for us?"
    - "What's it doing now?"
    - "I'm happy if you are!"
    - "Watch this!"

7.8 Recognizing and Recovering from a Loss of Situational Awareness

Now that you have a better understanding of the term S.A., we are going to begin looking at ways of recognizing when someone (i.e. you) is losing, or has lost, situational awareness, and how to recover from that loss.

Our Flight Safety network is full of examples involving individuals, or teams, which have suffered a loss of SA. It is extremely rare for an accident or incident to be the result of one lone factor. In most cases, there are several "links" in a chain of errors that lead to the mishap. In fact, most researchers would argue that all accidents are the result of at least 4 links, with many of them having 4 to 7 of these "links" present. We refer to this series of events as an "Error Chain."

In simple terms the error chain concept describes human error incidents/accidents as the result of a sequence of events, or failures, which resulted in a mishap. In many cases, this "chain" could have been broken if any of the links were recognized and rectified. Just as no chain is stronger than its weakest link, breaking any one link in the chain might potentially stop the process and prevent a mishap. Too often, people sit by as these links build without recognizing that the links were actually forming. In other cases individuals recognize one or more of the errors but do not act on it. Simply recognizing that an error chain is building is not enough. Each of us has a responsibility to "break the chain" when we see it forming. If you can learn to recognize some of the typical links, you may be able to break the chain before something serious occurs.



Unfortunately, error chains tend to become progressively harder to recognize as they continue to build. They are usually very easy to spot during an accident or incident investigation but when it's happening, they can be very hard to identify. Unfortunately, this is because human beings are not very good at seeing gradual change. This is why maintenance of SA is so critical. It keeps us on top of what's happening.

These links are important because they also happen to be clues to a loss of situational awareness. See Annex A for Aircrew Symptoms of a Loss of SA, Annex B for Maintenance personnel, and Annex C for Aerospace Controllers. The warning signs are somewhat similar, but there are some differences, which should be expanded upon for each group. Each of those Annexes includes a section of ways of recovering from a loss of situational awareness.

Please read the applicable Annex then proceed to the next section.

7.9 Conclusion

As we close out this module, you should have a pretty good understanding of situational awareness. In a nutshell, it involves "knowing what's going on around you in time and

space." Situational awareness isn't new. You rely on it everyday, when you drive or walk to work for example. You are constantly updating your mental picture to adapt to any changes (i.e. red light, puddles, etc.) that appear. Military aviation is a lot like being locked in a dark room full of snakes - there are a lot of hazards waiting to "bite you" and you only have one flashlight (attention). You have to scan the room carefully, noting anything of importance. You have to keep that "SA flashlight" moving around to know where you can and can't step. Since the situation is constantly changing, you have to keep scanning to maintain a high level of situational awareness. A high level of knowledge is the foundation of situational awareness. Armed with that, you should be better able to use the time available to attend to the important information that will ultimately help you make better decisions – the three critical resources: Knowledge; Time; and Attention.

It is very important that you keep your "SA flashlight" moving, so you do not get surprised. You should always be thinking about the future, and asking what are the implications on you and your task. Whenever your situation changes, after each task or sub-task, and whenever there is time, return to the big picture. This will make it easier to notice when something is not working out as expected. At times, you may have to make a conscious effort to return to the big picture. Think big to small… Try to stay goal-driven. If not, you may inadvertently be building an error chain of your own. The earlier you detect the chain is forming, the easier it will be to break it before a mishap occurs. You have been given the tools to recognize a potential loss of situational awareness, and how to recover from a loss if one occurs. At the first sign of trouble, you should ensure that everything is still proceeding as planned, or if everything makes sense. Sometimes just pulling yourself back from the situation for a minute can help you to identify an error chain in the works, and break it before it has any negative consequences.

Annex A

Recognizing and Recovering from a Loss of Situational Awareness - Aircrew

Symptoms of a Loss of Situational Awareness (Aircrew)

1. Ambiguity;
   - The problem is not clear or there is no agreement due to different perceptions of the situation. This can occur when two or more independent sources of information do not agree (instruments, gauges, people, senses, controls do not respond to indications, etc.). When people are involved, it often leads to an unresolved discrepancy (another link in the chain).

2. Fixation or Preoccupation (Channelized Attention);
   - One of the greatest causes of a loss of situational awareness. This occurs when we focus our attention on any one item or event to the exclusion of all others, drawing our attention away from the big picture. Things like high-density traffic areas, bad weather, abnormal and emergency conditions can lead to fixation or preoccupation.
   - In one study of controlled flight into terrain accidents involving fighter aircraft, channelized attention accounted for 31% of the accidents. *(Source: Handbook of Aviation Human Factors).*

3. Confusion or an Empty Feeling;
   - A sense of uncertainty, anxiety or bafflement about a particular situation. Usually the result of insufficient information to solve the problem but it may be the result of a general lack of knowledge or experience. This is often accompanied by physiological symptoms such as a throbbing temple, headache, stomach discomfort or nervous habit.

4. No One Flying the Aircraft;
   - No one monitoring the current state or progress of a flight. If it is not being attended to, perhaps other equally important priorities are being overlooked. This can happen very easily in automated aircraft!

5. No One Looking Out the Window;
   - Again a matter or priority. One of the greatest hazards in military aviation is the threat of mid-air collision. It is easy to be tempted to keep one's head in the cockpit rather than maintaining a careful eye outside.

6. Use of an Undocumented Procedure;
   - The use of a procedure, in order to deal with an abnormal or emergency condition that is not approved in flight manuals or checklists. The use of an undocumented procedure is not necessarily a bad thing, but it should not be done lightly. Recognize the potential link and decide if it is appropriate given the circumstances.

7. Violating Limitations or Minimum Operating Standards;
   - Intent to violate, or actual violation, intentional or unintentional, of defined minimum operating standards or specifications, as prescribed by regulations or more restrictive flight operations manuals or directives. These include weather conditions, operating limitations, crew rest or duty limitations, systems limitations, airspeed restrictions and so on. This category would also include limitations established by the crew.

8. Departure From SOP;
   - Intent to depart or inadvertent departure from prescribed standard operating procedures. Well-defined SOPs are the result of a synergistic approach to problem solving with the influence of time removed. They should serve as your foundation for decision-making and deviations should not be taken lightly.

9. Unresolved Discrepancies;
   - Failure to resolve conflicts of opinion, information, changes in conditions.

10. Failure to Meet Targets; and
    - Failure of the flight or flight crew to attain and/or maintain identified targets. Targets include ETAs, airspeeds, approach minima, altitudes and heading, configuration requirement, plans, procedures, or any other goals established by or for the flight crew. If you suddenly find yourself 10 minutes early, you should ask yourself why. You may be losing your situational awareness.

11. Reduced or Poor Communications.
    - When we start to lose SA, communications usually suffer dramatically. Typical signs would be people failing to react to incoming communications, requiring second transmissions (routinely), etc. The result is often withheld information, ideas, opinions, etc.

You should review the items of this list and ask yourself whether or not you have experienced any of these items. It can be a simple self-improvement tool – and it might save you at some point in the future.

<u>Recovering from a Loss of Situational Awareness (Aircrew)</u>

Recovering from lost SA can be very difficult. People have a tendency to hide weaknesses or vulnerabilities. However, the risk is far too great to keep lost SA a secret. It fact, it is quite possible that someone already knows! You must be proactive and speak up when you feel that either you, or someone else, are losing their SA. Here are some general guidelines that can help you recover from a loss of SA.

- ✈ Admit and verbalize that you have lost SA;
  - Even something simple like “Wait a minute…something’s wrong here? What are we doing?”

- If available, ask for some help from another crewmember.
- Admitting it to yourself can also help you get back on track. It can sometimes serve as a wake-up call that you need to look at the big picture.
- If you think someone else on your team has lost their SA, be assertive and ask questions if time is available. If time is critical, you may have to take the appropriate measures to prevent immediate danger. If it comes to that, worry about the consequences later…once safe.

✈ Revert back to basics;
- Maintain control of the aircraft, or whatever your primary task may be!
- First and foremost…fly the aircraft!
- Make sure someone is flying the aircraft (delegated); even the autopilot can help reduce the workload so you can gather your thoughts.
- Once out of immediate danger, give yourself a chance to get caught up.

✈ Create some time and space;
- Give yourself a safety margin while you sort out any potential situational awareness problems. Whatever space you need…between the ground, water, rocks, trees, and metal.
- If flying IFR, you can always ask for a clearance to "anywhere," request a hold, radar vectors, slow down, etc. Try to give yourself time to get sorted out before you enter one of the "Windows of Risk."

✈ Seek information – AIPA Process;
- Awareness;
- Implications;
- Plan;
- Act; and

✈ Obtain feedback."What happened? Why did it happen? What does it mean to us?"
- Try to learn from experience. When something "undesirable" occurs, make sure that you go through a detailed process of analyzing what happened and why it did. What lead to the loss of SA? What cues were present, yet missed? How can you avoid it in the future?

Annex B

Recognizing and Recovering from a Loss of Situational Awareness – Maintenance Personnel

Although the term “Situational Awareness” is relatively new within the CF maintenance community, its importance has long been recognized in other maintenance human performance courses. Situational awareness in maintenance is a primary factor in many CF incidents every year. There are several cases of technicians driving away from aircraft with hoses or power cords still connected, and technicians who either walk into something or fall off aircraft.

Symptoms of a Loss of Situational Awareness (Maintenance)

1. Ambiguity;
   - The problem is not clear or there is no agreement due to different perceptions of the situation. This can occur when two or more independent sources of information do not agree (gauges, people, senses, equipment, etc.). When people are involved, it often leads to an unresolved discrepancy (another link in the chain).

2. Fixation or Preoccupation (Channelized Attention);
   - One of the greatest causes of loss of situational awareness. This occurs when we focus our attention on any one item or event to the exclusion of all others. Greater hazard when working on busy flight lines, in bad weather (extreme cold, heavy clothes, limited field of view – just want to get the job done and get back inside), abnormal and emergency conditions (scramble to get aircraft launched), etc. It can also be the result of personal problems like a can-do attitude, inattention, complacency, fatigue, etc.)

3. Confusion or an Empty Feeling;
   - A sense of uncertainty, anxiety or bafflement about a particular situation. Usually the result of insufficient information to solve the problem but it may be the result of a general lack of knowledge or experience. This is often accompanied by physiological symptoms such as a throbbing temple, headache, stomach discomfort or nervous habit.

4. Use of an Undocumented Procedure;
   - The use of a procedure, in order to deal with an abnormal or emergency condition that is not approved in maintenance manuals or checklists. This problem may involve a simple checklist deviation, or it may be something much more serious, like violating towing procedure. Does the crew have a thorough understanding of the problem? Have all resources been used to their fullest potential?

5. Departure From Standard Operating Procedures (SOPs);
   - Intent to depart or inadvertent departure from prescribed standard operating procedures. Well-defined SOPs are the result of a synergistic approach to problem solving with the influence of time removed. As a result, in difficult situations, standard operating procedures represent an effective means of problem resolution without the sacrifice of time, which is often not available. This is not to suggest that SOPs will resolve all problems. However they are an effective starting point. Failure to follow SOPs constitutes a link in the error chain and is an appropriate indicator of rising risk.

6. Unresolved Discrepancies;
   - Failure to resolve conflicts of opinion, information, changes in conditions.

7. Failure to Meet Target Timelines; and
   - Failure of a technician or maintenance crew to meet planned fix or repair times. If you suddenly find yourself completing a task 30 minutes earlier or later than normal, you should ask yourself why and resolve the discrepancy. Did you miss something, forget a step or take an unauthorised short cut?

8. Reduced or Poor Communications.
   - When we start to lose SA, communications usually suffer dramatically. Typical signs would be people failing to react, requiring communications to be repeated (routinely), etc. The result is often withheld information, ideas, opinions, etc.

<u>Recovering from a Loss of Situational Awareness (Maintenance)</u>

Recovering from lost SA can be very difficult. People have a tendency to hide weaknesses or vulnerabilities. However, the risk is far too great to keep lost SA a secret. It fact, it is quite possible that someone already knows! You must be proactive and speak up when you feel that either you, or someone else, are losing their SA. Here are some general guidelines that can help you recover from a loss of SA.

- ✈ Stop what you are doing;
  - Rule number 1: Don't make the situation any worse!

- ✈ Admit and verbalize that you have lost SA;
  - Even something simple like "Hang on a second…what's going on? What are we doing here?"
  - If available, ask for some help from another technician.
  - Admitting it to yourself can also help you get back on track. It can sometimes serve as a wake-up call that you need to look at the big picture.
  - If you think someone else on your team has lost their SA, be assertive and ask questions if time is available. If you think there is imminent

danger, direct which actions should be taken. Worry about the consequences later.

- ✈ Seek information – AIPA Process:
  - Awareness;
  - Implications;
  - Plan;
  - Act; and

- ✈ Obtain feedback.“What happened? Why did it happen? What does it mean to us?”
  - Try to learn from experience. When something “undesirable” occurs, make sure that you go through a detailed process of analyzing what happened and why it did. What lead to the loss of SA? What cues were present, yet missed? How can you avoid it in the future?

Annex C

Recognizing and Recovering from a Loss of Situational Awareness – Aerospace Controllers

Symptoms of a Loss of Situational Awareness (AEC)

1. Ambiguity;
   - The problem is not clear or there is no agreement due to different perceptions of the situation. This can occur when two or more independent sources of information do not agree (radar screen, people, etc.) When people are involved, it often leads to an unresolved discrepancy (another link in the chain).

2. Fixation or Preoccupation;
   - One of the greatest causes of loss of situational awareness. This occurs when we focus our attention on any one item or event to the exclusion of all others. Things like high-density traffic, bad weather, abnormal and emergency conditions, can all lead to fixation or preoccupation. It can also be the result of personal problems like a can-do attitude, inattention, complacency, fatigue, etc.

3. Confusion or an Empty Feeling;
   - A sense of uncertainty, anxiety or bafflement about a particular situation. Usually the result of insufficient information to solve the problem but it may be due to a general lack of knowledge or experience. This link is often accompanied by physiological symptoms such as a throbbing temple, headache, stomach discomfort or nervous habit.

4. Being caught by surprise;
   - If you find that things are catching you unexpectedly, you may be losing the big picture.

5. Being reactive and not proactive;
   - A sign of good situational awareness is the ability to predict things that will happen in the future. People that are always reacting and anticipating may be losing their situational awareness.

6. Use of an Undocumented Procedure;
   - The use of a procedure, in order to deal with an abnormal or emergency condition that is not approved. Some situations require innovative solutions but whenever you find yourself “inventing” a procedure, you need to proceed very carefully.

7. Violating Limitations or Minimum Operating Standards;
   - Intent to violate, or actual violation, intentional or unintentional, of defined minimum operating standards or specifications, as prescribed by regulations or more restrictive operations manuals or directives.

8. Departure From SOP;
   - Intent to depart or inadvertent departure from prescribed standard operating procedures. Well-defined SOPs are the result of a synergistic approach to problem solving with the influence of time removed. This is not to suggest that SOPs will resolve all problems. However they are an effective starting point. Failure to follow SOPs constitutes a link in the error chain and is a potential indicator of rising risk.

9. Unresolved Discrepancies; and
   - Failure to resolve conflicts of opinion, information, changes in conditions.

10. Reduced or Poor Communications.
    - When we start to lose SA, communications usually suffer dramatically. Typical signs would be people failing to react, requiring communications to be repeated (routinely), etc. The result is often withheld information, ideas, opinions, etc.

<u>Recovering from a Loss of Situational Awareness (AEC)</u>

Recovering from lost SA can be very difficult. People have a tendency to hide weaknesses or vulnerabilities. However, the risk is far too great to keep lost SA a secret. It fact, it is quite possible that someone already knows! You must be proactive and speak up when you feel that either you, or someone else, are losing their SA. Here are some general guidelines that can help you recover from a loss of SA.

- ✈ Make some time;
  - You may be able to give someone a hold, radar vectors, slow them down, or anything else like that.

- ✈ Admit and verbalize that you have lost SA;
  - If available, ask for some help from another controller.
  - Admitting it to yourself can also help you get back on track and can sometimes serve as a wake-up call that you need to look at the big picture.
  - If you think someone else has lost their SA, be assertive and ask questions if time is available. If you think it is appropriate to prevent immediate danger, direct actions to be taken. Worry about the consequences later.

- ✈ Prioritize your inputs;
  - Focus on your goals. Let your goals determine what your priorities are.

- ✈ Seek information – AIPA Process:
  - Awareness;
  - Implications;
  - Plan;
  - Act; and

- ✈ Obtain feedback.“What happened? Why did it happen? What does it mean to us?”
  - Try to learn from experience. When something “undesirable” occurs, make sure that you go through a detailed process of analyzing what happened and why it did. What lead to the loss of SA? What cues were present, yet missed? How can you avoid it in the future?

Human Performance in Military Aviation

Module 8

Task and Workload Management

Introduction

In this module, we start bringing the earlier material together as we move towards the end of this training package. All of the things that we have discussed so far will ultimately play a large role in our ability to manage the tasks that we have to complete.

Module Objectives

The objective of this module is to:

- Provide you with an understanding of the fundamentals of task and workload management;
- Teach you how to recognize the causes and effects of high and low workload; and
- Provide you with the skills and tools to effectively manage workload.

Module Content

8.1 Workload

Workload refers to the *demands* imposed on someone by the task or tasks assigned and the *capacity* of the user to meet those demands.

This definition emphasizes a couple of important points. Workload is imposed on us from the outside, and consists of the many things we have to do. It is important to understand that workload is based on an individual's perception, and is completely subjective. Workload depends as much on our personal abilities as it does on how

much work is assigned. High workload for one person might not be much at all for another (more experienced) person. Workload also varies with training, procedures, experience, and sometimes with stress levels. There is another factor that contributes to *demands* imposed on us - *Time*. If you are required to manage a number of tasks in a short period of time it can become overwhelming, but if you have a lot of time you can manage more tasks and/or more complex tasks. As we saw in the decision-making module, the less time you have to accomplish a task, the higher the workload. When the workload exceeds our personal capacity we begin to make mistakes!

In the military, we are often faced with a large number of tasks and some type of time pressure. Emergency situations are probably the most extreme example of escalating workload. We have to do things and we have to do them NOW! The time element (lack of time) can create a huge workload.

When this happens you have to apply the 'Speed vs. Accuracy Trade Off' we learned about in Decision-Making. In some tasks we can sacrifice accuracy and accept some error in the interest of getting it done. Other tasks do not allow error. What separates competence from incompetence is knowing which one can be compromised and which one can't.

Of course, it is not just emergencies where we run into time constraints. We have deadlines, or cycles of work that are just naturally more 'busy' – for example an approach into a busy airport or maintenance tempo during a time of high Ops.

There are a number of factors affecting our workload such as:

- **Time pressure (or time available to complete task),**

- **Task structure, complexity, or difficulty.**
  - The more complex and difficult a task the more workload it creates.

- **Number of tasks to be managed.**
  - Workload imposed by one task may interfere with the performance of other concurrent activities. Research shows that as multi-tasking goes up, performance degrades rapidly. This applies to everyone.

- **Recent experience and proficiency.**
  - The more proficient and experienced an individual or crew is the better able they will be to perform and deal with high workload. Theoretically, increased training and experience results in higher performance and decreased workload under most circumstances.

- **Task duration.**
  - People are not good at maintaining high levels of vigilance over long, uninterrupted periods. If an individual is exerting himself or herself continually, they will burn out quickly. If they are bored, they will have a

hard time staying focused on the task/mission. Experienced personnel pace themselves, working at a rate and effort level that they can sustain for the expected duration of the task. Good leadership ensures that members of a team can maintain performance throughout an entire mission by setting the appropriate pace.

- **The rate at which information is being presented;**

- **The level of speed or accuracy that the operator must maintain;**

- **Unknowns:**
  - Factors such as sleep deficits, poor schedules, and excessive fatigue inevitably lead to degraded performance. Any unknowns, such as weather, traffic, ATC, etc can also affect workload.

When faced with a host of tasks competing for your attention during periods of high workload, you must decide which tasks to perform when, how frequently to switch from one task to another, and when it is appropriate to break off performance of an ongoing task to shift to one of higher priority. It's not always easy. Time pressure has made many professionals do strange things that they would not normally do. It is almost as if judgment gets suspended. Take away the time pressure and most of these people recognize they have made poor decisions afterwards.

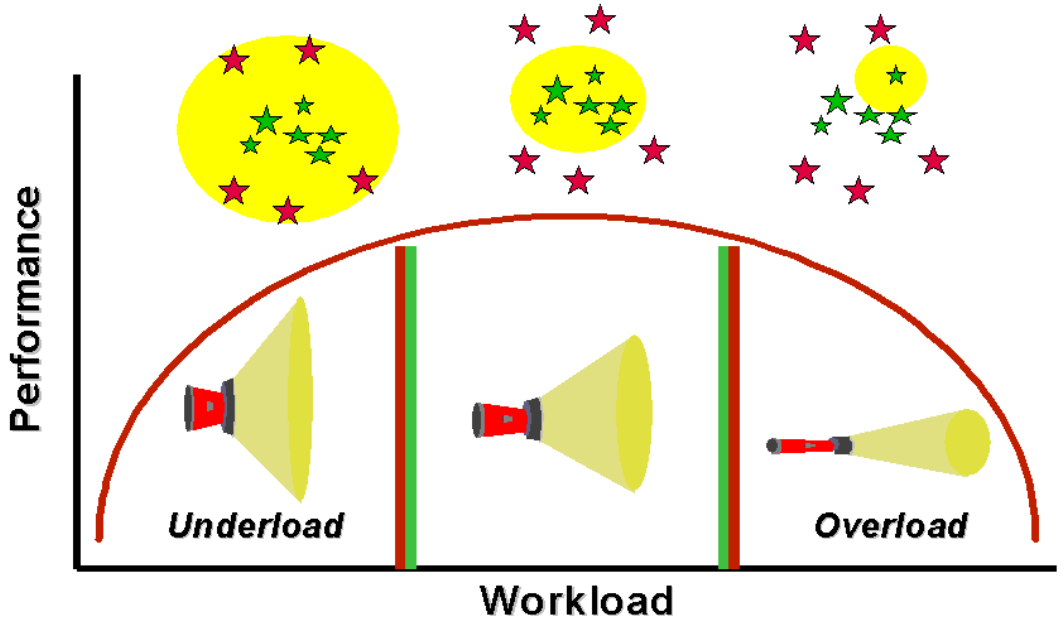
Interestingly however, it is not just in times of high workload that human beings make mistakes. Human beings are also particularly prone to making mistakes in times of low workload! We become bored. Our attention wanders. So we see that it is extremes in workload that are most likely to contribute to human error.

8.2 Optimal Workload

If workload is too high we feel overwhelmed; we start to miss things; we start to make mistakes; and performance degrades. If workload is too low we become complacent; our attention level drops; we become bored and drowsy; we become distracted; we start to make mistakes; and performance degrades. That doesn't mean that stress is necessarily a bad thing. A certain amount of 'stress' actually improves performance. The best, or optimum, workload is a moderate level – a "happy medium". See Figure 8.1.

> "The human is most reliable under moderate levels of workload that do not change suddenly and unpredictably."
>
> *Human Factors in Aviation, 1988*

Figure 8.1 – Task Underload and Overload[1]



When we talk about attention, we can compare it to an adjustable flashlight beam. Figure 8.1 demonstrates the effects of low and high workload on our performance and attention, using the flashlight analogy. The critical tasks are identified as light, green stars; distractions are identified as darker, red stars.

- **Low Workload (Underload)**
  - When our workload is too light we become bored, and our light-beam becomes very broad. Our attention drifts away from the critical tasks (light, green stars) and they can get lost in all the clutter we are absorbing. We become easily distracted (dark, red stars), and become susceptible to missing important inputs. You will have to make a dedicated effort to increase your attention level and push yourself toward the optimal range.

- **High Workload (Overload)**
  - As our workload increases, our awareness begins to drop and we can easily lose track of some of the critical tasks (light, green stars). We may end up fixating on a single task ('target lock').
  - Some of the causes of high workload include:
    - Unplanned events (surprises);
    - Lack of planning;
    - Time pressure;
    - Too much to do or multi-tasking;
    - Inexperience, lack of proficiency/training;
    - Lots of other things…

[1] Transport Canada Crew Resource Management Course

- **Optimum Workload**
  - At an optimum level of workload, we are actively involved in the task, and attending to all the important information. We are monitoring and managing critical tasks (light, green stars) and not wasting effort and time on stuff that is not important (dark, red stars).

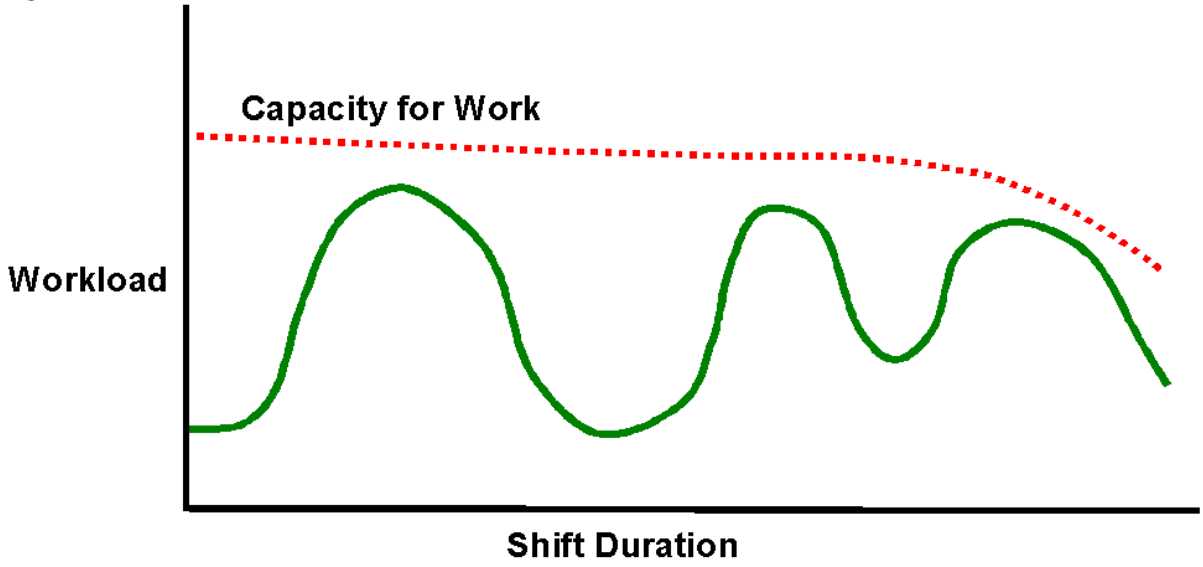
"Do you think that there are any situations where having such a tight beam is acceptable, that is where you might concentrate on only accomplishing one task?"

The answer is… Yes. There are times when it might be necessary to have a narrow beam – focusing on one critical task. For example, some emergencies may require your undivided attention. What becomes important is to make sure that someone else is attending to the other critical tasks!

The challenge for us is to effectively manage our workload during an entire shift, mission, or task. We often have periods of low workload followed by periods of very heavy workload.

Whether you are a maintainer, aircrew or AEC, your workload on any given shift or mission will typically vary considerably. We often have periods of low workload followed by periods of very high workload. Figure 8.2 represents the workload you may encounter on a typical shift. You should be able to relate your own experience to this and identify you own "highs" and "lows". Figure 8.2 also shows that capacity for work decreases over time.

Figure 8.2 – Workload Variation Over Shift Duration

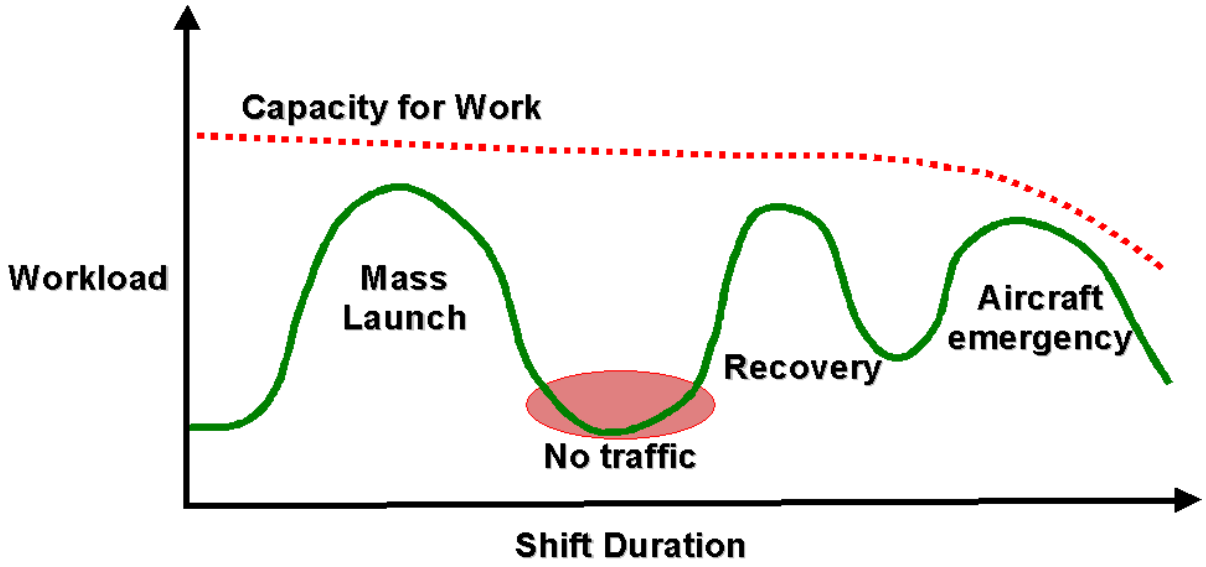


The following sections will provide some skills and knowledge for dealing with both high and low workload situations.

8.3 Dealing with Low Workload

Figure 8.3 below highlights a period of low activity – in this case for an AEC member just after a mass launch, when there is no traffic. The workload drops and the controller is faced with a potentially long period of little activity. *How do you think the Circadian Rhythms discussed in the Human Factors section might factor into this scenario?* If that period of no traffic falls into the late afternoon period or the overnight period, the controller may have trouble staying focused on the job…

Figure 8.3 – Low Workload



It may seem odd, but many incidents, accidents, or other poor performance issues have been attributed to periods of extremely low workload. W*hy would people make more errors when they have lots of time to get things right?* Well the answer becomes clear when you look at some of the symptoms of low workload.

8.3.1 Symptoms of low workload

These are some of the typical symptoms of low workload:

- Complacency,
- Inattention, and
- Drowsiness.

When you don't have much to do – watch out – that's when you get "bit"!

8.3.2 Managing Low Workload

There are a number of ways to manage low workload including:

- **Anticipate and plan.**
  - Before you do anything, try to identify those periods when you think that low workload is likely to occur. If you know that you have a long "quiet" period with little activity, plan something to do during that time. Maybe you could schedule a rest period ("Strategic Nap?") or get a bite to eat, etc. If you do choose to rest/sleep, remember the guidelines discussed in the fatigue module.

- **Stay mentally engaged in the situation.**
  - Work through problems or what if scenarios. Discuss something you recently did, anything that keeps your mind thinking about the job at hand.
- **Ensure the workload is distributed effectively.**
  - If someone is under-loaded, you should shift some of the burden to him or her. If you are the one who is under-loaded, get involved and ask the others if there is something that can be done to reduce their workload.

- **Prepare for the next task.**
  - You could get the weather for the destination (aircrew), review the approach or arrival procedure (aircrew & AEC), review/prepare the upcoming maintenance procedures, etc.;

- **Mentally rehearse – "What if…?"**
  - These are great ways of building your own abilities, making you more prepared for the occasions when things don't go right. Take an active role in your own development.

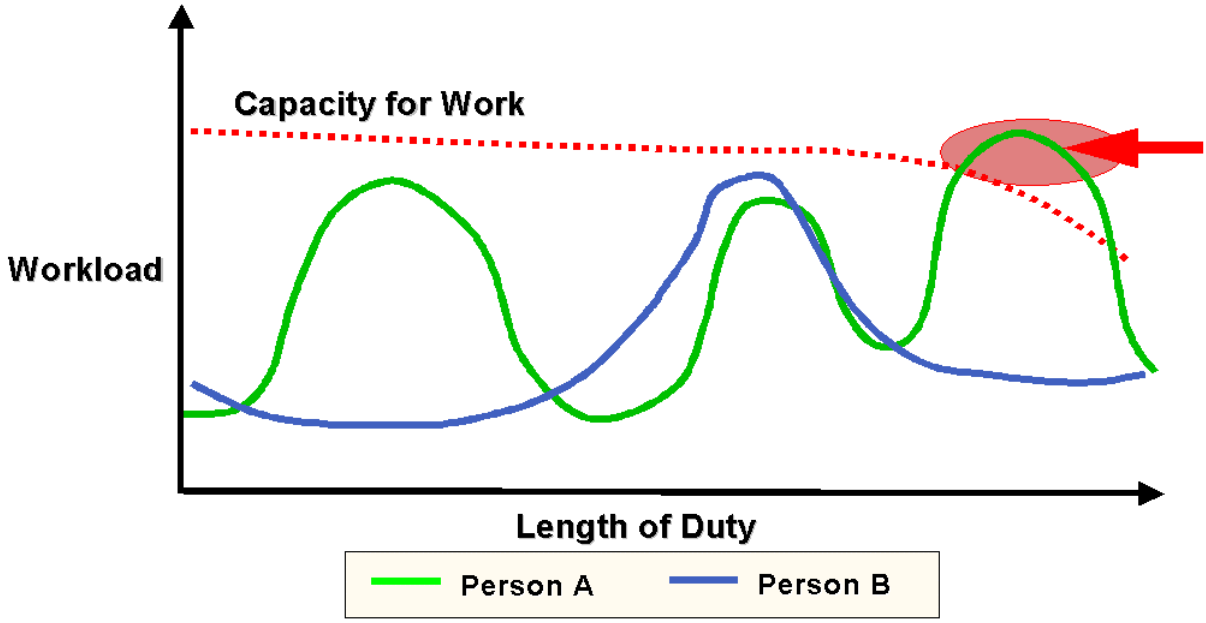
- **Engage in physical activity.**Do something that involves physical activity like chewing gum, walk around, stretch, etc. Sometimes it helps to ease the tension and allows the mind some time to recuperate.

The key is to stay involved use periods of low workload to prepare for upcoming periods of high workload.

8.4 Dealing with High Workload

At the other end of the spectrum we have high workload. Figure 8.4 provides an example where one individual (Person A) gets more work, towards the end of their shift, than he or she can handle. *What do you think are the likely consequences in this scenario?*

Figure 8.4 – Overload Situation



The excessive workload on Person A is almost certainly causing some tasks to be dropped or error of some kind. It is particular example; we can see that Person B has a low workload during this same time. Although it may not be possible, there may be a potential to shift some of the workload to Person B, thereby reducing the overload on Person A.

8.4.1 Recognizing Overload

We are often reluctant to ask for help, so we must look around us for symptoms of overload in others and ourselves. Be proactive! Recognize and identify the following symptoms and try to correct the situation.

- **Reduced or erratic performance.**
  - This is usually due to rushing. When we rush, we are more likely to make mistakes. Remember the speed-accuracy trade-off? People have a tendency to lower their standards when workload is high.

- **Uncertainty/Indecision/Discomfort.**
  - You or others are having a hard time coming to a decision or have a bad feeling about the situation. Chances are that if you are concerned about the mission or task, you may not be alone in your concern. Many people are simply waiting for the first person to speak up.

- **Missing important inputs (poor scan).**
  - Lack of awareness as to what is going on around them. Tunnel vision, target lock, or fixation.

- **Less communications.**
  - Failure to share information or respond to inquiries. Often, when workload is extremely high, people communicate less because they are concentrating so hard. This is related to "missing important inputs" described above.

- **Rushing.**
  - Decisions, plans, etc. are arrived at quickly without being thought through. Individuals may go from 'Awareness' straight to 'Act' in the decision-making process. 'Implications' and 'Planning' are shallowly examined or ignored.

- **Revert to habit patterns/basic training.**
  - Even though this may indicate overload, it can be a good thing. That's why we train so much on the basics. In some cases this can also be a bad thing. For example, if we use an older technique that is no longer appropriate.

The answer to coping with extremes in workload is workload management. Training and experience help us learn to manage workload.

Managing High Workload

Workload management is a way to prioritize tasks so that important tasks are always being taken care of in the most effective manner possible. When it comes to managing high workload, there are several things you can do to optimize performance. They include:

- **Prioritize:**
  - The goals and priorities should be clearly communicated to the entire team.
  - Make sure that your tasks support the strategic goal. Don't get hung up with tasks that do not support a higher-level goal! "What are we really trying to accomplish here?" "What is the purpose of this?" Let the goal(s)/priorities determine what information is important (goal-driven). The goal(s) should determine which information is important and requires your attention, not the other way around.
  - Keep the group focused on the objective!
  - Try not to waste time on non-critical items when workload is high.

- **Delegate or Share the Workload:**
  - Leaders must ensure that workload is properly divided among the team.
  - Team members must learn to recognize the signs of overload, and help maintain workload at acceptable levels. You may have to ask others if they require assistance or you may have to inform the leader of an overload situation that cannot be rectified.

- **Expand time available:**
  - Time pressure is a function of the amount of work to be done in a given time. While it is not always possible, you may be able to give yourself some more time while doing a task. For example, if you are finding yourself rushed to complete an in-flight check, you may be able to slow down, get a radar vector, or even enter a hold. The point is that you have given yourself some more time to deal with the situation. The same applies to aerospace controllers. In fact, they have many of the same options available to aircrew. They can delay departures, request aircraft to slow down, put an aircraft in a hold, etc. Again, they too have given themselves more time to deal with something of a higher priority (e.g. aircraft emergency on the runway). Maintenance personnel also have a number of opportunities to expand time. If towing an aircraft on a slippery ramp, the crew will go slower than usual to detect any problems, or they may request an extension on a particular task so they don't have to rush through it, which may result in errors being committed.
  - Remember that we often have options to expand the time available and sometimes we don't take advantage of them.
  - If you are unable to expand time, you may have to accept a loss of precision (speed vs. accuracy trade-off) in order to accomplish a task. It might be a risk you have to take. Ask yourself, if you can accept this loss of precision in order to get the job done. If not, then you have to do something about it. You may even have to inform your supervisor that the task cannot be completed on time. It's better to speak up than surprise people later on…

- **Monitor:**
  - Since we know that high workload increases the likelihood of error, we must establish effective error "trapping" mechanisms. Effective monitoring is an excellent way of trapping error.
  - It should be communicated that team members are expected to cross-monitor. "You watch out for me and I'll watch out for you!" That way, there is a greater chance that any errors will be picked up.

8.5 Task management

As individuals, each of us has a finite capacity for work and attention. Once you exceed your limit, you start to make mistakes. As we have discussed earlier in this course, there are a variety of other factors that can affect your ability to perform - things like nutrition, stress, fatigue, etc. Our personal ability to manage tasks is largely affected by the following four things:

- Time pressure;
- Our ability to attend to the task over a period of time. (Attention and vigilance);
- Distractions (from a variety of sources); and

✈ Our ability to remember *(Memory).*

Let's discuss them a little further.

8.5.1 Time Pressure 

There are two ways to manage time pressure:

1. **You can increase time available;**
   - We can often increase time by postponing.
   - Research done in CC130 community by the Human Factors section in DRDC showed that this option is frequently under-utilized. As one CC130 Aircraft Captain who participated in the study stated, "We can have up to 11hrs of gas, and all the time in the world to explore options and make plans, yet there we were rushing to come to a decision and just do something!"
   - Frequently we do have options available to us. We can cancel things, slow down, particularly in an aircraft; sometimes you can simply slow down the aircraft a bit. The same thing applies to controllers. For maintainers, you need to identify the fact that time pressure is getting excessive and force yourself to slow down your activities and take your time to ensure that it gets done properly.
   - This option may not always be available, but it is often overlooked. How about accepting a loss of precision. If you assess the situation as being time critical, then the next question you should be asking yourself is "can I accept a loss of precision in order to get this job done?" If not, you must do something about it. Perhaps delaying the task is the only responsible option.

Or…

2. **Reduce the amount of info to process.**
   - Another way to manage time pressure is to reduce the amount of information to process. Quite often we become data-driven (kind of like becoming a slave to the incoming data, trying to respond to absolutely everything). We become buried in information. We need to remain goal-driven! Think about your goals and then decide which data is pertinent to helping achieve those goals. Don't lose focus of the objective! Good preparation for the unexpected, training, the utilisation of job aids, delegating tasks and effective prioritization will assist you to reduce the amount of information to process.

8.5.2 Attention and Vigilance 

Our ability to manage tasks is largely affected by the attention we devote to the task itself. Attention refers to our ability to manage more than one task. Humans are much like an airport with only one runway. The mental runway can only land one aircraft at a time. Now we can pick up the pace and switch from task to task quickly –

sort of like landing one small plane quickly after another. However, it is possible for one task to take up a lot of "runway time" and "space" if it requires lots of thought, attention and mental calculation – sort of like landing a heavy, wide-bodied jet with a turbulent wake that prevents lighter aircraft from landing too soon behind it. Like the runway, attention is a limited resource. Once we have reached the maximum capacity - that is that. You can't make it better by trying harder.

Research is also very clear about multi-tasking – as the number of tasks we attempt to manage increase, performance decreases exponentially. Some people think they can manage an unlimited amount of tasks, and this simply is not true. Performance degrades, to a certain extent, with every new task we add to the pile. Once we reach the saturation point we will start to make serious errors. As a result, you must carefully prioritize inputs/information and focus on the most critical items first. In the aircrew community, an excellent analogy that has been around for years is…

Aviate…Navigate…Communicate!

And it must always be done in that order! No exceptions. If the plane is about to crash, everything else must take a back seat to the duty of flying the aircraft. Be safe, then worry about where you have to go, and then who you have to talk to. There are literally thousands upon thousands of examples, involving aircrew, groundcrew, and aerospace controllers where priorities have become mixed up and people forget what is really important. If you are part of a team, it is your responsibility to ensure that attention is being placed where it should. If you see it happening, it is your duty to speak up and try to rectify the problem.

Vigilance refers to our ability to remain alert and attentive over prolonged periods of time. As you probably know, it isn't easy to constantly monitor a situation. Vigilance over extended periods of time is extremely difficult. The longer you must monitor, the more likely you are going to make mistakes. Research in monitoring type operations, such as AESOps monitoring a sonar scope, show that humans are not very good monitors over extended periods of time. In fact, vigilance degradation is most significant after the first 20 minutes. In addition, human beings are not very good at noticing gradual change. When we monitor things, our brain tends to tune out small, gradual changes. Anybody doubting our ability to remain vigilant and focussed on monitoring can easily test his or her ability to monitor something over a long period by monitoring a second hand on a clock. In very short order, our thoughts will drift off due to the lack of stimulation. As time goes on our detection performance degrades with it.

In short, due to the way our brains work, humans are generally poor at monitoring and vigilance tasks, especially over extended periods. This can have important implications for us on the job, such as the aircrew and AEC communities that regularly have to monitor systems over long periods of time. In order to increase our ability to monitor effectively, we must change our focus of control regularly, shifting our attention to more active control and then come back to the monitoring tasks. It

has also been shown that regular breaks from a monitoring task can greatly reduce the impact on performance. For example, Search and Rescue Technicians (SAR Techs) typically try to rotate out of spotter positions every 20 minutes to rest their eyes, and their minds. After a short break, they are much more effective when they resume spotting duties. The same applies to a variety of tasks in military aviation.

8.5.3 Distractions

Distractions are everywhere! Although you cannot guarantee that you will never be distracted, there are several things you can do to help **avoid** becoming distracted while on the job.

- **Establish ground rules prior to the task.**
  - Make sure that everyone knows what is expected of him or her and what he or she should be looking out for.
  - Some people need to be told not to get worried about trivial information, and it is definitely wiser to do that beforehand.

- **Keep non-operational activities from interfering with your duties.**
  - People sometimes have a tendency to make light conversation during critical times. These people usually don't realize that they are a distraction, and you may have to tell them. You may have to say something like "Don't worry about that right now, we have a job to do and I need your attention here."
  - When doing a job, don't let personal issues interfere with the task. It is easy to say, and harder to do, but people need to try and separate their personal lives from their work.
  - If you think your personal problems are going to adversely affect your ability to perform, you must inform your supervisor.

- **Aircrew can adhere to the "Sterile cockpit" rule.**
  - Sterile cockpit rule means that only operationally relevant discussion occurs during certain times (i.e. below a certain altitude, or during a certain phase of flight). For example, during landing it is not the time to be discussing your plans for the weekend.
  - Most communities have some form of procedure in place that addresses the sterile cockpit rule. Do you have anything in place? What are your personal rules? Think about it…

- **Keep people focused on the task.**
  - Some people tend to jump from one task to the other, and nothing ends up getting done. People sometimes need to be told to forget about the other projects for now and concentrate on one – and do it right.

- **Actively work to increase everyone's situational awareness.**
  - As you complete a task, make sure that you are sharing your knowledge with the other people working with you. Promote a high

level of situational awareness by helping fill the information void in others. "Alright, I've just finished XX, so we don't have to worry about it anymore."

The strategies mentioned above will help you avoid distractions. But, since you may not always be able to avoid distractions, you should understand what options exist for **dealing** with distractions. Here are a few options:

- **Ignore the distraction**
  - In some cases, you can simply ignore it. Some examples might be static from the radio, aircraft noise on the ramp, etc.
  - As long as you can perform effectively, the distraction may not require any other action.

- **Delay your response**
  - Prioritize your actions. You may be able to let it go temporarily until you have more time to attend to that particular distraction.
  - "Don't worry about that right now…we'll do it after we ____."

- **Delegate**
  - Depending on your workload, and that of others, you may be able to ask someone else to handle the issue. Just be careful that you are not about to overload someone else.
  - "I'm busy right now, can you handle that?"

- **Handle it**
  - Sometimes you don't have a choice. You have to deal with it.
  - Remember to verbalize it to the rest of the team (if applicable) so they know that you are going to look after it. Always make sure that safety is not being compromised because of a distraction.
  - "Alright, we have to deal with this right now before we do anything else."

Additional information for aircrew, AECs, and maintainers: Probably one of the most serious distractions can occur during a checklist (or documented) procedure. Maintaining procedural discipline is very important. Checklists/CFTOs are only valuable if used properly. If the sequence is broken, they can't put you back on track. That's up to you. Develop personal procedural discipline. Here are some suggestions:

- ***Aircrew Points for Checklist Usage:***
  - *Verbalize any breaks in the sequence if it occurs.*
  - *Use your finger to keep track of place on the checklist.*
  - *Use Challenge-Verify-Response technique (The person who challenges also verifies that the proper selection has been made).*
  - *Never give the response unless it is confirmed (Physically, Visually, etc.)*

- ***Points for Maintenance Procedures***
  - *These same principles apply to maintainers. Use the CFTOs to ensure steps don't get missed.*
  - *If you have to stop during a procedure, try to do it at a well-recognized stage of the operation. Don't leave something almost complete…if you can finish a specific step, do it and then make a note to yourself (and others) where you actually stopped the procedure.*
  - *If you can't finish doing what you are doing, you may be better to reverse everything up to the last definite "step" that was completed. If you are interrupted while installing some nuts and you have only put them on finger tight, you may be better off to quickly remove them (if that is alright). Otherwise, someone else may arrive to finish the job and think that the nuts have been properly installed, and torqued. It is also possible that you might forget that they were only finger tightened. There have been several military and civilian examples of this happening in the past.*

- ***Points for Aerospace Controllers***
  - *Just as they are for aircrew and maintainers, procedures/checklists are excellent tools to help prevent errors.*
  - *It is important to keep track of the progress of any action you are taking, and be aware that any distraction may cause you to skip a step, or forget to complete an action.*
  - *There are a lot of distractions for aerospace controllers. Dealing with a large number of inputs from aircraft and different agencies, can make it difficult to focus on any one task. You may have to prioritize and accept that some people will be unhappy that they have to wait for you to finish doing what you are doing.*
  - *Keep track of what is going on around you and continually update your situational awareness. It will help you to react proactively rather than always reactively.*

8.5.4 Memory

Our ability to remember has a large impact on task management. Basically, humans have two types of memory:

- **Short-Term (Working) Memory**
  - Our short-term memory is extremely limited. When you try to remember a new phone number, you are accessing your short-term memory. Information in short-term memory is quickly lost unless you rehearse it. Normally people are able to hold 7 ± 2 items in their short-term memory.
  - As new information comes in, it replaces the earlier information. For instances, if you are trying to remember a phone number and someone calls your name, chances are the number will be lost.

- **Long-Term Memory**
  - This is where you store everything you know about the world. The stuff that you don't easily forget because it has been used so much.
  - You can transfer information from your short-term memory to your long-term memory by rehearsing and practicing.

8.5.4.1 Memory Aids

As mentioned, it is extremely easy to forget new information. Here are a few suggestions that you can employ to reduce the chance that the information will be lost.

- **Write it down.**
  - This helps solidify the item in your mind by making helping transfer it to your long-term memory. That's one of the reasons why AEC personnel prefer to use "strips" to track aircraft instead of computer printouts.

- **Recode it (from verbal to spatial).**
  - If you are trying to remember a sequence of events, physically touch or point to each item as you go through the list.
    - Example (aircrew) – To help remember decision height, you can touch the spot on the altimeter where the needle will be. This helps transfer the "number" to a spot on the altimeter.
    - Example (Maintenance) – If you have been told to remove several parts off an aircraft, by pointing to them as you go through the list, it will help you to remember them.

- **Physical Reminder**
  - Even something like a yellow sticky note cue you to the fact that you had to do something…

- **Association**
  - This item (X) goes with that item (Y). Make the connection between one item and another. It will help to remember them both.

- **Visualization**
  - Think about the item (what it is, why you are doing it, when it has to be done).

- **Rehearsal**
  - Make it part of a habit. "Okay, I'll do X, then Y, and then I have to do Z". Repeat as required…

- **Rules of thumb**

- Some quick rules of thumb make it easier to remember. They get you into the ball park quicker.

8.6 Using the AIPA Model

You can employ the AIPA process in your daily tasks. It only takes a couple of seconds to run through this process.

- ✈ Awareness
  - First and foremost…make sure you know what's going on! What are the goals and priorities? "What are we trying to achieve?" How much time is available? Is there enough time? What is causing the workload? Is the task in support of my higher-level goals? Monitor the situation to ensure you are maintaining awareness.

- ✈ ImplicationsThe next thing that you need to do is try to identify "What does it mean?" Whenever possible, try to get the rest of the team involved in this process. You should be particularly interested in finding out if you can increase the time available; or reduce the amount of information to process. For example…"If I continue along this course of action, I won't be able to complete the task." Can I increase the time available? Or "If I don't get this task completed on time there are serious implications." Can I reduce the amount of information to process? Delegate? Cancel tasks?

- ✈ Plan
  - Look at your alternatives as you devise a suitable PLAN. Once again, try to get input from the rest of the team at this stage in order to determine alternatives. Weigh the pros and cons. For example…I could increase the time available but that would result in the task being late. Then you need to ask yourself, "How critical is it if the task is late?" If it is critical, you have to ask for more time or more resources to get the job done, or accept that errors are more likely to occur as a result, and pass that up the chain of command. Perhaps you can reduce the amount of information by delegating the responsibility to one of the other people on the team. That might mean that you get the task completed on time without having to sacrifice quality.

- ✈ Act
  - Put it into action. Ensure understanding by monitoring the situation. Obtain feedback to ensure time is effectively managed.

8.7 Conclusion

In this module, we have learned that human beings perform best under conditions of moderate workload. However we have to acknowledge that it is the nature of the military aviation environment to go through extremes of workload. We saw that there are many factors affect our workload – time and individual capacity being two of the

most important. We should be closely monitoring performance in ourselves and in others for signs of both excessively low and excessively high workload. It is during these phases that error is most likely to occur.

The best way to manage workload is to approach it proactively. Plan ahead for the phases of flight or shift. What can you do during low workload periods to stay involved, avoid complacency and prepare for the times of higher workload? When you are overloaded, make sure that all the important information is being attended to. This may require a careful division of duties, where others are assigned additional responsibilities to reduce the workload on someone else. It may also mean that you may have to cancel or postpone the least critical tasks. Regardless, effective workload management requires planning, prioritizing and delegating tasks to ensure equitable workload distribution.

Use the AIPA process - it works! You have the knowledge to understand the implications of high and low workload. Maintain situational awareness, including an awareness of where you are likely to run into non-optimum workload throughout your shift or mission. Develop plans to avoid, trap or mitigate non-optimum workloads. Act to ensure effective performance is maintained.

Human Performance in Military Aviation

Module 9

Team Performance

Introduction

In military aviation, practically everything we do is done as part of a team. Being able to effectively interact as a team is absolutely critical to effective performance in military aviation. Ultimately, the way the team interacts will have a lot of impact on the success of operational missions and taskings.

Module Objectives

To provide you with the skills and concepts to develop effective team performance and improve operational effectiveness.

.....

Module Content

9.1 Defining Teams

A team is a group of people, but a group of people is not necessarily a team. A group requires several things before it can be considered a team:

- ✈ Shared Goals:
  - Members need to be working towards the same team goals. Just because a group is given a mission or goal, doesn't mean every member shares it.
  - If a member believes in and shares the goal, then they will work much harder to achieve it.

- ✈ Shared mental models:
  - In order to work effectively with each other and communicate, each member needs to share the team understanding of what is going on, what

the team intends to do, the systems with which the team is working, SOPs, terminology, etc.
- Without shared mental models the team could not function effectively.

✈ Shared attitudes:
- Ineffective teamwork often has its roots in faulty attitudes. Members need to feel that their contribution is important to team performance.
- Team members, and particularly leaders, need to enhance participation and create a feeling of mutual dependence and support within the team, to keep members involved in the success of the team.

✈ Interdependence:
- In truly effective teams, team members depend on each other and the team depends on each member for success.
- An excellent hockey team with only poor goalies to call upon is likely to be only mediocre in the final outcome. Frequently, team members have specialized skills critical to the accomplishment of the task.
- The team's success depends on members knowing and executing their job in an accurate and timely manner. If a team member(s) is not pulling their weight, the team will suffer.

We define the team as: "A group of *people* working towards a common *goal*." Anyone working towards that common goal is part of the team. As is clear from the definition, teams obviously have to focus on goal oriented tasks, such as setting clear expectations, assigning roles, monitoring performance, and focussing on results. Teams also have to focus on the people aspects in order to maintain effective performance over the long term. This includes such aspects as establishing relationships, communicating, providing feedback and advice, and managing conflict.

When teams are performing effectively, they often achieve much more as a cohesive unit than they could as a group of individuals. This phenomenon is called 'synergy' – where the sum of the whole (team) is more than the sum of the parts (individuals). The following quote emphasizes the importance of synergy:

> "If I were a passenger on an aircraft that developed serious mechanical problems. I would greatly prefer a cockpit populated by average pilots who work well as a team over one filled with superb technical flyers who do not."
>
> J. R. Hackman. *Cockpit Resource Management*

During a study on the effects of fatigue, NASA researchers discovered something important about the teams being evaluated. In this study crews, who had been flying regularly together, were pitted against newly formed crews who were well rested. The research found that crews who had just come off rotation did in fact suffer from the

symptoms of fatigue. What they did not expect to find was that these same crews out performed the well-rested crews. The effect of working together had more than compensated for the disadvantages of fatigue.[1]

9.2 Team Boundaries: Who is on the team?

As teams develop they naturally establish boundaries that define who is on the team. These boundaries can be both physical and psychological. In the military environment we wear uniforms, which distinguishes us from non-military. In the air force we wear distinctive uniforms to distinguish us from the other branches, and we even have distinctions within the air force. This is largely to help us associate with a team. Being a part of a "team" gives a sense of belonging, pride and motivation.

Boundaries help build the connection within the team. Unfortunately, boundaries can sometimes be a double-edged sword. There can be a downside if teams become too insulated and closed off. When this is occurring, there is a tendency to see things as "Us and Them". For example: ground crew vs. aircrew; pilots vs. navigators; navigators vs. AESOps; operational vs. support; air force vs. navy vs. army, etc. Healthy competition and team pride is one thing, but it cannot be allowed to go too far. Teams must keep the greater objective in sight.

Groupthink is a problem, which can develop in groups that are too cohesive and which become more concerned with fitting in than realistically examining alternative ideas[2]. Pressure to conform becomes unhealthy. Everyone starts to think alike. Experts have attributed many examples of poor performance and even disasters to narrowly set team boundaries and groupthink. In teams that are too closed off, members may subtly communicate that "outsider" input is not valued, or simply ignore that input. The tighter the team the more opportunity there is for the team to become closed to "outsiders" and outside influence (elite groups, which feel isolated and distinct from the mainstream, can be particularly susceptible).

It is particularly important that leaders be aware of this tendency and counteract it. Research has shown that the most effective leaders continually look for ways to expand team boundaries, beginning as soon as the team is formed.[3] Highly effective leaders work hard to create a larger vision for the "team". In particular, they make a conscious effort to include everyone and talk in terms of "we". The team may include aircrew, ATC, cabin crew, ground crew, support personnel, anyone else that contributes to the success of the mission. High performers specifically seek input and feedback from the expanded "team". In contrast, low performing leaders tend to talk in terms of "us" and "you."

[1] Hackman, R. (1993). New directions for CRM training. In Weiner, et al, (Eds.). *Cockpit Resource Management.* Toronto: Academic Press, p. 53.
[2] Ginnett, R. (1993). Crews as groups: Their formation and their leadership. In Weiner, et al, (Eds.). P. 87.
[3] Ginnett, In Weiner et al. P. 87.

These concepts and behaviours apply to all team members, not just the designated leader. Effective teams expand the boundaries as appropriate to the situation and seek input from the wider team members.

We define the team as: "A group of *people* working towards a common *goal*." Anyone working towards that common goal should be included as part of the team.

9.3 Leadership and Followership

We define leadership as: "The art and process of influencing *others* to work towards the accomplishment of a common *objective*". As you can see the definition is pretty much the same as the definition for teams. Once again the key elements are people and goals. In order to be effective, there must be a balance between task and people oriented actions. A leader has to care for his people, just as a subordinate has to care about their leader and the rest of the team's well-being. The situation will dictate which actions are more necessary than others. In the two lists below, you will find a number of people and task oriented actions the leader can do that will enhance team performance.

People Oriented Actions:
- Setting the tone
- Building relationships
- Building commitment
- Communicating
- Build team cohesion
- Supporting/encouraging team members
- Manage disruptions and conflict
- Reward effective performance

Task Oriented Actions:
- Establish clear communications and command authority
- Establish clear expectations
- Establish clear goals and priorities
- Allocating responsibilities
- Monitoring and adjusting
- Adapting to situation, events
- Follow-up to provide feedback, ways to improve, etc.

As you look through the two lists above, it should become clear that the "designated leader" is not the only person who can influence the team's performance. In fact, on many teams there can also be "functional leaders" who, depending on their expertise and abilities, may assume a certain leadership role on a team. A good leader will know when to use his or her "functional" leader to accomplish a mission or task.

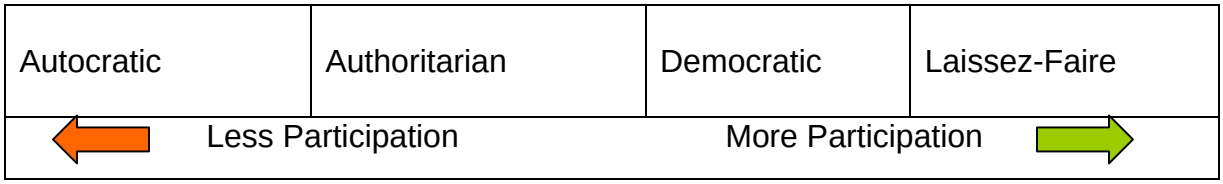
We are not advocating relinquishing command, but rather the careful usage of the full range of expertise available to accomplish a task. The designated leader must retain command, and ultimately decides whether or not to accept the "functional" leader's ideas, and or suggestions put forth. The opportunity to let a team member shine does a great deal for their confidence and helps strengthen the team. One way of looking at it is: "followers" are all "leaders in training" and should be given the opportunity to achieve their own successes and failures. For these reasons, you will see the definition for "followership" is very similar to both the definition of a team and the definition of leadership.

Followership - "Providing support to the leader and other team members as you work toward accomplishing the mission."

In effective teams, functional leaders do not usurp authority. They support the designated leader. You can't be a good leader if you won't be a good follower. Likewise, effective designated leaders do not abdicate responsibility, and carefully balance the needs of the team vs. the importance of the mission or task. Sometimes a leader has to make unpopular decisions, but if an individual has spent the time building a strong team, the tough decisions will be easier to accept by the rest of the team because they trust the leader and their decision-making ability.

9.4 Leadership and the Authority Gradient

Leadership is often described as an "art". As we discussed, effective leadership requires a flexible approach depending on the situation, the task, the expertise levels of team members and the personalities involved. For discussion purposes, situational leadership can be divided into four general approaches, as shown in the diagram below:



The concept of the authority gradient is important in aviation operations. It is about finding the right mix. Early CRM programs emphasized this aspect of HPMA and for good reason. Many high profile incidents and accidents have been tied back to the existence of a dysfunctional authority gradient, inside or outside of the cockpit. It is just as important today, and applies to the entire air force team.

When a leader is overly autocratic, it is no longer really a team effort. Excessive autocratic type behaviour on the part of leaders leads to an environment where subordinates simply disengage, stop participating and stop showing initiative. The task essentially becomes a one-person show, with the team members assuming minor supporting roles. Airplanes have actually flown into the ground piloted by dead captains because of co-pilots that were too intimidated to question or take control.

On the other side of the coin, a team becomes rudderless if the team is left to do everything as individuals. The team becomes weakened because of a lack of direction and feedback. Superiors who are excessively laissez-faire abdicate responsibility and set up a situation where team members may usurp authority out of frustration. Leadership and loyalties may be divided. Things don't get done. Decision-making is slow and ineffective.

In general, highly effective leaders move back and forth across the leadership continuum as required, avoiding the extremes.[4] Some activities and situations, such as mission planning, may lend themselves well to more democratic approaches. Others, such as emergencies, lend themselves to more autocratic approaches. Some people respond well to more direction, some require less direction. It is also important to keep in mind that leaders have their own styles and capabilities. What works for one person may not work for another person.

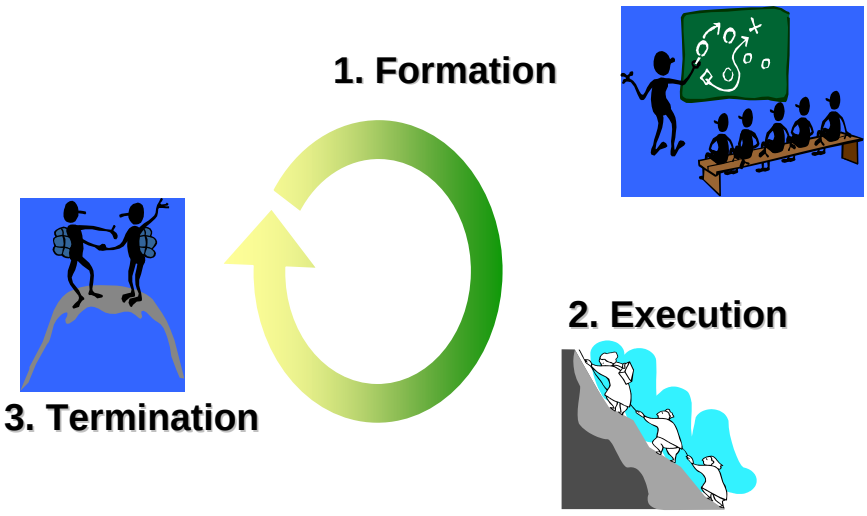
> "I learned very quickly as a young captain, you had to adapt your leadership style to meet the situation and the individuals. University students used logic, farm boys used common sense, and rogues from the inner city… you had to let them know that you could be one mean S.O.B."
>
> General Norman Schwartzkopf

9.5 The Team Development Cycle

Research in group dynamics shows that team development follows a common pattern. For simplicity sake we have narrowed the cycle down into 3 main phases that we wish to emphasize:

1. Formation;
2. Execution; and
3. Termination.

Each of these stages is critically important to the successful functioning of the team.



[4] Ginnett, in Weiner et al. p. 89.

Formation

Team formation is a particularly important stage. In this stage, people are brought together as individuals and must learn what their role and position is to be within the team. Research shows that people form their opinion of others very quickly - within a few minutes of meeting them![5] These perceptions, once established, are likely to strongly influence behaviour and carry on throughout the remaining stages. Leaders must be particularly careful to set the right tone from the very beginning. This stage should also provide a vision of what the team is trying to accomplish and a plan on how it is going to meet these objectives.

Execution

The execution phase is when the team actually performs the job. Performance at this stage depends to a great extent on the formation phase. In the military environment individuals are frequently expected to fit into the team very quickly. We can do this because we arrive ready to take our place in the team knowing, to a large degree, what is expected of us, how to do it, and where we fit in the team hierarchy. Training, SOPs, rules and regulations, rank structure, and standard terminology are some of the things that allow us to create new teams in a short time frame.

Termination

Termination of the team is also a critical stage of the team cycle, and probably the most neglected. Frequently this stage is characterized by half-hearted debriefs, and formulated reports and lack of follow-up. Rushed debriefs tend to focus on “critical elements” – unfortunately this can create a tendency to focus on the negative aspects of task execution. Positive aspects are often skipped over or taken for granted. This is understandable in that after completing the task at hand, the follow-up activities feel anti-climactic. The edge is off. Team members are already looking ahead to the next priorities – getting home, the next assignment, etc. However, when conducted properly, termination activities can provide a lot of benefit to both the team and individuals. As members leave the team they will have changed and their experiences, as part of the team, will influence their performance on the next team they are a part of. For this reason, it is important to close or address any outstanding issues and to provide feedback to the team members. The issues that go neglected today will appear again in the future if left unattended.

9.6 Team Interaction Skills

Having already identified that, in a lot of ways, we are all leaders and followers, we would now like to present the six team interaction skills, which are common to both leaders and followers. These skills were identified during research conducted by Western Michigan’s School of Aviation Sciences in conjunction with the Technical Advisor for Human Factors to the FAA. In this research, the performance of teams in a

[5] Ginnett, In Weiner et al.

variety of tasks and situations were compared. The researchers identified six distinct skills, which the individuals on high performing teams demonstrated.

The six skills, which distinguish high performing teams from the others, are:

1. Envisioning;
2. Modeling;
3. Influence;
4. Receptiveness;
5. Initiative; and
6. Adaptability.

1. Envisioning

Envisioning refers to being able to communicate a vision and a plan for the future. The keyword here is 'communicate'. For the team to function well there must be a common vision. It supplies meaning and direction – the compass to follow. It is an idea that gives the team something to work towards. Both leaders and followers can contribute to team vision, however it is closely linked with the team leaders effectiveness. People can be ordered to undertake tasks, but they cannot be directed to share the vision. People must be persuaded to share the vision. It must identify the goal, or 'end-state', as well as a 'way ahead'. It includes anticipating problems and opportunities. To develop or share a team vision requires an open communication environment.

To help ensure that the team has a common vision:

- Create an open communications environment;
- Encourage the sharing of each member's understanding of the situation;
- Clearly verbalize the objective and the plan;
- Formal orders, briefs, and mission plans are obvious examples of envisioning, however, there are other less formal means;
- Feedback and monitoring are required to ensure that the vision remains valid, that all members remain on task, and that actions and sub-tasks support the strategic goals.

2. Modeling

Modeling is demonstrating by example. We must remain aware that our actions send the strongest message. It is important for all team members, particularly the leader, to act as a positive role model for others. The leader sets the tone. Sloppiness on their part encourages sloppiness in others. Discipline, competence, and professionalism encourage the same from others. These qualities show team members that there is cause for the leader to exercise legitimate authority. Team members also can strongly influence the tone. Sloppiness on your part may encourage sloppiness in others. A team member who insists on acting professionally and competently can place subtle pressure on other team members, including a leader, to do things right.

Effective modeling includes:

- ✈ Setting and expecting a high standard;
- ✈ Giving advice and positive feedback to reinforce the importance of a high standard;
- ✈ Helping others to achieve a high standard;
- ✈ Treating others with respect; and
- ✈ Being loyal to those who are absent - it gains loyalty of those who are present.

3. Influence

Influence is about obtaining commitment from others to goals, ideas, or actions. All team members have degrees of influence. While some influence may come automatically with the appointment to a position of authority, influence is most effective when members grant it voluntarily because of competence, personality, trust, etc. Actions, which allow you to influence others include:

- ✈ Be competent.
  - There is no substitute. Without competence you are unlikely to influence outcomes.

- ✈ Take responsibility.
  - Team leaders are responsible for influencing the team to commit to the team goals and vision. Team members are responsible for supporting the team leader and other team members in the accomplishment of those goals.

- ✈ Communicate clearly.
  - It is hard to influence others if you cannot clearly communicate what it is you wish to achieve. Commitment can't be directed. Modelling is one form of communication. Use of logic is another. Use facts to support your case.

- ✈ Be tactful.
  - Tact involves courtesy, respect, and rapport. It also involves assertiveness. If you *know* the answer or have information that others don't – speak up - but communicate it in a constructive manner. People don't like being ordered around, except under exceptional circumstances, like an emergency. The end result is that you want others to listen to your ideas and consider them on their merits without becoming defensive or hostile.

Be sure you understand the difference between 'assertiveness' and 'aggression'. Assertiveness is a positive personality trait. Assertiveness focuses on the goal/task, effectiveness and efficiency – it is about win/win. Aggression is a negative personality trait. It is about personalities and win/lose. You may get what you want in the short term through aggressive tactics, but you will be burning bridges to do it.

In his book, *The 7 Habits of Highly Effective People*, Stephen Covey describes the "emotional bank account". In this concept you build up reserves (influence) by acts of trust, competency, teamwork, integrity, etc. By building up your 'account' you can use it to influence others when necessary, and if you are forced to make a significant withdrawal (for example, you make a big mistake), you will have built up some rainy day savings, which you can apply.

4. Receptiveness

Receptiveness refers to encouraging input and feedback from others. Receptiveness is one of the highest indicators of team effectiveness and it is important to set the tone right up front so that others will feel comfortable providing input. Indicate that you are not only open to others opinions and input – you expect it. Encourage others to participate.

Make constructive feedback a part of the team culture. "What could I have done better?" "How would you have done that?" Acknowledge that it is possible (and probable) to make mistakes. Thanking a team member for effective monitoring and feedback does not diminish a team leader's authority (on the contrary it may increase it) and it will send the signal that he or she is open to similar input in the future. This opens the door to increased team member commitment.[6] Pointedly use other's suggestions to show that input is valued and acknowledge the contribution to both your own performance and the teams' performance. "I tried that technique you mentioned – it worked great!"

Listen actively. Watch body language. Maintaining eye contact, paraphrasing, agreeing, and questioning demonstrate you are interested in what is being said.

Expand the team boundaries to ensure that all members who are contributing to the success of the mission are included. Be aware of signs of exclusivity, such as talk which refers to "us" and "them", when it should be clear the "them" is on the same side. Discourage this kind of activity. As we have already learned, the highest performing leaders make a concerted effort to expand the team boundaries.

Receptiveness may be hardest to demonstrate when you are in a tough position and there is not a lot of time to deal with "distractions." However, as soon as there is opportunity you should re-open the lines of communication.

[6] Ginnet, in Wiener et al, p. 90.

Actions that demonstrate receptiveness:

- Set the tone up front;
- Acknowledge it is possible to make mistakes;
- Encourage feedback;
- Listen actively; and
- Expand team boundaries. Include everyone who supports the mission.

5. Initiative

Initiative refers to acting without direction to solve problems and accomplish the mission/task. Initiative is about taking responsibility. Doing the things that need to be done. Looking for better ways of doing things. Being proactive. Taking appropriate action without always having to be told. When team members see initiative being rewarded, they will also begin to show initiative.

Excessively autocratic leaders, low expectations, lack of direction, lack of receptiveness – these are initiative killers; however, initiative is very contagious and one team member showing initiative can inspire the other members. When a leader helps create a vision of where the team is going, emphasizes the strategic goals, and how the team is going to get there, members are able to show greater initiative because they know the direction the team is headed in.

It is important that initiative is followed up with the other team members. Informing others of actions taken ensures everyone's situational awareness is up to date and confirms that the initiative was, in fact, appropriate to the situation.

Tips for creating initiative:

- Take responsibility for team performance;
- Look for more effective ways to do things;
- Help with workload management:
- Ensure good communication and team situational awareness; and
- Encourage initiative in others – it is contagious!

6. Adaptability

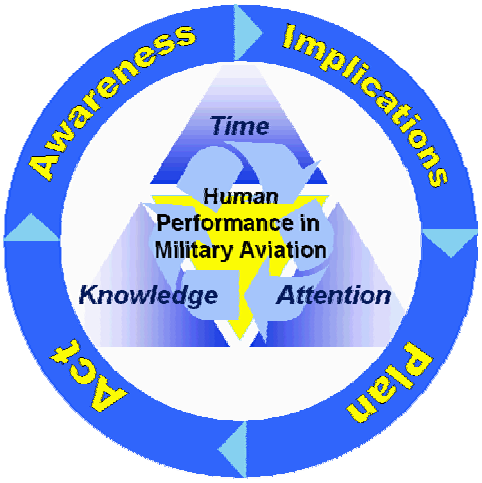
Adaptability is the capacity to adjust to a changing environment, ambiguity, or abnormal situations. Team members need to be able to operate within the structure, but understand the importance of flexibility. Members need to be able to recognize the need to revise plans and adapt. How quickly they can do that is critical. Highly adaptive teams are able to perform well even when time is short or there is a lack of information or resources. They quickly identify what is important or not important, and focus their attention accordingly.

Adaptability is the key to success. The keys to adaptability are:

- Maintain feedback;
- Maximize situational awareness;
- Revise plans as new information becomes available;
- Recognize the need to adapt quickly;
- Take advantage of team member strengths;
- Compensate for weaknesses.

9.7 Using the AIPA Decision Making Model to Align Team Performance

The AIPA decision-making model can be used to align team performance. It can be used as a checklist to ensure that all members understand the goals, what is happening, and what the plan is. It can also be used as a troubleshooting model for team members. If the team is performing poorly, the problem can normally be found in one of these elements.



Teams have to allocate roles, responsibilities, and tasks. How this should be done has a lot to do with the resources available to the individual members and the team as a whole. The three decision-making resources are time, attention and knowledge. Each must be taken into consideration.

For team members to perform effectively, the starting point is professional knowledge. Without that base, members cannot effectively operate. Tasks have to be assigned based on the capability of the individual. Also, ensure that team members have a common understanding of how things are supposed to work, and each member's responsibility. Technical ability, SOPs, standardized terminology, training together as a team in an operational environment – these are all methods of providing this common starting point.

- ✈ Ensure that all critical tasks are being attended to.
  - Allocate responsibilities - try not to overload individual members.
  - Manage the time resource so that members can attend properly to the tasks.

- ✈ Ensure maximum awareness of all team members.
  - Establish and communicate team goals.
    - Do not assume everyone has the same goals or automatically understands what the team is trying to accomplish.
    - Re-emphasize the goals at every opportunity.
    - Confirm perceptions to ensure that everyone understands the situation.
  - Direct attention to critical situations or events - communicate.
    - Team members must communicate any situations or changes that may impact on the success of the mission/task so that all members' awareness is maximized.
  - Provide feedback to others.

- ✈ Ensure all team members understand the implications.
  - Develop a common understanding of the situation and work through the implications arising from the changing situation, events, and problems.
  - Ensure all team members understand what things mean.

- ✈ Ensure all team members understand the plan/revised plan.
  - Define roles and responsibilities, command and control.
  - Ensure members understand the procedures to be followed.
  - Ensure all members are updated as plans are revised.

- ✈ Ensure all team members are carrying out actions to effectively support team goals.
  - Follow the plan.
  - Coordinate actions.
  - Provide and seek feedback.
  - Re-assess the situation and revise the plan as required – adapt to evolving situation.
  - Act to accomplish the goal.

9.8 Conclusion

Leaders need to establish goals, set the tone, assign responsibility and monitor performance for the team. Leaders need to balance the people oriented and the task oriented responsibilities.

Followers need to support the leader and the team, take responsibility, and show initiative. They need to be assertive when necessary, and they are also expected to show leadership when necessary.

Promote, develop, and practice the 6 Team Interaction Skills to maximize team performance. Use these skills as an informal means of evaluating your own performance within the team, and it can also be applied to other members of the team. Ask yourself whether or not you actively display those skills. Look for areas that need improvement. Leaders should also use the list of skills to determine whether or not they are promoting those skills in their own people, and as an evaluation team. Use the list to give feedback to subordinates, helping them improve if required. Ultimately, teams that master the 6 Team Interaction Skills are well on their way to high performance levels. Always look for opportunities to improve yourself and others. The AIPA model is an ideal tool that can be used to enhance team performance.

Human Performance in Military Aviation

Conclusion

Program Objectives

The objective of the HPMA program is to *"Increase operational effectiveness through individual and team performance training."* The program identifies and emphasizes the "underlying skills" or competencies displayed by effective performers. The effective application of the skills taught on this program will separate the highly competent from the "rest of the herd".

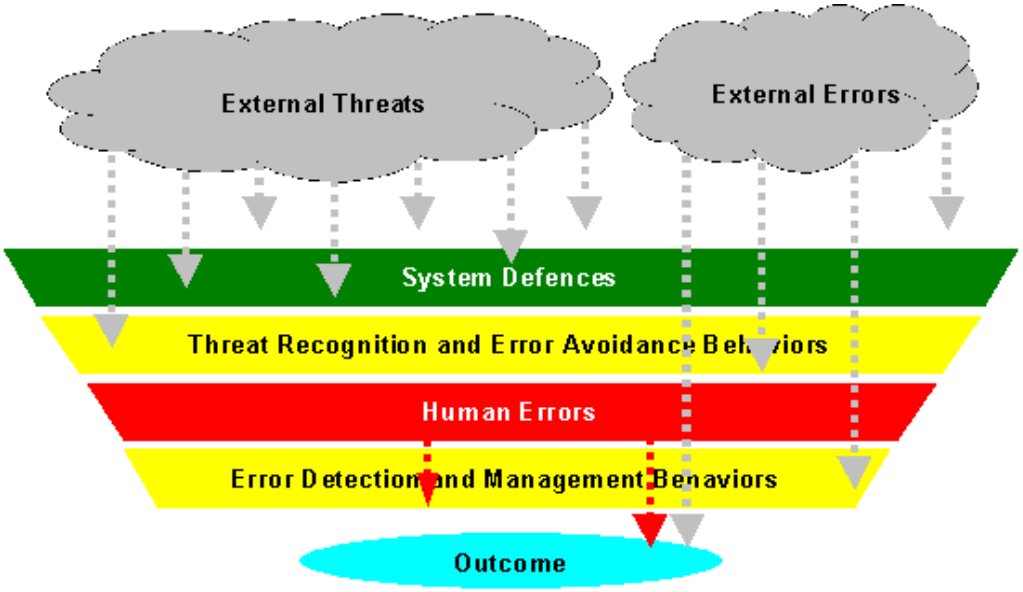
The skills presented in the HPMA program are important because it is impossible to prepare for every single possibility. We need effective mental skills that can be applied in any and all situations. HPMA is more concerned about teaching you a process. The skills taught in this program should allow you to make effective decisions, manage threat and error, adapt to whatever challenges and environmental situations you are exposed to, perform effectively as a team, and ultimately to accomplish the mission/task. In short, the goal of the HPMA program is to develop basic mental skills that support everything we do. These skills and tools you have been given will help you perform to your maximum capacity and, in the long run, will optimize operational effectiveness.

To conclude the HPMA handbook, we will provide you with a quick recap of the major concepts of the HPMA program.

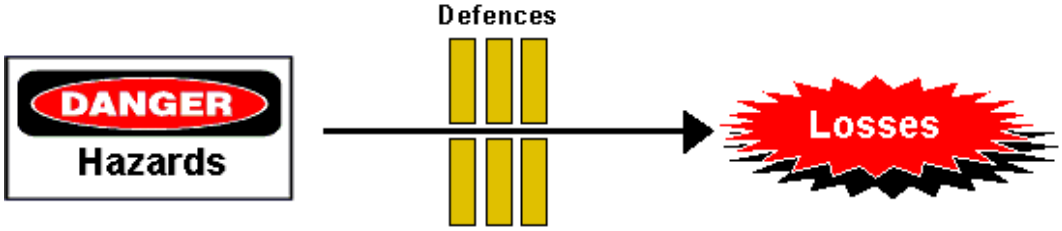
.....

Threat and Error Management

In military aviation, we work in an environment that can change from boring and routine to adrenaline soaked, heart-pumping excitement (or terror?) in an instant. We are routinely exposed to threats to both safety and the accomplishment of the mission. "To err is human". From time to time we, or others, will make errors that endanger the mission or ourselves. Either way, errors can result in reduced performance, loss of resources or danger to others and ourselves. We refer to this as the rain of threat and error.



To optimize operational effectiveness (and safety), we need to set up defences that act as barriers to the threat and error we face. SOPs, training and practice, effective planning, clear concise communication, professional attitudes: these are all examples of defences we can use to reduce the effects of threat and error. However, it is important to remember that a sole defence does not guarantee the elimination of all threats and errors. Multiple defences are required to block hazards that have made it past one of the lines of defence. Ultimately, you are the final defence! When everything else fails, you are expected to respond in order to prevent loss or serious performance degradation.



We all choose to accept a certain amount of risk. We cannot eliminate all the threats we face, nor can we eliminate all error. We have to learn to deal with threat and error. There are three simple strategies for managing threat and error:

1. *Avoid* them where possible;
2. Develop strategies to *trap* them when they occur; and,
3. When it isn't possible to avoid or trap them, *mitigate* their impact as much as possible by adapting rapidly to the situation.

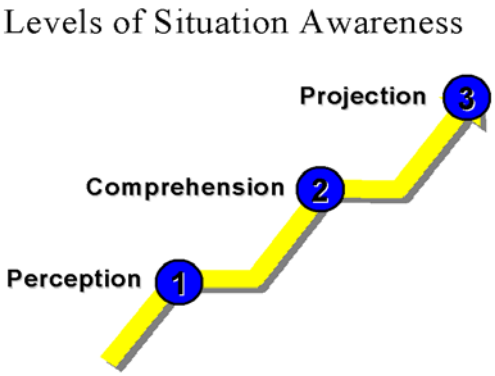
As we have already mentioned, the highest level of professional knowledge is the foundation for effective threat and error management.

Situational Awareness and Decision Making

Situational Awareness (SA) is the foundation of effective Decision-Making (DM) and therefore effective performance. You need to know what to do to develop SA, to maintain SA, and how to regain SA when it has been lost.

In order to have a complete SA "picture" we need to know what has happened in the past, what is happening right now and based on that, develop an accurate picture of what is most likely to happen in the future.

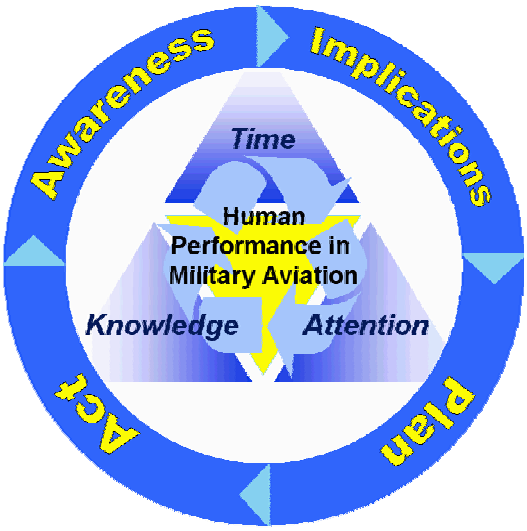
At the point where all three of these elements intersect is situational awareness. If any of the three is missing, an individual does not have situational awareness. From this, it should also be clear that SA is dynamic. All three of these elements are in a constant state of change, and individuals must continually update their understanding of each of these elements. From there, we can say that situational awareness can be broken into three specific "Levels". They are as follows:



By doing this, we can make situational awareness an observable item that can be evaluated. When a breakdown of situational awareness occurs, you should be able to identify the level where the breakdown occurred. For example, if a student fails to see a warning light (Level 1 – Perception), there is no way they will be able to figure out the implications (Level 3 – Projection). There may be a number of reasons for this breakdown at level 1 – training, poor student preparation, poor location of light, etc. Regardless, once the reason is identified, the potential for improvement is much greater.

The importance of SA is captured in the AIPA model. In fact, SA corresponds to Awareness and Implications in the AIPA DM model – be aware of what is going on – work through the implications. What does it mean to you? The mission? Safety?

Once an individual, or team, has sound situational awareness, they will be able to make a better decision. With a good understanding of the situation, a plan (and contingencies) will emerge. All that remains at that point is to act out the plan and then look for feedback (back to Awareness). Oddly enough, failure to act is a fairly common occurrence even when people know what they should do.



DM is not a linear (straight line) process; it is cyclical as indicated in the AIPA model. We talk about "*maintaining*" SA. We can also lose SA very quickly. We need to maintain feedback and update our SA at every opportunity so we know what is going on. Up to date SA allows us to revise our plans and adapt our actions as required by the changing situations we may find ourselves in. If we don't keep the loop closed we are very likely to make serious errors.

During that entire process, you must carefully manage the three critical resources. If done effectively, it will enhance the decision-making process and performance. The three resources to manage are:

- ✈ Knowledge
  - The highest level of professional knowledge is the starting point for effective DM and performance. Sounds obvious – but there is no substitute. If you don't have it when you need it, well … you know the rest. In order to *know* what is happening, you have to *attend*…

- ✈ Attention:
  - A limited resource. Make sure that the critical tasks are being attended to. Prioritize, delegate, give yourself *time*…

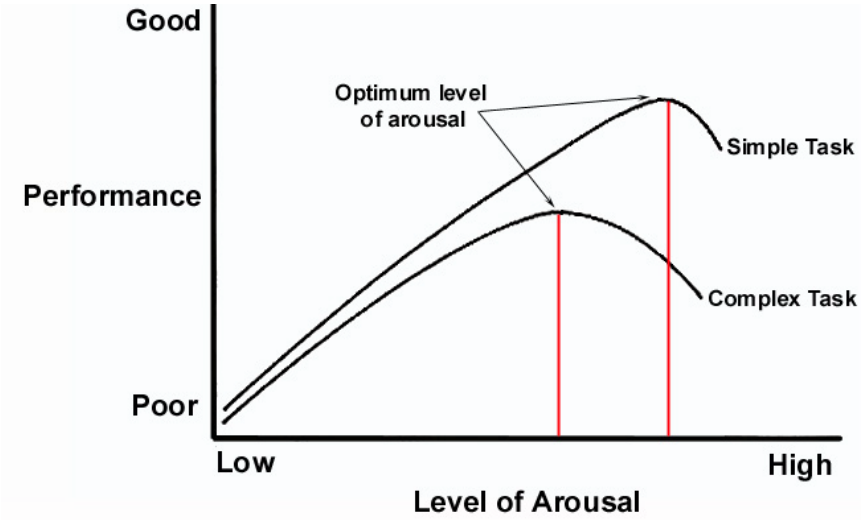
- ✈ Time:
  - We need to create enough time to adequately process the information necessary to make good decisions. In some situations time can become your most precious resource.
  - Research shows that frequently we fail to optimally manage this resource.
  - Carefully assess the time available and attend to the priorities necessary to give you the knowledge to make an informed decision. It may not be perfect, so allocate your attention effectively.

Individual Human Factors

Our personal physical and mental conditions are critical components effecting our performance and ultimately operational effectiveness. One of the best things you can do for both yourself and the Air Force is maintain your good health and a positive attitude. Good nutrition, adequate sleep, and regular exercise are three things that, for the most part, you have control over. Educate yourself on good eating habits –Stay away from the FADS! Get enough rest - research shows most of us don't get enough sleep. Exercise regularly! The value of regular exercise cannot be over-emphasized. Regular exercise has been shown to reduce stress by up to 30%! It helps control weight, it gives us greater endurance for those times when the going gets rough and it helps us think better.

Let's quickly review a couple of points from your earlier Individual Human Factors modules.

Figure: Yerkes-Dodson Curve (Performance vs. Stress)[1]

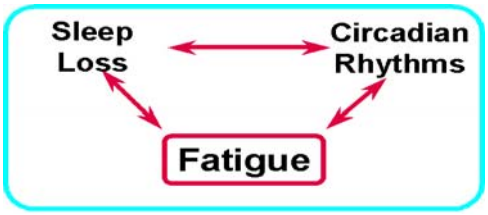


As we discussed, our performance is closely linked to our level of stress or workload. You have to remain alert for the conditions that can push you over that "hump" and on the rapid downward plunge associated with overload. If you think that someone is approaching their overload point, or you think that you are, you need to speak up and take measures to reduce the workload, or stress to an acceptable point. There are a number of ways to react…

- ✈ Recruit some additional resources;
- ✈ Remove the stressor (cause)
- ✈ Change your goal for something a little more manageable
- ✈ Or lastly…deal with it.

We also discussed fatigue and how it can impact performance. You have also learned about the two primary causes of fatigue:

1. Sleep loss; and
2. Circadian rhythm.

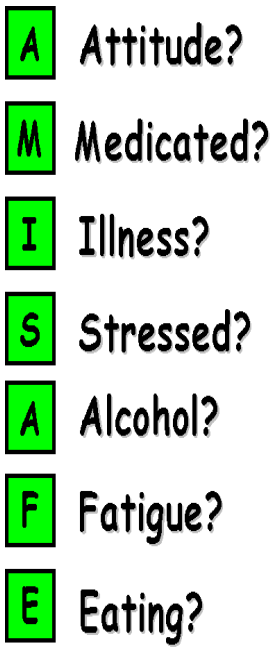


You have seen some of the symptoms and should have a better understanding of how fatigue impacts our performance, especially over time.

[1] Wickens, C.D. (1984) *Engineering Psychology and Human Performance*. Boston: Scott, Foresman & Co.

If you want to know whether or not you are prepared, use your "AM I SAFE" checklist.

- **A**ttitude – do I have the right attitude to do the job?
- **M**edicated – am I currently on some type of medication that could impair my judgement or my ability to do the job?
- **I**llness – am I suffering from any type of illness that could affect my work?
- **S**tressed – am I suffering from an acute or chronic stress? If yes, what can I do about it?
- **A**lcohol – have I been out drinking and could it affect the task at hand?
- **F**atigue – am I well rested? Have I had enough sleep for me to be alert enough to complete this task?
- **E**ating – have I had a good meal recently that will be able to tide me over until my next opportunity to eat?



This short, simple "Personal Checklist" was designed for self-assessment but can also be used on others too!

Communication

Effective communication is critical to effective performance. We need it to build SA, communicate plans, and provide feedback. The Five Essential Skills of communication are:

1. Inquiry
   - Ask the right questions to help increases your own situational awareness.

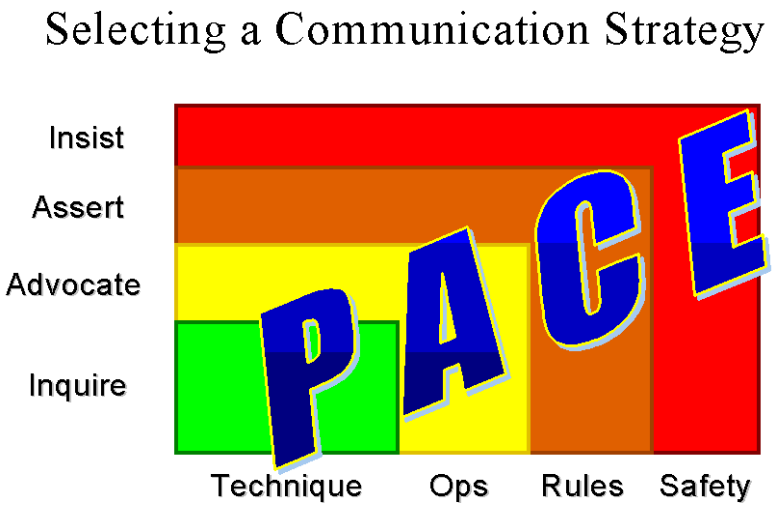
2. Advocacy/Assertion
   - Speak up to help increase someone else's situational awareness and ensure your point is received and understood.

3. Active Listening
   - Make the effort to truly understand another's perspective.

4. Conflict Management
   - Focus on what's right not who's right!

5. Feedback
   - Seek and provide feedback.
   - Ensure what you said has been understood.
   - Confirm that what you heard is what was meant.

Selecting a communication strategy depends on the situation. It can range from asking pointed questions: "Where do you think that smoke's coming from?" to outright confrontation at the extreme (and hopefully rare) end of the spectrum: "I'm not going to let you needlessly endanger us!" The PACE model provides you with a means of gradually escalating the level of the communication rather than being confrontational. PACE is a gradual escalation of communication and helps prevent conflict. If a situation isn't too serious, you can usually start by "PROBING" – inquiring about the situation for a better understanding. If that fails, the next step would be to ALERT the other individual(s) of the potential hazard and/or danger. Further escalation would be to CHALLENGE by stating the problem and "why" it is a problem. "This is why…" The most extreme cases may require you to make an EMERGENCY statement that is intended on getting them to immediately alter their course of action. "You must…" Of course, the severity of the situation, and the time available will determine where you begin the PACE process. If there is imminent danger or lives are at stake, you may have to go right to "Emergency". The situation, and the people involved, will play a large role in determining how PACE is applied.

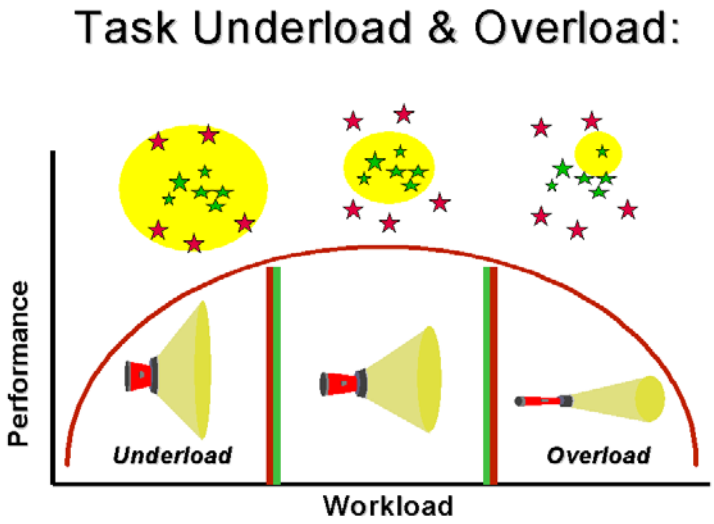


- **Probe** for a better understanding. - "What are we trying to do here?"
- **Alert** to any problems. - "If we continue on this course of action, I think something bad will happen. I think we should …"
- **Challenge** the correctness of the present course of action. "This is contravening regulation X and is putting us in a dangerous situation. We should …"
- **Emergency** action to address the problem. - "This is wrong. I'm not going to let this happen."

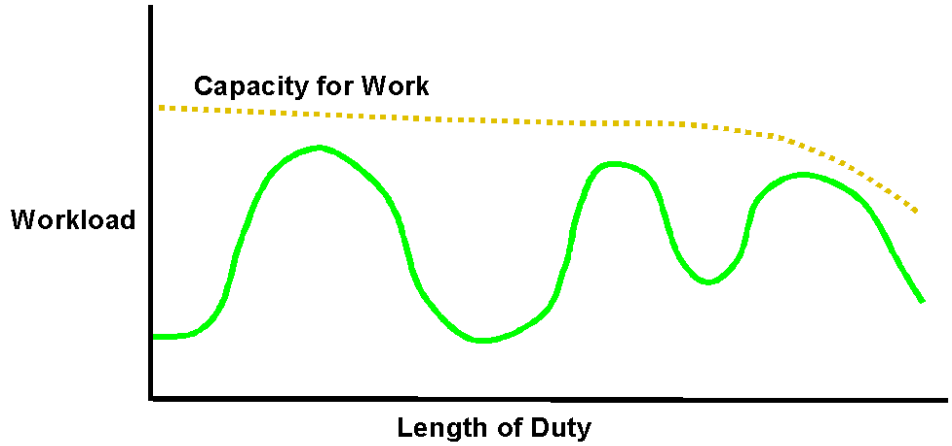
PACE is particularly suited to subordinates but supervisors should also use it and they need to recognize when someone is “PACEing” them. It is also important for supervisors/leaders to realize that subordinates are often very reluctant to assert themselves. Instead, subordinates are much more likely to ask questions, or PROBE, rather than come right out and say what is on their mind. When a subordinate is Probing, they may be trying to tell you that something is wrong. An effective leader will recognize the attempts of his or her subordinates to bring an issue to their attention.

Task and Workload Management

Workload is subjective. What may be an easy task for an experienced operator, controller or maintainer, may be overwhelming to a novice. It depends on how much a person is being asked to do, how much time they have to do it, and how much capacity/experience they have. As we discussed in the stress module, human beings perform best under situations of moderate workload (stress). If workload is too low we can become complacent, bored, inattentive, distracted – we can end up losing track of critical tasks. When workload is too high we cannot attend to all the critical tasks. In this situation there is increased chance of error. The figure below depicts the effects of workload, and our ability to attend. The green stars represent critical inputs, and the red stars represent inputs that are not critical to the task at hand.



When an individual is underloaded, they tend to absorb much more than they should, and lose track of the finer details. They may miss important inputs because there are too many elements competing for their attention – their situational awareness begins to suffer. At the other end of the spectrum, we see overload. When people are becoming overloaded, they tend to focus on a limited number of items, and risk missing important inputs. This is typically seen during emergencies in which people become fixated on something and neglect the other elements around them. Once again, situational awareness begins to suffer. There will be occasions when it may be necessary to focus a great deal of attention on one particular item, as may happen during an emergency. That is all right, as long as someone else is attending to the other critical elements!



We need to manage our workload to stay in the moderate level whenever possible: delegate, prioritize, postpone, cancel… whatever it takes to ensure critical tasks are controlled and keep you safe and effective. Look for opportunities to distribute workload to prevent any one member of your team from becoming overloaded, and if you feel that you are getting overloaded, speak up!

Team Performance

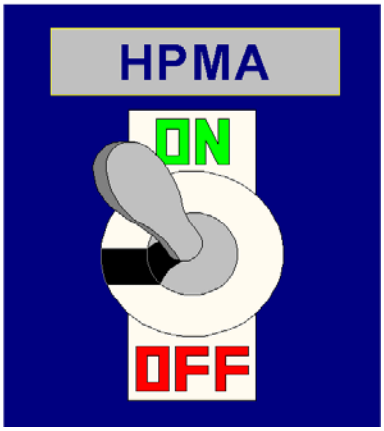
The importance of effective team performance cannot be over-stated. Ensure that your concept of team includes everyone that contributes to the success of the task or mission. Expand the boundaries – discourage "us vs them" attitudes. Research shows that this is one of the key attitudes that separate the very best leaders and team-members from the others. Work to maintain an appropriate authority gradient but encourage communication and feedback within the team.

The six critical team interaction skills are:

Team Interaction Skills

1. **Envisioning** - Provide a sense of vision to the team so. Everyone should be working towards the same goals
2. **Modeling** - Set an example
3. **Influence** - Work to gain the respect and trust of your team
4. **Receptiveness** - Ask for, and demonstrate that you are receptive to, feedback.
5. **Initiative** - Is critical and contagious.
6. **Adaptability** - Be prepared, anticipate and adapt.

Flipping the HPMA Switch to "ON"!



The overall aim of the HPMA program is to increase operational effectiveness through individual and team performance training. We tried to do that by:

- Providing you with the knowledge to improve performance in yourself and others – *it is up to you to apply it*;
- Providing you with the skills that will enhance human performance – *it is up to you to use, practice and perfect these skills*; and,
- Promoting a professional attitude towards military aviation – *it is up to you to maintain it*.

While our objective and tasking has been to provide you with skills and knowledge that you can apply "on the job", you have just learned some very valuable skills that can make you more successful and more effective at everything you do.

This is not the end of the HPMA program. It is just the beginning! The same concepts we have discussed in rather broad terms in these modules will be presented to you over and over again, but from this point on, you will apply these skills in a more precise, operationally focussed way. Threat and error management will take on a whole new meaning and importance as you begin working in the operational environment.

Looking into the future, some day you will be in a leadership position, you will then find that these skills are invaluable as you focus on improving the performance of your subordinates and developing their ability to make effective decisions, communicate effectively, integrate effectively into the team, etc. You yourself will then think about these things from a whole new perspective. Is fatigue a factor affecting Bloggin's performance? Is fatigue creating additional threat and likelihood of error? How can we avoid, trap, or mitigate it? Do my subordinates feel that I am receptive to their concerns/input?

We strongly believe that we have provided you with some of the best human performance skills available. We have laid the groundwork; it is up to you to make these skills your own. HPMA training is <u>not</u> "a silver bullet". The techniques taught in this program are only as good as the effort you make to apply and integrate them. The operative word here is "SKILLS". Just like physical skills, mental skills must be practiced and applied to in order to improve them and have them available when needed. <u>Use them or lose them</u>. If you make the effort to practice and implement the skills taught on this program on a daily basis, you will become more effective at everything you do – both on and off the job. Remember…

"We are what we repeatedly do. Excellence, then, is not an act but a habit."
- Aristotle

Human Performance in Military Aviation

Part 2

Tier 1 & 2 Implementation Guidance to Training Units

Reference: 1 CAD Orders, Vol 5, 5-303

Introduction

> "…simple fixes, such as a single CRM seminar, that only address a piece of the puzzle will not produce large and lasting change in crew (team) behavior."
>
> R. Helmriech, *The Future of CRM.*

The objective of the HPMA program is to improve individual, team and organizational effectiveness by making HPMA skill-sets and attitudes part of the Air Force culture. HPMA is not about providing quick fixes, silver bullets, or magic fairy dust. Simple fixes such as one-day seminars or once a year briefings will not provide meaningful, lasting improvement in performance. In order for HPMA to become part of the Air Force culture and have a meaningful impact on operational performance, HPMA must become an integral part of our operations and training. In our training establishments (TEs), course members need practice, reinforcement, continuous feedback, and good role models. The same also applies to the operational communities. It is assumed that much of our existing training already emphasizes the importance of HPMA concepts as Threat and Error Management, Decision Making, Communications, Situational Awareness, and Teamwork. HPMA provides the Air Force with a common frame of reference and approach.

Tier 1 HPMA (basic occupational training) and Tier 2 HPMA (operational training) are focused on providing new Air Force members with basic human performance skill-sets that can be applied on-the-job. This does not mean simply exposing them to the concepts over several classroom lessons. HPMA must be fully integrated into the day-to-day learning activities of the training unit.

At the reference, training establishments identified as responsible for carrying out Tier 1 and 2 HPMA training are directed to formally integrate HPMA content into their course Training Plans (TP) based on the directions outlined in this section of the HPMA Handbook. Unit Training Plans, particularly Chapters 2, 3, and 4 should be augmented, as required, to provide detailed direction to instructional and standards staff for program implementation.

Module Objective

The objective of this module is to provide direction for integrating HPMA concepts, skills and principles into Air Force Tier 1 and Tier 2 training programs.

Module Content

1.1 Program Integration

The HPMA program's primary focus is on improving performance in routine and non-routine situations that occur in military aviation. Training must reflect that focus. The intent of this program is to provide practical skills that support and enhance individual and team performance, resulting in increased operational effectiveness; therefore, it is critical that these concepts and skills be used and developed in realistic operational scenarios. Based on this, it should be clear that HPMA concepts and skills must be provided relatively early in the training program so that course members understand these concepts and recognize that they are skills which they will be given the opportunity to develop through practice and feedback in realistic operational scenarios throughout the course.

For Tier 1 HPMA training, the program is designed to be presented in the order and format provided in section 1 of this *Handbook*. It is not recommended that the HPMA modules be presented as a one-time session (i.e. all at one sitting); rather they should be spread out over the initial portion of the instructional program. Presentation of theory should be followed by practical application as soon and as often as possible. These early opportunities will prove valuable to student/apprentice development, helping them to grasp and master the skills in a carefully controlled environment.

For Tier 2 HPMA training, the basic content on the formal 2-day course does not have to be revisited. It is recommended, and assumed, that operationally relevant topics will be discussed/practiced to allow the student/apprentice the opportunity to employ HPMA skills and concepts in an operational setting. (NOTE: Central Flying School (CFS) will work with any training establishment to help develop such topics and offer assistance in developing specific training modules.)

1.2 Course Member Development

Ultimately, the goal is for course members to "internalize" these skills, that is, apply them habitually and independently. For this to happen, student/apprentice and instructor/supervisor interaction must gradually shift from an instructor-dependent process (where the instructor guides course members through the process, advises, and provides feedback on performance) to an independent process (where course members habitually apply the skills, self-analyze, and self-correct).

> As the course progresses, gradually shift the focus of responsibility from instructor to student. Shift from instructor-led analysis, direction of attention, feedback and reinforcement to student-led analysis. Over time, the student should be able to identify most of the main points, with the instructor raising any issues/points that the student did not identify.

The practical application of HPMA principles may be presented at any time during the training – classroom, case studies, small team tasks, part-task trainers, simulations, and, for aircrew, flights. Instructional staff should seize every opportunity to emphasize HPMA principles and to provide feedback as situations arise, whether planned instruction or real-life events. This continuous practice and feedback will enhance the student/apprentice's skill and knowledge and will assist in building the foundation of this long-term organizational change.

Development of HPMA skills falls into two principal areas:

1. Planned, scheduled instruction, (both classroom and practical); and
2. Opportunistic instruction, which seizes on opportunities presented by events (both within and outside the immediate training environment).

- ✈ <u>Planned instruction</u>:

  HPMA skills are not stand-alone concepts; rather they act as 'enablers' to support efficient and effective performance. HPMA skills should be developed as an integral part of course members' normal taskings. Training assignments provide controlled situations that naturally call for the application of skills such as threat and error management, decision-making, communications, teamwork, etc; however it may be necessary for the training establishment to adjust their instructional approach in order to ensure that all HPMA skills are being recognized and developed. In all cases, HPMA training and development should be incorporated into realistic, relevant training situations that also call on the member to use their occupational skills. It is also important that course members get to apply the skills in a variety of contexts, which increase in complexity and expectations appropriate to the level of student/apprentice experience. For example, in order to develop assertiveness and effective communications instructors may have to make

'intentional' errors in a controlled environment in order to provide course members with the opportunity to speak up. The training units shall ensure that the training plan provides opportunity for practice and feedback for these skills.

It is neither necessary, nor expected, that all HPMA topics will be covered in each training session. For example, some taskings may lend themselves to teamwork and communication elements and others to situational awareness and decision-making elements. The key is to identify which concepts are particularly suited to the training being undertaken and/or which concepts were particular relevant to course member performance during the course of the training exercises and scenarios.

- ✈ Moments of opportunity:

  Instructional staff must be ready to seize and take advantage of naturally occurring opportunities and events in order to demonstrate and expand on HPMA skills. Sample opportunities might include a miscommunication (either within the unit or elsewhere) between staff and students/apprentices, between trainees, a minor accident/incident, or a conflict in a group. While it may seem more convenient to utilize examples of ineffective performance, it is also equally as important to present positive examples of performance.

Instructional methodology:

The "Developmental Method" of instruction is generally the best method for presenting this type of material, both in the classroom and during practical exercises. Developmental instruction involves the instructor asking open-ended questions and using reasoning to allow the course members to work through the problem and arrive at their own solution. Initially, instructional staff may have to closely guide the course member by asking directed questions, critiquing responses, and providing feedback on performance. Gradually the course member(s) should be given, and accept, more responsibility for self-analysis and self-correction.

The instructor/supervisor is to serve the role of mentor, guiding the student/apprentice through the process, focusing on good points, weak points, and ways to improve. As with Tier 1 HPMA training, every opportunity should be used to practice the HPMA skills and concepts. It is important to highlight the importance of timely feedback during this Tier 2. Feedback is vital to the student/apprentice if they are to fully understand how HPMA applies to their job and/or roles and responsibilities.

Where possible, training should focus on the functioning of the member as part of the team rather than a collection of technically competent individuals. This may require some change in current training methodology. In addition, it is important that the boundaries of what constitutes the "team" be carefully expanded. The "team" member is anyone who has a contributing role in the success of the mission, including maintenance personnel, controllers, and aircrew. When appropriate, this

definition can be expanded further to include all agencies involved in the success of the mission, such as, logistics, maritime and/or land elements. Course members should be made aware that their behaviour during normal, routine circumstances can have a major impact on team performance during times of high workload or stressful situations. To the maximum extent possible, opportunities should be provided for members to practice their skills and to interact as members of the larger team.

1.3 Course Member Evaluation

HPMA skills and concepts should be a regular part of formal evaluations, student/apprentice debriefings, and the continuous, informal feedback provided during a course member's training. With regard to formal evaluation, Chapter 3 of unit Training Plans must be amplified to provide direction in the formal assessment of HPMA concepts and skills, that is, Enabling Checks (EC) and Performance Checks (PC). Existing PCs should be sufficient to support assessment of the HPMA skills; however it may be necessary to expand assessment checklists somewhat to ensure that HPMA skills are being evaluated.

HPMA skills can only be evaluated in conjunction with specific observable tasks. It is critical to understand that, when it comes to formal evaluation, a course member would not fail a performance check simply for "lack of situational awareness", for example. He/she would fail because a task was not completed satisfactorily, i.e., the performance standard(s) were not met. However, it is perfectly acceptable that performance analysis might find that 'lack of situational awareness' was one of the key contributing causes of poor performance. For example, a technician who tows an aircraft into a hangar door might be failed for 'improper towing technique leading to damaging the aircraft' and not for 'poor situational awareness'. However poor situational awareness might be one of the written comments on the progress report and one of the discussion points raised during the debrief.

HPMA skills must be evaluated alongside, or integrated into, existing assessment forms. Including HPMA skills in the assessment form will assist evaluators to identify those elements requiring comment. A sample HPMA assessment form is provided at (Annex A).

A key element of effective evaluation (both formal and informal) and performance improvement is student/apprentice debriefing. Debriefing should address both individual and team performance. It is expected that feedback on the course member's performance shall normally extend beyond technical ability, also addressing relevant HPMA factors, such as decision-making, team interaction, effective communication, etc.

Feedback directed to students must be attached to observed, measurable actions/behaviours.

As emphasized above, feedback directed to the trainee must be attached to observed, measurable actions/behaviours. Task successes and task failures should be analyzed in relationship to the HPMA skills. For example, if an individual asks a pertinent question at the appropriate time during a mission/task, the instructor should reinforce that by pointing out to the trainee that they effectively "PROBED" when the time was right. The instructor may then ask what the student/apprentice would have said if the "Probe" proved ineffective (i.e. would the trainee devise an effective "Alerting Statement" or a "Challenging Statement".) If the situation was potentially serious, the instructor could ask the student/apprentice how they would have employed the "Emergency Statement". Likewise, if the trainee failed to communicate effectively, the instructor could walk them through the "PACE" steps that could have worked in that particular situation. The same applies to the remaining HPMA skills. It would not be acceptable to criticize a trainee for lack of "situational awareness", or poor communication without specifically identify where exactly a problem occurred, what should have happened, and how to correct it in the future. In order to be effective, instructors need to know how to ask the right questions if they hope to understand a course member's thinking process. Feedback should identify course member strengths, weaknesses, and ways to improve.

There is no requirement that all of the elements identified on the checklist be debriefed on every mission/task. Some missions/tasks may lend themselves more to the development and evaluation of some HPMA skills than others. It is expected that instructors will focus on key HPMA elements that require particular emphasis.

With regard to informal, ongoing evaluation, the most effective feedback normally comes from individuals, or teams, debriefing themselves[1]. How much teams/crews learn during HPMA training, and take back to the operational environment, depends very much on the effectiveness of the exercise debriefings. Self-critique plays an important role in that development, and can often be more effective (i.e. lasting) than instructor critique. Thought provoking discussion is necessary so that individuals and teams can actively participate in the analysis, to sort out what happened and why, and from there develop strategies to improve performance. Team/crewmembers who actively discuss HPMA procedures tend to have more buy-in than those who are 'lectured' and thus are more likely to apply these concepts on the job. The instructor may have to vary his/her level of involvement to ensure important elements are addressed. As an independent observer the instructor will be able to add important points or correct any errors in perception that were not brought out by the course member(s) or other team members.

Critique should focus on overall team performance as well as individual performance. Be aware that teams and individuals may frequently be harder on themselves than the instructor would be. In some instances, instructors will have to act as moderator, guiding the debrief to ensure that the critique remains reasonable and constructive. Whenever possible, straight "lecturing" should be avoided. Instead questions such as, "What if you had done this…?" or "Why did you do it this way?" should be used to direct the process. Instructors must ensure that the debriefing experience remains

[1] Adapted from: *Facilitating LOS Debriefings*. NASA Technical Memorandum 112192 DOT/FAA/AR-97/6.

constructive, ensuring that performance strengths are identified and built on, as well as the performance weaknesses identified and addressed. Once the individual or team has completed self-analysis, the instructor should reinforce those things that were done well. Some areas may require additional one-on-one interaction and should be addressed in individual course member debriefs.

Some guidelines for debriefing course members are provided below[2]:

What You Should Do to Facilitate the Debriefing

- Set expectations for team/crew participation.
- Guide the session to the extent necessary to achieve the debriefing objectives.
- Adjust facilitation to the level needed to engage the team/crew to the maximum extent possible.
- Draw out quiet team-members.
- Ensure that all critical topics are covered.
- Integrate instructional points as needed into the team's discussion.
- Reinforce positive aspects of the team's behaviour.

What You Should Avoid Doing

- Avoid lecturing and having the debriefing become an instructor-centred session.
  - Long monologues or giving your own analysis and evaluation before allowing the team to work issues out for themselves pre-empts the team's own analysis and participation.
  - Avoiding lecturing does not mean you cannot teach, but you should teach through facilitation by integrating your own perspectives into the team's discussion. Rather than telling the team what they did wrong during the exercise and how they can improve, try to get the team to figure it out for themselves. If they discover what they need to work on by themselves, then they are much more likely to learn from their mistakes and carry that learning over to the line.

- Avoid giving your own analysis and evaluation before the team has completed their analysis.
  - Teams learn the most from their training experience when they make their own analyses. It is important that team-members learn to analyze and evaluate their own performance so that they can develop the habit of debriefing their own performance following line operations. If you give your analysis before the team does, the team will feel less responsible for making their own analysis. When a second instructor is playing the role of a team-member, he or she should participate as a team-member but should wait and give his or her analysis after the 'real' team-members have had the opportunity to analyze their

[2] Adapted from: *Facilitating LOS Debriefings*. NASA Technical Memorandum 112192 DOT/FAA/AR-97/6.

performance as a team. This does not mean that you allow the individual or teams to leave with any false understandings.

- Avoid giving the impression that only your perceptions are important.
  - You need to make it clear to the team that you are interested in what they have to say in order to encourage them to participate actively and analyze and evaluate their performance in depth. Avoid interrupting team discussion.
  - Interrupting shows a lack of interest in the team's views and may disrupt their train of thought and hinder their process of self-discovery. Interruptions also undermine the team's sense of responsibility for making their own analysis and evaluation. Rather than interrupting a team-member, try writing a note to yourself and then bring up your issue after the team-member has completed his or her comment. (Interrupting may be necessary if a team-member makes a statement contrary to Rules, Regulations or SOPs, is incorrect, or involves non-constructive criticism of another team member.)

- Avoid interrogation; be positive when discussing problems.
  - In order for the team to be able to take responsibility for initiating topics and discussing issues interactively, you must work to keep the discussion team-centred. Asking questions in a manner that resembles interrogation rather than guidance can hinder team discussion, forcing the team into a reactive, rather than a proactive, role.

- Avoid having a rigid agenda.
  - Have the team help develop the agenda to encourage them to identify areas in the exercise where they did well and/or need improvement. Keep the focus of the debriefing on topics introduced by the team, but introduce your own points as necessary to expand on team-initiated topics and to cover important issues not initiated by the team.

- Avoid short-changing high-performing teams by cutting their sessions short.
  - Do not assume that because a team did well there is nothing to talk about. Teams that perform well may not know why the exercise went well. Make sure that these teams recognize and discuss which HPMA techniques resulted in their positive outcomes so the team-members can transfer this knowledge to other situations, and to other team-members. Good teams can also learn from analyzing what they did well and *why* it worked. By analyzing their performance the team can learn what strategies were effective and how to use those strategies on the line. Team-members are more likely to transfer effective performance to the line if it has been reinforced by discussion. Make sure that positive performance is reinforced to ensure it continues!

It cannot be overstressed that more than anything else, HPMA is a learning experience. With the exception of Enabling Checks and Performance Checks, the

emphasis must be on developing skills in a supportive atmosphere. Inevitably, however some judgement must be applied in the assessment of HPMA skills. It is also critical that instructional staff is as consistent as possible in their approach.

1.4 Professional Development (PD) of Instructional Staff

A Professional Development (PD) program is required to ensure that all instructional staff understands the program requirements and that the unit is approaching HPMA consistently. The primary objective of the overarching HPMA program is that the concepts and skills become integrated into the everyday operational activities at the unit. Ongoing, regular PD events will ensure that the principles of HPMA are being continuously reinforced on the hangar, flight line, control tower, workshop, etc.

PD programs need to emphasize the following:

- HPMA should become something that is routinely and frequently discussed and debriefed at the unit.
- Instructional staff must model the desired skills/behaviours to reinforce HPMA concepts and skills.
- Instructional staff must understand the importance of seizing opportunities for reinforcing the HPMA concepts and skills.
- Instructors need to be competent in assessing and debriefing course members on HPMA issues in order to effectively develop course member skills.

1.5 Post Training Reinforcement

Training must be followed by reinforcement in the operational environment in order to create lasting change. Without reinforcement, the valuable lessons learned will not be internalized and will fade over time. The HPMA program is addressing this issue by promoting HPMA skills in the operational units (Tier 3 HPMA) as well as the training units (Tiers 1 & 2).

Annex A – Sample Maintenance/Aircrew/Aerospace Controller Assessment Form

An example generic feedback/assessment form is shown here. The "Technical Items" portion of the feedback/assessment form represents HPMA-related observable behaviours. It is not intended to be a complete list of technical items to be evaluated, rather how HPMA can be integrated into existing assessment tools. The actual "Technical Items" portion of an assessment would likely include many more aspects that relate to the specific mission/role. The "HPMA Content" portion provides HPMA-specific items that can also be evaluated during formal and informal opportunities. The intent of the "HPMA Content" section is to reinforce effective HPMA skills and provide constructive feedback on how to improve operational effectiveness.

Sample Assessment Form

Name:	Position:	Date:	Mission/Task:

Part I - Technical Items	Rating (see note)				NOTE: Items in this section can be used multiple times to reflect different sequences/events that occur during the course of the evaluation
	S	SD	U	N/O	Comments
Generic Items (can be applied to aircrew, maintenance, and aerospace controllers).					
Task/Mission Planning	☒	☐	☐	☐	
Contingency Planning	☒	☐	☐	☐	
Crew/Shift Brief – Complete – Delegation of Duties	☒	☐	☐	☐	
Checklist Procedures	☒	☐	☐	☐	
Task/Mission Execution	☒	☐	☐	☐	
Emergency Handling	☐	☐	☒	☐	Correct reaction to emergency XYZ took way too long due to inappropriate solicitation of crew input in this circumstance.
Crew/Shift Debrief	☒	☐	☐	☐	Excellent debrief – brought out the errors in emergency procedures. Identified strengths, weakness, and ways to improve.
Aircrew Specific Items					
Use of Autopilot	☒	☐	☐	☐	
Airmanship	☒	☐	☐	☐	
Maintenance Debrief	☒	☐	☐	☐	
Maintenance Specific Items					
Troubleshooting procedures	☒	☐	☐	☐	
Shift handover	☒	☐	☐	☐	
Effective paperwork tracking	☒	☐	☐	☐	
Aerospace Controller Specific Items					
Proper terminology	☒	☐	☐	☐	
Collision avoidance	☒	☐	☐	☐	
Lateral Spacing	☒	☐	☐	☐	
Vertical Spacing	☒	☐	☐	☐	

Part II - HPMA Content	Rating (see note)				*NOTE: Items in this section can be used multiple times to reflect different sequences/events that occur during the course of the evaluation*
	S	SD	U	N/O	**Comments**
Threat and Error Management – Avoid – Trap – Mitigate	☐	☐	☒	☐	Failed to trap emergency in part due to ineffectively communicating problem to crew and poor description of course of action decided on.
Decision Making – Awareness – Implications – Plan – Act	☐	☐	☒	☐	While Bloggin's was aware of the XYZ malfunction almost immediately, he made a poor decision to seek input from crew when time was critical. He should have known the correct actions to perform and acted on them.
Individual Human Factors – Identify & Recognize Stressors/Fatigue – Managed Stress/Fatigue – AMISAFE	☒	☐	☐	☐	
Rules, Regulations, and SOPs – Knowledge of rules, regs, SOPs. – Application (role knowledge) – Purposeful Departure (a/r)	☒	☐	☐	☐	
Communications – Inquiry – Advocacy/Assertion – Active Listening – Conflict Mngt / Resolve Discrepancies – Feedback – "PACE" Application – Clearly established objectives	☐	☐	☒	☐	Communications were ineffective during the XYZ emergency procedure. The short time period available to react to the emergency required immediate directive action – Emergency - rather than an inclusive approach.
Situational Awareness – Perception – Comprehension – Projection – Maintains/updates SA – Recognize/Recover from low SA	☒	☐	☐	☐	
Task & Workload Mngt – Manage Time, Attention, and Knowledge. – Effective Delegation/Supervision – Effective Prioritization – Goals clearly communicated & aligned.	☐	☐	☒	☐	At times, Bloggins did not make effective use of the other crewmembers. Certain individuals were becoming overwhelmed with the number of tasks and the workload was not distributed among the other members of the team. This was particularly evident during the XYZ emergency procedure as several items were missed by team member X.
Team Performance – Envisioning – Modelling – Influence – Receptiveness – Initiative – Adaptability	☐	☒	☐	☐	Despite problems noted above, Bloggins did provide a sound vision of what they were trying to accomplish and promoted good crew interaction skills. He is well liked, but had difficulty adapting to changes in the mission profile that resulted from the emergency procedure XYZ.

NOTE:
S – Satisfactory
SD – Satisfactory with Debriefing
U – Unsatisfactory
N/O – Not Observed

Annex B - Tier 2 Engineering / Maintenance Training Coordinators Guidance

Overview

Tier 2 HPMA is designed to provide opportunities for practice and feedback. For Engineering (AERE MOC 41A) and maintenance (AVN MOC 514, AVS MOC 526 and ACS MOC 565) personnel, the Tier 2 program will consist of 4 self-study modules, combined with routine feedback during daily activities. The training modules are contained in the Human Performance in Military Aviation (HPMA) Maintenance Tier 2 On-The-Job Training Program (OJTP) Handbook (NDID A-PD-050-HPM/PT-003). A similar handbook (NDID A-PD-050-HPM/PF-001), labelled "Supervisor's Copy," has been produced for supervisors, containing additional reference material and discussion suggestions. The Supervisor's Copy is a controlled document and must be safe guarded from wide distribution yet still accessible to personnel other than apprentices.

Pre-Requisite HPMA Training

AERE Officers and Maintenance Technicians will normally receive Tier 1 HPMA while at CFSATE Borden. However, some Direct Entry or civilian-trained personnel may not have received Tier 1 training. All candidates should receive Tier 1 prior to commencing the Tier 2 portion of HPMA training. As a result, some AERE Officers and Maintenance Technicians may require Tier 1 Bridge training, which can be carried out by any qualified HPMA Coordinator.

Program Objective

The overall objective of this Tier of training is to develop the individual's HPMA skills, taught during Tier 1, through actual employment and other realistic training scenarios. Each of the four OJT modules cover important aspects of a junior officer or technician's job, highlighting the importance of HPMA in their daily activities. Each module includes one or two case studies in which the trainee will have the opportunity to work through various scenarios, indicating how HPMA could be used to optimize performance. The intent is for the trainee to complete the package on their own and then meet with and discuss their responses with their supervisor. Rather than focussing on the “correct” textbook response to a scenario, the trainee will benefit from direct interaction with their supervisor, who's personal perspective and operational insight will help the apprentice to build upon their initial HPMA training. Supervisors will be given access to the "Supervisor's Copies", which contain suggested responses to the questions posed in the Student manuals. The purpose of this is to give the supervisor additional background material to assist them in mentoring the student and guiding them through the various scenarios. During the debrief sessions, supervisors are encouraged to build upon the "text book/staff

responses" and share their personal perspective, experiences and operational insight to bring additional value to the discussion.

Training Methodology

HPMA Training Coordinators are responsible to their respective Squadron Commanders for initiating and tracking the Tier 2 training of junior officers and maintenance apprentice technicians as per the following:

Junior AERE officers or apprentices shall begin the Tier 2 HPMA training package upon arrival at their first operational posting. The Tier 2 package is not to be completed in one session or done in a very condensed period. The first module should be assigned approximately 3 – 4 weeks after arrival at the unit. Subsequent modules shall be assigned every 4 – 6 weeks thereafter. This will permit the technicians to gain adequate operational exposure and experience with which to relate to each module. This will allow the trainee time to assimilate and relate better to the material as they gain familiarity with their new working environment and their experience level increases.

Squadron Training Coordinators shall issue Human Performance in Military Aviation Maintenance Tier 2 On-The-Job Training Program manuals (available by download from the HPMA Web site at http://winnipeg.mil.ca/cfs/hpma/HPMA_Downloads_Tier_1_e.htm) to apprentices. Supervisor Copies of the Tier 2 Manuals should be treated as controlled documents to prevent their contents from being compromised. As a result, Supervisor Copies shall be issued only when required.

Tier 2 trainees will be directed to complete the first module by reading the apprentice section and accompanying case studies, and then answering the Focus Questions. Once completed, the trainees will then discuss their answers with their supervisors. The supervisors have the post-module discussions to lead. These debriefs will be conducted in conjunction with the suggested follow-up questions in the back of the Supervisors Copy of the module. This will allow the supervisors the opportunity to both add their own experiences, advice and perspective in a mentoring-type role as well as making the material relevant to their specific working environment. For Junior AERE Officers the expectation is that the SAMEO or equivalent assigned mentor will conduct the debrief sessions.

Supervisors must familiarize themselves with the "Supervisor's Copies" in preparation for the debrief sessions. Debrief sessions could be either "one on one" or group/crew sessions. This is also an excellent opportunity for the supervisor to extend an invitation to senior Sqn personnel to address the apprentices after the completion of the specific OJT debrief. Given this opportunity to participate, the SAMEO, Sqn CWO and/or Senior MWO's can provide their personal perspectives on the role and duty of the apprentices as well as specific guidance on issues and expectations for the future.

Training Records

The following MITE Course Identification Codes have been assigned to the specific Tier 2 Maintenance Modules:

Maintenance Module	MITE Course ID Code
Module 1	115660
Module 2	115674
Module 3	115675
Module 4	115676

Each of the modules, which must be completed in sequence, is a prerequisite for the following module. Upon completion of each module, the associated MITE Course Identification Code for the module will be granted through the Unit ETO. After sufficient time has passed, the next module shall be assigned to the apprentice and the whole process repeats until all modules have been successfully completed.