MODULE 2	**THE DECISION-MAKING PROCESS**
OBJECTIVE	**At the end of this module, the participant will be able to describe the decision-making process.**
TRAINING TIME:	**60 minutes**
KEY TEACHING POINTS:	**THE MODEL OF PILOT PERFORMANCE** **DECISION-MAKING PROCESS** **PILOT PERFORMANCE LEVELS** **FACTORS**

[Slide # 1 at opening]

LINK

The process by which tasks are performed typically follows four steps:

1. Gathering of information;
2. Processing information;
3. Making a decision; and
4. Acting on that decision

Often, while acting on a decision in step four, more information may be gathered and the process is repeated. Simple enough. But each step is fraught with challenges that, to the unaware, may lead to bad decisions and possibly bad outcomes.

AIM

The purpose of this module is to examine decision-making in this process, its issues and challenges.

MOTIVATION

Some decisions are arrived at rather easily, others less so. The brain is sometimes quick at processing, other times slow. Training and practice play an important role in the outcome.

In the dynamic environment of flight, the types of decisions that must be made and the time with which the brain must process information in order to make a decision vary greatly. It is, therefore, important to understand the decision-making process in this context.

[Slide # 2]

OUTLINE

1. The model of pilot performance
2. Pilot decision-making process
3. Pilot performance levels
4. Factors

[Slide # 3]

1. The "Model of Pilot Performance".

As mentioned earlier, the process by which tasks are performed typically follow four steps:

Human Factors For Aviation—Basic Handbook, page 6

- Gathering information;
- Processing information;
- Making decisions; and
- Acting on those decisions.

Human Factors For Aviation—Basic Handbook, page 7

Actions cause things to change, and the process is repeated. Moreover, things rarely happen sequentially; many occur simultaneously.

Information Gathering: The pilot gathers the information needed for flying largely through the senses.

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There are, however, risks during this phase of the process:

(1) The information may be wrong, distorted or incomplete; or
(2) The senses gather the correct information but then it is subconsciously misinterpreted.

In both cases, the pilot uses incorrect information in the decision-making process. Obviously the less accurate the information, the more likely it is the pilot will make an ineffective decision.

Information processing: The brain processes the available information. Among the important factors are the pilot's abilities to:

- Take in all information;
- Choose from two or more items simultaneously;
- Discriminate between relevant and irrelevant information; and
- Switch rapidly between tasks that need to be handled at the same time (e.g., between flying the airplane safely and solving an in-flight emergency).

The risks during this phase of the process are:

(1) Attention may be concentrated too heavily on one task to the neglect of others;
(2) An important change in what is being attended to (e.g., checklist item) can be missed;
(3) The pilot's failure to use the best available information or to validate the information by crosschecking.

Decision Making: While this may be viewed as part of the information-processing phase, it is influenced by factors that do not affect the direct processing of information.

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Human Factors For Aviation—Basic Handbook, page 8

Accurate data may have been gathered and processed, but the quality of the decision may be influenced by a wide range of factors—from general social or emotional pressures to specific conditions. These will be explored further in the next module.

Implementing Decisions: This phase deals with the pilot's ability to implement the decision made in the third. Even if the pilot makes the correct decision, problems can still occur if there are factors that detract from the pilot's ability to act such as fatigue, drugs, or hypoxia.

[Slide # 6]

2. The Decision-making Process.

Types of decisions.

There are many approaches to decision-making. While all good, some are insufficient for the pilot where decision-making varies according to the amount of time available. In this, there are two types:

(1) Ample-time decision-making; and
(2) Time-critical decision-making.

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A Basic Model of Decision Making - ample time.

Human Factors For Aviation—Basic Handbook, page 141

Decision-making can be seen as starting with awareness of a situation that requires a decision. The awareness is achieved through the gathering and processing of information.

The next step is to identify and evaluate options, which calls for more processing and sometimes more gathering of information.

Finally, we choose. Having made a decision, we act on it and evaluate the results.

Step One: *Situational awareness* refers to the pilot's awareness of all the information relevant to the current situation.

It is one of a pilot's most potent defences against unexpected difficulty and also helps prevent small mistakes from linking up with others to form a chain of errors. To exercise it well requires:

- Knowledge; and
- Vigilance.

A problem is a deviation form the norm. To recognize a deviation, one must first have **knowledge** of the norm itself. In order to know when things are going wrong, you have to know how things should be.

Knowledge is of little value without **vigilance**. A pilot must continuously remain alert, not only to what is happening, but also to what **may** happen. Vigilance, however, is difficult to sustain when you are tired, sick, preoccupied or otherwise under stress.

Step Two: Evaluating Options consists of three components:

- **Diagnosis:** having identified a problem, you have to diagnose it accurately. This process may require all your resources (knowledge, memory, problem-solving and information-processing skills).

- **Generating solutions:** this requires both knowledge and creativity, which can be difficult to muster under stress.

- **Assessing Risks:** for each of your potential solutions, assess the associated risks in terms of consequences (severity) and the likelihood (probability) of failure or success.

The evaluation phase is analytical and should not to be associated with any emotion. Try to **keep a cool** and avoid clouding options with false hopes or assumptions. This is easier said than done, especially when the situation is dangerous or requires immediate decisions. When fear and anxiety are present, rational thought can be very difficult.

Step Three: Choosing from the Options. Select the solution that presents the best outcome for the conditions. This may not be easy since some of the alternatives may offer only a chance of success, rather than certainty.

Step Four: **Start Again.** The moment you make a decision and act upon it, the cycle starts over. Maintain or seek to regain your situational awareness so that you can evaluate whether the course of action brings relief or not.

During routine, familiar work, we know the normal flow of activity and the alternatives available to us by heart. If the situation is familiar, we don't need to consult all the options before doing something. Instead, guided by the path of least resistance, we seek only the information that is needed to act. However, if the work is not familiar or routine and we choose to rely on the usual cues, the potential for error is high.

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Decision Making - time-critical.

Human Factors For Aviation—Advanced Handbook, page 90

In the case of wind shear or loss of an engine on takeoff or final, there is no time for generating and evaluating options. Decisions have to be made quickly on the basis of past experience, either real or simulated training. Thus, the time critical nature of decision-making determines the solution.

Generally, there are three categories of **time-critical** problems:

- Rule-based problems - problems are well defined and have clear solutions (e.g., engine failure before V_1);
- Well-structured problems - problems are well defined and have previously formulated solutions such as a checklist or standard operating procedure (SOP); and
- Ill-structured problems - problems do not have a standard response prepared (i.e., difficult to anticipate)

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Mode of Action

Managing the Risks of Organizational Accidents, –page 68–70

There are two modes in which actions take place:

- The *conscious*; and
- The *automatic*.

The **conscious mode** is restricted in capacity, slow, sequential, laborious, error-prone, but potentially very smart. This is the mode we use for *paying attention* to something. But attention is a limited resource; if it is focused upon one thing, it is necessarily withdrawn from other things.

The **automatic mode** of control is the opposite. It is largely unconscious. The automatic mode is virtually limitless in its capacity. It is fast and operates at many levels simultaneously It is effortless and essential for handling the recurrences of everyday life.

It knows only what it knows, however, and is not a problem-solver. Naturally, we prefer to operate in this mode whenever possible.

[Slide # 10]

3. Pilot Performance Levels

As much as pilots prefer the automatic mode of action, they are perform at three different levels:

- Skill-based;
- Rule-based; and
- Knowledge-based.

Skill-based—routine, highly practiced tasks are carried out in a largely automatic fashion with occasional conscious checks on progress.

Rule-based—a rule-based approach is taken when a need to modify a pre-programmed behaviour is noticed. This situation is likely to be one that we have encountered before, or been trained to deal with, or is covered by procedures.

It is called *rule-based* because we apply memorized or written rules of the kind – "if this then do this." Applying a rules-based approach may be automatic by matching the signs and symptoms of the problem to some stored knowledge. We may then use conscious thinking to verify whether or not this solution is appropriate.

Knowledge-based—Only when we have repeatedly failed to find some pre-existing solution do we resort to the slow and effortful business of thinking things through. Given time and a forgiving environment to indulge in trial-and-error, we often come up with good solutions. But people are not usually at their best in an emergency.

Often, our understanding of the problem is patchy, inaccurate or both. Furthermore, consciousness is very limited in its capacity to hold information; it can store no more than two or three distinct items at a time. In addition, we can be plain scared, and fear, like other strong emotions, has a way of replacing reasoned action with 'knee jerk' or over-learned responses (e.g., Swissair).

It must be emphasized that these performance levels are not mutually exclusive. All can coexist at the same time.

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4. Factors

Novice/Expert Differences.

Novice pilots may more often find themselves having to create a solution rather than simply applying a procedure. For example, there have been several instances where inexperienced pilots found themselves in difficulty trying to close an open door in flight instead of concentrating on flying the aircraft. There is a double jeopardy here. Because novices are less able to recognize and accurately interpret a situation, they are more often forced into knowledge-based behaviour. But their knowledge base is less than that of a more experienced pilot, so they are more likely to make knowledge-based mistakes.

On the other hand, there are many examples of experienced pilots using knowledge-based behaviour to find creative solutions to seemingly impossible situations for which no rules exist; witness the United Airlines DC10 accident at Sioux City, Iowa.

Rule-based behaviour problems are also possible. If a rule or procedure is imprecise, the novice can invoke a bad rule or misapply a good rule. For example, if the engine fails after takeoff, you should land straight ahead unless you have enough altitude to turn safely. From the point of view of the novice, this is imprecise. What is *enough*? It is unrealistic to think that a rule can be developed for every eventuality, but rules can be developed for the most likely situations so that the novice will know what to do.

Using the Wrong Cues

There is a natural tendency to refrain from using all the information available in a given situation. Instead, we expect certain cues and use those cues to quickly confirm our assessment of the situation and take what appears to be the correct action.

Worse, once we make an assessment of a situation, we tend to resist changing the assessment, even when faced with compelling evidence.

Training and experience influence choices because people are prone to use plans and procedures that have worked in the past. Perception of the prevailing practices of other pilots around us may influence the choices we make. Also, regulations designed to promote safety often limit the number of alternatives by prescribing or prohibiting certain actions.

Once a plan is adopted, there is a strong resistance to deviating from or changing the plan. The tendency to persevere with a plan is very compelling, even in the face of what would objectively be judged as evidence that the strategy is inadvisable. Previous success with the same plan would increase the probability of perseverance.

Memory

Memory is fundamental to decision making. As pilots, it is essential that we are able to remember certain types of information.

Human Factors For Aviation—Basic Handbook, page 31

There are 2 types of memory.

- Long-term; and
- Short-term.

Long-term Memory

One of the most remarkable aspects of the brain is long-term memory, its capacity to store information over long periods of time. Sometimes we get information into long-term memory by intent; that is, through study or repetition. Other times, we remember things unintentionally, such as what people and places look like or how something smells.

What happens to information in long-term memory? Some think that as time passes some of this information disappears or decays if it is not used. “Use it or lose it” is the saying.

Others suggest that, once in memory, information is permanently stored, but over time

we just find it increasingly difficult to access.

Unless we use it, information in long-term memory becomes increasingly difficult to recall. That is why it is important to keep current. The more time that elapses, the less likely you will retain proficiency and the more likely you will be to forget important information or procedures.

Short-term Memory

Short-term memory is used to store information received in the very recent past, usually no more than the previous 30 seconds. It has a small capacity (usually about seven unrelated items) and loses information very quickly unless it is used or transferred to long-term memory. When the tower gives you a clearance with six or more items, for example, you are unlikely to remember it all without writing it down. If you rely on your memory, the chances are good that you will forget or distort some of the information given you.

Interference and **distraction** are factors that reduce a pilot's capacity to remember and use information in the decision-making process.

REVIEW

The objective of this module was to examine the decision-making process, its issues and challenges.

To achieve this objective, we explored 4 topics:

- The model of pilot performance;
- Pilot decision-making process;
- Pilot levels of performance; and
- Factors that can affect the decision-making process.

[Slide # 12]

The process by which tasks are performed typically involve:

- Gathering information;
- Processing information;
- Making decisions; and
- Acting or implementing those decisions.

The pilot decision-making process usually involves 4 steps:

- Situational awareness;
- Evaluating options;
- Choosing from options; and
- Start again.

The speed with which pilots can follow this process will depend largely on the time criticality of a given decision-making situation. When ample time is available, pilots may have to operate in the conscious mode whereas in time critical situations, the automatic mode prevails.

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As much a pilots prefer to operate in the automatic mode of action, depending on the decision-making situation, they will perform at three different levels:

- Skills-based;

- Rule-based; or
- Knowledge based.

The ability to perform at optimum levels is related to factors such as:
Experiential differences (the novice v expert);
Use of the wrong cues; and
Limitations to both long and short term memory.

LINK

In the next module, we will explore those factors that can further influence the decsion-0making process.