The Global Voice of Pilots

IFALPA

BRIEFING LEAFLET

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Enhancing Pilot Monitoring

The International Federation of Air Line Pilots' Associations (IFALPA) recognizes the critical roles of Pilot Flying (PF) and Pilot Monitoring (PM) as foundational elements in flight deck operations. While the aviation industry has established clear definitions and responsibilities for these specific **roles**, IFALPA advocates for a renewed focus on the monitoring **tasks** associated with both the pilot flying and monitoring positions during all phases of flight. This leaflet aims to highlight the pilot monitoring **tasks**, supporting flight safety and operational efficiency, and introduce tools for enhancing its effectiveness in the cockpit.

The PM **role** ensures a systematic and safe approach to flying by enhancing situational awareness, cross-checking for errors, handling communication, and supporting the decision-making process. As a **task**, monitoring requires the flight crew to observe, interpret, and understand all relevant flight information, adapt to changes, communicate deviations, and intervene when necessary. These two aspects serve as the foundation for ensuring flights operate safely and securely.

This briefing leaflet introduces a theoretical background on human perception, cognition, and a model of situational awareness for pilot monitoring tasks. It then describes five tools designed to enhance monitoring effectiveness and their real-world applications. The reader is invited either to review the complete document or to review the tools individually, with references to the theoretical background where necessary.

> IFALPA DEFINES MONITORING AS:
>
> *"The process of observing and creating an understanding (shared mental model), by seeking out the available information to compare actual and expected state. The purpose of monitoring is to support meaningful action."*

THEORETICAL BACKGROUND

To understand, enable, and teach good monitoring skills, a basic understanding of human perception and information processing is needed. This section summarizes some of the necessary underlying concepts.

COGNITION

Basic cognition: Humans perceive their environment through sensory stimuli (auditory, visual, olfactory, tactile, etc.) that are detected by our sensory organs. At any given moment, many stimuli are detected at the same time. In order not to overload the conscious mind, the brain filters these stimuli; only allowing certain stimuli to be recognized and understood by our brains. This recognition is often described as a “flashlight” of attention where we focus attention only to perceive certain stimuli and make them available for enhanced processing as well as available in our conscious cognition.

Some processes do not require our conscious attention but will change our cognition. Stress and anxiety change the way we perceive our environment. A simple conceptual model, (although evolutionarily incorrect), called the Triune Brain, suggests that our brain works in three different layers:

1. a **Reptilian Brain**, which is comprised of the oldest parts of our brain, the brain stem and cerebellum, which govern instinct and automation. This, for example, senses body temperature and regulates accordingly to allow for automated activity like riding a bicycle on “autopilot mode.”

2. The second layer is known as the limbic or **Mammalian** brain. This comprises parts of the brain that play an active role in emotional cognition and regulations of memory. An example of this is advanced processing and reaction to fear. This is due to the evolutionary need for quick reaction and survival. In addition to fear, this layer is known to control other specific emotions.

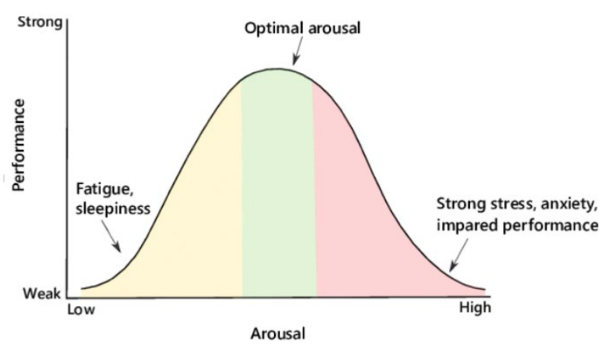
3. The last layer is known as the **Cortex**. The Cortex houses complex thought processes (abstract thinking, planning, attention, language, etc.). Within this model, the three layers can influence each other and take control of a lower layer. A fear reaction, for example, can draw attention resources to whatever stimulus is perceived as threatening and initiate fight-or-flight-reactions in the reptilian

brain even before the Cortex has had a chance to process and contextualize the stimulus.

Although this model has been shown to be evolutionarily inaccurate and overly simplistic, it is helpful as a conceptual tool to picture complex processes and understand the demands for attentional resources in human perception. This struggle eventually determines which perceived stimuli become conscious cognition and make up our perceived reality. Therefore, it is important to understand that emotions and basic instincts can sometimes “take a shortcut” to our cognition and influence the way we perceive our environment and where we place our attention.

MULTI-TASKING

Most theories assume a "bottleneck problem" with perception and attention, meaning there is a limit as to how many processes can run at the same time. That also means that multi-tasking has limitations, as two or more tasks compete for the same finite resources. There are “switching costs” to switching between tasks, notably a time lag in processing the task compared to only executing one task at a time. The more automated a task is, the faster the switching works. Surprising or new tasks will interfere with executing other tasks.



AROUSAL AND PERFORMANCE

Two interlinked factors further influence cognitive processes. The Yerkes-Dodson Law supposes an optimal level of arousal, which can be understood as a state of being physiologically alert, awake, and attentive. This law states that too little arousal diminishes performance due to boredom, whilst very high levels of arousal diminish performance due to a sensitivity to emotions. Optimum performance can be achieved at medium arousal levels.

This leads to stress and its effects on perception. Stress triggers a wide array of bodily reactions that prepare the body for action. The sympathetic system activates and initiates the release of hormones like epinephrine (adrenaline) and norepinephrine (noradrenaline) as well as adrenal steroids like cortisol. This increases the arousal level and might push it beyond the optimum performance level.

MENTAL WORKLOAD

Hancock and Caird (1993) developed a model of Mental Workload to predict workload depending on different variables. They argue that mental workload is dependent on an individual's **distance** from a task goal as well as from **effective time** for action and the individual's **effort** on the task.

Their model predicts workload to rise with greater distance to a task goal and less effective time for action. Effort as a variable can counteract some of the higher workload and influences performance but has its limits.

The distance from a task goal is not meant literally, although this could be partly the case in aviation, but figuratively. It describes the individual's perception of how much needs to be done to finish a task, with tasks often having start-, mid- and end-points that define them (e.g. an abnormal procedure).

At the same time, effective time for action is a subjective value that relies on the individual's perception of it (e.g. preparing an approach in normal flights vs. approach preparations during a smoke/fire abnormal may have very different perceived time constraints).

Therefore, mental workload is highly dependent on the individual's perception of the situation. The latter being dependent on experience, knowledge, and skill.

Hancock and Caird postulate different levels of mental workload: a stable workload is perceived as having enough time to finish the task whilst reducing the distance from the task goal. With further distance from the task goal and less time for action the level moves towards an unstable load level. At stable workloads the individual can achieve the task goal through many different strategies, whilst at high workloads the number of available strategies is highly restricted. This mental overload leads to stress and opens room for error.

A shared mental model, as described in the next section, can help to compare perceptions and either adjust perceived time for action, adjust distance from the task goal, or take action to finish the task in the available time.

SITUATIONAL AWARENESS

The perceived environment that becomes cognition and its representation in the pilot's mind leads to a concept known as situational awareness.

> Good Situational Awareness leads to decision-making that will initiate actions to manipulate the situation toward the desired outcome.

Endsley (1995) describes a theoretical model for Situational Awareness in dynamic human decision making, like in aircraft operations. In this model, Situational Awareness forms the basis for decision making and performance of actions to affect the environment according to current goals and objectives. Situational Awareness itself consists of three elements:

1. **perception** of elements in a current situation,
2. **comprehension** of the current situation, and
3. **projection** of a future state.

The first step in building Situational Awareness is to perceive relevant elements in the environment, e.g., engine display parameters or wind speed and direction from a respective display. That information then must be comprehended and put into perspective in light of the pilot's goals (e.g. safe flight from A to B). In this way, a holistic picture of the situation is formed that interprets available data and puts it in context. From this point, the highest form of Situational Awareness consists of the ability to project future actions of elements, e.g., performance changes when passing a strong inversion or possible shear potential when comparing ground wind with current winds.

Endsley goes more into detail on how Situational Awareness is achieved. Situational Awareness is restricted by limited attention and working memory capacity. Within a feedback loop (see figure above), working memory and long-term memory influence the perception and interpretation of information. Advanced knowledge as well as experience in an environment allows for expectations to be applied to a given situation. Information can be processed faster according to those expectations.

One way to align the preconceptions of the flight crew on what is about to happen is through briefings. Information in agreement with expectations will then be processed faster whilst unexpected information is more prone to erroneous processing.

As noted by Endsley, many incidents stem from a **failure to perceive** critical information. In these scenarios, debriefings serve as a tool to analyze and understand lapses in situational awareness. This can help crews and instructors pinpoint where the breakdown in situational awareness may have occurred, such as lapses in accurately **understanding** or **projecting** the situation.

The model defines two concepts: **Schemes** and **Scripts**.

Schemes are frameworks used to interpret information coherently. They are derived from experience and stored in long term memory.

Scripts are a sub form of schemes which provide a sequence of appropriate actions. A mental model can be described as a complex scheme to model a system's behavior. All of these are stored in long term memory and can help to conserve the resources of our working memory by quickly leading to decision making after recognizing relatable system behavior.

The key to using mental models, schemes, and scripts rests on the ability to recognize critical cues in the environment that will link to key features in the model. An individual with a good mental model can then very quickly match stored information with current environmental information to find the right mental model, scheme, or script. This ability is a function of training and experience as the outcome of actions will facilitate learning and change scripts, schemes, and mental models in long term memory.

Situational Awareness is further influenced by a person's goals and expectations. Goals direct attention to specific elements which heightens Situational Awareness and should lead to actions in line with the goals. At the same time this may prevent the perception of contradictory information due to limited attention. Should actions not yield the desired outcome, this can indicate that the current plan or goals aren't working and need to be changed. Both processes work as a feedback loop on SA, also affecting the mental model.

In systems with more than one operator, like flight decks, mental models can be compared and become a **shared mental model**. This can help to increase Situational Awareness for all operators as the shared mental model as well as shared goals and expectations influence perception of information.

STRESS AND ERRORS IN SITUATIONAL AWARENESS

Stress, physical as well as social, negatively impacts SA. Though small amounts of stress may help Situational Awareness by raising arousal levels, higher amounts of stress limit the attention field, also known as *cognitive tunnel vision* (Sheridan, 1981, as cited in Endsley, 1995).

Negative effects of stress can include a reduction in the ability to absorb and process information for decision making, attention resources focus on negative information, and the ability to scan for other stimuli is diminished. Stress also negatively affects working memory capacity and retrieval which can lead to workload overload. When workload demands exceed an individual's capacity, Situational Awareness will suffer. That is particularly true for very complex systems, these include a higher number of elements that need to be perceived, a high number of system components, and the dynamics of possible interactions between systems.

Automation can help to reduce workload; at the same time, it may reduce manual skills and therefore increase workload during automation failures. Automation may also lead to a loss of vigilance and an increase in complacency. This changes the feedback loop for SA, as the pilot has been reduced to a passive recipient of information, if the relevant information is presented to the pilot at all.

Errors in Situational Awareness can occur in all three stages of SA: perception, comprehension, and projection. At the perception level a person can simply miss information that would be relevant to a situation. Humans rely strongly on visual information so that stimuli from other senses are less likely to get processed. In this context, the pilot might believe that they have perceived all relevant information although there is no way to be certain. At the second level of SA, comprehension, the pilot might not be able to comprehend the meaning of the perceived data or might not match the data with the appropriate mental model. At the third level, projection, a pilot may apply an incorrect scheme based on the information they comprehend and inaccurately project the likely outcomes.

FIVE TOOLS TO ENHANCE PILOT MONITORING

Tool #1 – Managing Attentional Resources

Concept

The concept for this tool revolves around the essential skills of managing attentional resources in the dynamic and complex environment of a cockpit. Pilots are required to navigate a multitude of stimuli, e.g. air traffic communications, weather conditions, and the status of aircraft systems. The key to effective monitoring is the strategic allocation of limited attentional resources to elements deemed most critical in any given situation. This skill is enhanced through a combination of standard operating procedures (SOPs), relevant experience, and training.

These guide pilots in prioritizing tasks and focusing their attention effectively. Briefings are crucial in this process; they serve not only to identify priority areas but also to establish a shared mental model between pilots. A concise briefing maintains focus on potentially critical aspects of flight.

Operational Implementation

Managing Attentional Resources

Considering that humans have limited attentional resources, it is crucial to first assess the overall volume of workload pilots can handle, ensuring it aligns with the demands of the specific situation. The nature of the flight, whether it is a long-range single leg or consists of multiple short legs, significantly influences this workload management.

Various factors come into play depending on the flight operation type. For example, during line training, a trainee pilot, being relatively inexperienced, will naturally consume more attentional resources than a highly experienced colleague. Mitigating this involves quality training and the instructor's ability to tailor the workload, allowing trainees to maintain focus and attention suitable for their assigned flights.

Managing Perception of Identified Threats

In managing the perception of identified threats with a Threat and Error Management (TEM) approach, efficient crew strategy relies on developing a Shared Mental Model. This model is crucial for effective flight path management by the Pilot Flying (PF) and for diligent monitoring by the Pilot Monitoring (PM). The importance of an effective briefing is underscored here, when a threat is identified during a briefing the crew can strategize for its detection and response, should it become a reality.

Long-Term Feedback Loop

Debriefing sessions should always be used to underscore the crew's effective performance, even for unremarkable flights. This encourages crew members to develop and maintain a set of effective strategies and practices. By focusing on what was done well during uneventful flights/training session, such a debriefing approach not only highlights successful actions but also promotes personal growth in areas like self-awareness, self-confidence, and resilience. These contribute to a long-term feedback loop to improve responses in the future.

Debriefing of Situational Awareness Degradation

It is essential to recognize that not all necessary information may be available in each situation and there is a risk of focusing too narrowly on specific details (tunnel effect). Effective debriefing requires open communication among all crew members, including the instructor, to collectively address and learn from these situations. This process necessitates strong communication skills from all participants, acknowledging the inherent limitations of the available tools and methods, with the limits described in Tool #5 below.

Practical examples

Managing Attentional Resources

Consider a four-leg line training day: depending on the progression of the trainee, the instructor can facilitate the attention management of the trainee. This can be done by choosing PF legs and the level of automation accordingly, or for PM legs the complexity of airports flown.

Managing Perception of Identified Threats

A briefing is performed for a landing with a strong variable crosswind. A threat for this approach is that this crosswind component may turn into a tailwind component exceeding the aircraft limit. Therefore, the pilot monitoring is asked to pay extra attention to the tailwind component during the approach and call out if the maximum tailwind component is exceeded.

Long-term Feedback Loop

A threat from specific meteorological conditions at the destination was identified during the briefing. A mitigation strategy to be able to detect potential wind variation was set by the crew with an emphasis for PM to give specific attention to the navigation display. ATC reported winds at the maximum allowable so and additional mitigation was added by deciding a maximum value for PM to call for a go-around (i.e. knowing the Vapp an acceptable value of wind is added to have maximum GS, both pilots agreed that the value was to be red on ND display. Should the value be exceeded the crew also agreed on the height below which the G/A call will be made by PM).

During approach, wind variation was detected and announced by PM. This was taken into account by the PF, allowing them to maintain the flight path within acceptable deviations.

Debriefing allowed the crew to validate that the strategy was effective, on the one hand, and that the anticipation of a similar situation at that airport can be recognized as a usual threat in the future.

Debriefing of Situational Awareness Degradation

In autumn weather, an approach was conducted with a tailwind in icing conditions. The crew selects engine anti ice on for the conditions. Both PF and PM perceive that the deceleration capacities are significantly different than in usual conditions. The energy state of the aircraft didn't fulfill the stabilization criteria, and therefore led to a go-around.

The debriefing gave the opportunity to identify that the PF had in mind that, with the usual configuration at home base final descent point, the stabilization criteria would have been met. PM perceived concerns with the energy state but recognized they failed to voice it early enough for the go-around to be avoided. Based on this, the PF realized their projection wasn't accurate enough, the PM realized they had been stuck in trying to understand, which prevented them from acting (announcement, call for next flap setting or gear extension).

Tool #2 – Managing Cognitive Workload

Concept

Given that cognitive and attentional resources are limited, it is imperative for crews to monitor and manage their cognitive workload to maintain optimal performance on the flight deck. Failure to address excessive cognitive workload can lead to significant degradation in crucial aspects of flight operations such as performance, concentration, situational awareness, and communication. This decline can result in tunnel vision and a diminished capacity for reaction where one may react with emotion and instincts rather than rational thought. This state makes it challenging for individuals to recognize their own cognitive limitations, which is particularly hazardous for the Pilot Monitoring, whose role is crucial in maintaining a cognitive overview of the flight situation.

Operational Implementation

To mitigate these risks, proactive strategies should be adopted such as pre-planning, identification, and anticipation of potential workload spikes. This approach requires all crew members, especially the PM, to remain vigilant, not only of their own workload but also that of their colleagues.

This section outlines how effective management of cognitive workload involves continuous communication among crew members, allowing for the sharing and comparing of mental models to evenly distribute the cognitive load. By recognizing and expressing impending overload, the crew can take collective steps to adjust and reduce workload levels, thereby preventing an excessive cognitive workload. The aim is to provide practical guidelines and strategies for flight crews to maintain cognitive well-being, ensuring safe and effective flight operations.

Pilot Flying Workload

The workload of the Pilot Flying (PF) may be demanding, requiring a total engagement of the pilot to cope with the situation. This can be due to either malfunction or adverse weather, but also linked to the level of automation used and/or the level of comfort in all different possible modes.

There is a limit to the maximum workload that a pilot can handle. This human limit can be thought of as similar to the limits of the aircraft: to be effective, pilots must remain within a workload 'flight envelope'. There are also limits to the 'rate of climb' for one individual when more workload is required.

Taking these two limitations into consideration, the PF should anticipate demanding phases of the flight to provide the time needed for the brain to be up to speed when full workload has to be delivered. Like an aircraft operating near the edges of the flight envelope, PF being at maximum capacity can be acceptable with the appropriate safeguards.

Pilot Monitoring Workload

In similar situations, PM high workload might be significantly different from that of the PF. The cognitive comparison required for effective monitoring is only possible with the "human" brain (see section on Cognition above). Knowing that a mode reversion to a lower level of cognition is possible, and that this reversion is unconscious, the only strategy is for the PM not to be overloaded. This is beneficial for the whole crew and therefore is a shared responsibility of both pilots, PF and PM.

Ultimately, the PM must be aware that a workload above their maximum risks inducing a lack of proper monitoring. During this period, the flight has no effective monitoring. Fortunately, it is reversible when the workload decreases below PM's maximum threshold. This underlines the importance of the crew communicating their workload.

Practical example

Pilot Flying Workload

A threat is identified due to a demanding handling situation, either due to some weather, unusual slats/flaps configuration, sudden change in flying flight control law etc. When they can be anticipated, these situations benefit from a proper preparation, so that PF will have time to increase their level of engagement to efficiently address the situation.

For example, this is usually done by pilots facing channeling wind conditions. It is likely that they will disconnect the automation in advance of the lower minimums. A recommendation for an instructor with a low time pilot would be to explain the situation during the briefing so that the link between the strategy and the external conditions can be made consciously, and then duplicated when appropriate.

Pilot Monitoring Workload

Facing the exact same situation, the PM mitigation will probably be quite different. The PM can observe the workload increase (e.g. demanding weather conditions or an abnormal event). Having in mind the potential consequences of an overload, PM should avoid being close to the maximum level of engagement. This involves sharing the identification of the situation with the PF so that the crew can either adapt the pace or go around as necessary. This requires communication skills, assertiveness, and a positive safety culture.

Pilot Monitoring and Pilot Flying Workload

Consider an unexpected diversion due to medical emergency to an unfamiliar airport. PF will be busy preparing the approach and flying the aircraft, PM will be busy gaining and sharing information about the medical condition, informing ATC and passengers, and monitoring flightpath, etc. Workload can easily become high depending on time available, so both pilots need to also keep an eye on each other to recognize if workload is still acceptable or if more time needs to be created.

TOOL # 3 – Managing Time Pressure

Concept

Studies (Hancock & Caird, 1993) show the cognitive workload is linked with two dimensions: (1) **perceived achievability** of the task goal and (2) **perceived time** available to reach it. The perception of not being able to satisfy one or both conditions will lead to an increase in cognitive workload that may result in an overload. To mitigate misperception, it is important for crew members to have effective communication to maintain a shared mental model.

If the shared mental model concludes that there are difficulties in achieving the task goal in the perceived amount of time, two remedial options can be to "buy time" (ex: going around) and/ or (re-)prioritize tasks and then reassess the situation and possibly postpone actions.

Operational Implementation

The impact of time pressure is influenced by how individuals perceive both the time available, and obstacles or steps required to reach a particular goal, i.e. "distance".

An individual's perception of time can vary widely depending on psychological factors, personal experiences, and situational context. When people perceive that time is scarce or that they have a limited amount of time to accomplish a task, it can lead to feelings of stress, anxiety, and urgency. This perception of time available is also subjective, and two people facing the same deadline may experience it differently based on their individual perspectives.

A greater perceived distance, where numerous actions or complex procedures are involved, can contribute to a heightened sense of time pressure. The more steps or actions required, the greater the cognitive load and potential stress associated with the task.

Strategic Mitigation

To manage these aspects some strategic mitigations can be used; tools like workload management, briefings, and task sharing can be very efficient. When considering monitoring, briefings serve to highlight expectations in the mind of the PM, allowing them to "program" for the expected situation. With the briefing establishing a shared mental model, the crew as a whole can expect PF or PM to allocate the relevant amount of attention to detect the potential threats, leading to the planned corrective action (i.e. flying close to Cb, windshear can be anticipated, recall of different cues indicating, recall of the call out, PF actions, PM focus points).

Tactical Mitigation

When time becomes a factor, the perceived mental workload increases for both for PF and PM. PF is acting on the flight path (directly or through automation) and is therefore in charge of spatial tasks, which can be fulfilled with more basic modes of automation. As for PM, the monitoring is requiring high level cognitive processes. The brain may be overloaded to the point that it can reverse from human brain mode into the mammal brain mode. If this occurs, it is possible that the situation evaluation will no longer be based on cognitive comparisons but, at least partially, on emotional reactions partially based on previous experiences.

The countermeasure is to not allow situations where the PM will be close to a heavy cognitive workload. This can be achieved through mutual support of PF and PM, each maintaining awareness of the other’s workload.

Instructors should teach trainees when NOT TO ATTEMPT. For example, situations of high workload may require the crew to discontinue an approach or divert without trying for a landing.

Practical Example

Strategic Mitigation

Some events may be anticipated as being significantly subject to time reaction, and therefore have dedicated “memory items” to generate “immediate” actions. The strategic mitigation of threats having potentially the same time factor should also lead to “immediate” reaction. The anticipation of one very specific threat (i.e. overweight landing, or abnormal slats/flaps configuration leading to potential tail strike risk) should be briefed thoroughly, both PF and PM knowing what the other is supposed to do. In this shared mental model, plans are made to pay specific attention on the pitch value, knowing the target, the limit of which a call out must be done, and accordingly PF knowing the briefed height: above which a slight correction may be done, and under which a Go Around will be carried out.

Tactical Mitigation

During line training the PF (trainee) is managing the descent path well, when passing 7000ft they suddenly ask for flaps, reduce the thrust and ask for landing gear extension. According to PM (instructor), that was operationally too early, and created an acceleration of the approach pace.

Both could have found another option by voicing their own perceptions. PF/trainee could have expressed the perception they had was a high energy level potentially outside of stabilization criteria. It could have been confirmed by PM, leading to similar corrective actions, or invalidated allowing smoother action, with operational benefits.

PM (instructor), according to the progress in the training footprint, could have either challenged the operational impact by challenging PF by a call, or postpone the discussion to the flight debriefing.

Tool #4 – Managing Multi-Tasking

Concept

Properly managing multi-tasking involves effectively balancing and prioritizing tasks to ensure high performance and accuracy without overloading cognitive resources. The concept for this section focuses on the challenges and strategies for managing multi-tasking in the cockpit, particularly for the Pilot Monitoring (PM). Multi-tasking in aviation demands a high level of cognitive resource allocation. Since these resources are limited, engaging in multiple tasks simultaneously can lead to competition for cognitive capacities, resulting in reduced overall performance and an increased likelihood of errors.

For the PM, the consequences of a heavy workload can be severe, potentially leading to a complete loss of monitoring capability. This can occur due to a shift into a more instinctual, 'mammal mode' of thinking, prioritization conflicts between spatial and verbal tasks, or significant performance degradation when managing tasks of similar nature.

Operational Implementation

In terms of operational implementation, both the Pilot Flying (PF) and the PM have distinct primary responsibilities in managing the flight path. The PF primarily handles the flight path management, either directly or through automated systems. The PF's focus is spatial, but they also have verbal tasks. However, under increased workload, the PF might become fully absorbed in the spatial tasks, losing the ability to communicate or listen.

Conversely, the PM's primary focus is on flight path through verbal tasks like communication and monitoring, with spatial tasks being secondary (i.e. slats/flaps configuration change). If the PM's workload increases, actions could be performed in a way that contradicts the usual task distribution. For instance, the secondary task, such as selecting flaps or ECAM management, could take precedence over their primary task. In extreme cases, the PM might shift the focus entirely to spatial tasks as an additional PF, at the expenses of monitoring.

Additionally, the PM may face challenges when simultaneously handling tasks of the same nature, such as **making calls** for flap adjustments and **reading** checklists while needing to **listen** to critical automated callouts like a 1000/500ft alert, which could require a decision to initiate a go-around maneuver.

Practical Example

Pilot Flying Example

Anticipating challenging weather conditions, the briefing addressed the potential tail wind component, and a request was made to PM to "announce" the tail wind component.

During approach, there was a strong tail wind, but significantly more than reported by tower. PM did announce the wind (above the limits, but tower wind fulfilling company criteria) assuming that PF was taking the decision.

PF reported that he didn't hear PM announcement, PM thought that he was in charge of the call, when PF assumed that if above usual company tailwind restriction, the GA will be called.

PM Example 1

PILOT MONITORING MUST NOT BE UNDER HEAVY COGNITIVE WORKLOAD

Approach with more energy than expected. Flight is handled by PF without automation or flight director. Very high level of operational performance is PF's objective. In support, PM adjusts his attitude to cope. Speed reduction is asked, at the last limit, followed by flaps setting and gear extension. Focusing on the speed limits for flaps extension, and then reading the final check list, the flight did not fulfill stabilisation criteria, without realizing it.

Debriefing will report that PM didn't realise as he was very busy, and when available, below stabilisation threshold, the flight parameters were back to normal, in the meanwhile PM didn't (couldn't?) notice that the approach was not fulfilling stabilisation.

PM Example 2

PF asks PM for gear down and flap extension at the same time as ATS commands frequency change and because of the overload and trying to multitask, the PM selects flaps up instead of down.

Tool #5 – Managing Change

Concept

There has been a notable increase in the emphasis on combined crew performance to enhance flight safety. With this, the role of the PM has been brought to the same level with the PF to maximize the best outcome in all situations. This change is relatively recent in the history of aviation safety and organisations are still learning how to address the role and tasks of the PM, considering the limitations of human performance.

The air transport industry faces risks and has learned to mitigate them through regulation and normalization. Efforts have been made to regulate and normalize the PM role (i.e. move from Pilot Not Flying (PNF) to Pilot Monitoring (PM)). From a systemic approach, efforts should be made to share the knowledge of the tools presented in this document. As with any tools, they have their own limits and need to be practiced to achieve the desired level of performance.

Operational Implementation

IFALPA also would like to highlight specific points:

The first limitation to operational implementation lies in individual characteristics and personalities, and the way one shares their point of view, memory, feelings, emotions. Mentoring, as opposed to teaching, is the ideal way to address monitoring. The main difference is that the mentored individual must ask for support. The process is then based upon individual needs and willingness.

In the training environment, instructors and trainees must be able to discuss the trainee's psychology, physiology, and state of mind. This requires a non-punitive environment so that each of the pilots can exchange freely. It is a shared responsibility between the management and the pilot group to promote an open and supportive training environment which allows for such exchanges, briefings, and debriefing on monitoring.

Monitoring is not an isolated competency, rather it is embedded in several competencies. In this context, the training needs or training objectives are not founded in a regulatory framework. Having said that, in a competency-based environment, additional tools for instructors could facilitate better education and mentoring, which could be of great benefit for monitoring. Additional competencies for instructors such as active listening or nonviolent communication could be beneficial to lead more efficient briefings and debriefings.

The impacts of culture should also be taken in account. In some cultures, the authority gradient may stronger than others. When applying monitoring skills, this issue can be circumnavigated by setting a clear delegation to PM or reinforcing PM expectations (i.e. standard callouts are agreed to be used by PM during CAT III ops).

Finally, better monitoring may lead to cockpit reorganization with equal consideration of flight path management for PF and cognitive workload management for PM. The handling of the time factor in such a way that effective monitoring can be conducted may lead to some operational effects (i.e. higher average stabilisation height, G/A rate increase).

CONCLUSION

The cornerstone of maintaining the highest level of aviation safety lies in the unwavering commitment to vigilant flight path monitoring and cross-checking. The key to effective pilot monitoring is not just about maintaining a watchful eye on the controls and instruments but also fostering a culture of proactive communication, continuous learning, and teamwork among flight crews.

Effective monitoring is a dynamic skill that combines the use of technology with respect of human factors limits. By embracing the practices recommended in this document and incorporating them into daily operations, flight crews can significantly mitigate risks and enhance the safety of every flight. The essence of our message for pilots everywhere is to stay alert, stay informed, and stay connected with crew members.

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