

2.8 Workload Management

Introduction

In its simplest form, workload can be thought of as the amount of work needed to be done. But this simple view misses out on important aspects of workload: workload is imposed upon the flight crew and is dependent on the ability of the crew to meet the demands of the tasks.

A better definition is:



Workload: The demands imposed on someone by the tasks assigned and the capacity of the person to meet those demands within the conditions they find themselves.

Workload depends as much on our personal abilities as it does on how much work is assigned. It is important to note that workload is based on an individual's perception and is therefore subjective. High workload for one person might not be much at all for another (for example, more experienced) person.



Effective workload management is vital to ensure all tasks are completed and requires cooperation of resources both inside and outside the flight deck. The ICAO definition of workload management is:



Workload Management: Maintain available workload capacity, by prioritizing and distributing tasks using appropriate resources.¹

There are various factors that will affect workload, and these must all be managed:

Factors	Description
Time pressure 	The available time to complete the tasks. Shorter time, higher workload
Complexity 	The more complex and difficult a task, the more workload it creates. This could also be affected by the conditions within which the task occurs. For example, poor weather may significantly increase the complexity of a normally simple task.
Number of tasks 	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.
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. Generally, 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. High exertion will burn a crew out quickly. Bored crews will have a hard time staying focused. Experienced personnel pace themselves, working at a rate and effort level that they can sustain for the expected duration of the task.
Information rate 	The rate at which the information is being presented will affect workload. Information coming too fast can quickly overload a crew
Accuracy 	More concentration will be required to complete tasks with higher accuracy.
Human factors 	Factors such as sleep deficits, poor schedules, and excessive fatigue inevitably lead to degraded performance. Equally, effective human factors mitigations can decrease the difficulty of a task.
Interruptions 	Distractions can come from many areas; traffic, weather, failures, ATC. Changing attention between tasks uses extra mental capacity, therefore increasing workload more than just the sum of the tasks.

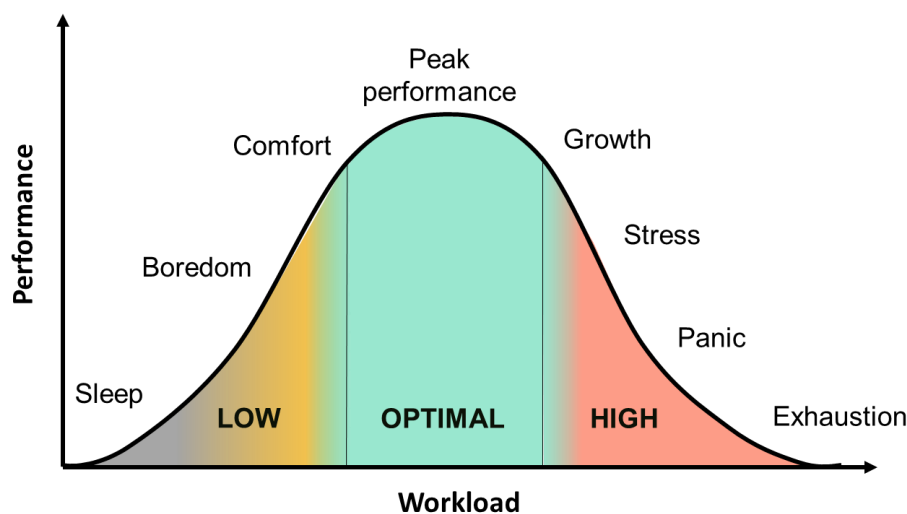
Generally, there are three ways to reduce workload:

1. Reduce time pressure.
2. Shorten duration of task
3. Increase experience level.

The first two may be achievable at any time, however, the third is a function of each individual and can only be changed through practice.

Workload vs Performance

People are most reliable under moderate levels of workload, but there is a spectrum of levels of workload that we must learn to operate in. Understanding this spectrum will aid in managing workload. Yerkes & Dodson described the relationship between the strength of a stimulus and the rate of learning. Each stage of strength of stimuli, or in this case the workload, has an associated rate of learning – which is comparable to the level performance at that time. The relationship forms a bell shape, known as the Yerkes Dodson curve.ⁱⁱ:



Low Workload

Underload occurs when workload decreases to levels well below one’s capability to meet demands. This is common in tasks that are simple but require constant effort or sustained attention. Periods of low workload are characterised by boredom and distraction with attention drifting from critical tasks, which leads to susceptibility to missing important inputs.

Counter underload by:

- Engage in conversations concerning the flight with other crew members or perform 'self-talk'.
- Try to stretch frequently and change your posture.
- Perform tasks that do not need to be completed at a specific time.
- Plan and prepare for future high workload period

Comfort to Optimum Zone:

Then as the workload increase, a comfort, coasting zone is found. This brings increased performance, but not at the maximum. Peak performance is at the optimal workload.

Growth Zone

Beyond peak performance, people are under more pressure, and they have the workload for growth. However, this can start to diminish performance as mistakes are made in the learning. This zone will be mentally tiring, and therefore task duration in this zone should be considered with the level of experience of the operator.

Overload



Overload is when workload increases towards, and perhaps surpasses, one's capability to meet demands. Periods of high workload are characterised by feelings of being overwhelmed, fatigued, and not coping, which leads to high levels of stress and increased probability of making errors.

Other symptoms include becoming overly task focused, potentially on an irrelevant item, which is a reduction of situational awareness.

The danger is that the errors lead to a further increase in workload, which rapidly drops the performance output with panic, and finally exhaustion.

Counter Overload by:

- Plan ahead to avoid overload.
- Consider how to 'buy extra time'?
- Increased monitoring
- Increase communication.
- Prioritize
- Delegate

Each of these areas will be discussed as a method of managing workload.

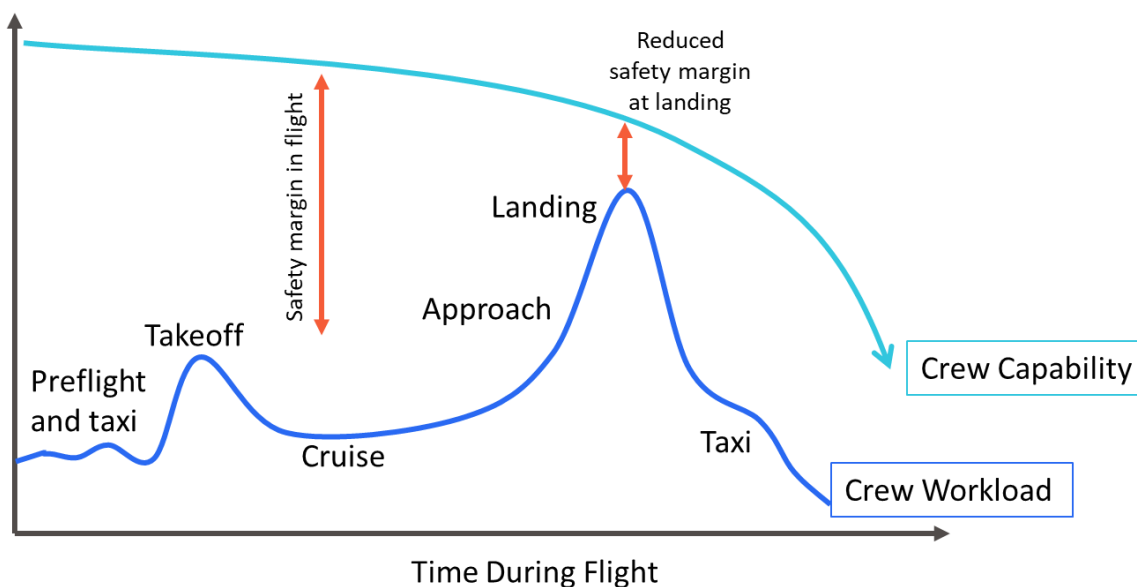
Observable Behaviors

The following observable behaviors describe in the CAE workload management competency (WLM):

<p>WLM</p> <p>Observable Behaviours ⁱⁱⁱ</p>	<p>WLM1 Exercises self-control in all situations</p> <p>WLM2 Plans, prioritizes, and schedules appropriate tasks effectively.</p> <p>WLM3 Manages time efficiently when carrying out tasks.</p> <p>WLM4 Offers and gives assistance.</p> <p>WLM5 Delegates tasks</p> <p>WLM6 Seeks and accepts assistance, when appropriate</p> <p>WLM7 Monitors, reviews, and cross-checks actions conscientiously</p> <p>WLM8 Manages and recovers from interruptions, distractions, variations, and failures effectively while performing tasks</p>
--	--

Time Management

Managing time throughout a flight is an important feature of workload management. This includes anticipation of when workload will be higher, so you can plan and off load tasks to the less busy times. The levels of workload experienced through a standard flight aligns with where accidents happen,^{iv} as shown on this graph. In particular, note the highest workload at landing, where over 50% of accidents occur^v. Towards the end of a flight, the crew attention will also be diminishing as fatigue sets in. On long haul flights, overall capability of the crew may drop dramatically around the time of landing due to the length of time they have been awake. This significantly reduces the safety margin, explaining why most accidents happen at this point.



Workload does not always follow this pattern, it may suddenly increase for an unforeseen reason such as runway change, deteriorating weather, or an aircraft emergency. At this point the crew may need to buy extra time to work through the task list. Consider reducing speed, adding a small orbit en route, or entering a holding pattern to make extra time for you and the crew to ensure all tasks are completed appropriately. Obviously, this comes with a warning on fuel consumption – check you have enough for the extra airborne time!

Prioritize, Shed or Multitask

The term *prioritizing* refers to selecting the order of tasks based upon their relative level of importance, whilst *shedding* tasks refers to the thoughtful deferment of low priority tasks and distractions to decrease workload. In addition to considering a task’s importance, the urgency of a task must also be considered. In certain circumstances, it may be acceptable to expend extra effort on a lower priority task to “get it out of the way” and still leave sufficient time and resources to complete the more important task.

Some easy tasks may be able to be completed concurrently by a single person, but this requires the brain to flick back and forth between tasks very quickly. However, it is impossible to fully concentrate on two complex tasks at the same time. Do not fall into the trap of attempting to multitask on the vital and/or complex tasks – too many tasks may reduce the quality with which they are completed.^{vi}

Important	PLAN	DO
	SHED	DELEGATE
Not important	Non Urgent	Urgent

A matrix can be used to decide what to do with each task:

- Urgent and important and tasks: do now!
- Non-urgent but important but tasks must be planned.
- Urgent but less important tasks can be delegated.
- Non-urgent and non-important tasks should be shed.

An overview of prioritization is to ensure each of these is addressed before the next:

Aviate
Navigate
Communicate

Delegation

In safety critical operations, there may be occasions where lots of tasks fall into the DO category, as being both urgent and important. This is why we have multi crew operations! Effective delegation has several steps:^{vii}



1. **Know what can and cannot be delegated:** Some responsibilities of the captain must remain those of the captain unless they are incapacitated. For example, any decision that impacts the safety of the passengers, crew, or aircraft, must always rest with the captain's authority. Equally, there will be many legal decisions and signatures that must be carried out by the captain that also cannot be delegated. Understanding your crews' strengths and weaknesses will aid you in deciding which tasks they can handle.
2. **Define the task:** Make sure you clearly state what the task is that you wish the team member to do. You may need to give boundaries to the task, a time limit, or specific outcomes you require. Communication is key to ensure this understanding has been passed on correctly.
3. **Trust:** Once a task has been delegated, be patient, and allow the team to do their jobs. Continual checking on them will not help them. Remember that you have your own task to do, which is why you delegated this task!
4. **Feedback:** Let the team know when they have done a good job or give them pointers on how to complete the task to a better standard. Feedback also includes asking your team for feedback on you – was there anything you could have done differently to ease the load for everyone.

Monitoring

Whilst continually checking on delegated tasks is not ideal, monitoring of all the aircraft tasks crew and systems is essential for flight safety.

Effective monitoring and cross-checking, which can help to mitigate errors associated with high workload, and is also linked to many other of the ICAO competencies:

- **FPA 8:** Effectively monitors automation, including engagement and automatic mode transitions.
- **FPM 8:** Effectively monitors flight guidance systems including engagement and automatic mode transitions.
- **PSD 8:** Monitors, reviews, and adapts decisions as required.

- **SAW 1:** Identifies and assesses accurately the state of the aircraft and its systems.
- **SAW 2:** Identifies and assesses accurately the aircraft’s vertical and lateral position, and its anticipated flight path.
- **SAW 3:** Identifies and assesses accurately the general environment as it may affect the operation.
- **SAW 4:** Keeps track of time and fuel.
- **WLM 5:** Reviews, monitors, and cross-checks actions conscientiously

To cover all the areas of monitoring, the UK CAA produced the paper ‘Monitoring Matters’^{viii}, and even suggests that monitoring might be considered a competency in its own right. This publication suggests several different types of monitoring:

Type of Monitoring	Description of behaviour	Example
Passive	keep an eye on maintain regular surveillance listen to	Scanning displays to see if anything is ‘out of place’
Active	cross check oversee report on	When a call out is required for engine instruments, or automation modes.
Periodic	check over a period of time	Checking aircraft state at certain time intervals, such as fuel quantity and burn
Mutual	cross check watch over oversee report on	When one crew member double checks that action the other has performed.
Predictive	advise urge	Comparing actual flight path data with predictions or expectation, confirming speeds etc.

Just as monitoring appears in many other competency behaviors, managing workload also requires all the other competencies:

KNO 4, 5, 7 & PRO 3,5,7: Essential for prioritizing workloads and understanding who can complete tasks.

LTW 1: Know the team and consider the workload of other crew members before communicating with them, as your communication may interrupt an important task.

COM 1,2,3,4: Communicate your intention and requirements to all concerned.

PSD 1,7,8,9: Reviewing plans frequently and modify when necessary to accommodate changes in workload.

SAW6,7: Making a contingency plan for possible events or changes in the near future events (e.g., possible runway change for departure or arrival).

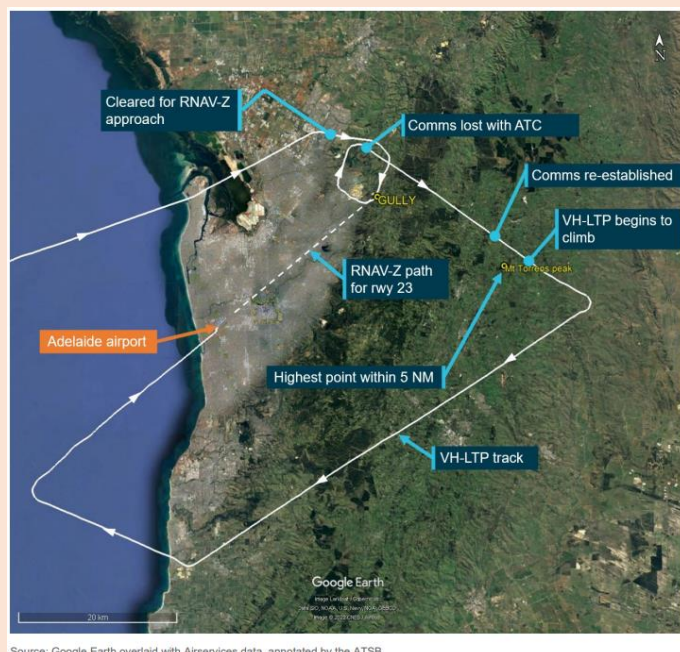
Case Study

Flight Below Minimum Altitude, 12 Aug 2021^{ix}

A twin-engine Aero Commander 500-S, on a private flight from Port Lincoln to Adelaide descended to 3,800 ft during the approach. ATC cleared them to track direct to the, the initial waypoint for the RNAV instrument approach into Adelaide, waypoint GULLY.

However, due to turbulence the pilot had difficulties entering the details into the aircraft's touchscreen multi-function display. The additional workload created by the turbulence meant that by the time the pilot correctly input the approach into the system, the aircraft had just overflown GULLY. When the pilot selected 'Direct-To' the autopilot gave a sharp turn to orbit and attempt to overfly the waypoint.

With the effects of surprise and startle contributing, the pilot also entered the wrong radio frequency and lost contact with ATC. The workload was now significantly greater than the pilot could manage, and the aircraft descended to a minimum of 2,480 ft when the highest terrain within 5NM was at 1,913 ft.



Radio contact was re-established after 4 minutes, and the aircraft climbed to 5,000 ft. The flight was completed without further incident.

ATSB Director Transport Safety Dr Stuart Godley made the following comments regarding the workload management during this incident:

- *“Distractions and unanticipated events can further increase a pilot’s workload leading to undetected errors and a loss of situational awareness.”*
- *“During high workload phases of flight, pilots should remain focused on monitoring the aircraft instruments and avoid fixating on a problem.”*

Summary

- In general, there are three ways to reduce workload: reduce time pressure, shorten duration of task, and increase experience level.
- Growth and learning occur just beyond peak performance, but overload at this point may cause a slide to panic or exhaustion.
- Plan ahead: use times of low workload to complete tasks and make busy periods easier.
- Most accidents occur at landing when workload is high, and capability may be dropping. Use extra vigilance at this time.
- Prioritization of tasks is important to avoid losing capacity to multitasking. Shed tasks that are unimportant and non-urgent.
- Delegate tasks to appropriate team members to spread workload.
- Monitoring is vital for many competencies and effective monitoring will reduce workload.

References

ⁱ IATA. (2023). Competency Assessment and Evaluation for Pilots, Instructors and Evaluators-Guidance Material.

ⁱⁱ Yerkes RM, Dodson JD (1908). The relation of strength of stimulus to rapidity of habit-formation *Journal of Comparative Neurology and Psychology*. 18 (5): 459–482. doi:10.1002/cne.920180503.

ⁱⁱⁱ IATA GM: Competency Assessment and Evaluation for Pilots Instructors and Evaluators

^{iv} Mansor, Shuhaimi & Perumal, Kannan. (2008). A synthesis of an aircraft approach, landing & overrun.

^v <https://www.skybrary.aero/articles/approach-and-landing-accidents-ala>

^{vi} Clear, J., The Myth of Multitasking: Why Fewer Priorities Leads to Better Work Available online at : <https://jamesclear.com/multitasking-myth>

^{vii} Harvard Business Review (2020). How TO Delegate Effectively. Available at: <https://online.hbs.edu/blog/post/how-to-delegate-effectively>. [Accessed: 27 Apr 2023]

^{viii} UK CAA. (2013) Monitoring Matters Guidance on the Development of Pilot Monitoring Skills. CAA Paper 2013/02. Loss of Control Action Group. Available at: <https://www.caa.co.uk/safety-initiatives-and-resources/safety-projects/monitoring-matters/make-monitoring-matter/>

^{ix} ATSB (2022). Flight below minimum altitude involving Aero Commander 500 S, VH-LTP near Adelaide Airport, South Australia, on 12 August 202. Available at: https://www.atsb.gov.au/publications/investigation_reports/2021/aair/ao-2021-033