Teamwork: communication, cross-checking and manag disagreement

Guiding question

Concrete → interfaces → measurement → calculation → failure → recovery.

Course map

The real phenomenon → Vocabulary and problem boundary → Course-specific system view → Mathematical relationship and reading the symbols → Worked calculations and interpretation

1 — The real phenomenon

An effective team makes intent, state, risk and need for help explicit. Cross-checking protects against individual error but must remain targeted. Technical disagreement must be speakable without paralyzing decisions; final authority and escalation criteria are known before the crisis.
The guiding question is: How do we move critical information without drowning the crew? Reasoning starts with the physical or operational function before introducing the mathematical relationship. The goal is not to accumulate terminology, but to know which quantity changes, why it changes and what becomes hazardous when it leaves its domain. For “Teamwork: communication, cross-checking and managing disagreement”, the first task here is therefore to identify the mechanism specific to this subject before searching for an equation or reference value.

2 — Vocabulary and problem boundary

In “Teamwork: communication, cross-checking and managing disagreement”, distinguish the phenomenon, available measurement, any command, the margin and the success criterion. The calculation boundary states what is included and excluded; without that boundary, a percentage, mass or time may be mathematically correct but wrong as an engineering conclusion. For “Teamwork: communication, cross-checking and managing disagreement”, the chosen boundary also states what would otherwise be double-counted or omitted from a mission budget.
sleep, workload, recovered errors, decision time, handover quality and unresolved conflict
accumulated fatigue, confirmation bias, incomplete handover or misunderstood authority
analog simulations, delayed-communications scenarios, performance measures and structured debriefs

Equation - evidence - decision

T_message = information_utile / durée

Failure to test: The reference failure is not a vague “broken component.” For “Teamwork: communication, cross-checking and managing disagreement”, test in particular accumulated fatigue, confirmation bias, incomplete handover or misunderstood authority. Diagnosis asks which symptoms appear first, which are only consequences and which action preserves the most options.

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3 — Course-specific system view

This lesson does not reuse one generic picture for every subject. The system view follows cause → measured quantity → decision or physical response → limit for “Teamwork: communication, cross-checking and managing disagreement”. The English text remains fully equivalent while large translated illustrations are intentionally deferred until their dedicated artwork is supplied. For “Teamwork: communication, cross-checking and managing disagreement”, the system view must expose inputs, outputs, measured quantity and the consequence of drift without relying on a generic module diagram.

4 — Mathematical relationship and reading the symbols

Read aloud : a teaching message-density metric can relate useful information to communication duration.

Before substituting numbers, write the unit of every term, state whether the relationship is a physical law, approximation or project indicator, and check dimensional consistency. This is especially important here because “Teamwork: communication, cross-checking and managing disagreement” combines quantities that do not all have the same evidence status. For “Teamwork: communication, cross-checking and managing disagreement”, this relationship is chosen because of the phenomenon under study; a different dominant quantity would require a different equation or model.

5 — Worked calculations and interpretation

12 points in 6 min = 2 points/min

4 critical actions × 20 s = 80 s

2 unresolved disagreements out of 10 decisions → 20% escalated in this example

1. 1. Briefing 12 points in 6 min = 2 points/min Interpretation: this result is used only after comparison with units, margin and the scenario boundary for “Teamwork: communication, cross-checking and managing disagreement”.

2. 2. Cross-check 4 critical actions × 20 s = 80 s Interpretation: this result is used only after comparison with units, margin and the scenario boundary for “Teamwork: communication, cross-checking and managing disagreement”.

3. 3. Escalation 2 unresolved disagreements out of 10 decisions → 20% escalated in this example Interpretation: this result is used only after comparison with units, margin and the scenario boundary for “Teamwork: communication, cross-checking and managing disagreement”.

6 — What the formula does not contain

Operational table

Phenomena / sections:	3 — Course-specific system view ; 4 — Mathematical relationship and reading the symbols ; 5 — Worked calculations and interpretation
Relationship to revisit:	T_message = information_utile / durée
Expected decision:	measure → compare with margin → choose nominal, degraded or stop

Check before continuing

Explain without rereading: 3 — Course-specific system view ; 4 — Mathematical relationship and reading the symbols ; 5 — Worked calculations and interpretation. State one measured quantity, one margin and one possible decision.

Teamwork: communication, cross-checking and managing disagreement

The relationship “T_message = information_utile / durée” does not by itself contain all of “Teamwork: communication, cross-checking and managing disagreement”. It does not automatically tell us whether a sensor is valid, a structure is aging, a resource is accessible, a command arrives in time or a secondary failure removes margin. The example 12 points in 6 min = 2 points/min therefore remains a local calculation rather than a complete architecture.

To make the model useful, explicitly add the quantities that dominate this subject: sleep, workload, recovered errors, decision time, handover quality and unresolved conflict. We can then ask which variation truly changes the result, which is negligible and which forces an architectural change. For “Teamwork: communication, cross-checking and managing disagreement”, this model limitation states exactly what a correct calculation still cannot establish about the real system.

7 — Instrumentation, observability and data quality

For “Teamwork: communication, cross-checking and managing disagreement”, observability relies on sleep, workload, recovered errors, decision time, handover quality and unresolved conflict. Each datum has a unit, acquisition rate, uncertainty, timestamp and validity domain. A value arriving without context can be more dangerous than no measurement because it creates unjustified confidence.

Consistency is checked with at least one independent piece of information when the function is critical. A trend, physical balance or second measurement principle helps distinguish a real system change from a drifting sensor. For “Teamwork: communication, cross-checking and managing disagreement”, the selected instrumentation must distinguish a real physical change from sensor drift or a bad state estimate.

8 — Phenomenon-specific failures and recovery

The reference failure is not a vague “broken component.” For “Teamwork: communication, cross-checking and managing disagreement”, test in particular accumulated fatigue, confirmation bias, incomplete handover or misunderstood authority. Diagnosis asks which symptoms appear first, which are only consequences and which action preserves the most options.

The degraded mode must be defined before failure: minimum function, allowable duration, consumed stock, crew action, abort condition and return-to-nominal criterion. That sequence is topic-specific and cannot be replaced by one universal paragraph about redundancy. For “Teamwork: communication, cross-checking and managing disagreement”, the degraded mode is defined around the minimum function specific to this subject, with an abort threshold and a return-to-nominal condition.

Operational table

Phenomena / sections:	7 — Instrumentation, observability and data quality ; 8 — Phenomenon-specific failures and recovery
Relationship to revisit:	T_message = information_utile / durée
Expected decision:	measure → compare with margin → choose nominal, degraded or stop

Check before continuing

Explain without rereading: 7 — Instrumentation, observability and data quality ; 8 — Phenomenon-specific failures and recovery. State one measured quantity, one margin and one possible decision.

Teamwork: communication, cross-checking and managing disagreement

9 — NASA / reference case

NASA adapted Crew Resource Management to spaceflight as Space Flight Resource Management (SFRM), used for astronauts and flight-control teams. The lesson therefore treats teamwork as observable, trainable competencies rather than simply “getting along.”

The ISS SFRM model highlights eight competency families: Communication, Cross-Culture, Teamwork, Decision Making, Team Care, Leadership/Followership, Conflict Management and Situation Awareness. On Mars, radio delay makes these competencies even more important because disagreement, authority ambiguity or loss of situation awareness cannot always be resolved immediately by Earth.

The practical rule is to connect each critical decision to a closed loop: message sent, acknowledgement, read-back, named owner, escalation criterion and log entry. SFRM does not replace technical competence or procedures; it structures how the team uses them under pressure.

10 — Architecture trade

A good solution for “Teamwork: communication, cross-checking and managing disagreement” does not maximize one metric. Compare nominal performance, mass, energy, simplicity, maintenance, crew time, common dependencies and recoverability. An option that improves 4 critical actions × 20 s = 80 s can still be rejected if it makes failure detection or repair much harder.

The trade is recorded together with its assumptions. If environment data, mass or mission cadence changes, we know which conclusions must be recomputed instead of silently preserving an obsolete choice. For “Teamwork: communication, cross-checking and managing disagreement”, the trade is evaluated against the interfaces actually touched by this subject rather than a generic list of desirable qualities.

11 — Demonstration, testing and success criteria

The evidence strategy for “Teamwork: communication, cross-checking and managing disagreement” combines analog simulations, delayed-communications scenarios, performance measures and structured debriefs. Every test records exact hardware, software, configuration, environment, tolerances and success criterion. A successful demonstration outside the mission domain does not replace qualification inside it.

Evidence grows by levels: analytical relationship, simulation, component, subsystem, integrated system, duration and failure. This hierarchy prevents one spectacular test from being presented as validation of the whole mission. For “Teamwork: communication, cross-checking and managing disagreement”, demonstration must reproduce the constraints that make this phenomenon difficult; a spectacular test outside the mission domain is insufficient.

Operational table

Phenomena / sections:	9 — NASA / reference case ; 10 — Architecture trade ; 11 — Demonstration, testing and success criteria
Relationship to revisit:	T_message = information_utile / durée
Expected decision:	measure → compare with margin → choose nominal, degraded or stop

Check before continuing

Explain without rereading: 9 — NASA / reference case ; 10 — Architecture trade ; 11 — Demonstration, testing and success criteria. State one measured quantity, one margin and one possible decision.

Teamwork: communication, cross-checking and managing disagreement

12 — Decision exercise

Situation: revisit “Teamwork: communication, cross-checking and managing disagreement” with a 20% increase in the most penalizing quantity from the first worked example while one measurement or backup path is unavailable.

Situation: revisit “Teamwork: communication, cross-checking and managing disagreement” with a 20% increase in the most penalizing quantity from the first worked example while one measurement or backup path is unavailable. Expected answer: recompute the relationship, identify remaining margin, check whether observability is still adequate, and decide whether degraded operation remains acceptable. Multiplying by 1.2 is not enough if the variation also changes interfaces or limits.

13 — What to retain without over-generalizing

14 — Topic-specific primary sources

These references directly document the phenomenon, technology or human constraint addressed in this lesson. They do not by themselves define an official Mars architecture. For “Teamwork: communication, cross-checking and managing disagreement”, the bibliography is deliberately targeted to this page so that readers can trace each claim back to the relevant primary document.

Topic-specific primary sources

NASA NTRS — Space Flight Resource Management for ISS Operations - https://ntrs.nasa.gov/citations/20110010923

NASA NTRS — Space Flight Resource Management Training for ISS Flight Controllers - https://ntrs.nasa.gov/citations/20110008191

NASA NTRS — Mentoring SFRM for ISS Flight Control Training - https://ntrs.nasa.gov/citations/20090014106

Operational table

Phenomena / sections:	12 — Decision exercise ; 13 — What to retain without over-generalizing ; 14 — Topic-specific primary sources
Relationship to revisit:	T_message = information_utile / durée
Expected decision:	measure → compare with margin → choose nominal, degraded or stop

Check before continuing

Explain without rereading: 12 — Decision exercise ; 13 — What to retain without over-generalizing ; 14 — Topic-specific primary sources. State one measured quantity, one margin and one possible decision.