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# Defining Research Issues for Single Pilot Operations in Transport Aircraft:

# Why Should We Care About Crew Resource Management (CRM)?

NASA Ames Single Pilot Operations Technical Interchange Meeting
10-12 April 2012

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## Introduction:

- Research Associate with the SJSURF at NASA Ames
- Pilot for a major U.S. Flag Carrier with extensive domestic and international experience

  (type-rated in B-737, 747, 757/ 767, 777, L-188)
- Former Navy Instructor Pilot, P-3 CRM course manager
- Recent work has been related to the study of NextGen procedures and technology

# Briefing Goal

When I’m done I’d like you to have a clearer understanding of an airline pilot’s duties, responsibilities, and tasks so you are better prepared for your later discussion of SPO (Single Pilot Operations) for transport aircraft.

# Overview

1. Some history and CRM (Crew Resource Management) background
   - A little history
   - A notional graphic description of CRM and technology effects
   - CRM history, definition, and concepts

# Overview

2. Discussion of cognitive functions that pilots must perform on every flight (as opposed to machine interface tasks)

From: “Crew Resource Management 2nd ed.” Kanki, Helmreich, Anca (Eds.), 2010, pg 22, Figure 1.4

# CRM Considerations for Transport SPO

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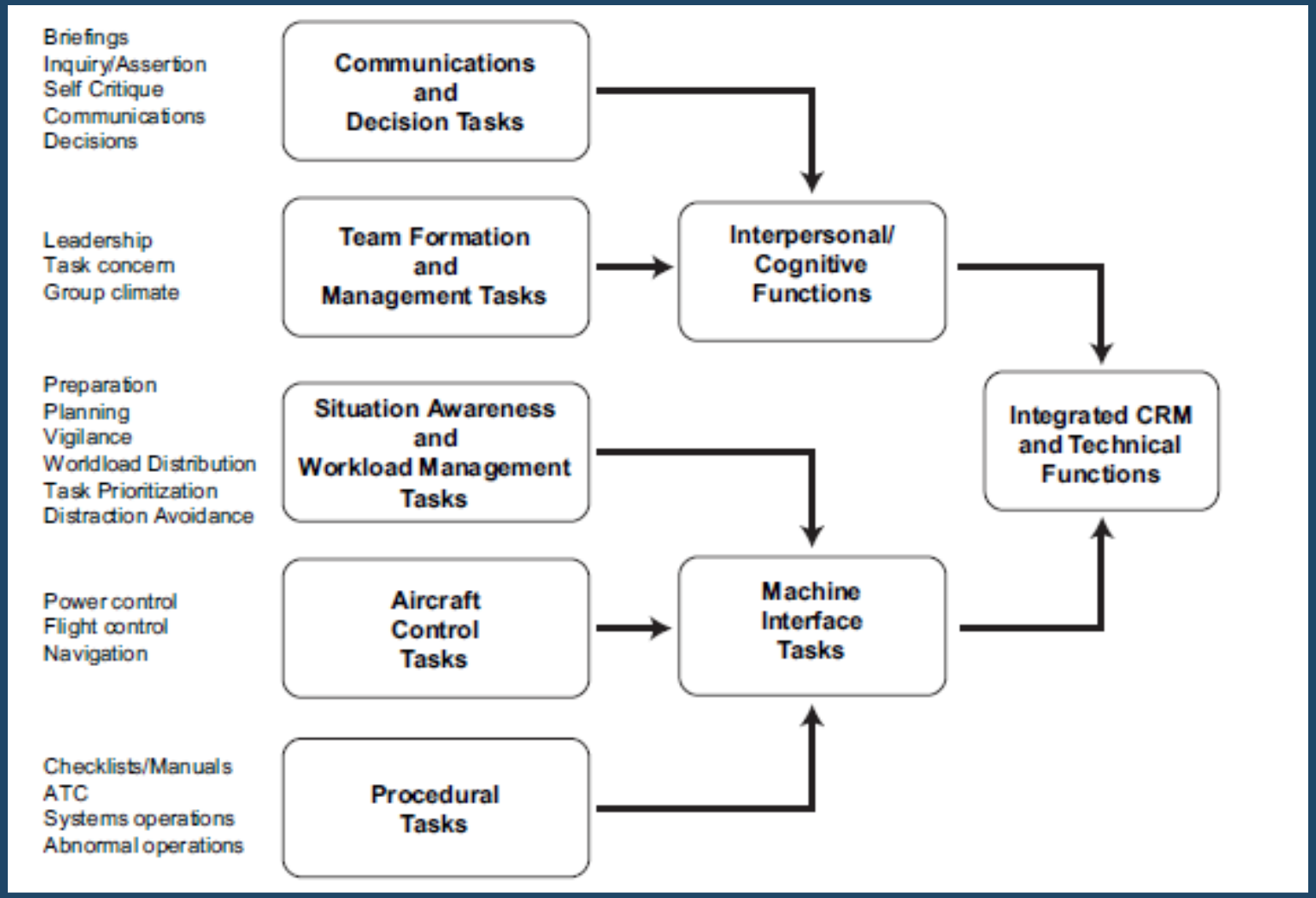
## Goal and Overview




From: "Crew Resource Management 2nd ed." Kanki, Helmreich, Anca (Eds.), 2010, pg 22, Figure 1.4

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# A Little History

# CRM Considerations for Transport SPO

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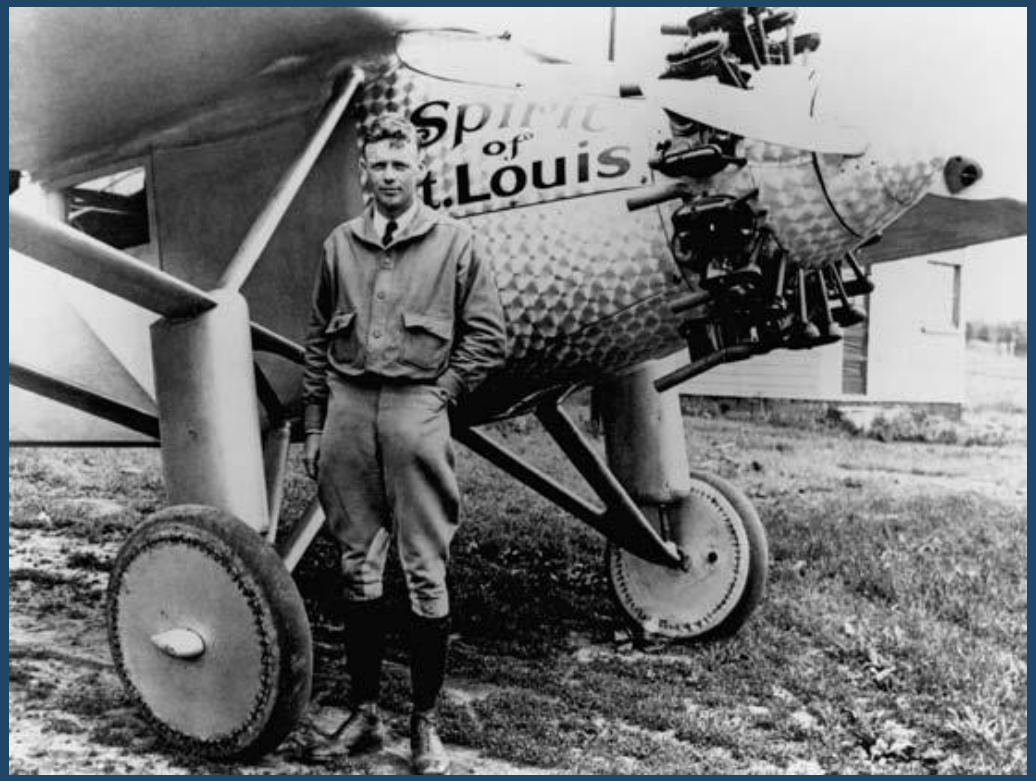
Some History and CRM Basics

## In The Beginning:



# In The Beginning:

SPO was the only way to go!

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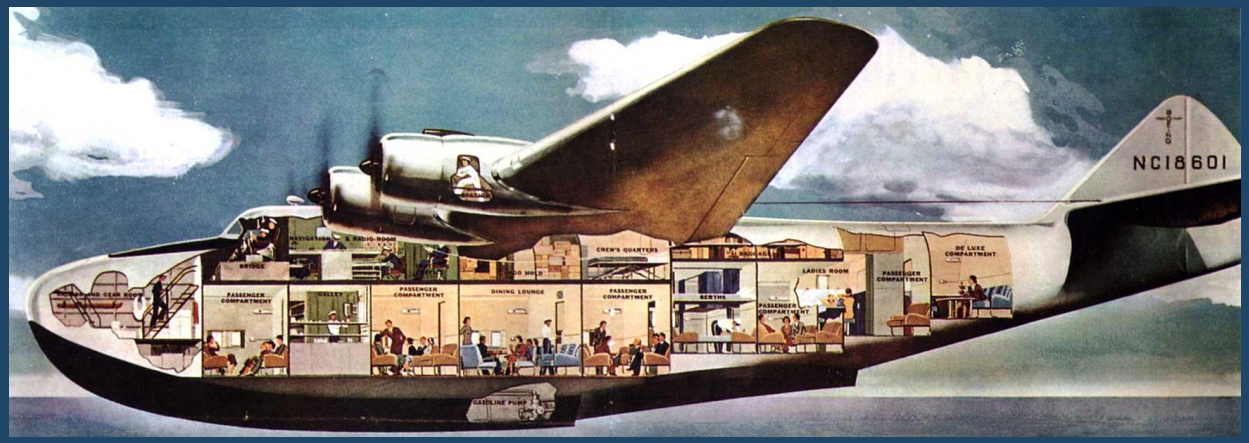
Some History and CRM Basics

# The Evolution of the Big Crew: SPO Aviators Must Now Work Together



# CRM Considerations for Transport SPO

Some History and CRM Basics

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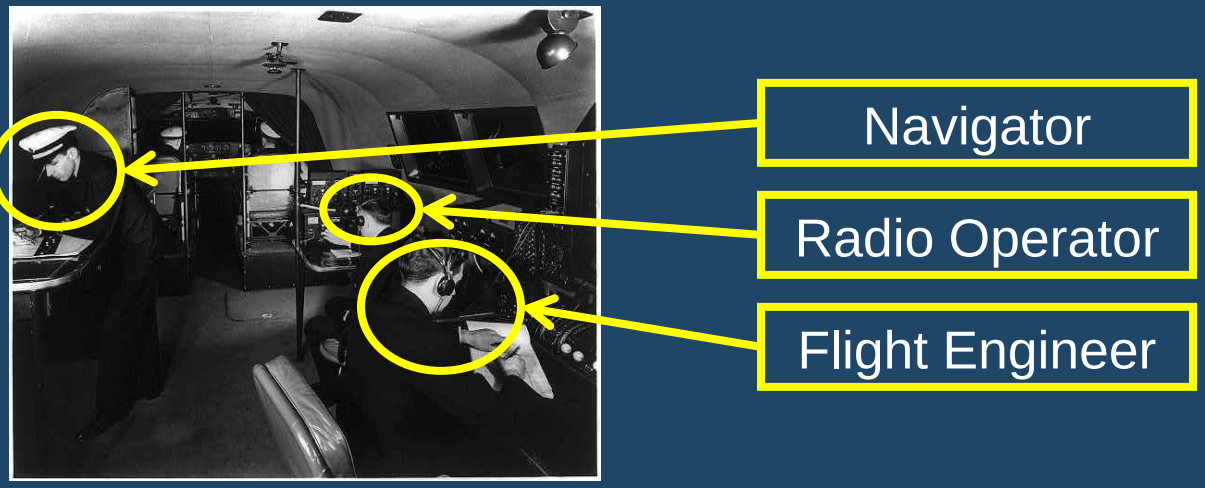
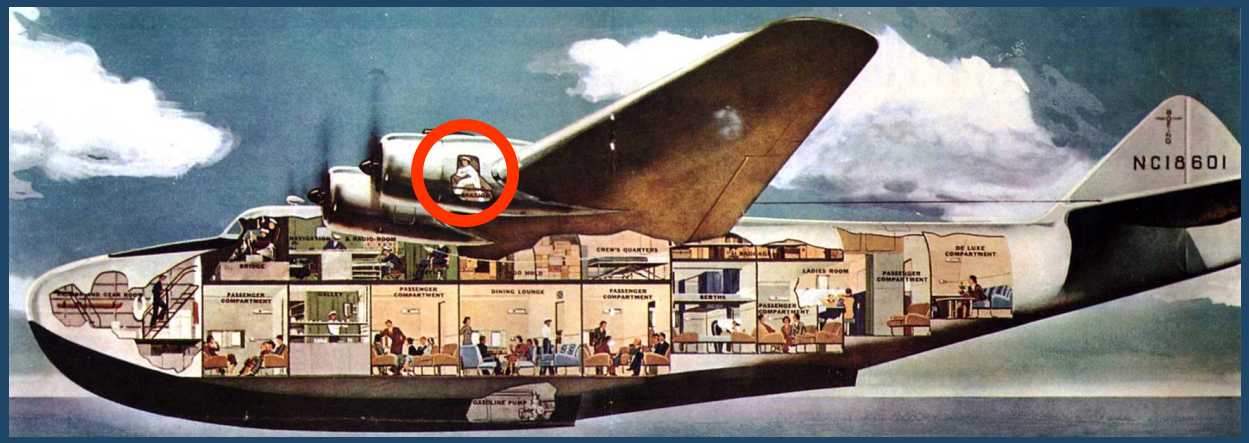
## SPO Aviators Must Now Work Together



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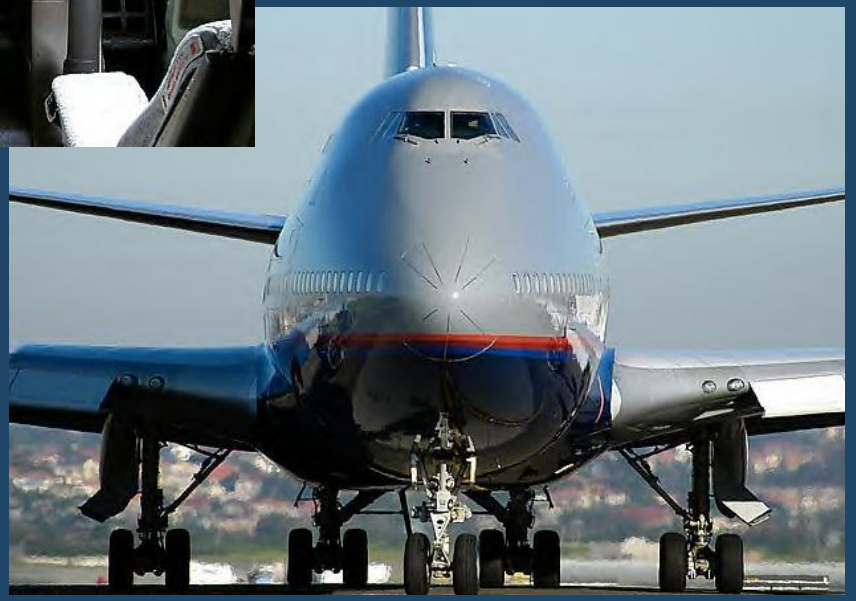
Some History and CRM Basics

# The Modern Era: Technology Reduces Crew Size Again



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Some History and CRM Basics

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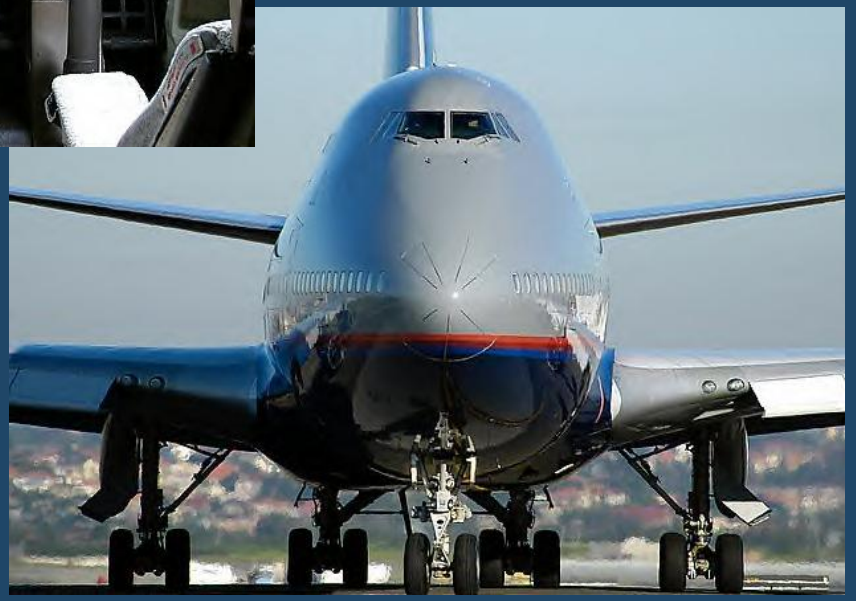

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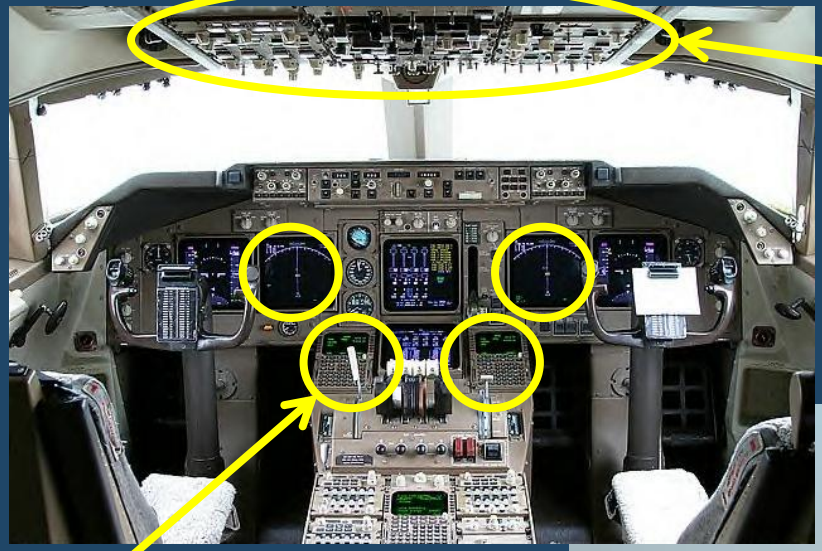

Flight Engineer

Navigator

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Some History and CRM Basics

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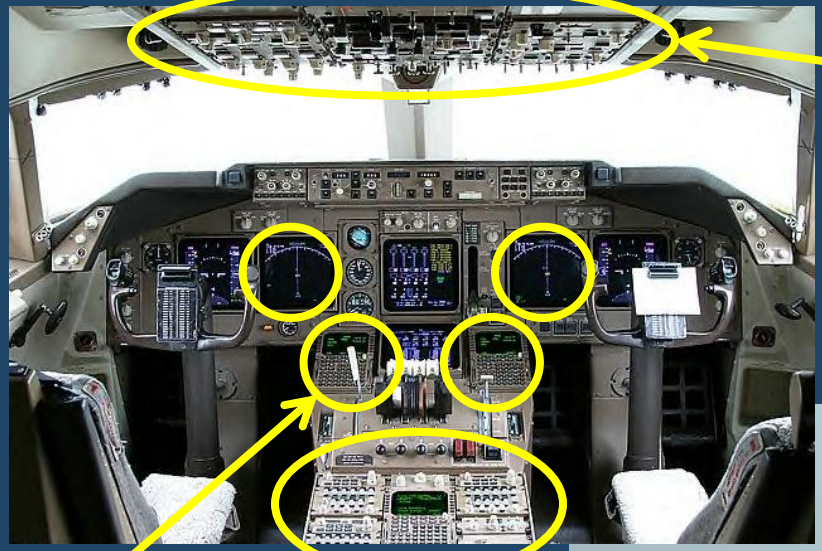

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Radio Operator

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Some History and CRM Basics

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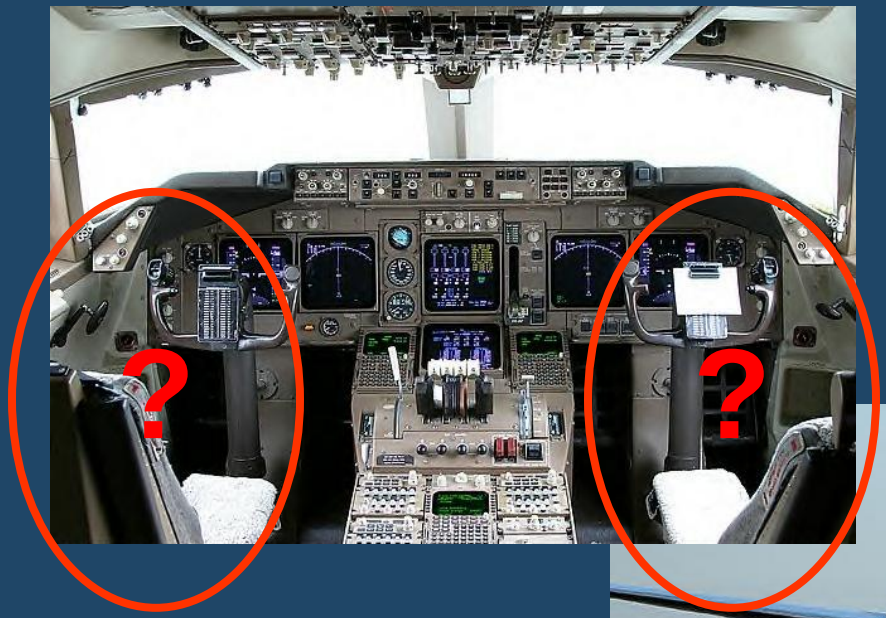
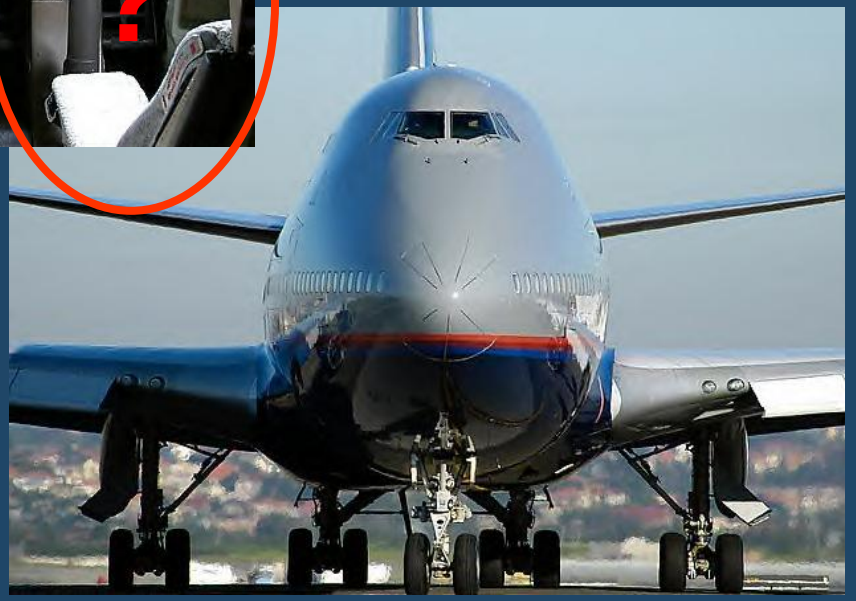



Why aren't we using SPO now? Is it feasible? How is CRM relevant?



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# A Notional Graphic Description of CRM and Technology Effects

# (Why did CRM happen and what does it mean for SPO?)

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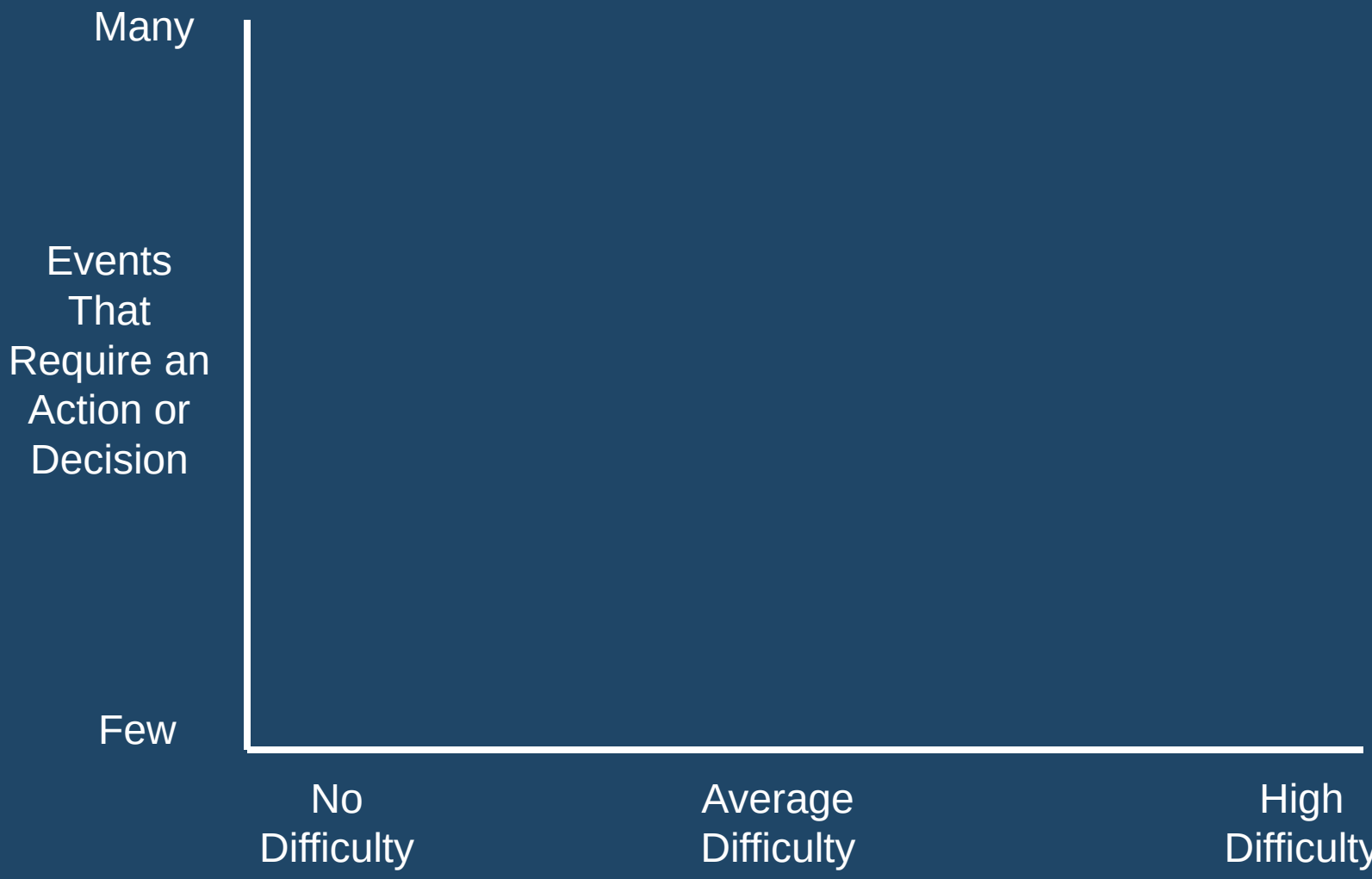
# Distribution of Flight Events



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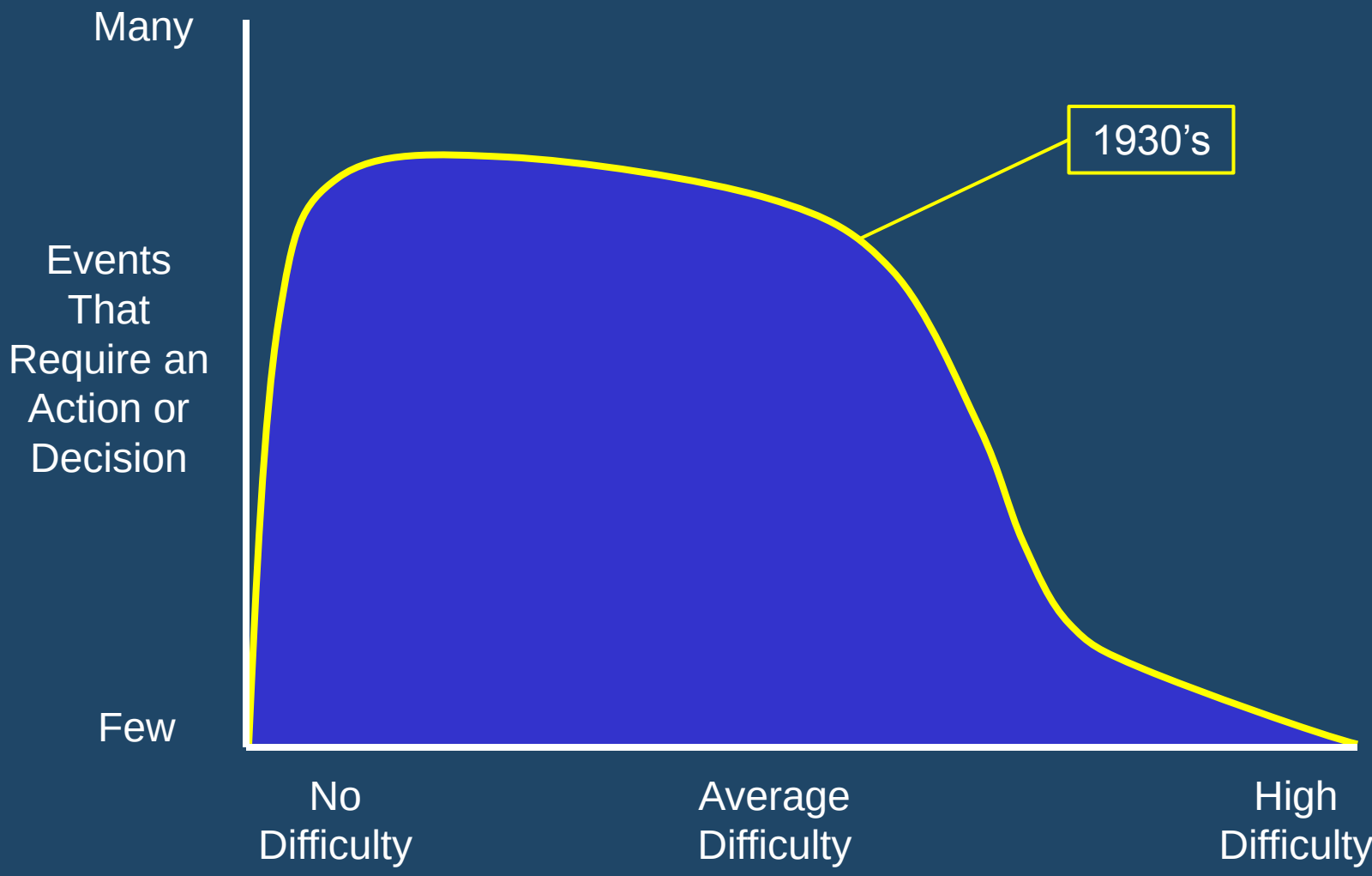

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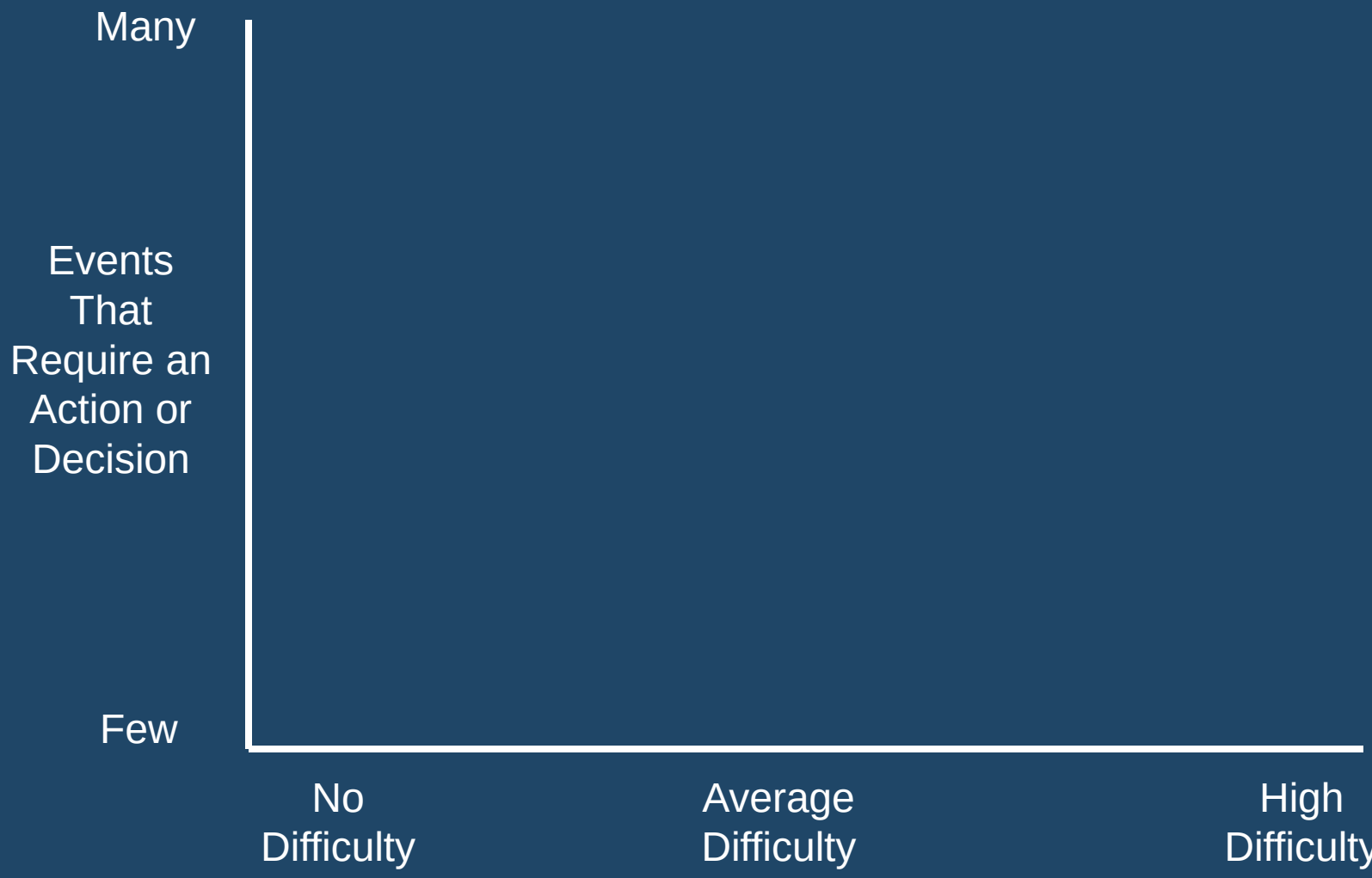
# A Model of Varying Crew Functionality



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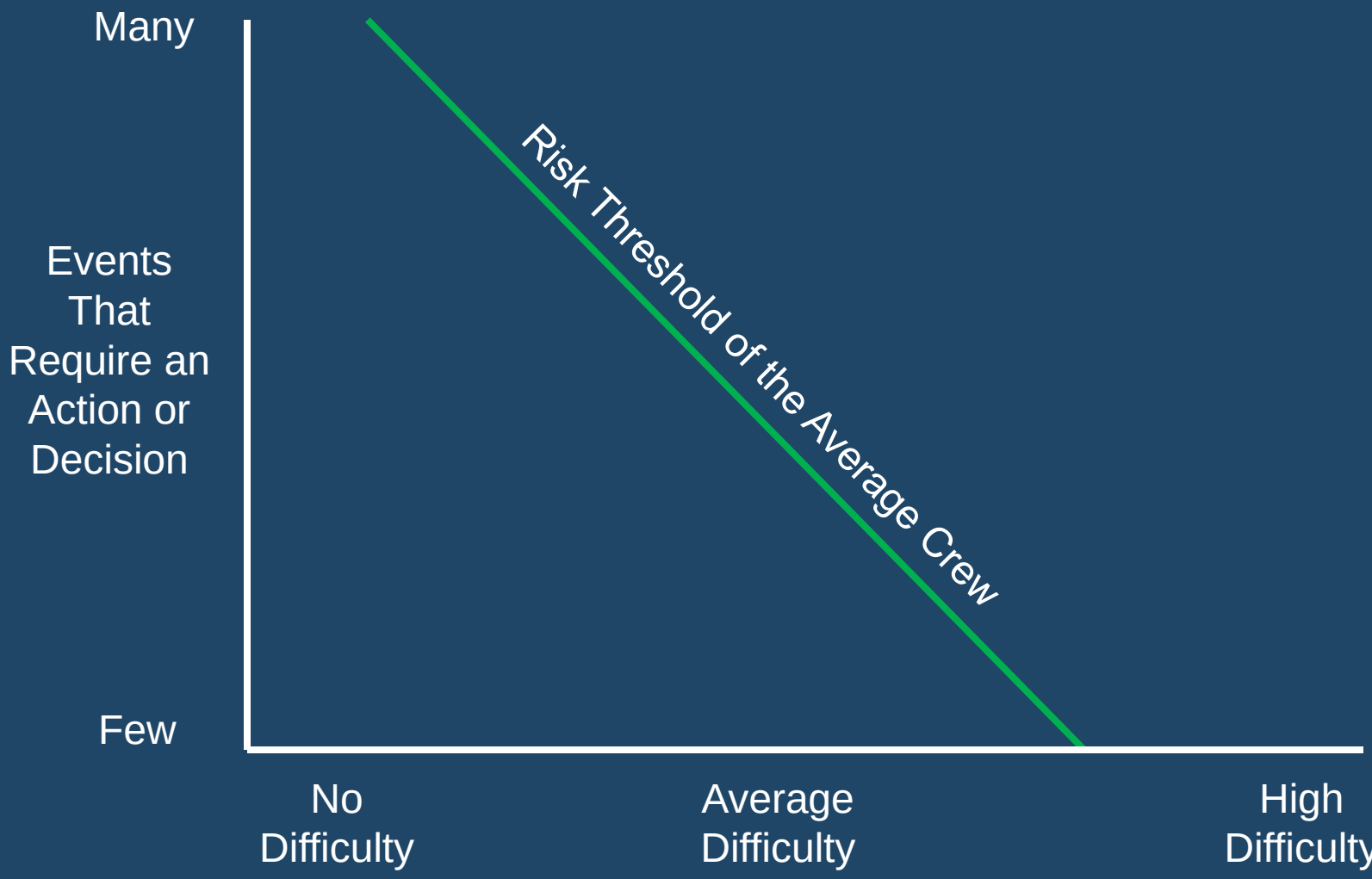

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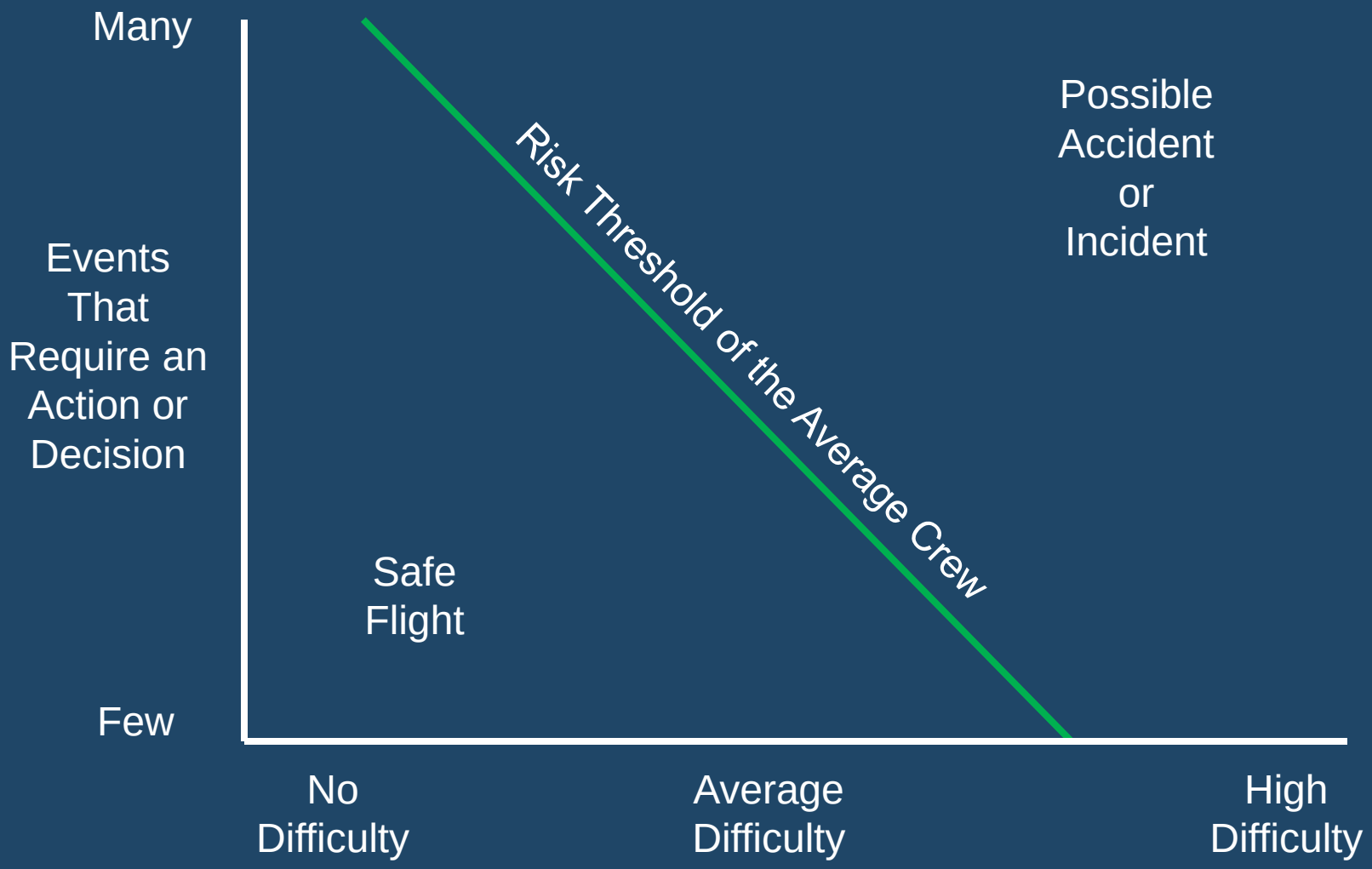

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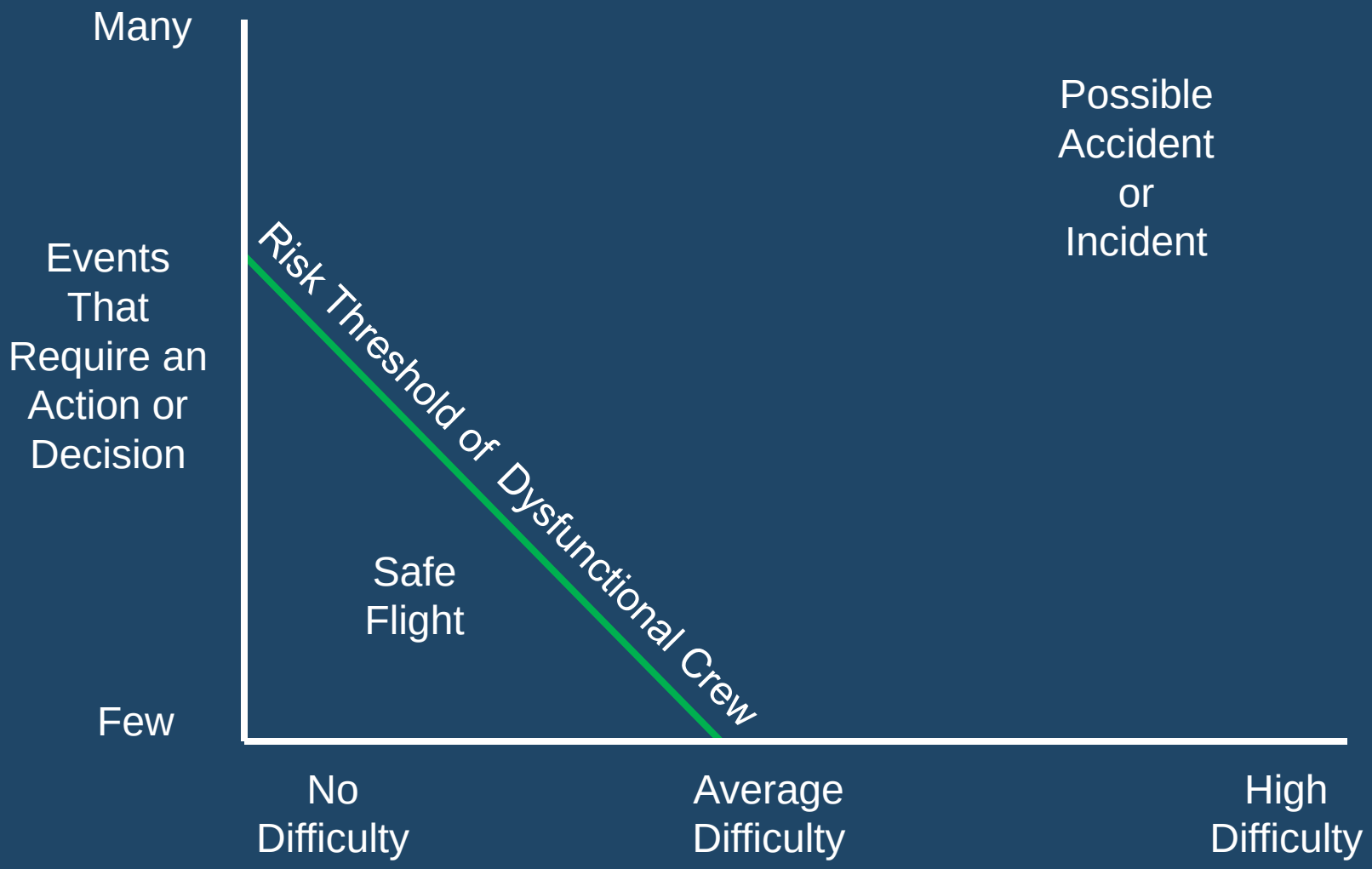

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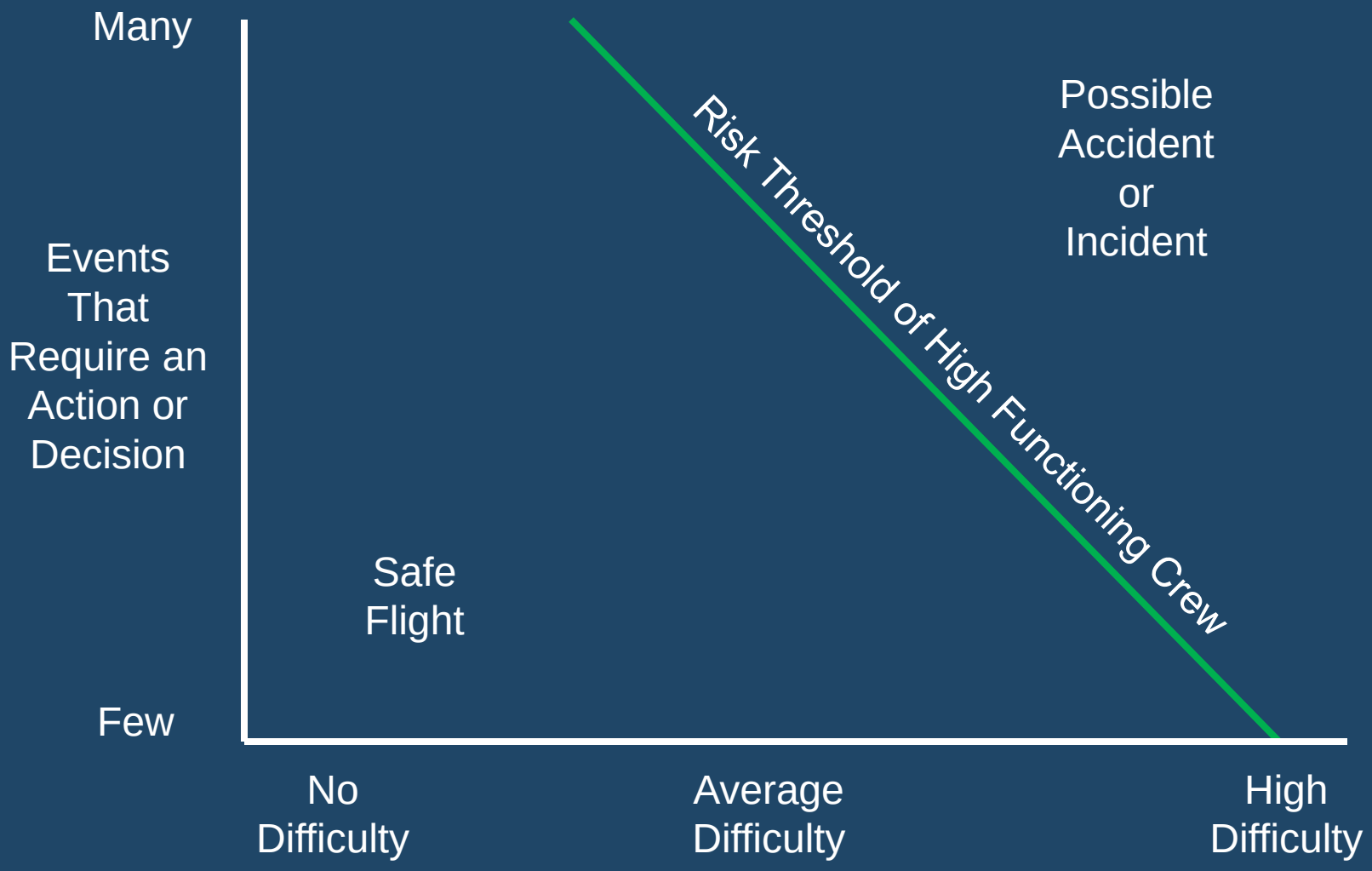

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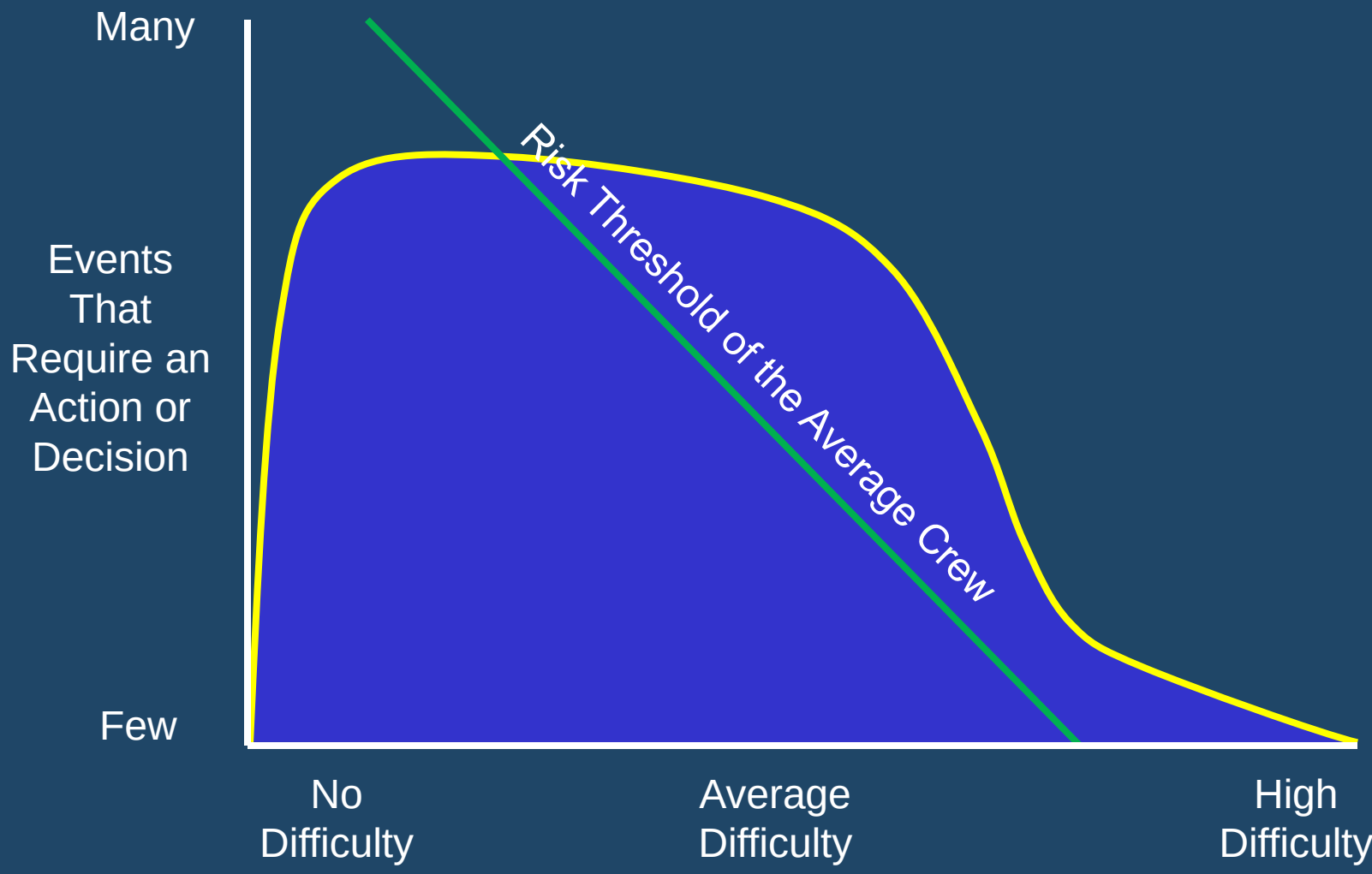
# Distribution of Events with Crew Functionality



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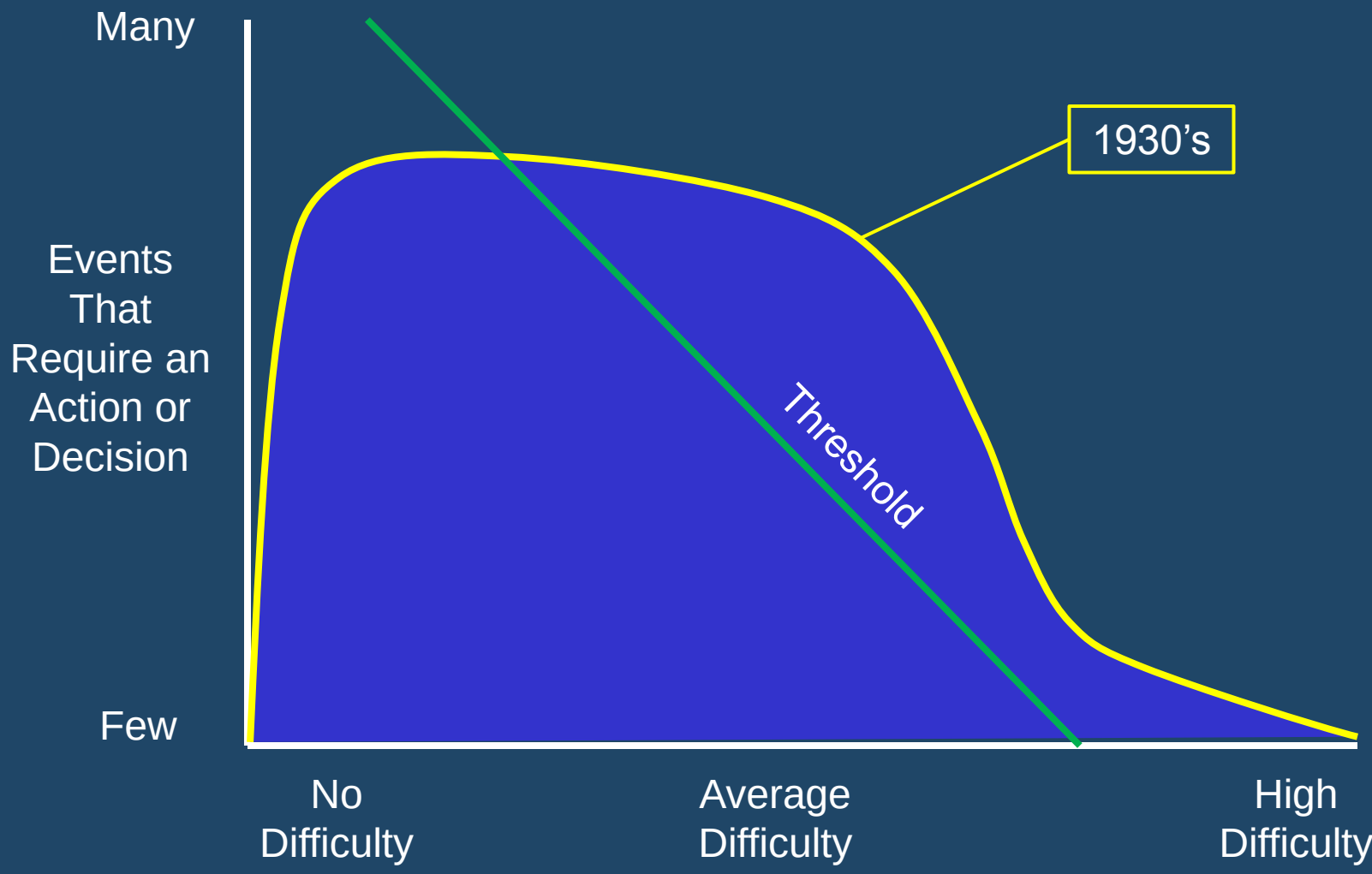
## The Effect of Technology



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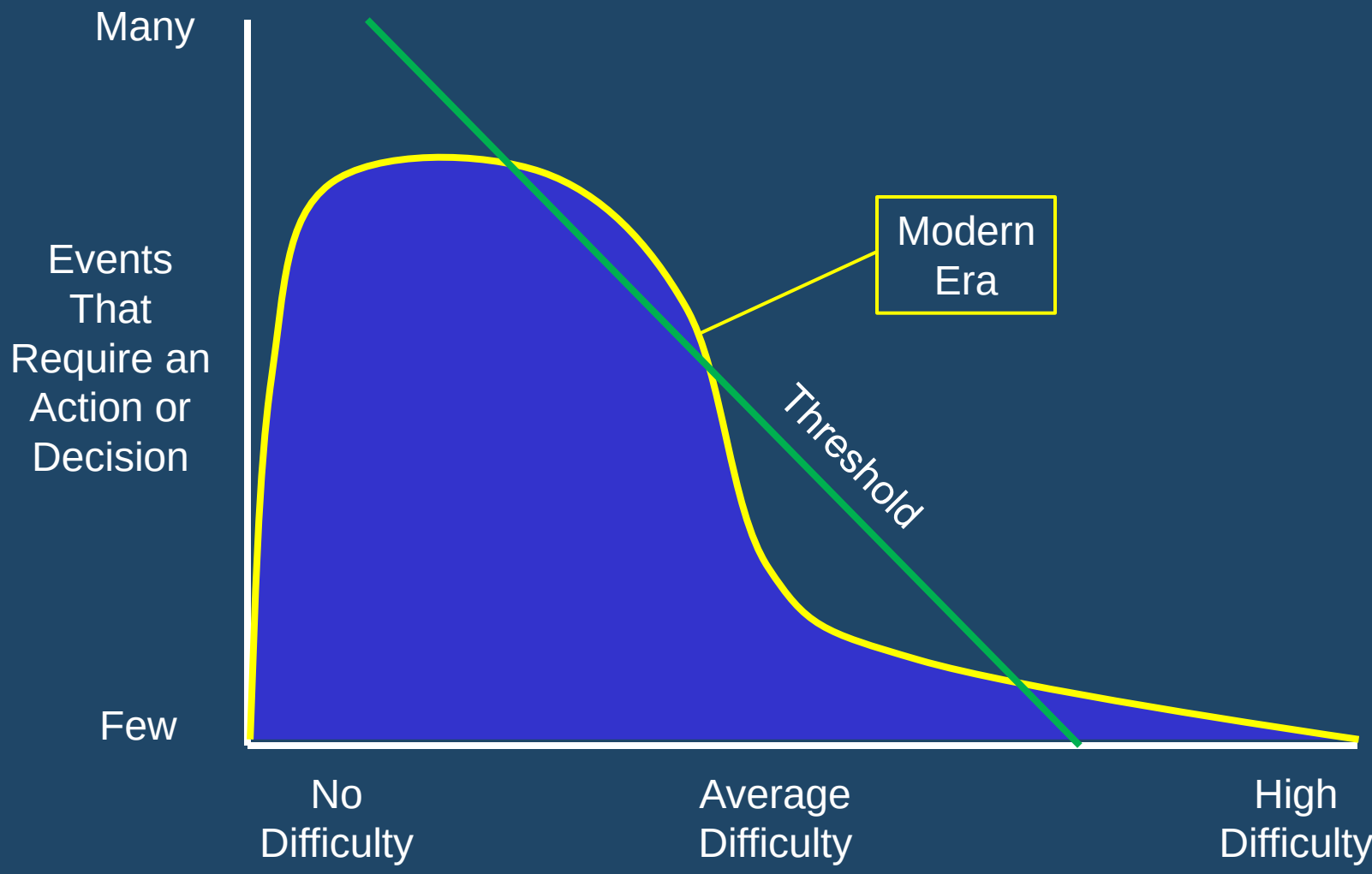

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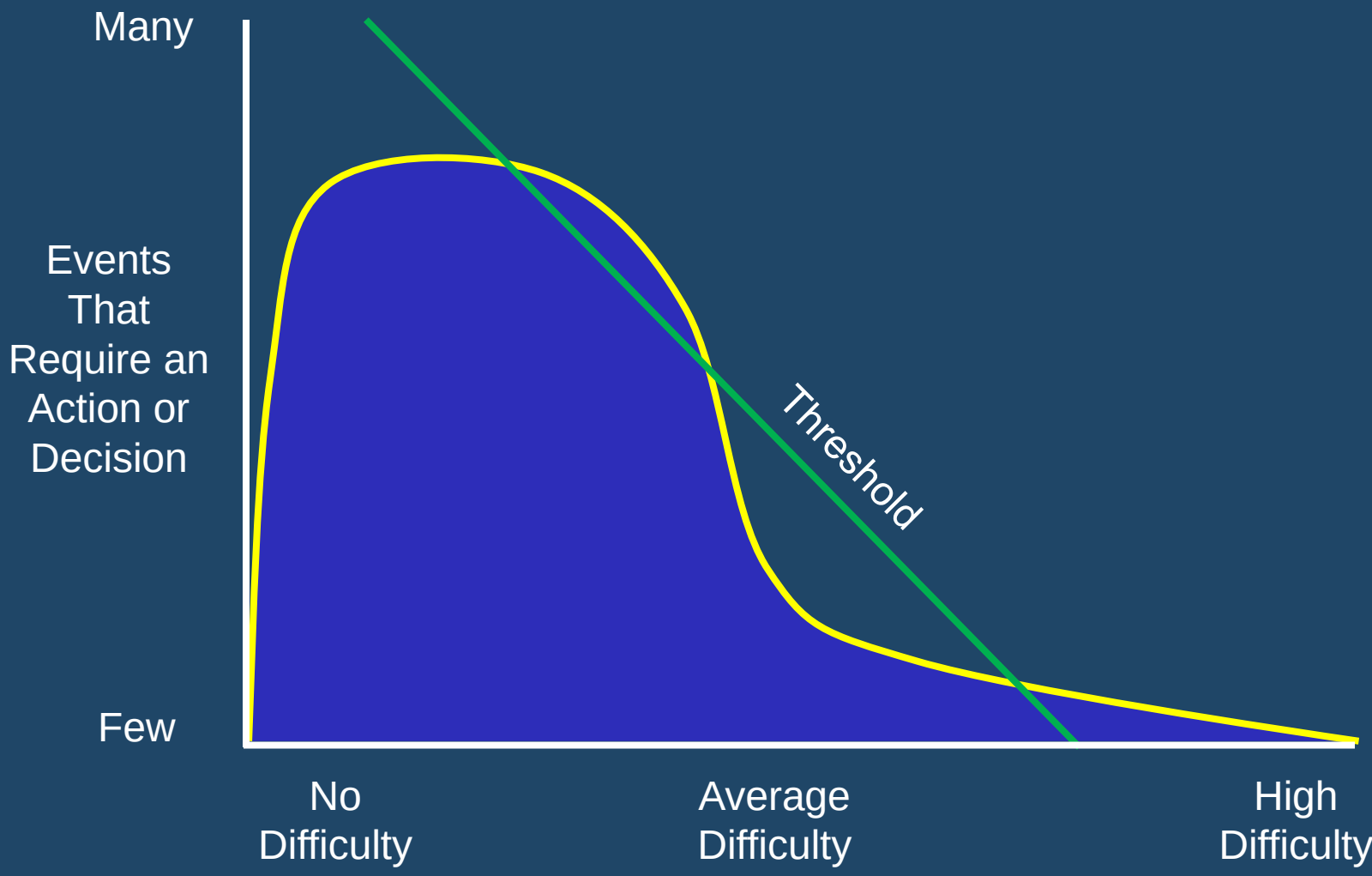
# The Effect of Crew Dysfunction



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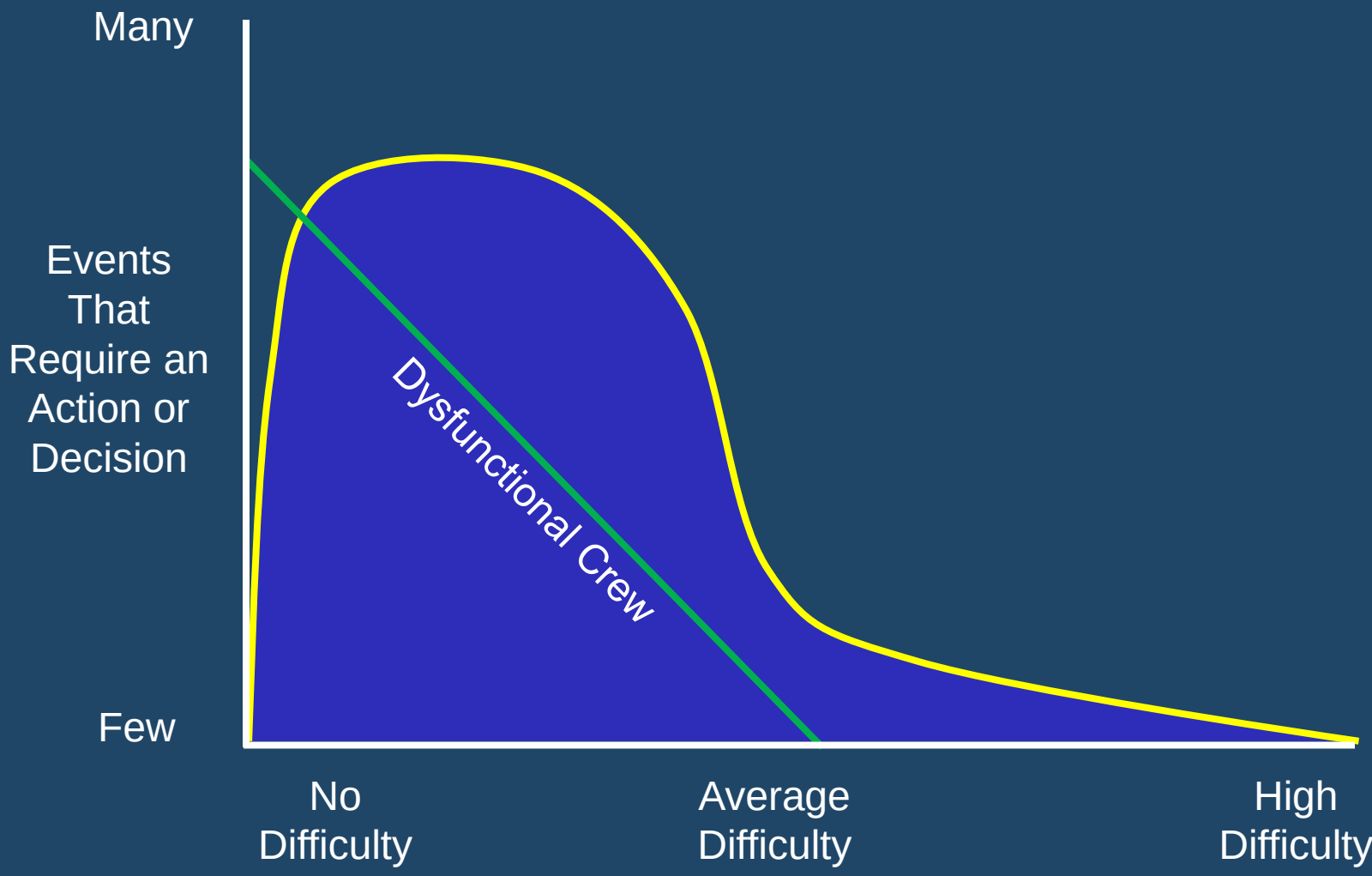

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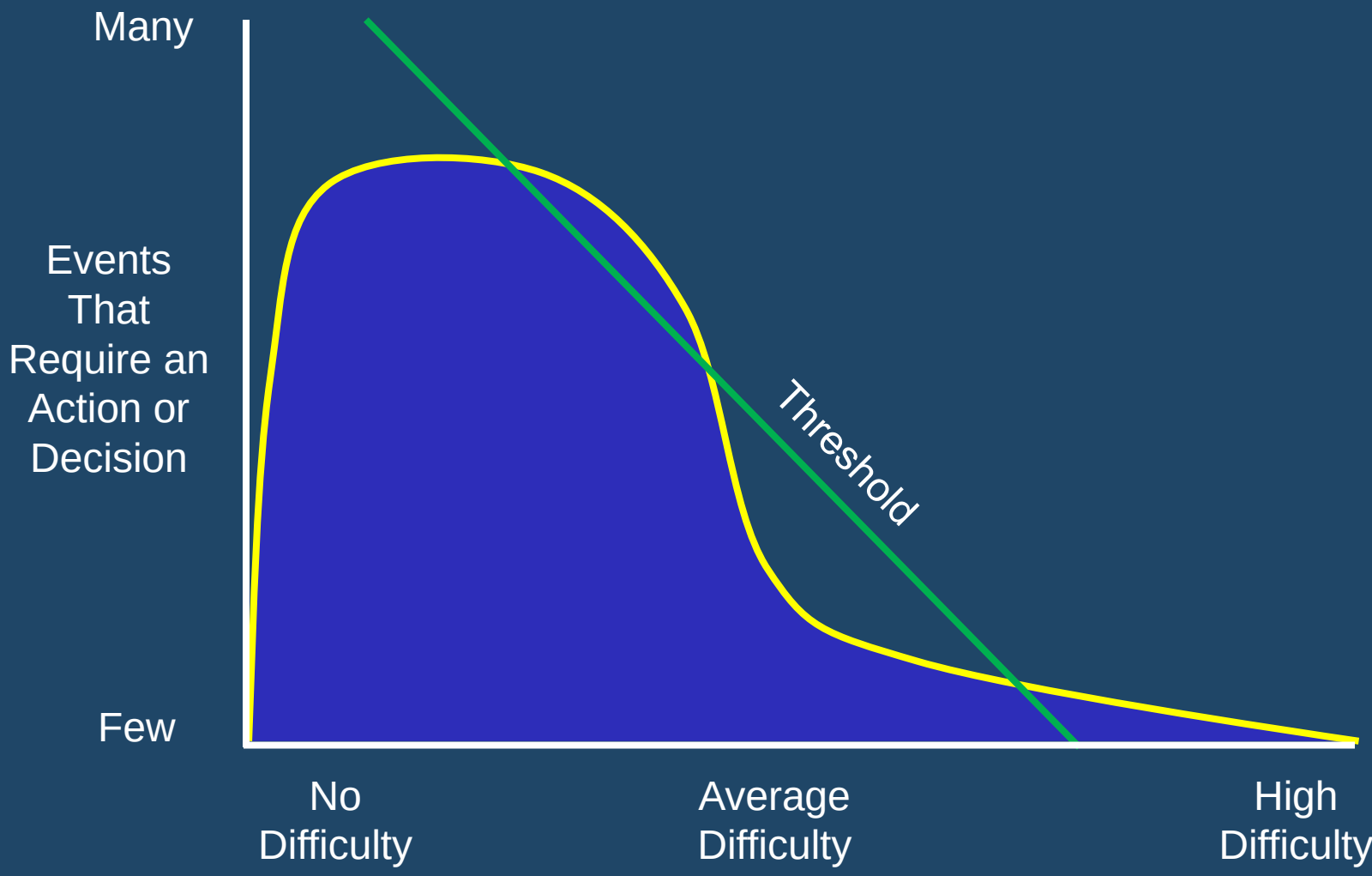
## The Effect of CRM on Crew Functionality



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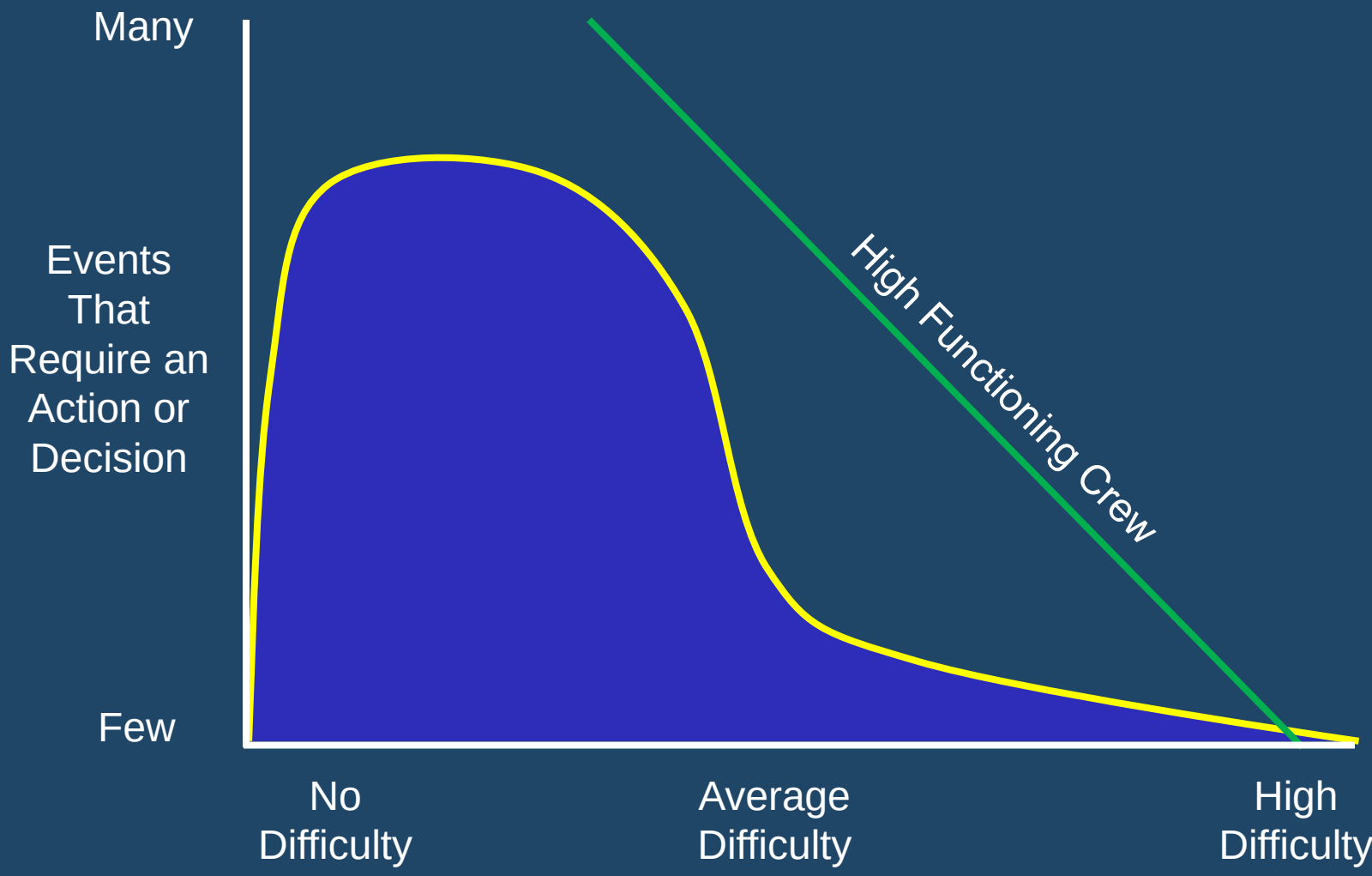

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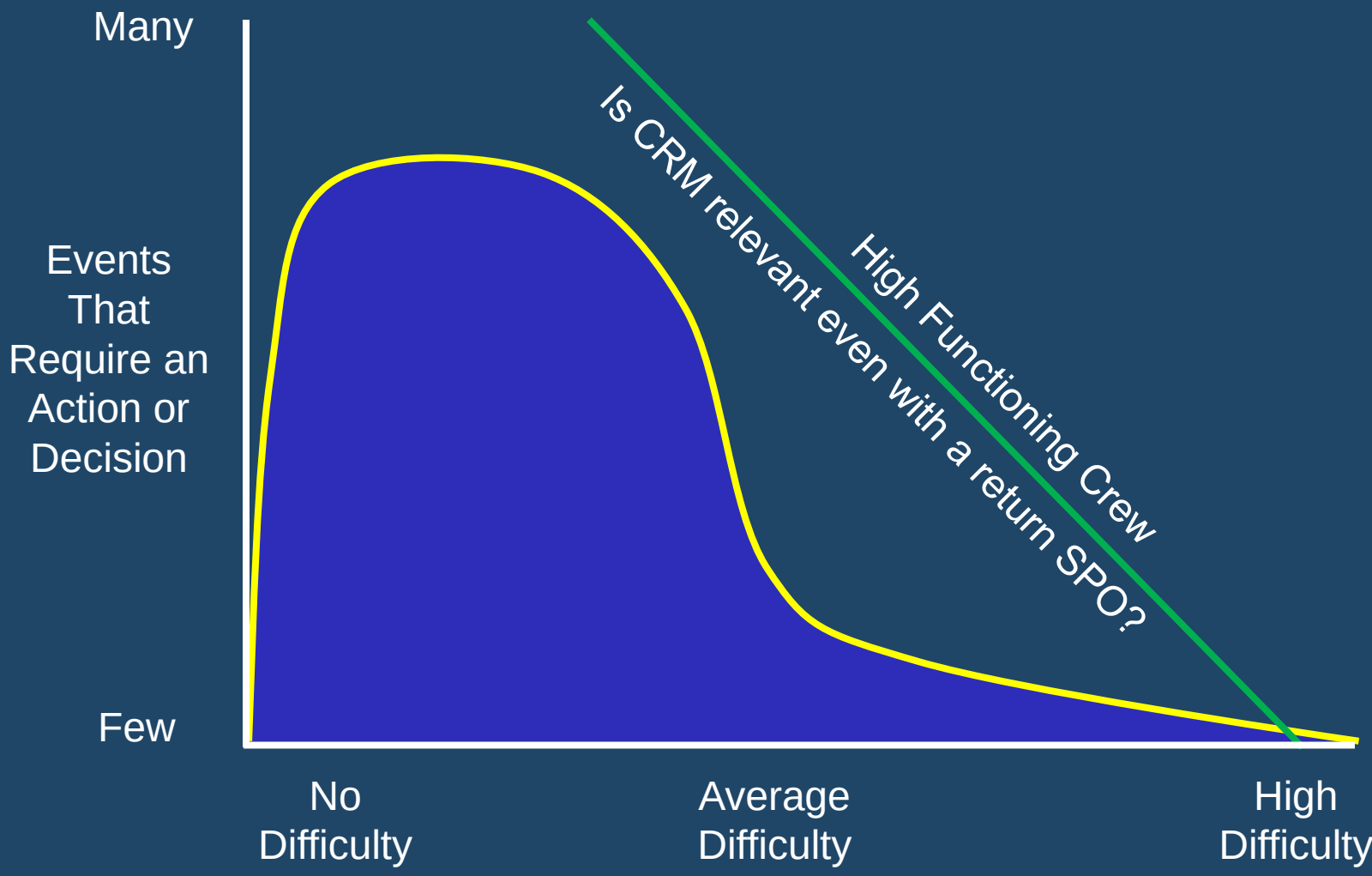

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# CRM History, Definition, and Concepts

# Crew Errors Become a Safety Emphasis

In the mid and late seventies, attention was focused on accidents involving major air carriers where the primary causal factors were seemingly inexplicable errors and lapses of judgment on the part of presumably highly trained and proficient flight crews.

- EAL 401 Miami, Florida, 1972
- UAL 173 Portland, Oregon, 1978

# CRM Considerations for Transport SPO

## Some History and CRM Basics

Research was conducted which recommended the following :

Airline pilots of the 1970's and 80's, hired and trained based on old SPO values (i.e. rugged individuals), needed new training on how to successfully operate in human teams in order to improve crew performance and thus safety.

# Evolution of CRM Training

- Initial training was by seminar (“Charm School”)
- Now CRM is fully seamless and integrated with all line and training events
  - Evaluated during realistic line oriented scenarios
  - CRM skills are observed and de-briefed
- CRM as a concept has disappeared into the group of skills that all pilots use (e.g. learning to fly on instruments, or weather radar operation)

# CRM Success Stories

- UAL 232 Sioux City, Iowa, 1989
- UAL 811 Honolulu, Hawaii, 1989
- US 1549 “Miracle on the Hudson”, 2009

# CRM Success Stories

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# OK, CRM sounds good!  What is it?

# CRM Definition

"…Use all available resources - information, equipment, and people - to achieve safe and efficient flight operations"

Both internal and external to the aircraft. (i.e. Dispatch, ATC, NWS, flight automation, etc.)

This is where CRM may apply to SPO

J. Lauber, quoted in "Crew Resource Management 2nd ed." Kanki, Helmreich, Anca (Eds.), 2010, p. 5

# The Basics:

- Commonly Trained CRM Skills
- Threat and Error Management

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# Commonly Trained CRM Skills

- Decision making
- Adaptability / Flexibility
- Mission Analysis
- Monitoring and Correcting
- Communication
- Leadership
- Assertiveness
- Situation Awareness

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# Commonly Trained CRM Skills

- Decision making
- Adaptability / Flexibility
- Mission Analysis
- Monitoring and Correcting
- Communication
- Leadership
- Assertiveness
- Situation Awareness

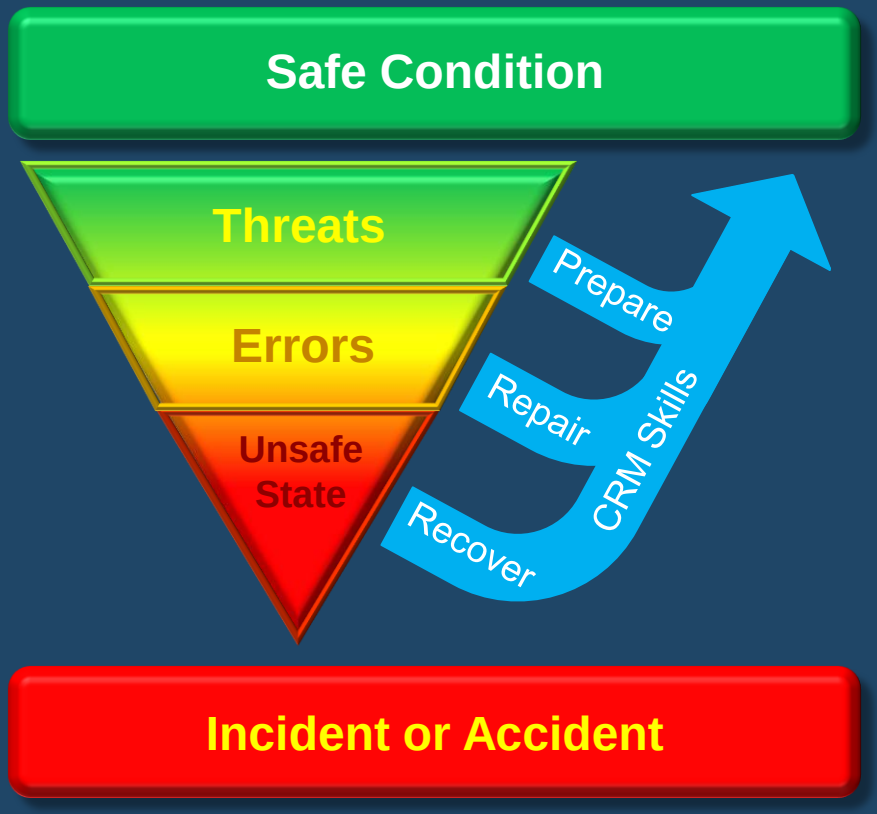
Why might these things still be important when there is only one pilot?

# Threat and Error Management

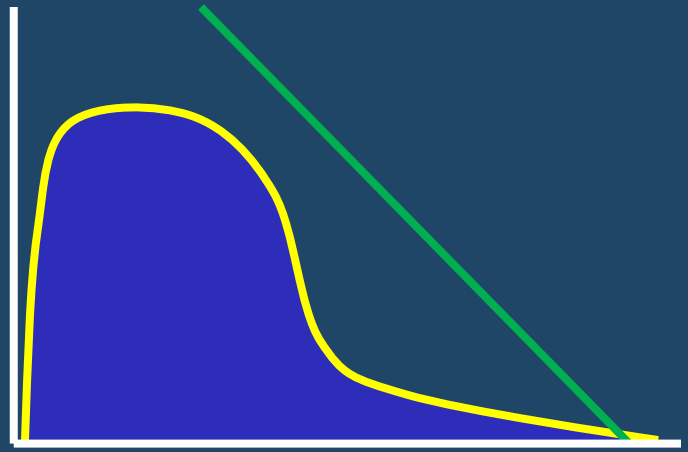
- Constant observation to identify and prepare for threats to the operation
  - Any unusual circumstance that could affect the aircraft or crew (fatigue, maintenance issues, weather, unusual airport configuration, etc.)
- Constant monitoring of self and crew actions to identify, repair, and minimize errors

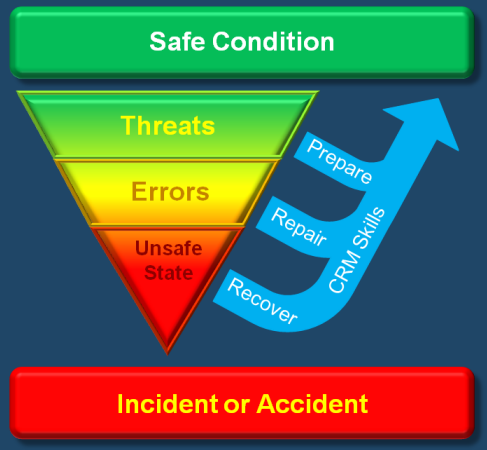
Some History and CRM Basics

# Threat and Error Management



# A Thought Concerning Collaboration:






What is it that allows these concepts to work?

- An effective leader making decisions in collaboration with equally capable team members.
- How can we ensure that automation which may replace a human will have good CRM skills?

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# Discussion of Pilot Cognitive Functions

The duties and responsibilities of managing the “project” of getting an airline flight safely planned, flown, and recovered, are most of what pilots do every day.

They do this as part of, and in concert with, a complex web of teams.

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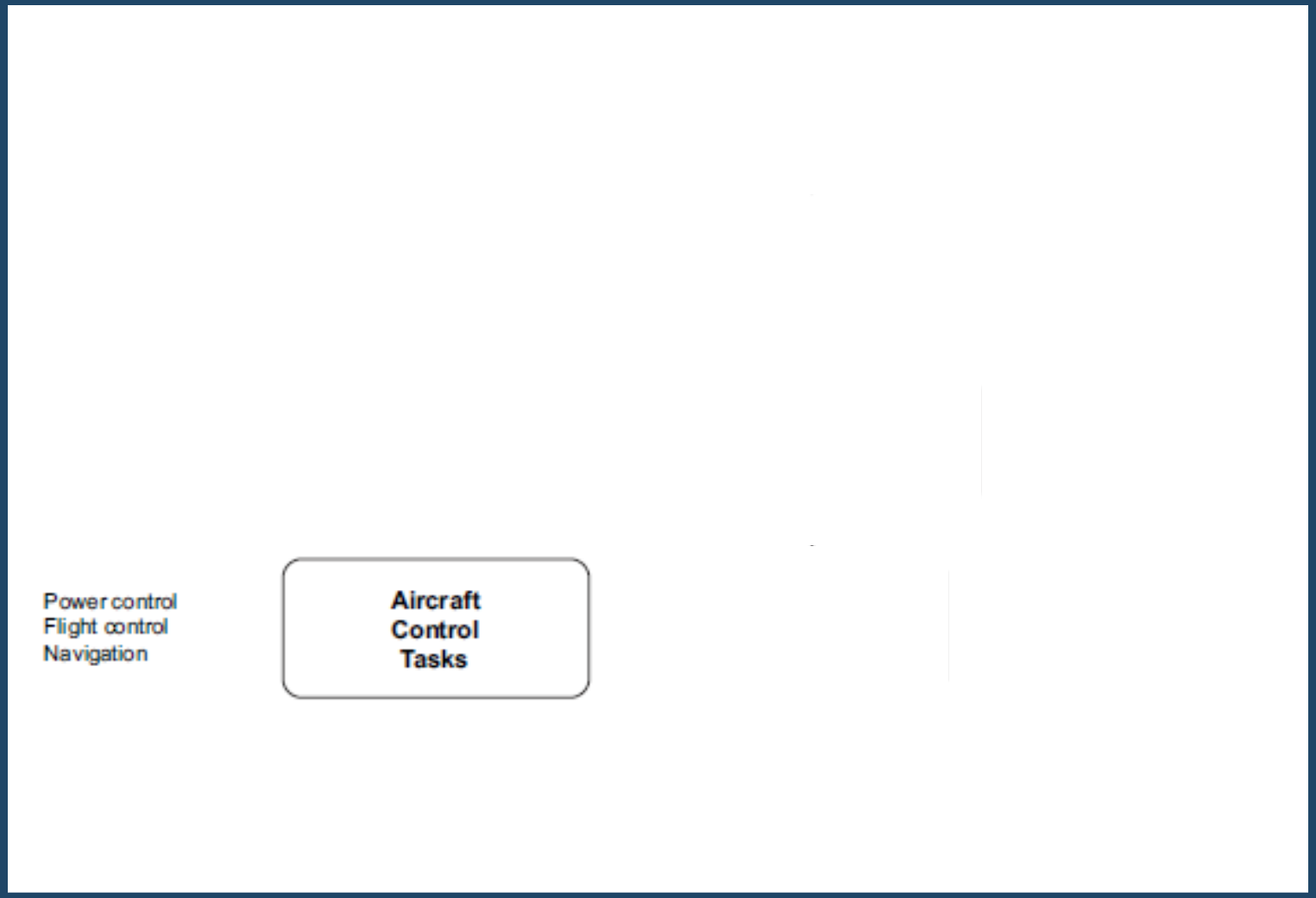
CRM research and training has embraced this philosophy and may provide some rich insight as we begin to explore SPO for transport aircraft.

# CRM Considerations for Transport SPO




From: “Crew Resource Management 2nd ed.” Kanki, Helmreich, Anca (Eds.), 2010, pg 22, Figure 1.4

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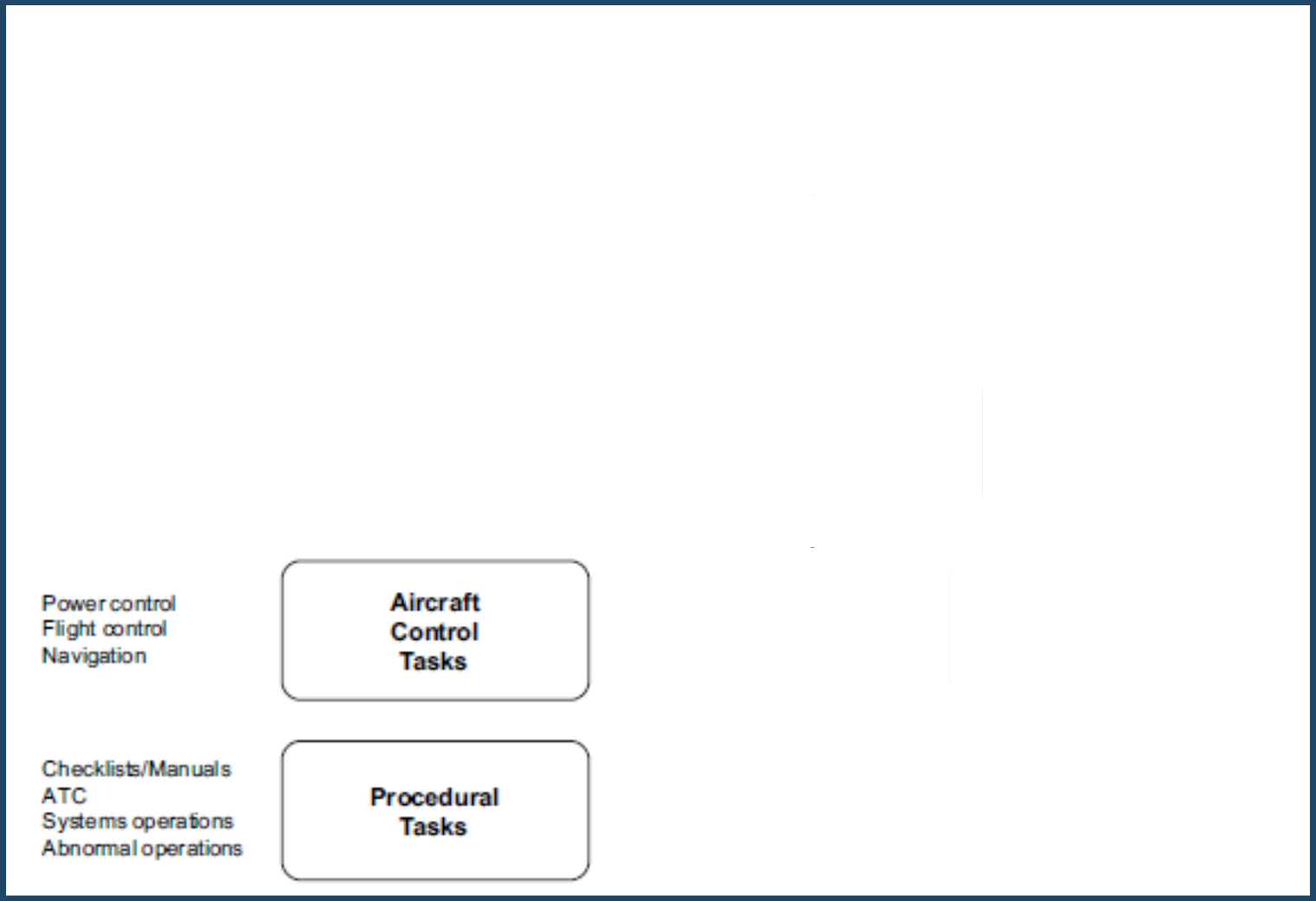


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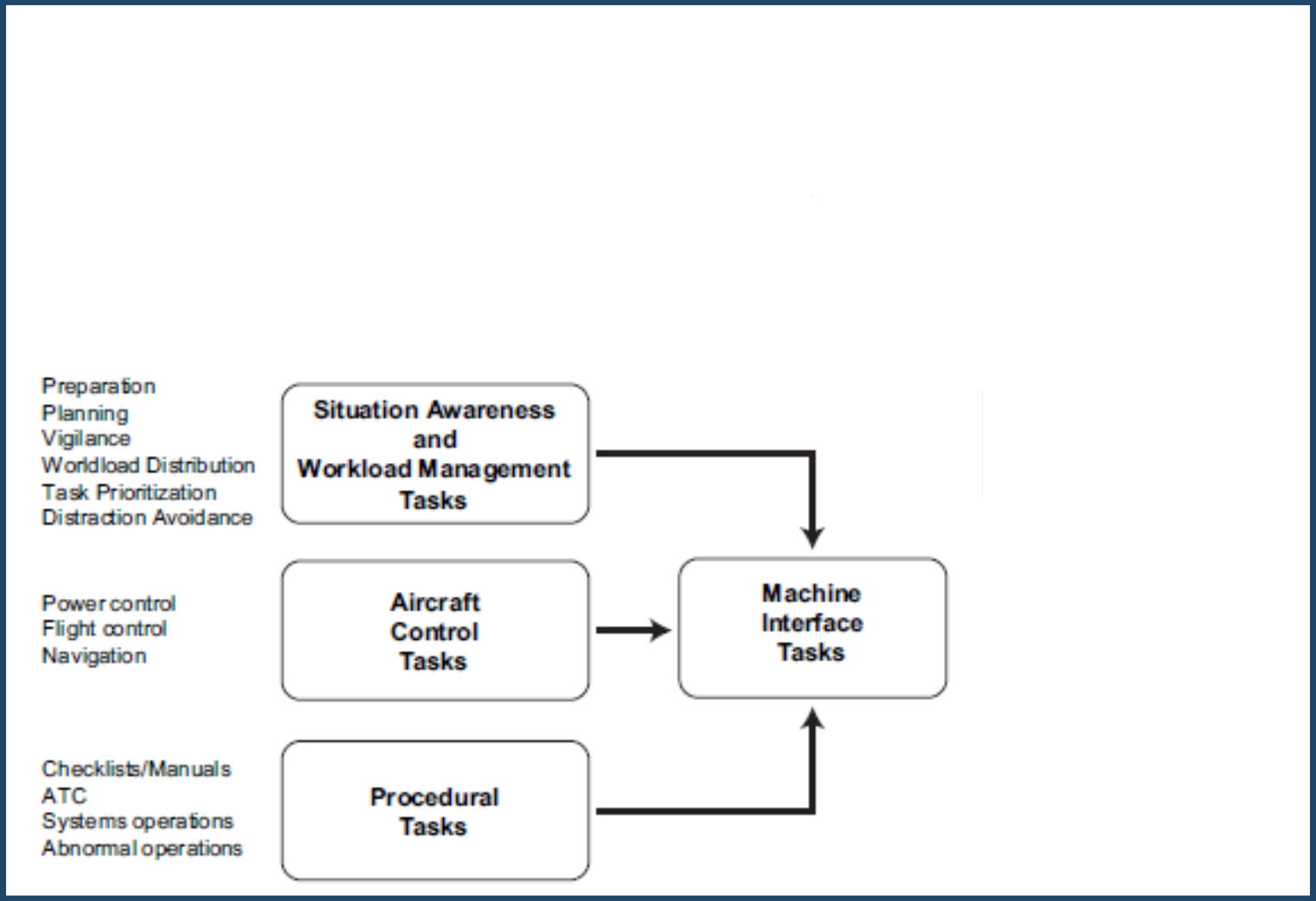


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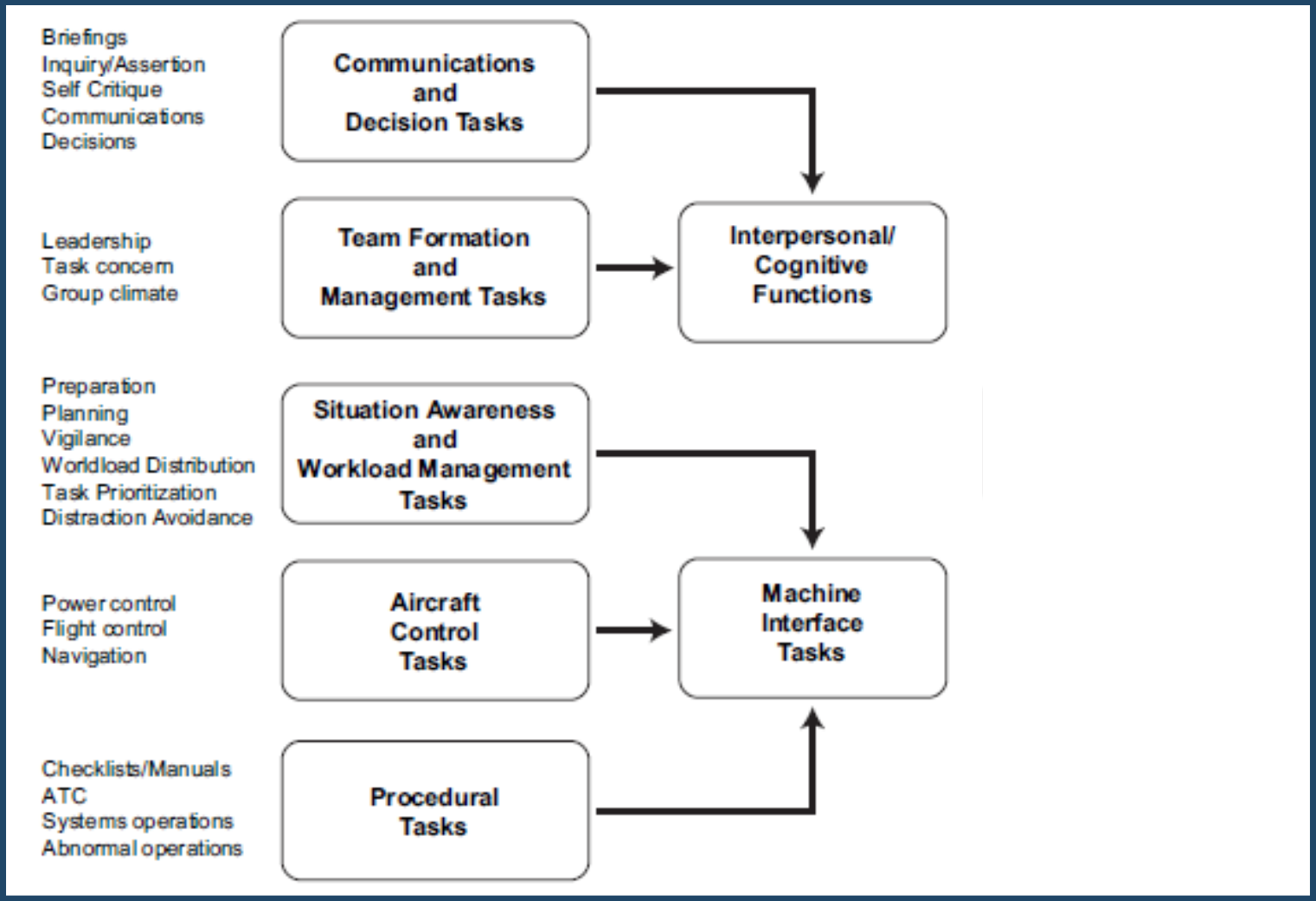


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# CRM Considerations for Transport SPO

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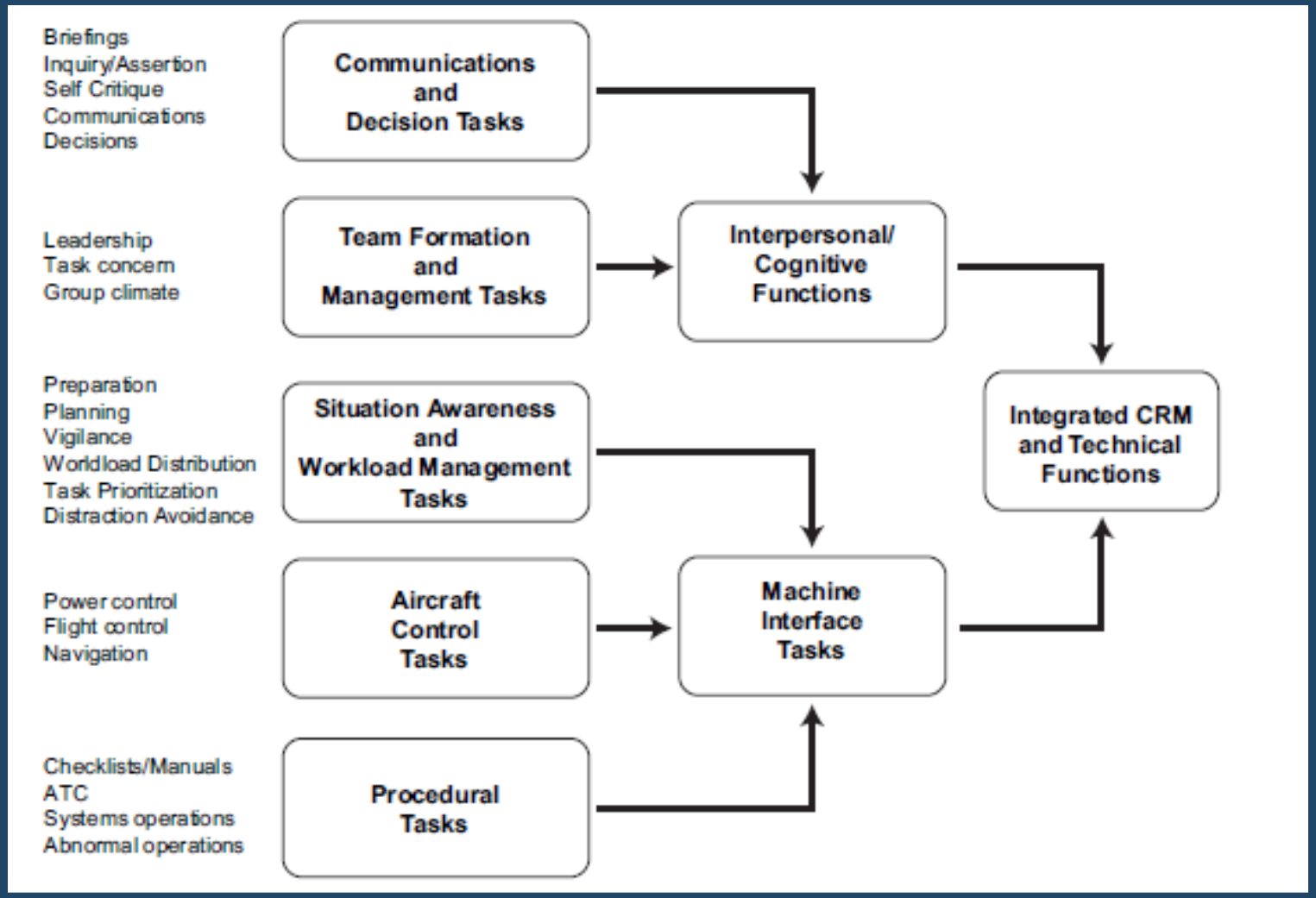


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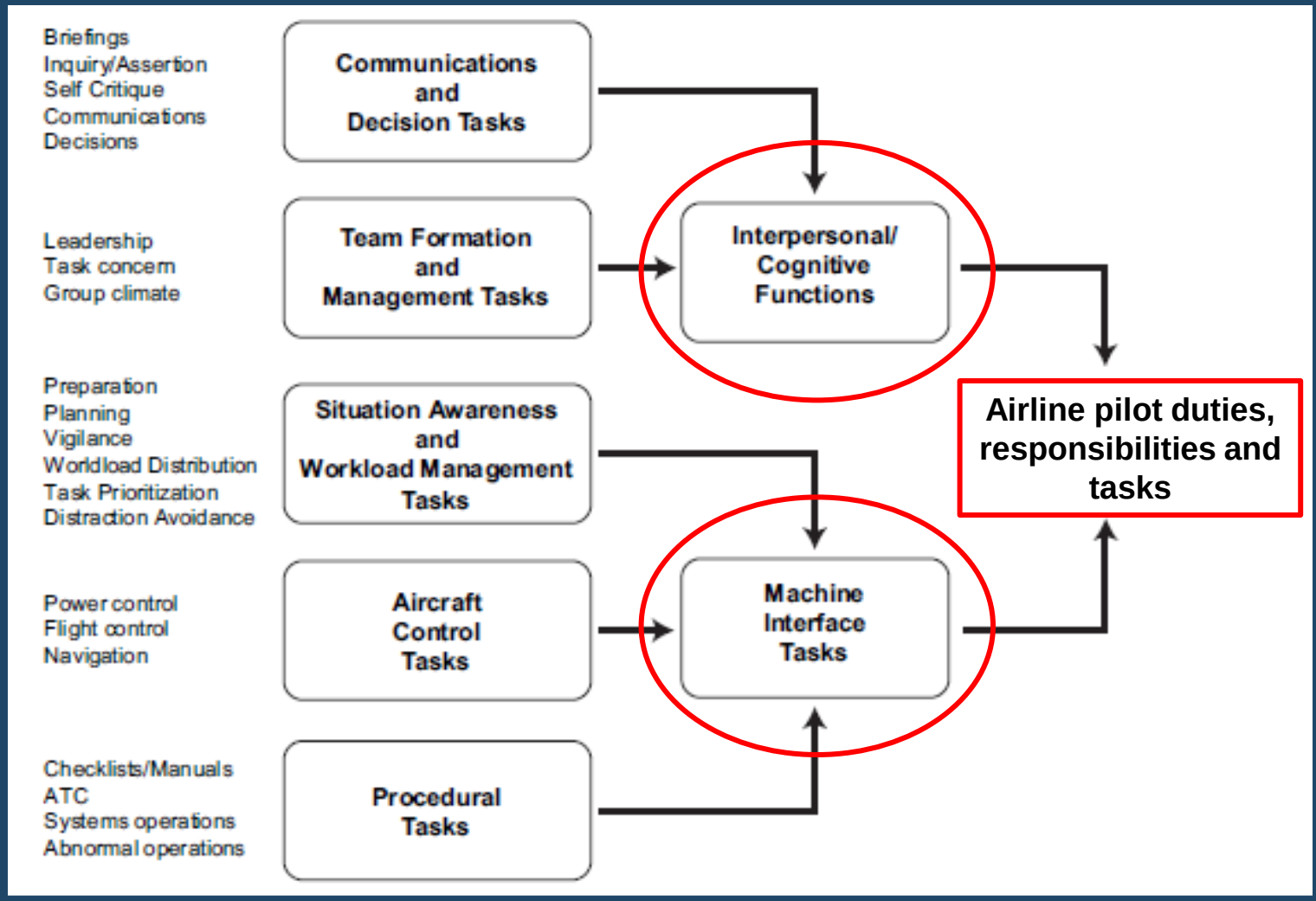


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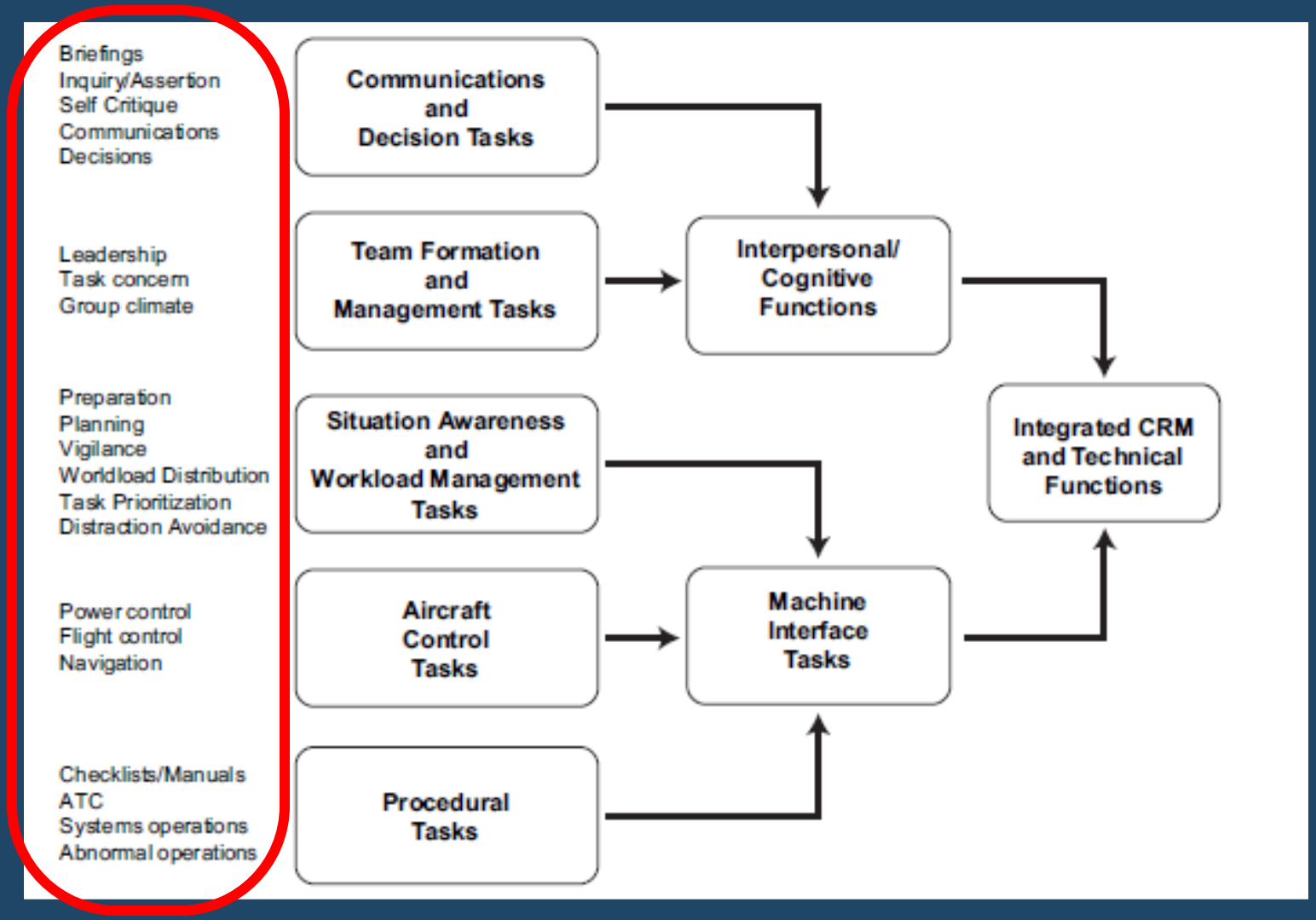
# CRM Considerations for Transport SPO

## Pilot Cognitive Functions

So by considering CRM concepts, we have two broad areas into which the pilot's duties responsibilities and tasks can be placed:

- Machine Interface Tasks
  - Flight control, navigation, planning, checklists, etc.
- Interpersonal/Cognitive Functions
  - Decision Making, Communication, Leadership, Monitoring/Correcting, etc.

# CRM Considerations for Transport SPO

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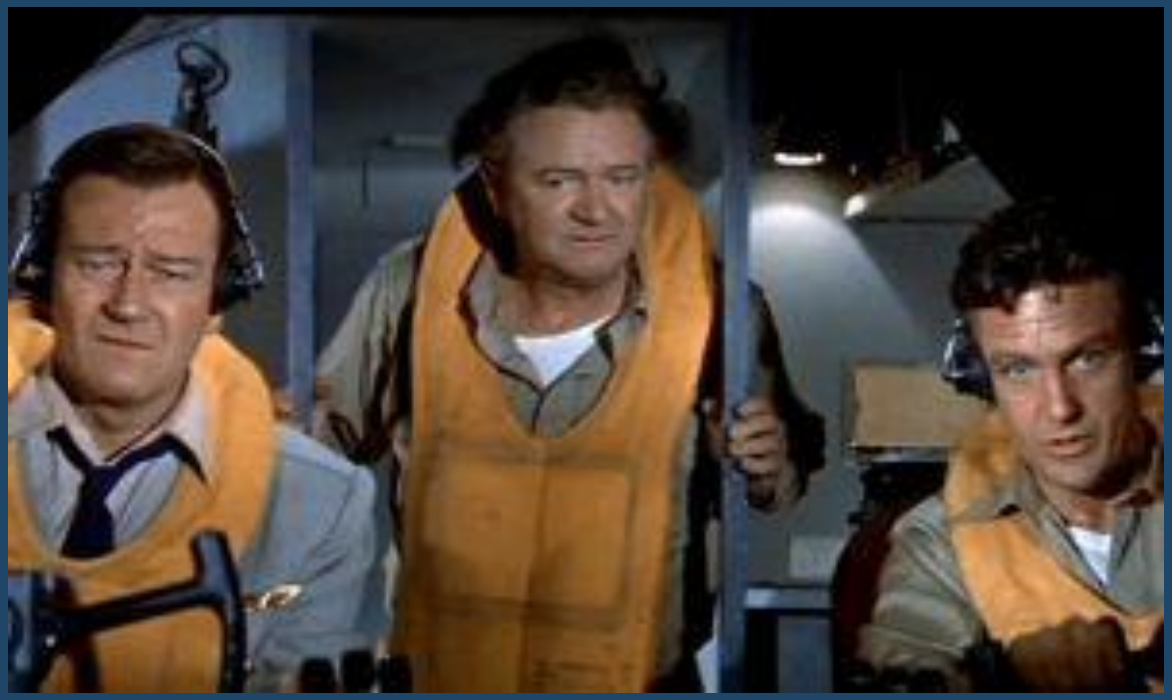
## Conclusion

In Conclusion, I believe we should:

- Retain safety benefits reaped from CRM while designing SPO
- Use CRM concepts to define the duties and responsibilities of not just the pilot but the web of teams and automation that will exist in SPO
- Enable a single pilot to adequately coordinate with all resources to produce sound decisions at high levels of performance and safety

# A Last CRM Example…



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# CRM in the 1930's ?

Let's not go back THERE…

# CRM Considerations for Transport SPO

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*Questions?*