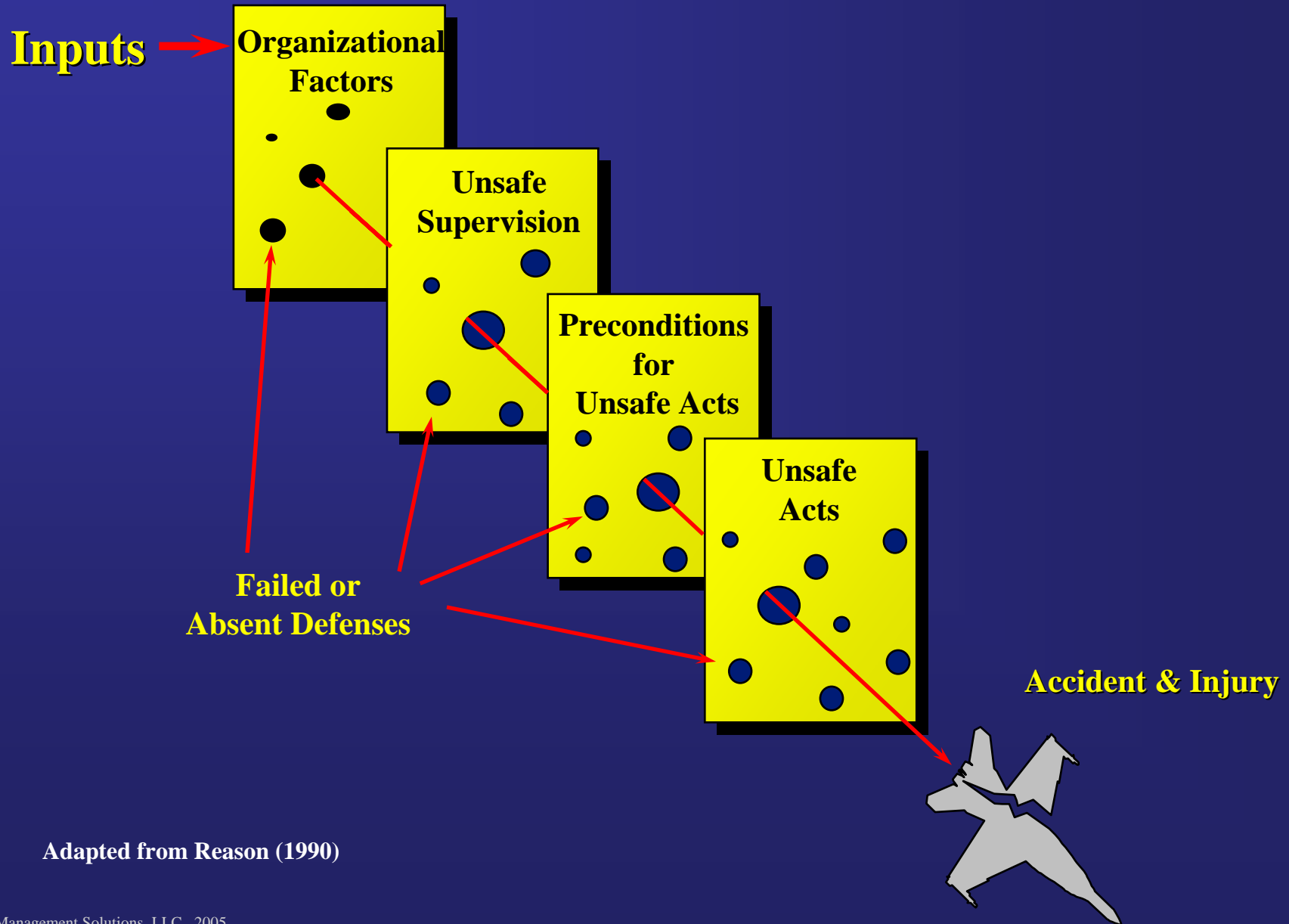


The Human Factors Analysis and Classification System (HFACS)

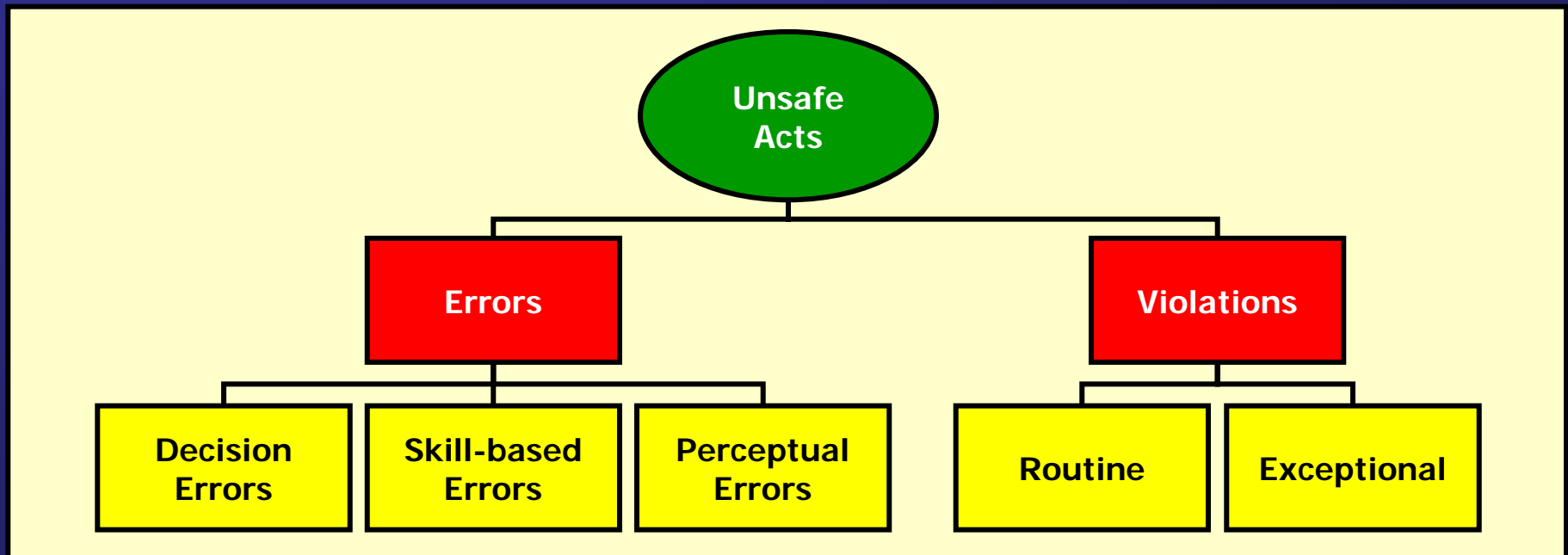


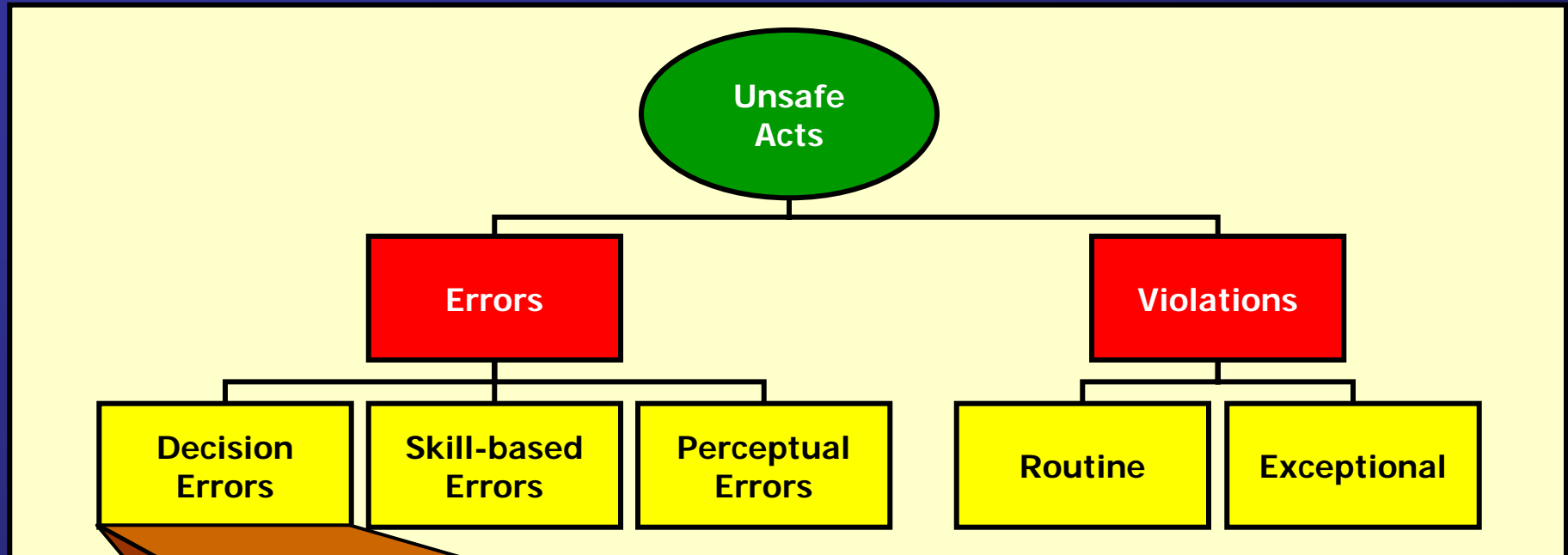
Scott A. Shappell, Ph.D.
Wiegmann, Shappell, & Associates

“Swiss-cheese” Model of Human Error



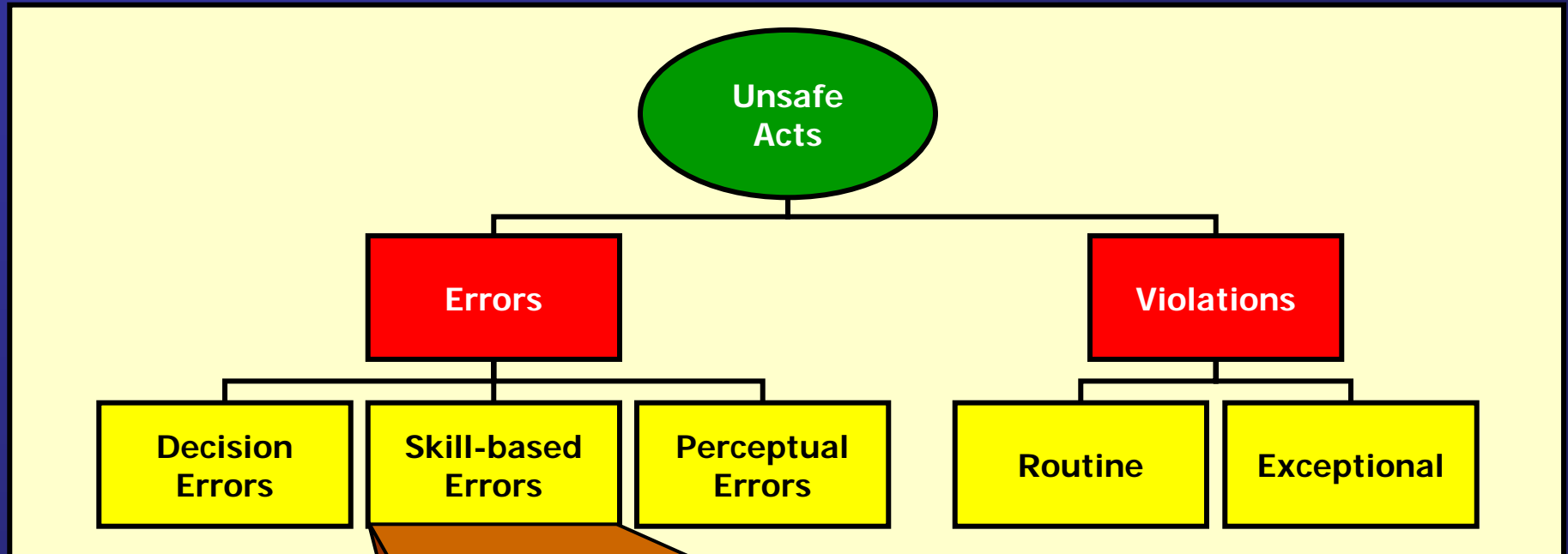
Adapted from Reason (1990)





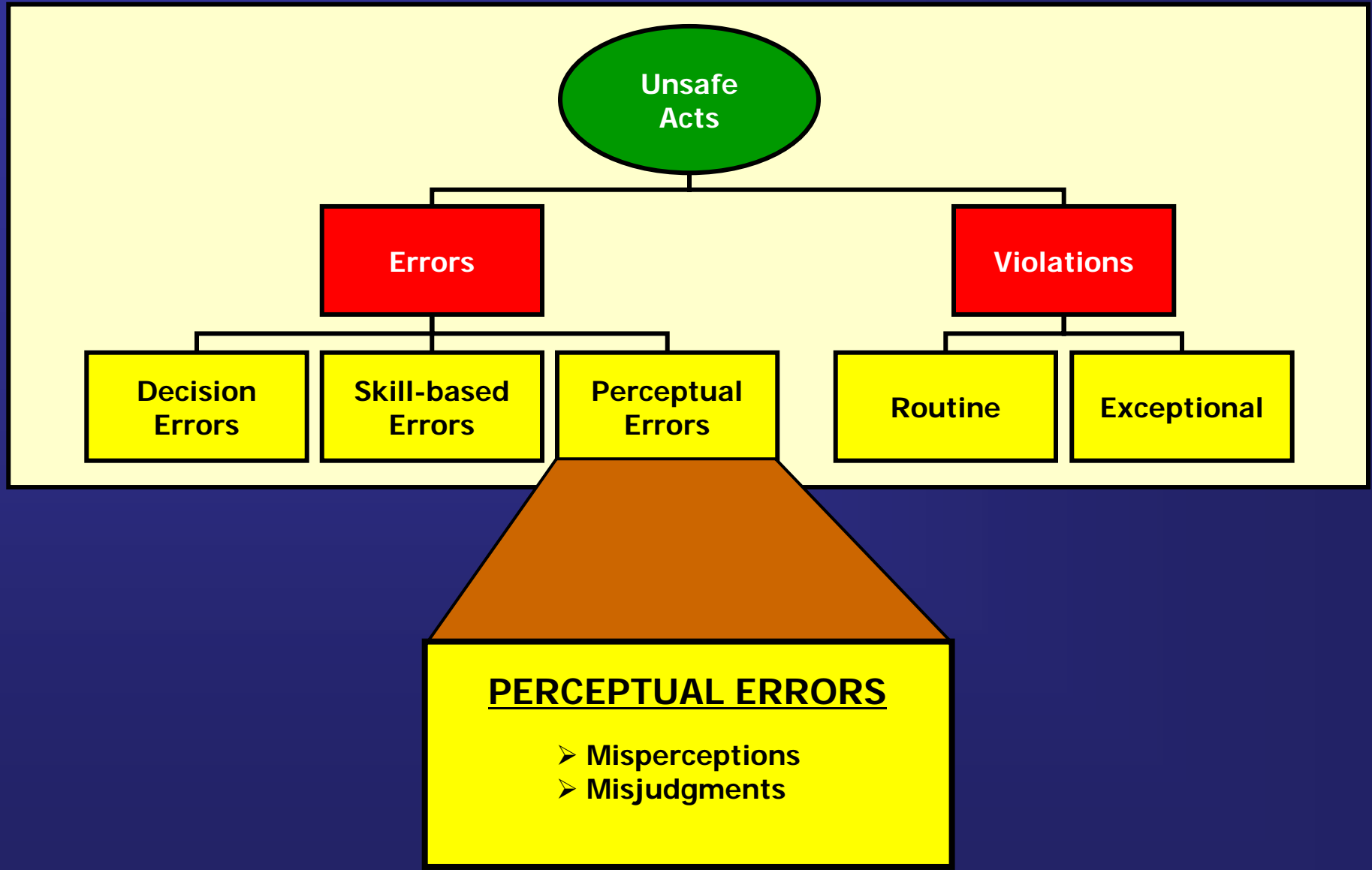
DECISION ERRORS

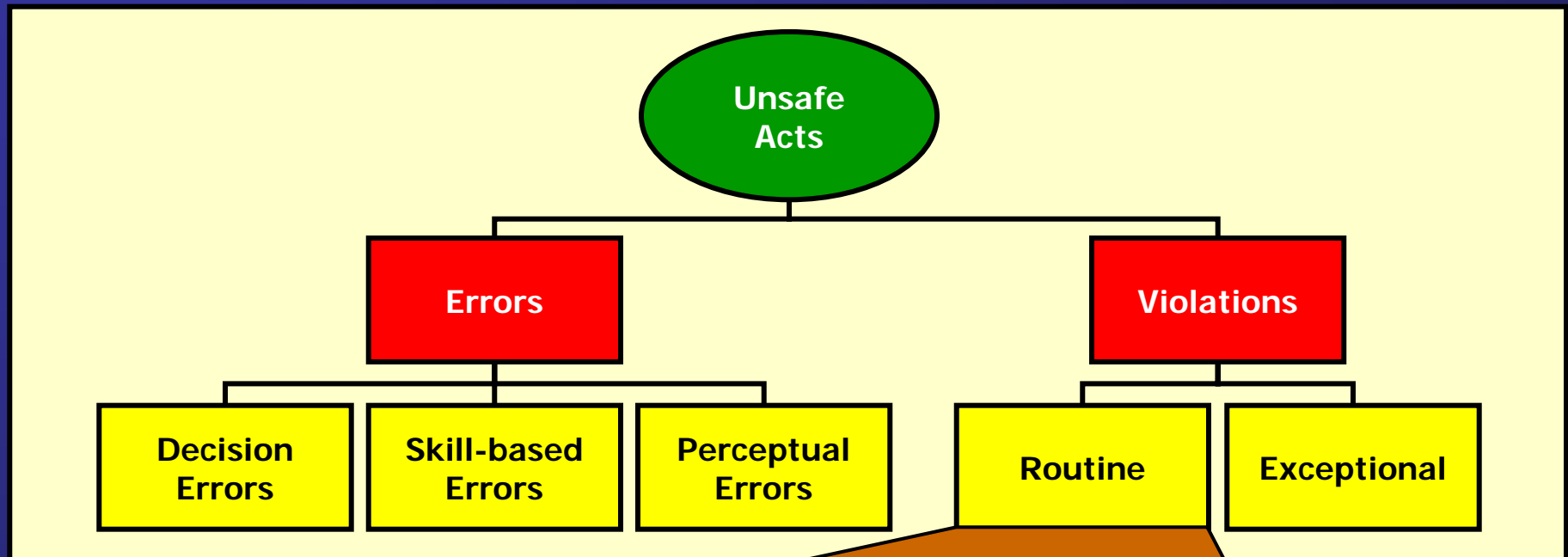
- Rule-based Decisions
- Choice Decisions
- Ill-Structured Decisions



SKILL-BASED ERRORS

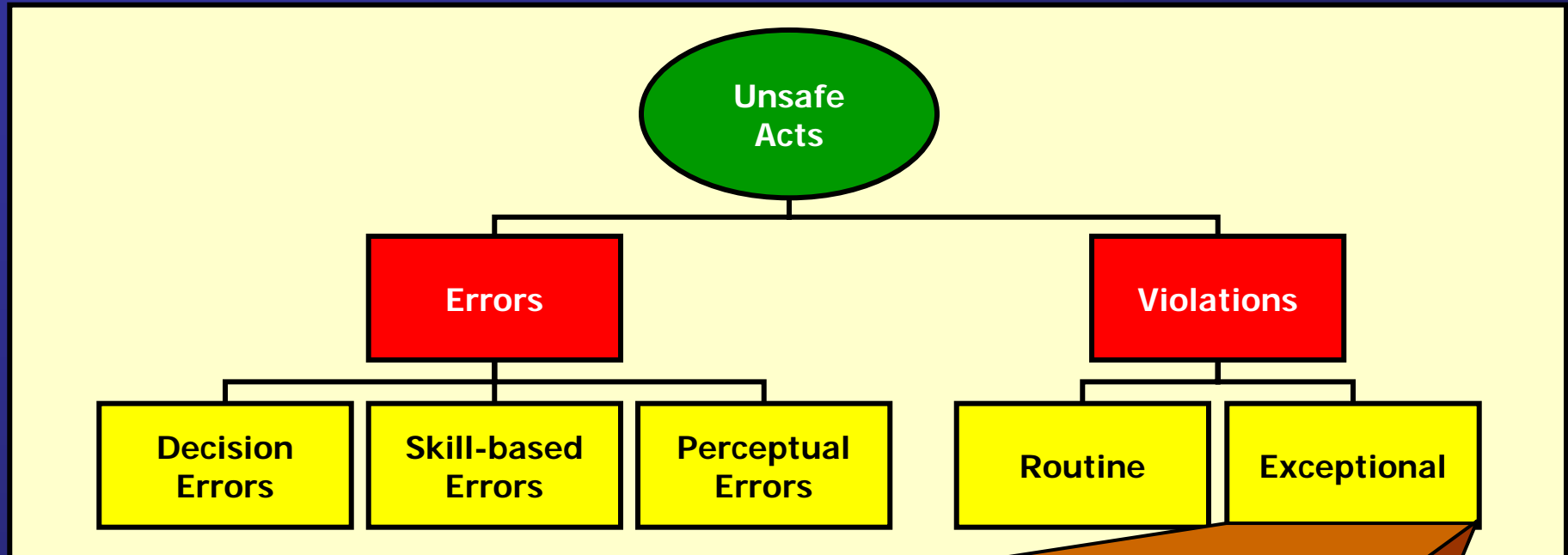
- Attention Failures
- Memory Failures
- Technique Errors





ROUTINE VIOLATIONS
(Habitual departures from rules condoned by management)

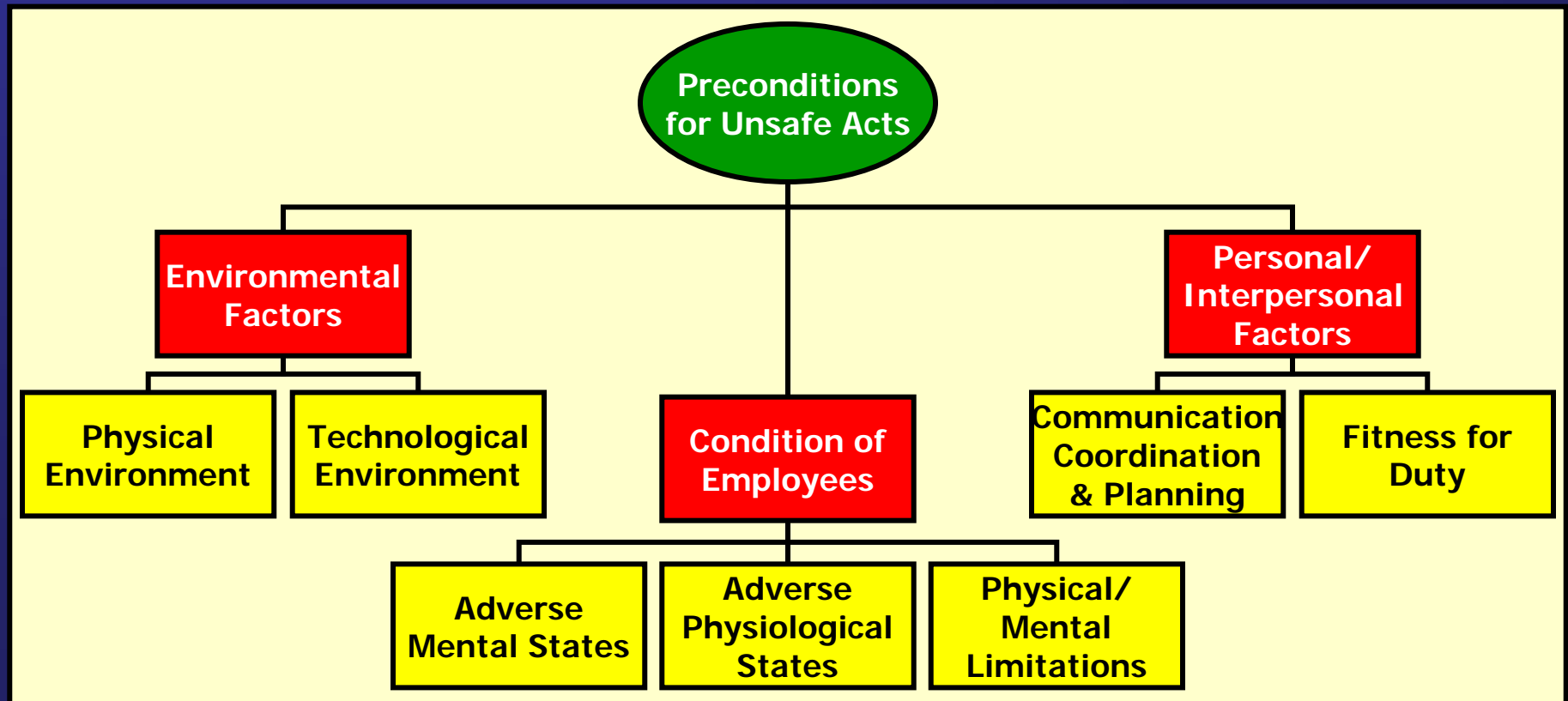
- Violated training rules
- Failed to comply with departmental manuals
- Violation of orders, regulations, and/or SOPs

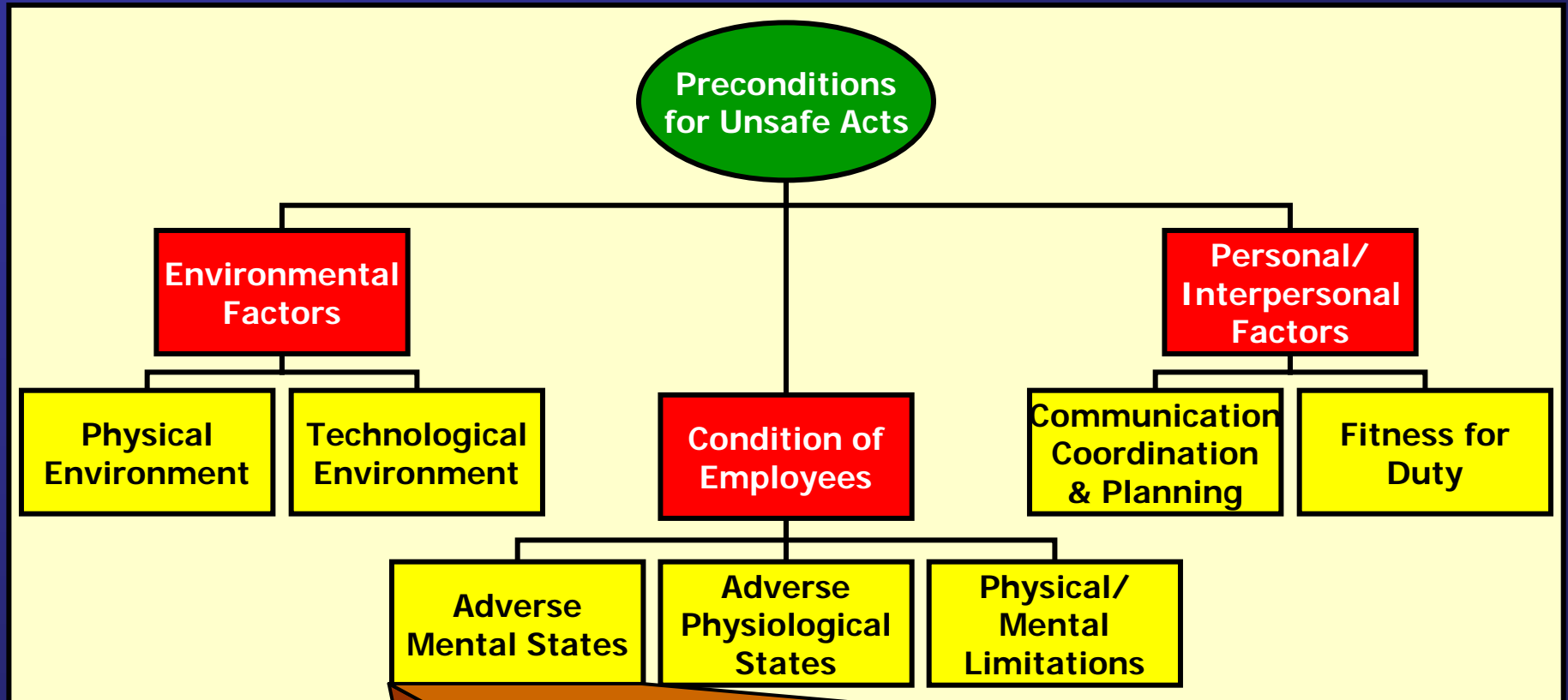


EXCEPTIONAL VIOLATIONS

(Isolated departures from the rules not condoned by management)

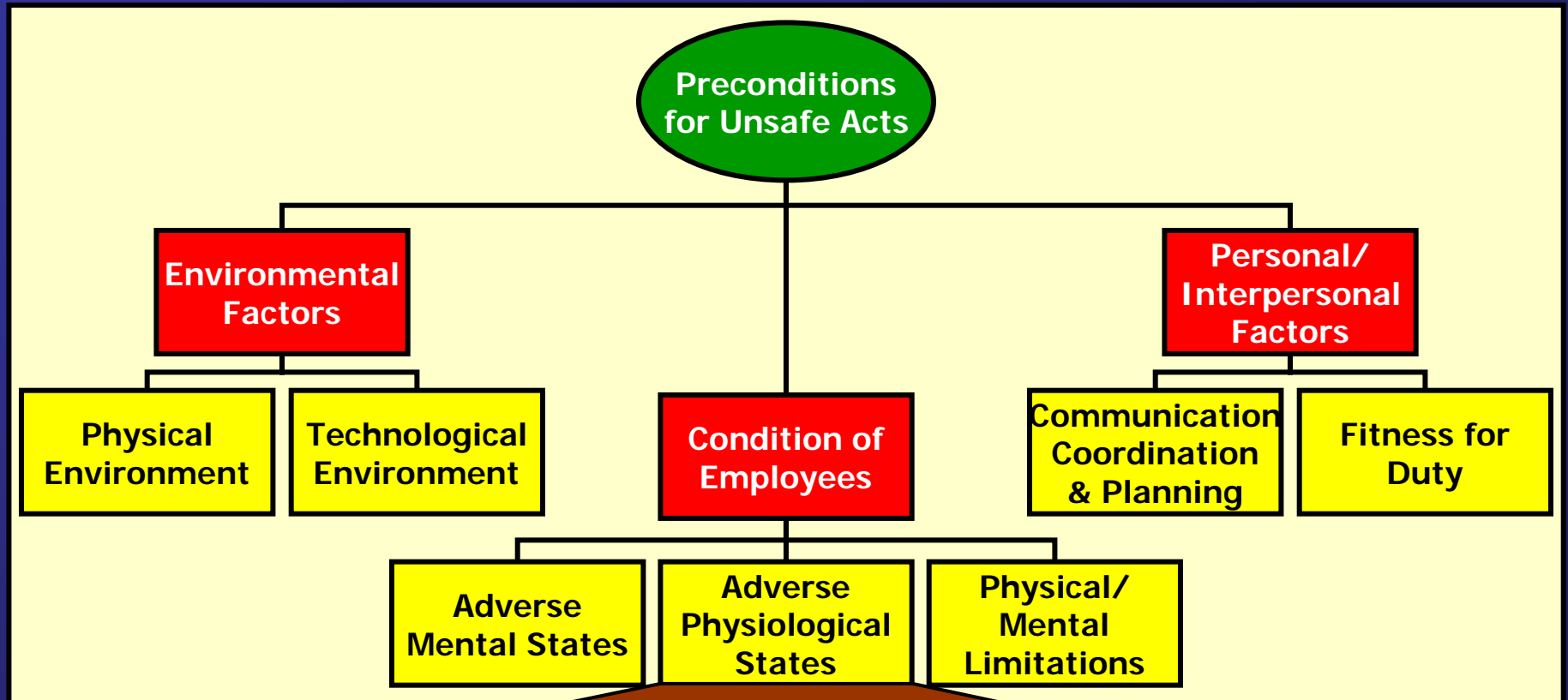
- Performed unauthorized operation
- Accepted unauthorized hazard
- Not current/qualified





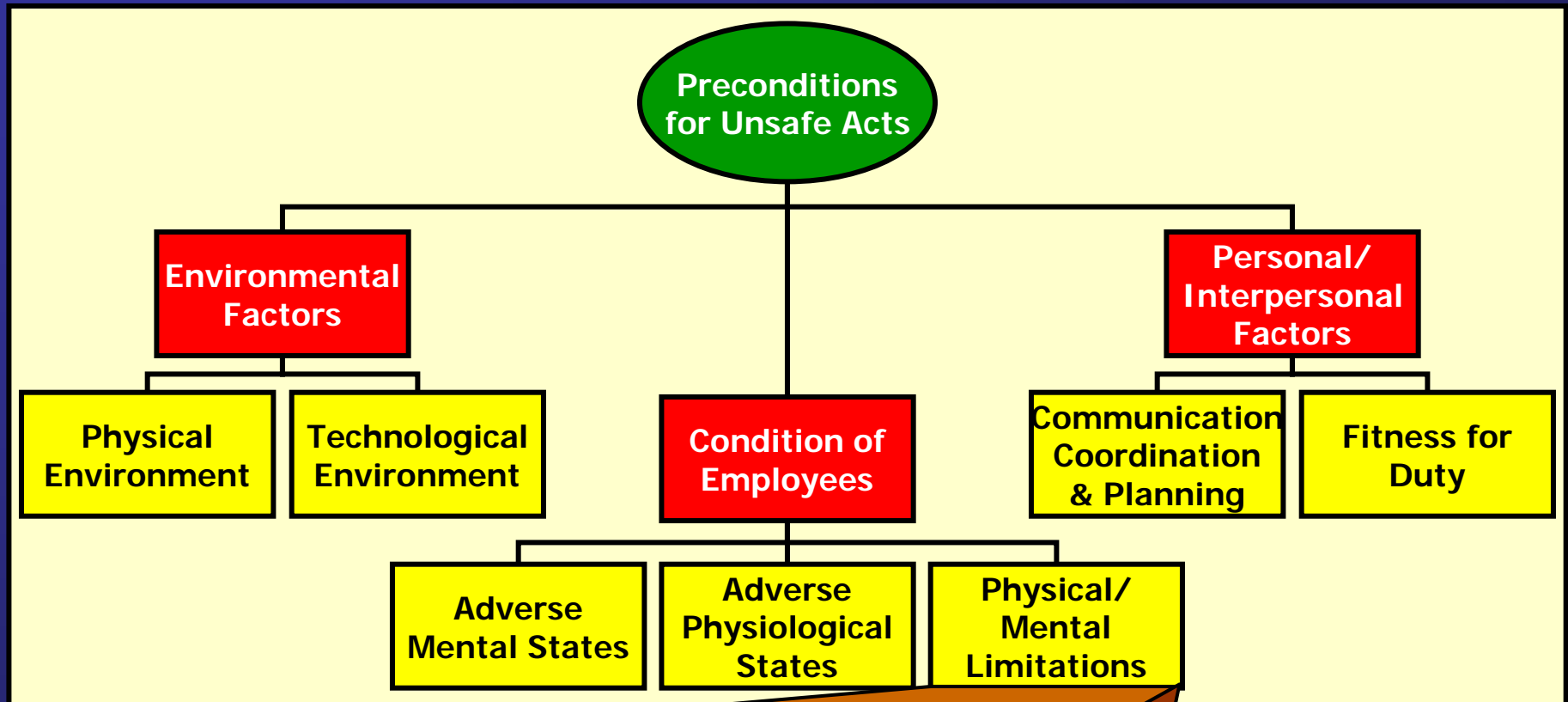
ADVERSE MENTAL STATES

- Complacency
- Stress
- Overconfidence
- Mental fatigue
- Distraction
- Confusion



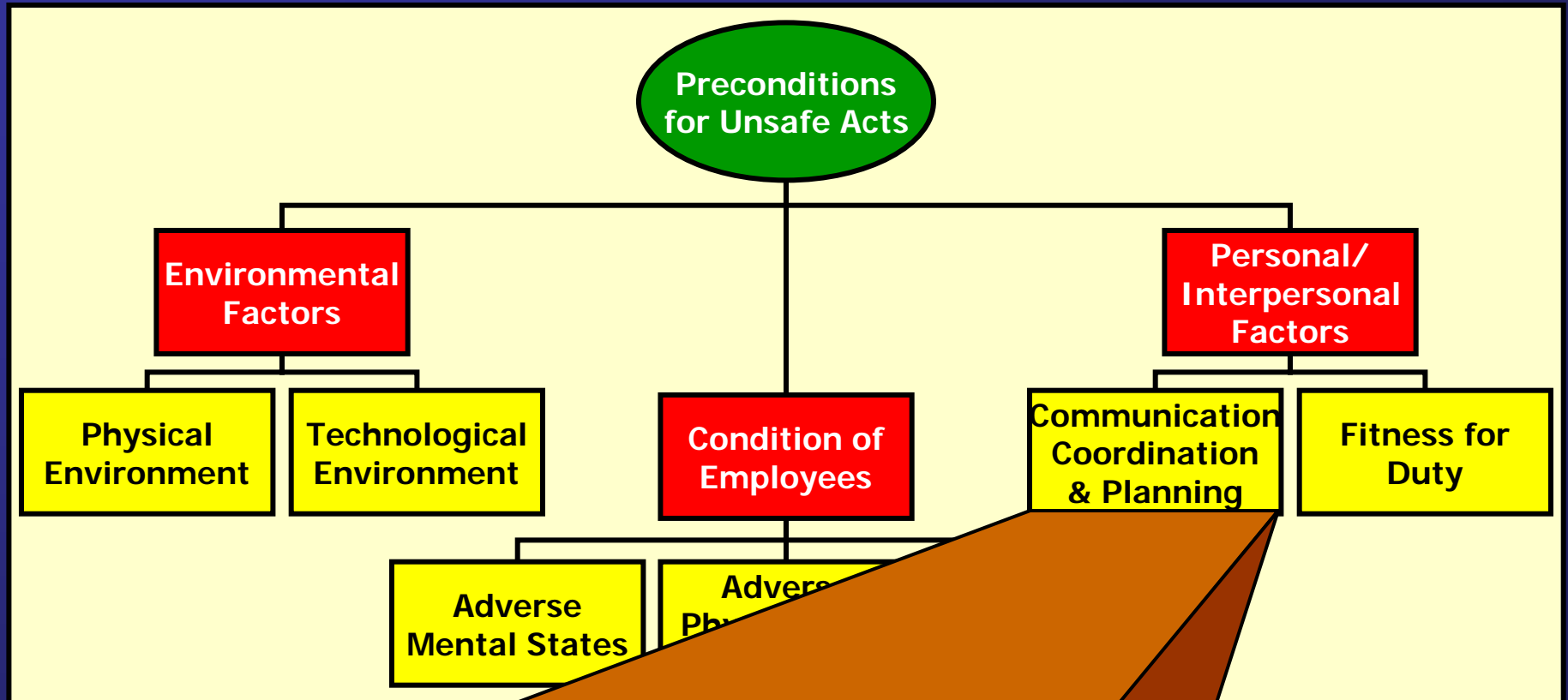
ADVERSE PHYSIOLOGICAL STATES

- Physical fatigue
- Visual Illusions
- Hypoxia
- Medical illness



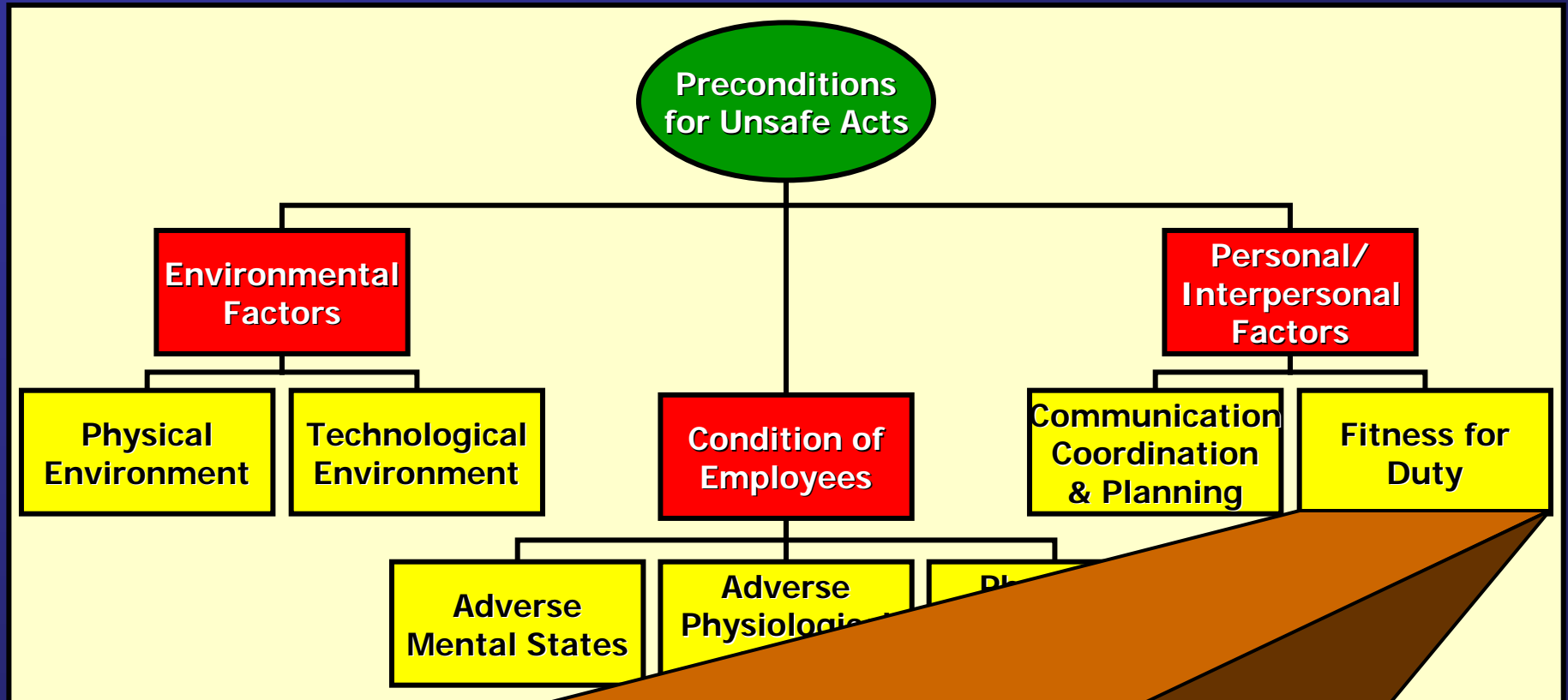
PHYSICAL/MENTAL LIMITATIONS

- Visual limitations
- Hearing limitation
- Not current/qualified
- Incompatible physical capability
- Incompatible intelligence/aptitude



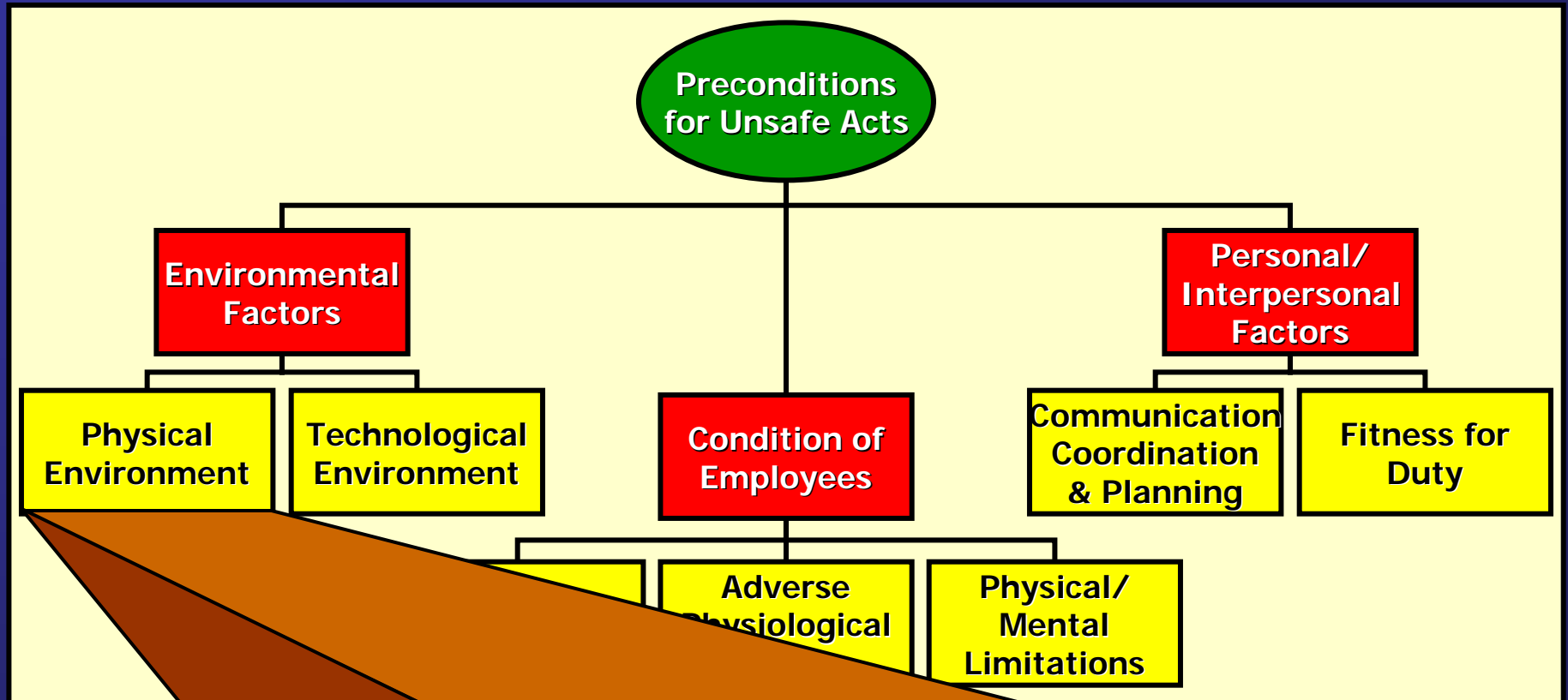
Communication Coordination & Planning

- Failed to conduct adequate brief
- Lack of teamwork
- Poor communication/coordination
- Failure of leadership



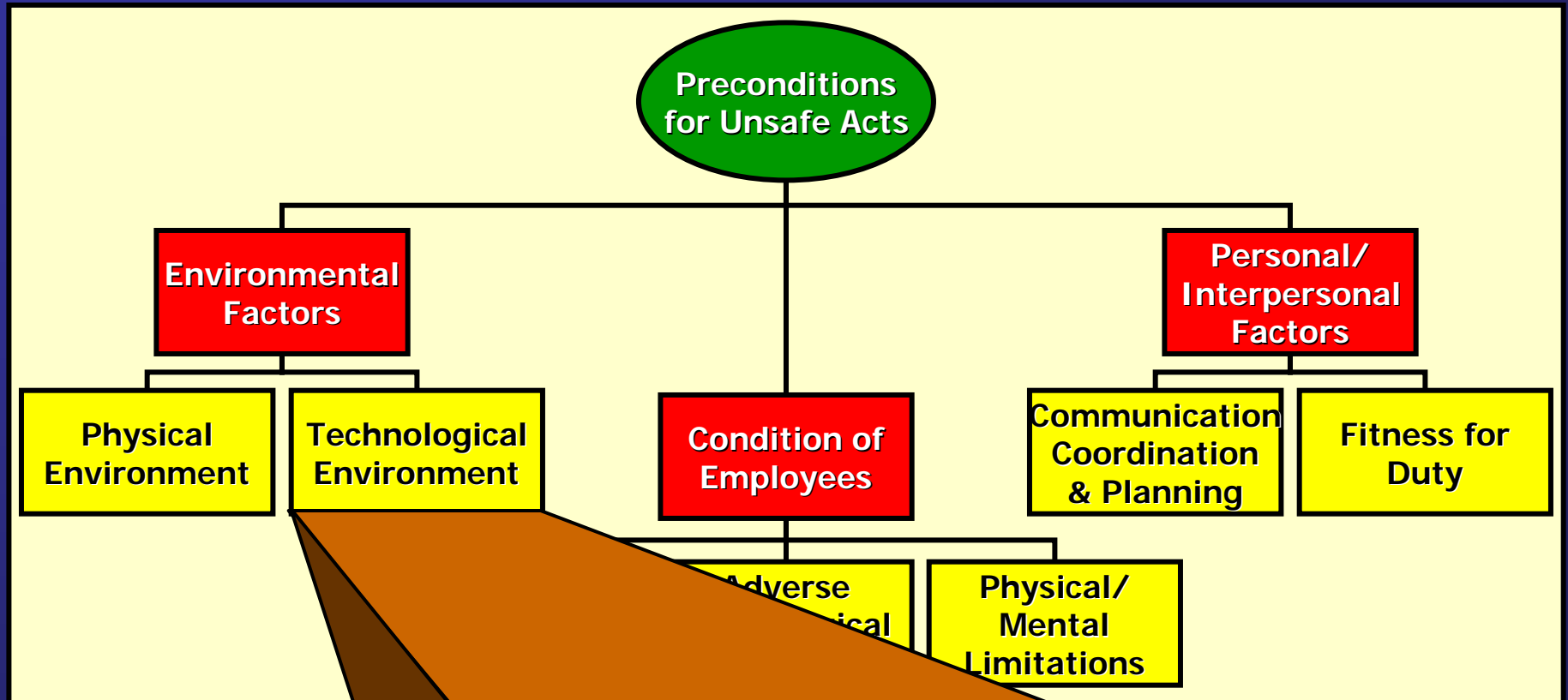
Fitness for Duty

- Crew Rest Requirements
- Bottle-to-Brief Rules
- Self-Medicating
- Poor Dietary Practice
- Overexertion While Off Duty
- Inadequate preparation/skill



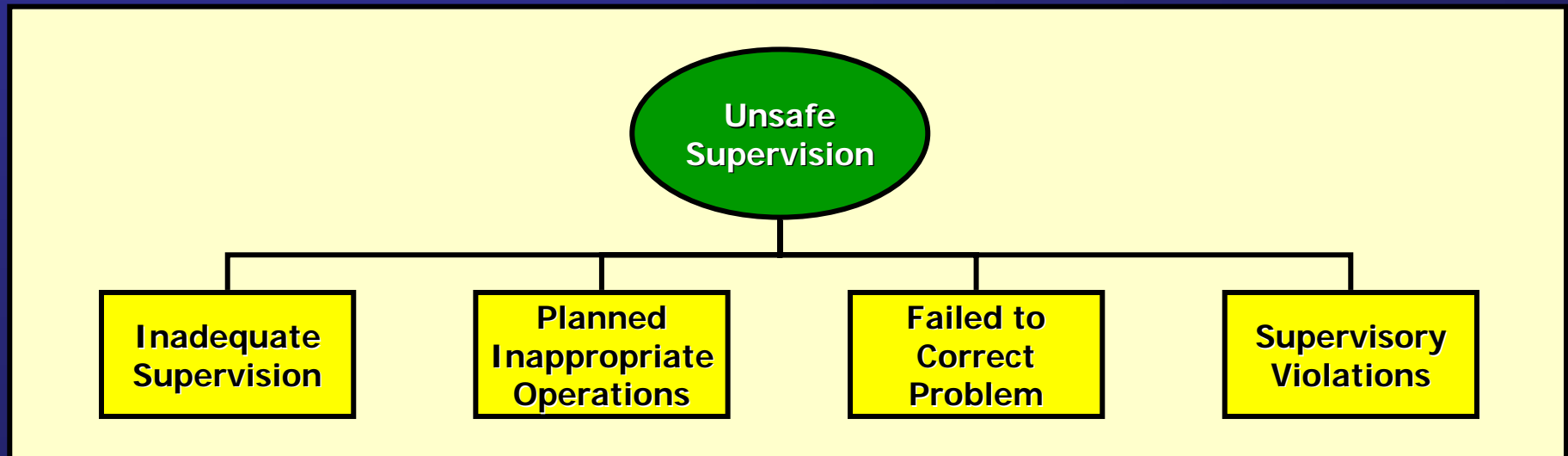
PHYSICAL ENVIRONMENT

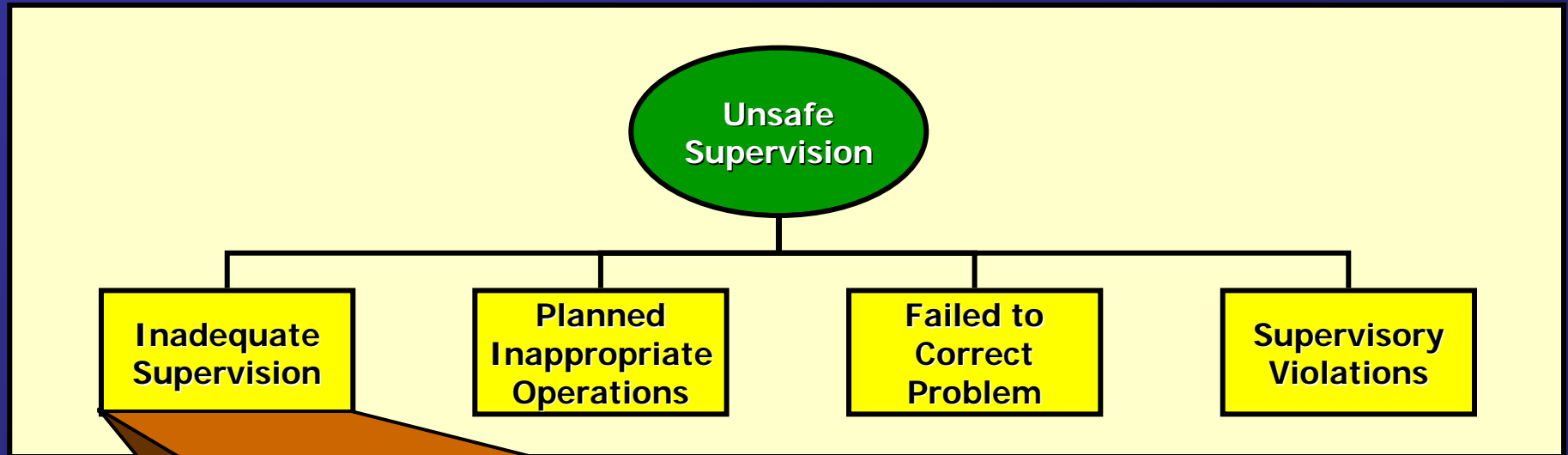
- Weather
- Lighting
- Noise
- Heat
- Vibration



TECHNOLOGICAL ENVIRONMENT

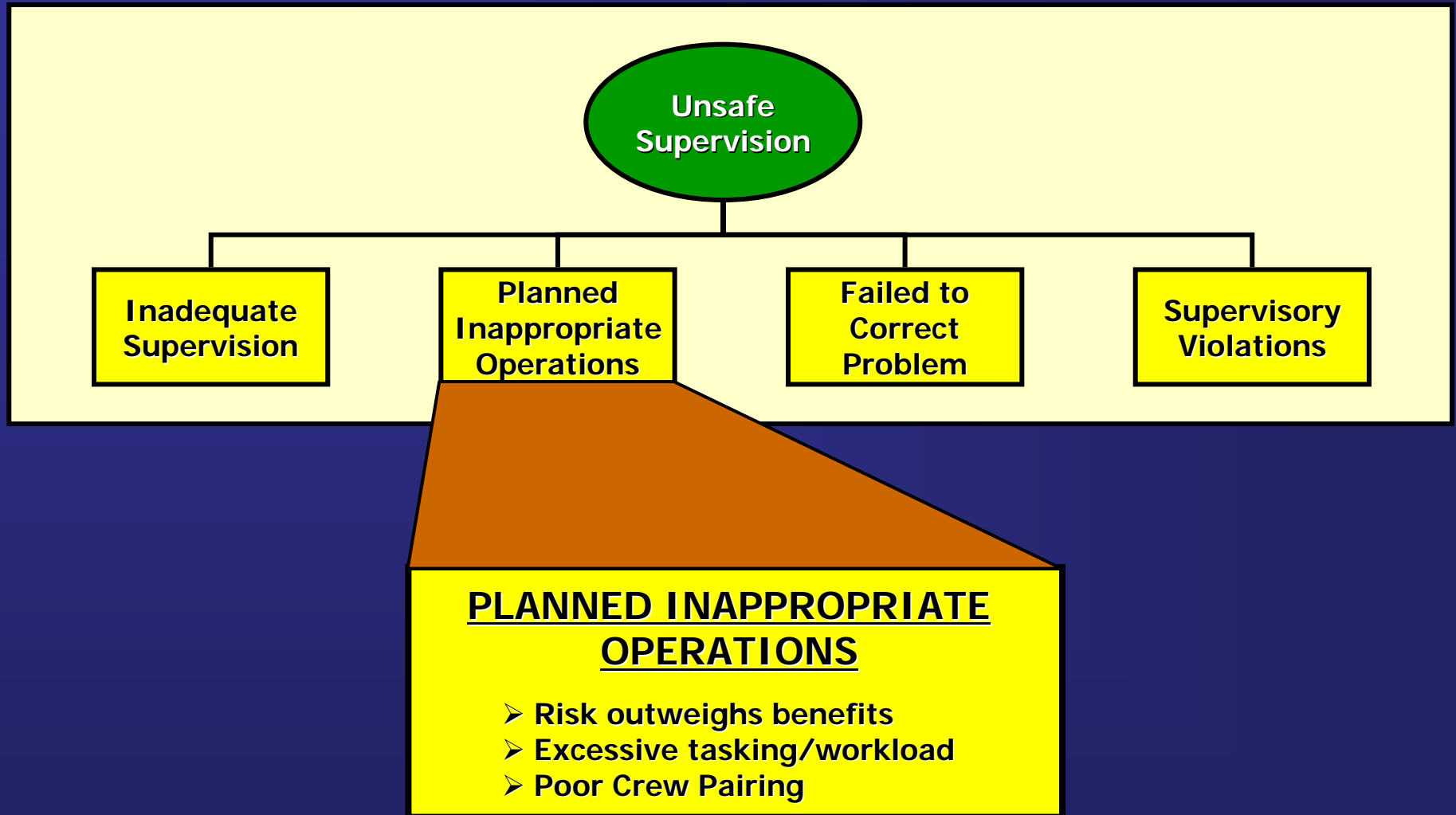
- Equipment and controls
- Automation reliability/complexity
- Task and Procedure Design
- Manuals and Checklist Design
- Interfaces and Displays

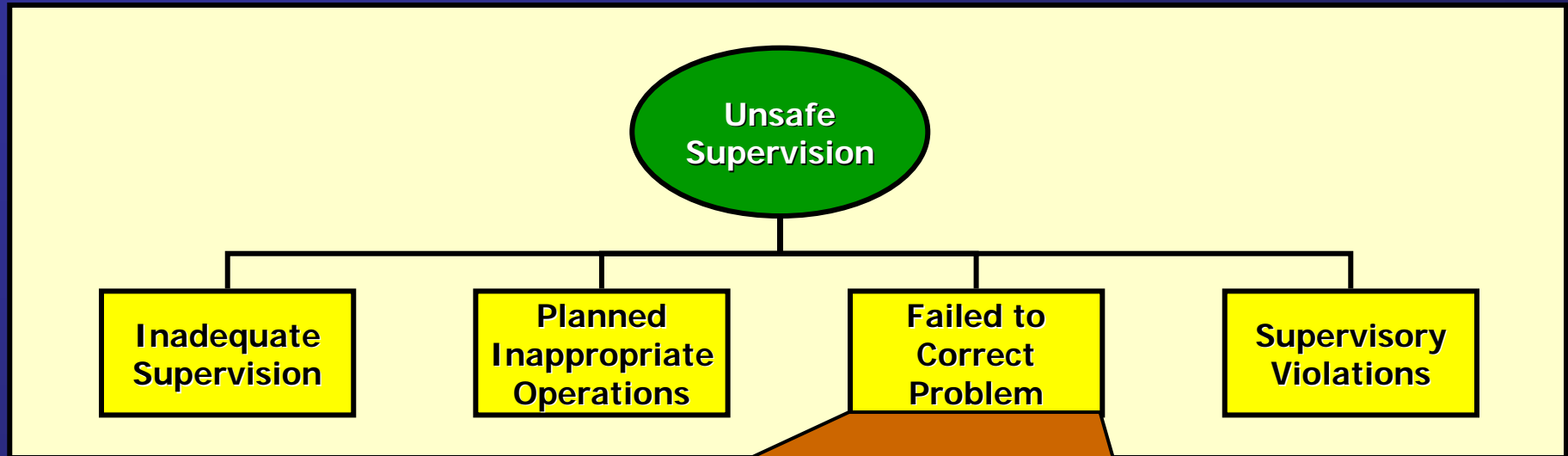




INADEQUATE SUPERVISION

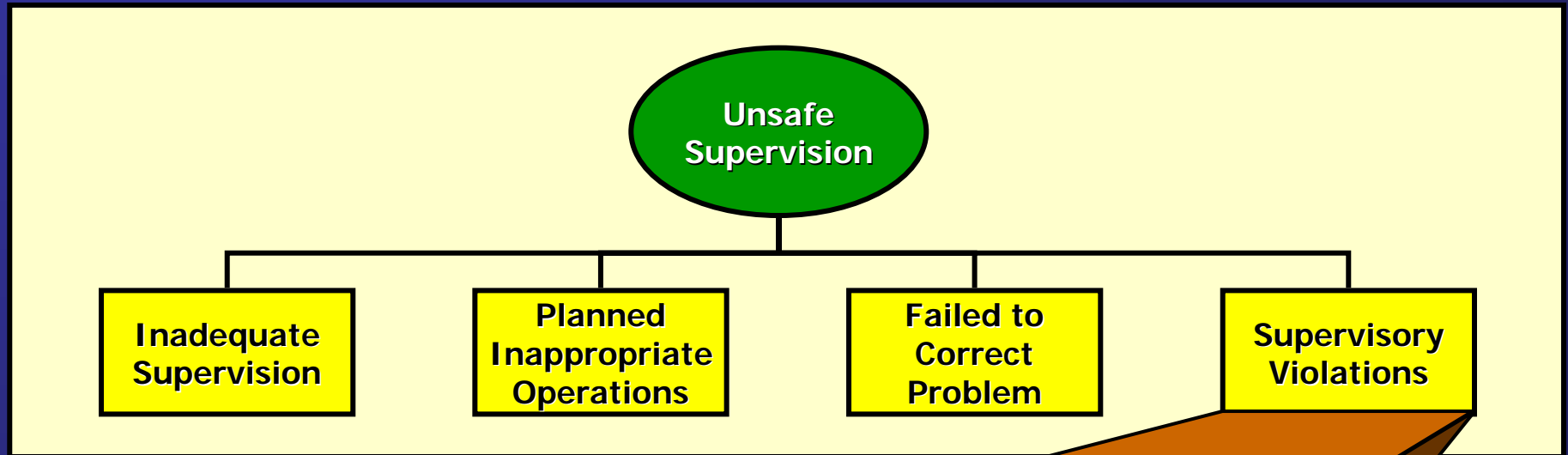
- Failure to Administer Proper Training
- Lack of Professional Guidance
- Failure to Provide Oversight





**FAILED TO CORRECT A
KNOWN PROBLEM**

- Failure to Correct Inappropriate Behavior
- Failure to Correct a Safety Hazard



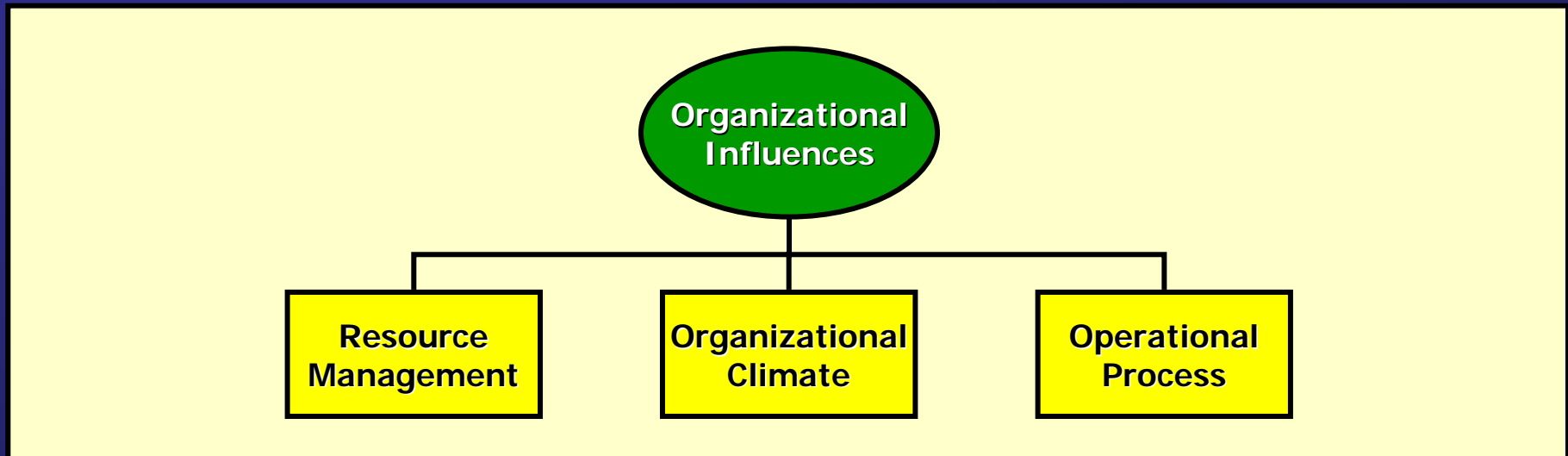
SUPERVISORY VIOLATIONS

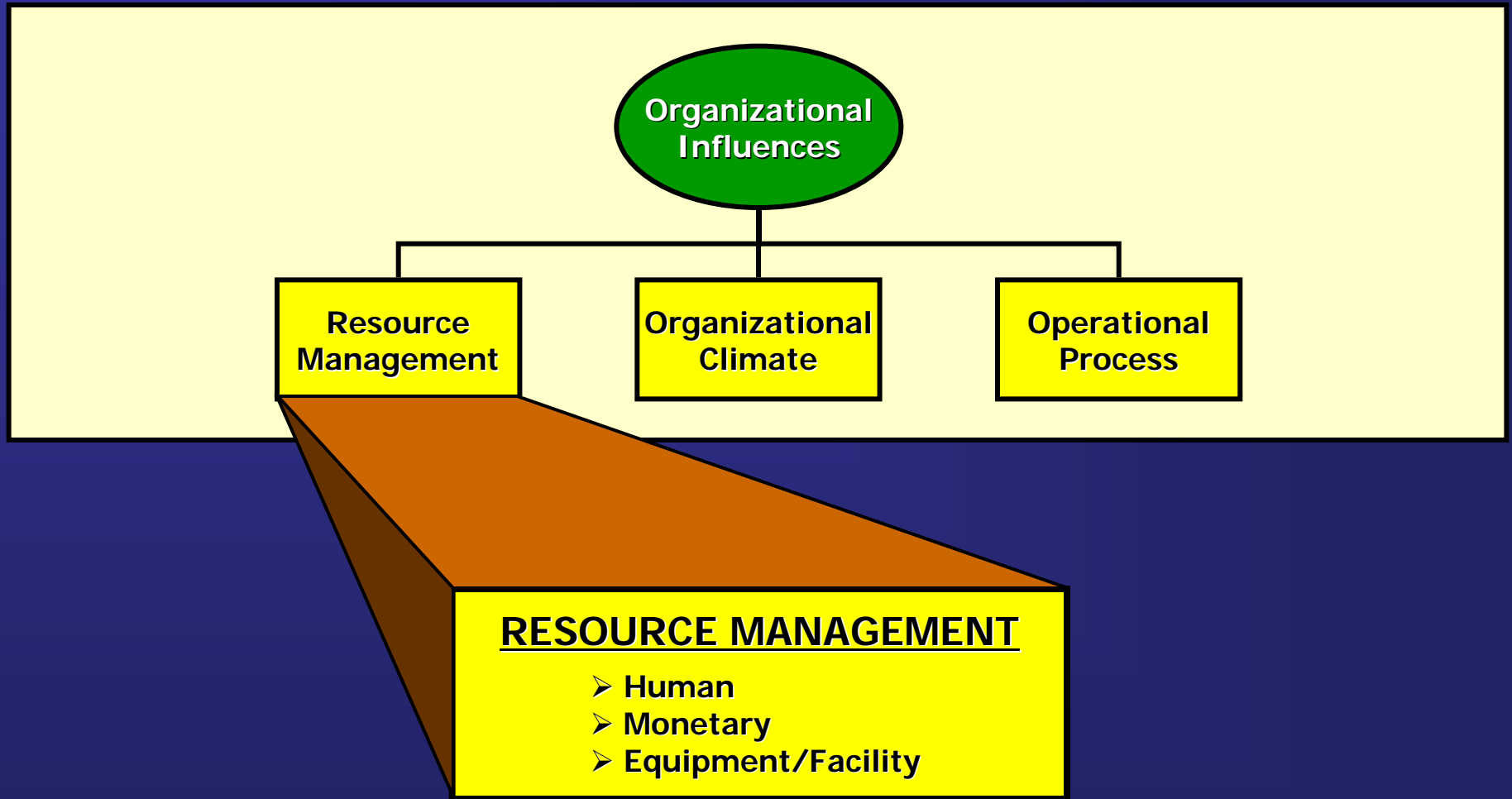
- Failed to enforce the rules
- Authorized unnecessary hazard
- Authorized unqualified crew for flight

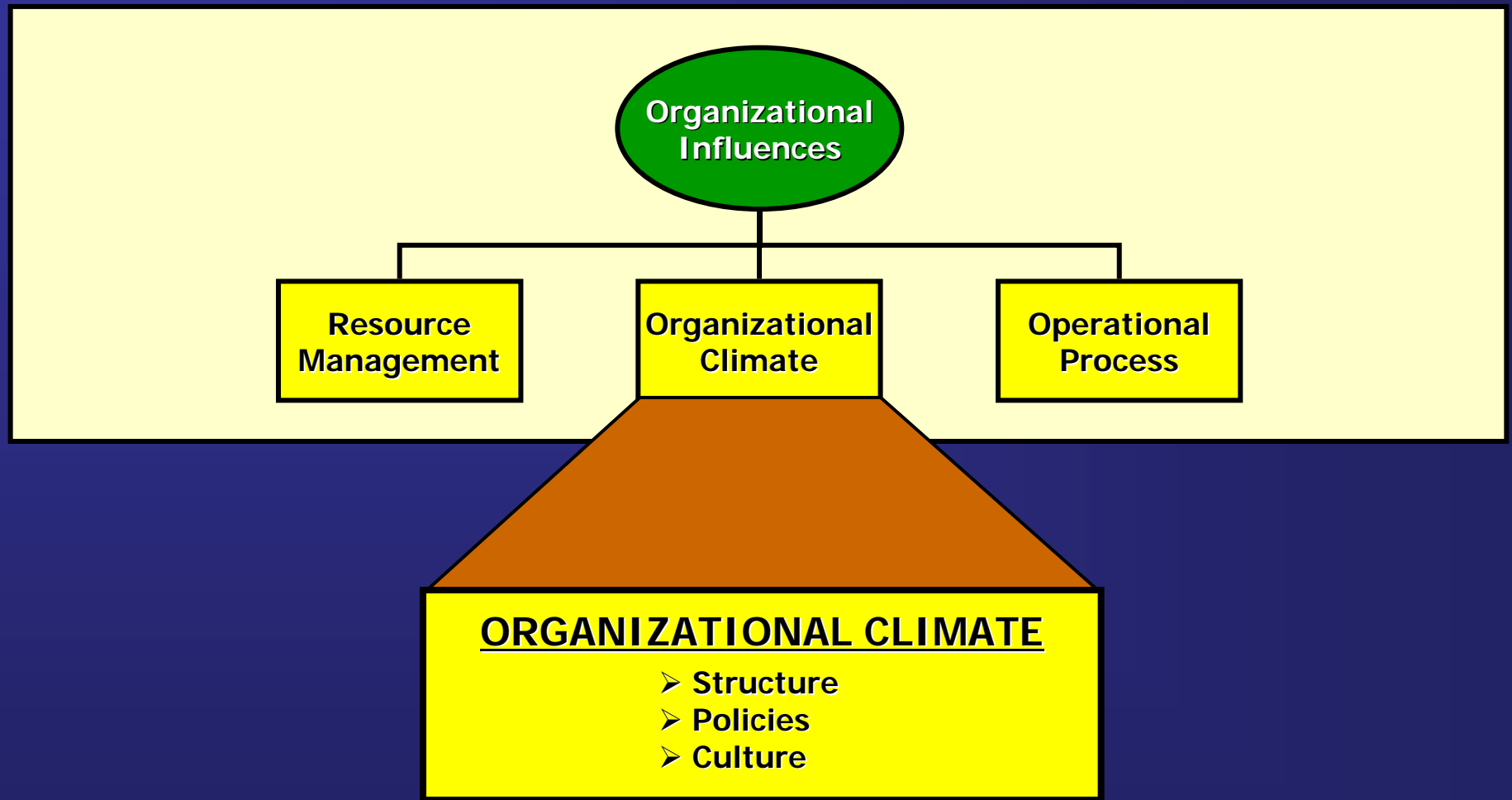


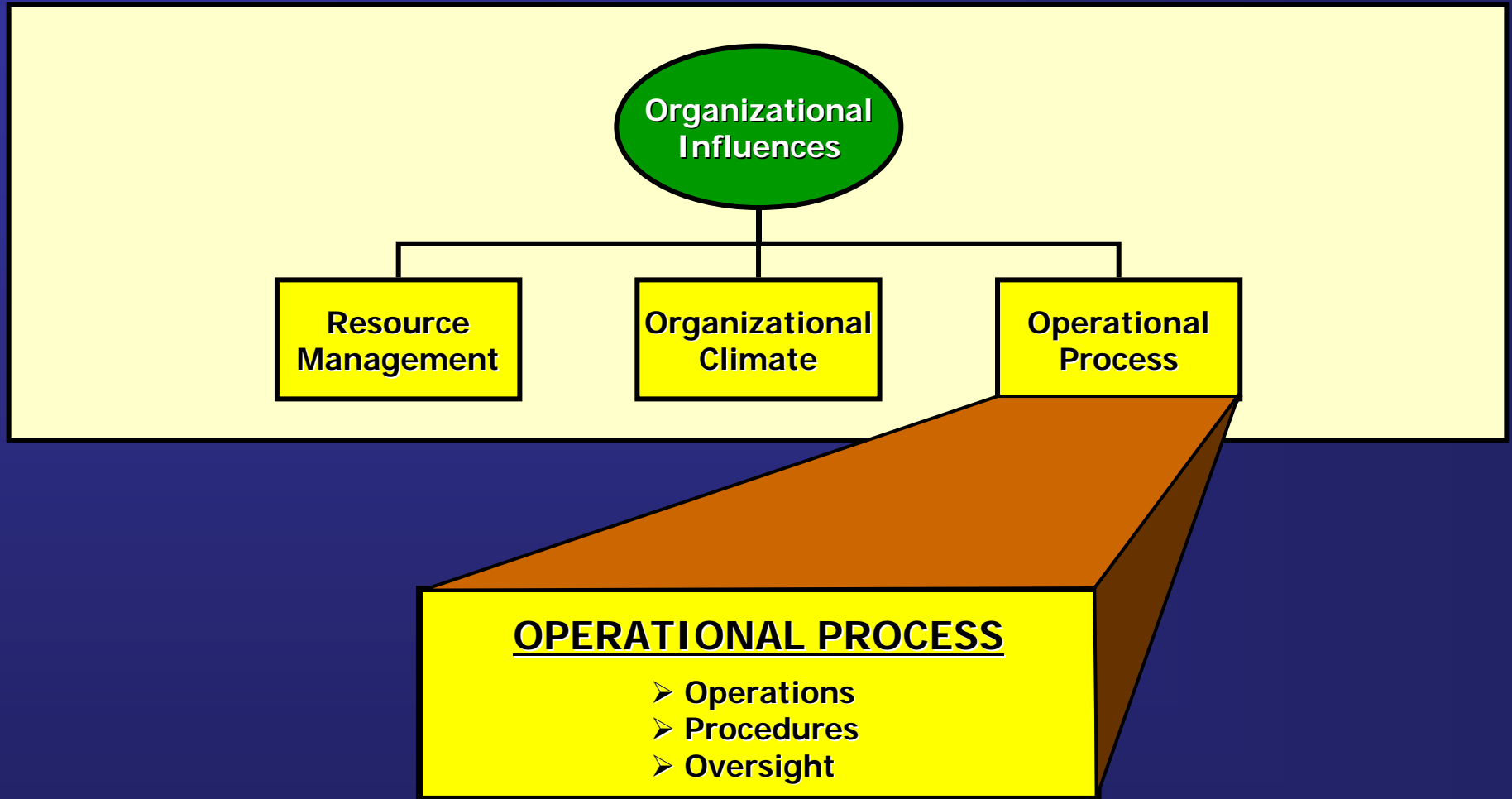
HIFACS[®]

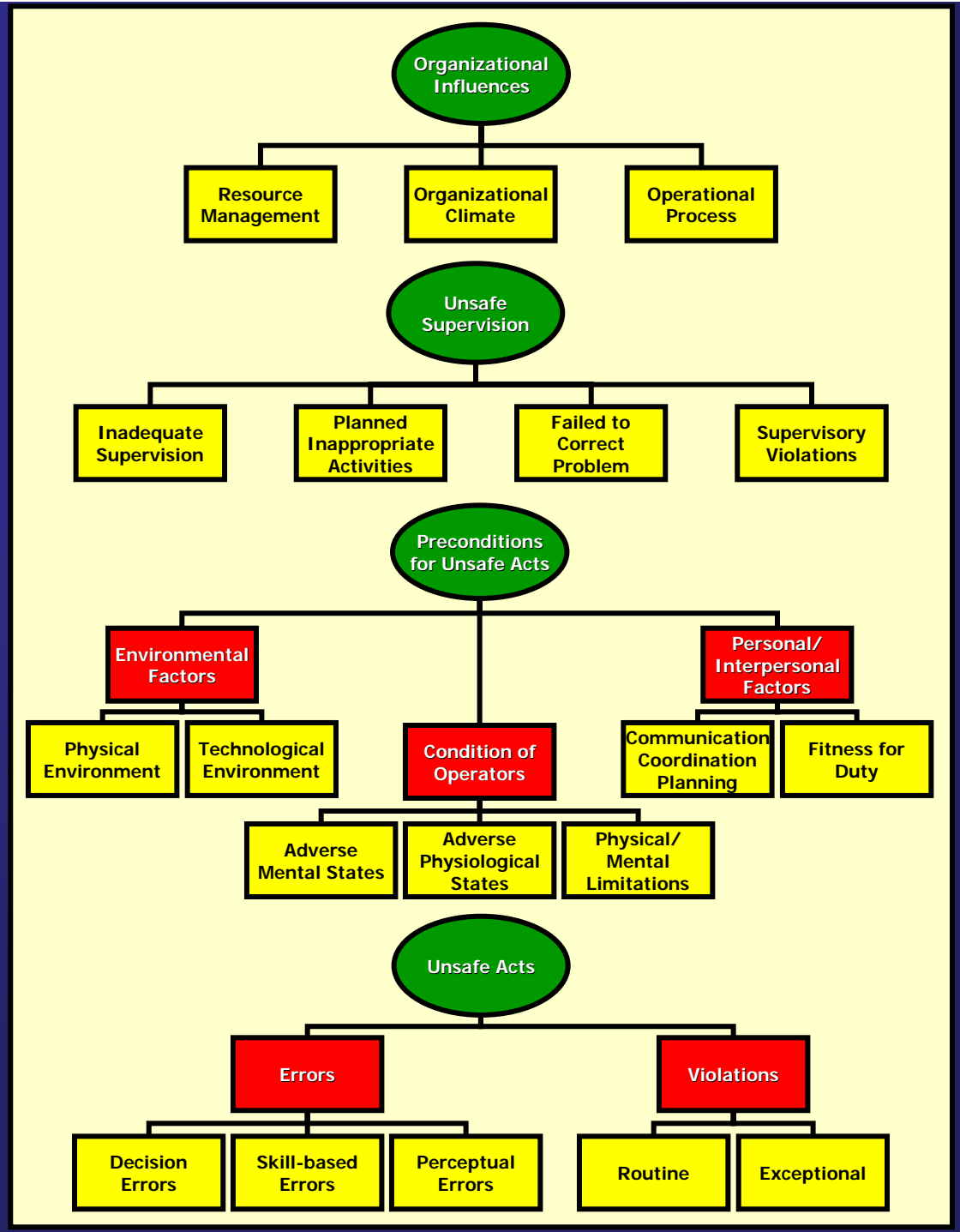
Human Factors Analysis and Classification System



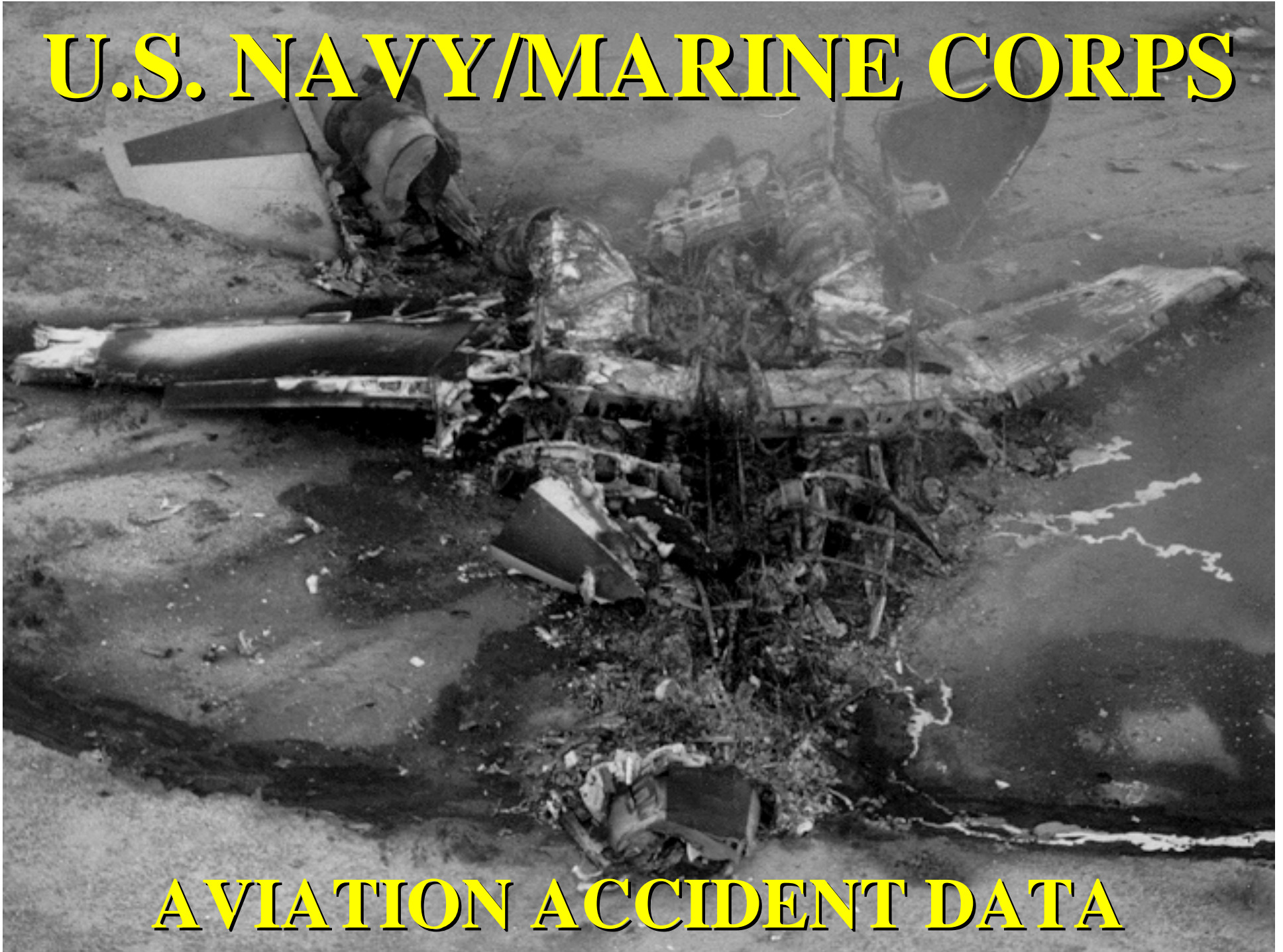








U.S. NAVY/MARINE CORPS



AVIATION ACCIDENT DATA

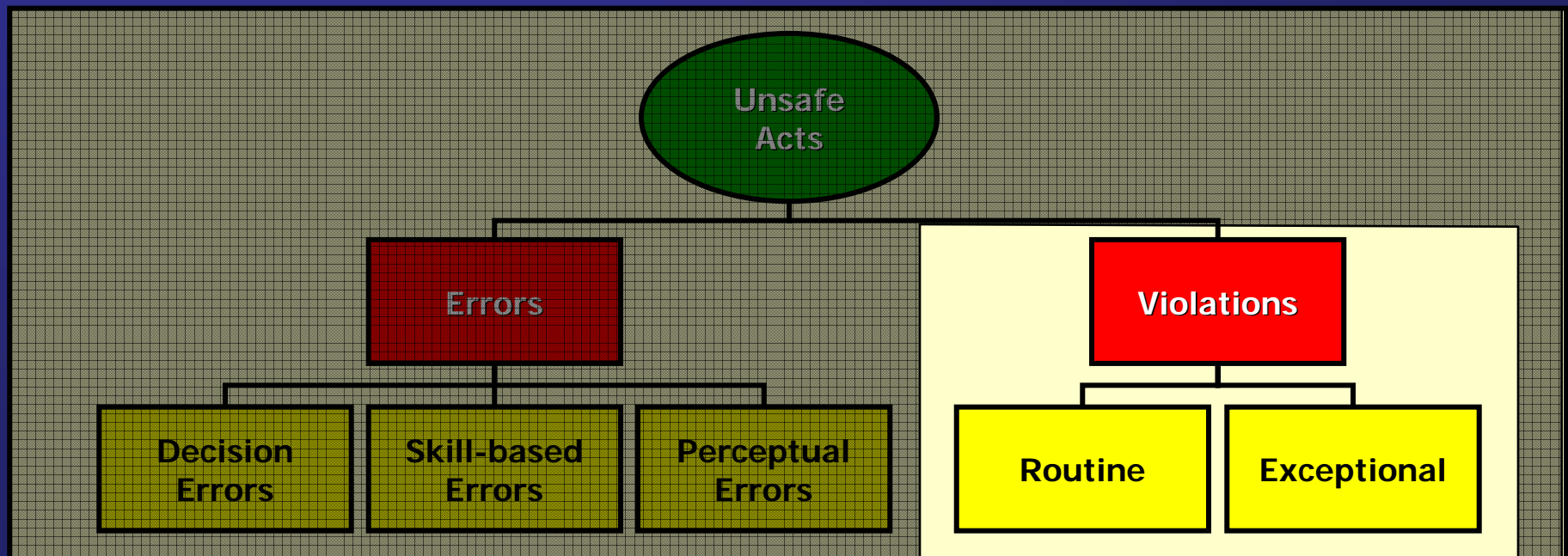
Hazard Identification & Prioritization



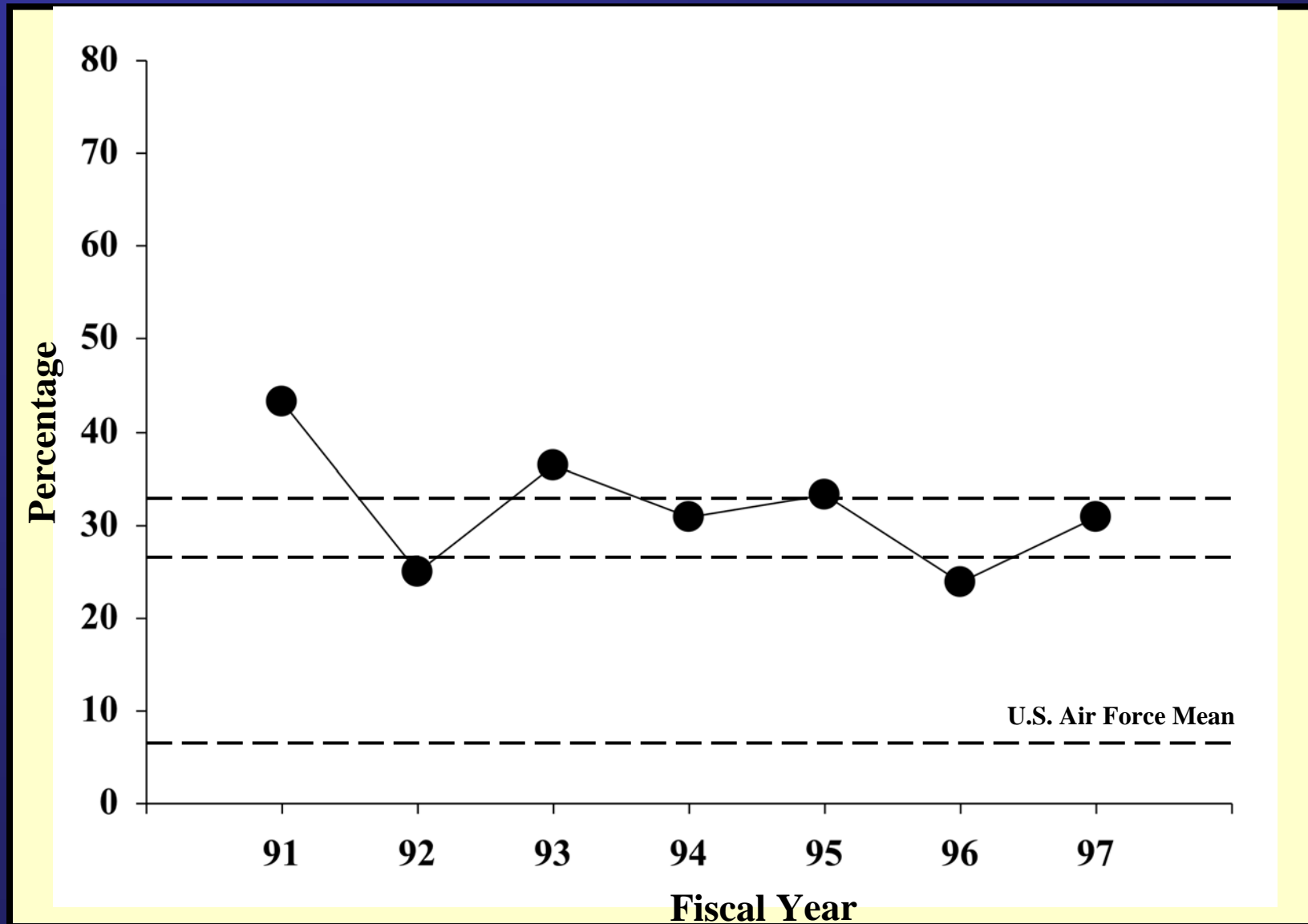


HIFACS[®]

Human Factors Analysis and Classification System



Percentage of Human Error Mishaps Associated with Violations (FY 91-97)



OK Doc, Go Fix It!

IDENTIFY INTERVENTIONS



Hazard Identification And Prioritization



Traditional Intervention Approaches



- **Human-Centered**
- **Technology-Centered**
- **Environment-Centered**
- **Task-Centered**
- **Organization-Centered**



HFIX[®]

Human Factors Intervention matrix

Human

Technology

Environment

Task

Organizational

Decision
Violations

Skill-based
Errors

Perceptual
Errors

Violations



HFIX[®]

Human Factors Intervention matrix

Human

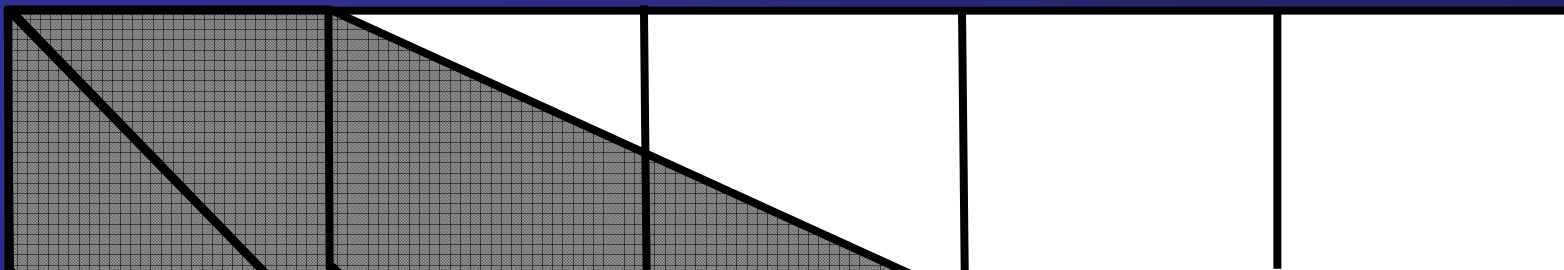
Technology

Environment

Task

Organizational

Violations



“How can I change the way I select individuals for the job, so that I don’t have “rule-breakers” or excessive risk-takers?”

“How can I change the way I train employees to change people’s attitudes about violation rules?”

“How can I change incentives to change an individual’s motivation to break the rules?”

“How can I change the way teams work together to increase peer pressure to follow the rules?”



HFIX[®]

Human Factors Intervention matrix

Human

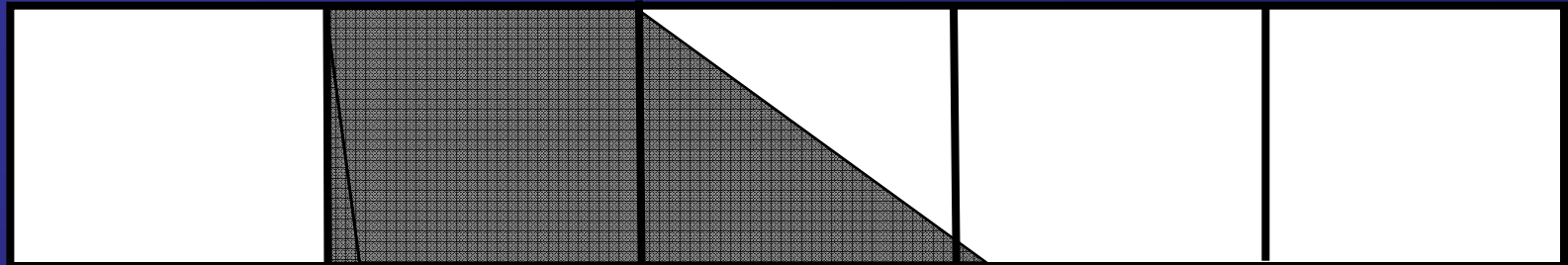
Technology

Environment

Task

Organizational

Violations



“How can I use automation to reduce violations of the rules?”

“How can I change the displays or other technology to reduce rule-breaking?”

“How can I redesign checklists, manuals, handbooks, etc. to reduce violations?”

“How can technology to better monitor pilot behavior in the cockpit or track violations of the rules?”



HFIX[®]

Human Factors Intervention matrix

Human

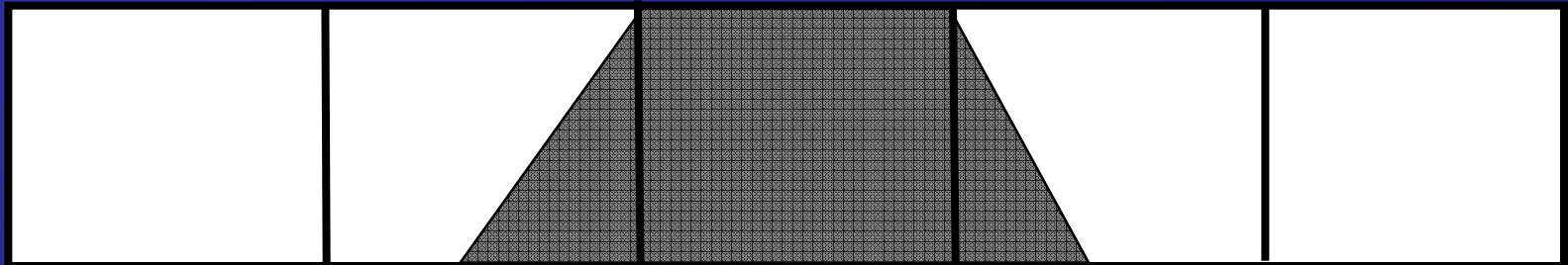
Technology

Environment

Task

Organizational

Violations



“How can I change the environment to prevent individuals from breaking the rules?”

“How can I change the environment to prevent people from becoming hurt, if they do break the rules?”



Human Factors Intervention matrix

Human

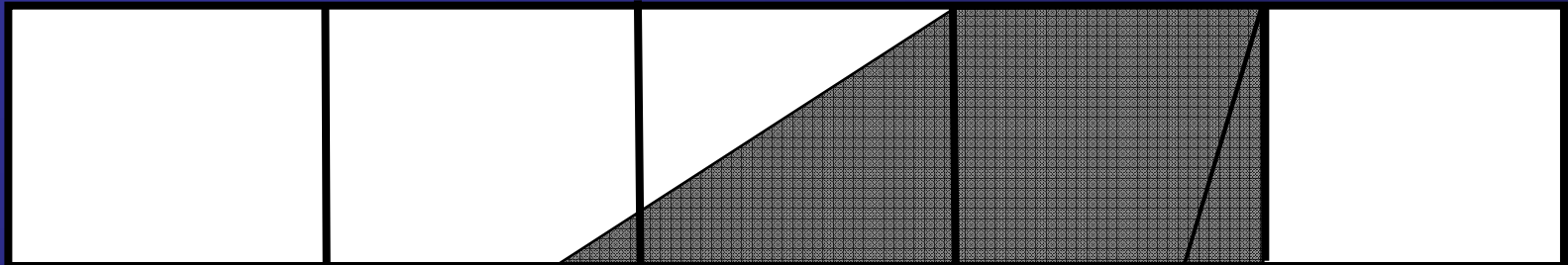
Technology

Environment

Task

Organizational

Violations



“How can I change the task/mission to prevent violation of the rules?”

“How can I improve oversight of the work process to reduce violation of the rules?”

“How can I improve enforcement of the rules to reduce violations?”



HFIX[®]

Human Factors Intervention matrix

Human

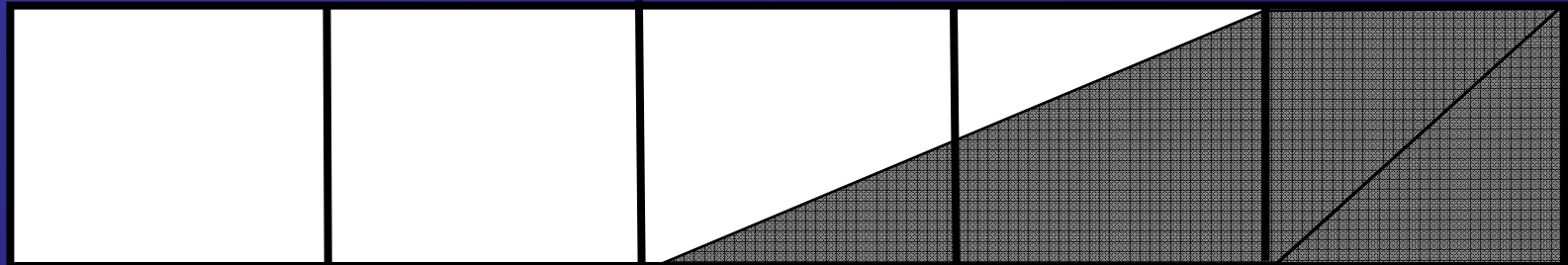
Technology

Environment

Task

Organizational

Violations



“How can I change the structure of the organization (e.g., chain of command, communication channels, line of authority, etc.) to reduce violations?”

“How can I change the culture of the organization (e.g., goals, values, norms, policies, etc.) of to reduce violations?”

“How can I change organizational processes (e.g., ops tempo, incentives, pressures, procedures, etc) to reduce violations?”

INTERVENTION IDENTIFICATION

Proposed Intervention

Enhanced Weather Displays

Enforcing the Rules

Cockpit Cameras

Risk Counseling

Senior Aviators on SH-60 Debts

Ground Proximity Warning System

Accountability

Procedure Modification/Addition

Professionalism

●

●

●

Flight Data Recorders

Training in Restricted Ranges Only

Intervention Assessment (FACES)

Feasibility – can it be done?.

Aceptability – will operators
accept it?

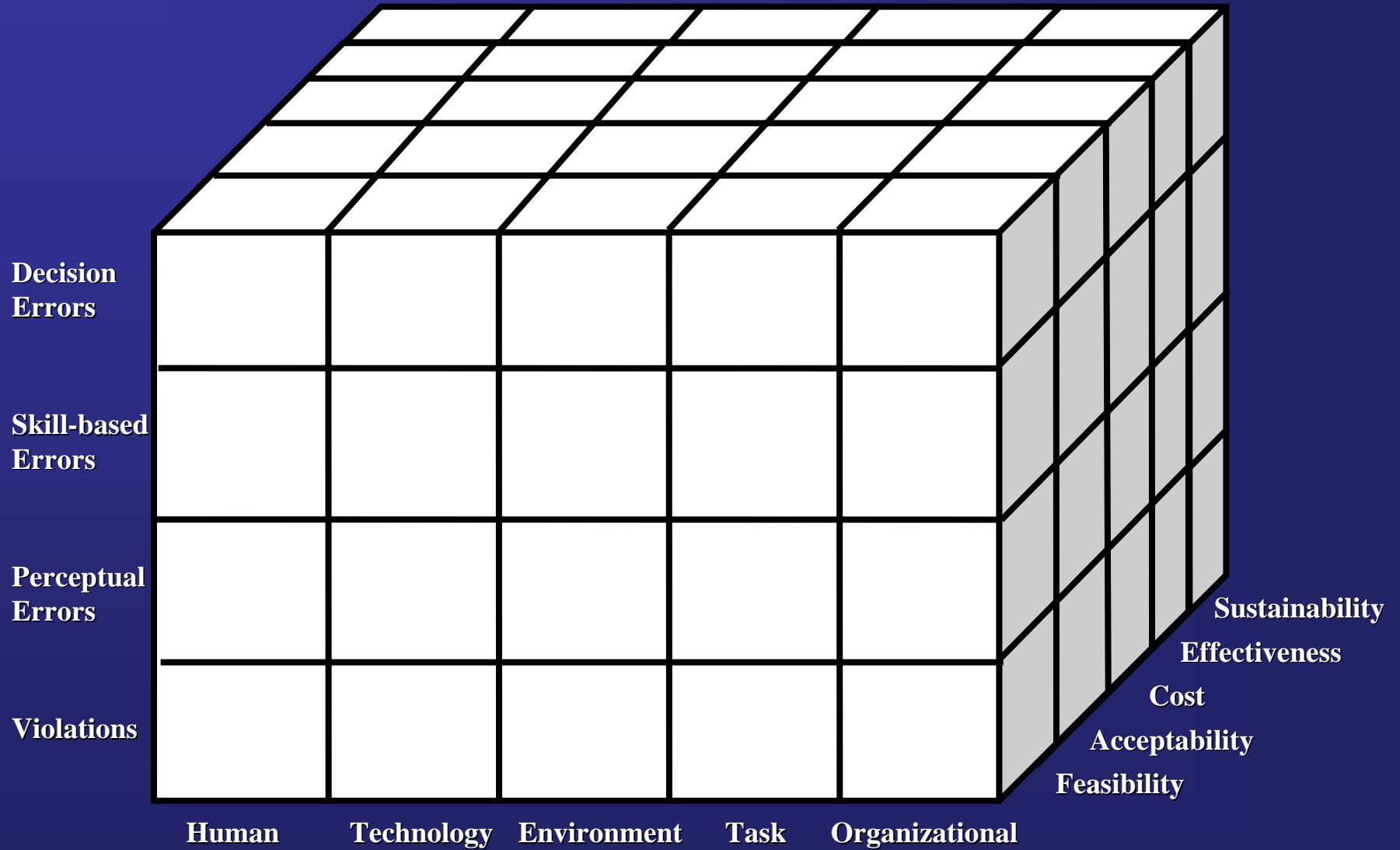
Cost – can we afford it?

Effectiveness – will it work?

Sustainability – will it last?



HFIX Cube (HFIX³)



INTERVENTION PRIORITIZATION

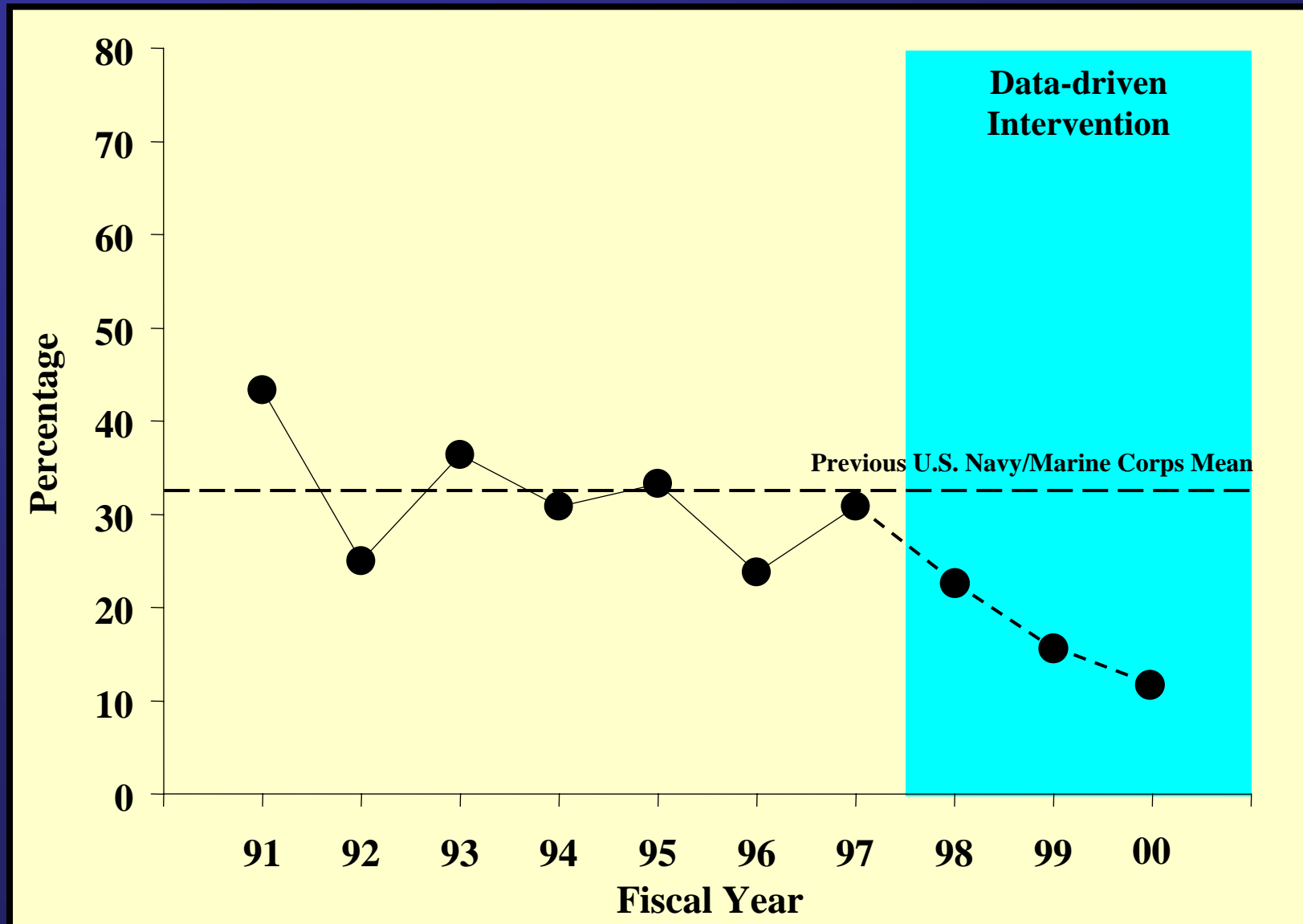
Proposed Intervention	Feasibility	Acceptability	Cost	Effectiveness	Sustainability
Enhanced Weather Displays	4	4	1	2	3
Enforcing the Rules	5	3	4	5	3
Cockpit Cameras	4	2	3	3	4
Risk Counseling	5	2	3	2	2
Senior Aviators on SH-60 Debts	4	4	3	5	4
Ground Proximity Warning System	4	4	2	2	3
Accountability	5	4	5	5	3
Procedure Modification/Addition	5	4	4	4	4
Professionalism	5	4	5	4	4
●	●	●	●	●	●
●	●	●	●	●	●
●	●	●	●	●	●
Flight Data Recorders	4	3	2	4	4
Training in Restricted Ranges Only	4	4	3	5	4

Initial Intervention Strategy



- Professionalism
- Accountability
- Enforcing the Rules
- Detachment Supervision

Percentage of Human Error Mishaps Associated with Violations (FY 91-00)



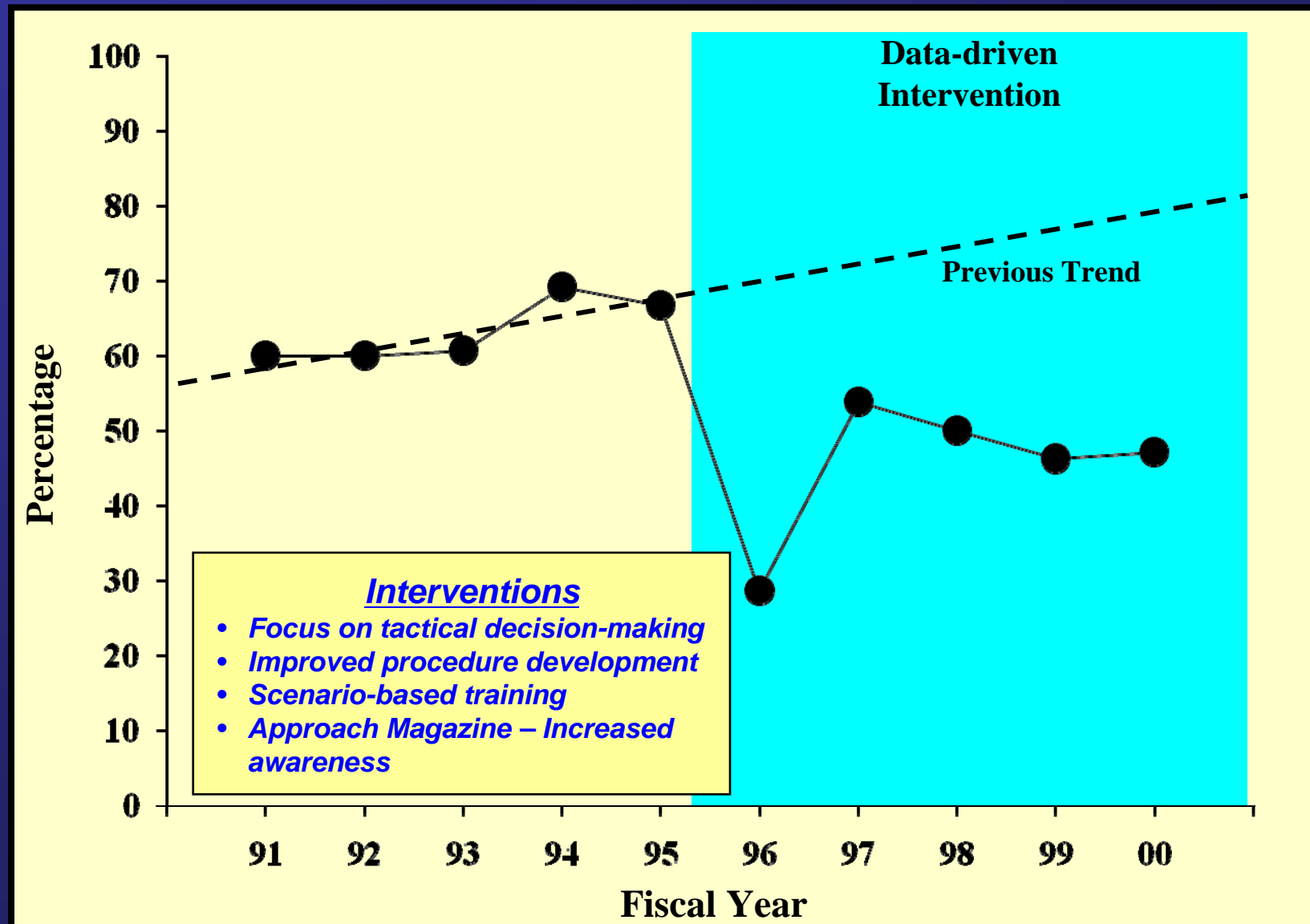


U.S. Naval Aviation Mishaps

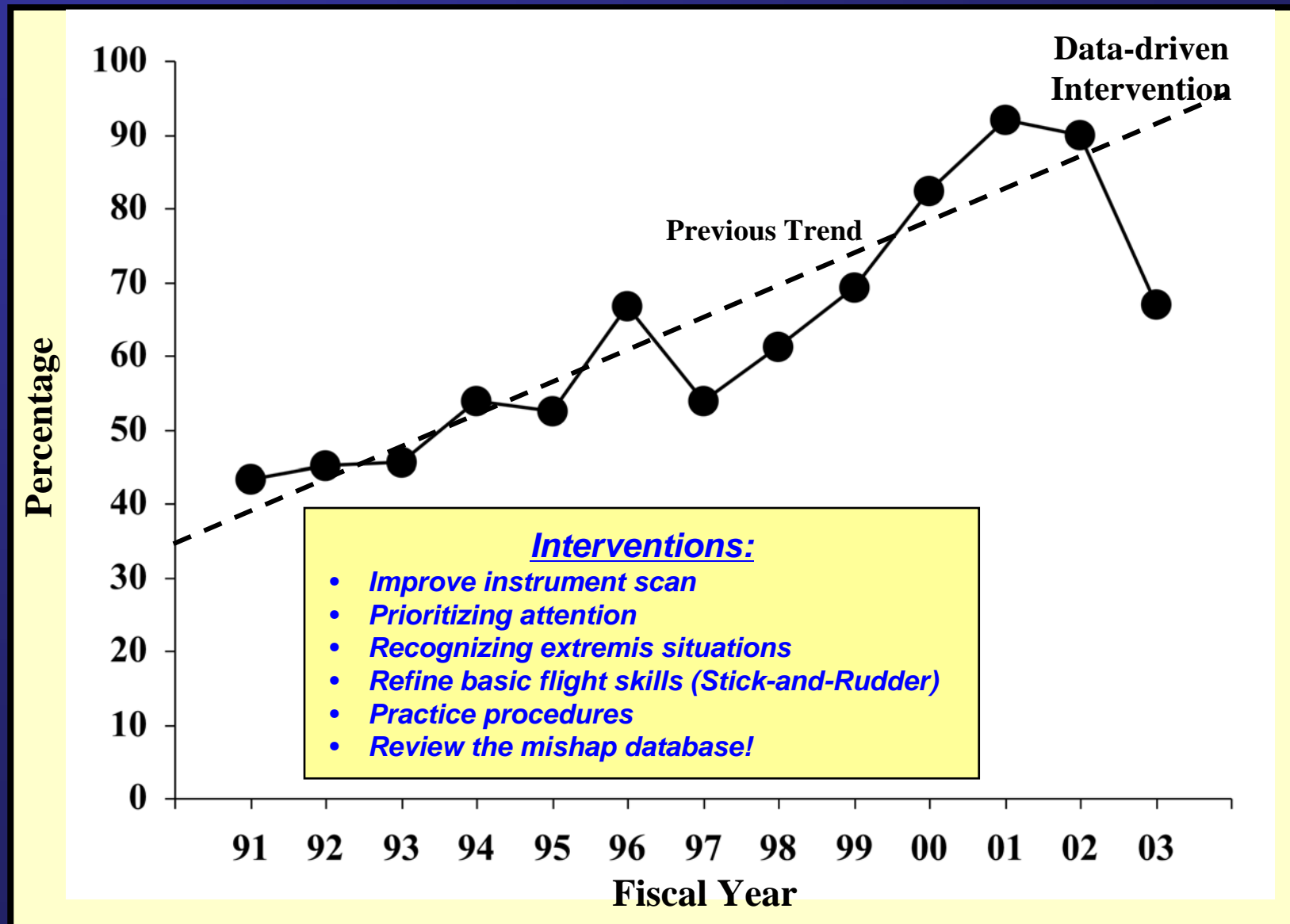
**But what about
other errors?**



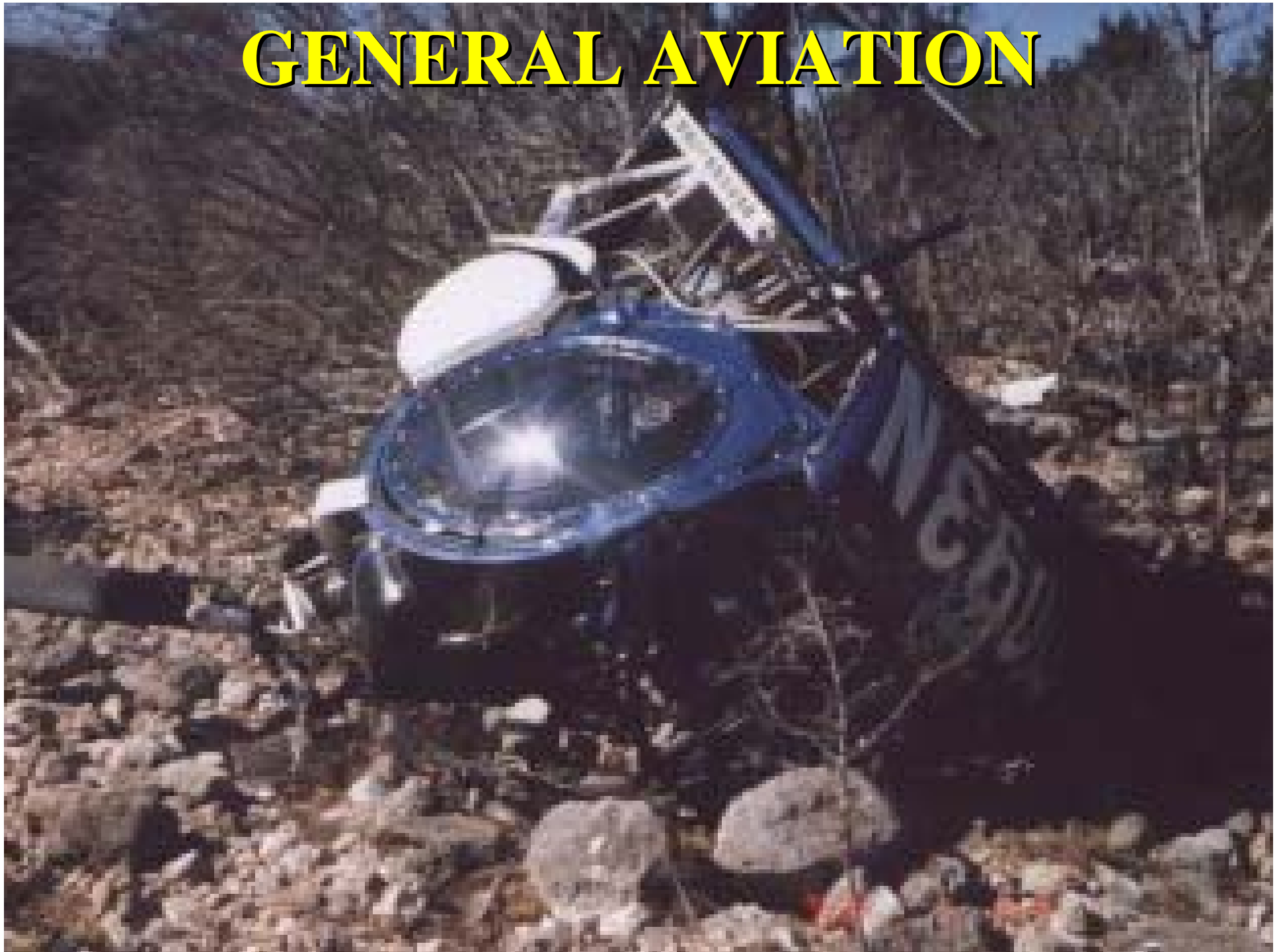
Percentage of Human Error Mishaps Associated with Decision Errors (FY 91-00)



Percentage of Human Error Mishaps Associated with Skill-based Errors (FY 91-03)



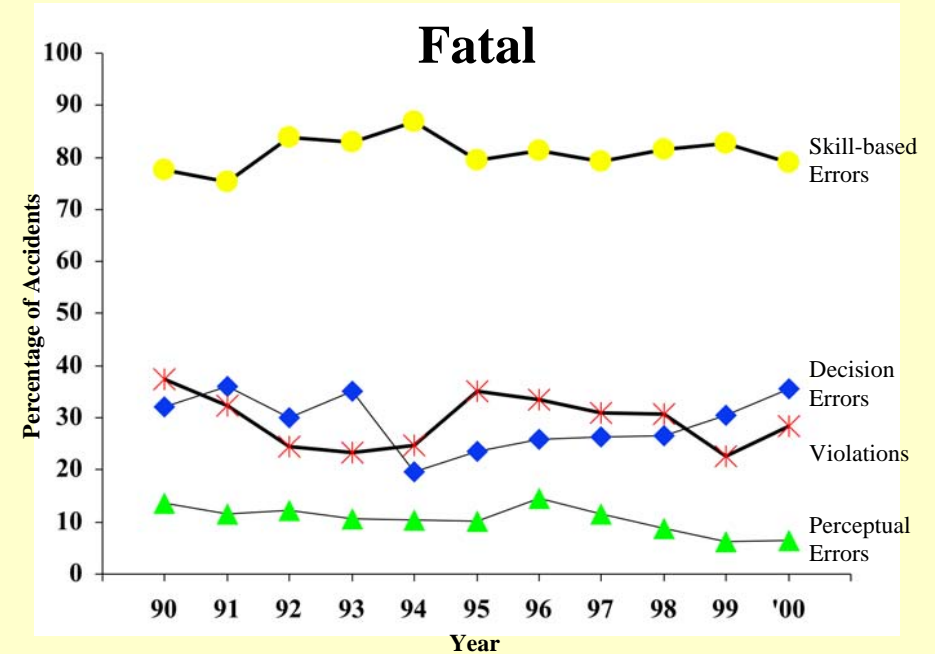
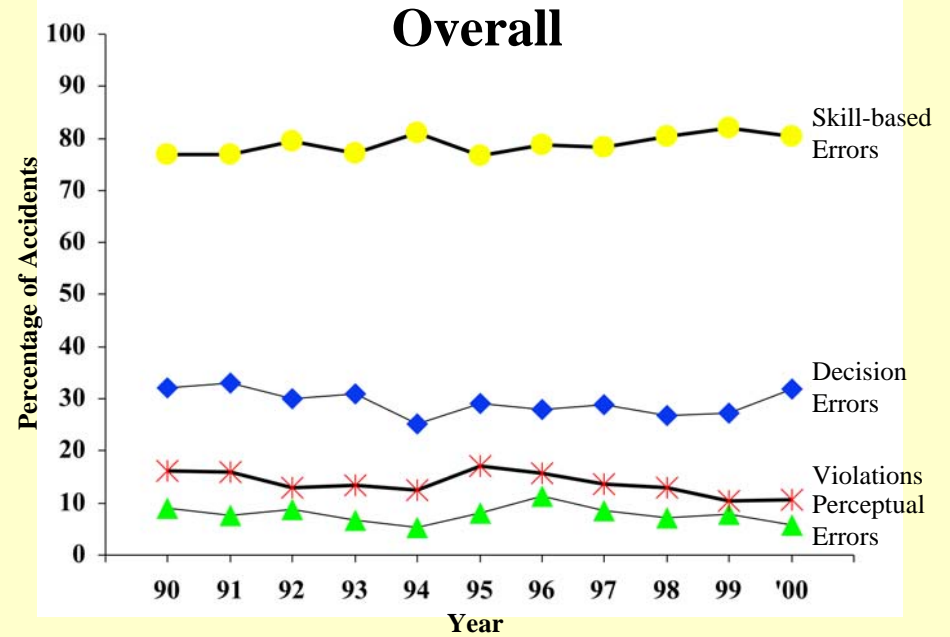
GENERAL AVIATION





METHOD

- Analyzed all (over 20,797) FAR Part 91 – “GA accidents” occurring between 1990 and 2000
 - Eliminated
 - 14 CFR Part 91 F (Ferry flight)
 - 14 CFR Part 137 (Agricultural Flights)
 - 14 CFR Part 91 (Blimps, balloons, ultra-lights, gliders)
 - Remaining 18,531 accidents were then screened for aircrew error
- The remaining 14,436 accidents were associated with over 34,000 human causal factors, as reported by the National Transportation Safety Board (NTSB).
- The NTSB human causal factors were classified into HFACS causal categories independently by seven GA pilots.
 - All were certified flight instructors
 - Mean flight hours = 3,530



Percentages do not add up to 100%

COMMERCIAL AVIATION



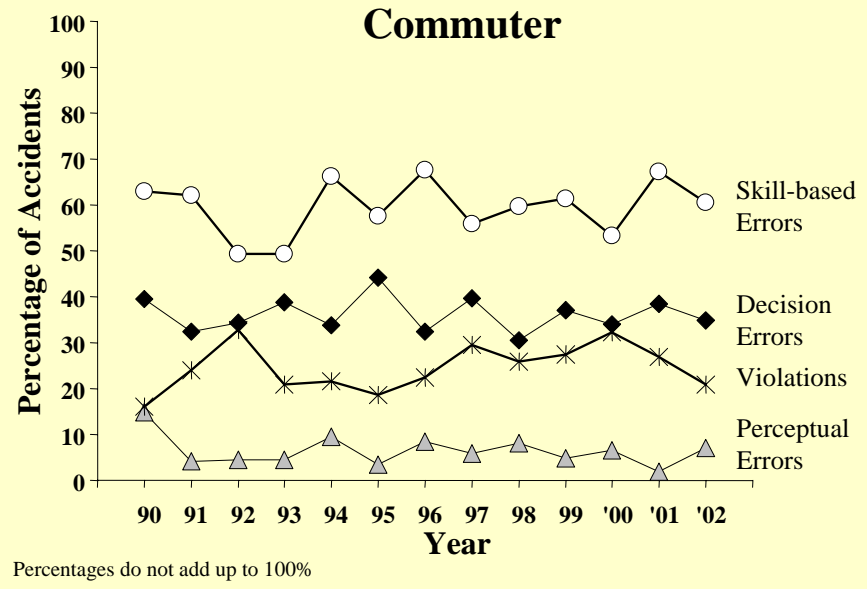
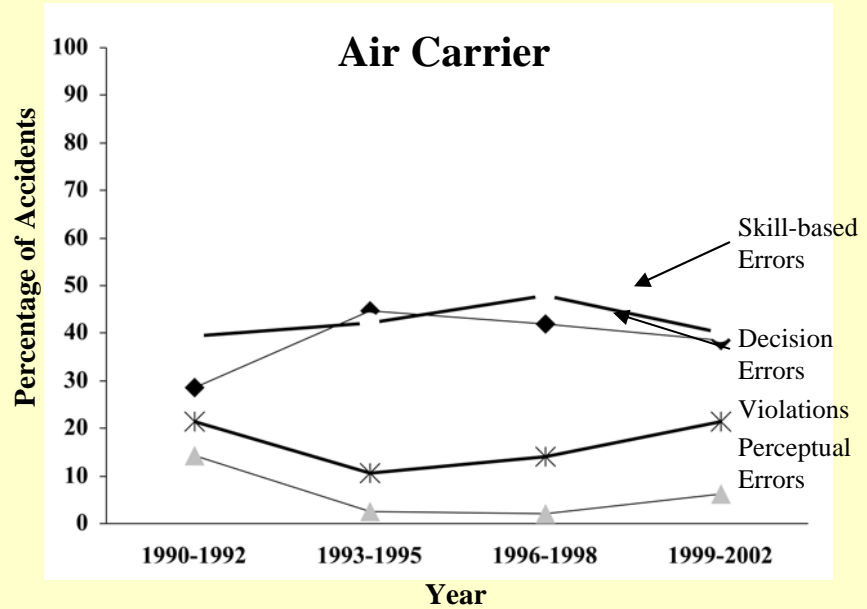


METHOD

- **Data Sources**
 - **NASDAC**
 - **NTSB Narrative Summary (long narrative if available)**
- **Data Analysis**
 - **1020 “Commercial Aviation” accidents occurring between 1990-2002 were examined.**
 - **181 Air Carrier accidents**
 - **839 Commuter accidents**
 - **The human causal factors were classified into HFACS causal categories independently by seven pilot-raters**
 - **All pilot raters had a minimum of 1000 hours of flight time and were instructor pilots.**
 - **No new cause factors were created during the coding process and consensus between coders was achieved on all classifications.**
 - **Human factors quality assurance**
 - **Additional demographic factors (e.g., weather conditions, lighting, and fatalities) were transcribed from the source documents verbatim**



- Given the small number of air carrier accidents (n=181) it was not possible to do an annual comparison. Instead blocks of 3 and 4 years were used.
- With few exceptions the unsafe acts committed by commercial (air carrier and commuter) pilots has remained relatively consistent across the years of this study.
- There may have been a slight increase in violations after the 1993-1995 time frame.



HFACS[®]

Human Factors Analysis and Classification System



Canadian Air Force



Royal Netherlands Air Force



Alaska Airlines / Horizon Air



WALT DISNEY
Parks and Resorts

**phelps
dodge**



Indian Air Force



Federal Aviation
Administration



CHC



Australian Government

Australian Transport Safety Bureau