Importance of Human Factors in Quality Improvement

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Error

- You've carefully thought out all the angles.
- You've done it a thousand times.
- It comes naturally to you.
- You know what you're doing, its what you've been trained to do your whole life.
- Nothing could possibly go wrong, right ?

Think Again.

Outline

- Human Factors Defined
- What Do Human Factors Engineers do?
- Human Error Analysis: One Example Technique
- How should you get started?
- Document System Changes
- Conclusion

Human Factors Defined

- Human Factors discovers and applies information about human behavior, abilities, limitations, and other characteristics to the design of tools, machines, systems, tasks, jobs, and environments for productive, safe, comfortable, and effective human use (Sanders and McCormick, 1993)
- Human Factors IS NOT …
  - just applying checklists and guidelines
  - just using oneself as the model for designing things
  - just common sense

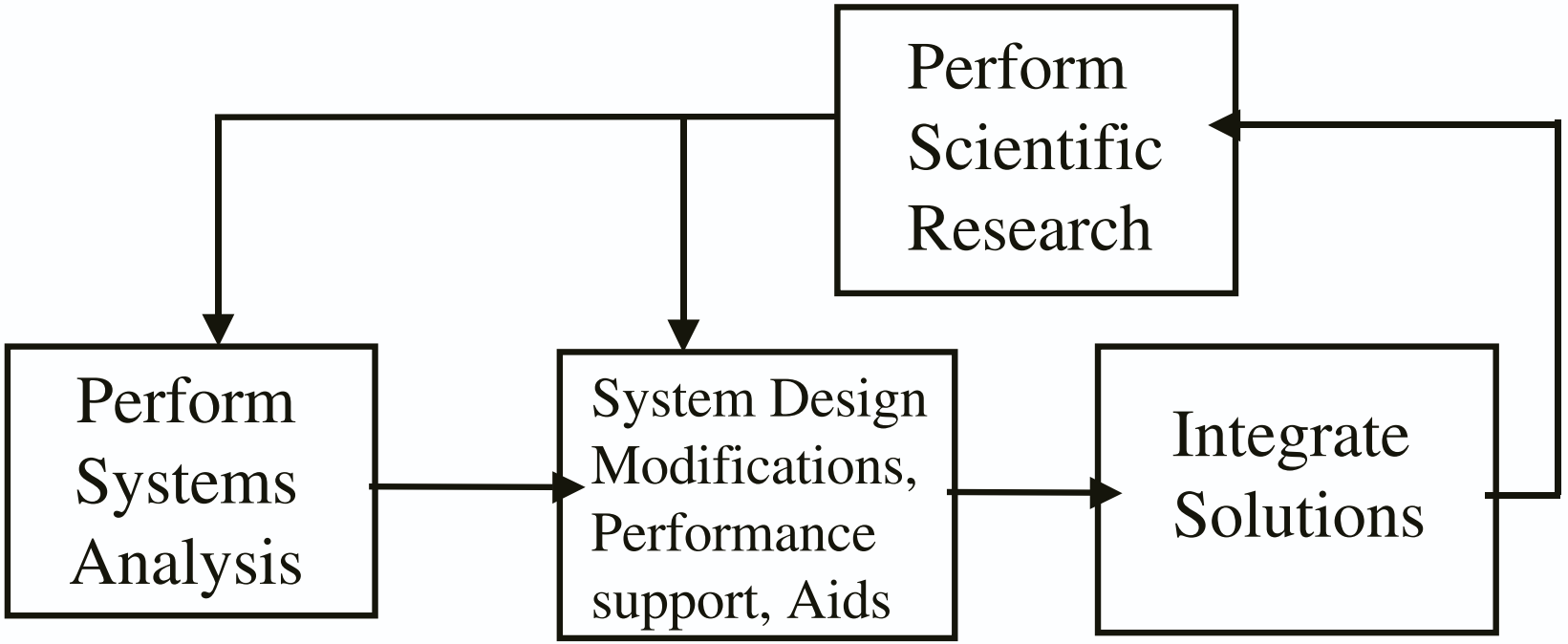
Cost of Ignoring Human Factors Is Poor Quality!

- Increased probability of accidents and errors
- Less spare capacity to deal with emergencies
- Increased labor turnover
- Lower productive output
- Increases in lost time
- Higher medical costs
- Higher material costs
- Increased absenteeism
- Low quality work
- Injuries, strains

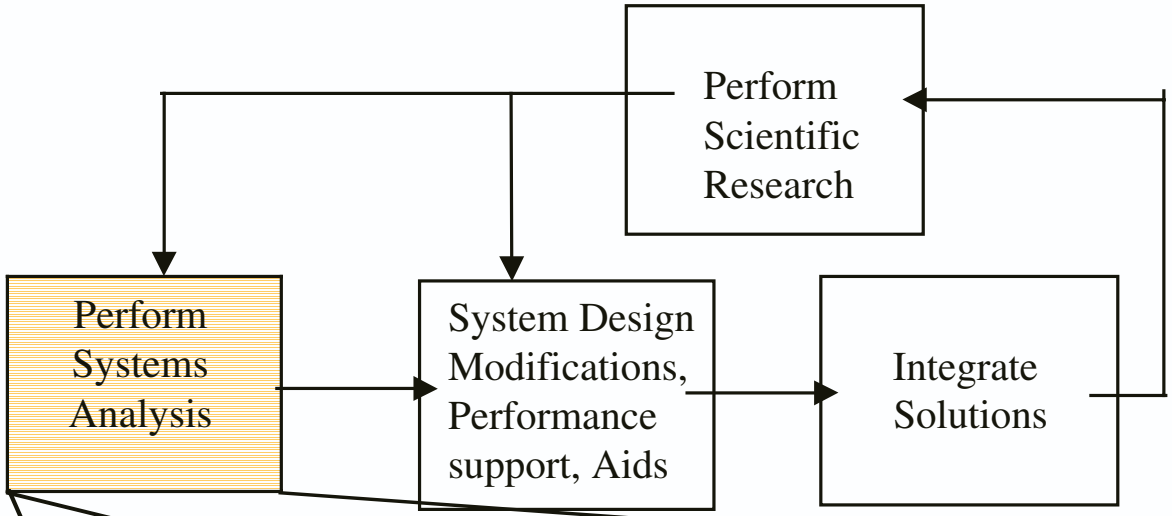
What Do HFEs Do?

- Human Factors Engineering uses a *systems analysis* approach.
- Humans are considered a critical *system component.*
- HFEs analyze systems focusing on human operators to determine what they are required to do to achieve system goals.
- HFEs determine how the *system* can be designed or modified to meet goals.
- Humans have certain capabilities and limitations, and the system must be designed with an understanding of the human component subsystem requirements.

What Do HFEs Do?



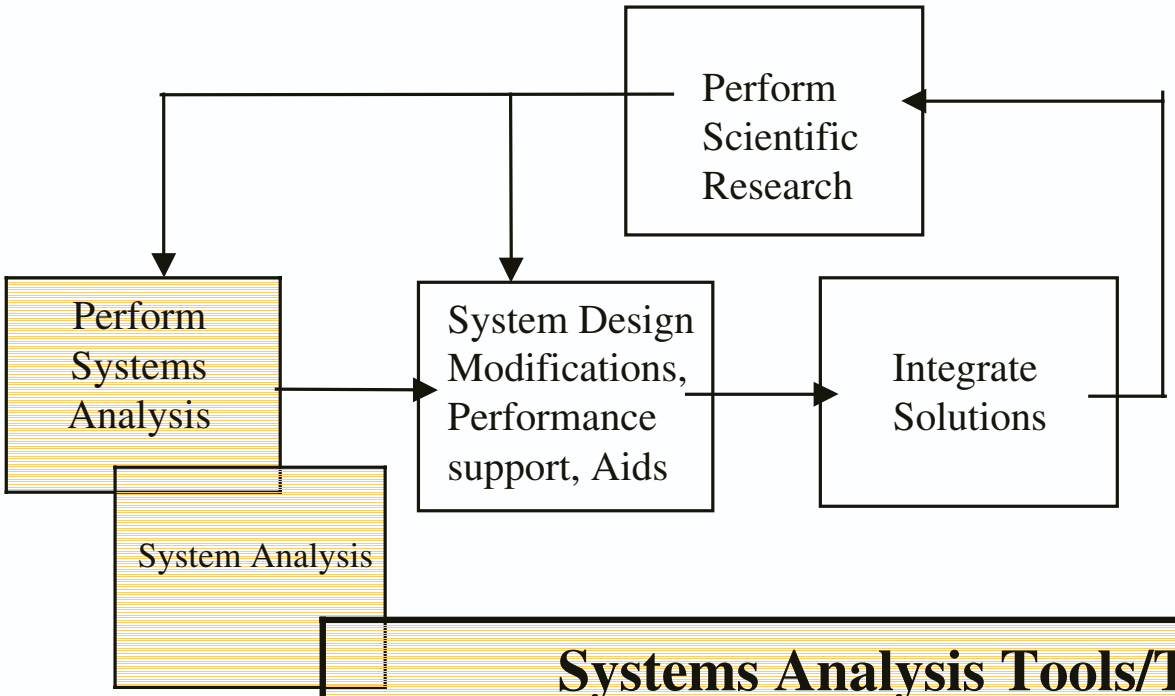
What Do HFEs Do?



System Analysis

- Function analysis
- Task Analysis (cognitive, physical)
- Accident/incident analysis
- Workload analysis
- Communication patterns/information flow
- Work place layout
- Environmental Analysis
- Task-Interface analysis
- Reliability assessment (Human error analysis)
- Etc.

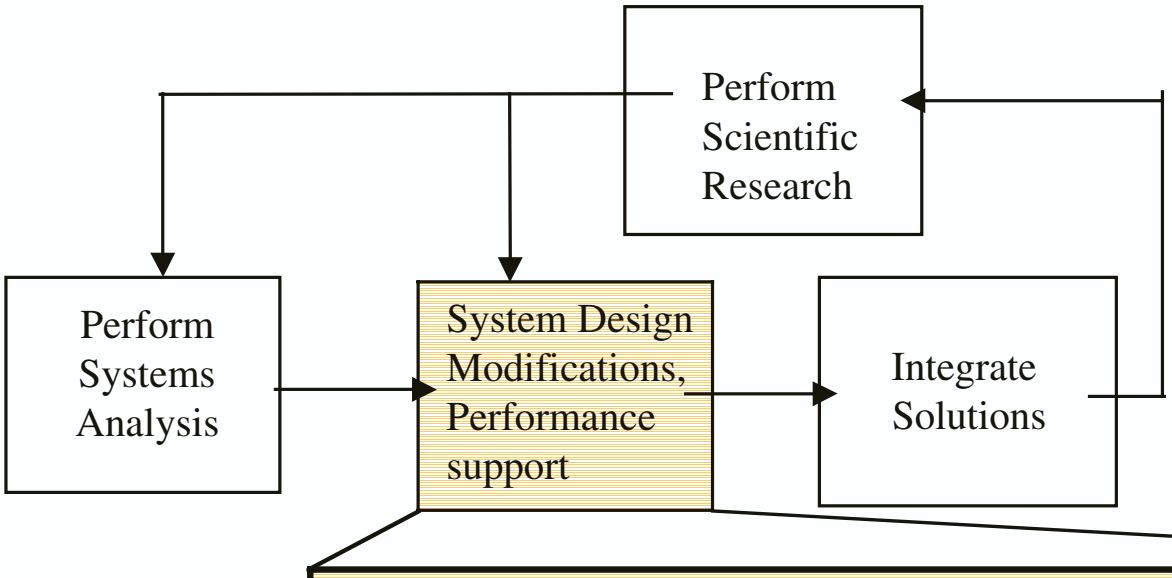
What Do HFEs Do?



Systems Analysis Tools/Techniques

- Activity sampling
- Hierarchical task analysis
- Link analysis
- Simulation studies
- Verbal protocols
- Interviews
- Questionnaires
- Critical Incident Techniques
- Decision action trees
- Decision ladders
- Operator action event trees
- Time line analysis
- Time and motion study
- Etc.

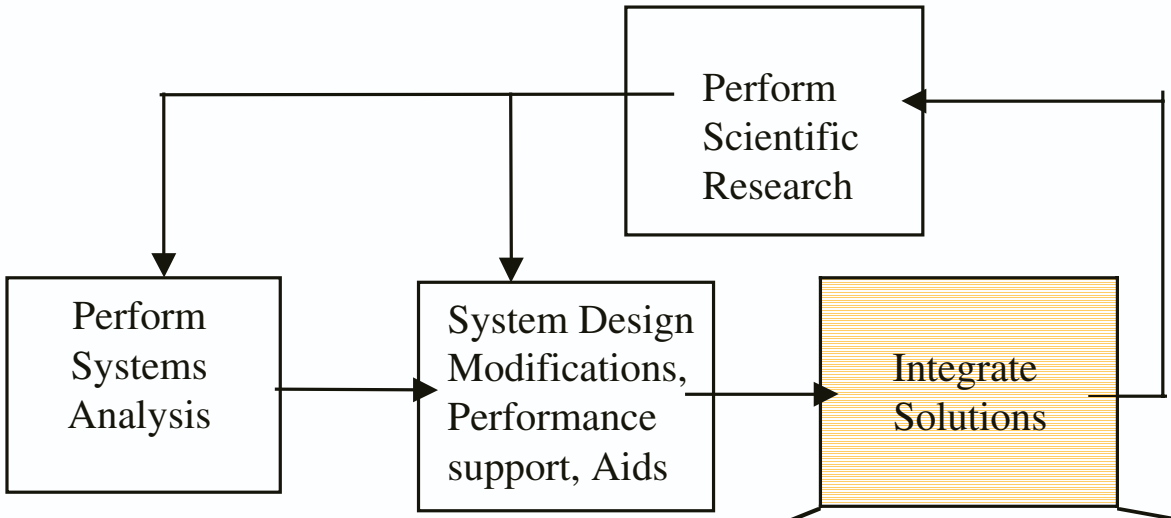
What Do HFEs Do?



System Modifications

- Redesign of workflow (task sequence, responsibility)
- Environmental improvements (noise, lighting, alarms)
- Redesign of information flow
- Development of support technology
- Changes to system interfaces
- Suggest changes to organizational policies
- Develop training programs
- Incorporation of safety systems

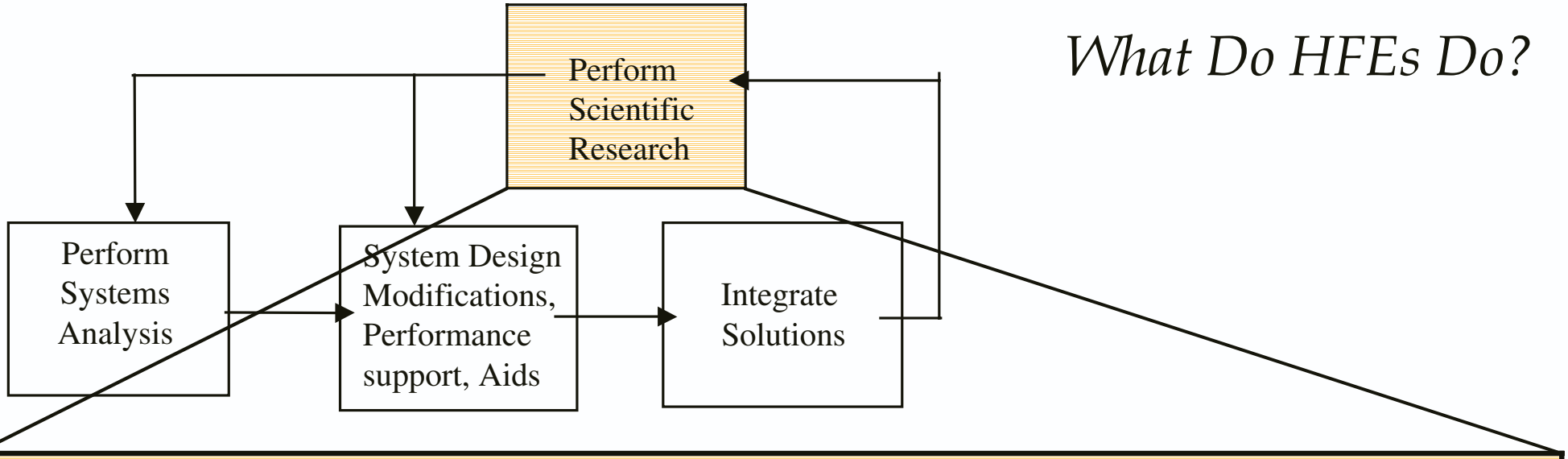
What Do HFEs Do?



Integration of Solutions

- Organizational changes and support
- Training
- New Technology
- Cost-benefit analysis

What Do HFEs Do?



Human Factors Research

- R&D of system and task analysis techniques
- Human decision making
- Cognitive modeling
- Mental workload
- Visual performance
- Shift work
- Simulation and modeling
- Display of information
- Effects of aging on performance
- Adaptive displays
- Communication
- Test and Evaluation
- Usability Testing
- Human computer interaction
- Safety
- Training
- Biomechanics
- Physical workload
- Manual material handling
- Human Error
- Virtual Environments
- Complex system modeling
- Human control and tracking
- Auditory perception
- Multi-modal interfaces
- Individual differences

Human Error Analysis: One Example of a Human Factors Analysis Technique

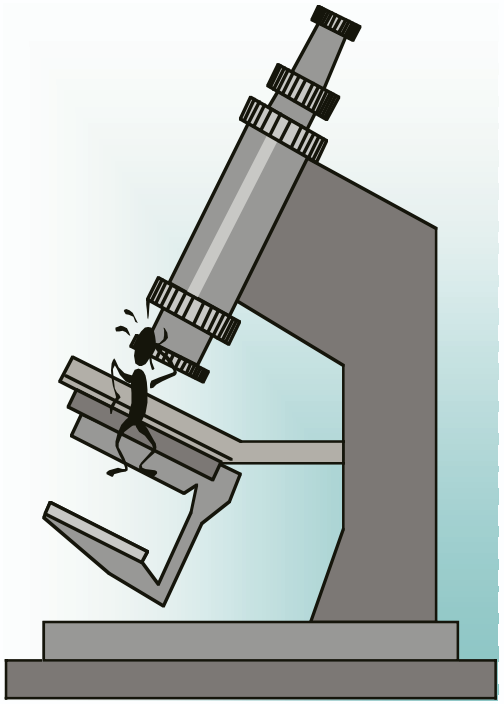
Human Error and Accidents

- **"Human beings by their very nature make mistakes; therefore, it is unreasonable to expect error-free human performance."**
  - **Shappell & Wiegmann, 1997**

Human Error and Accidents

- It is not surprising then, that human error has been implicated in 60-80% of accidents in complex systems.
- In fact, while accidents solely attributable to environmental and mechanical factors have been greatly reduced over the last several years, those attributable to human error continue to plague organizations.

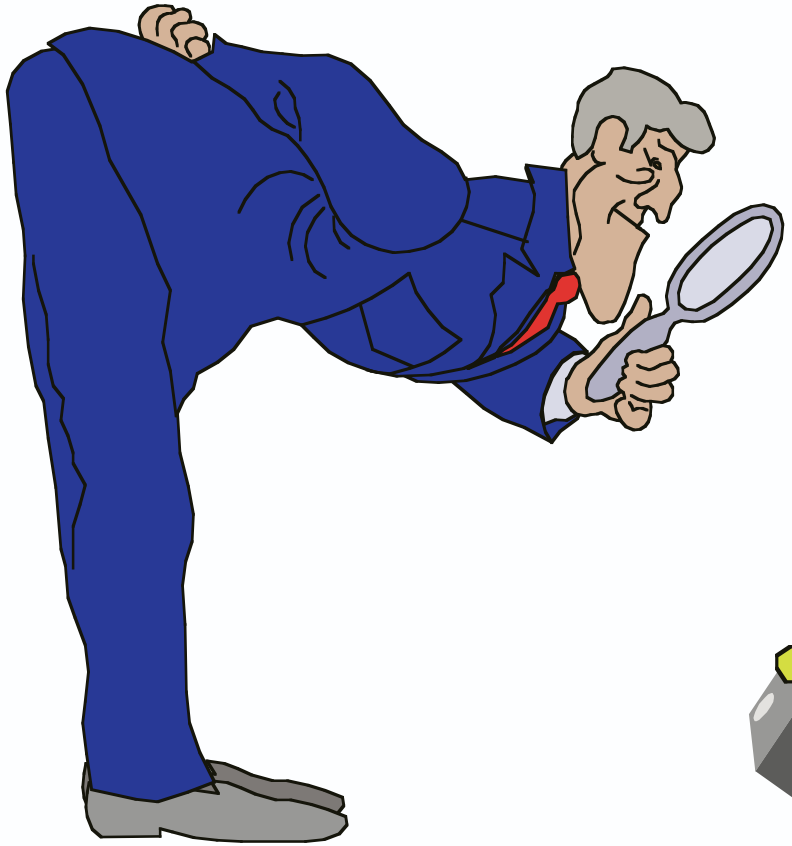
Where Do We Usually Look to Prevent Accidents?

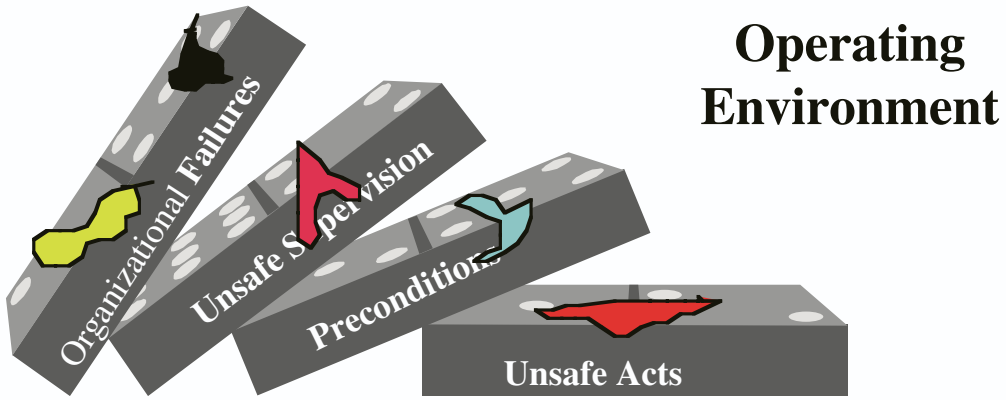


Human Error and Accidents

- Why is the human blamed?
  - It is human nature to blame what appears to be the active operator when something goes wrong.
  - Our legal system is geared toward the determination of responsibility, fault, and blame.
  - It is easier for management to blame the worker than to accept the fact that the workplace, procedure, environment, or system needs improving.
  - The forms we fill out to investigate accidents are usually modeled after the unsafe act, unsafe condition dichotomy.

Where Should We Look to Prevent Accidents?





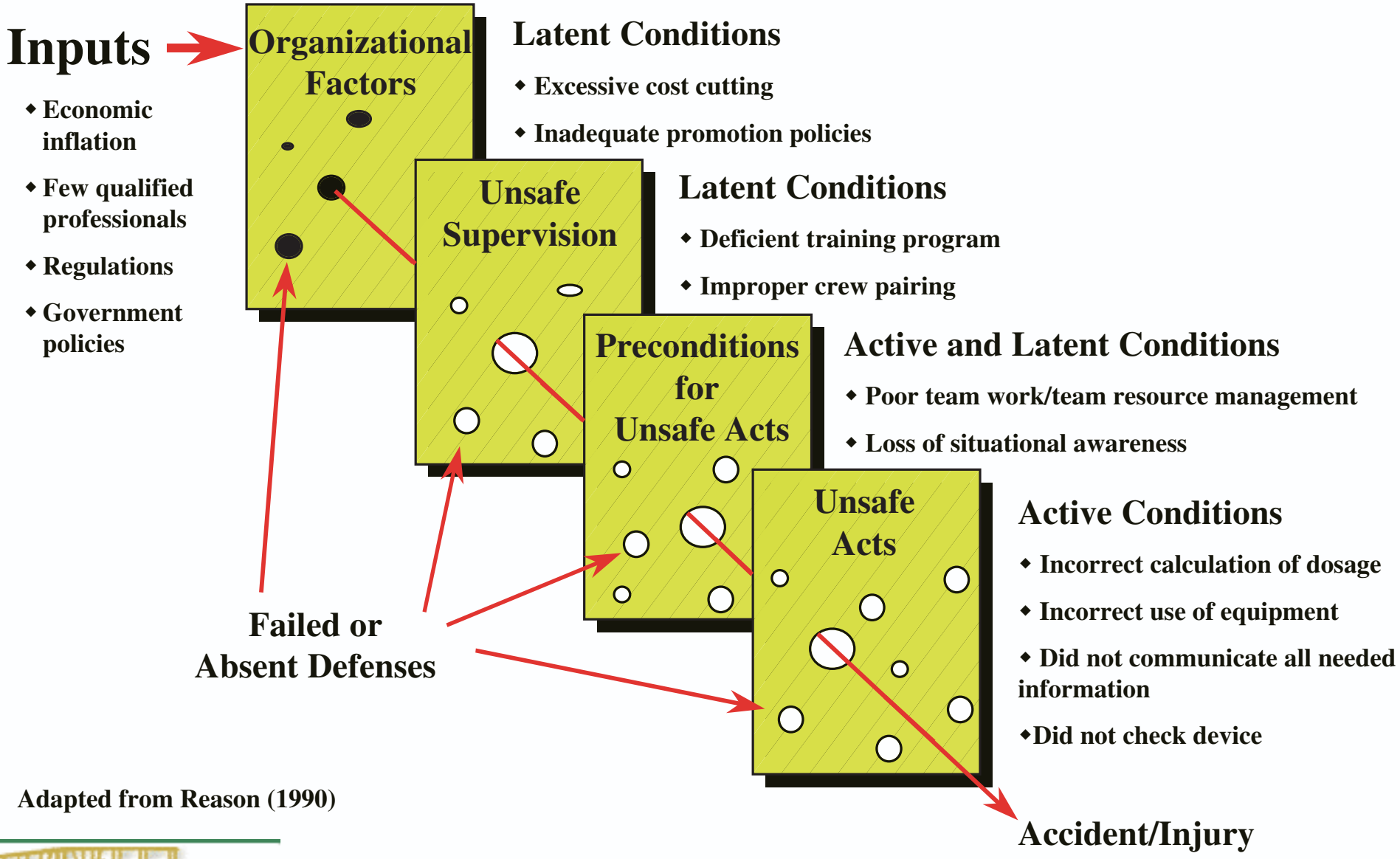
Human Factors Analysis and Classification System (HFACS)

- HFACS is based on the "Swiss Cheese" model of error by James Reason (1990)
- Applied to human error analysis in aviation by
  - Scott Shapell, Ph.D., Civil Aeromedical Institute and
  - Doug Wiegmann, Ph.D., University of Illinois

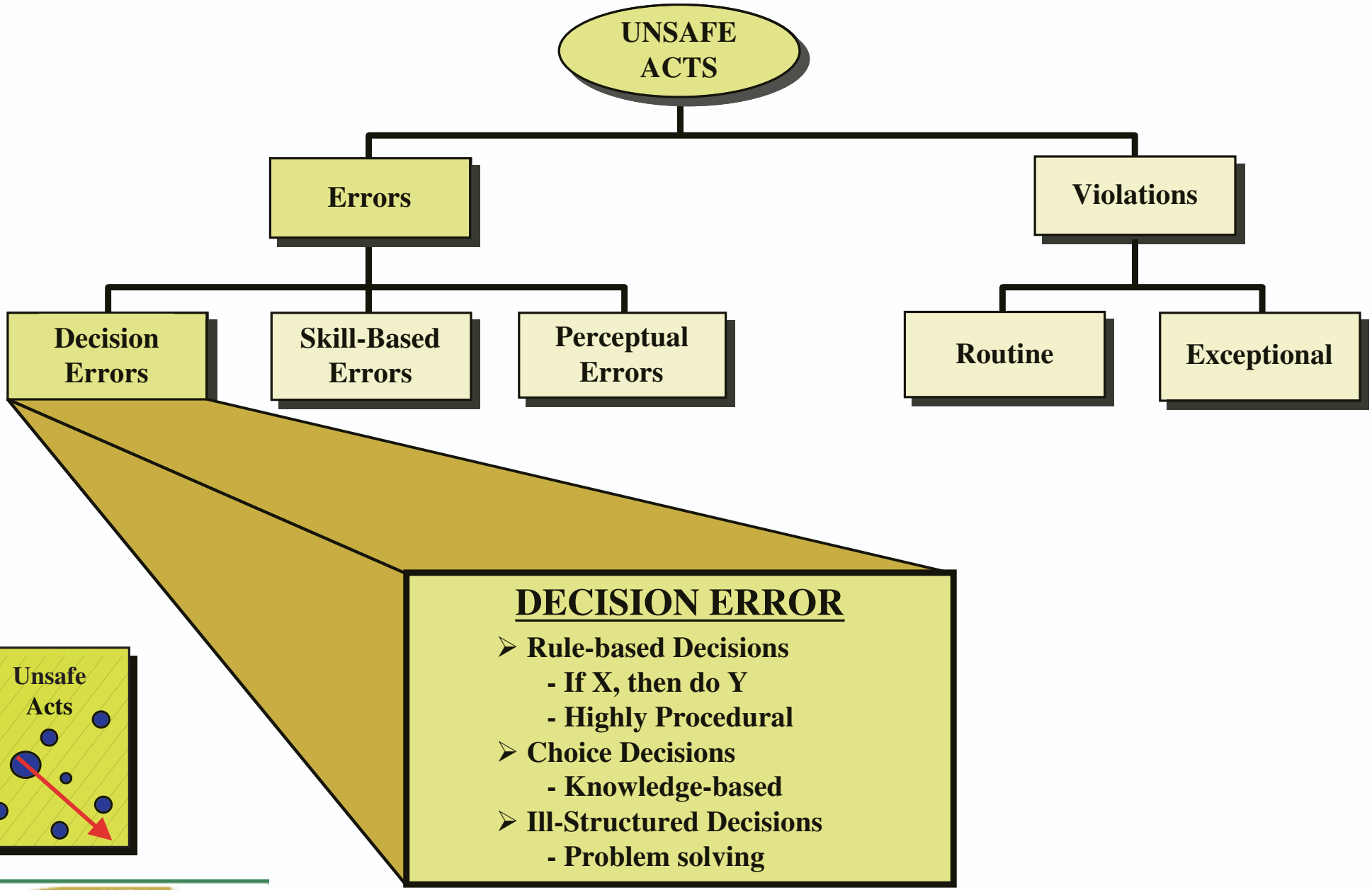
HFACS: Guiding Principles

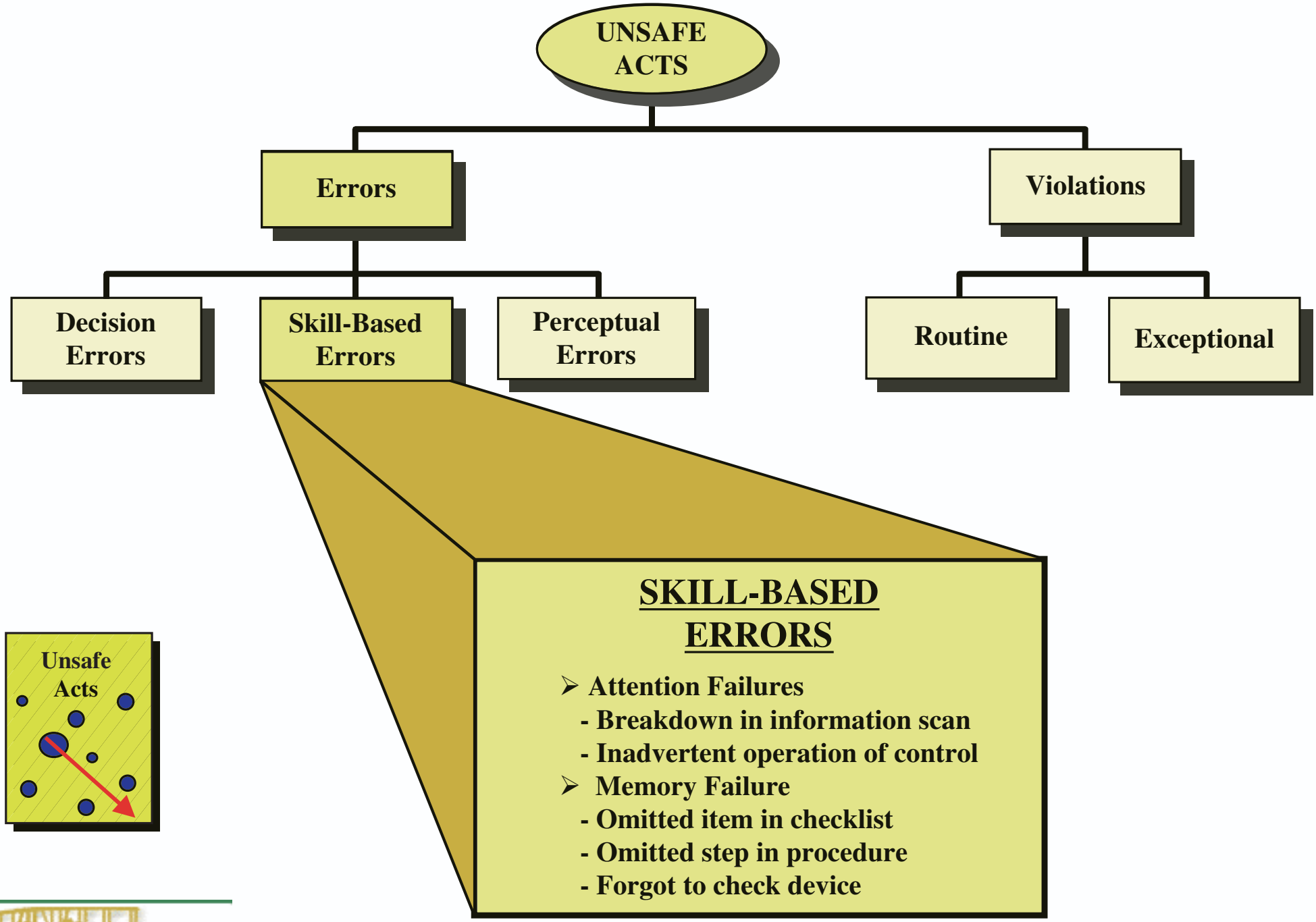
- Principle 1: Health care systems are similar in nature to other complex productive systems.
- Principle 2: Human errors are inevitable within such a system.
- Principle 3: Blaming errors on the human is like blaming a mechanical failure on the device.
- Principle 4: An accident, no matter how minor, is a failure of the system.
- Principle 5: Accident investigation and error prevention go hand-in-hand.

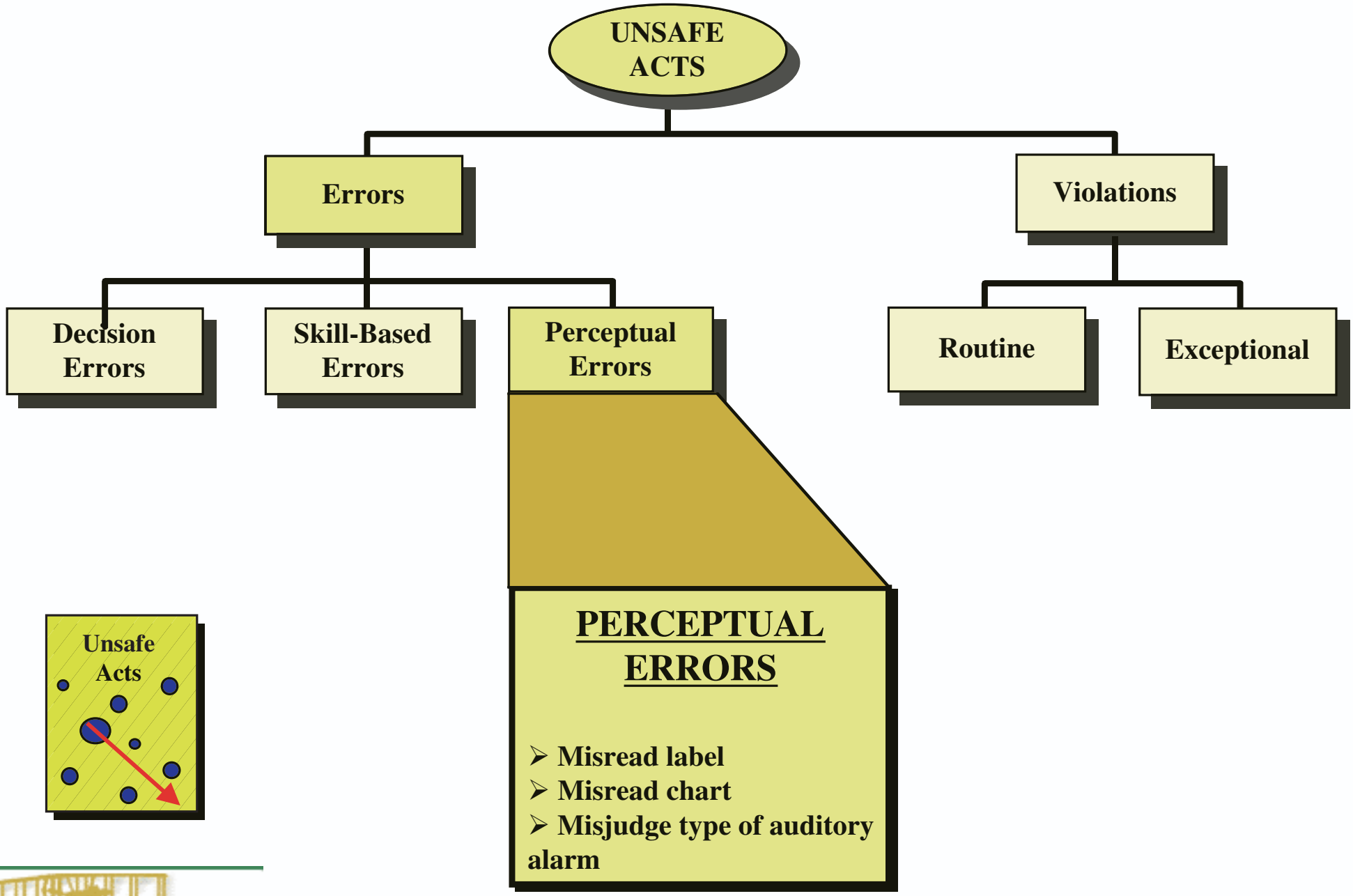
Breakdown of a Productive System

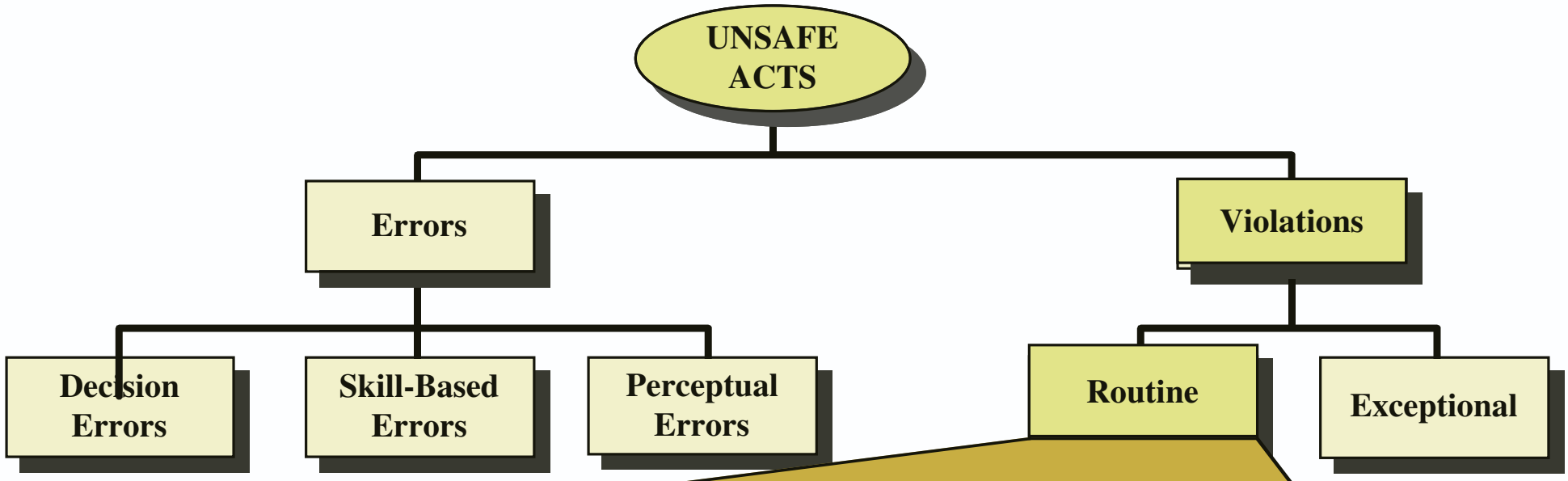


Adapted from Reason (1990)


UNSAFE ACTS
Errors
Violations
Decision Errors
Skill-Based Errors
Perceptual Errors
Routine
Exceptional
DECISION ERROR
➢ Rule-based Decisions
- If X, then do Y
- Highly Procedural
➢ Choice Decisions
- Knowledge-based
➢ Ill-Structured Decisions
- Problem solving
Unsafe Acts


UNSAFE ACTS
Errors
Violations
Decision Errors
Skill-Based Errors
Perceptual Errors
Routine
Exceptional
SKILL-BASED ERRORS
➢ Attention Failures
- Breakdown in information scan
- Inadvertent operation of control
➢ Memory Failure
- Omitted item in checklist
- Omitted step in procedure
- Forgot to check device
Unsafe Acts

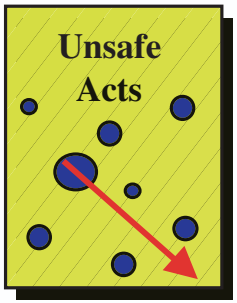

UNSAFE ACTS
Errors
Violations
Decision Errors
Skill-Based Errors
Perceptual Errors
Routine
Exceptional
PERCEPTUAL ERRORS
➢ Misread label
➢ Misread chart
➢ Misjudge type of auditory alarm
Unsafe Acts

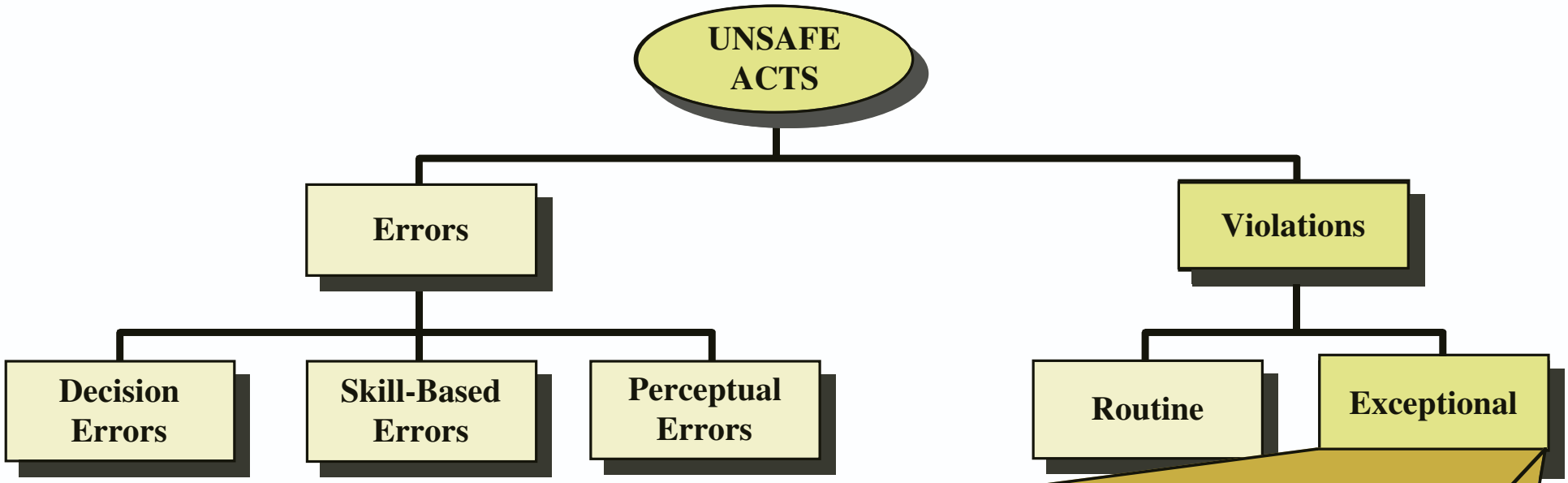


ROUTINE (INFRACTIONS)

(Habitual departures from rules condoned by management)

- Violation of Orders/Regulations/Standard Operating Procedures
  - -not checking ID bands
  - -failure to confirm allergy status when ordering antibiotic in doctors office
  - -Double check system for blood transfusion
  - -Side bed rails not raised
- Failed to Adhere to policy
- Not Current/Qualified for procedure
- Improper Procedures

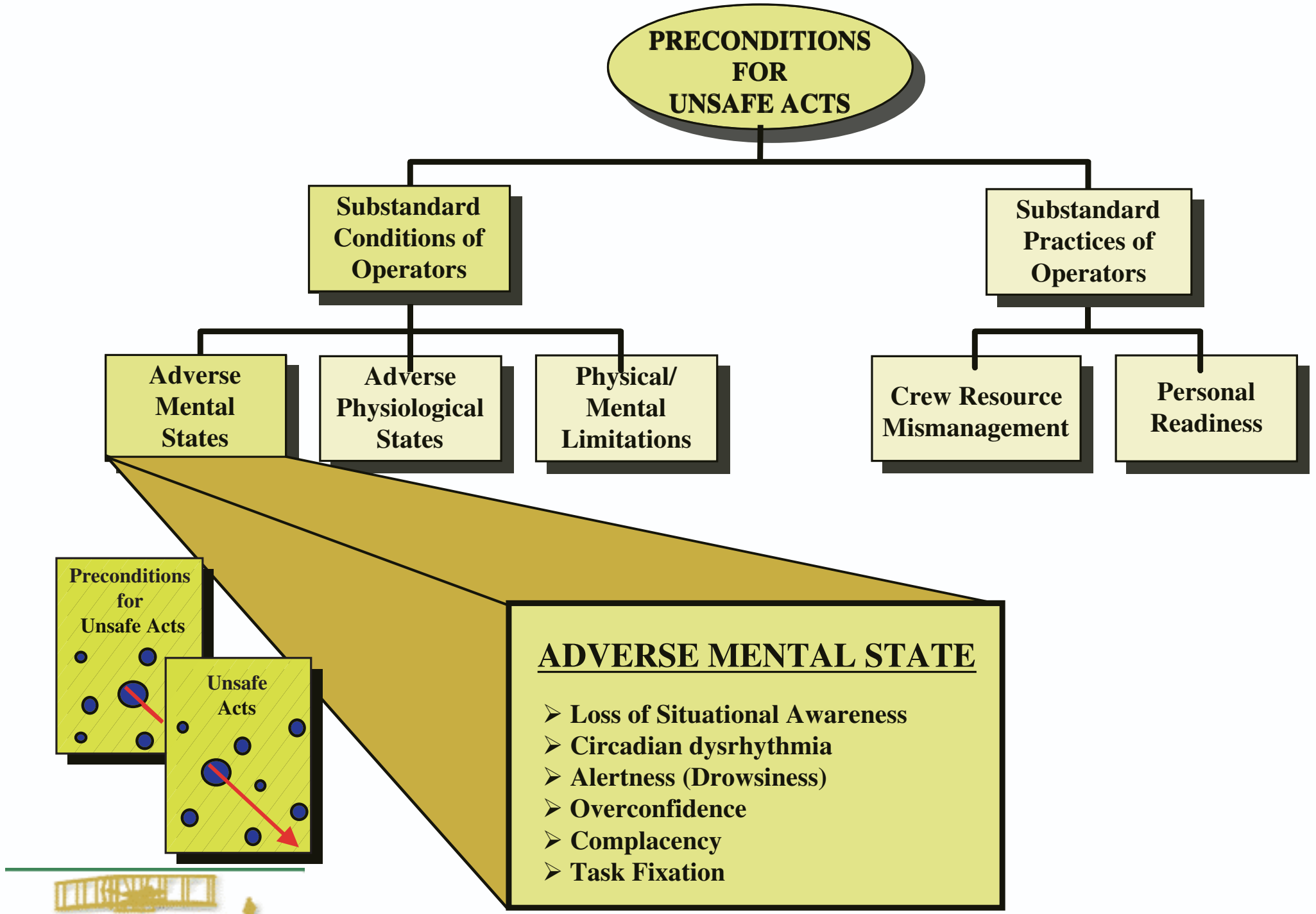


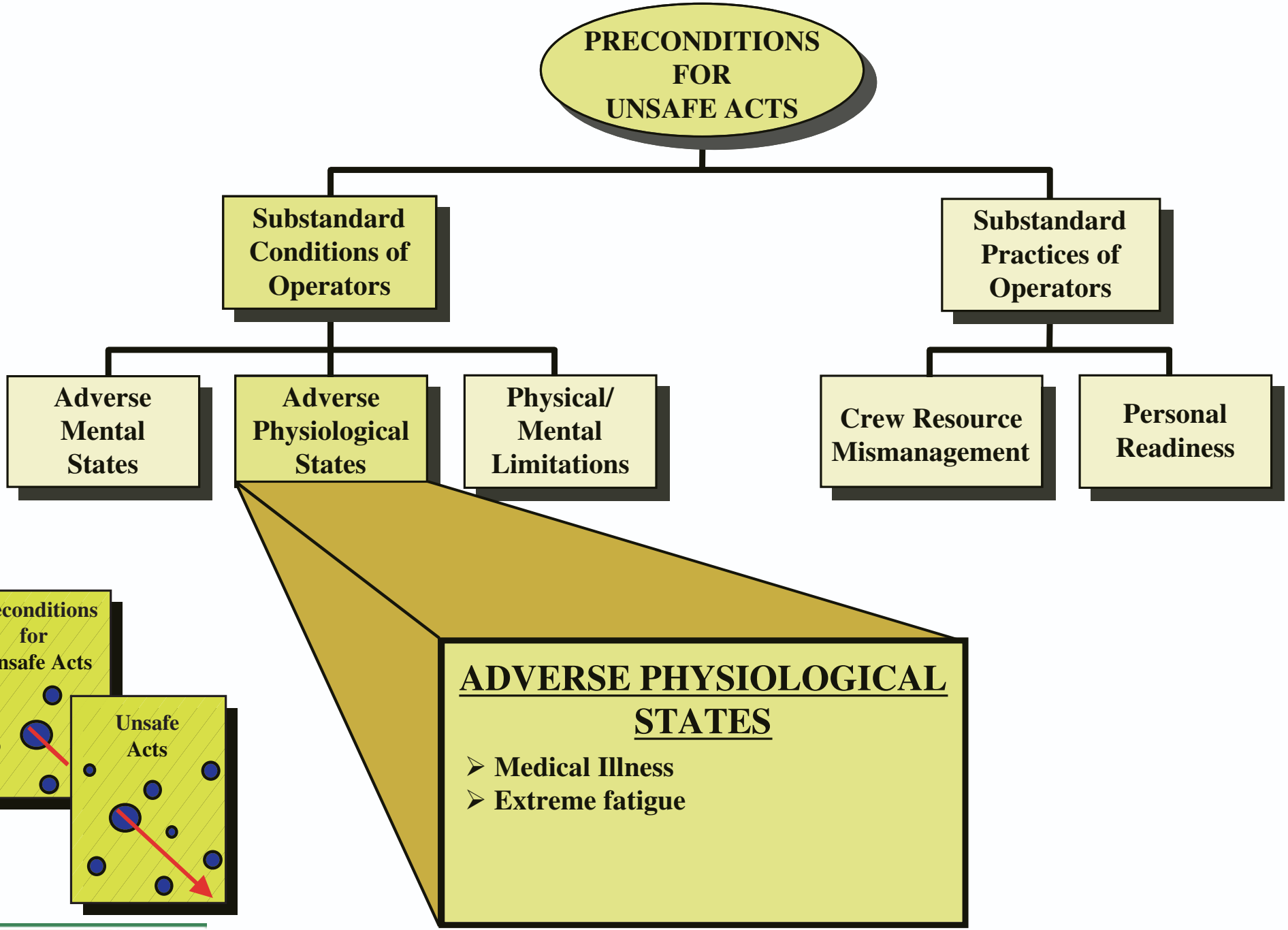


EXCEPTIONAL

(Isolated departures from the rules not condoned by management)

- **Violated**
  - **Keep drugs on floor**
  - **Extending surgical procedure without patient consent**
- **Accepted Unnecessary Hazard**
- **Not Current/Qualified for Procedure**
- **Violated standard medical practice**


PRECONDITIONS FOR UNSAFE ACTS
Substandard Conditions of Operators
Substandard Practices of Operators
Adverse Mental States
Adverse Physiological States
Physical/ Mental Limitations
Crew Resource Mismanagement
Personal Readiness
Preconditions for Unsafe Acts
Unsafe Acts
ADVERSE MENTAL STATE
Loss of Situational Awareness
Circadian dysrhythmia
Alertness (Drowsiness)
Overconfidence
Complacency
Task Fixation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Personal Readiness
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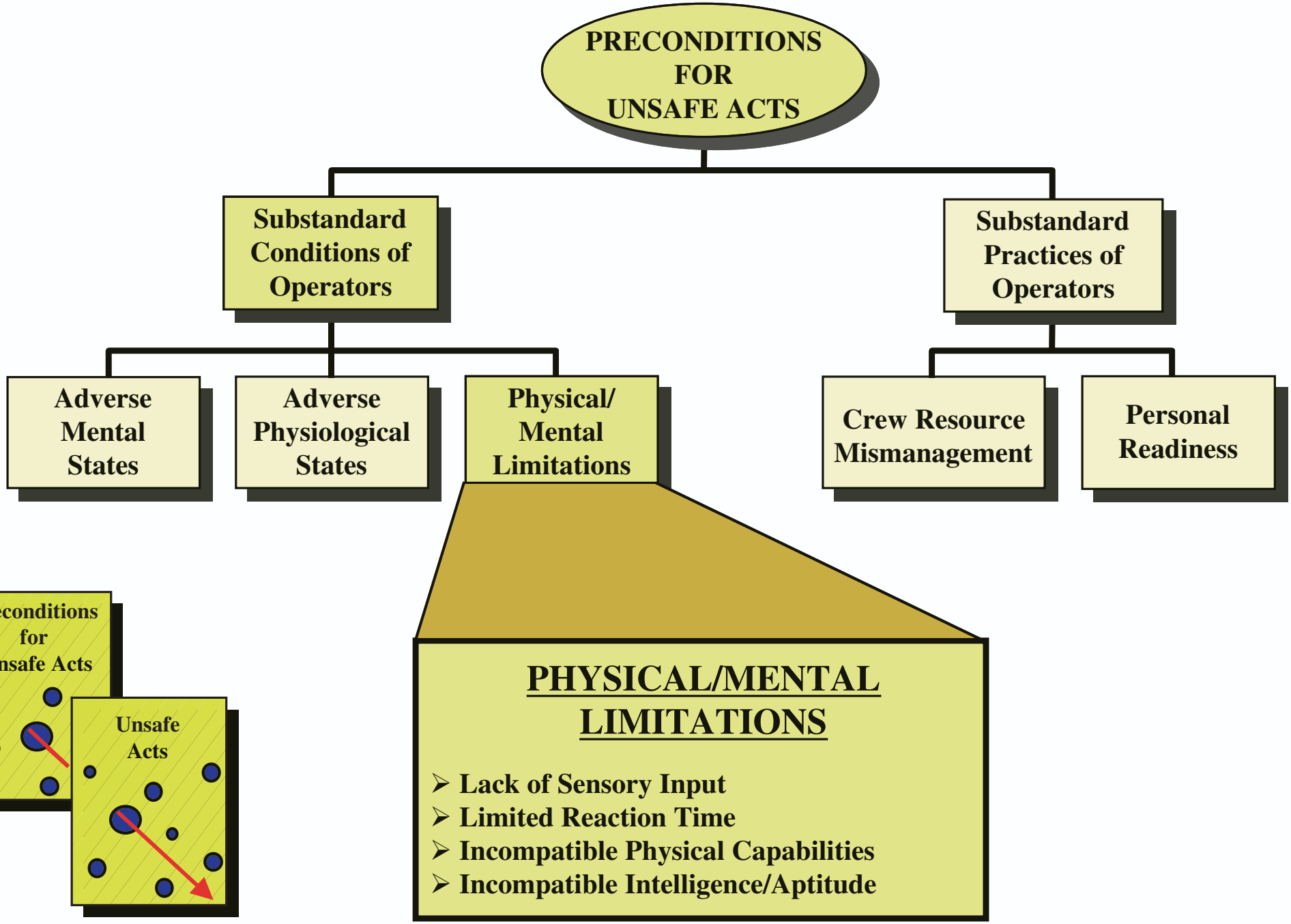
Unsafe Acts
ADVERSE PHYSIOLOGICAL STATES
Medical Illness
Extreme fatigue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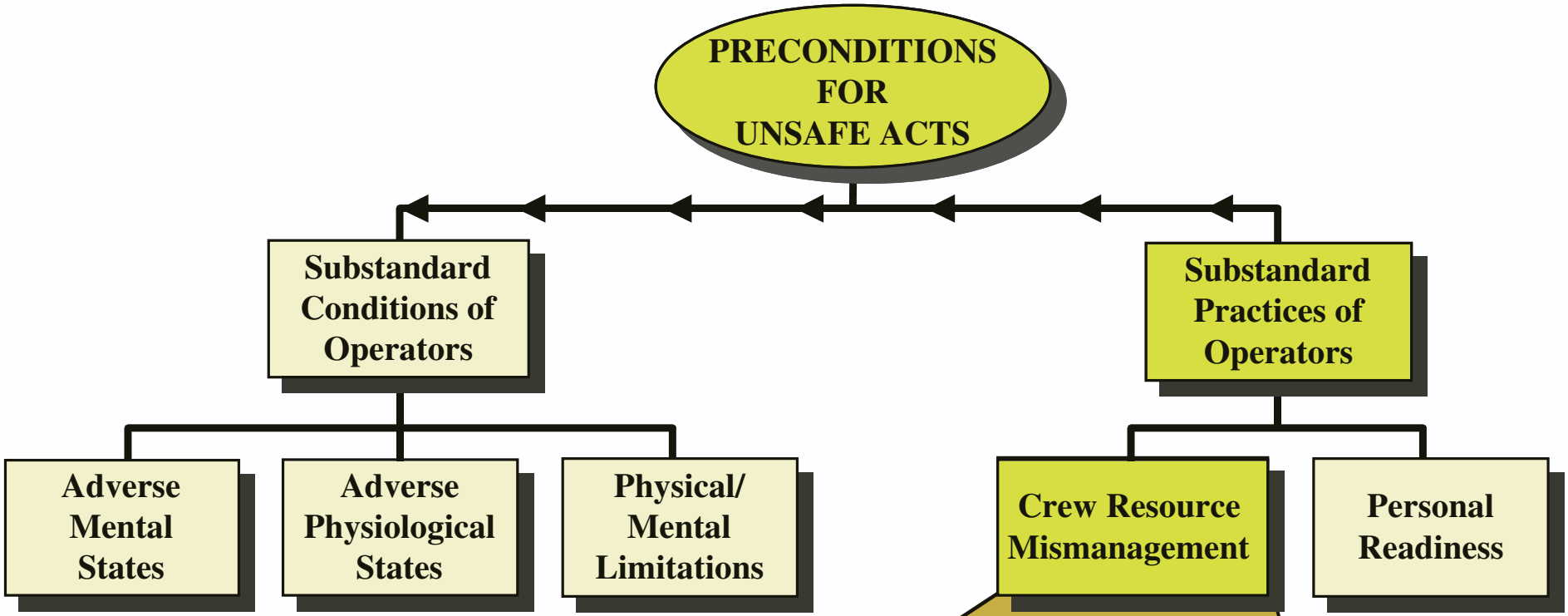
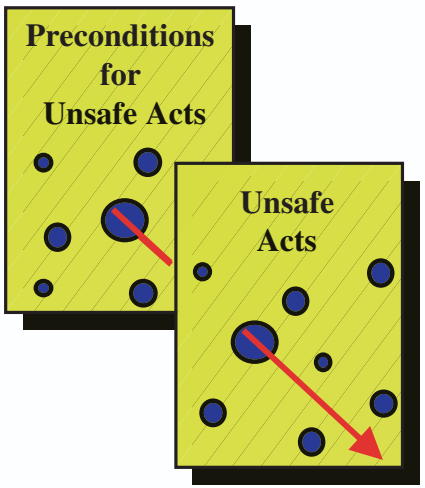
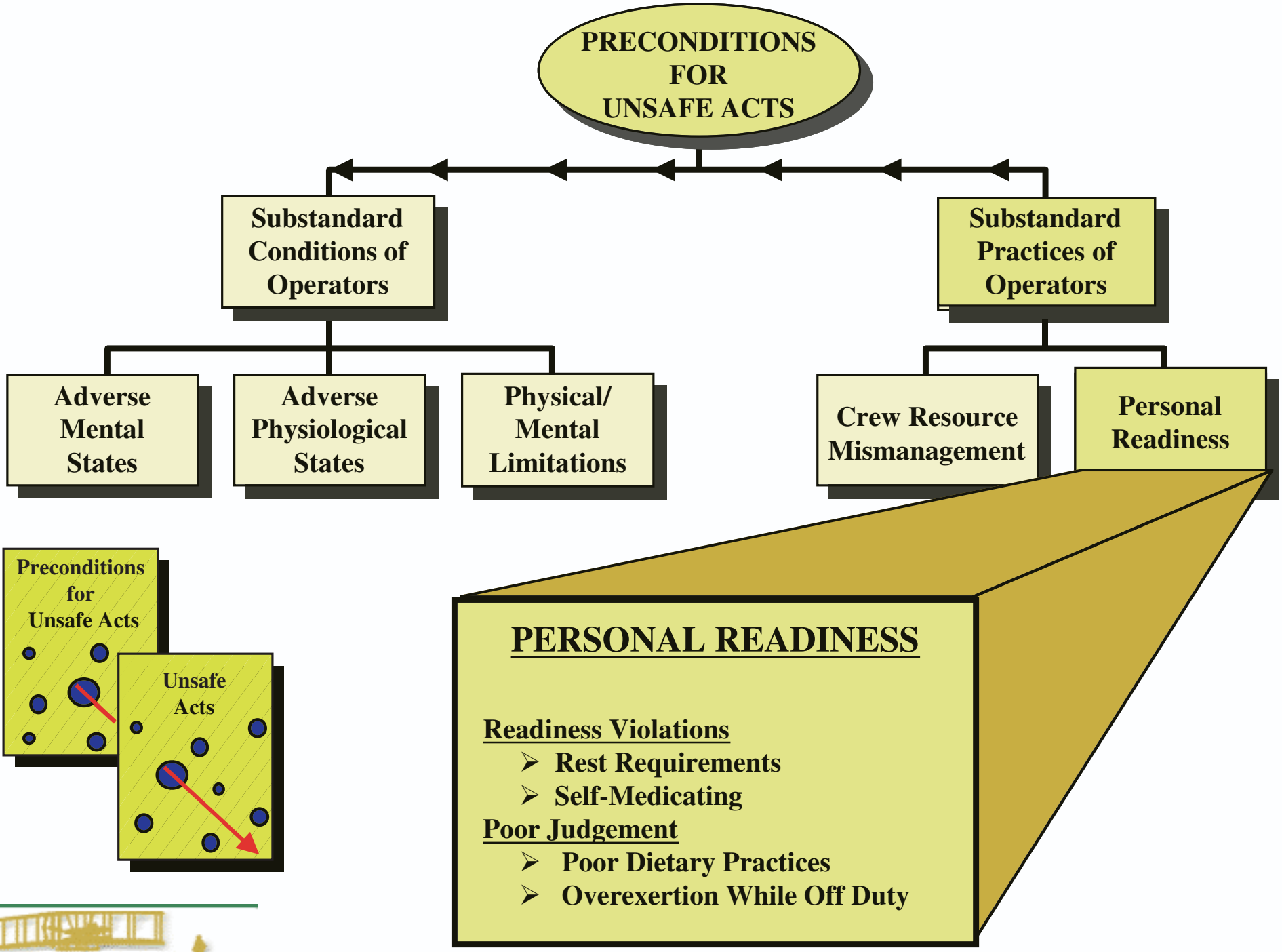
Personal Readiness
Preconditions for Unsafe Acts
Unsafe Acts
PHYSICAL/MENTAL LIMITATIONS
Lack of Sensory Input
Limited Reaction Time
Incompatible Physical Capabilities
Incompatible Intelligence/Aptitude





CREW RESOURCE MISMANAGEMENT

- Not Working as a Team
- Poor team Coordination
- Improper Briefing Before a Procedure
- Inadequate Coordination of materials/technologies/human resources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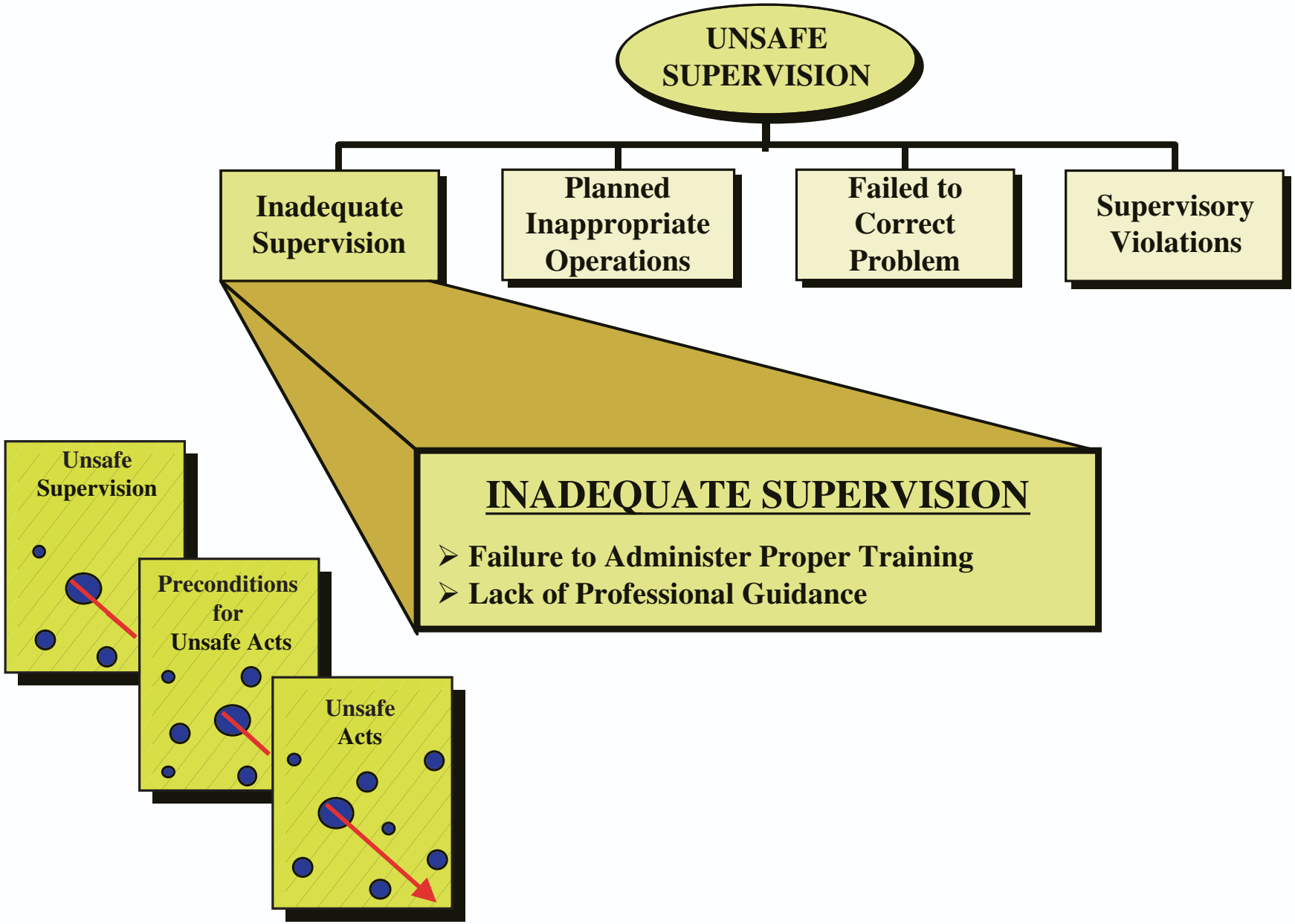
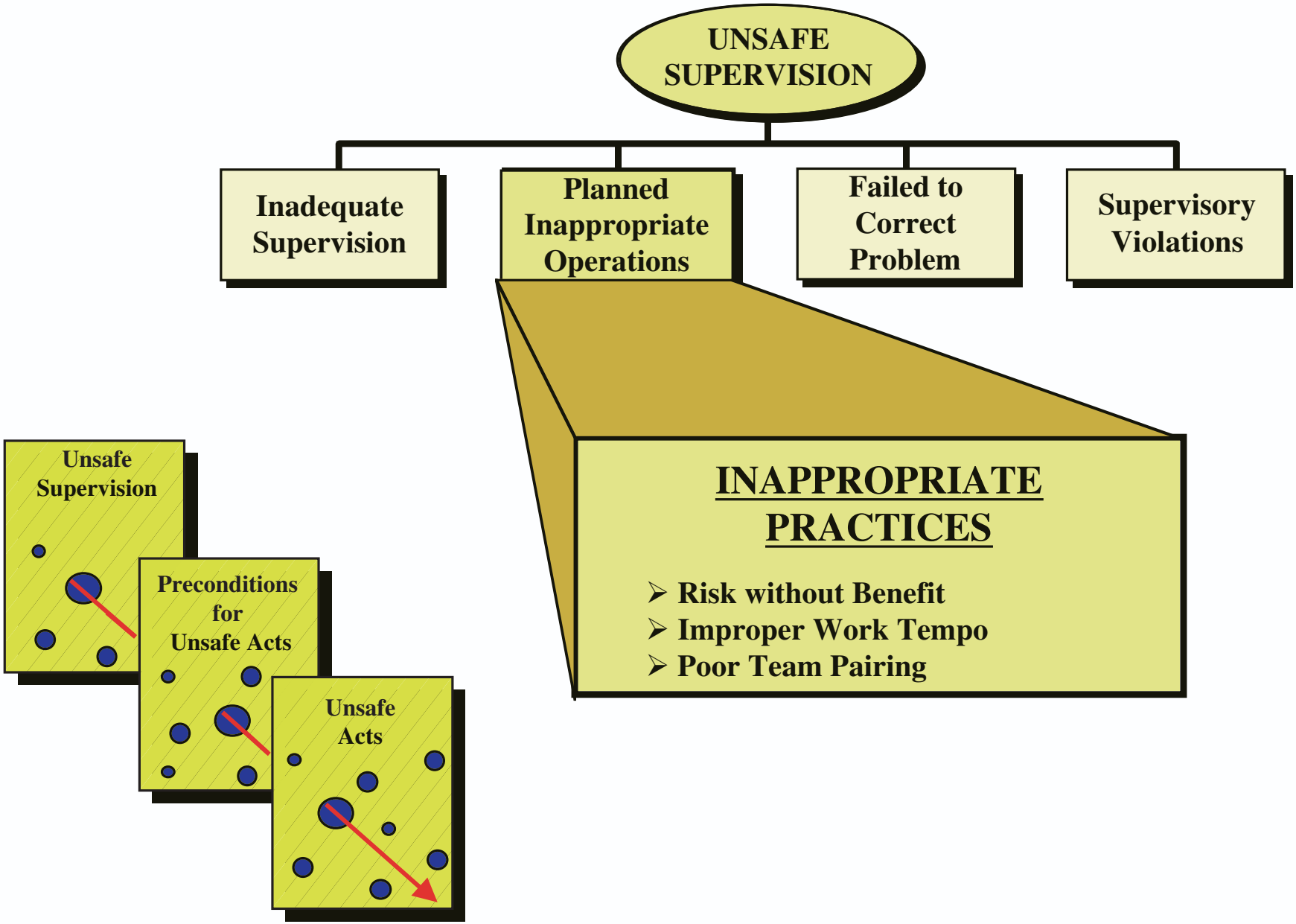
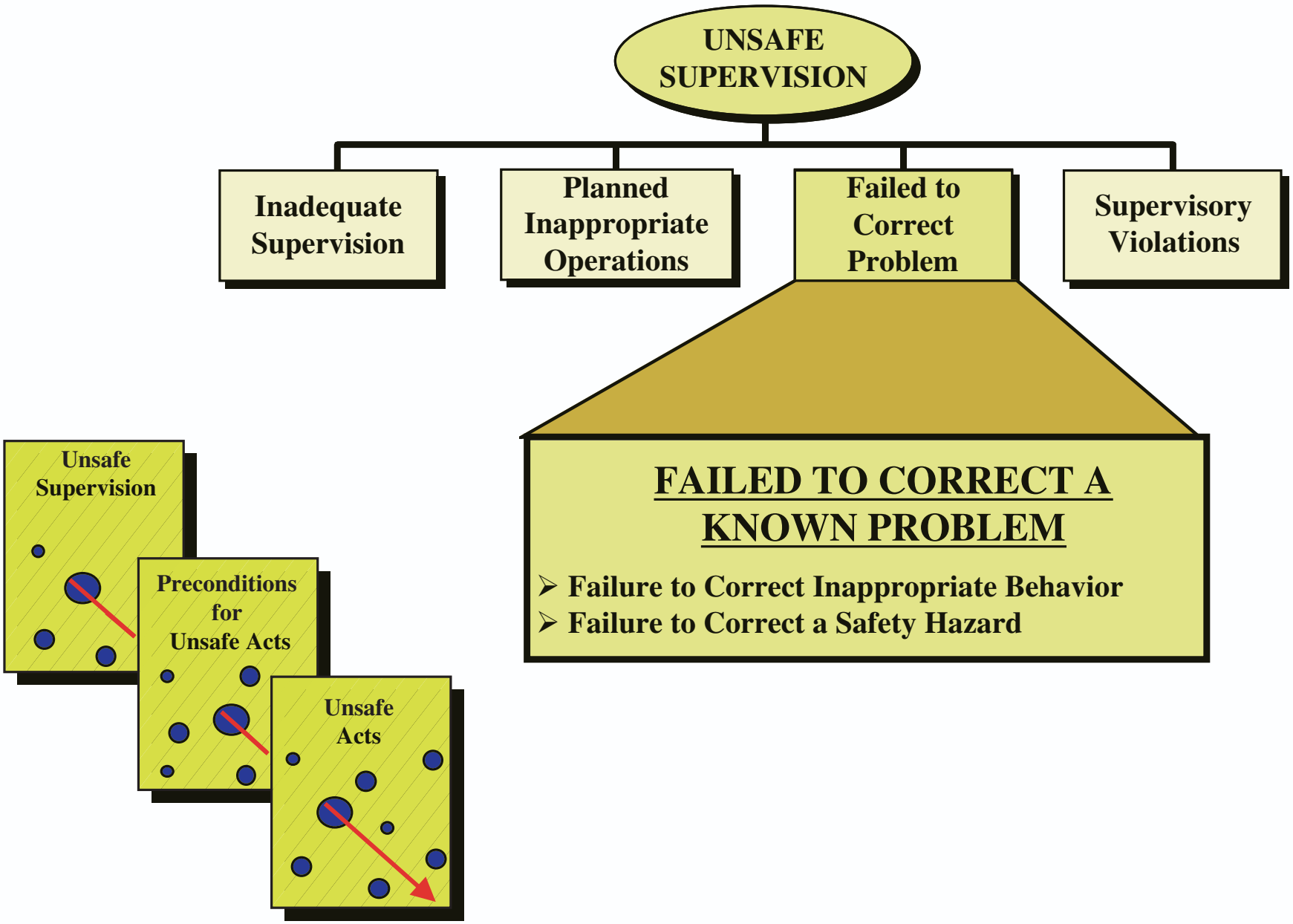
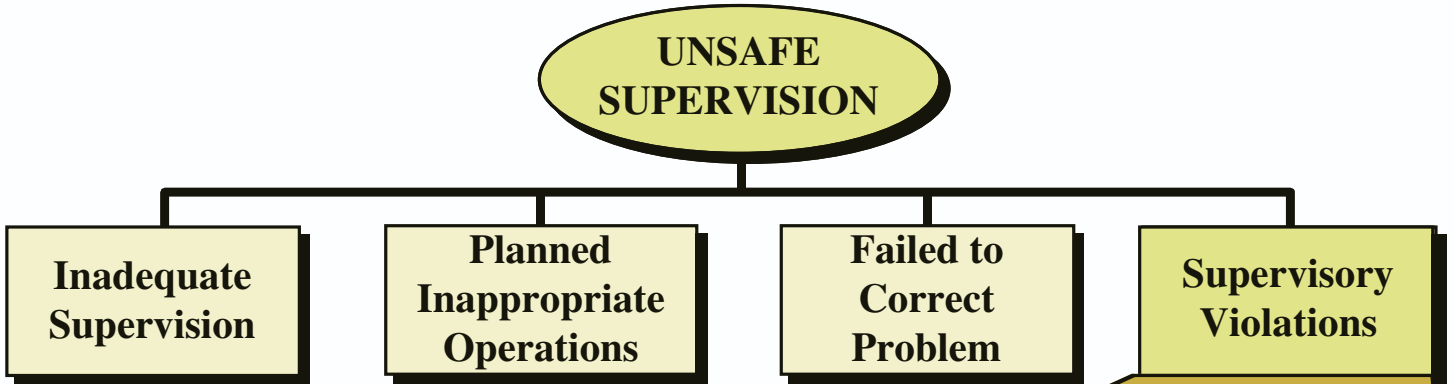
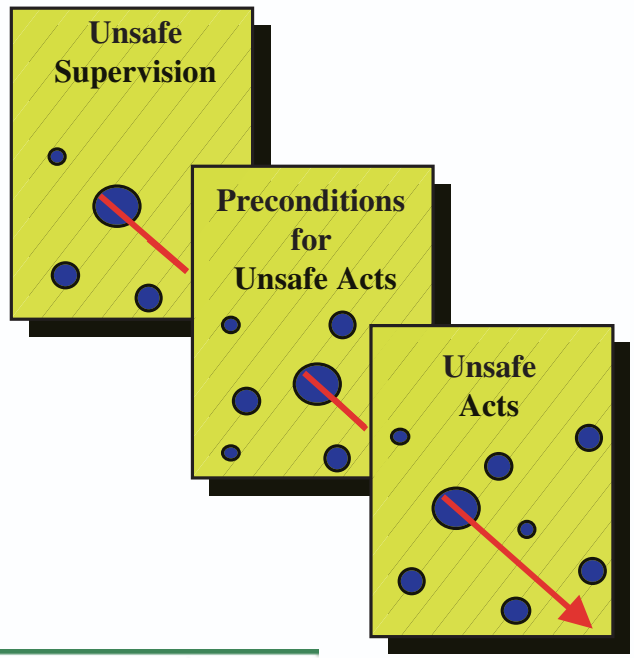
Physical/ Mental Limitations
Crew Resource Mismanagement
Personal Readiness
Preconditions for Unsafe Acts
Unsafe Acts
PERSONAL READINESS
Readiness Violations
Rest Requirements
Self-Medicating
Poor Judgement
Poor Dietary Practices
Overexertion While Off Duty


UNSAFE SUPERVISION
Inadequate Supervision
Planned Inappropriate Operations
Failed to Correct Problem
Supervisory Violations
INADEQUATE SUPERVISION
➢ Failure to Administer Proper Training
➢ Lack of Professional Guidance
Unsafe Supervision
Preconditions for Unsafe Acts
Unsafe Acts


UNSAFE SUPERVISION
Inadequate Supervision
Planned Inappropriate Operations
Failed to Correct Problem
Supervisory Violations
INAPPROPRIATE PRACTICES
Risk without Benefit
Improper Work Tempo
Poor Team Pairing
Unsafe Supervision
Preconditions for Unsafe Acts
Unsafe Acts

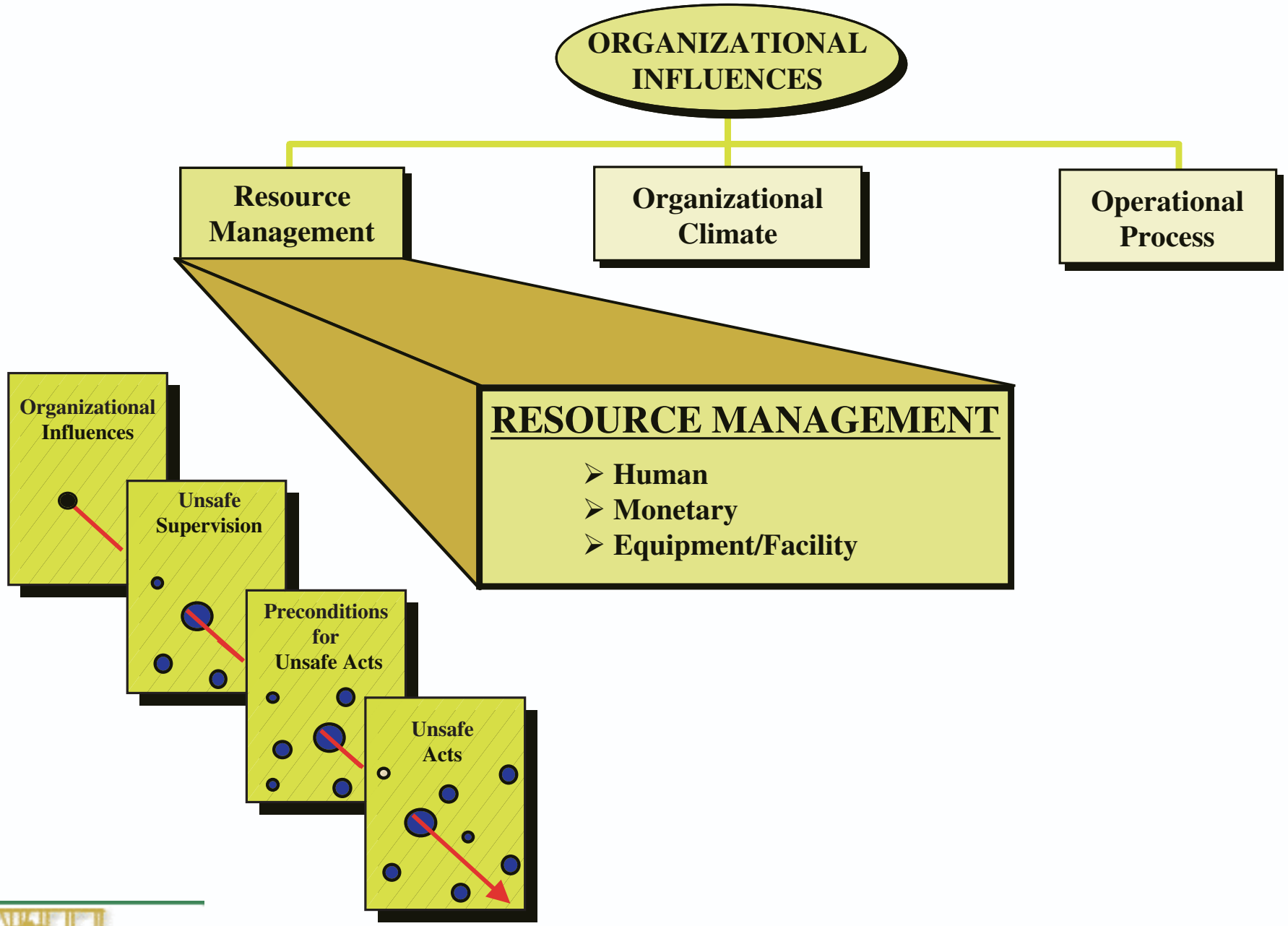

UNSAFE SUPERVISION
Inadequate Supervision
Planned Inappropriate Operations
Failed to Correct Problem
Supervisory Violations
FAILED TO CORRECT A KNOWN PROBLEM
➢ Failure to Correct Inappropriate Behavior
➢ Failure to Correct a Safety Hazard
Unsafe Supervision
Preconditions for Unsafe Acts
Unsafe Acts

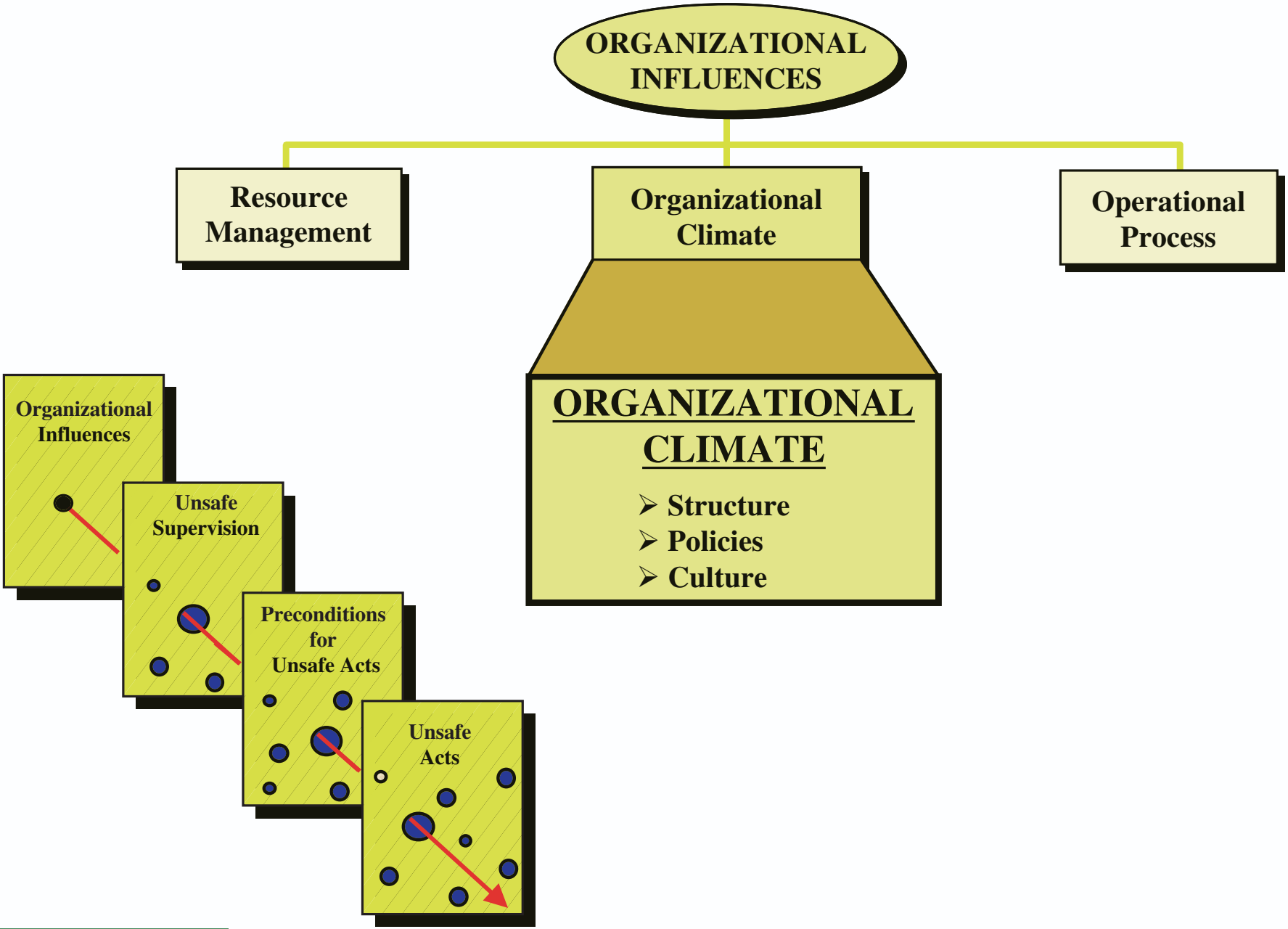




SUPERVISORY VIOLATIONS

- Not Adhering to Rules and Regulations
- Willful Disregard for Authority by Supervisors

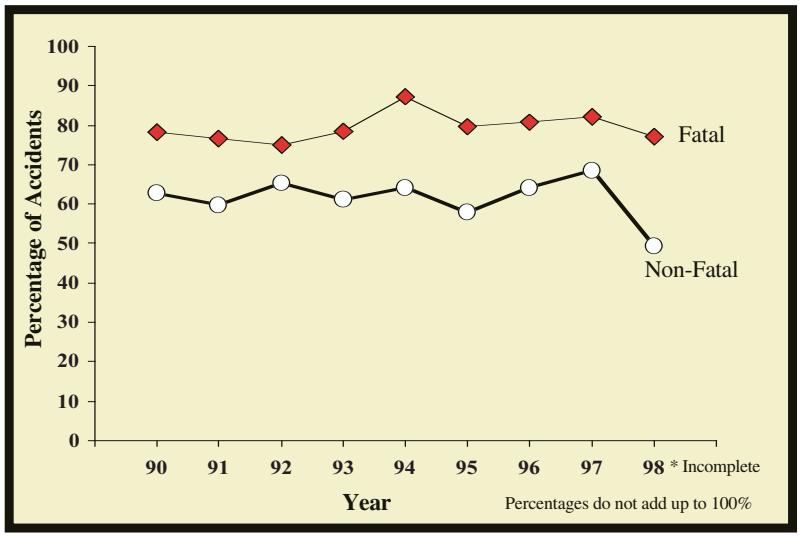

ORGANIZATIONAL INFLUENCES
Resource Management
Organizational Climate
Operational Process
RESOURCE MANAGEMENT
Human
Monetary
Equipment/Facility
Organizational Influences
Unsafe Supervision
Preconditions for Unsafe Acts
Unsafe Acts


ORGANIZATIONAL INFLUENCES
Resource Management
Organizational Climate
Operational Process
ORGANIZATIONAL CLIMATE
Structure
Policies
Culture
Organizational Influences
Unsafe Supervision
Preconditions for Unsafe Acts
Unsafe Acts

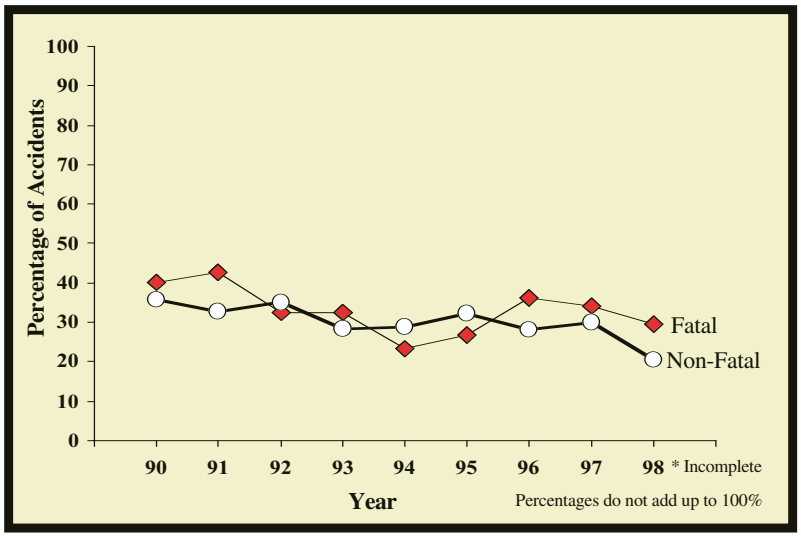

ORGANIZATIONAL INFLUENCES
Resource Management
Organizational Climate
Operational Process
OPERATIONAL PROCESS
Operations
Procedures
Oversight
Organizational Influences
Unsafe Supervision
Preconditions for Unsafe Acts
Unsafe Acts

FAR Part 91 - General Aviation: Fatal vs. Non-Fatal Accident Comparison

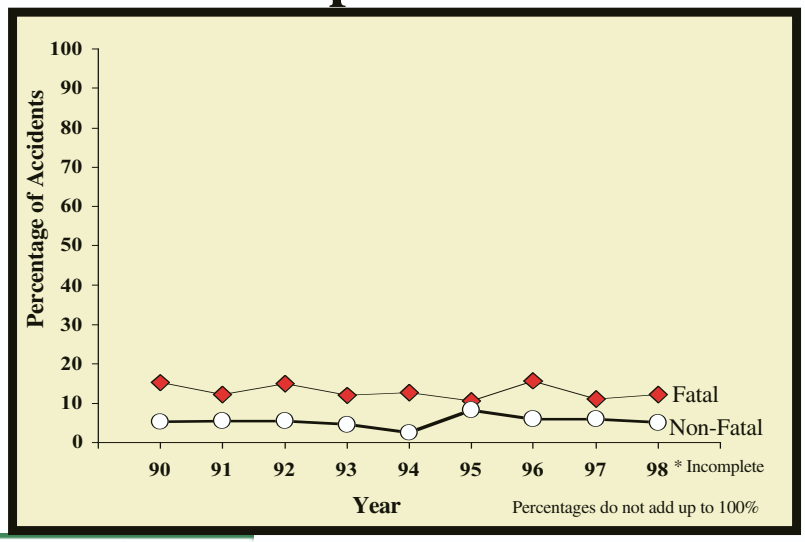
Skill-based Errors



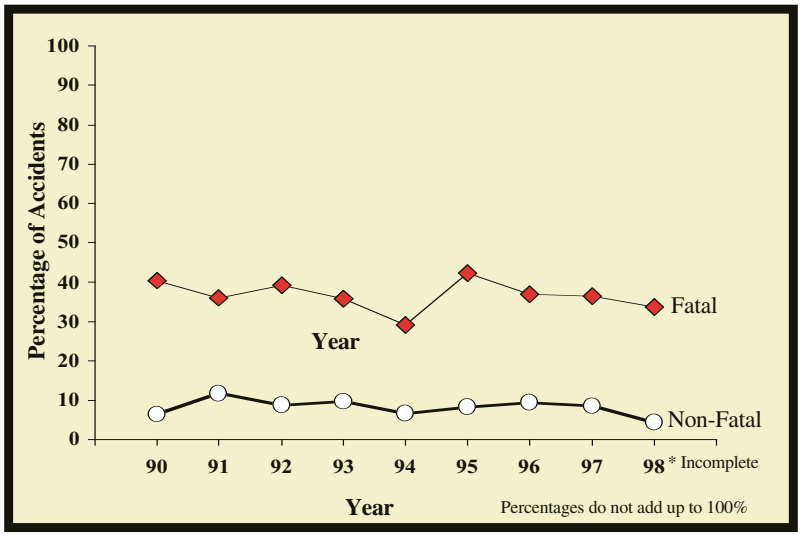
Decision Errors

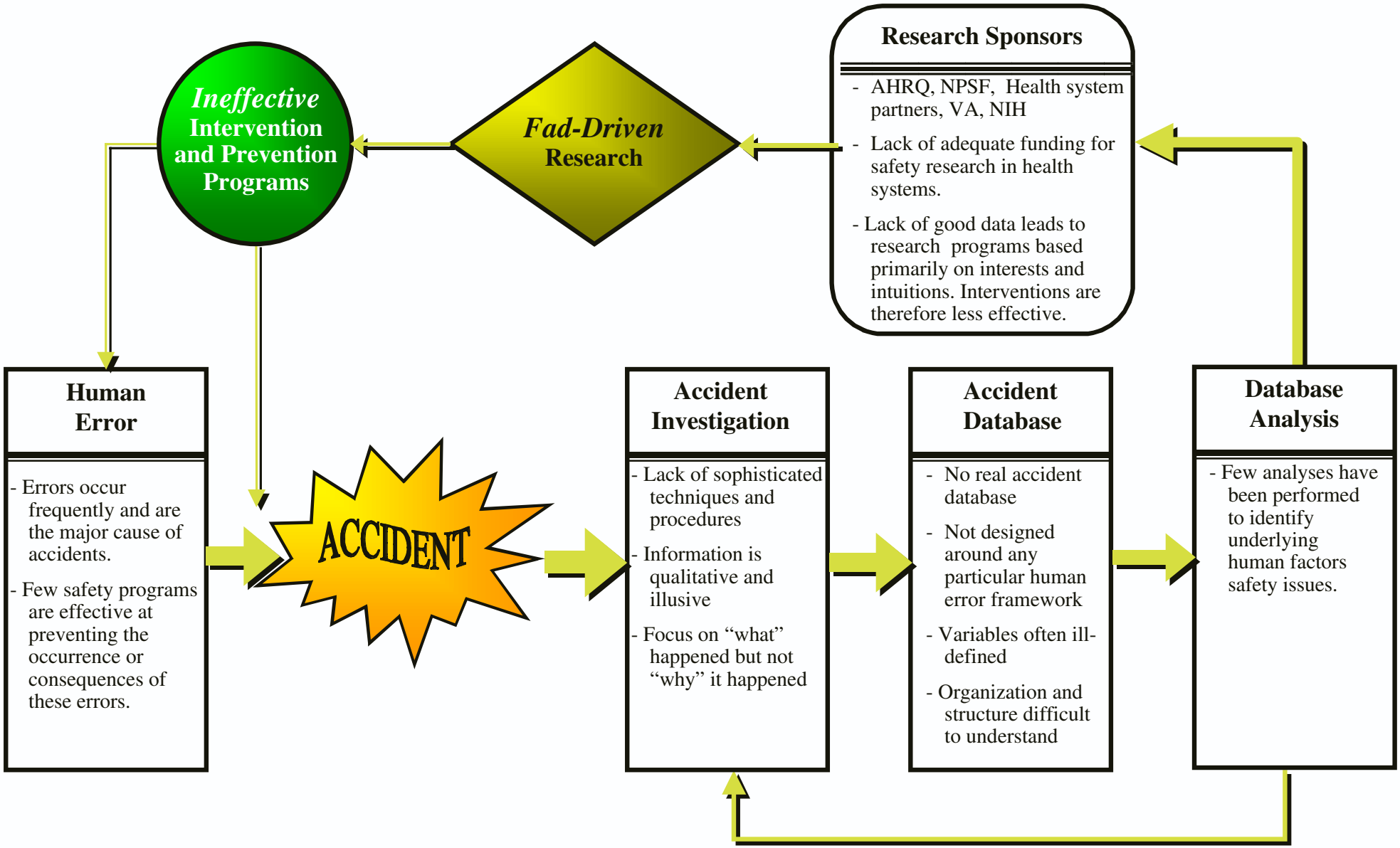


Perceptual Errors

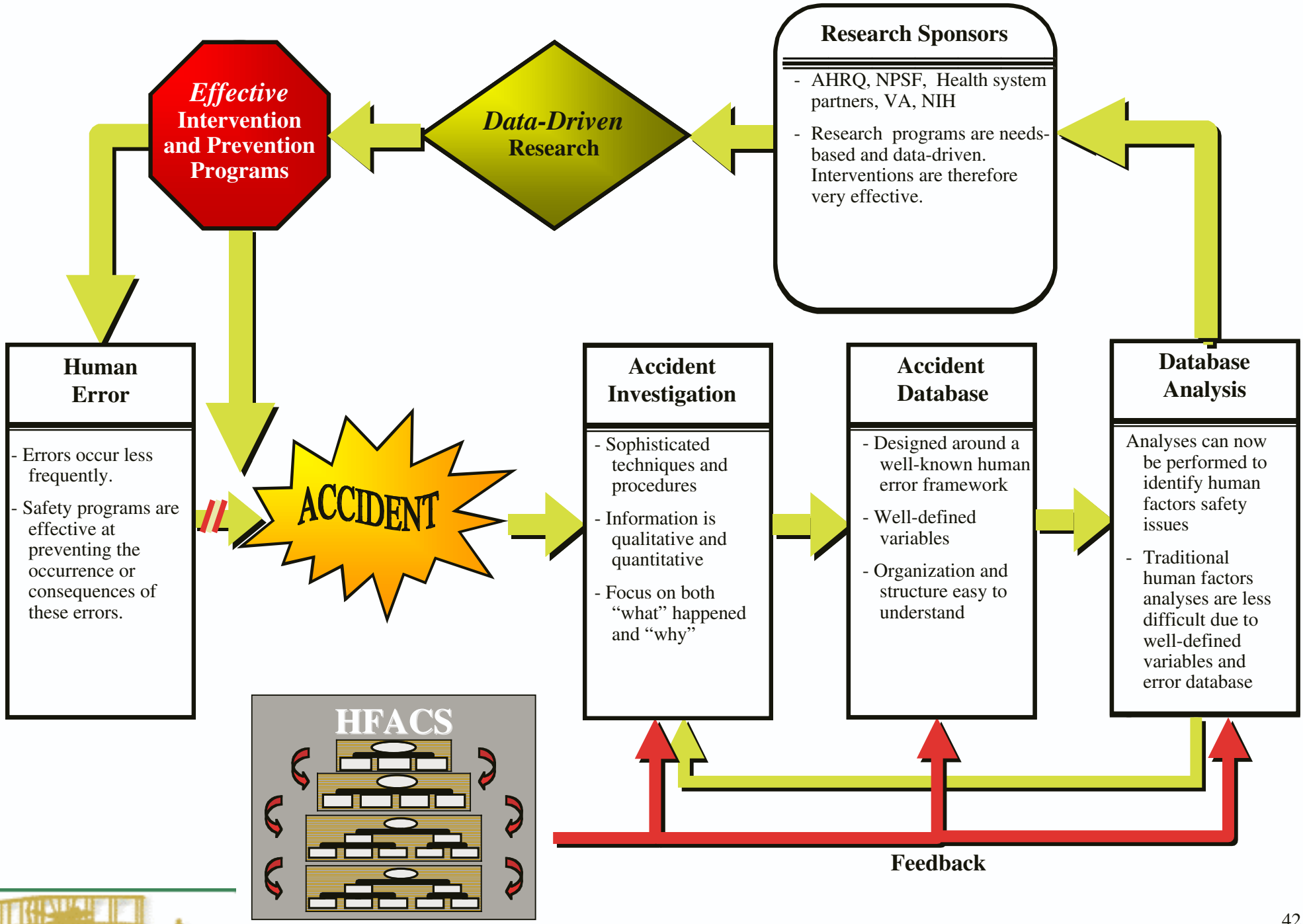


Violations





Wiegmann, D. & Shappell, S. (In press). Human error analysis of commercial aviation accidents: Application of the Human Factors Analysis and Classification System (HFACS). *Aviation, Space, and Environmental Medicine*.


Research Sponsors
- AHRQ, NPSF, Health system partners, VA, NIH
- Research programs are needs-based and data-driven. Interventions are therefore very effective.
Effective Intervention and Prevention Programs
Data-Driven Research
Human Error
- Errors occur less frequently.
- Safety programs are effective at preventing the occurrence or consequences of these errors.
ACCIDENT
Accident Investigation
- Sophisticated techniques and procedures
- Information is qualitative and quantitative
- Focus on both "what" happened and "why"
Accident Database
- Designed around a well-known human error framework
- Well-defined variables
- Organization and structure easy to understand
Database Analysis
Analyses can now be performed to identify human factors safety issues
- Traditional human factors analyses are less difficult due to well-defined variables and error database
HFACS
Feedback

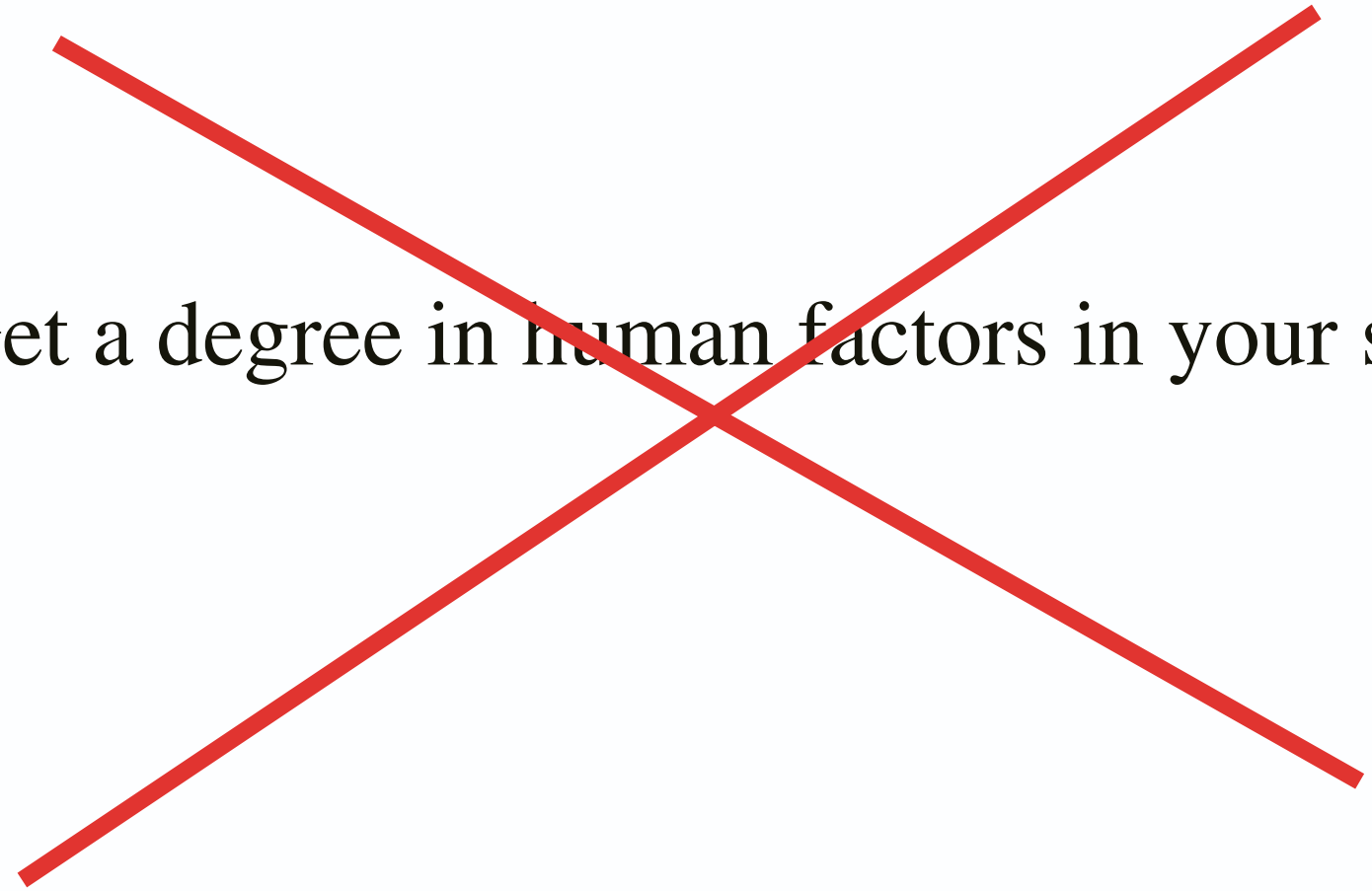
Human Factors Has Been Effectively Applied to a Variety of Complex Systems

- Aviation
  - Design of aircraft
  - Air Traffic control
- Nuclear Power Plants
- Manufacturing
- Aerospace
  - Space station
  - Space shuttles
- Anesthesiology
- Computer Systems
- Remotely Operated Vehicles
- Automobiles

How Should We Start?

Get a degree in human factors in your spare time!

How Should We Start?



How Should We Start?

- Work with a human factors consultant specialist
- Use your purchasing clout to work with vendors
- Be sure to document benefits from system modifications
  - It is important to determine how analysis and intervention have affected the system. Cost-benefit analysis is an important aspect of the systems engineering approach.

Example System Benefits

- Reduction in reported incidents and accidents
- Reduction in error
- Improved communication
- Reduced personnel requirements because tasks can be more easily accomplished
- Increased customer satisfaction
- More quality time with customers
- Reduced job injuries
- Reduced patient waiting times
- Less "lost" information (forms, documents, etc)
- Better handoff
- Reduced workload
- Increased worker job satisfaction
- Etc…

Conclusion

The profession of Human Factors is dedicated to improving the quality of complex systems. Lessons learned can be directly applied to medical systems. Work with Human Factors Engineers to benefit from their expertise.

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Suggested Reading

- Introductory Textbooks on Human Factors
  - Sanders, M.S. and McCormick, E.J. (1993) *Human Factors in Engineering and Design*, 7th Ed. New York: McGraw Hill, Inc.
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- Bogner, M. S. (Ed.) (1994). *Human error in medicine*. Hillsdale, NJ: Lawrence Erlbaum Associates.
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