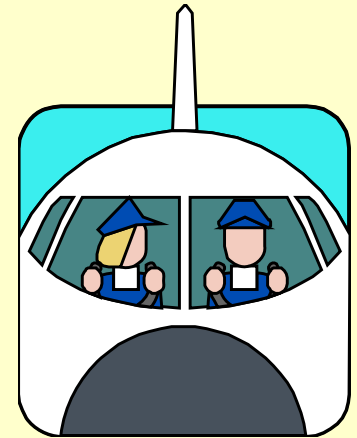


Organizational factors

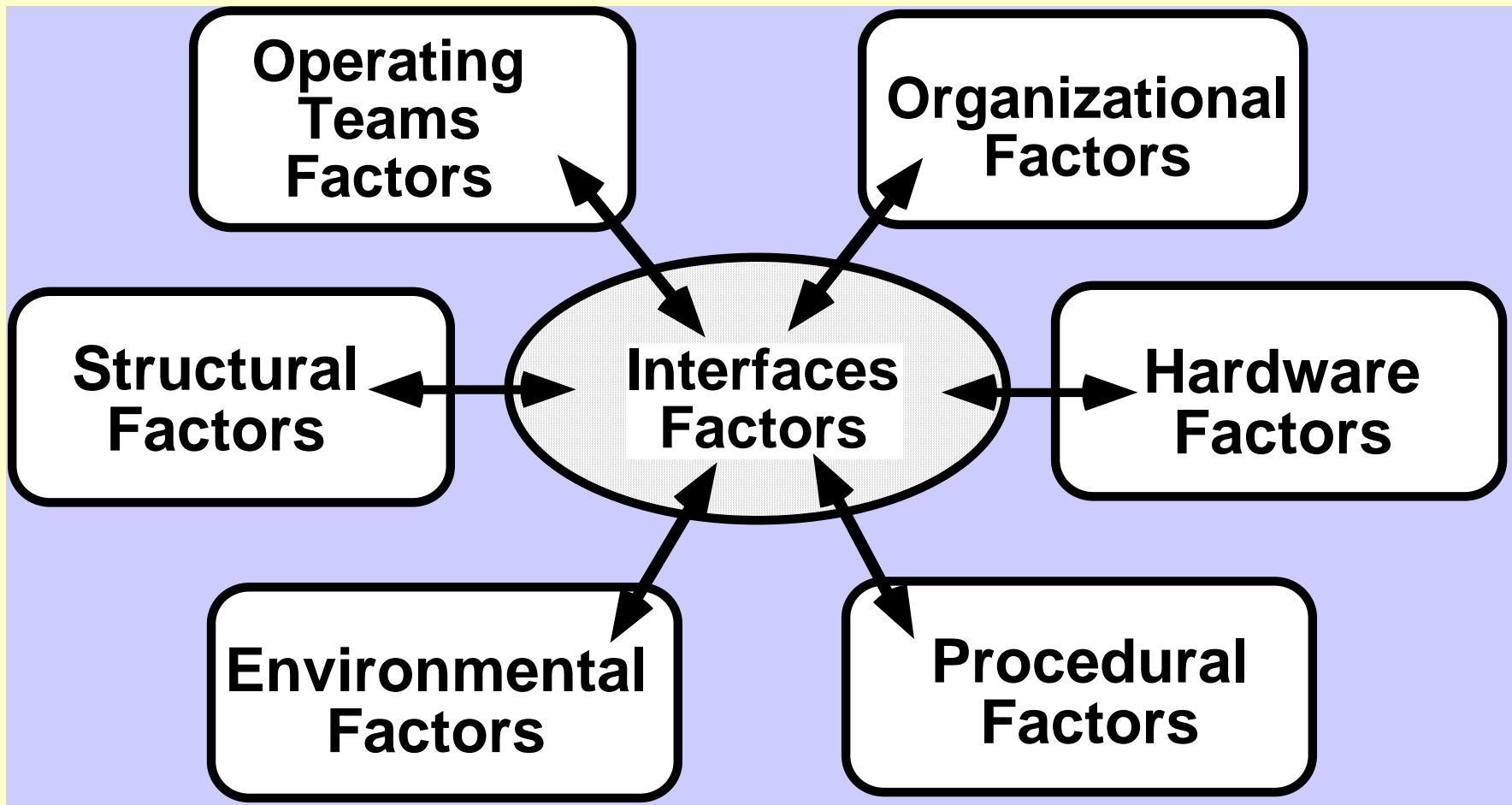
Prof. R. G. Bea, 2005



- **Organizations**

- determine means and methods
- provide the energy and resources required for high consequence accidents
- are responsible for $\geq 80\%$ of contributing and compounding factors responsible for high consequence accidents
- are the single most important element that determine the quality and reliability of engineered systems
- can be ‘re-engineered’ to develop High Quality and Reliability Systems

System components, factors, & stop rules



Analyzing Engineered Systems

- Inter-related
- Interdependent
- Interactive
- Synthesis - Expansionism approaches
- Decomposition - Reductionism approaches
- *“can not cut a cow in two and have two cows”*
- Employ both analytical approaches



System health criteria

(Elms 2004)

- **Balance** - appropriate between parts
- **Completeness** - necessary parts present
- **Cohesion** - structure & relationships
- **Clarity** - lack of ambiguity or poor definition
- **Consistency** - element properties match requirements
- **Closure** - closed feedbacks for controls
- **Continuity** - links, interfaces present & working

HOF & HOE



- **Most efforts to date focus on HE & HF - *the sharp end of the spear***
- **In-depth study of accidents indicates OE & OF exert major influences - *the blunt end of the spear***
- **Errors are results, not causes (Woods, 1994)**
- **Factors critical in development of errors**

Logic of failure - *Dorner, 1989*

- Most reality models wrong & incomplete
- Contradictory goals rule, not exception
- Repair service behavior
- Time arrangements flawed
- Interpretations of numbers based on size



Failures to deal with complex systems - *Dorner, 1989*

- **Thinking slow**
- **Knowledge storage slow**
- **Act without analysis**
- **Side effects not anticipated**
- **Assume absence of negative**
- **Time pressures**
- **Memory limitations**
- **Reductive analysis**
- **Wrong models**
- **Active treated as passive**
- **Blind to changes**
- **Prone to cyclical action**
- **Cognitive vagabonding**
- **Shift responsibilities**
- **Low uncertainty capacities**
- **Extrapolations based on present**
- **Over-steering**
- **Violations**
- **Incapacity for nonlinearities**

Organizational performance:

HRO Roberts, 1989

- **Command by exception - migrating decision making**
- **Redundancy - robustness**
- **Procedures & rules - clear, correct**
- **Training - normal, abnormal, unbelievable**
- **Situational awareness - maintaining the bubble**



High Reliability Organizations

Reward & Recognition

- Drive the correct behaviors
- Value contribution of the line

Process auditing

- spot the expected and unexpected

Migrate decision making to the appropriate person

Senior managers who see the big picture

Quality Systems

Formal rules and procedures

Depth/Org. Capacity

Training

- High technical competence

Risk Perception

- Knowledge that risks exist?
- Extent to which risk is acknowledged and mitigated

HRO hypotheses

Libuser, Roberts, 1993

- **Extensive process auditing**
- **Risk mitigating reward systems**
- **Higher quality standards**
- **Risk perception**
- **Command & control systems**

Command & control

- **Migrating decision making**
- **Redundancy**
- **Rules & procedures**
- **Training**
- **Senior management sees big picture**



HRO 'hows'

Weick, Sutcliffe, Obstfeld (1998)

- **Preoccupation with failure**
- **Reluctance to simplify interpretations**
- **Sensitivity to operations**
- **Commitment resilience**
- **Under-specification of structures**

Non-HRO's

- Focus on success
- Underdeveloped cognitive infrastructure
- Focus efficiency
- Inefficient learning
- Lack of appropriate diversity
- Information & communications filtering
- Reject early warning signs of degradations



Non-HRO's

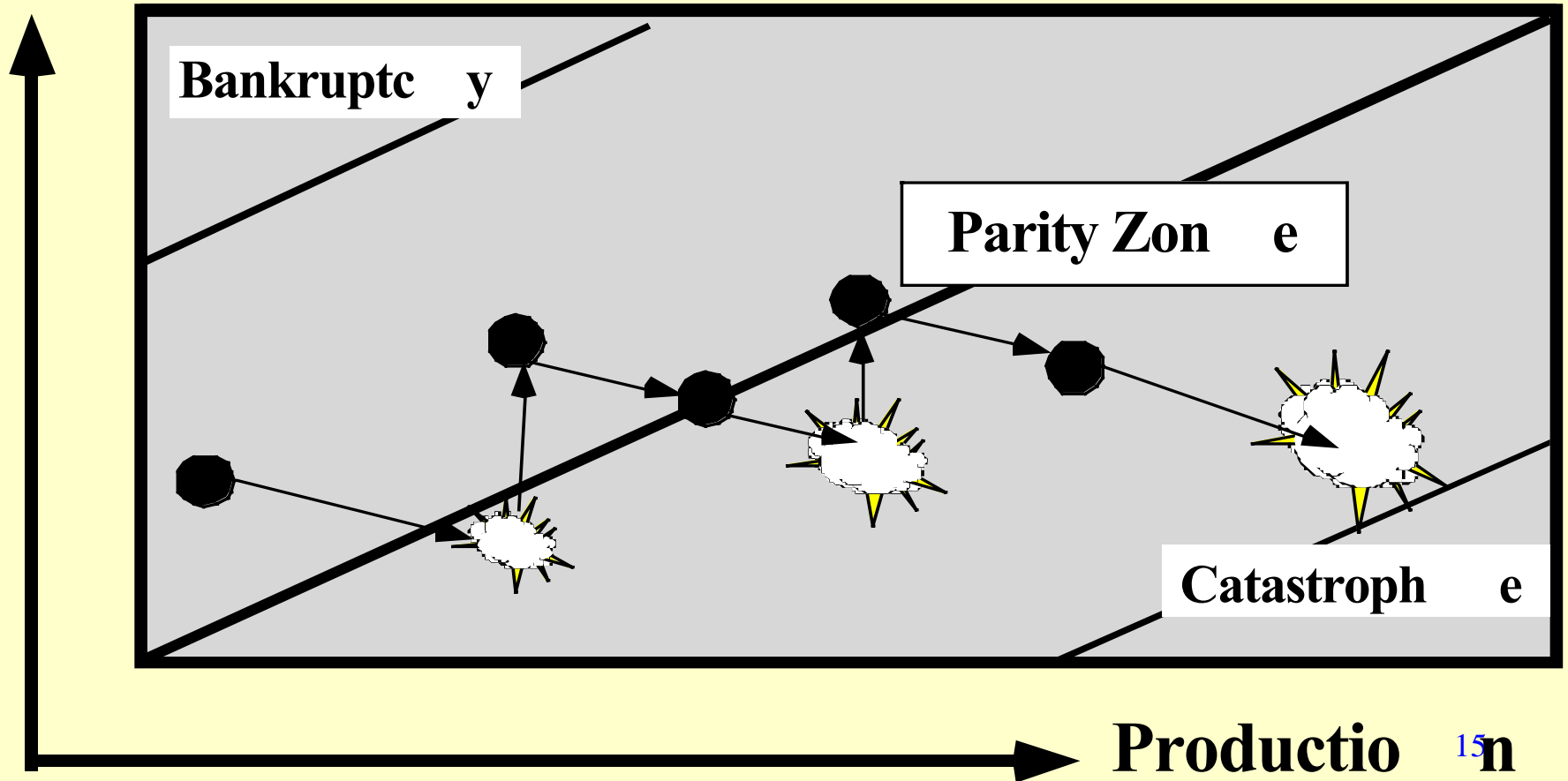
“organizations in which people shuffle papers and lose a few, attend meetings and solve nothing, catch airplanes and miss connections, conduct briefings and persuade no one, evaluate proposals and miss the winners, and meet deadlines for projects on which the plug has been pulled.”

Weick, Sutcliffe, Obstfeld 1998

Life of an organization

Reason, 1997

Protection



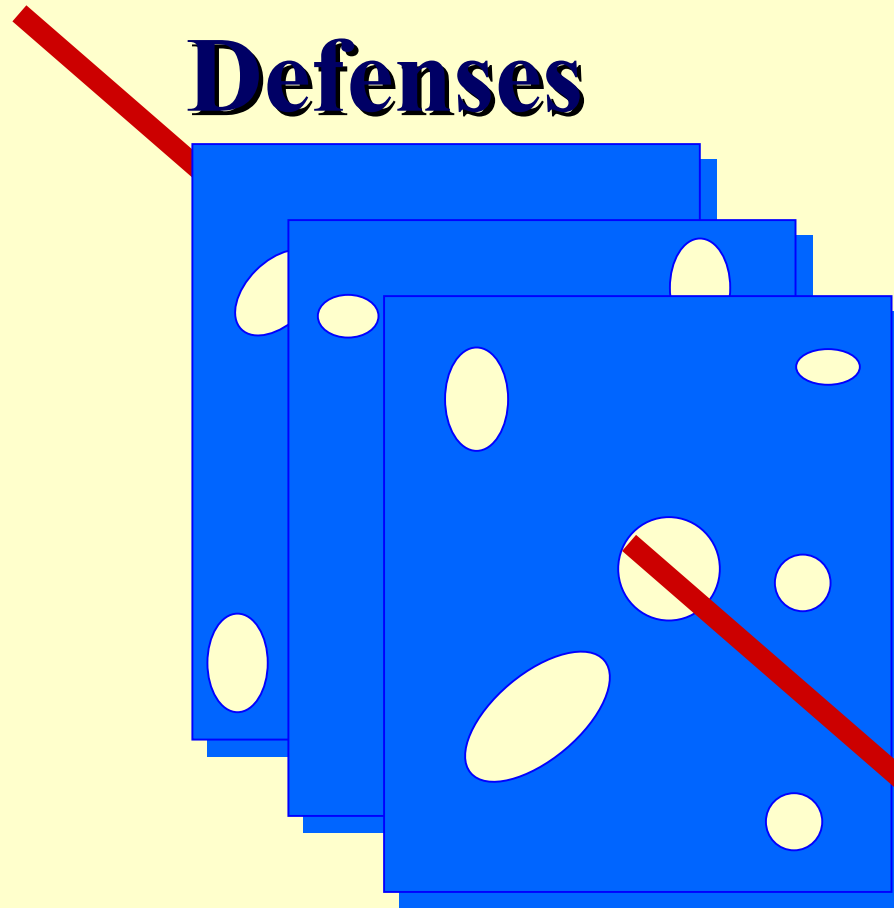
Production ¹⁵n

Organization in-depth defenses

Reason, 1997

- **Create awareness & understanding**
- **Management of active & latent conditions**
- **Warnings of degradations**
- **Restoring systems**
- **Safety barriers**
- **Procedures to contain and eliminate hazards**

Swiss Cheese Model ***(Reason, 1990)***



Defenses

Some holes in defenses are result of *latent* errors others of *active* errors

Accident trajectory

'The Spear'

Blunt end -
organizations

Sharp end -
operators



Organizational 'safety culture'

Merry, 1998

- **Visible leadership & commitment**
- **Safety role of line management**
- **Strategic business importance of safety**
- **Supportive organizational practices**
- **Involvement of all**
- **Learning organization**



Safety culture (continued)

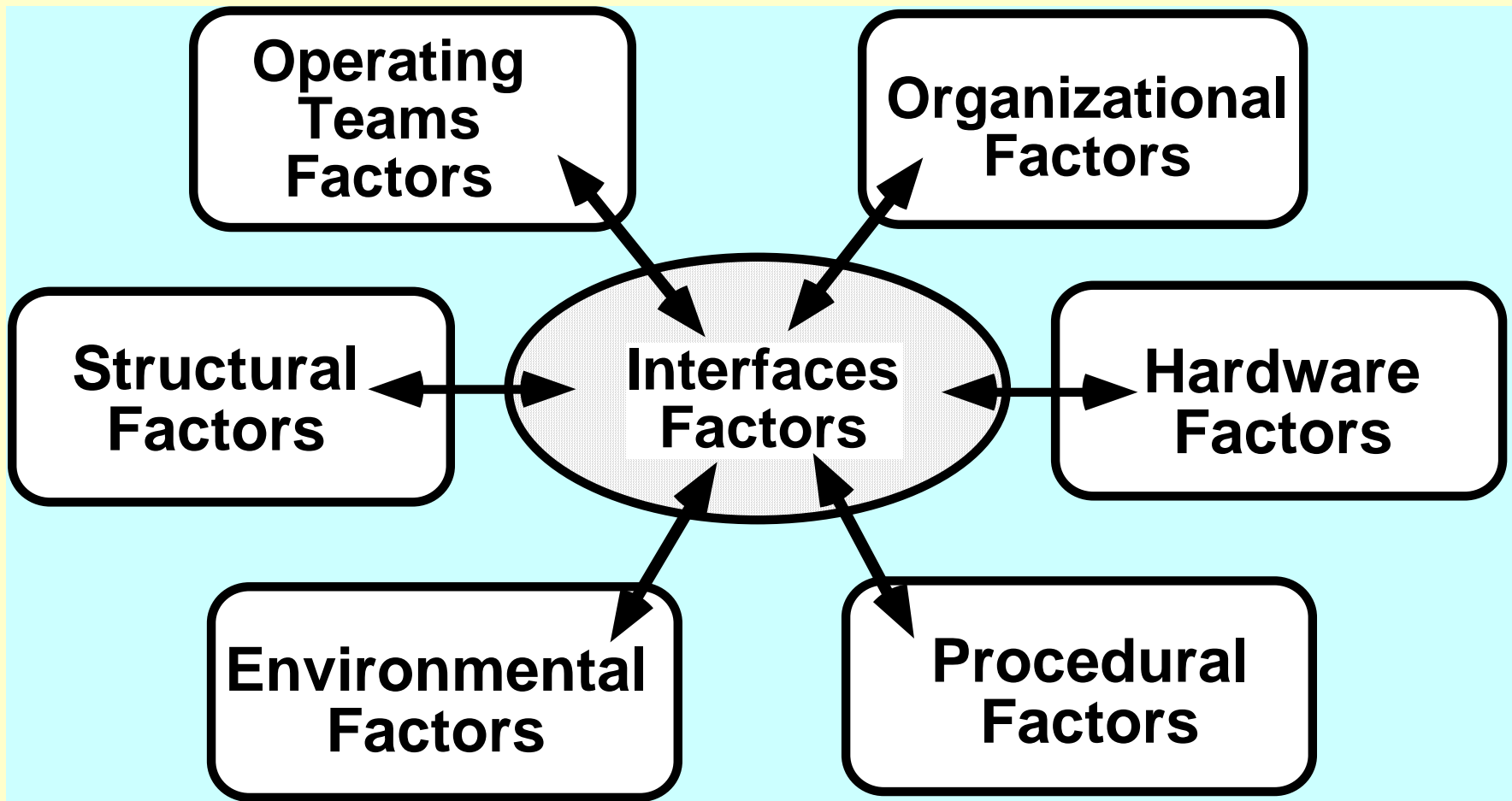
- **Safety performance measurement**
- **Mutual trust**
- **Open communications**
- **Absence of safety versus production incentives**
- **Demonstration of care for those affected**

Safety culture attributes

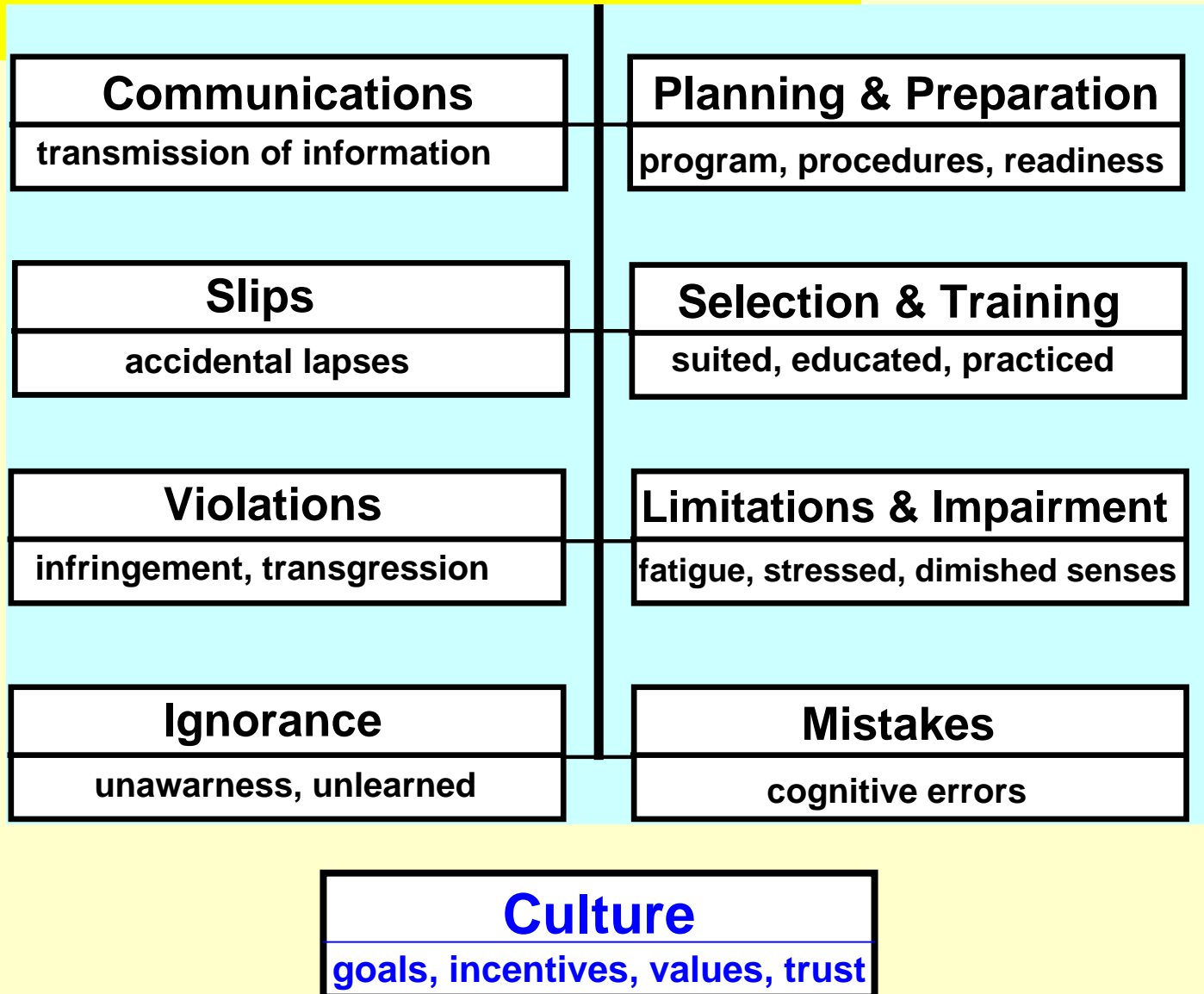
- **Safety performance measurement**
- **Mutual trust between management & labor**
- **Open communications**
- **Absence of safety versus production conflicts**
- **Demonstration of care for those affected by business**

System component taxonomies

phenomenological, heuristic



Operator malfunctions



Organizational malfunctions

Communications
transmission of information

Culture
goals, incentives, values, trust

Violations
infringement, transgression

Ignorance
unawareness, unlearned

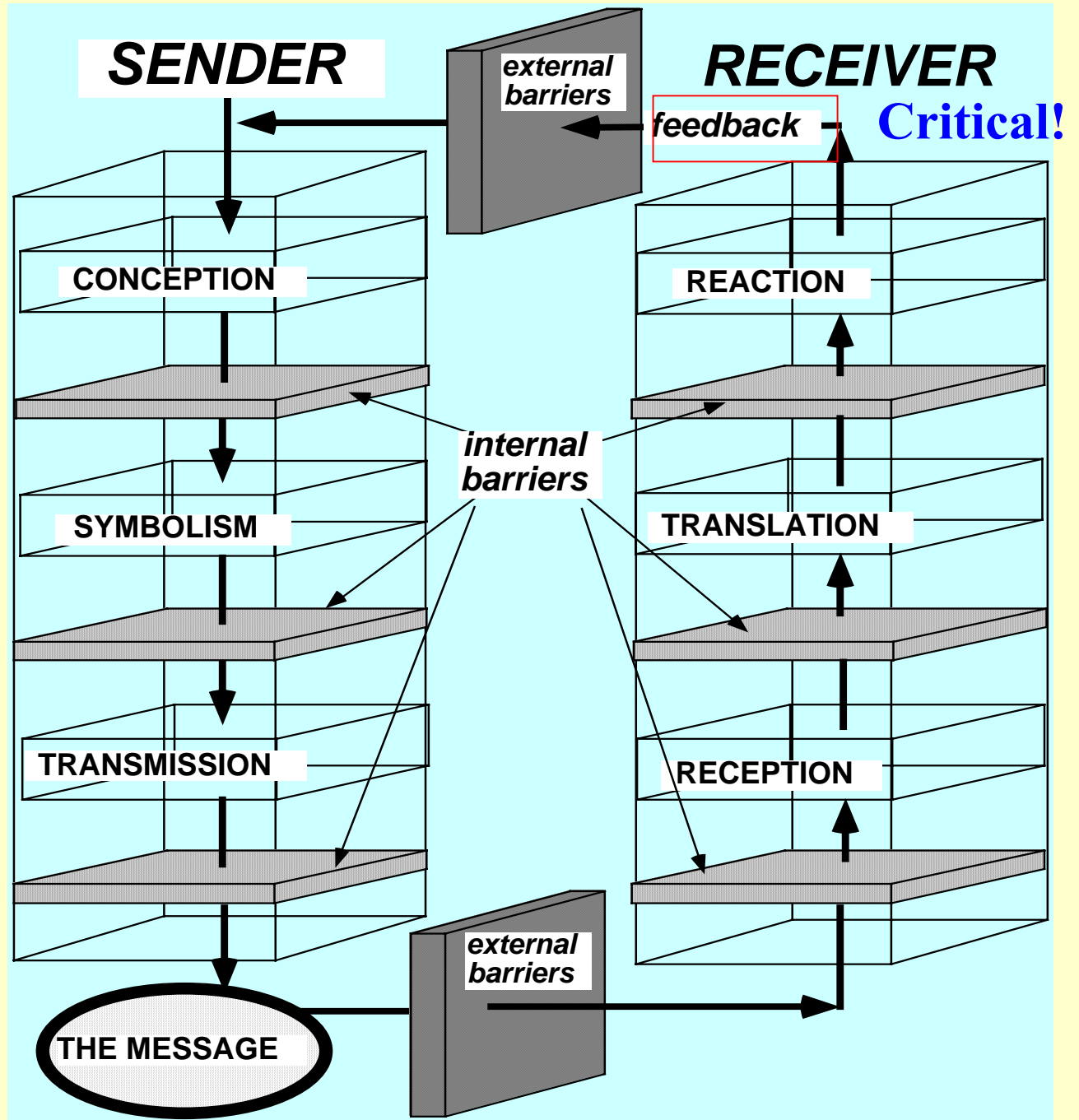
Planning & Preparation
program, procedures, readiness

Structure & Organization
connectness, interdependence

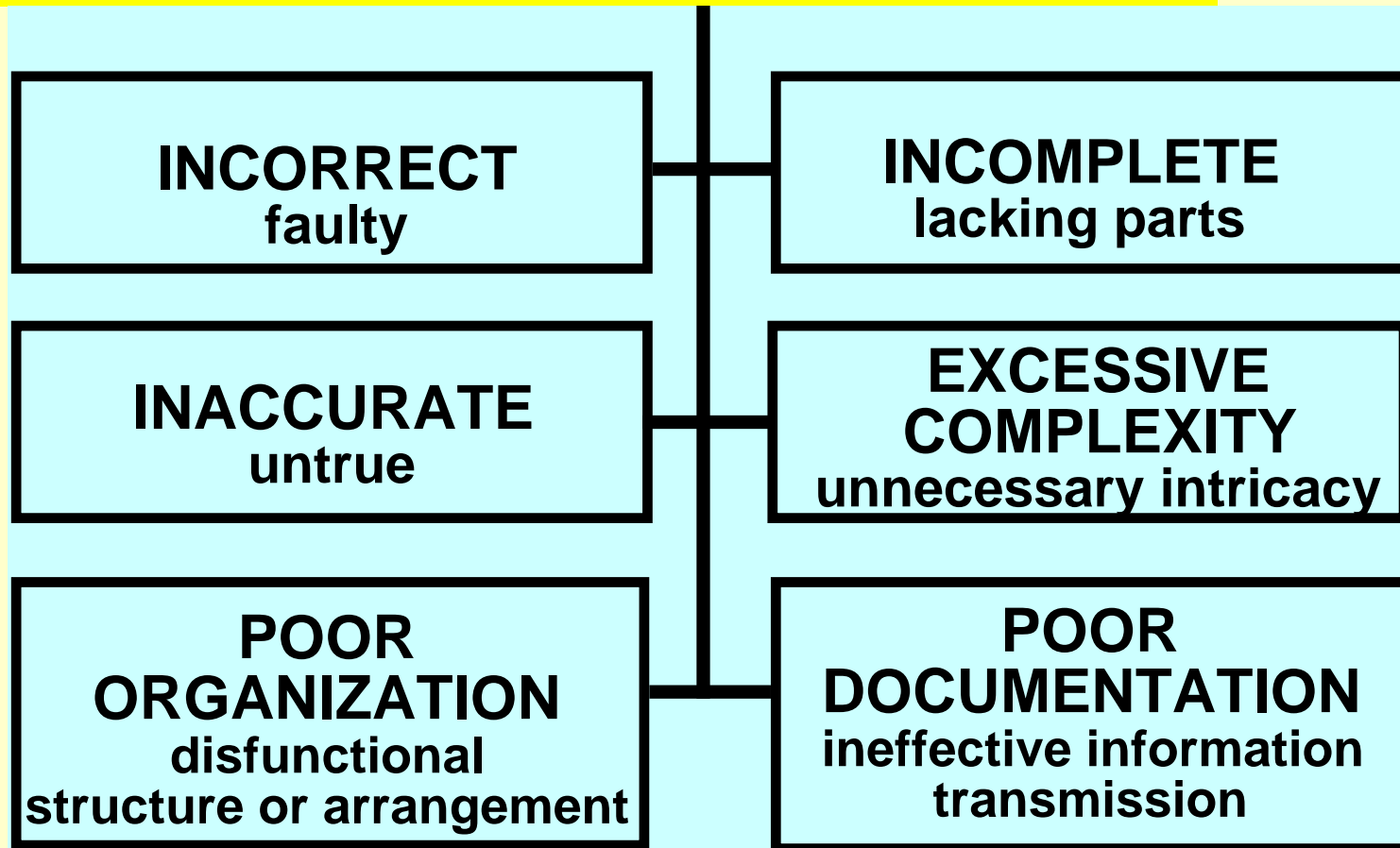
Monitoring & Controlling
awareness, correction

Mistakes
cognitive errors

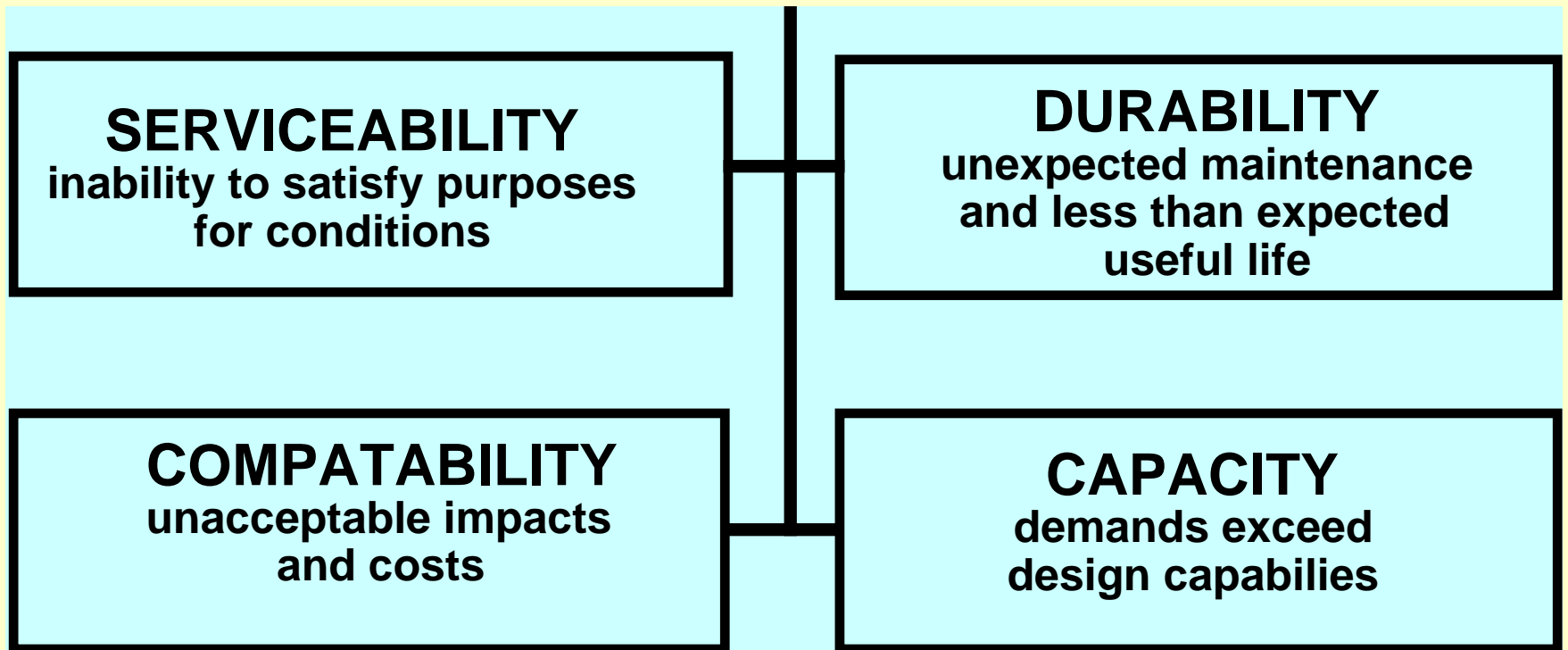
Communications



Procedure malfunctions



Structure & hardware malfunctions



Environmental influences

- **Internal (e.g. light, ventilation, noise)**
- **External (e.g. temperature, rain, fog)**
- **Social (e.g. values, beliefs, morays)**

QMAS PSF's (Bea, 2000)

