ISASI Human Factors Working Group Panel

William (Bill) Bramble, Senior Human Performance Investigator, National Transportation Safety Board, Washington, USA

Toni Flint, Inspector of Air Accidents (Human Factors), Air Accidents Investigation Branch, Aldershot, UK

Fanny Rome, Safety Investigator – Human Factors & Ergonomics, Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile, Le Bourget, France

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Human Factors in Civil Aircraft Accident Investigations

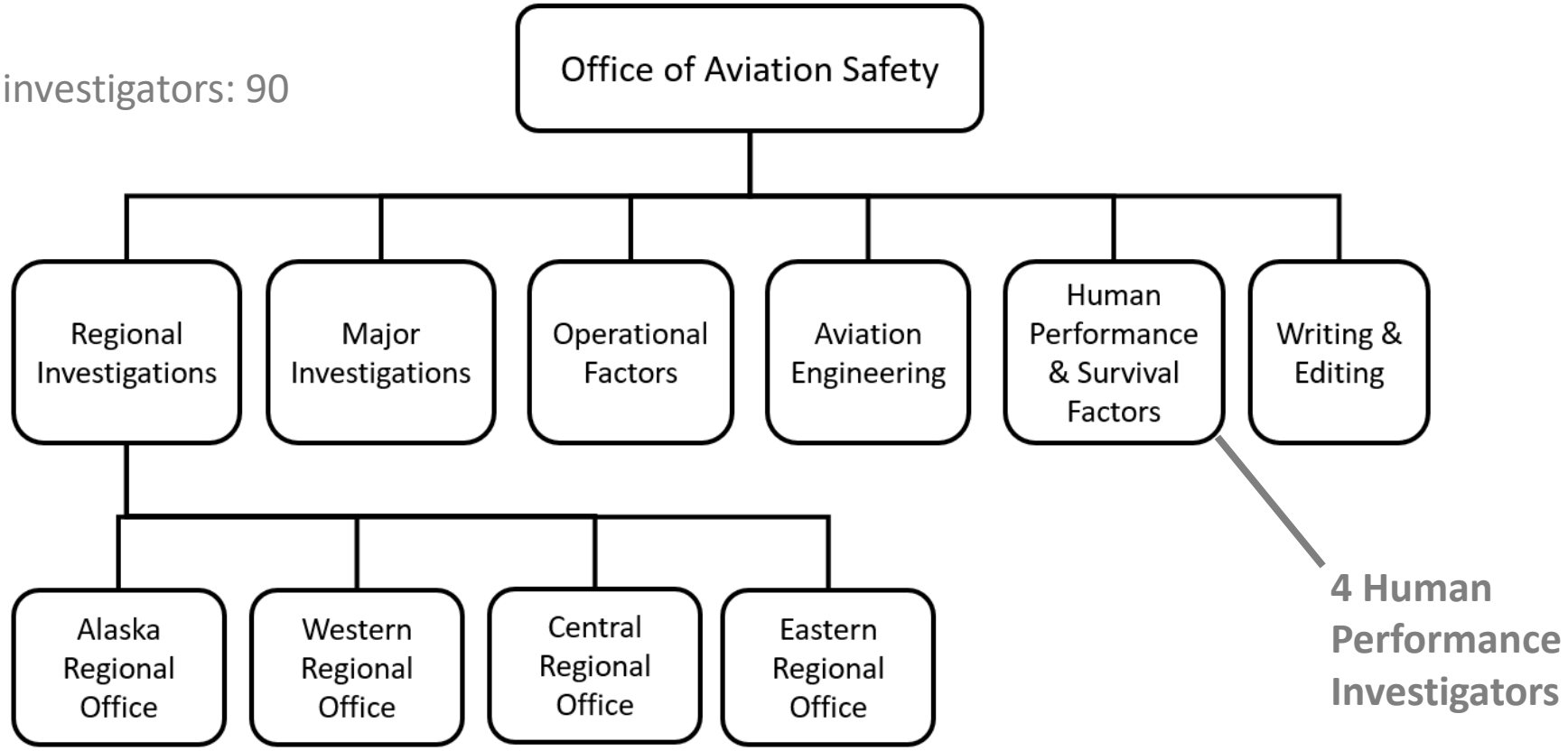
What is the State of the Art…
and Where Do We Go from Here?

Human Factors in Aircraft Accident Investigation at the NTSB

*Disclaimer: Opinions expressed during this presentation are mine and do not necessarily reflect the official views of the National Transportation Safety Board

Human Factors in the NTSB Office of Aviation Safety

Working-level investigators: 90

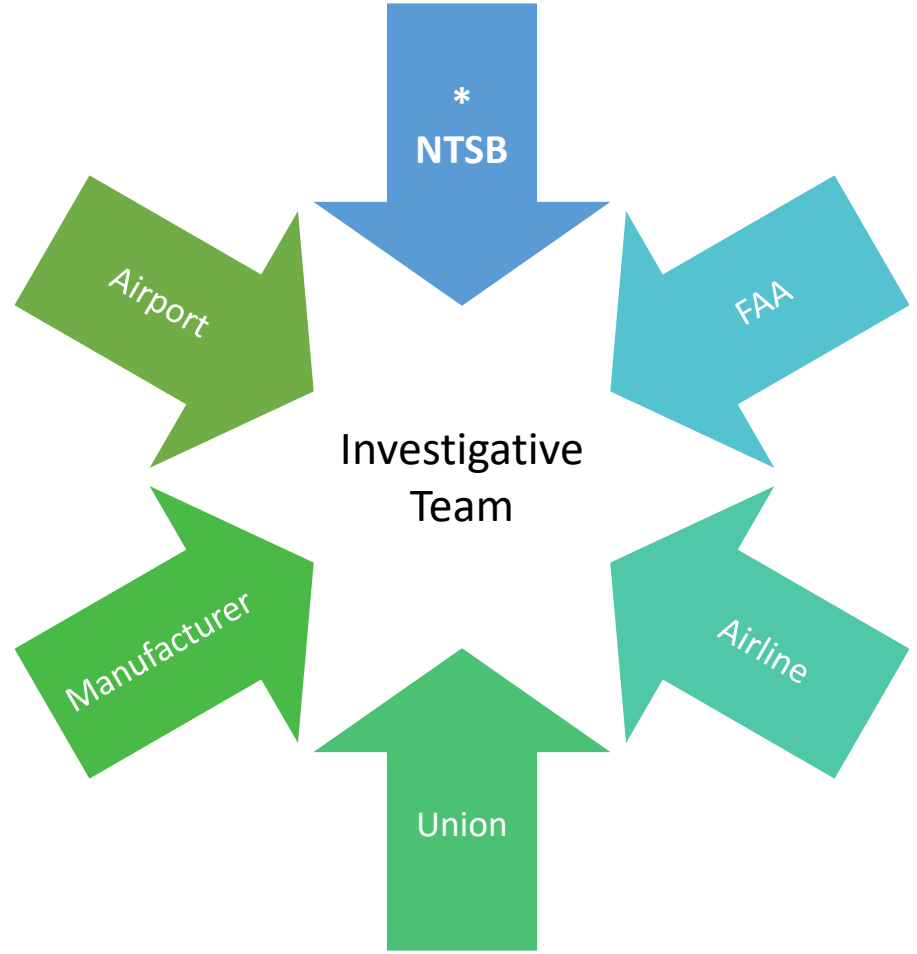


NTSB Aviation Human Performance Investigators

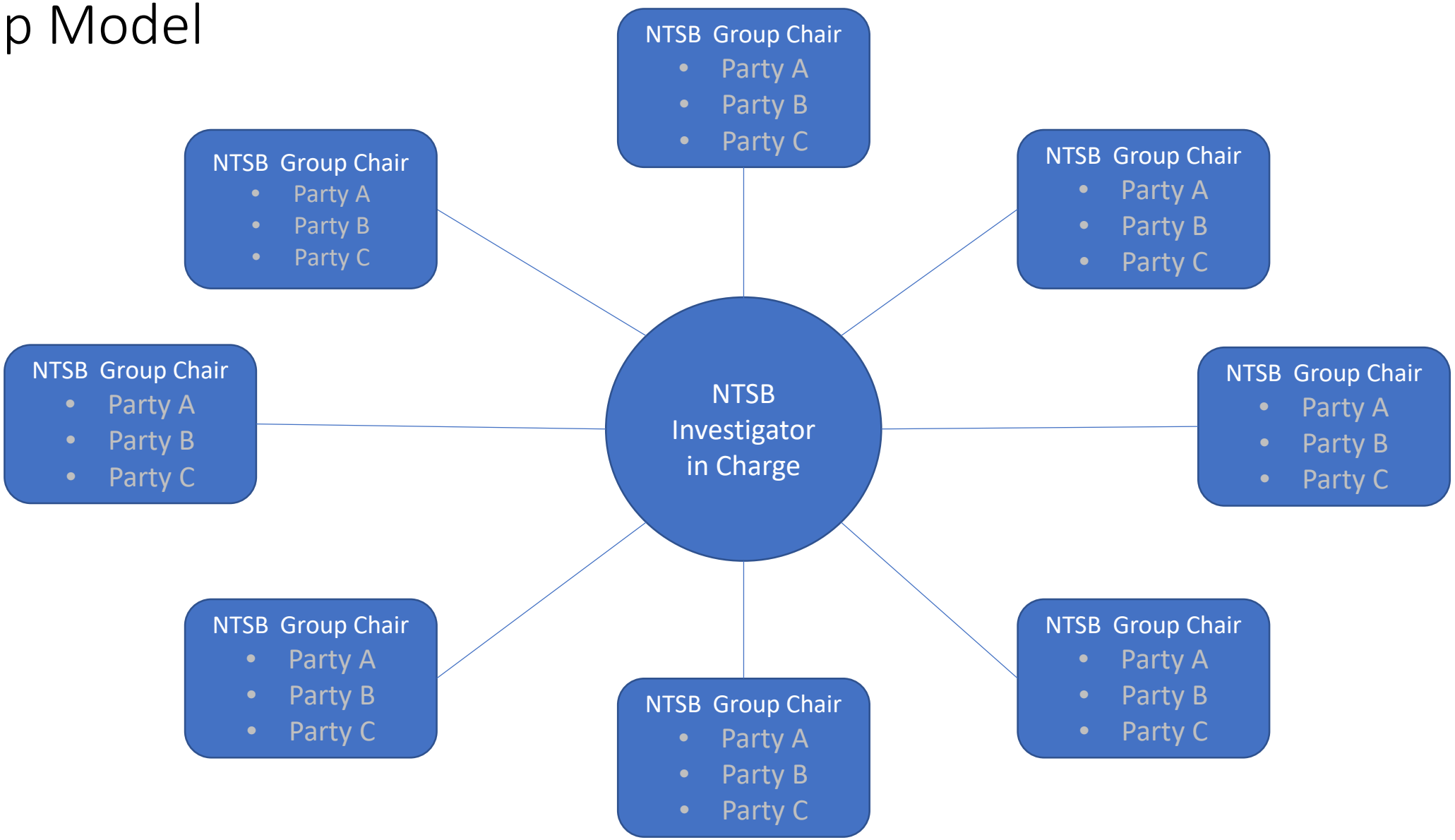
- Front-line, working investigators
- Ph.D.’s in psychology or engineering with a concentration in human factors and some aviation training and experience
- Responsible for investigating operator fitness for duty and applying HF models and paradigms
- Operate within the NTSB party system and discipline-based working group model

NTSB Party System

Major Accident Investigation



NTSB Working Group Model



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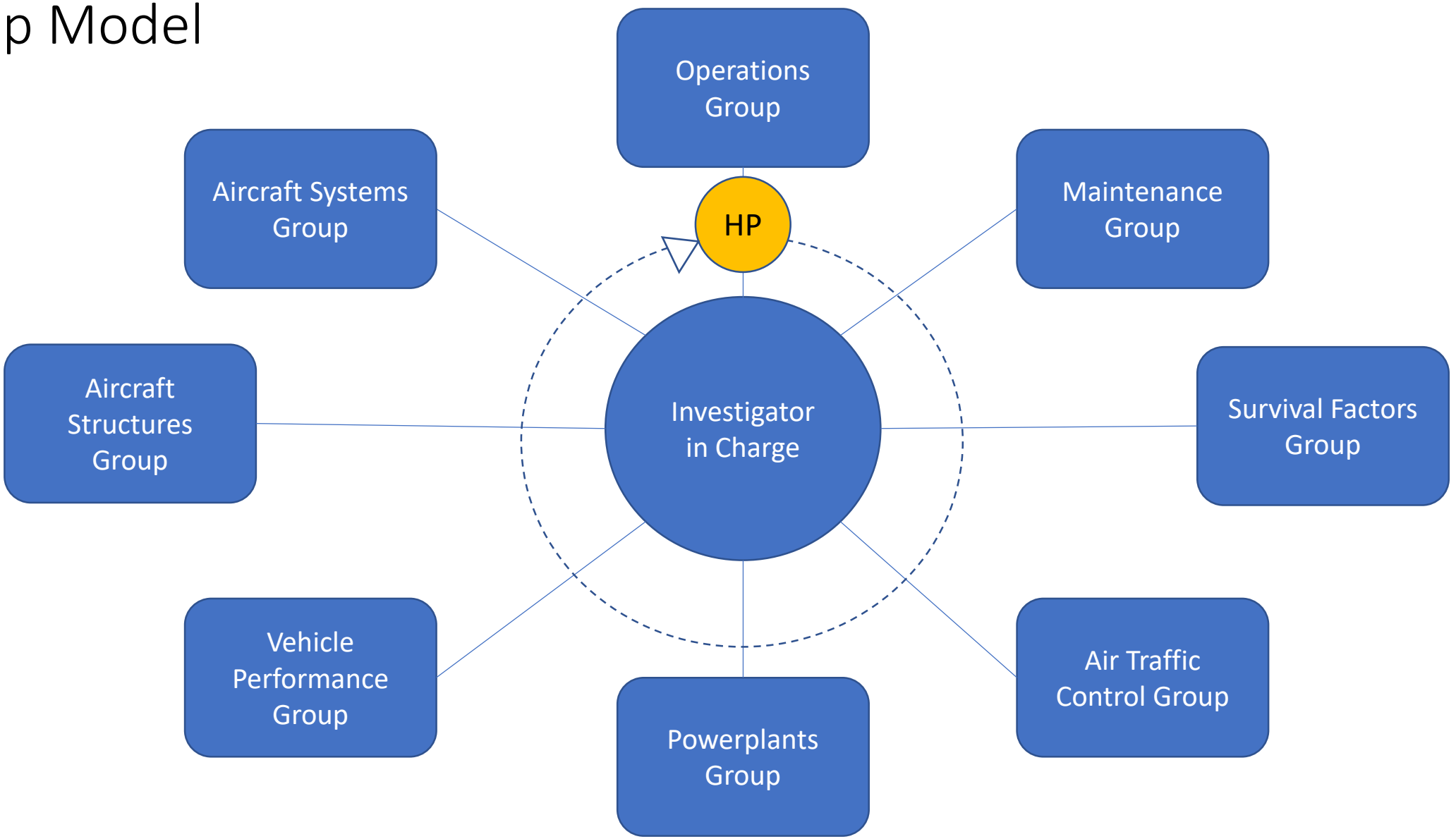


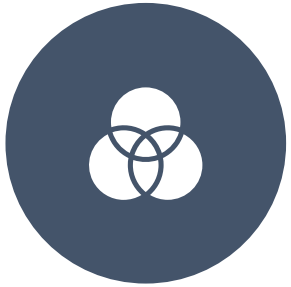
Professional Successes

- Accepted as a core investigative specialty
- Considered key to fact-finding and analysis
- Have incorporated HF and system safety concepts in some landmark accident reports
- Have initiated a disproportionate number of safety recommendations

Professional Challenges

- Some colleagues have a limited understanding of human factors
- Working group model can lead to confusing overlap of responsibilities
- Working group model can create artificial barriers to HP involvement
- Lack of structure in the analysis process can lead to concatenation of ideas and haphazard integration of human factors

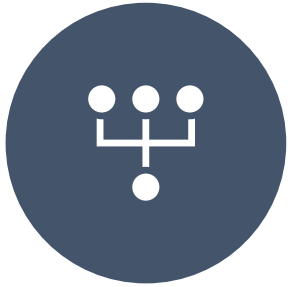
What's Missing?



Organizational policy defining HF and system safety and their relationship to other investigative specialties

Investigative protocols and organizational processes that support systematic integration of HF in accident analysis

Organizational policy defining how HF and systems safety should inform models of accident causation



Organizational policy describing how HF and system safety inform safety improvement strategies

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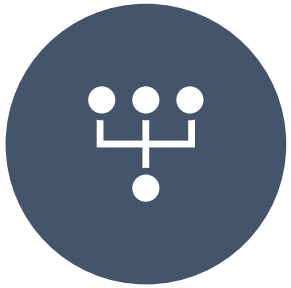

Organizational policy describing how HF and system safety inform safety improvement strategies

NTSB Major Investigations Manual on Human Performance Investigation

- Human performance attention can be addressed toward any individual involved in the accident
- Human performance attention may be directed at larger system issues, such as those concerning company policy, training, and design
- The work of the human performance specialist may parallel operations or air traffic control, except the human performance specialist examines certain evidence in greater depth.
- In other cases, such as medical and equipment design issues, the human performance specialist may be the lead collector of evidence for an investigation.

An Improved Mission Statement

- Improving safety depends on our ability to understand how human and other system characteristics interact to produce accidents.
- The human factors and system safety disciplines study such interactions and try to optimize them through the application of scientific theory and data.
- Human factors investigation is an inductive reasoning process that requires deep knowledge of human, organizational, operational, and engineering system characteristics and knowledge about how these system elements can be degraded or interact unfavorably, therefore…
- Close collaboration between human factors and other investigative specialties is required.

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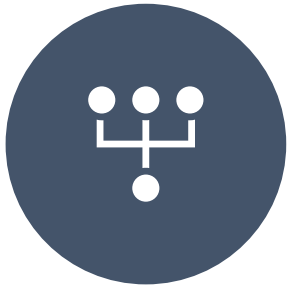
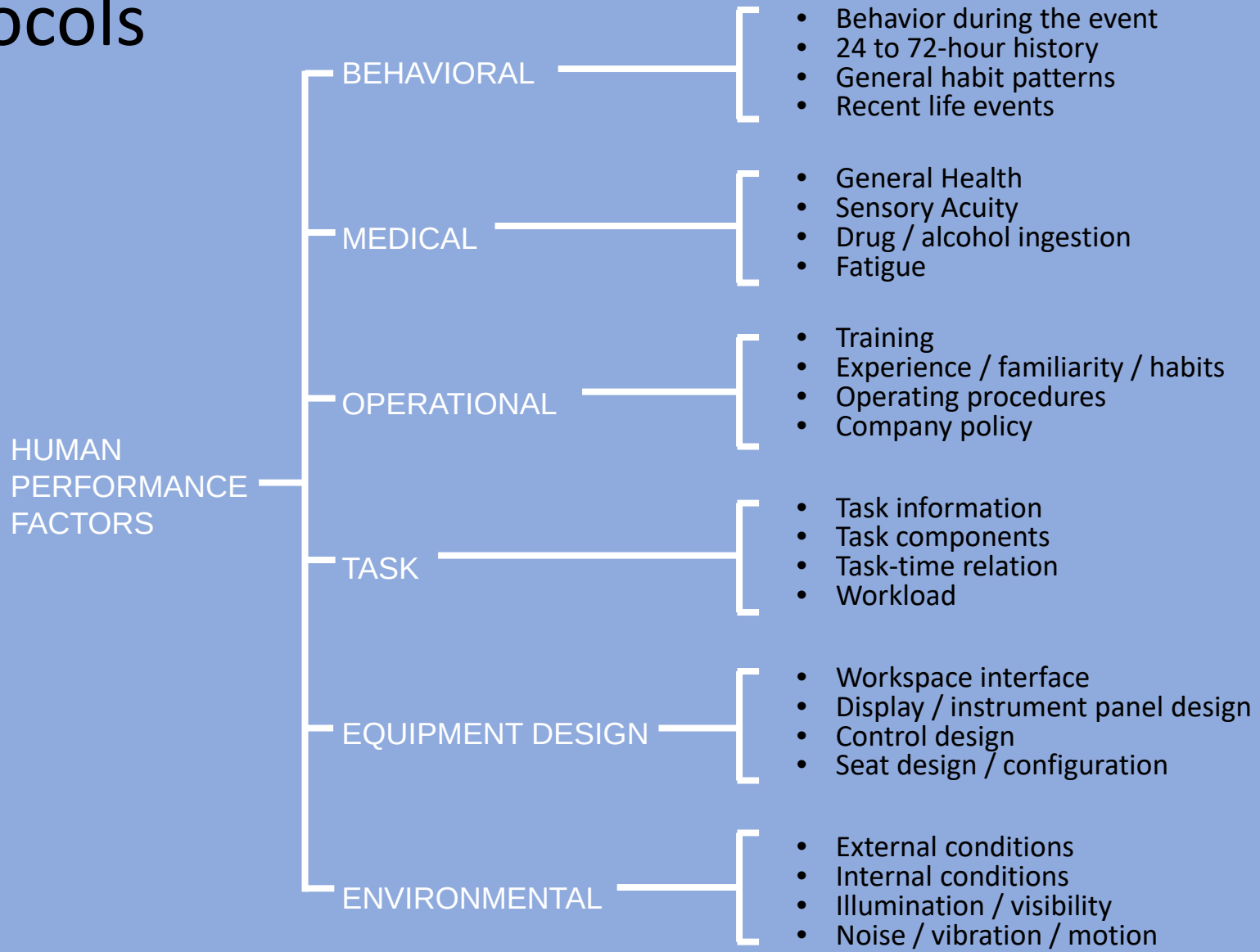
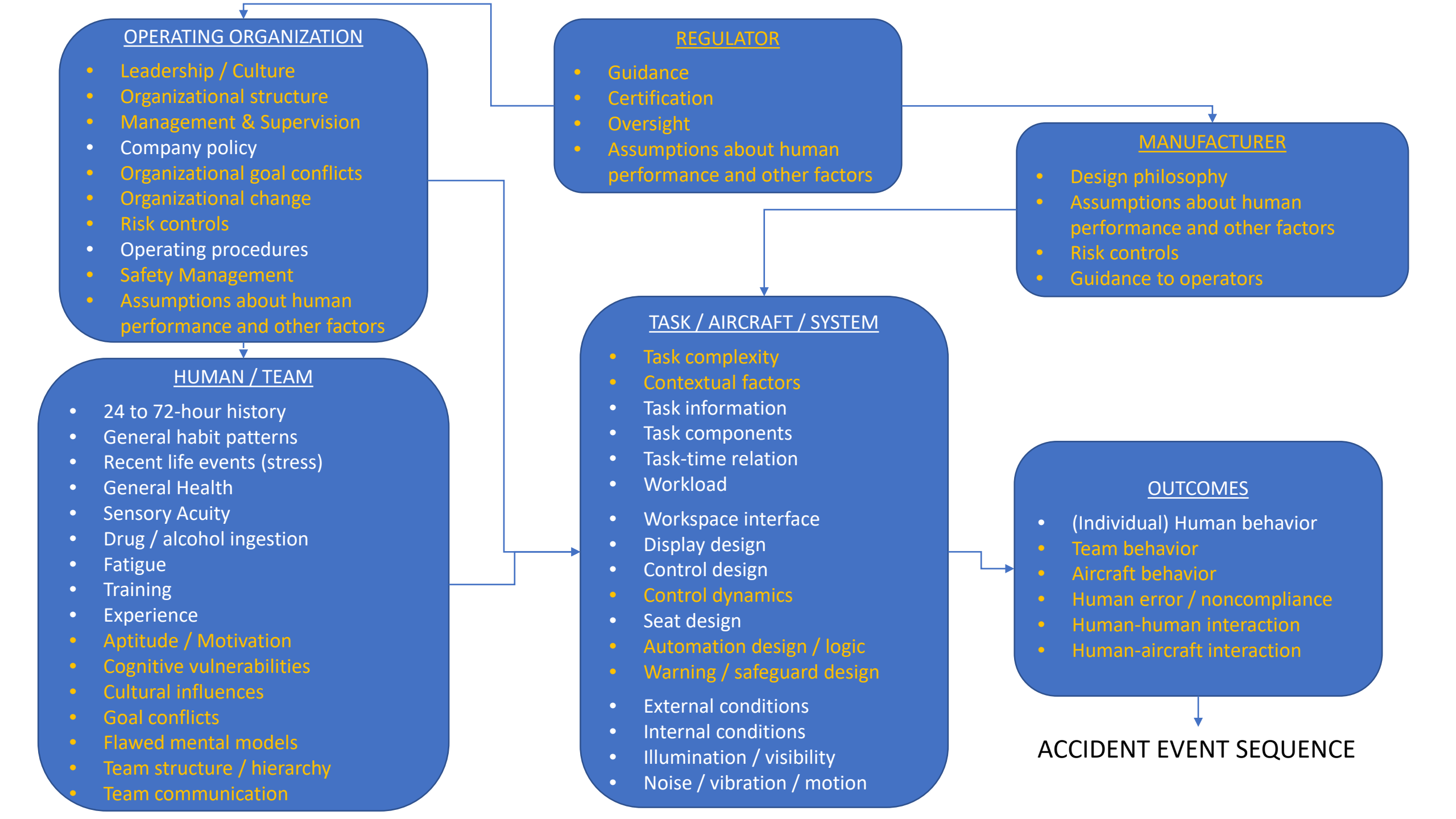


Organizational policy describing how HF and system safety inform safety improvement strategies

Investigative Protocols

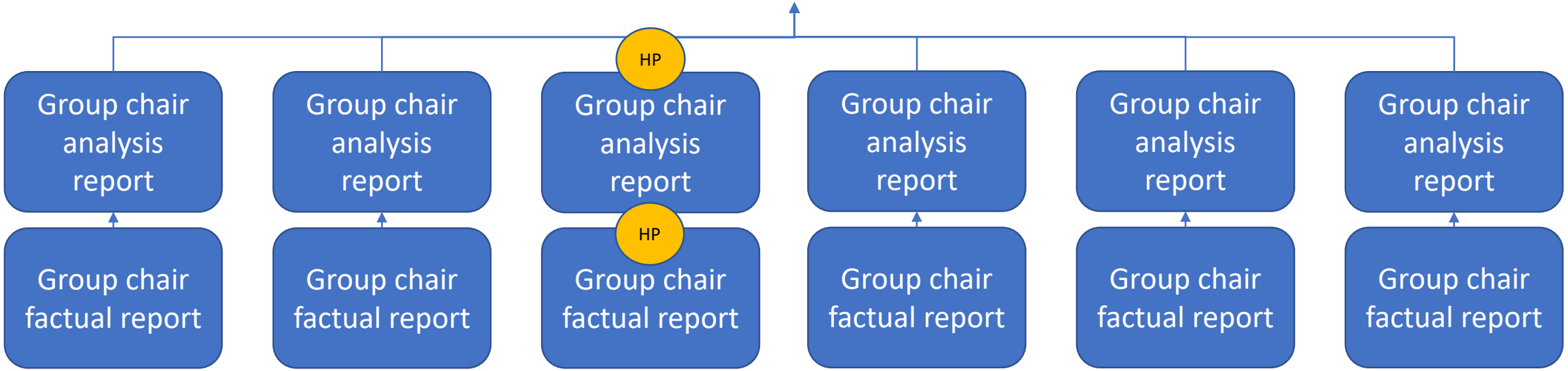
NTSB Human Performance Model (1983)

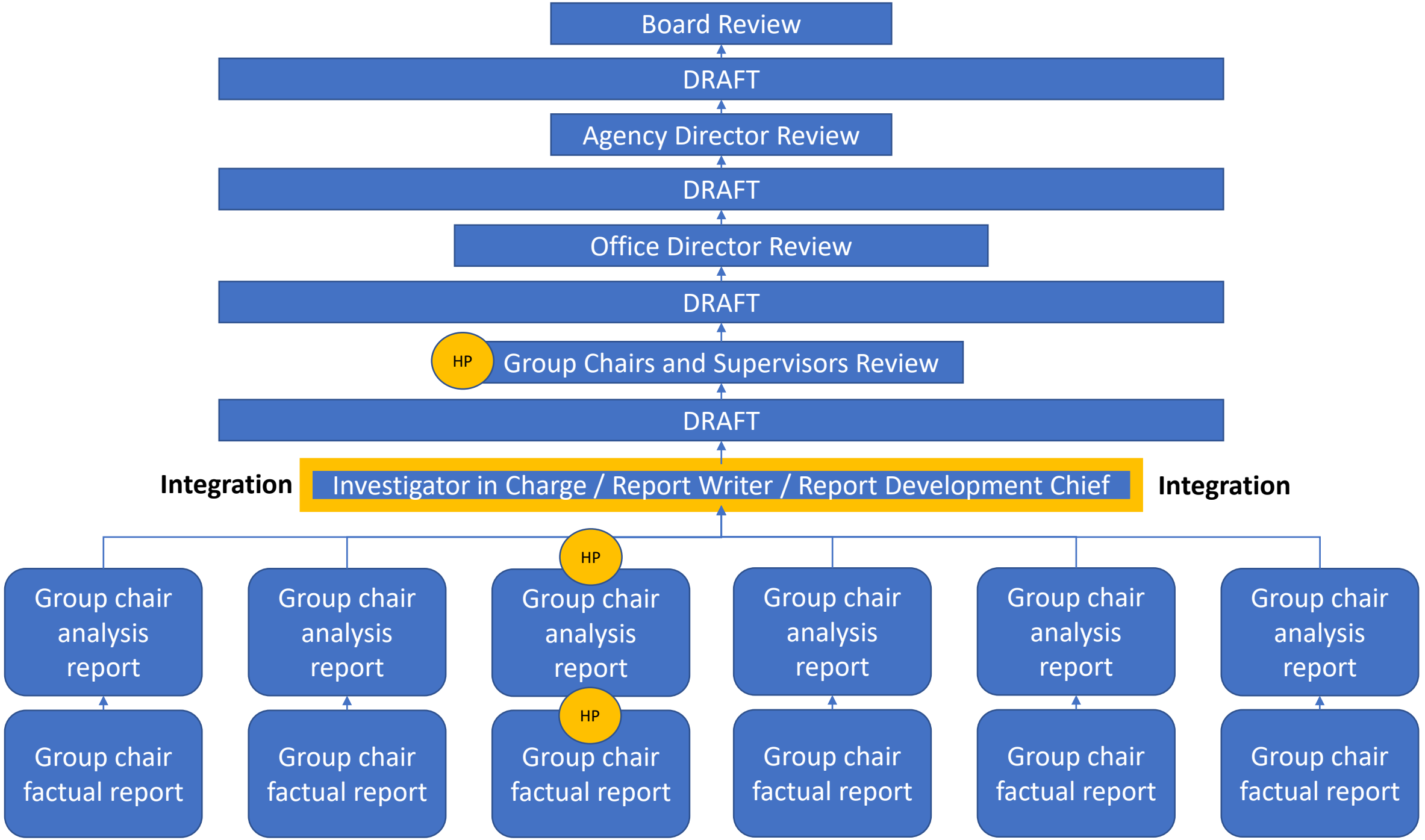



OPERATING ORGANIZATION
Leadership / Culture
Organizational structure
Management & Supervision
Company policy
Organizational goal conflicts
Organizational change
Risk controls
Operating procedures
Safety Management
Assumptions about human performance and other factors
REGULATOR
Guidance
Certification
Oversight
Assumptions about human performance and other factors
MANUFACTURER
Design philosophy
Assumptions about human performance and other factors
Risk controls
Guidance to operators
HUMAN / TEAM
24 to 72-hour history
General habit patterns
Recent life events (stress)
General Health
Sensory Acuity
Drug / alcohol ingestion
Fatigue
Training
Experience
Aptitude / Motivation
Cognitive vulnerabilities
Cultural influences
Goal conflicts
Flawed mental models
Team structure / hierarchy
Team communication
TASK / AIRCRAFT / SYSTEM
Task complexity
Contextual factors
Task information
Task components
Task-time relation
Workload
Workspace interface
Display design
Control design
Control dynamics
Seat design
Automation design / logic
Warning / safeguard design
External conditions
Internal conditions
Illumination / visibility
Noise / vibration / motion
OUTCOMES
(Individual) Human behavior
Team behavior
Aircraft behavior
Human error / noncompliance
Human-human interaction
Human-aircraft interaction
ACCIDENT EVENT SEQUENCE

Investigative Analysis

- Each group chairman shall submit an analysis report based on the information contained in his or her factual report. Group chairmen should begin writing their analysis reports as soon as appropriate and should not wait until the entire factual portion of the investigation is complete.
- The analysis report should review and evaluate all facts documented by the group regarding their relevance to the accident and should state the principal findings and their relevance to a probable cause of the accident.




Board Review
DRAFT
Agency Director Review
DRAFT
Office Director Review
DRAFT
HP
Group Chairs and Supervisors Review
DRAFT
Integration
Investigator in Charge / Report Writer / Report Development Chief
Integration
HP
HP
Group chair analysis report
Group chair analysis report
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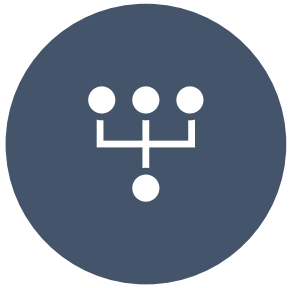


Organizational policy describing how HF and system safety inform safety improvement strategies

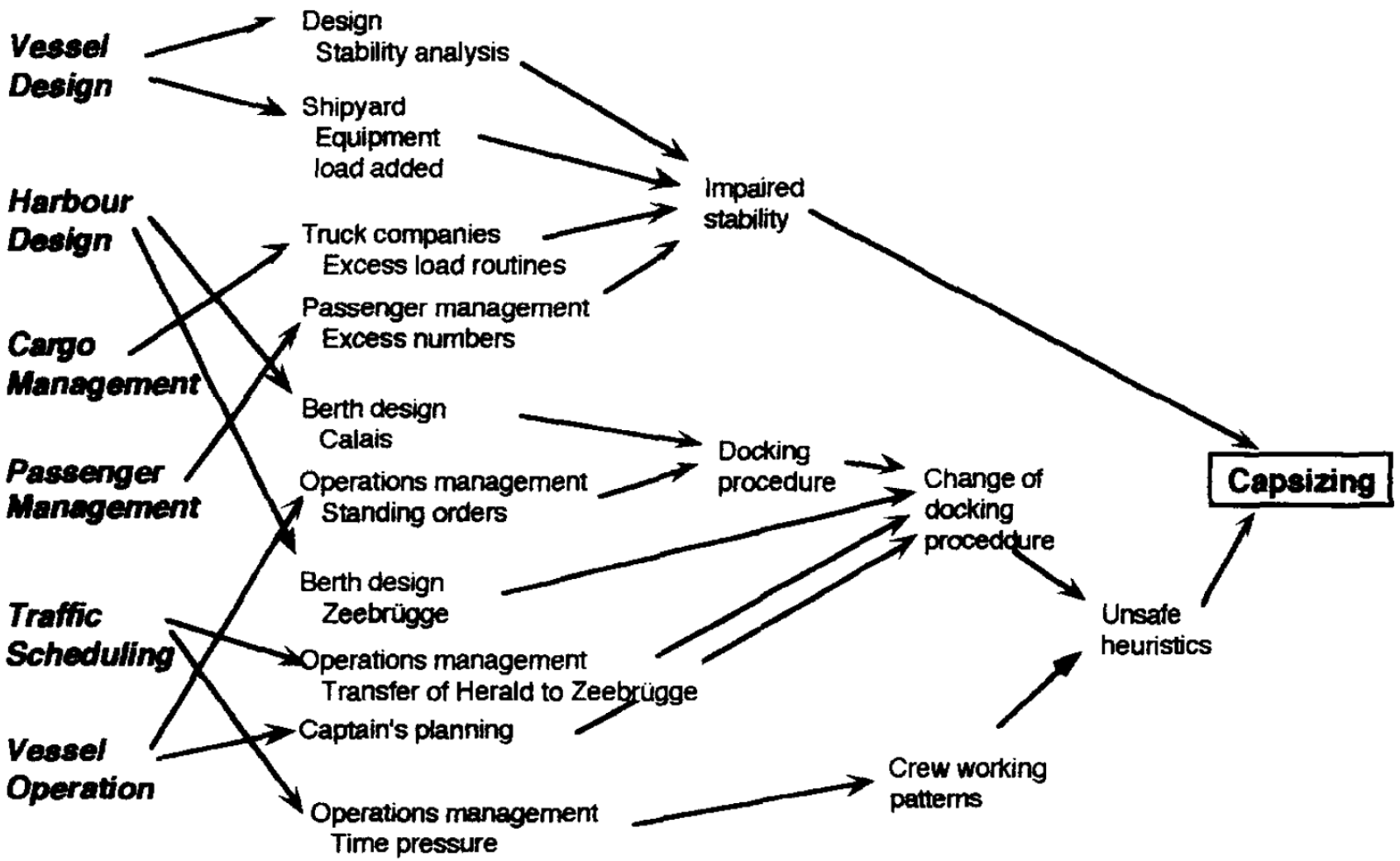
US Code of Federal Regulations

§ 845.30 Board products.

(a)Reports of investigations.

(1) The Board will adopt a report on the investigation. The report will set forth the relevant facts, conditions, and circumstances relating to the accident or incident and the probable cause thereof, along with any appropriate safety recommendations and/or safety alerts formulated on the basis of the investigation. The scope and format of the report will be determined in accordance with Board procedures.

Accounting for Complexity



- Rasmussen (1997)

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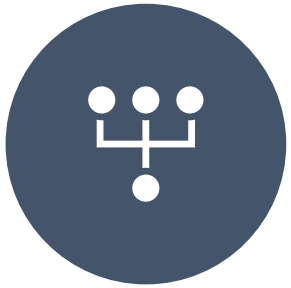

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Sociotechnical Systems

The socio-technical system involved in risk management includes several levels ranging from legislators, over managers and work planners, to system operators. This system is presently stressed by a fast pace of technological change, by an increasingly aggressive, competitive environment, and by changing regulatory practices and public pressure.

Traditionally, each level of this is studied separately by a particular academic discipline, and modelling is done by generalising across systems and their particular hazard sources. It is argued that risk management must be modelled by cross-disciplinary studies, considering risk management to be a control problem and serving to represent the control structure involving all levels of society for each particular hazard category.

– Rasmussen (1997)

System Safety Order of Precedence

- Eliminate the hazard
- Reduce risk through design alteration
- Incorporate engineered features or devices
- Provide warning devices
- Incorporate signage, procedures, training, and PPE

How HF Investigation Could Evolve

- Policy, culture, and training role
- Investigative facilitation role
- Investigative analysis role
- Safety improvements role