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Testing a Safety Management System in Aviation

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Outline

- Introduction
- Research approach
  - Safety management system
  - Causal model
- Sources for evidence/ evidence from ADREP data
- Conclusions

Introduction

- It is now widely acknowledged that human performance factors have a dominant influence on the safety of aviation operations

- Many literature have indicated that the underlying processes are the causes behind the symptoms we observe in the cockpit, in air traffic control rooms and in maintenance shops

Introduction

- To understand how safety depends on the effects of managerial and organizational influences working through the online operational failure
- To show how managerial and organizational factors influence the performance of human action based on real data
- Link the quantitative management influences into the technical model of CATS

Safety management system_ Delft Method

- Based on the principle of a problem solving cycle, the core of the Delft SMS can be defined as:

> *" To improve the management processes through which an organization provides effective risk control objectives, instructions and resources to the online human and technology in order to improve their performance and reduce their error probabilities".*

Safety management system_Delft Method

Delivery systems (DSs):

Human

- Procedures, rules and checklists to guide behaviour
- Manpower planning and availability of people to do tasks
- Competence and suitability
- Communication and coordination between online risk controllers
- Commitment, motivation and conflict resolution

Technology

- The desired functioning of the technology coupled with;
- A good man-machine interface. So that it can be operated easily and correctly

Each DS consists of a number of tasks & Should be properly managed

Task analysis, allocation of function, selection, training etc

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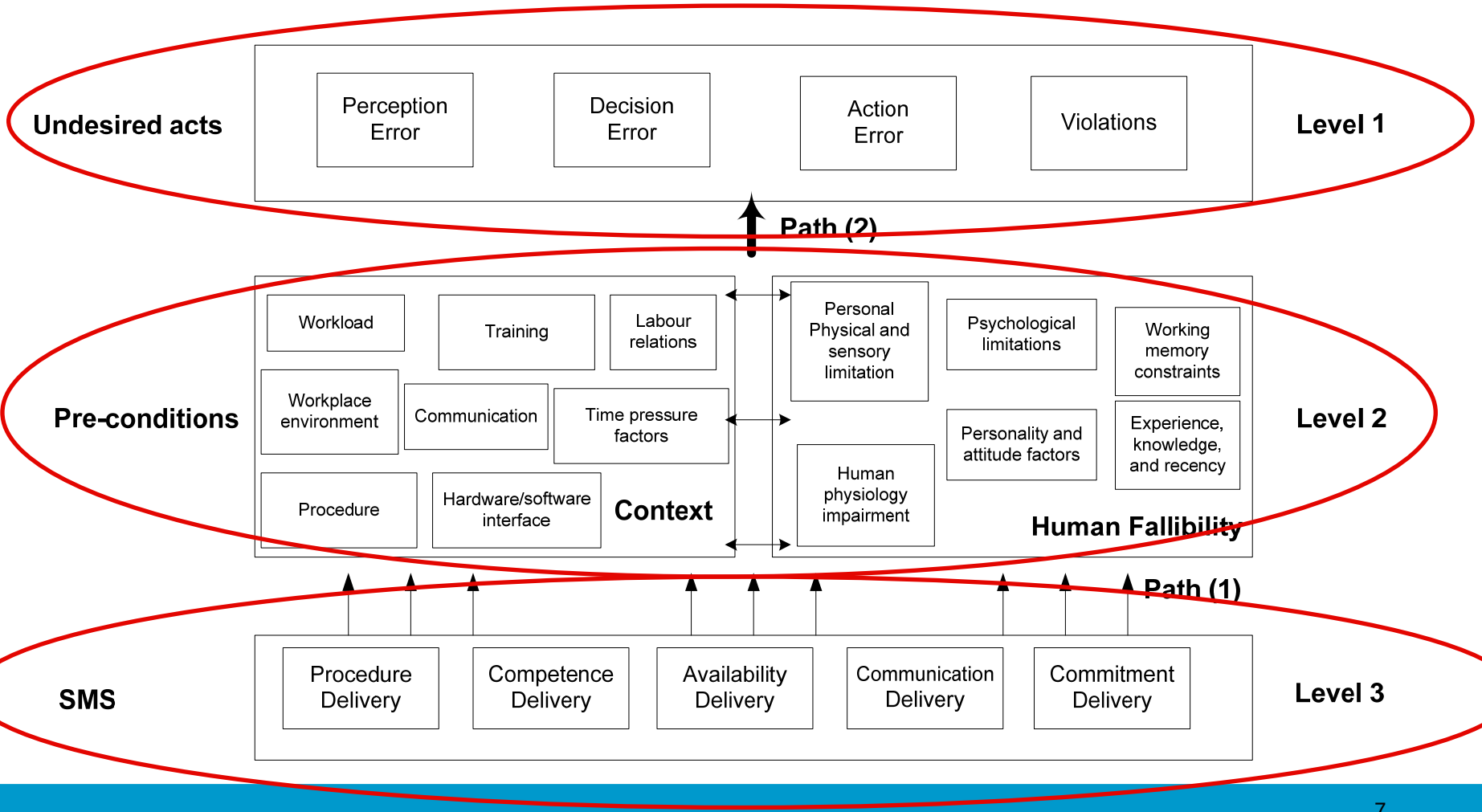
Causal Model



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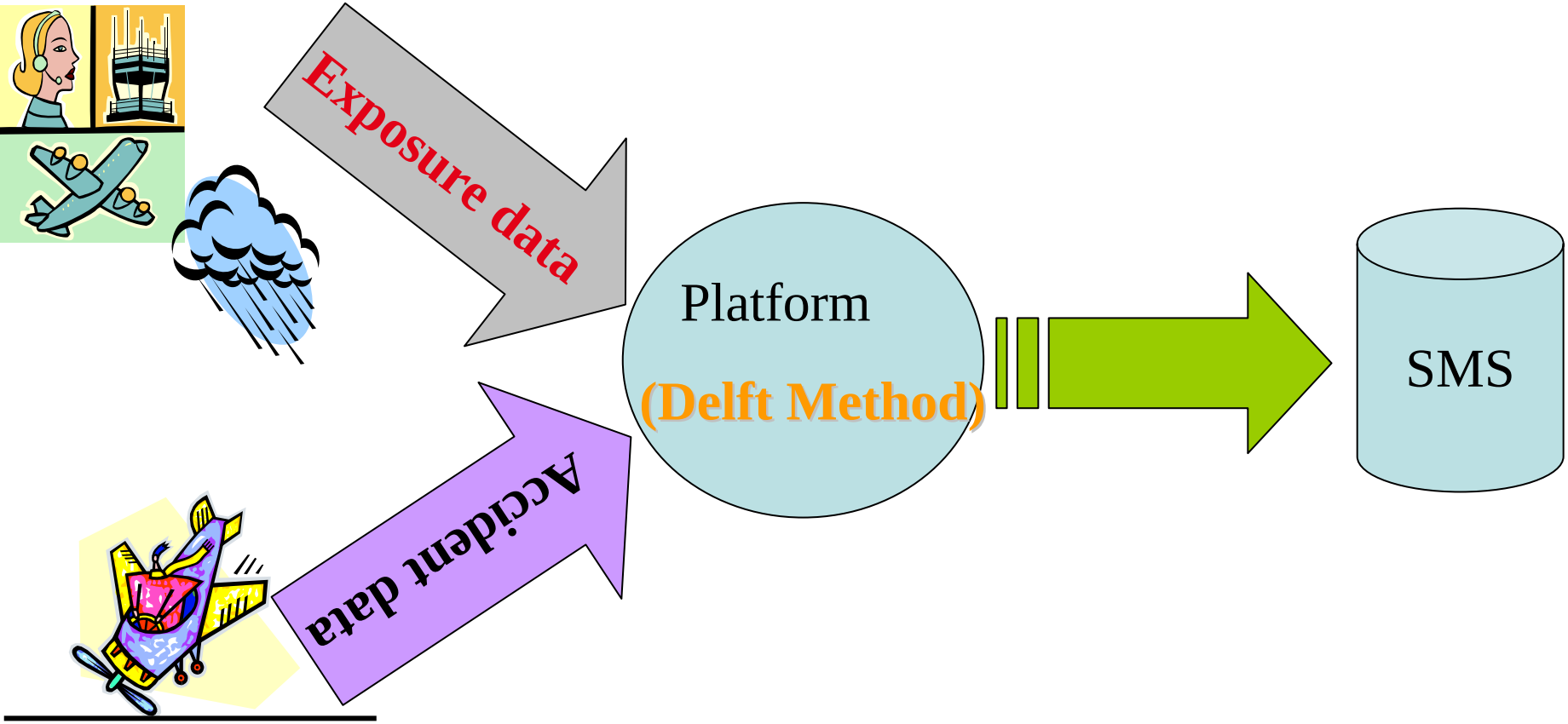
Data resource

1. ICAO Accident/Incident Reporting System (ADREP): ICAO has a standard report format, which has been adopted by ICAO member states throughout the world. Member states are urged to submit their accident/incident data using the standard ADREP taxonomy and report format
2. Line Operations Safety Audit (LOSA): They trained observers fly in the cockpit and record the types of threats and errors committed, and how flight crews managed these situations to maintain safety during normal operations

This will be compared to the occurrence of the same deviations in accidents

3. Structured expert judgement



- Aggregate such data within a common taxonomic structure is difficult

ADREP DATA Analysis

- Query to the dataset:

  from 1990 to 2006,
  Commercial aircraft and
  Mass group >=272 000 Kg
- Accidents number: 5876 (543, 9.2%)
- Data entries: 18,427

  (2436, 13%)

ADREP Classification

- **Errors in operating the aircraft**: these errors are coded into 122 descriptive factors in ADREP taxonomy, which are grouped into 5 categories
    - Flight crew's perception/judgment (perception)
    - Flight crew's decision error (decision)
    - Flight crew's operation of equipment error (action)
    - Flight crew's aircraft handling error (action)
    - Crew action in respect to flight crew procedures (violation)

- **Why a human error took place:** the underlying causes are described in more than 250 explanatory factors at the greatest level of detail in the ADREP taxonomy

Table 1: Selected examples of underlying causes

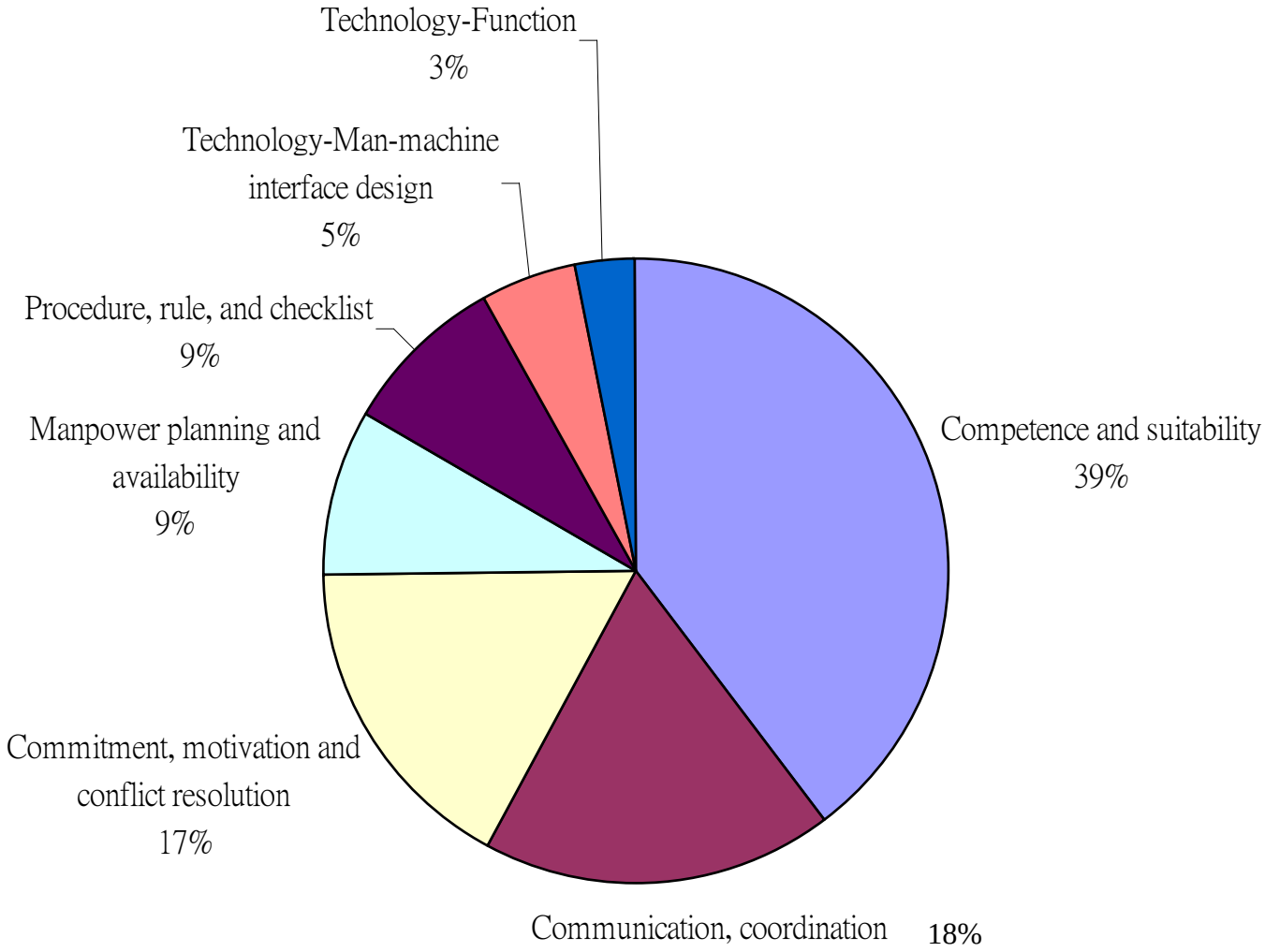
Human being	Flight crew's operation of auxiliary power Unit
Personal size	Flight crew's operation of electrical system
Loss of consciousness/fainting	Workplace seat design inadequate
Impairment-chronic alcohol abuse	Inadequate information/data sources
Fatigue-rest/duty time	User friendliness/usability
Psychological-confirmation bias	Reliability of automation
Experience of route	**Interface between human and system support**
Interface between human and the work environment	Standard Operating Procedures
Landing/take-off site infrastructure	emergency and abnormal procedures
Visibility from workspace/workplace	Company procedures
Cultural issues	Simulator training
Operational control personnel policies	**Interface between humans**
High workload due to staff/skills shortage	Interface between humans in relation to surveillance
Interface between the human and the hardware/software	Interface between humans in relation to cross-checking
Flight crew's operation of air conditioning	Interface between humans in relation to the use of teletype communications

ADREP DATA Analysis

- Based on our model, we coded ADREP's descriptive factors and explanatory factors into our model

ADREP Results (1) (level 3 → level 1)

- Frequencies of management failure in our 7 DSs in relation to online human errors and technological failures (pilot, ATC, etc.)



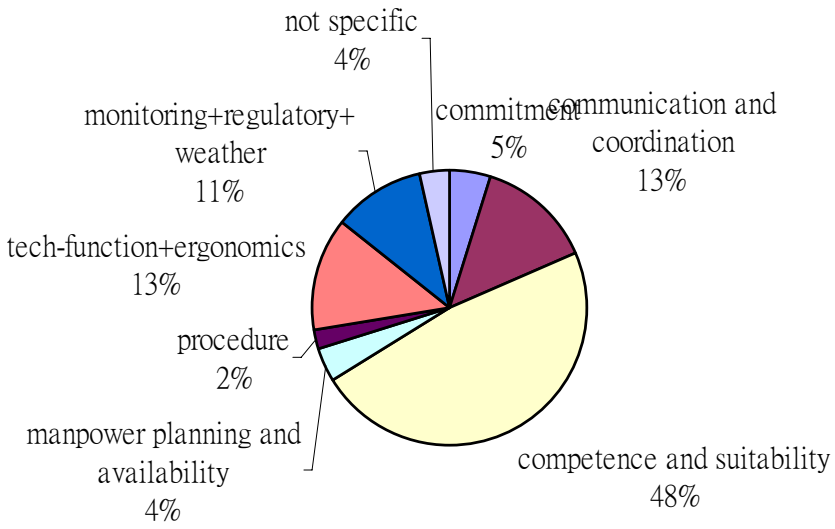
ADREP Results (2) (level 2)

#of Factors		Examples
5	Fundamental limitations that exist in the human's sensory, cognitive and motor process	Failure to monitoring the outside situation; Lack of attention and action in the chain of human information processing
4	Commitment & Conflict resolution	Routine violation; Pilots discouraged from making go-around due to cost implications
3	Online supervision	Failing to notice that a task has been carried out incorrectly
2	Online communication and coordination problems	With ATC and between team members
1	Competence of airmanship and crew resource management skills	

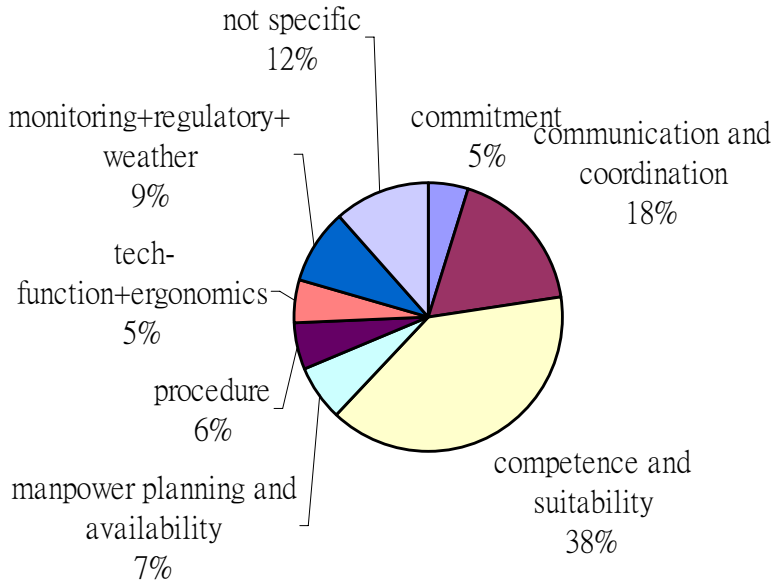
ADREP Results (3) (level 3→level 1)

DS_subject	flight crew's perception /judgment	flight crew's decisions	flight crew's operation of equipment	flight crew's aircraft handling	crew action in respect to flight crew procedures	Grand Total
commitment	10	10	56	37	30	143
communication and coordination	27	37	42	34	94	234
competence and suitability	95	82	108	156	141	582
manpower planning and availability	8	14	22	20	19	83
procedure	5	12	31	18	19	85
tech-ergonomics+function	26	10	9	19	7	71
Others (monitoring+weather +regulatory)	22	19	33	33	30	137
not specific	7	24	26	48	48	153
Grand Total	200	208	327	365	388	1488

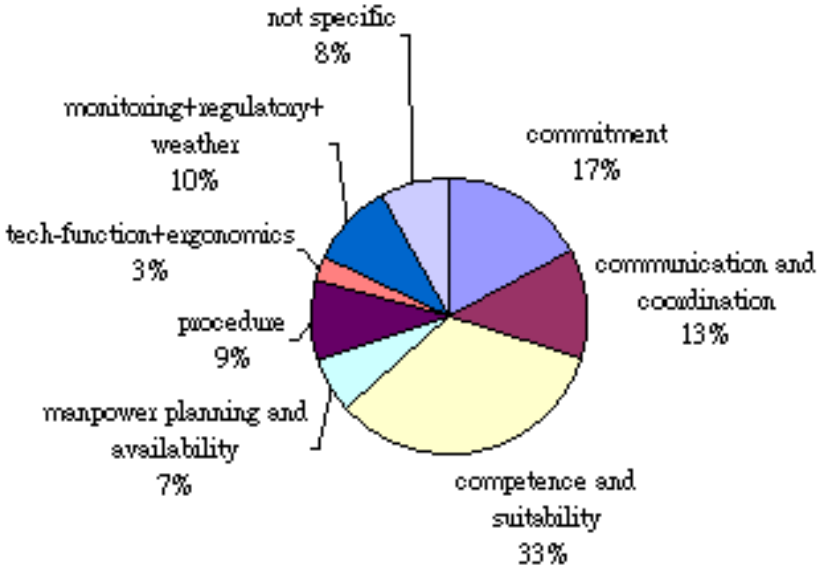
flight crew's perception/judgment



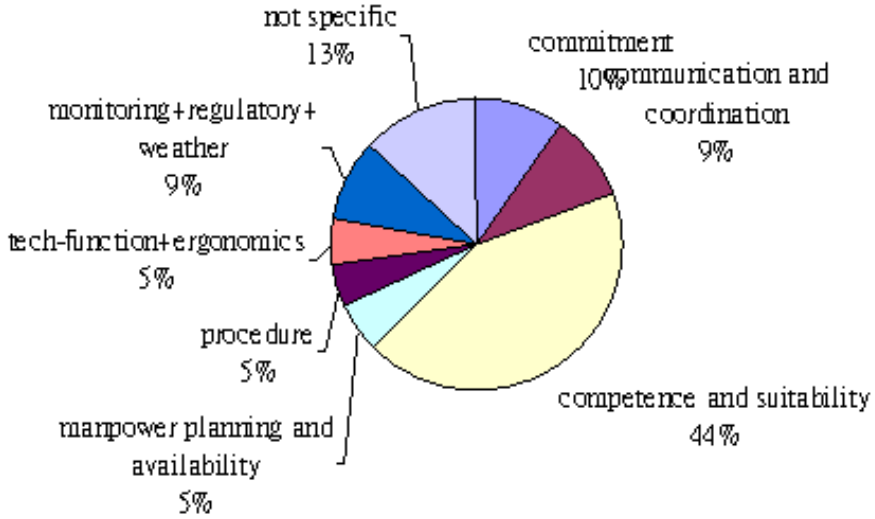
flight crew's decisions



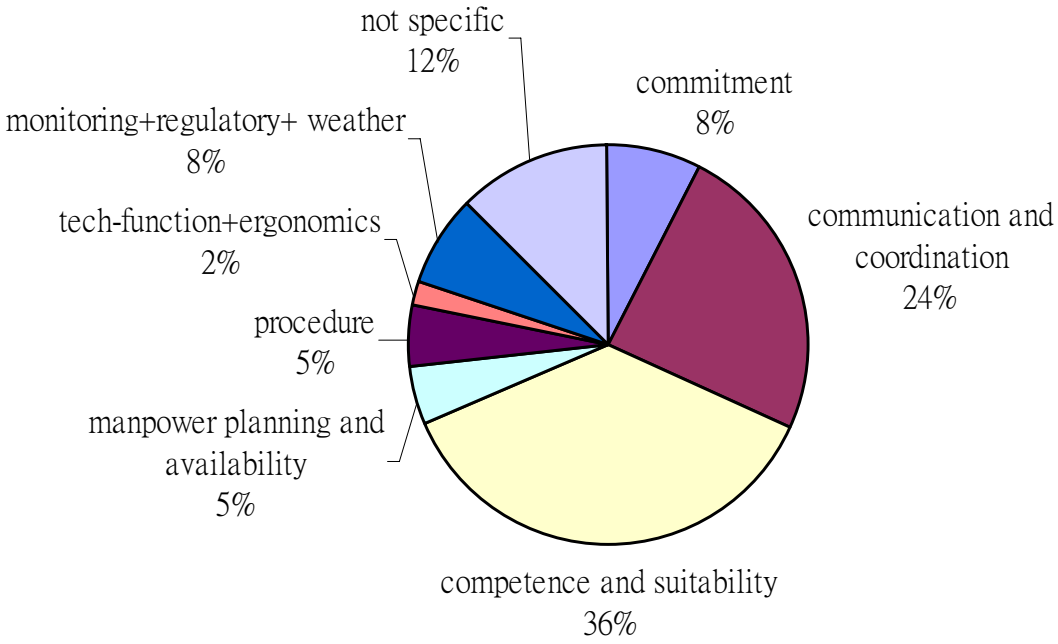
flight crew's operation of equipment



flight crew's aircraft handling



crew action in respect to flight crew procedures



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Chi-square test

	flight crew's decisions	flight crew's operation of equipment	flight crew's aircraft handling	crew action in respect to flight crew procedures
flight crew's perception/judgment	0.000612176	**6.21748E-11**	0.000556885	**3.73521E-16**
flight crew's decisions		0.019356645	**0.121420046**	**0.2346341758**
flight crew's operation of equipment			0.023696465	0.000817026
flight crew's aircraft handling				0.012876677

Test whether there is a significant difference in managerial pattern (level 3) on undesired acts (level 1) for pilots

ADREP Results (3) (level 3-level 1)

- Managers have to treat different resources and controls to prevent different unsafe acts
- Competence and communication are the most important factors
- Commitment is important in Actions
  - *operating an equipment* (17%)
  - *aircraft handling* (10%)
- Communication is important in *violating a procedure* (24%)
- Technology function is important in *flight crew perception and judgment* (13%)

Conclusions

1. In the causal model, to understand how safety depends on the effects of managerial and organizational influences working through the online operational failure, context is very important

2. ADREP data indicates that there is still a deficiency of detail in managerial factors

3. There is a great need to develop a common taxonomic structure

4. There is differences in managerial influences for preventing different types of online human errors

Future work

1. Mapping of these sources onto each other for further analysis will be the next objectives of this research to integrate it into CATS

Thank you for your attention