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Promoting Safety in Ground Handling

Akselsson, Roland; Ek, Åsa; Hallberg, Mattias; Ternov, Sven

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LUND UNIVERSITY

PO Box 117
221 00 Lund
+46 46-222 00 00



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Department of Design Sciences
Ergonomics and Aerosol Technology

Promoting Safety in Ground Handling

Roland Akselsson, Åsa Ek, Mattias Hallberg and Sven Ternov

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Promoting Safety in Ground Handling

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Department of Design Sciences/Ergonomics & Aerosol Technology

Swedish Centre for Aviation R&D, Change@Work, LUCRAM

HFA

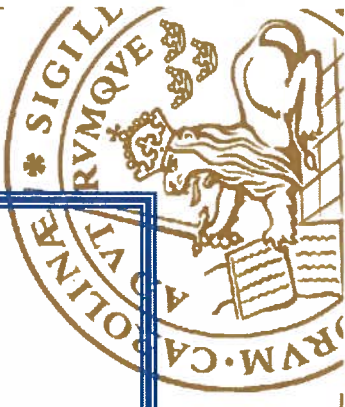
Supported by the Swedish Civil Aviation Administration

Staffan Karlsson

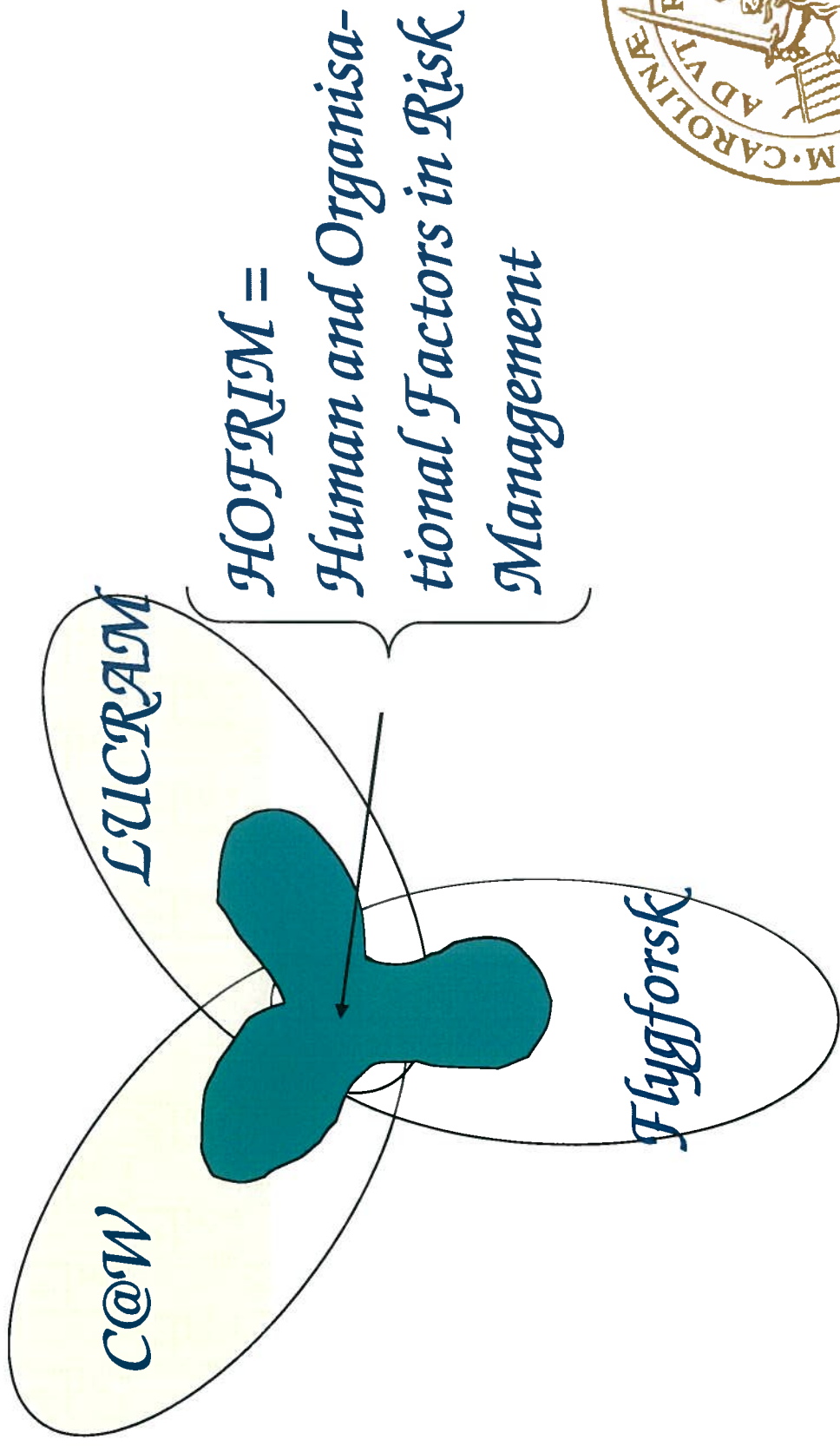
OUTLINE

Promoting Safety in Ground Handling

- **The group HOFRIM and its programme**
- **Goal and method**
- **Ground handling**
- **Measurement of Safety Culture**
- **Investigation of System Weaknesses**
- **Results and discussions**



The Lund HOFRIM group I



The Lund HOFRIM group II

Professors

Roland Akxelsson

Curt R Johansson

Clemens Weikert

Lars Fredholm

Göran Jense

Experts and assistants

Bengt Erik Stenmark

Anders Jacobsson

Johan Jönsson

PhD students

Marcus Arvidsson

Nicklas Dahlström

Åsa Ek

AnnSofie Fyhr

Lidia Kovatcheva

Max Mejia

Sven Ternov

Master students



Ergonomics I

Lund University

Lund Institute of Technology

**Dept of Design Sciences
Ingvar Kamprad Design Center**

Ergonomics and Aerosol Technology




Ergonomics II


Professors associates	Research areas	PhD students
Roland Akselsson	HOFRIM; Ergonomics in Design; Physio-erg	8
Gerd Johansson, Roy Davies, Joakim Eriksson	User interface; VR; Rehabilitation ergonomics	3
Per Odenrick	Organisation development, SMEs	2
Ingvar Holmér Jan 1, 2003 --	Indoor climate and physiology	(2)
Jan Erik Rendahl	Change management	2
Mats Bohgard, Anders Gudmundsson	Aerosols	3
Matts Ramstorp	Cleanroom technology	




The Lund HOFRIM group III

Some basic principles

- 

To err is human.
Design for safety
- 

A systems approach.
Involvement by all
3. Latent conditions,
Safety barriers,
Situational factors
4. Proactive risk mgmt
- 

5. Safety Culture
A learning
organisation
6. Continuous improvements.
Change processes.
7. Naturalistic or dynamic
distributed decision making.
8. Psychosocial and physical
work environment
9. Comparative studies
between different
trades



1. To err is human. Design for safety.

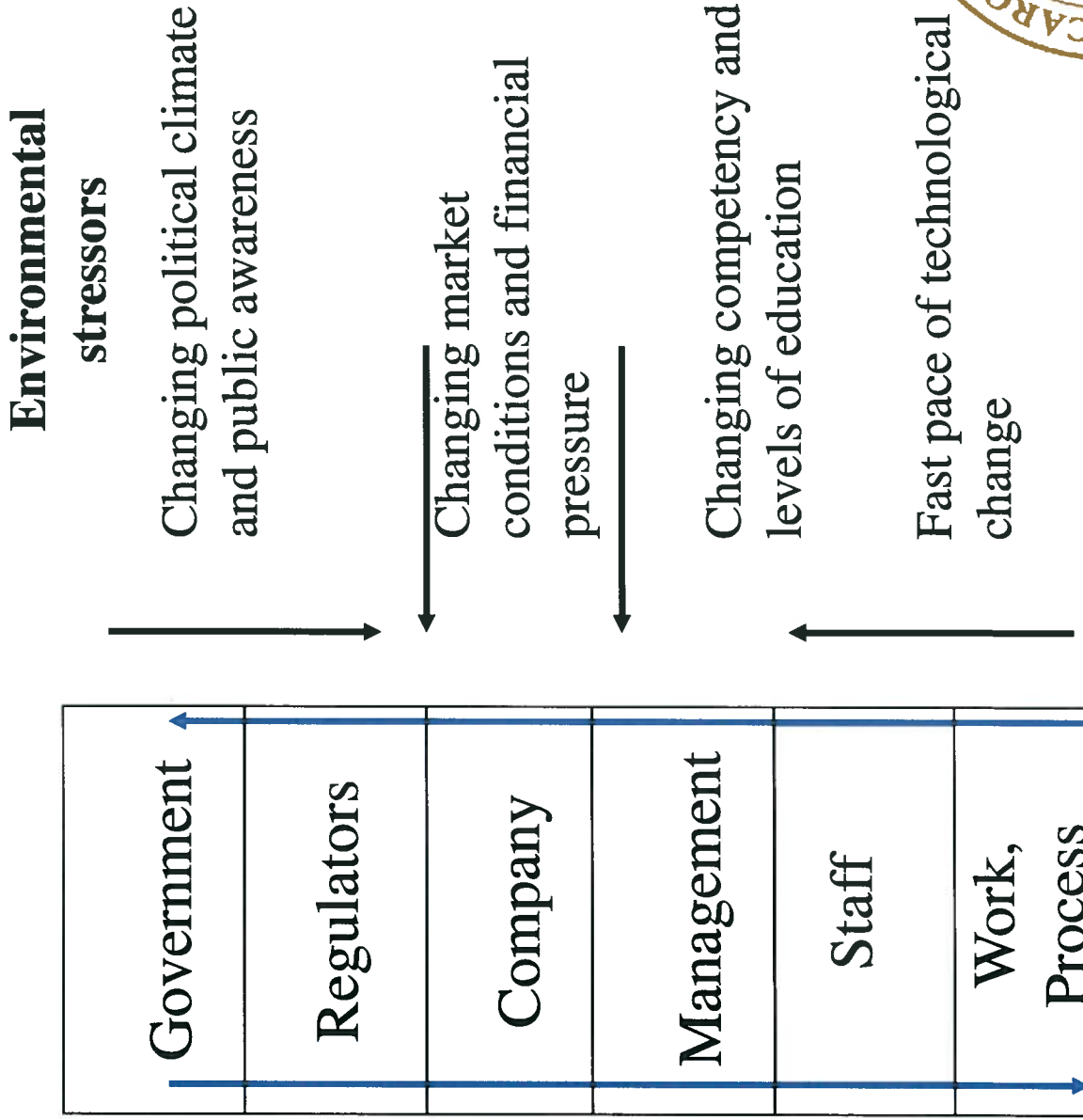
- Design forgiving systems
- Consider the typical and atypical users
- Consider normal and atypical use
- Consider the environment
- Diffusion and the design envelope
- Visibility, Affordance, Mapping, Feedback
- Usability (Relevance, Efficiency, Attitude, Learnability)



Test early with real users



2. A system view



Rasmussen 1997

System perspective

The Socio-Technical System

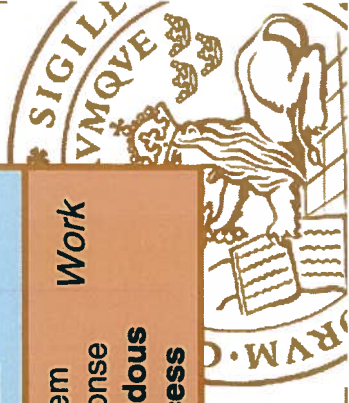
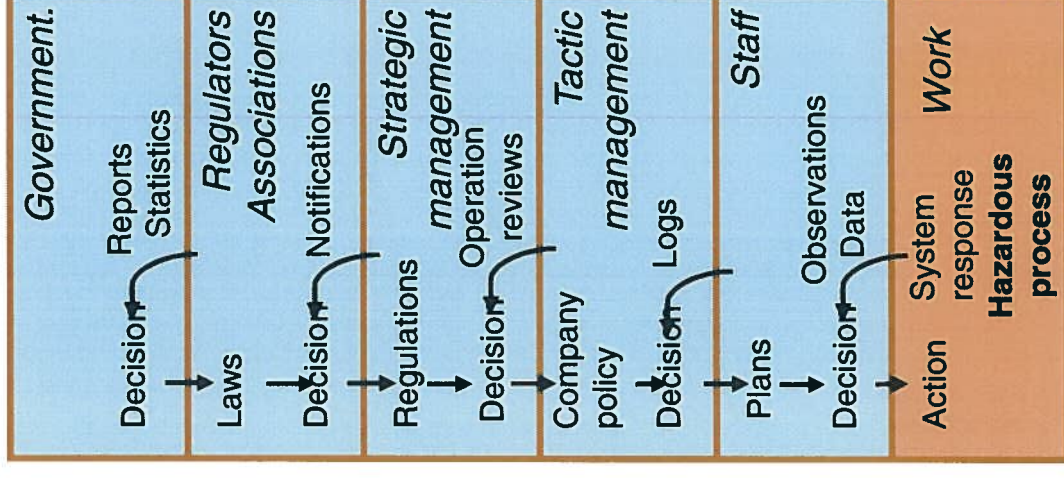
Nested levels of decision-making involved in Risk Management and regulatory rule making.

The control processes can be described in terms of – and supported by – closed loop feed back of information

Accident and work analysis should focus on these conditions for control and dynamic learning during every day work



Picture from Inge Svedung



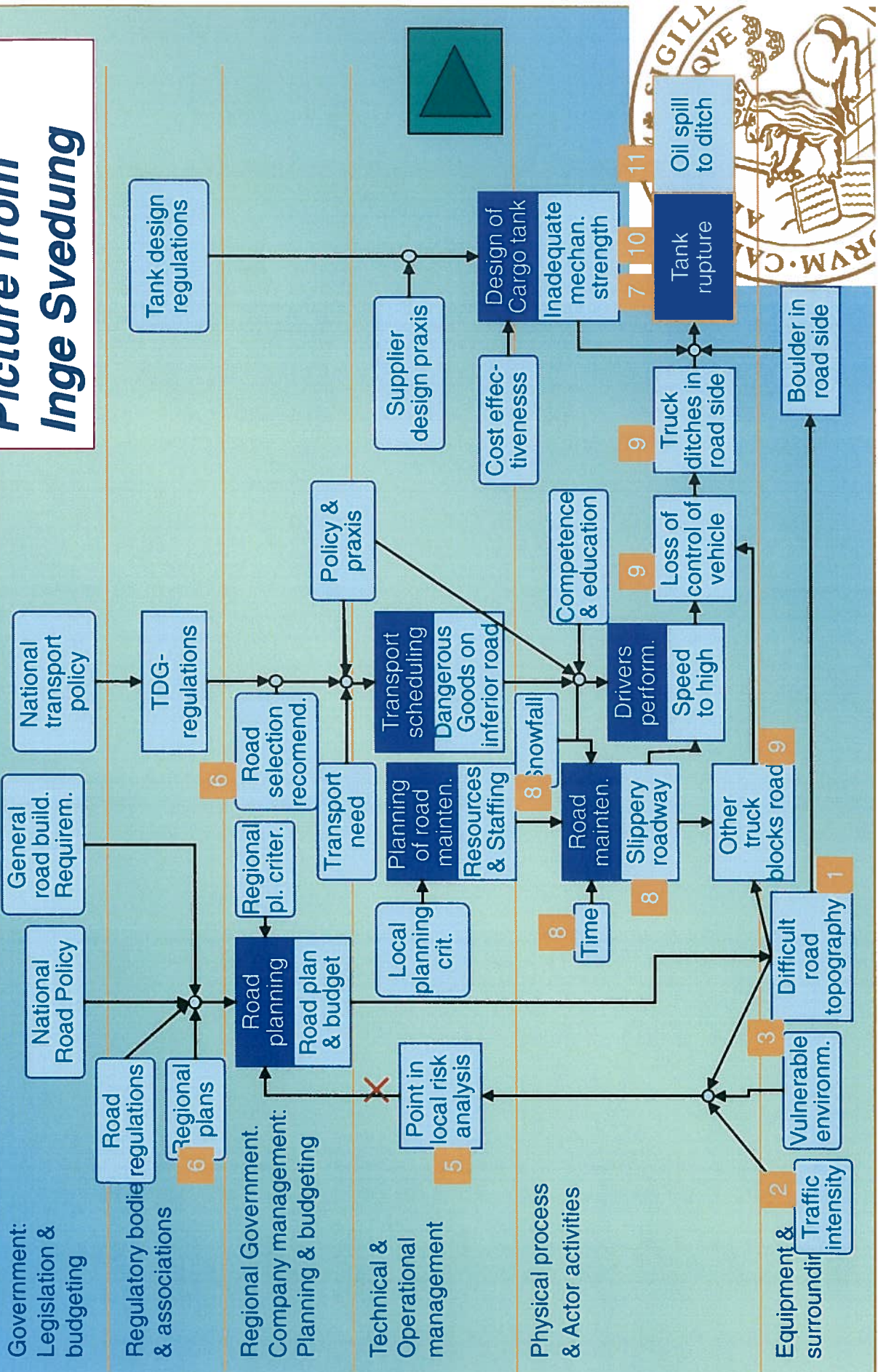
Mapping of Functions and Preconditions

An "AcciMap"-example

System: Transport of Dangerous Goods by road

SYSTEM LEVEL

Picture from Inge Svedung



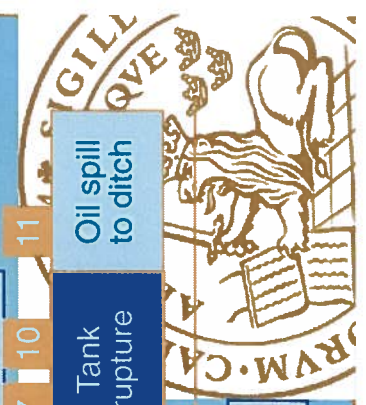
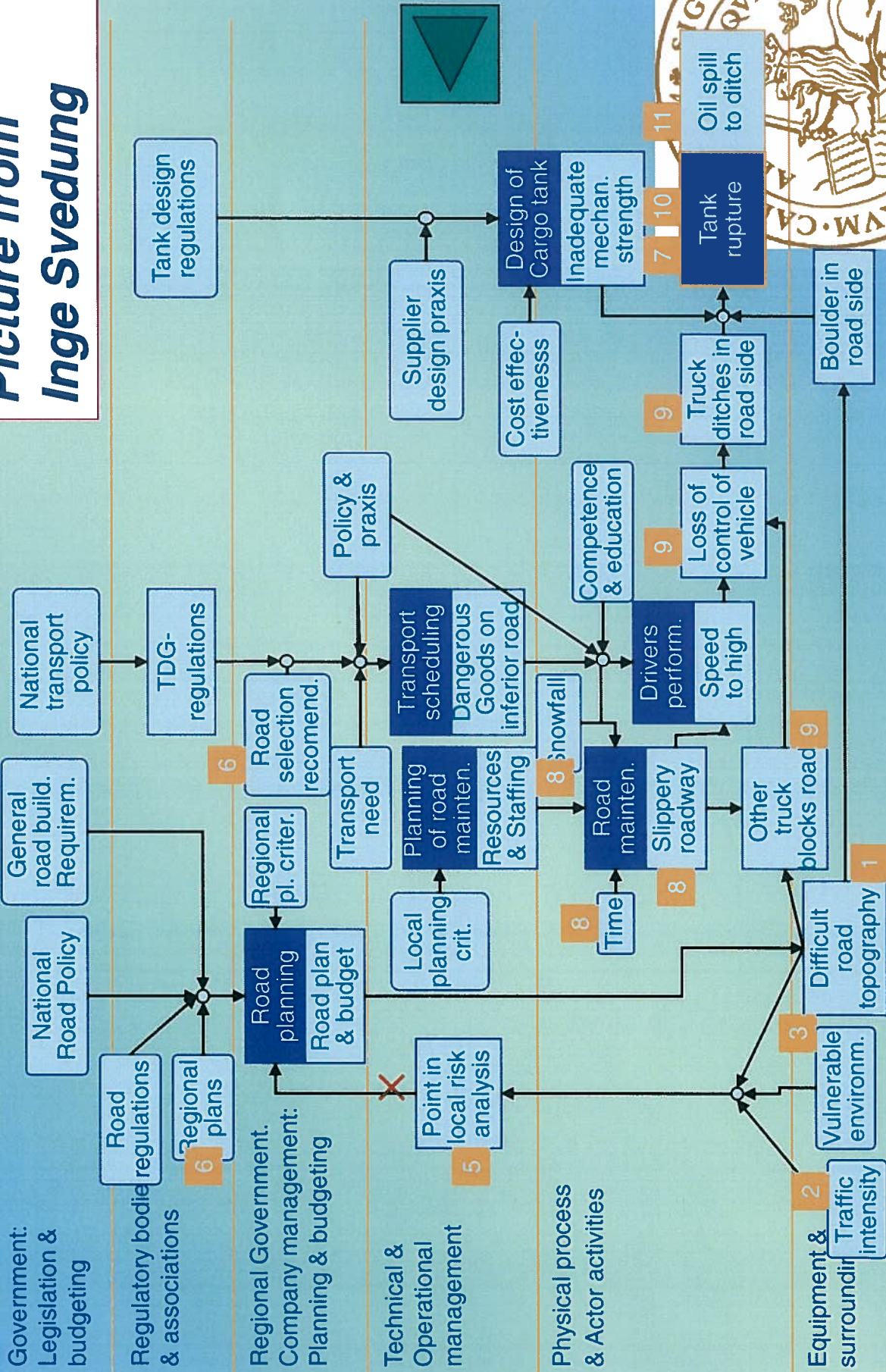
Mapping of Functions and Preconditions

An "AcciMap"-example

System: Transport of Dangerous Goods by road

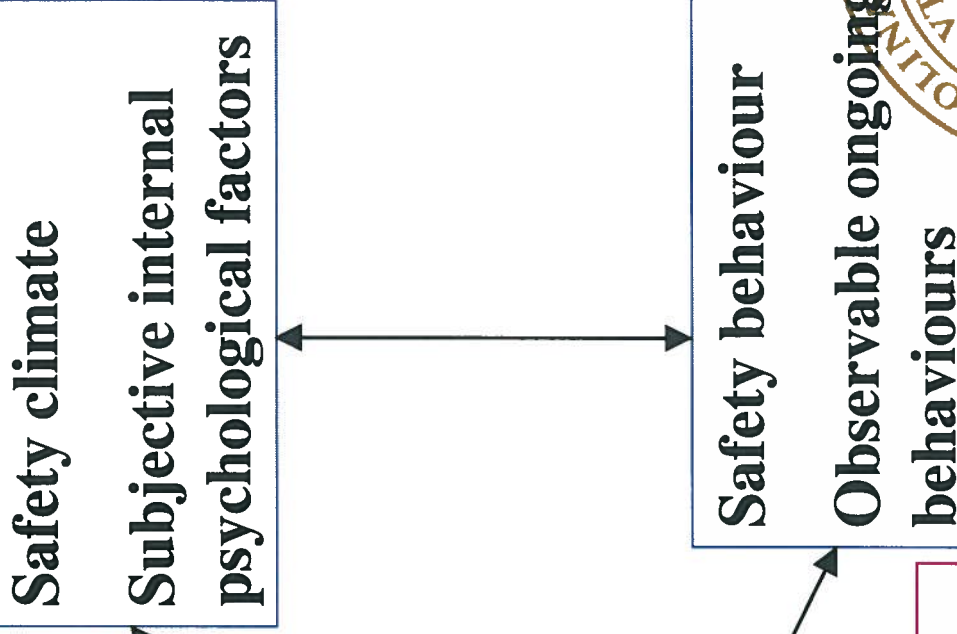
SYSTEM LEVEL

Picture from
Inge Svedung



5. Safety Culture

The way we work here



A reciprocal model. Cooper and Phillips, 1995. Cooper, 1996, 1997, 2000



Learning

Important sources for learning:

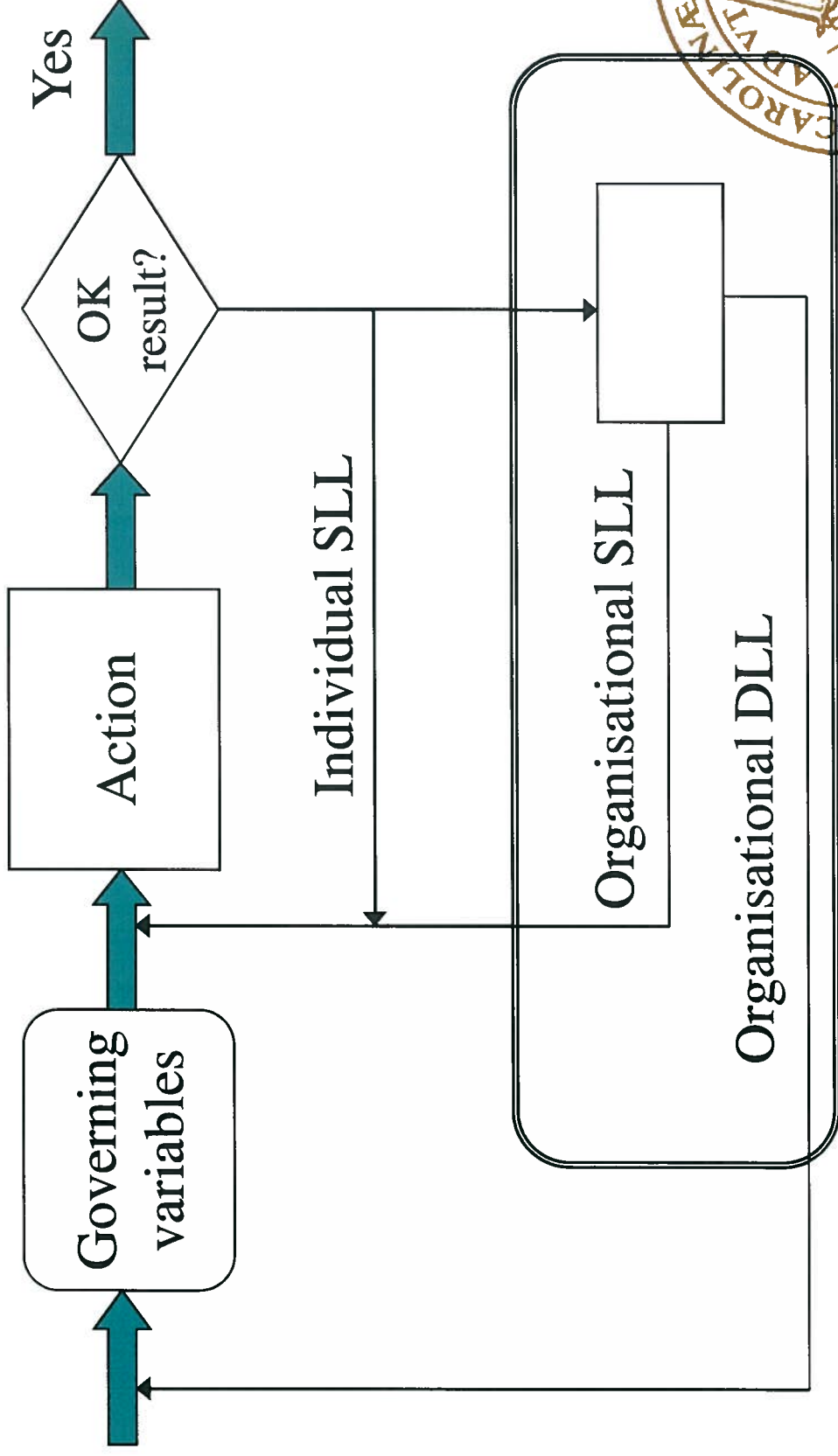
1. Unsafe acts
2. Unsafe situations
3. Near accidents
4. Accidents
5. 1- 4 in other organisations
6. Risk analyses
7. Internal audits

8. External audits
9. Education
10. Training
11. Expert involvement
12. Participation in relevant research and development



'Single- and double loop learning' SLL and DLL

After Koornneef



HOFRIM projects

- **Safety Culture** (Åsa Ek, RA)
- **HUFA. HF in aviation** (Åsa Ek, Markus Arvidsson, Sven Ternov, Curt R Johansson, RA, LFB)
- **RAMP. Safety at ground handling** (Åsa Ek, Mattias Hallberg, Sven Ternov, RA) (pilot project)
- **MARSAF. Maritime safety** (Åsa Ek, Max Mejia, BE Stenmark, Göran Jense, RA)
- **OSHANA. Learning from near-accidents in SMEs** (Johan Jönsson, Curt R Johansson, Per Odenrick, RA, Group in Austria)
- **Safety in Drug Handling** (AnnSofie Fyhr, RA)
- **Safety in Medical Care** (Sven Ternov, RA)
- **[VERDI – Integration of HF in Design** (Lars Hanson, Mikael Blomé, Per Odenrick, RA, PhD-students and researchers from Chalmers and NIWL, Saab)]



HOFRIM projects – new

- **Pilot training and stress** (Nicklas Dahlström, School of Aviation, Lund University)
- **Safety and downsizing** (Anders Jakobsson, Fire Safety Engineering & LUCRAM)
- **CBT - Centre for Decision Making** (Campus Helsingborg, Community of Helsingborg, Scandlines, C-ITS, LUCRAM, etc.)
- **Integration of management systems for SHE** (Lidia Kovatcheva, Kristianstad University, LUCRAM)
- **Safety in test running of new cars** (2 master students, SAAB)
- **Organisational factors and safety in SMEs** (2 master students, Trygg-Hansa)



Ground handling characteristics

e.g.

- **Various organisations sharing a work environment**
- **Working in a limited space**
- **Severe temporal pressure**
- **Serious hazards on the ramp**
- **Accidents with serious human and economic consequences**
- **Importance for security**



Safety for

- **Passengers**
- **Personnel**
- **Aircraft**
- **Luggage**
- **Airport Equipment**

Security



Goal

Promoting Safety in Ground Handling

The long-term goal is to develop a program for promoting safety in ground handling at airports.

The goal of the current pilot project is to plan such a project by e.g. testing a couple of tools in such a program. Also we want to find out what could be used from other efforts in the world?



Methods

Promoting Safety in Ground Handling

- **Literature review**
- **A pilot study of Safety Culture in part of the ground handling in one airport**
- **A pilot study of system weaknesses in part of the ground handling in one airport**
- **Inference from other projects**



Some good interesting work

- **SCARF** – Safety Courses for Airport Ramp Functions (Trinity College Dublin; Loughborough Univ of Techn; Univ of Gronningen; Traffic Research Centre (NL); Universidad de la Laguna, Tenerife. Four airlines and three airports.
E.g. Nicholas McDonald (1996); Isla and Diaz (1997)
- **INDICATE** – Identifying Needed Defences In the Civil Aviation Transport Environment. This is a method to proactively improve airline safety performance
Edkins (1998)
- **QDHB** – A quality management system developed for municipal airports in Sweden
- **etc**



INDICATE – Identifying Needed Defences In the Civil Aviation Transport Environment. I

Six core safety activities

- 1. Appoint a safety manager**
- 2. Conduct staff focus groups to identify hazards**
- 3. Establish a confidential hazard reporting system**
- 4. Conduct regular safety meetings with management**
- 5. Maintain a safety information database**
- 6. Ensure that safety information is regularly distributed to all staff**



INDICATE – Identifying Needed Defences In the Civil Aviation Transport Environment. II

Evaluation criteria

- **Safety culture**
- **Staff risk perception**
- **Willingness to report safety hazards**
- **Action taken on identified safety hazards**
- **Staff comments about the safety management within the company**



QDHB

- **Web-based quality management system (efficiency, competitiveness, safety)**
- **Network of 28 municipal airports in Sweden**
- **Includes**
 - **Processes and instructions for operation of an airport**
 - **Systems for system safety and environment**
 - **Form for reporting about operation**
 - **Training material etc**

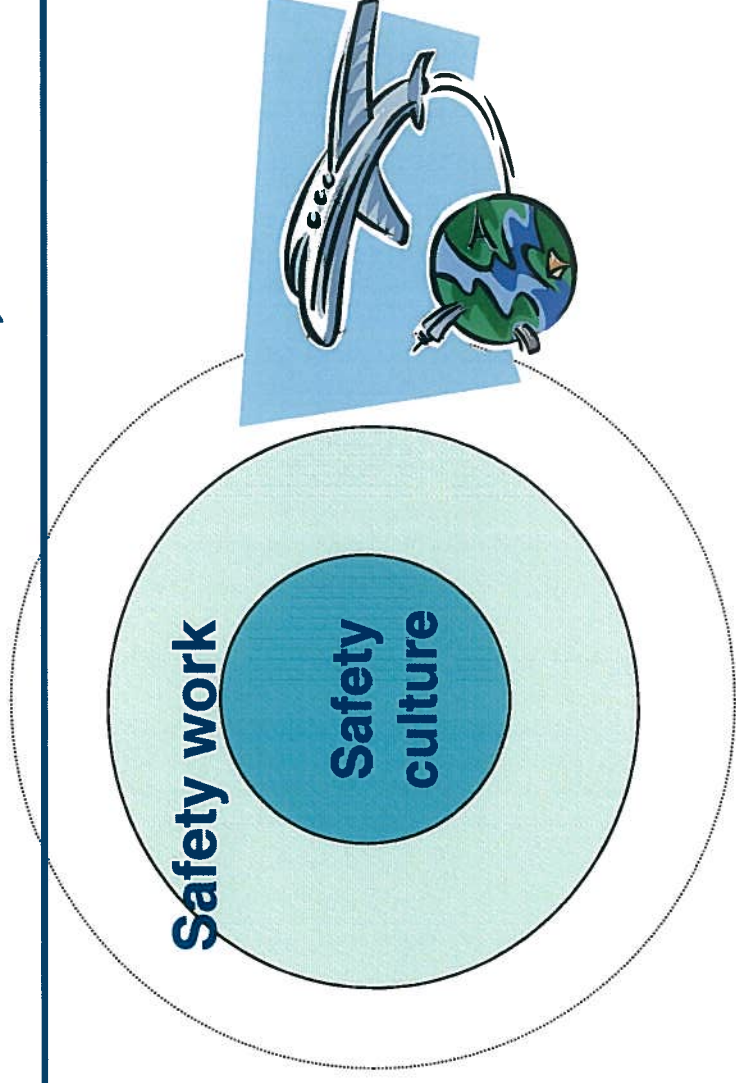
In Swedish: www.qdhb.org/qdhb.htm



Part. Safety Culture

Safe Handling of Aircraft

Åsa Ek, ..



How successful the safety work will be depends to a great extent on the safety culture.



What has been done in the Safety Culture part of the ground handling study?

Observations – used for ramp workers

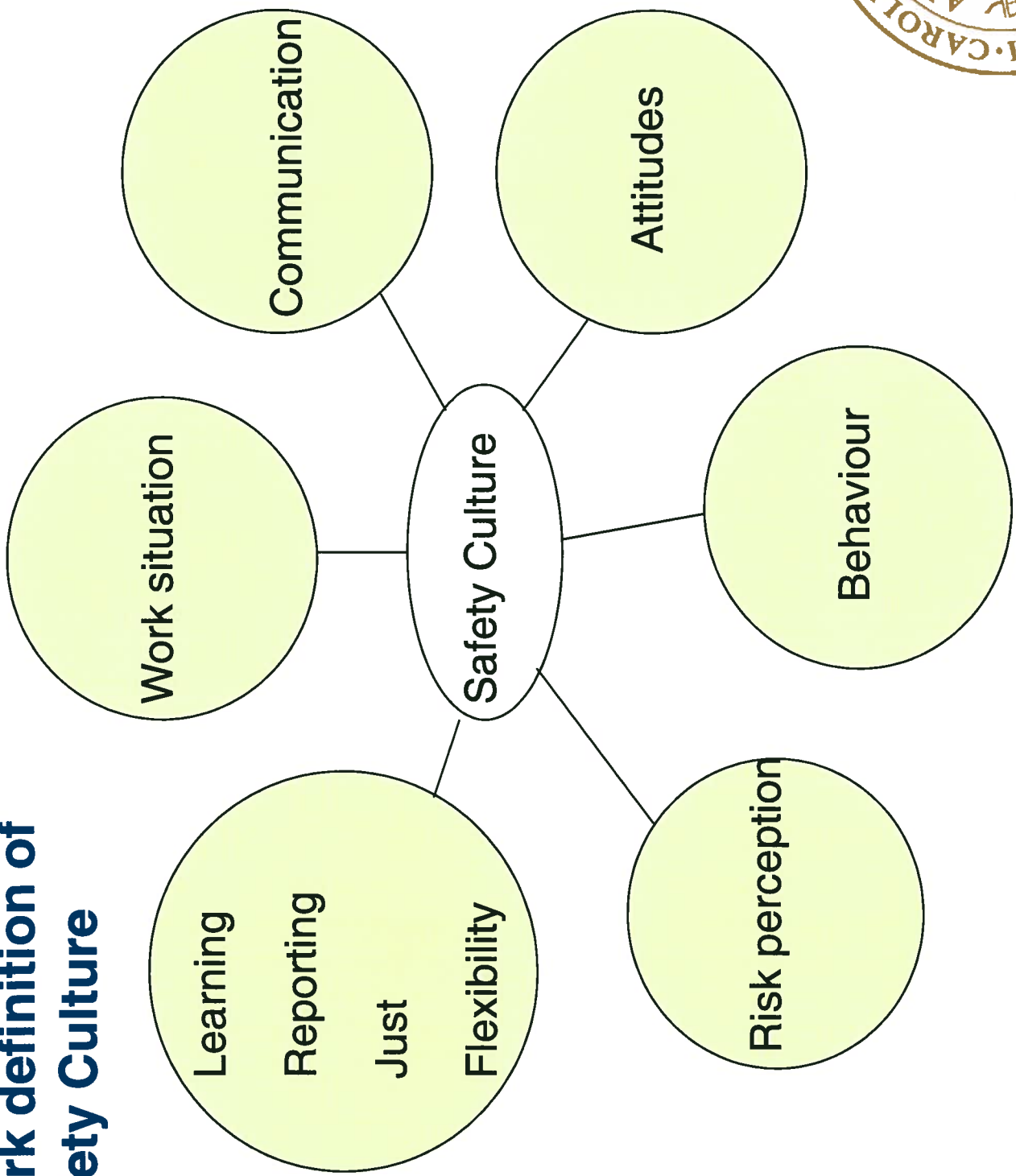
Questionnaires – 94 questions,
response rate = 75%

Interviews – 10 persons, in different positions

Collection of facts



Work definition of Safety Culture



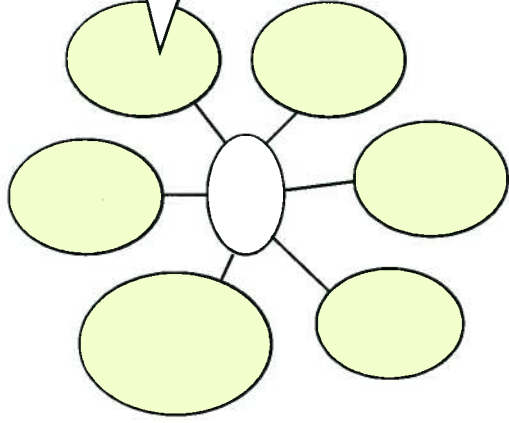
Assessment of Safety Culture by Ground Handling Leaders

Three different assessments:

- 1) What percentage of positive answers from the personnel describes a good Safety Culture today?
- 2) What is a reasonable goal?
- 3) What is the limit for what is acceptable?



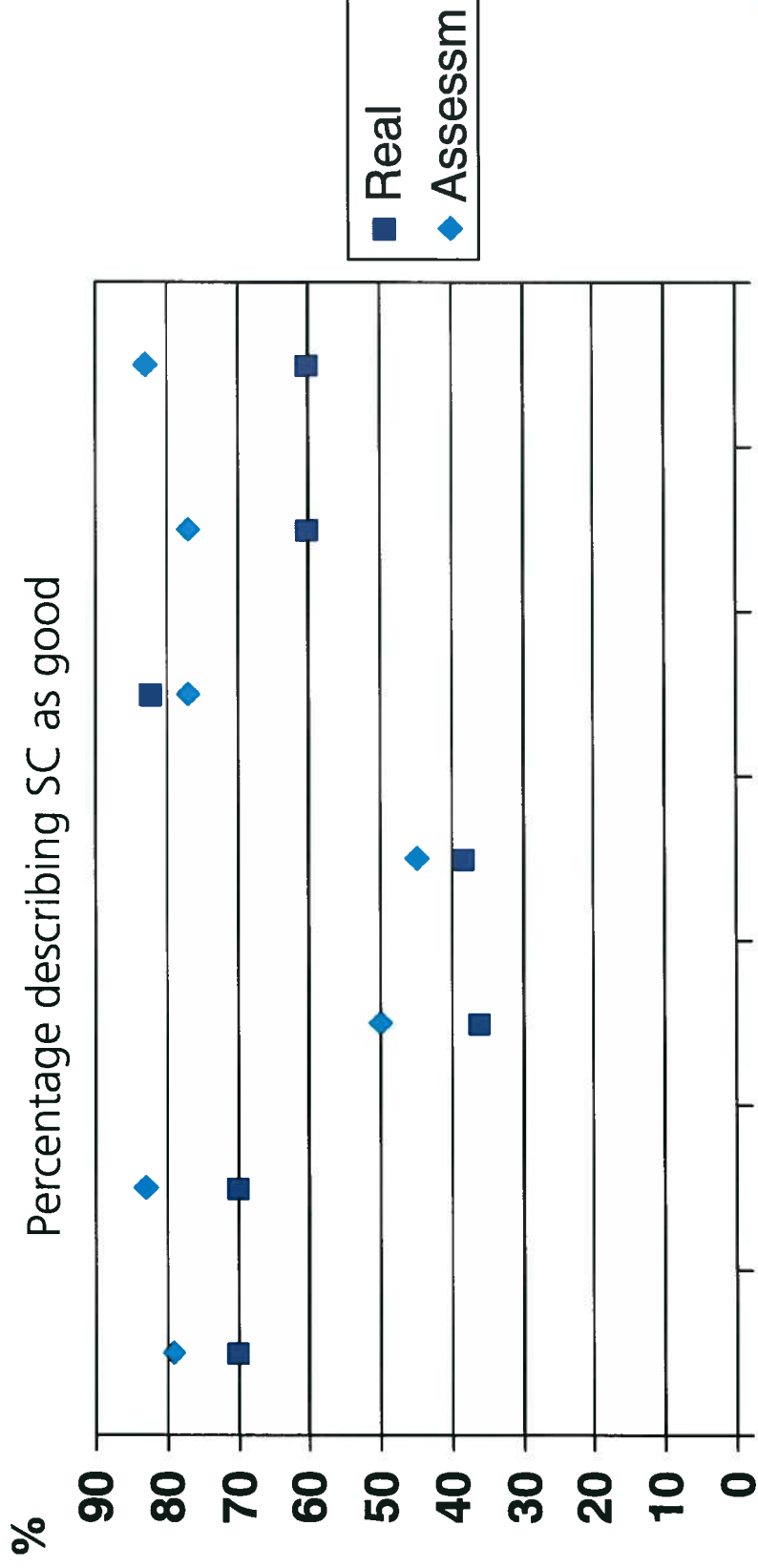
Communication



**Do you get the information
you need for working in a
safe way?**



Assessment of Safety Culture by Ground Handling Leaders

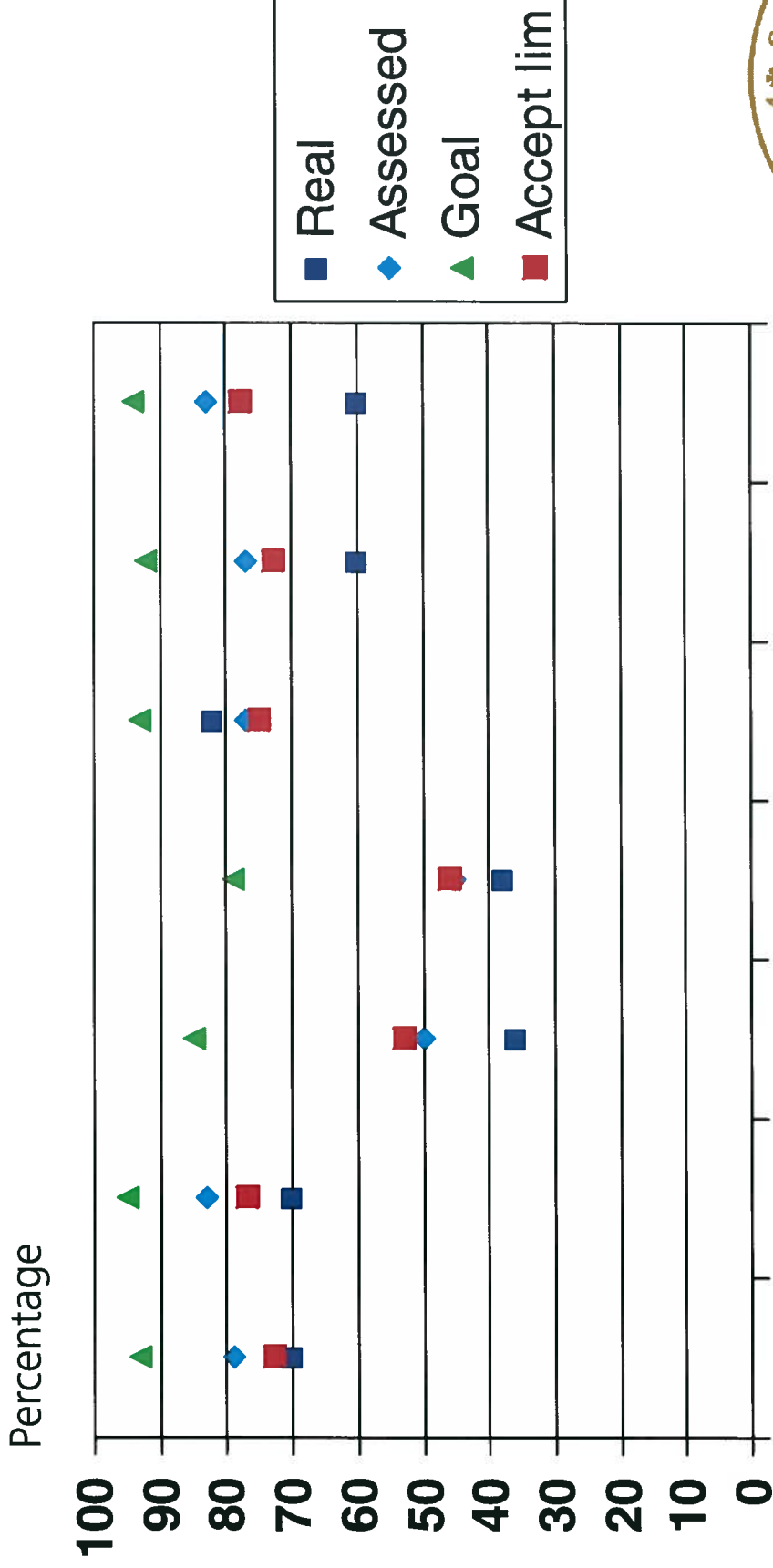


Learn Report Just Flex Comm Behav Percep

→ Reality often somewhat worse than (not as good as!) assessed.



Assessment of Safety Culture by Ground Handling Leaders



Learn Report Just Flex Comm Behav Percep

→ Reality often worse than assessed limit for what is acceptable.
Goals are good.



Result – Work Situation

Good marks regarding:

- comfort and well-being
- education in safe work AD
- clarity in work/situations
- cooperation within ground handling



- stress (20)
- staff insufficient (AD 32, I 42)
- education in safe work (I 28)
- physical exhaustion (32)

AD = aircraft damage

I = injuries



Result - Flexibility

Good marks regarding:

-doing somebody else's undone work task
yourself



-no encouragement to give suggestions/ideas for
improvements at work (36)

-seldom asked about how to solve a problem that has
emerged (30)



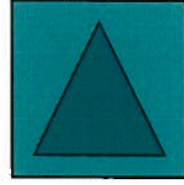
Result – Communications at work

Good marks regarding:

- gets the information needed for safe work
 - in most cases in time
- clear instructions from supervisor
- communication between units in the ground handling



- gets seldom the information needed for safe work (I 25)
- insufficient training in communication at accidents (42)
- not clear who to contact to discuss safety (AD 20, I 24)



AD = aircraft damage

I = injuries



Result - Reporting

Good marks regarding:

- information about safety questions
- can say what you think about safety (AD, I)
- management of SH AB listens to the employees about safety questions
- reports if equipment is damaged



- insufficient collection of information about if machines/ technical equipment are functioning (30)
- insufficient collection of information about if work routines are functioning (27)



AD = aircraft damage

I = injuries



Result - Just

Good marks regarding:

- just assessment if work has gone wrong
- does not hesitate to take one's own initiatives (because of concern if something would go wrong)
- gets often attention if one is not working in a safe way



-you feel operators being worried to get the blame for mistakes
(32)

-gets seldom acknowledgement for safe work (AD 48, I 49)



AD = aircraft damage

I = injuries



Result - Learning

Good marks regarding:

- habit to, on one's own accord, look for problems in aircraft safety
- those responsible for ground handling act on info about failing safety (AD, I)
- doing improvements if deficiencies in work are discovered that may affect (AD)



- little encouragement to pay attention to safety deficiencies in the daily work (26)
- measures seldom in reasonable time after reporting (22)
- improvements are, in most cases, not done until something negative has occurred (47)



AD = aircraft damage

I = injuries



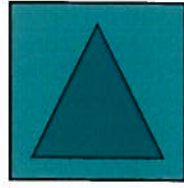
Result - Behaviour

Good marks regarding:

- colleagues encourage to safe work (AD, I)
- airport men work in a safe way
- ground handling management does not urge anybody to take short cuts at work
- management in SH AB does not urge anybody to take short cuts at work



- can do the work faster if some rules are not followed (46)
- almost no talk about how to improve work for increased safety (AD, I)



AD = aircraft damage
I = injuries



Result – Attitudes towards safety

Good marks regarding:

- SH AB, staff management & FPM are considered working for good safety (AD, I)
- feels it is worth time to talk about near-misses to learn
- feels great personal responsibility for airport safety



- very seldom taken part in the planning for safety (72)
- feeling the management SH AB hardly has any interest in the FPM well-being (20)



AD = aircraft damage

I = injuries



Result – Opinion about safety

Good marks regarding:

- thinks that work is done in a safe way (AD, I)
- has confidence in the ground handling management regarding safety
- feels that the ground handling work is done with good safety margins regarding the aircraft



- rather big risk to hurt oneself at work (58)

AD = aircraft damage

I = injuries



Preliminary summary of results of the SC investigation

What was positive:

- ◆ Communication in the daily work
- ◆ Behaviour concerning safety
- ◆ Attitude concerning safety
- ◆ Opinion about safety

Mixed positive and negative:

- ◆ Work situation
- ◆ Reporting
- ◆ Flexibility

What was negative:

- ◆ Learning
- ◆ Justness



Part: Disturbance-Effect-Barrier (DEB) Analysis on the loading and unloading process at an airport

Mattias Hallberg (now SYCON), Sven Ternov and Roland Akseleson

Primary goal: Is the DEB method useful for a major investigation of system weaknesses at ground handling as a link in proactive risk management?

Method: The loading and unloading processes were studied with the DEB method at Sturup airport.



Disturbance-Effect-Barrier (DEB) I

Developed by Sven Ternov.

Building on Failure Mode and Effect Analysis (FMEA), on Action Error Analysis (AEA) and on Man, Technology, Organisation (MTO) analysis.

The process is first divided in parts (a task analysis).



Disturbance-Effect-Barrier (DEB) II

Unloading from luggage wagons to the arrival conveyor band.

Act	19 Towing truck to conveyor belt	20 Parking the truck	21 Unloading on conveyor belt	22 Truck and wagons to suitable place
Comments				
Document				
Possible disturbances				
Effect on the system				
'Probability'				
Latent conditions				
Barriers				



Disturbance-Effect-Barrier (DEB) III

Act	19 Towing-truck to conveyer belt
Comments	The driver drives the truck with loaded wagons to conveyer 1 or 2
Document	7,8
Possible disturbances	Luggage falls of the wagon. 1) Discovered by the driver. 2) Not discovered by the driver. 3) Raining, snowing.
Effect on the system	1) Loss of time. Damage? 2) Discovered later. Damage? Loss of time. The traveller has to wait. 3) Luggage damaged by moisture.
‘Probability’	1) Occurring
Latent conditions	1,2) Too much loaded wagons (See also col 4&6). Poorly stowed (see also col 15). 3. Poor design of sheltering
Barriers	1,2) Watch backwards (also risk). 3) Good sheltering



Act: Study of load message (LDM) (col 4)

Latent conditions

- **Not clear who should read LDM**
- **LDM not easy to read**
- **LDM placed in a bad position**



And then ..

- **Disturbance analysis. What happens if ...?**
- **Feedback from the operators (ground handling staff)**
- **Suggest reduction of latent failures and new or improved barriers**



Results part 2

- **16 system weaknesses were identified**
- **Some improvements were implemented before the report was written**

- **The DEB investigation should be extended**
- **More participation from ground handling staff could save time and improve the quality**



How to get a common view ..

.. About what is important in an organisation?

Sometimes it looks like it is the economic result of the year which is the only important thing.

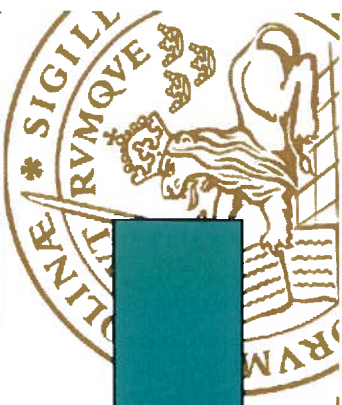
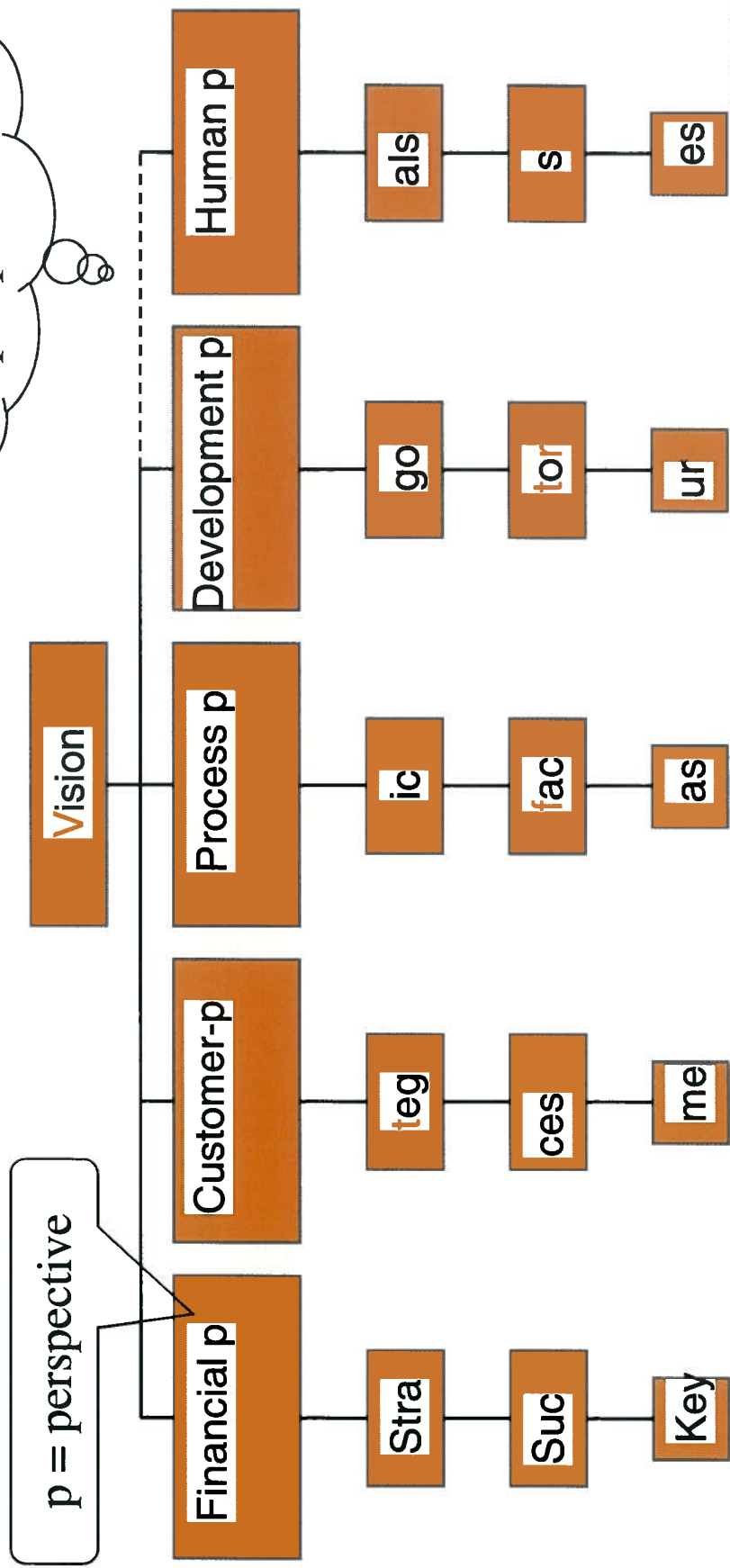
Balanced ScoreCard or something similar are more and more used to bring out other perspectives as relations to good customers, human resources etc. Sometimes also Safety.

By including safety in such a system employees, middle management, top management, customers and other interested parties get the same view.



Balanced ScoreCard

Safety could be included as a perspective



Action plan

Results I

We hit an organisation with a good safety culture. But that was not the important answer for us. It was instead that the two methods (Safety Culture Evaluation and DEB-analysis) generated results in a form and way that they could be used by the organisation for learning and continuous improvements

We also get ideas on how to improve the methods.



Further ideas from the pilot project

- A generic AcciMap and an InfoMap should be tested
- Training programmes may be needed (SCARF?)
- Safety as a perspective in Balanced ScoreCard (or equivalent) may be an instrument for disseminating the importance of safety management to all interested parties (e.g. board, management, employees, customers, shareholders)



Some basic principles for safer ground handling

which we would like to use and further develop

1. **To err is human.
Design for safety**
2. **A systems approach.
Involvement by all**
3. **Latent conditions,
Safety barriers,
Situational factors**
4. **Proactive risk mgmt**
5. **Safety Culture
A learning organi-
sation**
6. **Continuous improvements.
Change processes.**
Naturalistic or dynamic distributed decision making.
- 7.
8. **Psychosocial and physical
work environment**
9. **Comparative studies between different
trades**



**Thank you for listening -
- and coming to Lund**



Tentative results – hypotheses 1

- **Ground handling needs special concern for safety and security in aviation, especially in an age of stress on and changes of organisations**
- **Safety culture measurements could be an efficient tool supporting continuous improvements of safety and security – i.e. they should be used as a part in the learning and improvement process**
- **DEB-analysis after some adaptation is a powerful method for identification of system weaknesses and for support of improvements**

