



**INTERNAL CATS DOCUMENT**

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Identification of User Requirement for CATS

Distribution:

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## **Summary**

This memorandum reports on seven interviews held with members of the CATS advisory and expert groups regarding user requirements for the causal model for air transport safety (CATS), which is being developed.



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(65 pages in total)



## 1 Introduction

This memorandum reports on seven interviews held with members of the CATS advisory and expert groups regarding user requirements for the causal model for air transport safety (CATS), which is being developed.

More specifically, this memorandum outlines:

- The interviewed members of the CATS expert and advisory groups (Section 2);
- The approach followed to identify user requirements by means of interviews (Section 3);
- A summary of the interviews (Section 4);
- Conclusions (Section 5) regarding generally agreed user requirements and work to be done;
- The list of questions used in the interviews (Appendix A); and
- The full interview reports (Appendix B).

## 2 Interviewees

The selection of members of the CATS advisory and expert groups to be interviewed regarding CATS User Requirements has been made by Alfred Roelen (NLR) and Rob van der Boom (DGTL). This selection is assumed to give a first indication of the “users” of CATS.

A list of the persons interviewed to obtain user requirements for CATS has been given below, together with these persons’ roles within their organisations and with respect to CATS:

Interviewee	Organisation	Role in organisation	Role in CATS
Bart de Vries	KLM	Director Flight Safety & Operational Quality Assurance, F/O 737	Advisor
Arthur Dijkstra		Captain and Safety Researcher – Accident Investigator	Expert
Eric Perrin	Eurocontrol Experimental Centre (EEC)	Co-ordinator EEC Safety Management System, co-ordinator EEC Safety Assessments and deputy EEC Safety Co-ordinator	Expert
Henk van Leeuwen	NIVR	Head Aeronautics Division	Advisor
Jan Busstra	DGTL	Program Leader for Aviation Safety	Advisor
Job Brügger	LVNL	Safety Manager	Advisor
Jos Wilbrink	IVW	Director of Aerodromes and Air Navigation Services Inspectorate	Advisor
Rudi den Hertog	Fokker Services	Chief Engineer and Deputy Head of Design Organisation	Expert



For easy reference, the interviewees and the interviews with them will normally be referenced by means of their organisations' names.

### **3 Approach to the interviews**

A question list has been developed to structure the interviews. The addressed topics are:

- Introduction interviewee;
- General expectations of CATS;
- Possible use of CATS by the interviewee;
- Specific questions regarding the level of detail;
- Specific questions regarding data to be used;
- Specific questions regarding occurrences to exclude; and
- Concluding remarks.

The full question list has been included in Appendix A.

With the exception of the interview with Eric Perrin (EEC), which has been performed by email, all interviews have been held in meetings of the interviewees and the interviewer, Hans de Jong (NLR). The interviewer has made reports of the interviews and has sent these to the interviewees to verify correct understanding and completeness. Appendix B contains the reviewed reports of the interviews.

### **4 Summary of interview results**

This section contains a summary of the interview results, structured according to topics similar to the list used in the interviews.

The objective for this summary has been to balance:

- Taking as much of the requirements, expectations and advice of the interviewees as possible into account; and
- Creating a simple and coherent set of user requirements regarding CATS.

Results obtained in only one or two interviews have generally been suppressed, unless they enhance the coherent set of user requirements, or appear to be valuable original viewpoints. For topics where clear controversy exists, this is indicated.

Observations (indicated in *italics*) are intended to consolidate the interview inputs.

It is recognised that simple techniques as “majority voting” are not generally appropriate in processing interview results:

- Not all interviewees may have equally strong requirements for and knowledge/ understanding of all aspects; and



- Selecting the majority answer (if this exists!) for various aspects may not lead to coherent model, especially if the interviewees have different objectives in mind.

Instead of applying extensive processing of the interview results at this stage, it appears more prudent to feed back the emerging collection of initial user requirements to the interviewees and employ a second round of interviews for further development. Therefore the observations have been based only on the interview results and common sense.

#### **4.1 The ultimate goal behind CATS**

CATS seems to attempt to balance between a generic model and applicability to the Dutch situation (NIVR). It has been indicated that CATS should be used to improve safety (LVNL and IVW).

*It does not appear clear what the goal behind CATS is, and this is hampering its development as different goals and scopes ask for different choices in developing the model.*

#### **4.2 Who are the users of CATS?**

It appears unclear who will be the users of CATS, and it is indicated and argued (for instance by NIVR) that clarity of CATS' users is a prerequisite for CATS to succeed.

An implicit indication of the users of CATS has been made by the selection of interviewees: the set of organisations represented presents a starting point.

*Based on the selection of interviewees, whether the interviewees consider themselves as future users and whether they have expectations regarding CATS, a sensible choice of the users of CATS appears the organisations in Dutch aviation:*

- KLM, LVNL and probably Schiphol;
- DGTL and IVW; and
- Perhaps organisations as Fokker Services.

*Concerning the other organisations involved in the interviews, NIVR rather has an advisory role regarding CATS and EEC has a scientific interest in CATS, mostly to extend on/ complement/ validate their Integrate Risk Picture.*

#### **4.3 Expectations regarding the general function of CATS**

On the highest level of generality, three expectations regarding the function of CATS have been indicated:

- CATS should be able to determine the safety effects of future changes;
- CATS should provide understanding how safety depends on the operation; and
- CATS should be used as a monitoring/evaluation tool.

These general functions are elaborated below:



Function 1: CATS should be able to determine the safety effects of future changes

Almost all of the interviewees indicate that CATS should serve as a tool to determine the safety effects of changes in the aviation system or a subsystem thereof (DGTL, IVW, KLM, LVNL and, to some extent EEC and Fokker Services), thereby supporting decision making and policy development.

Function 2: CATS should provide understanding how safety depends on the operation

Some of the interviewees indicate that CATS should provide understanding on how safety depends on the operation (EEC, IVW and LVNL), all of its aspects and their interactions. With this understanding, it should be able to indicate the big risks, strong and weak areas and provide strategic directions for safety improvement and safety research.

Function 3: CATS should be used as a monitoring/evaluation/comparison tool

In addition to function 1, DGTL also expects CATS to indicate periodically the state of affairs in aviation regarding safety and how the Netherlands and individual organisations are doing. Such a function is expected by IVW to review the effect of changes. A monitoring/evaluating function of CATS is not supported by KLM.

IVW states that CATS could be used to compare States; this is however complicated and not an important goal for CATS. DGTL indicates that CATS should be able to offer a comparison function to organisations in the operation. These organisations (KLM, LVNL) however do not support such a use of CATS.

*There is unanimous support for CATS to determine the safety effects of future changes, thereby supporting decision making and policy development.*

*There is reasonable support for CATS as a tool providing understanding how safety depends on the operation, indicating the big risks and providing strategic directions for safety improvement.*

*Note that these functions are related:*

- Understanding how safety depends on the operations obviously helps the determination of the safety effects of changes and helps to provide the broadly requested confidence in the results; and*
- Directions for improvement indicate what changes are promising.*

*A third function mentioned – monitoring, evaluation and comparison of the state of affairs in aviation regarding safety – has little support.*



#### **4.4 Properties of CATS**

It is recognised that changes in the aviation system may have effects at a very different place in the system. CATS should be able to find such effects (KLM). CATS should not only tell what happens with safety when changes are made to the operation itself, but also to its development, management and environment (LVNL).

*CATS should also be able to study the effects of changes behind the direct operation, such as development, management and environment.*

The risk results of CATS should to some extent be quantified (KLM), for instance by means of expected accident probabilities (LVNL), although it is recognised that quantification may not always be feasible, and qualitative answers may be sufficient (DGTL). Such results can be used to verify conformance to target levels of safety, for the overall system or parts of it (EEC).

Reliability of the results of CATS is crucial (IVW); indications of the reliability should be given (KLM). The results need to be understandable to the users – CATS should not be a black box. Reliable and understandable results are necessary for confidence in CATS.

*Risk results should be quantified (to some extent), reliable (or have well-defined reliability) and understandable (CATS should not be a black box) in order to have confidence in CATS.*

CATS should identify the big risks are and what causes/ contributes to it (IVW). It should indicate possible solution areas (IVW, KLM and LVNL) to help the right organisations (the risk owners, also to be identified by CATS) to solve the problem (KLM).

*The results of CATS should help to identify possible solutions areas.*

Consider safety always in its political and societal context; there may be tension between safety and other areas of interest (KLM, DGTL).

CATS is a tool for strategic operational changes for which time is usually not critical; there are usually at least months available (DGTL, IVW, KLM and LVNL).

*CATS is a tool for studying the effects of strategic operational changes; there is usually at least months available for its application.*

#### **4.5 What should be detailed in the CATS model?**

The table below indicates the priorities (H – High and L – Low) assigned by the interviewees to detail a number of operational aspects in the CATS model:



Priority to develop in CATS model	KLM	EEC	NIVR	DGTL	LVNL	IVW	Fokker Services
Runway layout	H	H			H	H	<sup>1</sup>
Discerning captain/first officer in the crew	L	L	L		L	L	
Discerning PF/PNF in the crew	L	L	L		L	L	
Number of engines of an aircraft	L	L			L	L	<sup>2</sup>
Influence of safety culture	L/H <sup>3</sup>	H	H <sup>4</sup>	H	H	H	H

Other priorities indicated are:

- KLM: Airspace structure, A380, Controller Pilot Data Link Communications (CPDLC); capacity should not be an input parameter;
- EEC: airspace design and complexity, controller's roles and responsibilities, future roles of controllers and pilots, future automation, avionics interactions and safety nets;
- NIVR: crew interaction, incident reporting;
- DGTL: organisational model, top management responsibility for safety, establishing and propagating appropriate attitude, chain of responsibility;
- LVNL: management of an organisation, airspace structure and characteristics, degree of automation;
- IVW: Crew Resource Management, degree of responsibility, arrangement and usage of airspace, Schiphol 2020, business jets, limits to the present air transport system; and
- Fokker Services: CPDLC.

Fokker Services motivations the restriction to standard aircraft as follows:

- In 2015 the fleet will consist for about 50% of B737 and A320; the other half will be better;
- The percentage of "new" aircraft such as B787 and A380 is still very low in 2015;
- It is much harder to translate results based on all aircraft to a Fokker, than results applicable for B737 and A320; and
- Going into details for all aircraft types and airports would take five years extra.

*Safety culture is unanimously considered as very influential on safety, needing to be addressed in modelling with high priority.*

<sup>1</sup> Take a standard airport with two pairs of parallel runways.

<sup>2</sup> Take a standard aircraft – B737 and A320.

<sup>3</sup> KLM has no questions to CATS regarding safety culture (hence L), but considers safety culture as very influential on safety (hence H).

<sup>4</sup> It is a challenge to quantify and explain decisive aspects such as safety culture.



*Runway layout is considered an operational aspect to be modelled with high priority by a majority of the interviewees.*

*Other aspects mentioned several times as important details of the model are:*

- Airspace (all of its aspects);*
- Organisation/ management/ Safety Management System (SMS)/ responsibility; and*
- Human roles, responsibilities and interaction in cockpit and ATC.*

*A few times mentioned as important details are:*

- Automation;*
- Controller Pilot Data Link Communications (CPDLC); and*
- New aircraft types (A380, Very Light Jets).*

#### **4.6 What data should be used by CATS?**

##### What data to consider/ distinguish/ exclude in general?

KLM Be careful to exclude data. Feed the model with a lot of data and restrict to relevant data for specific questions. One could apply weight factors to distinguish more or less important data for the problem at hand.

EEC

NIVR

DGTL It is more important that CATS is realised than that it can answer any question. Realisation may need curtailment, which should be conferred on.

LVNL

IVW

Fokker  
Services

##### What aircraft to consider/ distinguish/ exclude?

KLM

EEC Consider Western jets, as well as turboprops, small Western jets and Eastern jets – the latter three categories show similar accident frequencies.

NIVR Take into account that piston engine aircraft are significantly less safe than jet aircraft.

DGTL

LVNL Consider aircraft of at least 5700kg, discern Western from aircraft made elsewhere and exclude helicopters.

IVW Aircraft size, reliability and certification basis, speed limitations and number of engines are relevant for certain questions.




---

Fokker    Restrict to B737, A320 and perhaps also B747.  
Services

---

*Consider jets and turboprops, discern make/ model.*

What flights to consider/ distinguish/ exclude?

---

KLM

---

EEC        Include training, military, ferry, calibration flights et cetera if they are involved in events with commercial aircraft.

---

NIVR       Exclude military flights – this is not difficult to do.  
Training, ferry, calibration flights et cetera have a larger accident rate than normal flights. The distinction is usually clear for accidents, but not always for incidents.

---

DGTL

---

LVNL       Consider commercial aviation, exclude military aircraft.

---

IVW        All flights present opportunities to learn from (in military aviation there is much more knowledge of bird strikes).

---

Fokker     Statistically irrelevant.

Services

---

*Consider commercial flights and exclude military flights not involved in occurrences with commercial flights.*

*Exclude accident data regarding training, ferry and calibration flights not involved in occurrences with commercial flights. This exclusion may not be feasible for incidents.*

What parts of the world to consider/ distinguish/ exclude?

---

KLM        Be careful to exclude areas. Depending on the question seemingly remote areas could become relevant.

---

EEC        Restrict to ECAC.

---

NIVR

---

DGTL       As the user objectives especially concern the Dutch context and the EU, it should be considered what effects data outside the EU have on realisation, reliability and significance.

---

LVNL       Consider similar organisations, respectively geographical areas, such as the United States.

Parts of the world other than Europe and the US may be interesting for some questions; are they really so bad?

---

IVW        Restrict to air traffic situations comparable to the Netherlands. Exclude data from

---




---

airports in the neighbourhood of mountains.

---

Fokker Services Do not exclude data as this decreases the amount of data available, but include region in the data.

---

*There is reasonable support for focussing on what is comparable to the Netherlands: the EU/ Europe/ ECAC and the United States. However, other parts of the world may have valuable/ interesting/ relevant data. Consider the costs and benefits of such extensions. When considering other parts, including region data seems prudent.*

What years to consider/ distinguish/ exclude?

---

KLM Since aviation is the result of an evolution process, take all data into account, with weight factors.

---

EEC Begin in the nineties.

---

NIVR Do not begin before 1970 (introduction of aircraft such as B747, DC10) and not later than 1980 (pretty representative for now).

---

DGTL Looking back very far is less relevant because development is progressive.

---

LVNL As the aim is to look ahead, do not look back too far. It is questionable whether the seventies should be included.

---

IVW Do not go back more than forty years.

---

Fokker Services First reaction: from 1990 on; on second thoughts from 1970 to include almost all B737 flight hours.

---

*The specific answers regarding the beginning of the time frame to consider range from 1970 to 1990.*

What occurrences to consider?

---

	General	Include	Exclude
KLM	The model should be such that it does not take data into account that is not relevant for the problem at hand.	– Deliberate actions by pilots.	
EEC	ICAO defined accidents should be included.	– Overweight take-offs.	– Deliberate actions by pilots.
NIVR		– Overweight take-offs.	– Deliberate actions by pilots.
DGTL			



LVNL	<ul style="list-style-type: none"> <li>– Wild life strikes as these are controllable;</li> <li>– Deliberate actions by pilots; and</li> <li>– Overweight take-offs.</li> </ul>	<ul style="list-style-type: none"> <li>– Terrorism; and</li> <li>– Natural disasters.</li> </ul>
IVW Accidents and incidents should be considered.	<ul style="list-style-type: none"> <li>– Bird strikes; and</li> <li>– Overweight take-offs.</li> </ul>	<ul style="list-style-type: none"> <li>– Volcano eruptions; and</li> <li>– Flying against a mountain.</li> </ul>
Fokker Services		

*Accidents in the sense of ICAO Annex 13 should be considered. It is recognised that the amount of accident data is limited or even insufficient. Incident data could help, provided its quality is sufficient.*

*It is a challenge to translate historical figures to effects of future changes.*

*Overweight take-offs and bird strikes are to be considered. Natural disasters such volcano eruptions should be excluded, as well as accidents that could not happen in the Netherlands (such as flying against a mountain). Opinions differ about considering deliberate actions by pilots, perhaps terrorism is an aspect to exclude.*

## 5 Conclusion

### The ultimate goal behind CATS

It does not appear clear what the goal behind CATS is, and this is hampering its development as different goals and scopes ask for different choices in developing the model.

### Who are the users of CATS?

Based on the selection of interviewees, whether the interviewees consider themselves as future users and whether they have expectations regarding CATS, a sensible choice of the users of CATS appears the organisations in Dutch aviation:

- KLM, LVNL and probably Schiphol;
- DGTL and IVW; and
- Perhaps organisations as Fokker Services.

Concerning the other organisations involved in the interviews, NIVR rather has an advisory role regarding CATS and EEC has a scientific interest in CATS, mostly to extend on/ complement/ validate their Integrate Risk Picture.



### Expectations regarding the general function of CATS

There is unanimous support for CATS to determine the safety effects of future changes, thereby supporting decision making and policy development.

There is reasonable support for CATS as a tool providing understanding how safety depends on the operation, indicating the big risks and providing strategic directions for safety improvement.

Note that these functions are related:

- Understanding how safety depends on the operations obviously helps the determination of the safety effects of changes and helps to provide the broadly requested confidence in the results; and
- Directions for improvement indicate what changes are promising.

A third function mentioned – monitoring, evaluation and comparison of the state of affairs in aviation regarding safety – has little support.

### Properties of CATS

- CATS should also be able to study the effects of changes behind the direct operation, such as management, organisation and environment.
- Risk results should be quantified (to some extent), reliable (or have well-defined reliability) and understandable (CATS should not be a black box) in order to have confidence in CATS.
- The results of CATS should help to identify possible solutions areas.
- CATS is a tool for studying the effects of strategic operational changes; there is usually at least months available for its application.
- CATS should also be able to study the effects of changes behind the direct operation, such as development, management and environment.

### What should be detailed in the CATS model?

- Safety culture is unanimously considered as very influential on safety, needing to be addressed in modelling with high priority.
- Runway layout is considered an operational aspect to be modelled with high priority by a majority of the interviewees.
- Other aspects mentioned several times as important details of the model are:
  - Airspace (all of its aspects);
  - Organisation/ management/ Safety Management System (SMS)/ responsibility; and
  - Human roles, responsibilities and interaction in cockpit and ATC.
- A few times mentioned as important details are:
  - Automation;
  - Controller Pilot Data Link Communications (CPDLC); and
  - New aircraft types (A380, Very Light Jets).



#### What data should be used by CATS?

- Consider jets and turboprops, discern make/ model.
- Consider commercial flights and exclude military flights not involved in occurrences with commercial flights. Exclude accident data regarding training, ferry and calibration flights not involved in occurrences with commercial flights. This exclusion may not be feasible for incidents.
- There is reasonable support for focussing on what is comparable to the Netherlands: the EU/ Europe/ ECAC and the United States. However, other parts of the world may have valuable/ interesting/ relevant data. Consider the costs and benefits of such extensions. When considering other parts, including region data seems prudent.
- The specific answers regarding the beginning of the time frame to consider range from 1970 to 1990.
  
- Accidents in the sense of ICAO Annex 13 should be considered. It is recognised that the amount of accident data is limited or even insufficient. Incident data could help, provided its quality is sufficient.
- It is a challenge to translate historical figures to effects of future changes.
- Overweight take-offs and bird strikes are to be considered. Natural disasters such volcano eruptions should be excluded, as well as accidents that could not happen in the Netherlands (such as flying against a mountain). Opinions differ about considering deliberate actions by pilots, perhaps terrorism is an aspect to exclude.

#### Work to be done

In this memorandum, the results of interviews with members of the CATS advisory and expert groups have been processed into a set of user requirements for CATS that is as simple and coherent as possible, and that takes as much as possible the requirements, expectations and advice of the interviewees into account. The initial set of user requirements has made the aim of CATS clearer, and the user requirements can now be tailored further with this aim in mind.

A second round of interviews is the appropriate way to make the user requirements more specific. Obvious examples of topics to address in these interviews are:

- Safety culture has been indicated as highly influential on safety. How can safety culture be characterised? What does it depend on? How to make it tangible in the causal model?
- Which parameters (such as airport layout, airspace characteristics, aircraft types, fleet mix, and language of the pilots) are important to safety and shall be taken into account in the model? and
- Understanding the CATS model is a condition for confidence in its results. How can CATS be made sufficiently understandable to its users?



## Appendix A Question list

### Introduction interviewee

Id	Question
1.	What organization do you represent?
2.	What are your/ your department's responsibilities?
3.	What do you/your department do to fulfil these responsibilities?
4.	What kind of decisions do you make in carrying out these responsibilities?
5.	What changes to your company's activities do you implement?

### General expectations of CATS

Id	Question
6.	Could you elaborate on your expectations from CATS in general terms?

### Possible use of CATS by the interviewee

Id	Question
7.	What information do you expect from CATS in making your decisions, in what formats and what level of detail?
8.	What information do you expect from CATS to evaluate the effect and the effectiveness of changes?
9.	Do you expect to review the status of this information periodically or driven by problems?
10.	What are you looking for in information to be delivered by CATS?
11.	Do you want to use CATS information to observe emerging trends or correlations? Are you interested in both positive trends (improvements) and negative trends (deteriorations)?
12.	Would you want to use CATS data to compare your company's safety performance with others?
13.	How much time will you spend in monitoring CATS data relevant for your area of responsibility?
14.	Do you expect your decisions based on CATS data to be time critical? How much time do you have typically to review the data and make a decision?




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**Specific questions regarding the level of detail**


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- | Id  | Question   |
|-----|--|
| 15. | Could you indicate and motivate your priorities (High/Medium/Low) for developing the following details in the model? |
| a)  | Runway layout  |
| b)  | Discerning captain/first officer in the crew   |
| c)  | Discerning PF/PNF in the crew  |
| d)  | Number of engines of an aircraft   |
| e)  | Influence of safety culture  |
- 

**Specific questions regarding data to be used**


---

- | Id  | Question  |
|-----|---|
| 16. | What data should be used to quantify the model in terms of aircraft?                                      |
| a)  | Size  |
| b)  | Make (Russian made aircraft?)   |
| c)  | Type (jet, turboprop, piston, ...)  |
| 17. | Should certain types of flights be excluded from the data (training, military, ferry, calibration, ...)   |
| 18. | Should the data to be used for quantifying the model restrict to parts of the world? Which?               |
| 19. | How far would do you want to look back in terms of data? (At most ten years back, from 1970, 80, 90, ...) |
- 

**Specific questions regarding occurrences to exclude**


---

- | Id  | Question  |
|-----|---|
| 20. | Are there occurrences you would want to exclude from the data? Please motivate. |
| a)  | Wild life strikes   |
| b)  | Deliberate actions by pilots  |
| c)  | Overweight take-offs  |
| d)  | ...   |
- 

**Concluding remarks**



## Appendix B Interview results

### Appendix B.1 Bart de Vries and Arthur Dijkstra (KLM)

#### Introduction interviewees

Id	Question	Answer
1.	What organization do you represent?	<i>KLM</i>  <i>Note that BdV is the official KLM person for CATS; AD is substitute and will perform the tasks.</i>
2.	What is the role of your department and your position within it?	<ul style="list-style-type: none"> <li>– <i>BdV is Director Flight Safety &amp; Operational Quality Assurance (hoofd van vliegveiligheid en van kwaliteitszorg operaties) and F/O 737. In this function, he has direct access to KLM's COO (Hartman). He reports to the head of Flight Operations (hoofd vliegdiens) for Flight Safety matters.</i></li> <li>– <i>AD is Captain and Safety researcher – Accident Investigator. He is MSc in Human Factors, obtained under supervision of Sydney Dekker at the University of Linköping.</i></li> </ul>
3.	What are your/your department's responsibilities?	<ul style="list-style-type: none"> <li>– <i>Consider all incidents, analyze, investigate &amp; advise improvements to KLM management.</i></li> <li>– <i>Responsible for internal quality assurance in KLM, take care of compliance with regulations regarding safety, including the "Luchtvaartwet". This includes guarding the licence to operate, performance of audits and inspections, and producing findings to management.</i></li> </ul>
4.	What decisions do you make in carrying out these responsibilities?	<ul style="list-style-type: none"> <li>– <i>Classify a particular occurrence as an incident.</i></li> <li>– <i>Investigate a particular incident.</i></li> <li>– <i>Decide whether persons concerned with a particular incident should temporarily not perform their jobs (not as a disciplinary measure but rather to secure their experiences in the incident for investigation).</i></li> <li>– <i>When investigations would give occasion to this: advise to ground a fleet or suspend part of operations.</i></li> <li>– <i>What is audited? (This may be changed ad hoc.)</i></li> <li>– <i>Audit certain processes as research tool resulting from incidents.</i></li> </ul>
5.	What changes to your company's activities do you implement?	<ul style="list-style-type: none"> <li>– <i>Change the department's organization and processes.</i></li> <li>– <i>Give advice to operational management, which keeps the responsibility for decisions, such that Flight Safety &amp; Operational QA can still consider the results independently.</i></li> </ul>



### General expectations of CATS

Id	Question	Answer
6.	Could you elaborate on your expectations from CATS in general terms?	<p><i>The most important requirements are:</i></p> <ul style="list-style-type: none"> <li>– <i>The model is not threatening for the sector: it will not be used for determining the capacity of Schiphol (by decision, the discussion about capacity has been separated from CATS) and the model will not be used to impose new regulations on the sector.</i></li> <li>– <i>The model will be useable for all players in Dutch aviation, including KLM.</i></li> </ul> <p><i>Example questions to CATS:</i></p> <ul style="list-style-type: none"> <li>– <i>Currently air traffic arrives at Schiphol via three Initial Approach Fixes. Suppose we want to introduce an extra IAF. What are the effects? The CATS model should tell where extra risk is introduced and what measures could help. The redeveloped concept for dealing with the fourth IAF/ arrival route should then be re-evaluated by the model.</i></li> <li>– <i>The safety effects of introducing CPDLC would be another question for CATS.</i></li> </ul> <p><i>More generally, CATS should be able to handle changes of the aviation system at large.</i></p> <p><i>The model should yield results that to some extent are quantified.</i></p> <ul style="list-style-type: none"> <li>– <i>The model should yield indications of the reliability of the risk indications.</i></li> <li>– <i>The model should not be a black box: it should be possible to analyse the results of the model. This is necessary to gain confidence in the model.</i></li> </ul>




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**Possible use of CATS by the interviewee**

Id	Question	Answer
7.	What information do you expect from CATS in making your decisions, in what formats and what level of detail?	<ul style="list-style-type: none"> <li>– <i>Risk information: for system changes CATS should tell where the associated risks are, in such a format that this is not only understandable for KLM, but also for the other air traffic organisations and the authorities.</i></li> <li>– <i>The information should be such that it helps the concerned organisations to find a solution. The right organisations should be concerned about solving the problem. To this end, the model should point out the actors associated to the risks – the risk owners – and indicate for instance that the responsibility for solving for the risk lies for 80% with organisation A and 20% with organisation B.</i></li> <li>– <i>Always consider the political and societal context.</i></li> </ul>
8.	What information do you expect from CATS to evaluate the effect and the effectiveness of changes?	<i>(Addressed above)</i> <i>It often happens that changes somewhere in the aviation system have an effect at a very different place. CATS should be able to find such effects.</i>
9.	How often would you review the status of this information?	<i>CATS should NOT be used as a monitoring tool. It should be used based on problems like effects of the introduction of the A380 and further increased traffic –answers examples in Question 6.</i>
10.	What are you looking for in information to be delivered by CATS?	<i>For aviation system changes, CATS should identify</i> <ul style="list-style-type: none"> <li>– <i>Risks;</i></li> <li>– <i>Owners of risk; and</i></li> <li>– <i>Possible solutions areas (such as training, procedures and design).</i></li> </ul>
11.	Do you want to use CATS information to observe emerging trends or correlations? Are you interested in both positive trends (improvements) and negative trends (deteriorations)?	<i>No.</i> <i>The regulatory framework is also lacking for this. Data from IVW (CAA the Netherlands) is suitable for feeding the model, but it should NOT be used to make the model into a system for signalling problems.</i>
12.	Would you want to use CATS data to compare your company's safety performance with others?	<i>No.</i>

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13. How much time will you spend in monitoring CATS data relevant for your area of responsibility?
- *This question is not appropriate: the use of CATS is problem driven. If there is no system change (such as a new "gebruiksplan" plan to use Schiphol), then no action by CATS.*
  - *CATS should not be used on the basis of incidents. It could be used if, after a series of incidents, a measure is devised, which then could be studied by CATS.*
- 
14. Do you expect your decisions based on CATS data to be time critical? How much time do you have typically to review the data and make a decision?
- *There is always too little time, but as a safety manager you are not too impressed by this.*
  - *CATS is seen as a product for strategic operational changes. In terms of time available, it is then rather a matter of months than days.*
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### Specific questions regarding the level of detail

Id	Question	Answer
15.	Could you indicate and motivate your priorities (High/ Medium/ Low) for developing the following details in the model?	
a)	Runway layout	<i>High</i>  <i>A sixth runway at Schiphol is a typical example of a strategic operational change.</i>
b)	Discerning captain/first officer in the crew	<i>Low</i>
c)	Discerning PF/PNF in the crew	<i>Low</i>
d)	Number of engines of an aircraft	<i>Low</i>  <i>KLM does not have questions in this direction. However, CATS should be usable for studying the safety effects of a new Concorde, or for instance the A380.</i>
e)	Influence of safety culture	<i>Low</i>  <ul style="list-style-type: none"> <li>– <i>KLM does not have questions in this respect.</i></li> <li>– <i>Safety culture is considered as very influential on safety (better safety culture gives better/more safety barriers) and it should therefore play a role in the model.</i></li> <li>– <i>Maybe safety culture should be considered on a national (Dutch) scale.</i></li> </ul>
f)	<i>Airspace structure (such as Functional Airspace Block)</i>	<i>High</i>
g)	<i>A380</i>	<i>High</i>
h)	<i>CPDLC and more generally e-enabled aircraft</i>	<i>This change brings new risks, as with the replacement of voice communication, some information is lost. There are no study results yet concerning CPDLC in the TMA.</i>
i)	<i>Capacity issues</i>	<ul style="list-style-type: none"> <li>– <i>NOT a question should be: there are 500,000 movements per year now, suppose we increase this to 550,000; what happens?</i></li> <li>– <i>Capacity issues should only be addressed as being results of changes, such as increasing crosswind limits to 20 knots, or other specified changes.</i></li> </ul>




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**Specific questions regarding data to be used**

Id	Question	Answer
16.	What data should be used to quantify the model in terms of aircraft	<p><i>This is a very important question.</i></p> <ul style="list-style-type: none"> <li>– <i>The general approach should be to feed the model with a lot of data, and to restrict to relevant data for specific questions. For studying CFIT, the terrain should for instance be included in the model.</i></li> <li>– <i>A general idea concerning data is: more is better, but apply weight factors according to time and place, where the factors depend on the problem at hand.</i></li> </ul>
a)	Size	
b)	Make (Russian made aircraft?)	
c)	Type (jet, turboprop, piston, ...)	
17.	Should certain types of flights be excluded from the data (training, military, ferry, calibration, ...)	
18.	Should the data to be used for quantifying the model restrict to parts of the world? Which?	<p><i>Be very careful with excluding areas! In Africa, things happen that could be relevant for the situation here. For instance, in general the maintenance of runways is less good in Africa. The effects of this would become relevant if Schiphol decides to stop maintaining the runways for a few years.</i></p>
19.	How far would do you want to look back in terms of data? (At most ten years back, from 1970, 80, 90, ...)	<p><i>Since aviation is the result of an evolution process (almost all developments have been written in blood) one should take all data into account, with weight factors.</i></p>

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**Specific questions regarding occurrences to exclude**


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Id	Question	Answer
20.	Are there occurrences you would want to exclude from the data? Please motivate.	<i>If the model functions well, it does not take irrelevant (according to flight phase, related to ATM, et cetera) data into account for the problem at hand.</i>
a)	Wild life strikes	
b)	Deliberate actions by pilots	<i>Do not exclude</i>
c)	Overweight take-offs	
d)	...	

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**Concluding remarks**

*BdV expresses interest for results of the other interviews. He proposes that the bundled interview results are distributed among the members of CATS's advisory group. The interview results are not for political usage.*

*Summarizing, KLM is very interested in CATS, but CATS should not backfire on KLM. This is tricky business as everybody watches over your shoulder. CATS should not be a toy for the authorities, the whole sector should benefit from it. Do not tell the "Tweede Kamer" (Dutch Lower Chamber) that the causal model will solve all problems.*



## Appendix B.2 Eric Perrin (Eurocontrol Experimental Centre)

### Introduction interviewee

Id	Question	Answer
1.	What organization do you represent?	<ul style="list-style-type: none"> <li>- <i>EUROCONTROL</i></li> <li>- <i>EUROCONTROL Experimental Centre (EEC)</i></li> </ul>
2.	What are your/your department's responsibilities?	<ul style="list-style-type: none"> <li>- <i>Department: Safety Research Team (SRT)</i></li> <li>- <i>Co-ordinator EEC Safety Management System</i></li> <li>- <i>Co-ordinator EEC Safety Assessments</i></li> <li>- <i>Deputising EEC Safety Co-ordinator (Barry KIRWAN)</i></li> </ul>
3.	What do you/your department do to fulfil these responsibilities?	<ul style="list-style-type: none"> <li>- <i>Carry out safety R&amp;D (methods development) and safety assessment of R&amp;D (in particular Future CONOPS safety validation) to ensure full scope assessment of the future ATM system</i></li> <li>- <i>Safety Management System Implementation</i></li> <li>- <i>Fostering Safety Culture</i></li> </ul>
4.	What kind of decisions do you make in carrying out these responsibilities?	<i>Impacting upon future concepts design by making sure designers think about safety from the start. It helps to avoid 'bolt-on' safety or safety fixes, and rather leads to safety being a more integral part of the concept.</i>
5.	What changes to your company's activities do you implement?	<i>Full safety management approach to design activities:</i> <ul style="list-style-type: none"> <li>- <i>safety considerations,</i></li> <li>- <i>safety planning,</i></li> <li>- <i>safety process (systemic top-down and SAM-like bottom-up),</i></li> <li>- <i>safety assurance,</i></li> <li>- <i>safety promotion and</i></li> <li>- <i>training.</i></li> </ul>



### General expectations of CATS

Id	Question	Answer
6.	Could you elaborate on your expectations from CATS in general terms?	<ul style="list-style-type: none"> <li data-bbox="626 384 1421 632">– <i>The EEC has been the mainspring of the development of an integrated risk modelling for ATM which started in early 2004. The EEC has been a precursor for the development of a powerful process – the so-called Integrated Risk Picture (IRP) – to ensure that aviation will get rid of the partitioned and fragmented nature of safety assessment processes of the past. This has been and is being closely co-ordinated with the FAA within the framework of the FAA/EUROCONTROL Action Plan 15 (safety).</i></li> <li data-bbox="626 642 1421 856">– <i>I am glad to see that both the integrated safety project being developed by the University of Maryland and the CATS project are using similar methodology to IRP. This shows we're going in the right direction. Building an Integrated Risk model is a challenging and innovative activity, not yet de facto fully mature and co-ordination, cross-fertilisation and cooperation between different research centres in Europe is key to the success.</i></li> <li data-bbox="626 867 1421 1081">– <i>At the EEC, the Integrated Risk Picture has been developed to ensure that the project would meet its objectives within the available time frame, i.e., be ready to support SESAR CONOPS validation. Consequently, and although the risk modelling required a lot of methodological development, data gathering and analysis, et cetera, the IRP has been using techniques whose applicability to aviation risk modelling has been proven in practice.</i></li> <li data-bbox="626 1092 1421 1339">– <i>CATS is to me a more long-term research topic and I would expect a feedback on the practicability of more advanced techniques (e.g. Bayesian Believe Networks) for a potential further improvement of the EUROCONTROL product. In addition, although IRP covers the overall aviation system, its main focus is on ATM. To me CATS expands on the non-ATM bits and on accidents for which ATM, a priori, is not an important contributor (causing or preventing).</i></li> <li data-bbox="626 1350 1421 1396">– <i>In a word, cross-fertilisation and learning from each other are my main expectations.</i></li> </ul>



### Possible use of CATS by the interviewee

Id	Question	Answer
7.	What information do you expect from CATS in making your decisions, in what formats and what level of detail?	<p><i>Again, my expectations are very similar to the requirements that drove the need for the IRP, i.e., answering to the questions:</i></p> <ul style="list-style-type: none"> <li><i>– What is the safety assessment of the overall system?</i></li> <li><i>– How might these new elements interact?</i></li> <li><i>– Are there negative interactions that can be avoided or even positive interactions, as yet unplanned into the system design concept, which could yield extra safety?</i></li> <li><i>– Where are the strong and weak safety areas in the overall system?</i></li> </ul> <p><i>Providing strategic direction for aviation improvements and safety research is one of the main requirements for both IRP &amp; CATS. In addition, although CATS seems to very much building upon the foundations of the IRP, validation of such models is always quite challenging since usually most of available data is being used in constructing the model. Consequently if another model, say CATS, is available to obtain comparable results, then practicability of a comparison could be investigated.</i></p>
8.	What information do you expect from CATS to evaluate the effect and the effectiveness of changes?	<p><i>My present understanding is that CATS does not have (yet?) a prediction mode. Enabling to assess overall safety targets compliance, linking operational improvements to ATM contribution to risks (e.g. barriers efficiency), enabling a safe transition strategy are information I expect from such a model. The EUROCONTROL IRP is developing on those fronts I have just mentioned. Again co-ordination is required so that we ensure that best use is made out of scarce resources.</i></p>
9.	Do you expect to review the status of this information periodically or driven by problems?	<p><i>Ultimately, and this is why the EEC has embarked on the development of the so-called Safety Roadmap based on IRP, what we need is a true risk management system based on operational feedback. There is a need for an early warning system. This is why such a model has to focus on precursors to be monitored. Indicating overall compliance with future safety targets and setting targets (albeit uncertain ones) for future monitoring via ESARR2 are key drivers. In addition, permanent collection of data enables to validate the model (in terms of structure and recommendations/conclusions).</i></p>



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10. What are you looking for in information to be delivered by CATS?
- If CATS only develops a baseline risk model, then it is essentially information related to strategic decision making. As said above, such information can enable validating the recommendations made out of IRP. If CATS further develops into the predictive domain, then as for the IRP, information are overall TLS conformance, setting of safety target for constituent OI, barrier causal breakdown, etc. In addition, a better understanding of the impact of SMS performance on contribution to risk is important information. Since this is rarely documented in accident/incident report, this is really a safety research agenda. IRP is looking at it and will try in 2006 to improve the realism and utility of the modelling. If CATS resources enable to go further in terms of sophistication, then this is certainly an area I would be interested in.*
- 
11. Do you want to use CATS information to observe emerging trends or correlations? Are you interested in both positive trends (improvements) and negative trends (deteriorations)?
- Yes to both. Positive contribution modelling will be tackled by the EEC in 2006 and safety benefits (functional performance) are key drivers in the way EUROCONTROL as an Agency is considering Safety Case developments (see ongoing activity at the SAM TF level of Success/Failure Cases).*
- 
12. Would you want to use CATS data to compare your company's safety performance with others?
- Not applicable to the EEC and certainly not a very good way of promoting safety culture in organizations anyway.*
- 
13. How much time will you spend in monitoring CATS data relevant for your area of responsibility?
- If CATS proves to be a complementary activity to the EUROCONTROL IRP, then time should not be an issue.*
- 
14. Do you expect your decisions based on CATS data to be time critical? How much time do you have typically to review the data and make a decision?
- Safety Learning is a key activity at the EEC and within the Agency (see for instance SAFLEARN and ESP activities respectively). A lot of effort is dedicated to learning from the past and to build this knowledge into the design of future CONOPS.*
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**Specific questions regarding the level of detail**

Id	Question	Answer
15.	Could you indicate and motivate your priorities (High/Medium/Low) for developing the following details in the model?	
a)	Runway layout	<i>High for its contribution (either positive or negative) to runway collision and taxiway collision risks.</i>
b)	Discerning captain/first officer in the crew	<i>Low (EEC is mostly interested in ATM)</i>
c)	Discerning PF/PNF in the crew	<i>Low (EEC is mostly interested in ATM)</i>
d)	Number of engines of an aircraft	<i>Low (EEC is mostly interested in ATM)</i>
e)	Influence of safety culture	<i>High since goes hand in hand with SMS influence on risks</i>
	Are there other details you would like to prioritize?	<i>Yes quite a few which are again driving IRP development and other safety and CONOPS activities in EUROCONTROL: airspace design and complexity, controllers roles and responsibilities (Tactical/Strategic), ATC v. Pilot future roles and responsibilities, future automation and performance with respect to Human, ATC-avionics interactions, future safety nets.</i>
f)	...	<i>See above</i>
g)	...	<i>See above</i>


**Specific questions regarding data to be used**

Id	Question	Answer
16.	What data should be used to quantify the model in terms of aircraft	<i>At present most of the studies (including the EUROCONTROL IRP) assume turboprops, small Western Jets and Eastern built jets to have the same accident/incident frequencies as the basic datasets which normally consider Western Jets. So a Yes to a), b) and c) is my position.</i>
a)	Size	<i>Yes (all)</i>
b)	Make (Russian made aircraft?)	<i>Yes (all)</i>
c)	Type (jet, turboprop, piston, ...)	<i>Yes (all)</i>
17.	Should certain types of flights be excluded from the data (training, military, ferry, calibration, ...)	<i>No if they're involved in events with commercial aircraft (infringement of airspace, TCAS-related incidents, et cetera)</i>
18.	Should the data to be used for quantifying the model restrict to parts of the world? Which?	<i>Yes. ECAC (that's what the IRP does; FAA is developing their IRP for the US).</i>
19.	How far would do you want to look back in terms of data? (At most ten years back, from 1970, 80, 90, ...)	<i>1990's – It does not make sense to develop and quantify a model based on data not adequately representing what aviation is nowadays.</i>



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**Specific questions regarding occurrences to exclude**

Id	Question	Answer
20.	Are there occurrences you would want to exclude from the data? Please motivate.	<i>ICAO defined accidents should be considered.</i>
a)	Wild life strikes	<i>Do not know</i>
b)	Deliberate actions by pilots	<i>Yes</i>
c)	Overweight take-offs	<i>No</i>

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**Concluding remarks**

*No concluding remarks*



### Appendix B.3 Henk van Leeuwen (NIVR)

#### Introduction interviewee

Id	Question	Answer
1.	What organization do you represent?	<ul style="list-style-type: none"> <li>- See <a href="http://www.nivr.nl">www.nivr.nl</a></li> <li>- NIVR - the Netherlands Agency for Aerospace Programmes (“Nederlands Instituut voor Vliegtuigontwikkeling en Ruimtevaart”).</li> </ul>
2.	What are your/your department’s responsibilities?	<ul style="list-style-type: none"> <li>- NIVR is a foundation (“stichting”) with an executive board (“bestuur”) consisting of five members who are appointed by the Ministers of:               <ul style="list-style-type: none"> <li>- Economic Affairs,</li> <li>- Transport, Public Works and Water Management,</li> <li>- Education, Culture and Science,</li> <li>- Defence and</li> <li>- Finance.</li> </ul> </li> </ul>
3.	What do you/your department do to fulfil these responsibilities?	<ul style="list-style-type: none"> <li>- In addition to this, the Executive Board has an independent chairman, appointed by the Minister of Economic Affairs.</li> <li>- The mission of NIVR is to foster scientific, industrial and service activities in the fields of aircraft development, air transport and space programmes in the Netherlands in an international context.</li> </ul>
4.	What kind of decisions do you make in carrying out these responsibilities?	<ul style="list-style-type: none"> <li>- The objective of NIVR is stimulation of scientific, industrial and service-providing activities in the Netherlands in the area of aircraft development, air transport and space in an international context.</li> <li>- NIVR employs about 25 persons: one director and divided over three departments:               <ul style="list-style-type: none"> <li>- Aeronautics division (6),</li> <li>- Space division (11) and</li> <li>- Business operations (7).</li> </ul> </li> </ul>
5.	What changes to your company’s activities do you implement?	<ul style="list-style-type: none"> <li>- The predecessor of NIVR, NIV (the Netherlands Agency for Aircraft Development) was founded in 1946 and has always been involved in the development of Fokker aircraft. In 1971, the organisation also enlisted in the area of space. After Fokker’s bankruptcy in 1996, the task of NIVR has been adapted (see the mission and objective stated above). The last ten years, the aeronautics division of NIVR is more generally involved in civil aircraft and engines such as the Airbus, defence and the Joint Strike Fighter (JSF) in particular, Unmanned Aerial Vehicles (UAV), European framework programmes, et cetera.</li> <li>- NIVR has some involvement in aircraft usage and this has been the reason for DGTL (the General Directorate for Civil Aviation and Transport – the commissioner of CATS) to involve NIVR in CATS.               <ul style="list-style-type: none"> <li>- On the one hand, NIVR supports DGTL in managing the project (NIVR’s Michael Portier is project secretary). NIVR has also advised DGTL to build in a review halfway the project, to enable adjustment of the plan; and</li> <li>- On the other hand, NIVR brings in its expertise via HvL’s participation in CATS’s advisory group.</li> </ul> </li> </ul>



## General expectations of CATS

Id	Question	Answer
6.	Could you elaborate on your expectations from CATS in general terms?	<p data-bbox="402 468 928 493"><u>The target group for CATS needs to be clarified</u></p> <ul style="list-style-type: none"> <li data-bbox="402 499 1421 684">– CATS has its origins in politics. In the Aviation Act (“Luchtvaartwet”), safety is an important theme. This involves setting norms, which only makes sense if achievement of these norms is verifiable. Safety however is to some extent intangible and this challenge has politically inspired the decision to put aside money for the development of a causal model. So there is money and pressure to come up with something, but the objective is not fully clear, and neither is the target group.</li> <li data-bbox="402 690 1421 913">– Unclearness about the target group for CATS is a serious issue, as it is decisive for what to develop in the model and what not. Three different target groups are conceivable:               <ul style="list-style-type: none"> <li data-bbox="444 787 764 812">– The government/politics;</li> <li data-bbox="444 819 1421 879">– The sector organisations such as LVNL (ATC the Netherlands) and AAS (Amsterdam Airport Schiphol); or</li> <li data-bbox="444 886 867 911">– The general public/Dutch citizens.</li> </ul> </li> <li data-bbox="402 919 1421 1068">– HvL predicts that if the target group discussion is not pursued well, the following phenomenon will arise: Experts are involved, they make a model. Ben Ale (the CATS project manager) has indicated that not all necessary data to quantify the model is available. Therefore the model will need to involve many assumptions and will be of a probabilistic nature.</li> <li data-bbox="402 1075 1421 1356">– This is bound to fail if the general public is the target group: they will not understand this and feel taken for a ride (“belazerd”). HvL recalls that external safety contours were presented to the public. A journalist identified the Bijlmer accident location with respect to the contours and concluded that many locations in the neighbourhood of Schiphol are even less safe... Another example of the kind of discussions to expect with media was related to a severe November storm that occurred a couple of years ago. There was significant damage to a degree that occurs only once per century. The next year a similar November storm occurred and a journalist concluded that such storms would not occur again for the next two centuries...</li> <li data-bbox="402 1362 1421 1423">– If the target group is LVNL and AAS, the chance of success for CATS is larger – more expertise may be expected from these organisations.</li> <li data-bbox="402 1430 1421 1520">– If the target group is the government/politics, measurability is a key requirement for CATS. In the context of the many assumptions necessary, an important question is their effect on reliability of the results.</li> </ul> <p data-bbox="402 1556 756 1581"><u>A Boeing study/ cultural aspects</u></p> <ul style="list-style-type: none"> <li data-bbox="402 1587 1421 1772">– About ten years ago, Boeing performed a study originating from the observation that in 2020, on the average one jet aircraft per week will crash, provided aviation will continue to grow with 4 – 5% annually and provided the accident probability remains equal. One does not need to be a media expert to know that this will have a huge impact on how the public perceives aviation safety. Publicity for commercial aircraft accidents in US and EU is large.</li> <li data-bbox="402 1778 1421 1871">– Hence the Boeing study deduced, the safety level needs to be improved. Considering the causes for unsafety, Boeing observed that human factors played a role in more than two thirds of the accidents. In the old days of aviation, wings broke off and engines</li> </ul>



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*failed, but technique has enormously improved and has become a minor cause.*

- *Boeing involved a sociological model by a Dutch scientist, which involved a couple of human kinds (verify with original Boeing report):*
    - *The Atlantic kind, mostly associated with people in the US, Northern Europe, Australia, New Zealand, characterised by “rationality”, “common sense”, “equality”,*  
*...*
    - *The “macho” kind, associated with South American people, Latin people in general, Asian people, and characterised by “honour”, “hierarchy”, “status”, ...*

*The accidents of the last 40 years were analysed regarding the above classification and it turned out that “macho” kind of behaviour was an important factor for accidents in South America and Asia. An example is the situation where the captain misses or misinterprets something and where the first officer does not dare to correct. Note that care needs to be taken with such generalisations: this situation also caused/contributed to the Tenerife disaster, with a Dutch crew. Boeing concluded that it is important to improve these human/cultural aspects.*
  - *In view of these observations, the question with accident data is how representative they are for the West-European/Dutch/Schiphol situation. The following accident examples appear less relevant:*
    - *Accidents due to overweight in combination with a too short runway (this was a frequent cause for accidents in Russia, shortly after the collapse of the Soviet Union). Russian pilots used to take more chances. They grew into a habit of performing overweight departures because they “always” went well. In combination with engine failures this practice lead to many accidents;*
    - *On a flight from Moscow to Vladivostok, the captain gave the control stick to his son, who slowly put the aircraft in a nose dive. When his father noticed, he had to correct so much to prevent a flight into terrain, that the wings broke off due to the too high g-forces; and*
    - *Several less safe aircraft are forbidden on Schiphol for noise reasons.*
  - *Years ago, Turkish aviation had a bad safety reputation. Now it has become professional and it performs comparable to Western Europe. One of the reasons for the relatively high accident probability was again related to crew mentality in dealing with safety: many pilots were former military jet pilots used to having ejection seats and taking more chances. In one accident, which occurred in Ankara with a 727, there was a failure of the runway lights. The pilots decided that they knew the airport so well that they could land, so they did not perform a missed approach and crashed in the landing.*
  - *Now it is realised that if you hire military pilots, they have to be brainwashed regarding safety – a very different mindset is necessary for civil aviation. KLM in principle does not hire ex military pilots.*
  - *16 years ago there was an accident in Zaire/Congo where a Caravelle collided with a helicopter. It turned out to be caused by two pilots, trained for flying Dakotas (propeller aircraft), who just took the opportunity to fly a bit with a Caravelle (jet aircraft). Unsurprisingly due to the completely different aircraft characteristics, they lost control and coincidentally collided with the helicopter.*
  - *Regarding safety culture, a challenge is how to make it concrete and explain it to public.*
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**Possible use of CATS by the interviewee**


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Id	Question	Answer
7.	What information do you expect from CATS in making your decisions, in what formats and what level of detail?	
8.	What information do you expect from CATS to evaluate the effect and the effectiveness of changes?	
9.	Do you expect to review the status of this information periodically or driven by problems?	
10.	What are you looking for in information to be delivered by CATS?	
11.	Do you want to use CATS information to observe emerging trends or correlations? Are you interested in both positive trends (improvements) and negative trends (deteriorations)?	<i>NIVR is not a prospective user of CATS. In this sense, NIVR has no expectations/user requirements. NIVR has an advisory role in CATS and helps to run the project.</i>
12.	Would you want to use CATS data to compare your company's safety performance with others?	
13.	How much time will you spend in monitoring CATS data relevant for your area of responsibility?	
14.	Do you expect your decisions based on CATS data to be time critical? How much time do you have typically to review the data and make a decision?	

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**Specific questions regarding the level of detail**

Id	Question	Answer
15.	Could you indicate and motivate your priorities (High/Medium/Low) for developing the following details in the model?	
a)	Runway layout	
b)	Discerning captain/first officer in the crew	<i>More important aspects are:</i> – <i>Kind of human; and</i> – <i>Crew interaction.</i>
c)	Discerning PF/PNF in the crew	<i>See the Boeing study/cultural aspects under Question 6.</i>
d)	Number of engines of an aircraft	
e)	Influence of safety culture	<i>High:</i> – <i>Many accidents in outlying districts are caused by/have contributions from cultural aspects. See the Boeing study/cultural aspects under Question 6.</i> – <i>Note that reporting of incidents is also a safety culture aspect, see below Question 19.</i> – <i>See also below the concluding remarks.</i>

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### Specific questions regarding data to be used

Id	Question	Answer
16.	What data should be used to quantify the model in terms of aircraft	
a)	Size	
b)	Make (Russian made aircraft?)	
c)	Type (jet, turboprop, piston, ...)	– <i>Piston engine aircraft are relatively unsafe compared to jet aircraft due to vibrations. For jet aircraft the frequency of occurrence of an engine failure is about once per five careers; for piston engine aircraft once per career.</i>
17.	Should certain types of flights be excluded from the data (training, military, ferry, calibration, ...)	– <i>Military flights should be excluded, and that should not be difficult to do.</i> – <i>The other flights do have a higher chance of accidents, but the distinction is not always clear for other occurrences than accidents.</i> – <i>Ferry flights are not only less safe than normal flights because of technical problems: also perfectly okay aircraft are ferried. Pilots have a larger tendency to scorch (“rauzen”) during ferry flights, which they would not do with a normal flight with passengers.</i>
18.	Should the data to be used for quantifying the model restrict to parts of the world? Which?	
19.	How far would do you want to look back in terms of data? (At most ten years back, from 1970, 80, 90, ...)	– <i>This topic has been discussed in the advisory group as well. It is a relevant question, but hard to answer.</i> – <i>You should not go back further than 1970. The first jets flew in 1958 and there was a transition for piston to jet engine aircraft until say 1970. In 1970, the 747, DC-10 and Tristar came into service and safety benefited from the introduction of these widebody aircraft with high bypass engines.</i> – <i>1980 is pretty representative for now; so do not start later than 1980</i>

#### Incident reporting

- *Australia is one of the safest countries of the world regarding aviation. Qantas did not have a single accident since 1954. Australia was the first state with a reporting system that pilots, flight engineers, air traffic controllers could use anonymously to file incident reports for use by safety analysts. The Australian incident reporting system works well. The British CAA has taken over the Australian way of working.*
- *In view of the safety iceberg phenomenon (there are many incidents for every accident) incidents are very informative.*
- *In the Netherlands, air traffic controllers are vulnerable to criminal prosecution for errors they may make. This does not make it attractive to file incidents, and as a result of the prosecutions a few years ago, indeed a lot less near misses are reported. This is also a safety culture effect and hard to catch in numbers.*



### Specific questions regarding occurrences to exclude

Id	Question	Answer
20.	Are there occurrences you would want to exclude from the data? Please motivate.	
a)	Wild life strikes	<ul style="list-style-type: none"> <li>– Elk strikes in Sweden should be excluded.</li> <li>– (There are hares on Schiphol.)</li> </ul>
b)	Deliberate actions by pilots	– Not representative - exclude
c)	Overweight take-offs	– Do NOT exclude
d)	...	

### Concluding remarks

#### More safety culture

- Not the technology, but the sociological/human aspects become more and more important in air transport safety. Wings do not break anymore and engine failures are rare. It is rather safety culture aspects that are important nowadays. These aspects need to be brought in at the beginning of the training of the humans in air transport (pilots and controllers in particular). It is crucial to introduce a culture where people feel free to address each other.
- As an example of dealing with these safety cultural issues, HvL talks about the developments in Chinese air transport. Chinese aviation is growing quickly at 10 – 15% per year. Orders of 100 Boeings have not been exceptional. There is/was a shortage of pilots, but the quick inflow of pilots has been abandoned, due to a quick increase in accidents – pilots were put on aircraft too quickly. Pilot training is now significantly improved, and it includes safety culture aspects. HvL is convinced of the effectiveness of the Chinese approach and the safety record is good by now. As a result of accidents, measures have been taken in a structured way. The Chinese set themselves goals (not democratically) and achieve these.
- Safety culture is important everywhere: in the cockpit, in ATC, on the ground and in the interactions between all of these.

#### Data/ looking back and ahead/ generic versus representative

- With historical data you look back, whereas it is so important to look ahead (like in the Boeing study) to decrease accident probability.
- Human factors remain important and have to be dealt with, but these translate into statistics slowly.
- CATS tries to achieve different of even conflicting goals: One the one hand, a generic model is expected from CATS. On the other hand, it must be applicable for Schiphol. This contributes to the following Achilles heels for CATS:
  - Is the data used representative for the Dutch situation?
  - Shortage of data, and structure and assumptions of the model.



## Appendix B.4 Jan Busstra (DGTL)

### Introduction interviewee

Id	Question	Answer
1.	What organization do you represent?	<i>DGTL (“Directoraat Generaal Transport en Luchtvaart”) – General Directorate for Transport and Civil Aviation.</i>
2.	What are your/your department’s responsibilities?	<i>JB is program leader for aviation safety (“programmaleider (afdelingsleider) luchtvaartveiligheid”). This program deals with internal safety, external safety and security. For security there is a division of roles between the Ministry of Transport, Public Works and Water Management and the Ministry of Justice.</i>
3.	What do you/your department do to fulfil these responsibilities?	<i>Within the Ministry, DGTL makes policy and regulation. It is at the beginning of the policy making cycle – policy is initiated, formulated and chosen, up to political decision making. DGTL and IVW (“Inspectie Verkeer en Waterstaat”) – the Transport and Water Management Inspectorate – work together as in a team time-trial (“ploegentijdrit”). Up to political decision making, DGTL has the lead. IVW follows to be able to implement and enforce the policy adequately later. DGTL follows IVW in the implementation and enforcement to maintain and develop their practical expertise, which is necessary to develop policy that works in practice. In the past, the roles of DGTL and IVW – policy respectively supervision – were split more strongly. In the present view DGTL and IVW manage the job together.</i>
4.	What kind of decisions do you make in carrying out these responsibilities?	<i>Decisions are related to problems seen by us or brought up to us. We put these problems on the political or policy making agenda and identify options to deal with them. The recommended options take the consequences on safety into account.</i>
5.	What changes to your company’s activities do you implement?	<i>JB’s role within DGTL is to set the agenda, just like DGTL’s role on a macro level is to set the agenda for the working field.</i>



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**General expectations of CATS**

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Id	Question	Answer
6.	Could you elaborate on your expectations from CATS in general terms?	<p><i>JB associates CATS with Safety Management Systems (SMSs) and risk analysis in particular...</i></p> <p><i>Important questions for JB are:</i></p> <ul style="list-style-type: none"><li><i>– How is the state of affairs in aviation regarding safety? How are the Netherlands doing in this respect? How are individual organisations doing?</i></li><li><i>– What are the safety effects of changing certain variables in aviation? In view of his role, JB would like CATS to have a crystal ball function, forecasting the future safety effects of turning a certain button in the aviation system</i></li></ul> <p><i>Summarising, JB would like to use CATS as an evaluation tool and as a way to map risks of future changes. JB does not want to prioritise one of these functions above the other.</i></p>

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## Possible use of CATS by the interviewee

Id	Question	Answer
7.	What information do you expect from CATS in making your decisions, in what formats and what level of detail?	<i>JB wants information that his scientific advisers can use to make significant statements regarding policy. JB is pragmatic in the sense that not every question can be or needs to be answered in a quantitative, scientific way. Sometimes qualitative or intersubjective (based on expert opinion) judgments are sufficient.</i>
8.	What information do you expect from CATS to evaluate the effect and the effectiveness of changes?	<i>(In addition to what has been said under Question 6:) Also the fields of tension between safety and other policy areas are of interest. An example is that it is desirable from a safety point of view to pack dangerous goods well whereas, from a security point of view, these goods should be open for inspection. Another example is the tension between noise restrictions and safety: due to noise, arrival routes have been set up differently as they would under safety conditions alone. External safety is considered as a residual product of internal safety.</i>
9.	Do you expect to review the status of this information periodically or driven by problems?	<i>The state of affairs will be monitored periodically, while the prognostic use of CATS will be problem or measure driven.</i>
10.	What are you looking for in information to be delivered by CATS?	<i>Insight in effects before things are changed, as a factor in decision making. Hence a MER like function (MER stands for "Milieueffectrapportage" – Environment Effect Report). In traffic safety there has been talk of VER – Safety Effect Report – in the SWOV – the Dutch national road safety research institute.</i>
11.	Do you want to use CATS information to observe emerging trends or correlations? Are you interested in both positive trends (improvements) and negative trends (deteriorations)?	<i>Yes, for the "state of the nation" function of CATS. Compare this function of CATS with the check you do every morning by looking in the mirror – can I face my colleagues like this, or should I do something about myself? No special distinction between positive and negative trends.</i>
12.	Would you want to use CATS data to compare your company's safety performance with others?	<i>An organisation working on policy has some distance to the action. CATS should offer this function to the individual organisations. It should enable organisations to</i>



*see for themselves how their state of affairs is regarding safety and what the pros and cons of changes are.*

*The sum of the results for the various organisations gives the results for usage by the policy maker.*

13. How much time will you spend in monitoring CATS data relevant for your area of responsibility? *No idea.*

14. Do you expect your decisions based on CATS data to be time critical? How much time do you have typically to review the data and make a decision? *Decision making in politics is rather a matter of months/years than hours/days. CATS is rather a strategic than a tactical instrument. Political fires ("brandjes") are exceptions regarding time scale – CATS might incidentally be used for this. Usually there is much more to these situations than reason and figures.*

#### **Specific questions regarding the level of detail**

Id	Question	Answer
15.	Could you indicate and motivate your priorities (High/Medium/Low) for developing the following details in the model?	
a)	Runway layout	
b)	Discerning captain/first officer in the crew	<i>If somebody else finds this important that is okay, but JB considers things on a more general level.</i>
c)	Discerning PF/PNF in the crew	
d)	Number of engines of an aircraft	
e)	Influence of safety culture	<i>This is an important subject for DGTL; it is considered as a condition for effective Safety Management. The aspects</i> <ul style="list-style-type: none"> <li><i>– Safety culture;</i></li> <li><i>– An adequate organisational model; and</i></li> <li><i>– Top management's responsibility for safety and their active establishment and propagation of appropriate attitude within the organisation</i></li> </ul> <i>together make a closed chain of responsibility for safety.</i>
	Are there other details you would like to prioritize?	<i>Not for the time being.</i>



### Specific questions regarding data to be used

Id	Question	Answer
16.	What data should be used to quantify the model in terms of aircraft	<p><i>As an introduction, JB tells that he worked for “Rijkswaterstaat” – the Department of Public Works. A shore radar system was being developed for the Westerschelde and the ambition was to put everything in it. It turned out that this would make the system not realisable.</i></p> <p><i>Analogously, it is more important for CATS that it gets there, than that it can answer any question. If realisation necessitates curtailment, we should be advised, or asked to make choices.</i></p>
a)	Size	
b)	Make (Russian made aircraft?)	
c)	Type (jet, turboprop, piston, ...)	
17.	Should certain types of flights be excluded from the data (training, military, ferry, calibration, ...)	
18.	Should the data to be used for quantifying the model restrict to parts of the world? Which?	<p><i>The aforementioned user objectives – what are the risks today and which risks would result from certain changes – especially concern the Dutch context, and looking more broadly the EU. Outside the EU, it needs to be questioned what the effects on realisation, reliability and significance are.</i></p>
19.	How far would do you want to look back in terms of data? (At most ten years back, from 1970, 80, 90, ...)	<p><i>In JB’s view, technological development in aviation is so progressive that looking back very far is less relevant.</i></p> <p><i>Referring to the look in the mirror again: you look for pimples and spots; it is not relevant how you looked when you were born.</i></p>

### Specific questions regarding occurrences to exclude

Id	Question	Answer
20.	Are there occurrences you would want to exclude from the data? Please motivate.	
a)	Wild life strikes	
b)	Deliberate actions by pilots	
c)	Overweight take-offs	



**Concluding remarks**

*In addition to what has been discussed before, JB wants to stress:*

- The relation between CATS and SMS is very important. CATS should be an instrument in that environment.*
- It is a big challenge for Rob van der Boom and the others involved in CATS to see to it that CATS does not become an exclusive Dutch circus act. Take care that it fits in the international context, that this supports CATS and also wants to get to work with it.*

*CATS is working in the right way, but it is still a long way to the finish.*

*Sometimes there are indefinable matters with the advanced, like momentum, spirit of the times, et cetera. CATS has the momentum, but tail wind does not imply you finish first.*

*Referring back to the team time-trial comparison, the team members need each other, with their specialties and qualities, to finish successfully.*



## Appendix B.5 Job Brügger (LVNL)

### Introduction interviewee

Id	Question	Answer
1.	What organization do you represent?	LVNL
2.	What is the role of your department and your position within it?	<i>JB is safety manager of LVNL:</i> <ul style="list-style-type: none"> <li>– <i>He reports exclusively to the executive board (“bestuur”, consisting of Kroese and Klein Ikkink) about all safety information considered relevant by safety manager or board;</i></li> <li>– <i>On behalf of the board, the safety manager checks safety information within the organisation to guard objectivity;</i></li> <li>– <i>The safety manager nationally and internationally represents the board with regard to safety, for instance in the Dutch air traffic sector, in CANSO, towards the government and the VPS; and</i></li> <li>– <i>The safety manager has a consulting role towards the board regarding safety, for instance involving just culture and reporting.</i></li> </ul>
3.	What are your/your department’s responsibilities?	
4.	What kind of decisions do you make in carrying out these responsibilities?	<i>The safety manager for instance advises the board whether a safety assessment (“VEMER”) should be made for changes to the ATM system.</i>
5.	What changes to your company’s activities do you implement?	<i>Changes to the Safety Management System (SMS) in general. This for instance includes organization, execution and culture aspects.</i>



### General expectations of CATS

Id	Question	Answer
6.	Could you elaborate on your expectations from CATS in general terms?	<p><i>JB considers himself as a (future) user of CATS (rather than an adviser).</i></p> <p><i>A key expectation (user requirement) is that CATS helps with <u>improving</u> safety.</i></p> <p><i>One of the challenges for JB in steering safety of LVNL's ATM product and background for his interest in CAST is that decisions regarding a change to the ATM system are based on expected accident probabilities, per ATM subproduct and per flight, whereas "realized" safety is measured via incidents ( i.e. apparent <u>unsafety</u>). The "transformation function" between these quantities is unknown. The complexity is for a great deal due to the complex intellectual activities of several human operators in air traffic directly during the creation of the ATS product.</i></p> <p><i>JB wants the model to tell what happens with safety when changes are made to:</i></p> <ul style="list-style-type: none"> <li><i>– Provision of the ATM product;</i></li> <li><i>– Its development (concerning for instance the LVNL processes "instandhouden" en "veranderen")</i></li> <li><i>– Its management ("besturen"); and</i></li> <li><i>– The environment in which this happens.</i></li> </ul> <p><i>JB wants means to get insight in how safety arises and where steering has the best effect on safety.</i></p>



## Possible use of CATS by the interviewee

Id	Question	Answer
7.	What information do you expect from CATS in making your decisions, in what formats and what level of detail?	<p><i>Example results would be confirmation (or rejection) of:</i></p> <p><i>a) "R/T is the weakest link (readback/hearback errors) in causing SID deviations";</i></p> <p><i>b) "With this quantity/density of traffic in this airspace, there is no operational solution satisfying the safety criteria"; and</i></p> <p><i>c) "Increased automation of ATC leads to more safety and efficiency".</i></p>
8.	What information do you expect from CATS to evaluate the effect and the effectiveness of changes?	<p><i>How does the interaction of traffic, airspace, procedures, systems, humans result in Safety, Efficiency and Environment ("VEM")?</i></p> <p><i>Example: Insight in the relation on say 10<sup>6</sup> Euro for training on the number of movements that can safely be made.</i></p>
9.	How often would you review the status of this information?	<i>Say once a year.</i>
10.	What are you looking for in information to be delivered by CATS?	<i>No decisions, but information that supports decision making; the organization wants to make the decision.</i>
11.	Do you want to use CATS information to observe emerging trends or correlations? Are you interested in both positive trends (improvements) and negative trends (deteriorations)?	<p><i>Yes.</i></p> <p><i>A relevant question for example is: What is the influence on safety of the introduction of Very Light Jets? and Why?</i></p>
12.	Would you want to use CATS data to compare your company's safety performance with others?	<i>No.</i>
13.	How much time will you spend in monitoring CATS data relevant for your area of responsibility?	<i>Based on a frequency of once per year, this will be at most a few days.</i>
14.	Do you expect your decisions based on CATS data to be time critical? How much time do you have typically to review the data and make a decision?	<i>No. Time critical decisions often concern aspects of the ATM system on a detailed level for which decision support information is obtained elsewhere.</i>


**Specific questions regarding the level of detail**

Id	Question	Answer
15.	Could you indicate and motivate your priorities (High/Medium/Low) for developing the following details in the model?	
a)	Runway layout	<i>High</i>
b)	Discerning captain/first officer in the crew	<i>Low</i>
c)	Discerning PF/PNF in the crew	<i>Low</i>
d)	Number of engines of an aircraft	<i>Low</i>
e)	Influence of safety culture	<i>High</i>
f)	<i>Management (“bestuur”) of an organization, involving</i> <ul style="list-style-type: none"> <li>- <i>Development of the organization;</i></li> <li>- <i>Style of leadership;</i></li> <li>- <i>Management of resources;</i></li> <li>- <i>Support; and</i></li> <li>- <i>The degree of hierarchy<sup>5</sup>.</i></li> </ul>	<i>Medium</i>
g)	<i>Airspace structure and characteristics</i>	<i>High</i>
h)	<i>Degree of automation</i>	<i>High</i>

<sup>5</sup> JB mentions research by the John Hopkins University into safety of low cost versus high cost carriers. Low cost carriers turned out to be are safer! The explanation was that there are fewer levels between decisions and operations, enabling quicker implementation of changes.




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**Specific questions regarding data to be used**

Id	Question	Answer
16.	What data should be used to quantify the model in terms of aircraft	
a)	Size	$\geq 5700kg$
b)	Make (Russian made aircraft?)	<i>It is necessary to discern Western from non-western made aircraft.</i>
c)	Type (jet, turboprop, piston, ...)	<i>Exclude helicopters and military aircraft.</i>
17.	Should certain types of flights be excluded from the data (training, military, ferry, calibration, ...)	<i>All of the mentioned flights should be excluded. Consider only Commercial Aviation.</i>
18.	Should the data to be used for quantifying the model restrict to parts of the world? Which?	<ul style="list-style-type: none"> <li>– <i>For questions regarding Schiphol, consider similar organizations. Usually &lt;Northern America&gt; is then also considered;</i></li> <li>– <i>Interested whether it is really so bad in Africa and Russia; and</i></li> <li>– <i>Other parts of the world may be interesting for instance for safety culture questions and comparisons.</i></li> </ul>
19.	How far would do you want to look back in terms of data? (At most ten years back, from 1970, 80, 90, ...)	<p><i>The aim is to look ahead. Therefore do not look back too far.</i></p> <p><i>It is questionable whether the seventies should still be considered. In a sense it was a transition period from glamorous aviation towards tough competition, economic interests and infrastructural issues. The generation of aircraft may be less representative.</i></p>

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### Specific questions regarding occurrences considered

Id	Question	Answer
20.	Are there occurrences you would want to exclude from the data? Please motivate.	
a)	Wild life strikes	<i>These should not be excluded as they are controllable.</i>
b)	Deliberate actions by pilots	<i>(Such as suicide): do not exclude.</i>
c)	Overweight take-offs	<i>Do not exclude. JB recalls the Iberia Airbus that returned to Amsterdam after a supposed bomb report. It made an overweight landing since this Airbus could not dump fuel. In the US, an A320 with a blocked front wheel has been flying for three hours in order to loose sufficient fuel to land.</i>
d)	<i>Terrorism</i>	<i>Exclude</i>
e)	<i>Natural disasters (earth quakes, volcanic eruptions, meteorites, ...)</i>	<i>Exclude</i>
f)	...	
g)	...	

### Concluding remarks

*No concluding remarks*



## Appendix B.6 Jos Wilbrink (IVW)

### Introduction interviewee

Id	Question	Answer
1.	What organization do you represent?	<i>IVW – “Inspectie Verkeer en Waterstaat” – The Transport Inspectorate and Water Management Inspectorate.</i>
2.	What are your/your department’s responsibilities?	<i>JW is director of the Aerodromes and Air Navigation Services unit. Transport of hazardous materials by air is also supervised by this unit. The unit supervises compliance with applicable laws and regulations and, more generally, secures (“borgen”) safety and environment.</i>
3.	What do you/your department do to fulfil these responsibilities?	<i>The air transport sector itself is responsible for safety as much as possible – IVW is not directly active in the air transport operation. IVW regulates organisations by means of allowance to and continuation in the air transport operation:</i> <ul style="list-style-type: none"> <li>– <i>IVW issues certificates for entry to the market;</i></li> <li>– <i>IVW performs system inspections (audits) and product inspections for renewal of certificates and in between (unannounced); and</i></li> <li>– <i>IVW performs theme inspections for aspects deserving extra attention. Runway incursions are an example of this – Amsterdam Airport Schiphol and LVNL (ATC the Netherlands) have been asked to indicate how they deal together with runway incursions.</i></li> </ul>
4.	What kind of decisions do you make in carrying out these responsibilities?	<ul style="list-style-type: none"> <li>– <i>On the basis of risk analysis it is decided where and how often to perform inspection. These inspection aspects depend increasingly on the maturity of the organisation’s safety management system (SMS): for airports, the Demeyere Model is applied. This model involves “do as you would be done by” (“wie goed doet goed ontmoet”): if the airport is doing well in terms of risks, maturity of the SMS, openness, reliability, et cetera, the inspection regime can be relaxed. This model is currently being implemented for airspace (and the corresponding ANSPs: LVNL, Maastricht Upper Area Control (MUAC) and the Royal Dutch Meteorological Institute (KNMI)).</i></li> <li>– <i>Depending on the findings of the inspections, there is a spectrum of means to persuade the inspected organisation to remedy the findings:</i> <ul style="list-style-type: none"> <li>– <i>Argue and convince (the most used means);</i></li> <li>– <i>Increase frequency and depth of inspections;</i></li> <li>– <i>Send the organisation an “angry” letter;</i></li> <li>– <i>Have a conversation with the organisation’s directors (without coffee);</i></li> <li>– <i>Give the organisation an administrative fine; or</i></li> <li>– <i>Withdraw/suspend license/certificate.</i></li> </ul> </li> </ul>



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5. What changes to your company's activities do you implement?
- *Model Demeyere is being implemented for inspection of air-space (the ANSPs).*
  - *My part of the inspection will be certifiable by the end of 2007 according to INK (Instituut Nederlandse Kwaliteit) standards (these standards are more applicable for authorities than the ISO standards).*
  - *Identify and fill in vacancies and, depending on the experience attracted, determine training necessary to perform the functions.*
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### General expectations of CATS

Id	Question	Answer
6.	Could you elaborate on your expectations from CATS in general terms?	<p><i>The original reason for developing CATS was in the context of external safety. If sufficiently reliable external safety evaluations could be obtained, it would be possible to reduce external safety contours, leaving more room outside of them or more aircraft would fit in same contour. This original idea has been abandoned.</i></p> <p><i>JW has expectations regarding CATS, but also concerns regarding the amount of available data.</i></p> <p><i>Some of the complications regarding the use of CATS concern the unpredictability of certain changes:</i></p> <ul style="list-style-type: none"> <li><i>– An important aspect is human factors. The role of air traffic controllers may for instance shift from controlling to monitoring. As an effect, controllers may have a too low workload and fall asleep.</i></li> <li><i>– As the Überlingen accident has shown, safety nets may also have counterproductive effects. GPWS has been bothered by nuisance alerts. EPGWS appears to be working well.</i></li> </ul> <p><i>Another issue regarding the expectations regarding CATS is the absence of a clear ultimate goal (such as the former US vice-president Al Gore's goal to reduce the number of air traffic accidents in the US with 80% within a well-defined period). A clear goal could be to reduce the number of accidents with 50% in the next five years and to reduce the number of serious incidents with 70%.</i></p> <p><i>The special attention for and actions by the sector regarding runway incursions show that such goals are feasible. Important causal/contributing factors for runway incursions have been identified amongst others: miscommunication, entries to the runway and not obeying instructions from ATC by pilots.</i></p> <p><i>For more causes and insight, more data is necessary, and this in turn necessitates international co-operation. For ATM, Europe and Euro-control have made initiatives such as a dedicated ATM part within the ECCAIRS framework. Such initiatives need serious effort and should not only concern incidents.</i></p> <p><i>In this respect, IVW has established the ABL ("Analysebureau Luchtvaartvoorvallen") at the beginning of 2006.</i></p> <ul style="list-style-type: none"> <li><i>– We could learn from the labour inspection approach: if an organisation is sloppy in one respect, it is more likely sloppy in other respects, too. Attitude towards regulation is a valuable indicator.</i></li> <li><i>– A central expectation from CATS is to find a connection between aspects of the air transport operation and safety: where should things be changed to achieve more safety? This definitely is an opportunity for CATS. In this sense it would be an extension of the usual risk analysis. Such a function requires a large amount of data; not only accident but also incident data. This is an issue in the Netherlands. Punitive legislation to some extent impedes reliable reporting of incidents. In this context, the sector organisations can do research by themselves by building in causal models.</i></li> <li><i>– Although JW would give much for it, he does not expect much usable results from CATS in the near future, in view of the many complications.</i></li> </ul>



### Possible use of CATS by the interviewee

Id	Question	Answer
7.	What information do you expect from CATS in making your decisions, in what formats and what level of detail?	– <i>JW expects to use CATS as a risk analysis tool: where are the big risks, for the current situation and for changes? To some extent this depends on the ultimate goal behind CATS.</i>
8.	What information do you expect from CATS to evaluate the effect and the effectiveness of changes?	– <i>In addition to what has been answered above, CATS should also be able to monitor the effects of changes. IVW has made a start with such effect measurements and these will be developed further in 2007.</i>
9.	Do you expect to review the status of this information periodically or driven by problems?	– <i>For a quality organisation, such statuses need to be reviewed in a structural way, i.e., periodically. The appropriate frequency needs to be determined.</i> – <i>Occasionally, CATS may be applied on the basis of problems encountered.</i> – <i>Reliability of the information provided is a very important aspect.</i>
10.	What are you looking for in information to be delivered by CATS?	– <i>Quantification/explanation of what causes/contributes to an accident and which (causal) connections can be made.</i> – <i>CATS should have predictive power for future developments and thereby help to decide what aspects to keep or to redevelop.</i>
11.	Do you want to use CATS information to observe emerging trends or correlations? Are you interested in both positive trends (improvements) and negative trends (deteriorations)?	– <i>See again the answer to Question 9.</i> – <i>Yes, if possible. It would be interesting to know the effects of the changing role of air traffic controllers. Accident analysis does not provide data for that.</i> – <i>Definitely interested in negative trends. Interest for positive trends in the sense: if something is going well, the inspection effort can be lowered.</i>
12.	Would you want to use CATS data to compare your company's safety performance with others?	– <i>On State level this is done to some extent. CATS could do this, but suitable explanation needs to be given.</i> – <i>For JW this is not an important goal for CATS. There are complications related to such an approach.</i>
13.	How much time will you spend in monitoring CATS data relevant for your area of responsibility?	– <i>Within the department, some days of effort will be needed for analysis and for choices for motivation.</i>



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| 14. | Do you expect your decisions based on CATS data to be time critical? How much time do you have typically to review the data and make a decision? | <ul style="list-style-type: none"> <li>– <i>JW does not think so. CATS will usually require serious study for establishing causal relations.</i></li> <li>– <i>JW/IVW will remain up to date regarding CATS results by ongoing involvement.</i></li> </ul> |
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### Specific questions regarding the level of detail

Id	Question	Answer
15.	Could you indicate and motivate your priorities (High/Medium/Low) for developing the following details in the model?	
a)	Runway layout	– <i>High; including the complete system of runways and taxiways plus usage.</i>
b)	Discerning captain/first officer in the crew	– <i>This distinction in itself is not advised. Crew Resource Management (CRM) is much more important.</i>
c)	Discerning PF/PNF in the crew	– <i>Same answer as above.</i>
d)	Number of engines of an aircraft	– <i>Low for the time being. It is a relevant aspect for ETOPS (Extended Range Twin Engined Operations) and for environment. It could become more important for safety in relation with bird strikes.</i>
e)	Influence of safety culture	<ul style="list-style-type: none"> <li>– <i>High within organisations; and</i></li> <li>– <i>Considering the chain of organisations involved in air transport, the interfaces are very important. In this respect, safety culture also has High priority.</i></li> <li>– <i>Research on behalf of the VACS (“Veiligheidsadviescommissie Schiphol”) has shown that the degree of responsibility of an organisation is important. This is to some extent related to safety culture.</i></li> </ul>
	Are there other details you would like to prioritize?	Yes
f)	<i>In a general sense: arrangement and usage of airspace, Schiphol 2020, business jets, how is everything going to fit?</i>	
g)	<i>Limits to the possibilities of the (present) air transport system</i>	High

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### Specific questions regarding data to be used

Id	Question	Answer
16.	What data should be used to quantify the model in terms of aircraft	
a)	Size	– <i>Aircraft size is relevant for runway and taxiway layout (such as for Lelystad).</i>
b)	Make (Russian made aircraft?)	– <i>Reliability, certification basis and the level above that are relevant.</i>
c)	Type (jet, turboprop, piston...)	– <i>For airspace, limitations regarding speed are very important.</i> – <i>The number of engines is important for climbing ability.</i>
17.	Should certain types of flights be excluded from the data (training, military, ferry, calibration...)	– <i>Preferably not: also these flights present opportunities to learn from. In military aviation there is for instance much more knowledge about bird strikes.</i>
18.	Should the data to be used for quantifying the model restrict to parts of the world? Which?	– <i>One should restrict to air traffic situations more or less comparable to the situation in the Netherlands. This may be difficult (Sydney is far away, but you feel immediately at home).</i> – <i>Airports in the neighbourhoods of mountains are not comparable – exclude corresponding data.</i> – <i>The Dutch situation should be approached. JW realises that this limits the amount of available data. One should therefore not restrict to accidents but take also incidents into account.</i>
19.	How far would do you want to look back in terms of data? (At most ten years back, from 1970, 80, 90...)	– <i>Do not go back more than forty years.</i> – <i>Only go back in time for aircraft types currently flying. A Caravelle accident at Heathrow should for example not be considered.</i>



### Specific questions regarding occurrences to exclude

Id	Question	Answer
20.	Are there occurrences you would want to exclude from the data? Please motivate.	
a)	Wild life strikes	– <i>Do not exclude bird strikes, but exclude exotic animals like reeboks and bisons. The situation should look like the Dutch situation as much as possible.</i>
b)	Deliberate actions by pilots	– <i>Do not exclude in generality. The suicide by Egyptian pilots should perhaps be excluded.</i>
c)	Overweight take-offs	– <i>Do not exclude.</i>
d)	<i>Volcano eruptions</i>	– <i>Exclude</i>
e)	<i>Flying against a mountain</i>	– <i>Exclude, unless it can be translated to a navigation error. A useful criterion may be whether you can learn something from it for the Dutch situation.</i>

### Concluding remarks

- *Frederik Demeyere will join the expert group.*
- *IVW is currently involved in the discussion about Target Level of Safety and Tolerable Level of Safety. The exclusion/inclusion of safety nets is an important topic there.*
- *A second Safety Policy Note (“Nota Veiligheidsbeleid”) would help by means of concrete safety targets. This would also clarify the ultimate goal of CATS.*



## Appendix B.7 Rudi den Hertog (Fokker Services)

### Introduction interviewee

Id	Question	Answer
1.	What organization do you represent?	<i>RdH is from Technical Services, one of the five subdivisions Fokker Services, which in turn are part of Stork Aerospace Services.</i>
2.	What are your/your department's responsibilities?	<p><i>Technical Services has four main roles:</i></p> <ul style="list-style-type: none"> <li><i>– Type Certificate HOLDERSHIP Fokker Aircraft;</i></li> <li><i>– CONSULTANCY;</i></li> <li><i>– DOCUMENTATION; and</i></li> <li><i>– MODIFICATIONS.</i></li> </ul> <p><i>The last three activities are for all types of aircraft, also non Fokker platforms (Gulfstream V MPA for the Japan Coast Guard, new cockpit for KDC-10/DC10 for KLU, winglets for A320 flight test aircraft, et cetera).</i></p> <p><i>RdH is Chief Engineer and Deputy Head of Design Organisation (HODO). (A HODO is required by EASA Certification Specification CS 21 (previously JAR). This function is analogous to an airline's AOC – Air Operator Certificate.)</i></p>
3.	What do you/your department do to fulfil these responsibilities?	<i>All activities of Technical Services can be linked to the above roles; it is actually an engineering house.</i>
4.	What kind of decisions do you make in carrying out these responsibilities?	
5.	What changes to your company's activities do you implement?	<p><i>All changes regarding the three roles mentioned in 2.</i></p> <p><i>Technical Services is allowed to do everything with aircraft, except building new ones.</i></p>





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*other half will be better (ETOPS, with more hydraulic systems, maintained to tighter standards.);*

- The percentage of “new” aircraft such as B787 and A380 is still very low in 2015;*
- It is much harder to translate results based on all aircraft to a Fokker than results applicable for B737 and A320. Taking all aircraft together obscures the picture, they are often not comparable.*

*It is hopeless to go into details for all aircraft types and airports; this would take five years extra.*

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**Possible use of CATS by the interviewee**


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Id	Question	Answer
7.	What information do you expect from CATS in making your decisions, in what formats and what level of detail?	<i>RdH will see what CATS will yield.</i>
8.	What information do you expect from CATS to evaluate the effect and the effectiveness of changes?	<i>RdH will see what CATS will yield. He is sceptic. The biggest problem is how to translate history to future. In FAST it already takes so much effort to make a qualitative assessment, a quantitative assessment seems for the moment out-of-reach.</i>
9.	Do you expect to review the status of this information periodically or driven by problems?	<i>Cannot decide yet.</i>
10.	What are you looking for in information to be delivered by CATS?	
11.	Do you want to use CATS information to observe emerging trends or correlations? Are you interested in both positive trends (improvements) and negative trends (deteriorations)?	
12.	Would you want to use CATS data to compare your company's safety performance with others?	
13.	How much time will you spend in monitoring CATS data relevant for your area of responsibility?	
14.	Do you expect your decisions based on CATS data to be time critical? How much time do you have typically to review the data and make a decision?	

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**Specific questions regarding the level of detail**

Id	Question	Answer
15.	Could you indicate and motivate your priorities (High/Medium/Low) for developing the following details in the model?	
a)	Runway layout	<i>Take a standard airport with two pairs of parallel runways</i>
b)	Discerning captain/first officer in the crew	
c)	Discerning PF/PNF in the crew	
d)	Number of engines of an aircraft	<i>Take a standard aircraft – B737 and A320.</i>
e)	Influence of safety culture	<i>The influence of safety culture on safety is considered very large, much larger than keeping to rules.</i>
	Are there other details you would like to prioritize?	
f)	CPDLC	<p><i>CPDLC is unlikely to replace voice communication. It is far too laborious and it is necessary to get the pilot's attention. It is not going to work in the European theatre below 10,000ft.</i></p> <p><i>CPDLC would work if you could change routes with a mouse click. This may become possible with the A380, and exchange such new routes with ATC once they are equipped for that, but not for other aircraft.</i></p> <p><i>You have to deal with the present population of aircraft, which will remain many years. Introduction of a new kind of CNS (Communication, Navigation &amp; Surveillance) systems would cost about half a million Euros per aircraft. ATC has to be adapted as well. Ground and Flight crews have to be trained, pilots as well, ATC systems on the ground have to be replaced, so the total costs would rather be 2 million Euros per aircraft. Hence, such changes will not come quickly; work on the basis of the present aircraft. See the illustration below:</i></p>

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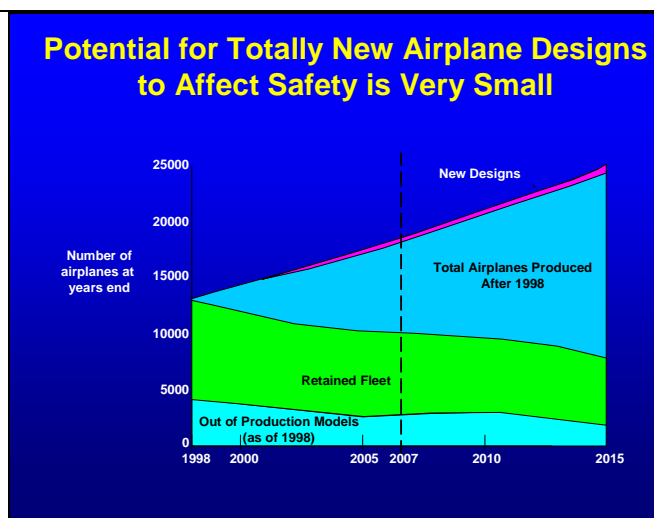


Figure 2: Proportion of new airplane designs

### Specific questions regarding data to be used

Id	Question	Answer
16.	What data should be used to quantify the model in terms of aircraft	<i>Restrict to B737 (<math>150 \times 10^6</math> flight hours, <math>100 \times 10^6</math> landings) and A320. You could consider also including B747 (1000 aircraft, <math>100 \times 10^6</math> flight hours, not so many landings).</i>
a)	Size	<i>This is fixed by the choice for B737 and A320</i>
b)	Make (Russian made aircraft?)	<i>Idem</i>
c)	Type (jet, turboprop, piston, ...)	<i>Idem</i>
17.	Should certain types of flights be excluded from the data (training, military, ferry, calibration, ...)	<i>Statistically not interesting</i>
18.	Should the data to be used for quantifying the model restrict to parts of the world? Which?	<i>The region of the world has large influence on safety. Include region in the data. Excluding data should be avoided; this decreases the large amount of data available.</i>
19.	How far would do you want to look back in terms of data? (At most ten years back, from 1970, 80, 90, ...)	<i>First reaction: from 1990 onwards. On second thoughts: from 1970 onwards, then you have almost all B737 flight hours.</i>



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**Specific questions regarding the level of detail**

Id	Question	Answer
20.	Are there occurrences you would want to exclude from the data? Please motivate.	
	a) Wild life strikes	
	b) Deliberate actions by pilots	
	c) Overweight take-offs	

**Concluding remarks****References**

- *Rudi den Hertog (Fokker Services) Concept of Operations 2011, Hazard Identification Workshop, presentation for FAST Introduction - Day 1, FAST/ Eurocontrol, 2006.*
- *Brian Smith (NASA Ames)? Excel sheet with about 200 Areas of Change, classified according to importance for potential hazards for Concept of Operations 2011, 2006.*

*These references have been given to HdJ by RdH.*