

THE ENHANCEMENT AND IMPLEMENTATION OF THE FLIGHT OPERATIONS RISK ASSESSMENT SYSTEM (FORAS)

Danny C. Ho
Wu-Han Yeh
Shao-Chieh Kao
EVA Airways

Huan-Jyh Shyur
Chi-Bin Cheng
Tamkang Univ.

The 64th International Air Safety
Seminar
Singapore
2011

WHAT IS FORAS?

- ◉ Proactive risk assessment of flight operations
 - Example: approach & landing risk
- ◉ An expert system incorporates fuzzy theory



HOW IT LOOKS LIKE?

FORAS Flight Operations Risk Assessment System



Frank Kao 高紹傑

[Main Page](#) | [Interruption Report](#) | [Job Status](#) | [Administrator](#) | [Help](#)

[Flight Inquire](#)

Flight No.	BR		Fleet	
Flight Date	2011/09/23	~	2011/09/23	
Dep. Airport		Arr. Airport		Region
<input type="button" value="Search"/>				

[Flight List](#)

Normal Warning Alert Data Incomplete Beyond Limits Interrupted Processing

DRV	ALRV	Flt No	A/C No.	Fleet	Dep. Time(TPE)	DEP A/P	ARR A/P	Region	DRV	ALRV	Created Time	Recalc
		BR31	B16716	B777	2011/09/23 20:00	ANC	TPE	THM	1.00	1.00	2011/09/22 17:35	
		BR68	B16715	B777	2011/09/23 17:25	BKK	TPE	THM	1.00	1.00	2011/09/22 15:00	
		BR772	B16301	A330	2011/09/23 14:15	TSA	SHA	THM	1.00	1.15	2011/09/23 11:48	
		BR855	B16405	B747	2011/09/23 14:10	TPE	HKG	THM	1.00	1.00	2011/09/23 11:42	
		BR392	B16701	B777	2011/09/23 13:55	SGN	TPE	THM	1.00	1.00	2011/09/23 11:26	
		BR67	B16717	B777	2011/09/23 13:50	BKK	LHR	EUR	1.00	1.00	2011/09/23 11:21	
		BR868	B16410	B747	2011/09/23 13:45	HKG	TPE	THM	1.00	1.22	2011/09/23 11:17	
		BR35	B16711	B777	2011/09/23 13:30	YYZ	TPE	THM	1.22	1.00	2011/09/23 11:02	

WHO USES FORAS?



EXEMPLIFIED USAGES

- ◉ Senior Management

- Risk due to inadequate crew rest policy?
- Risk due to insufficient flight crews?

- ◉ Safety Department

- Which risk factor is more critical?
- Why has risk increased for sector SFO-JFK?

- ◉ Dispatchers

- How will risk index change after a crew substitution?

- ◉ Flight Crews

- Risk assessment for Flight 101?

IN THIS PRESENTATION

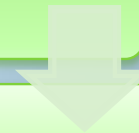
Background of FORAS

Methodology

Implementation

Ongoing development

Demonstration



BACKGROUND OF FORAS

- ◉ Initiated by Flight Safety Foundation ICARUS Committee in 1997
- ◉ Contributors
 - Dr. Michael Hadjimichael and colleagues, Naval Research Laboratory
 - First implementation at EVA Airways
 - Presented at the 60th IASS in 2007
 - Relevant information

<http://www.nrlmry.navy.mil/foras/>



WHAT'S NEW IN THIS NEWLY IMPLEMENTATION?

Revision of risk models

A new system architecture

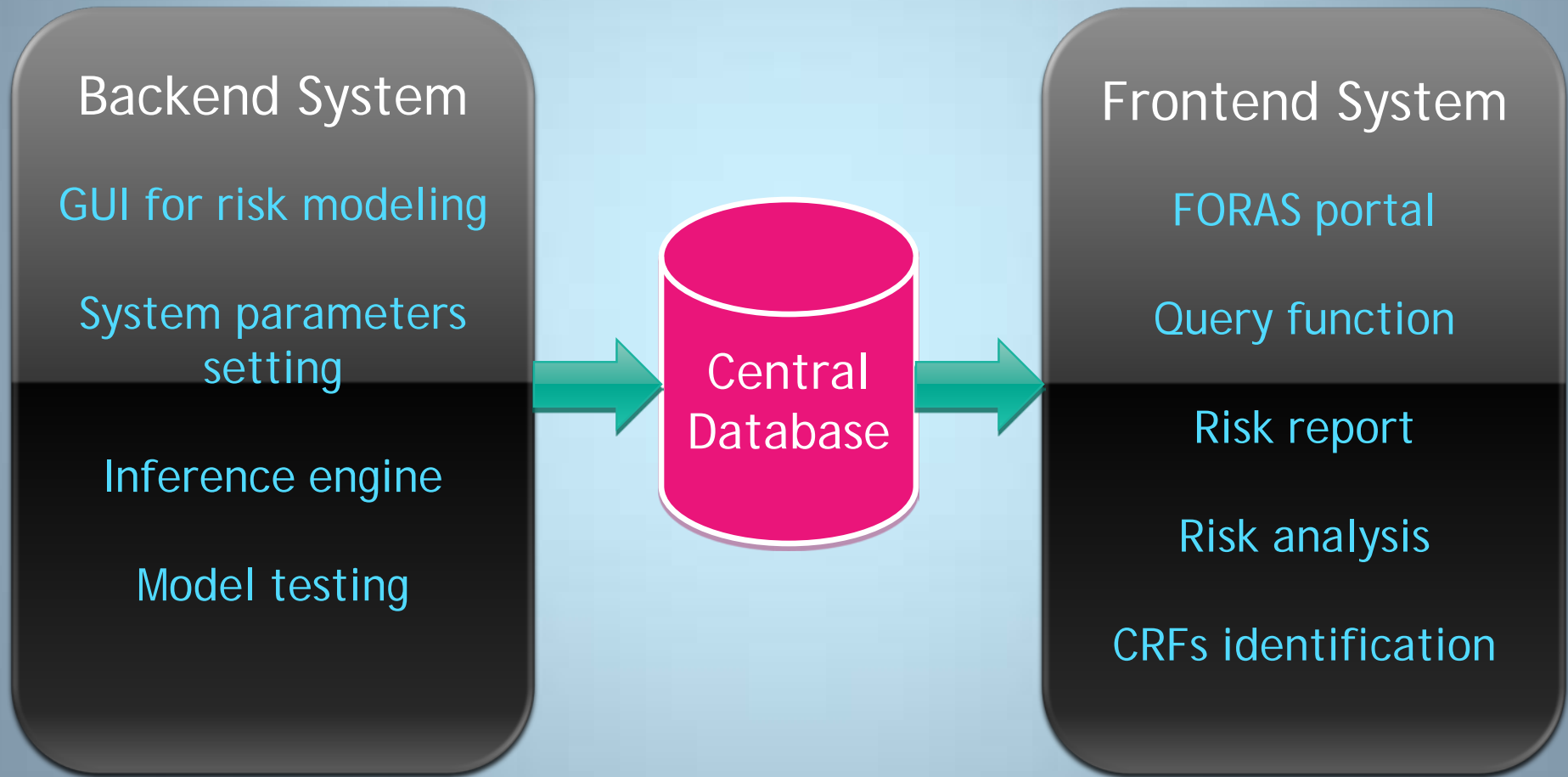
A GUI for risk modeling

Flexible parameters setting

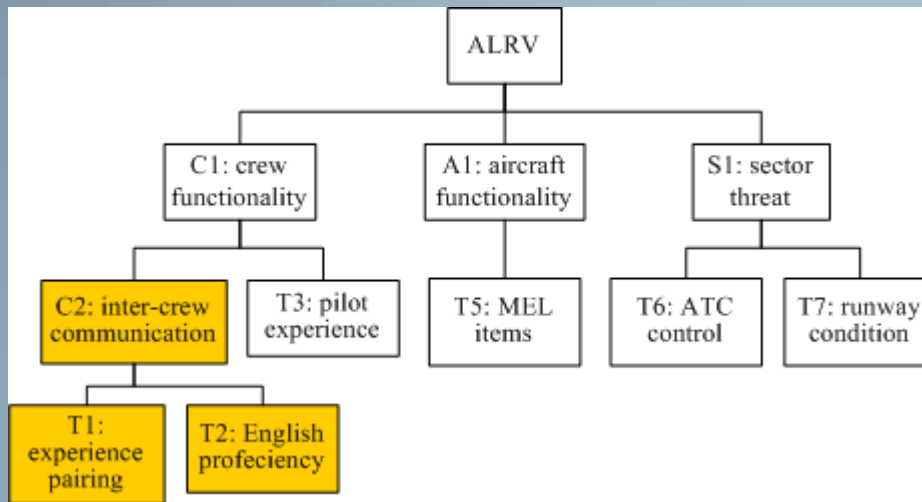
Online analysis functions

Critical risk factors identification

SYSTEM ARCHITECTURE



A. Risk break-down to a tree structure

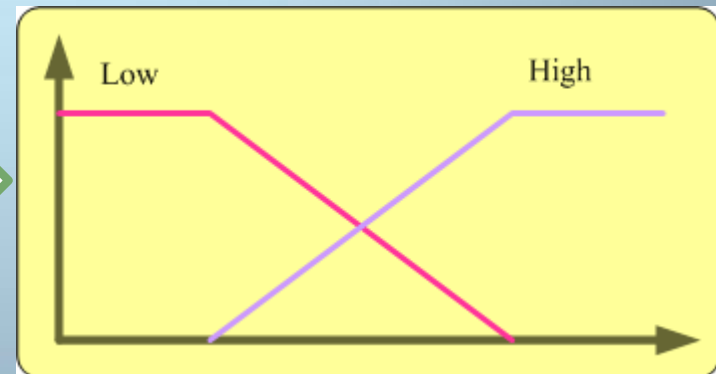


B. Relation described by rules:

If T1 is low and T2 is low, then C2 is 1
If T1 is low and T2 is high, then C2 is 4

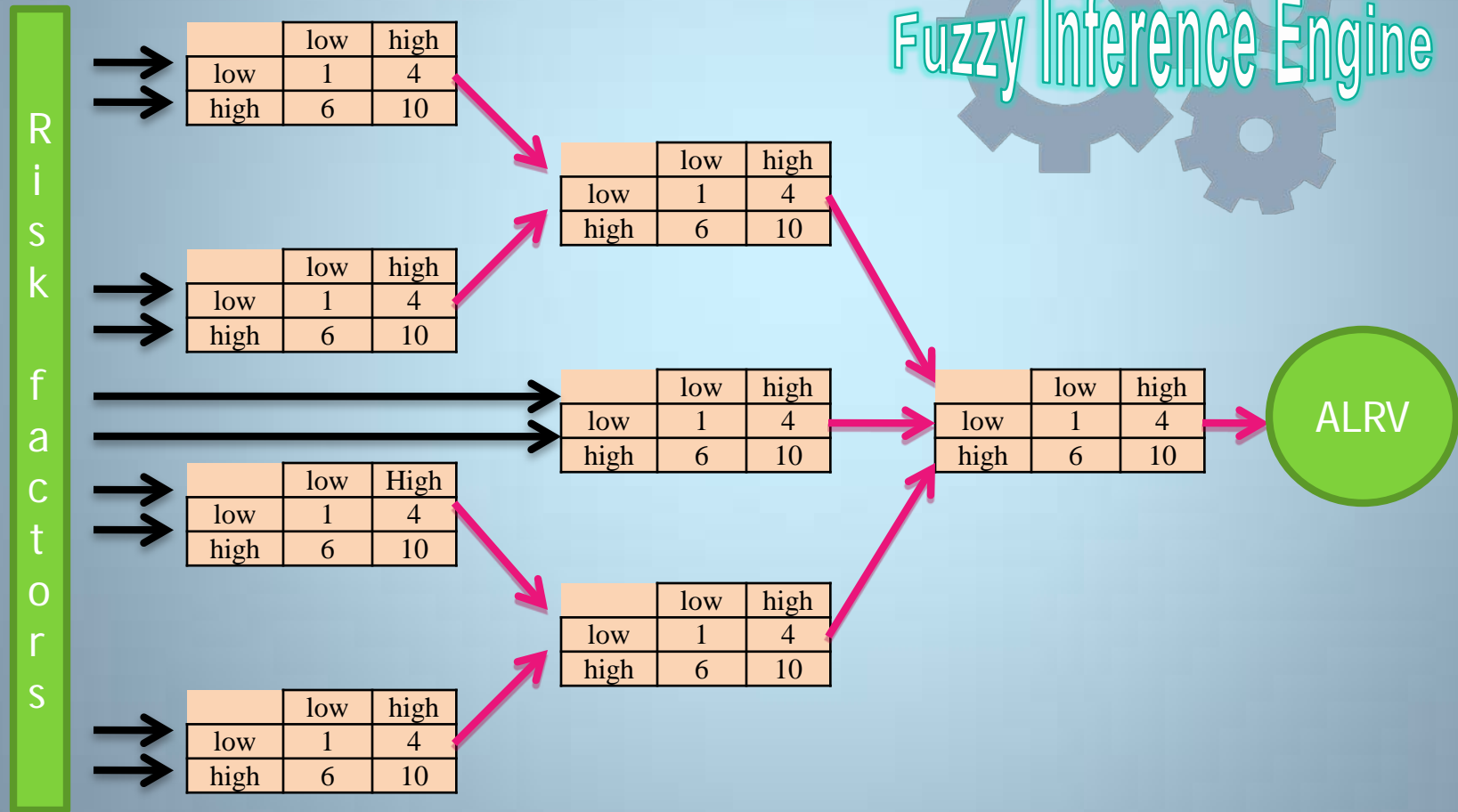
:

C. Quantification by membership functions

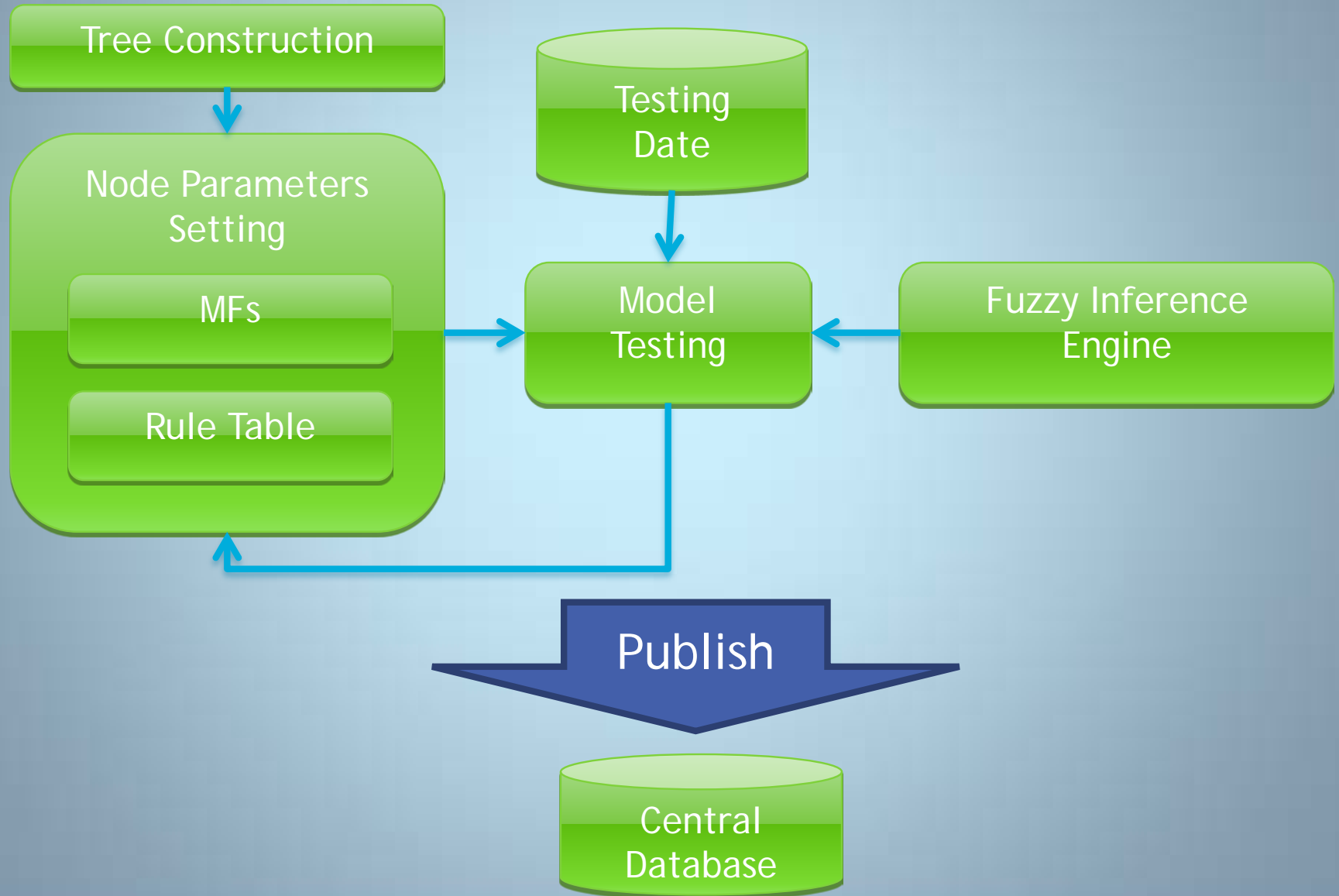


Group
Decision
Making

RISK ASSESSMENT INFERENCE PROCESS



BACKEND SYSTEM



IMPLEMENTATION



MEMBERSHIP FUNCTIONS SETTING

EVA

Node Info

Project id : tree

Node name : experience paring

Node id : T01

Node type : Terminal

Node parent : C06

Node upperlimit : 10

Node lowerlimit : 1

Current MF (click on MF to select)

Select MF Number 3

MF1 Name Low

MF2 Name Median

MF3 Name High

Select type Rightopen

Left End 6

Mode 8

Current Variable

Name

Type Rightopen

Display range Min 1.0

Display range Max 10.0

SAVE

Close

Graph showing membership functions for the variable 'High' (red line) and other functions (black lines) plotted against the x-axis (1 to 10) and y-axis (0 to 1.0).

RULES SETTING

Rule Table

rule list

1. if [T01 is low] and [T02 is low] and [C1 is Low] then [C06 is 10] []

2. if [T01 is low] and [T02 is medium] and [C1 is Low] then [C06 is 6] []

3. if [T01 is low] and [T02 is high] and [C1 is Low] then [C06 is 5] []

4. if [T01 is medium] and [T02 is low] and [C1 is Low] then [C06 is 8] []

5. if [T01 is medium] and [T02 is medium] and [C1 is Low] then [C06 is 5] []

6. if [T01 is medium] and [T02 is high] and [C1 is Low] then [C06 is 4] []

7. if [T01 is high] and [T02 is low] and [C1 is Low] then [C06 is 7] []

8. if [T01 is high] and [T02 is medium] and [C1 is Low] then [C06 is 5] []

9. if [T01 is high] and [T02 is high] and [C1 is Low] then [C06 is 4] []

C1-Low

C1-Median

C1-High

T02-Low

T02-Median

T02-High

T01-Low

10

T01-Median

8

T01-High

7

Node id:

C06

Node name:

comm level

Node type:

Risk

Reset

Delete rule

Show rule

Save

Close

MODEL TESTING

IMPLEMENTATION

Click

ATV_AIRLINE_DESIGNATOR_CODE	ATV_FLIGHT_NUMBER	ATV_FLIGHT_STARTDATE	ATV_START_AIRPORT_CODE	ATV_END_AIRPORT_CODE	ATV_FLEET

New

Delete

Import

Save

Calculate

Cancel

FRONTEND SYSTEM



PORTAL: REAL-TIME RISK REPORT

FORAS

Flight Operations Risk Assessment System

Frank Kao 高紹傑

Main Page | Interruption Report | Job Status | Administrator | Help

Flight Inquire

Flight No. Fleet

Flight Date ~

Dep. Airport Arr. Airport Region

Flight List

☒ Normal ☐ Warning ☐ Alert ☒ Data Incomplete ☐ Beyond Limits ☐ Interrupted ☒ Processing

DRV	ALRV	Flt No	A/C No.	Fleet	Dep. Time(TPE)	DEP A/P	ARR A/P	Region	DRV	ALRV	Created Time	Recalc
<input checked="" type="radio"/>	<input checked="" type="radio"/>	BR31	B16716	B777	2011/09/23 20:00	ANC	TPE	THM	1.00	1.00	2011/09/22 17:35	<input type="checkbox"/>
<input checked="" type="radio"/>	<input checked="" type="radio"/>	BR68	B16715	B777	2011/09/23 17:25	BKK	TPE	THM	1.00	1.00	2011/09/22 15:00	<input type="checkbox"/>
<input checked="" type="radio"/>	<input checked="" type="radio"/>	BR772	B16301	A330	2011/09/23 14:15	TSA	SHA	THM	1.00	1.15	2011/09/23 11:48	<input type="checkbox"/>
<input checked="" type="radio"/>	<input checked="" type="radio"/>	BR855	B16405	B747	2011/09/23 14:10	TPE	HKG	THM	1.00	1.00	2011/09/23 11:42	<input type="checkbox"/>
<input checked="" type="radio"/>	<input checked="" type="radio"/>	BR392	B16701	B777	2011/09/23 13:55	SGN	TPE	THM	1.00	1.00	2011/09/23 11:26	<input type="checkbox"/>
<input checked="" type="radio"/>	<input checked="" type="radio"/>	BR67	B16717	B777	2011/09/23 13:50	BKK	LHR	EUR	1.00	1.00	2011/09/23 11:21	<input type="checkbox"/>
<input checked="" type="radio"/>	<input checked="" type="radio"/>	BR868	B16410	B747	2011/09/23 13:45	HKG	TPE	THM	1.00	1.22	2011/09/23 11:17	<input type="checkbox"/>
<input checked="" type="radio"/>	<input checked="" type="radio"/>	BR35	B16711	B777	2011/09/23 13:30	YYZ	TPE	THM	1.22	1.00	2011/09/23 11:02	<input type="checkbox"/>

DETAILED REPORT

Flight Date (TPE)

Flight No.

DEP.

ARR.

Year Avg. ALRV

1.16

Crew Func.

2.44

Sector Threat

2.18

A/C Func.

1

Back

Tree

T Value

D Value

CPI

Trend Analysis

Print

[-] ALRV - Approach & Landing Risk Value: 1.15

[-] A1 - Aircraft Functionality : 1

[-] TA01 - Approach and Landing Related MEL items : 0

[-] C1 - Crew Functionality : 2.93

[-] C2 - Intercrew Communication : 1.67

[-] C5 - Communication Proficiency : 4

[-] TC03 - English Proficiency : 5

[-] TC04 - Nationality : 1

[-] TC01 - Experience Pairing : 7.80

[-] TC02 - Rank Composition : 4

[-] C3 - Pilot Experience : 1.60(2,1,,)

[-] C8 - A/C Flying Experience : (1,1.32,,)

[-] TC09 - Flying Recency : (1,3,,)

[-] C12 - Flying Amount : (1,1,,)

[-] TC10 - Sectors @ Rank : (1967,764,,)

[-] TC11 - Pre-EVA Experience : (1789,324,,)

[-] TC12 - EVA Sectors : (1967,1231,,)

[-] TC08 - In-type experience : (6389.70,2680,,)

[-] C9 - Airport Familiarity : (5.21,1,,)

[-] TC05 - A/P Recency : (5.73,0.13,,)

[-] TC06 - Special A/P : (0,0,,)

[-] TC07 - Previous Visits : (2,11,,)

[-] C4 - Pilot Fatigue : 4.53(5.56,3,,)

[-] C10 - Transcient Fatigue : (4.83,4.83,,)

TREND ANALYSIS

Trend Analysis -- ARR

Flight Date :
Fleet : A330

Flight N.O. :
Region :

Sector :

Tree

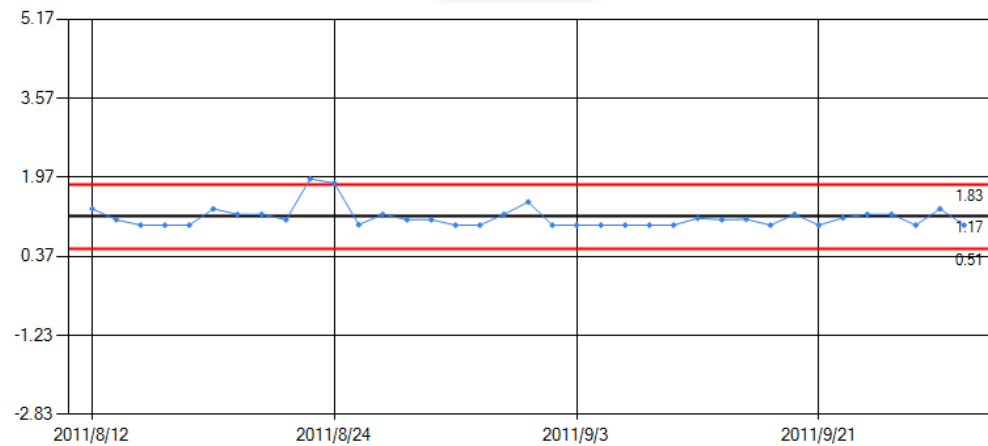
Refresh

Flight

Fleet

Region

FitNO:



CRITICAL RISK FACTORS

- ◉ To identify the risk factors that contribute to the risk value the most
- ◉ Idea
 - Those risk factors having greater marginal effects than the others are considered more critical

```
For i=1,..., n    /* n risk factors in total */  
  Case  
     $f_i \in \text{LB}$   
      
$$d_i = -\frac{r_{\text{max}}(f_1, \dots, f_i + \Delta f_i, \dots, f_n) - r_{\text{max}}(f_1, \dots, f_i, \dots, f_n)}{\Delta f_i};$$
  
     $f_i \in \text{SB}$   
      
$$d_i = -\frac{r_{\text{max}}(f_1, \dots, f_i - \Delta f_i, \dots, f_n) - r_{\text{max}}(f_1, \dots, f_i, \dots, f_n)}{\Delta f_i};$$
  
     $f_i \in \text{N}$   
      
$$d_i = -[r_{\text{max}}(f_1, \dots, f_i^*, \dots, f_n) - r_{\text{max}}(f_1, \dots, f_i, \dots, f_n)];$$
  
  EndCase  
Next i;  
Rank  $d_i, \forall i;$ 
```

TRIAL RUN

IMPLEMENTATION

FORAS

Flight Operations Risk Assessment System

EVA AIR

Frank Kao 高紹傑

Main Page | Interruption Report | Job Status | Administrator | Help

CP1

Run

NodeID	Description	Value		
TA01	Approach and Landing Related MEL items	<input type="text" value="0"/>		
TC01	Experience Pairing	<input type="text" value="5.50"/>		
TC02	Rank Composition	<input type="text" value="4"/>		
TC03	English Proficiency	<input type="text" value="5"/>		
TC04	Nationality	<input type="text" value="1"/>		
TC05	A/P Recency	<input type="text" value="0.20"/>	<input type="text" value="0.60"/>	<input type="text" value="0.23"/>
TC06	Special A/P	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
TC07	Previous Visits	<input type="text" value="110"/>	<input type="text" value="69"/>	<input type="text" value="23"/>
TC08	In-type experience	<input type="text" value="2815.90"/>	<input type="text" value="2848.90"/>	<input type="text" value="122.10"/>
TC09	Flying Recency	<input type="text" value="4"/>	<input type="text" value="19"/>	<input type="text" value="8"/>
TC10	Sectors @ Rank	<input type="text" value="288"/>	<input type="text" value="321"/>	<input type="text" value="11"/>
TC11	Pre-EVA Experience	<input type="text" value="344"/>	<input type="text" value="267"/>	<input type="text" value="300"/>
TC12	EVA Sectors	<input type="text" value="903"/>	<input type="text" value="834"/>	<input type="text" value="11"/>
TC13	Pre-Sectors in duty period	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
TC14	Pre-Duty hour	<input type="text" value="1"/>	<input type="text" value="1"/>	<input type="text" value="1"/>

INTERRUPTION REPORT

IMPLEMENTATION

FORAS

Flight Operations Risk Assessment System



Frank Kao 高紹傑

[Main Page](#) | [Interruption Report](#) | [Job Status](#) | [Administrator](#) | [Help](#)

Total Interruption Report : **3** T-Value with Missing Data

Departure

FLTNO	DEP. Time(TPE)	System Time	DEP A/P	ARR A/P	Fleet	Region	Missing Data
BR6191	2011/10/06 20:30	2011/10/06	NRT	TPE	MD11	NAS	TS16 TS03
BR19	2011/10/05 04:10	2011/10/05	GUM	TPE	A330	OCE	TS01 TS02 TS16 TS03

Arrival

FLTNO	DEP. Time(TPE)	System Time	DEP A/P	ARR A/P	Fleet	Region	Missing Data
BR6192	2011/10/06 15:05	2011/10/06	TPE	NRT	MD11	NAS	TS12 TS15 TS16 TS03

ADMINISTRATOR FUNCTION

IMPLEMENTATION

FORAS

Flight Operations Risk Assessment System

EVA AIR

Frank Kao 高紹傑

Main Page | Interruption Report | Job Status | Administrator | Help

Back | Authority Setting | Drop-down list

Authority Setting

New | Cancel

User ID | Display |

☐ Detail

☐ CPI

☐ Recalc

☐ Print

☐ Query

☐ Admin

Insert

ID	NAME	FSJ	DETAIL	CPI	REC	PRINT	QUERY	ADMIN	
e239171	William Yeh 葉武漢	1	1	1	1	1	1	1	<div>Edit Delete</div>
e844340	Niko Feng 馮久倫	1	1	1	1	1	1	0	<div>Edit Delete</div>
e861005	Frank Kao 高紹傑	1	1	1	1	1	1	1	<div>Edit Delete</div>
ed39168	Luis Lu 呂仕捷	1	0	0	0	0	1	0	<div>Edit Delete</div>

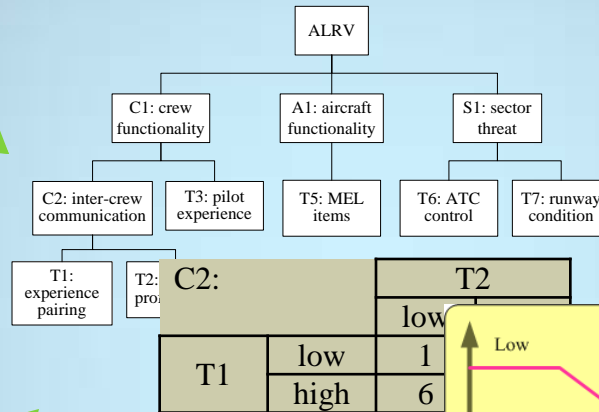
GROUP DECISION MAKING PROCESS



Dispatchers



Pilots



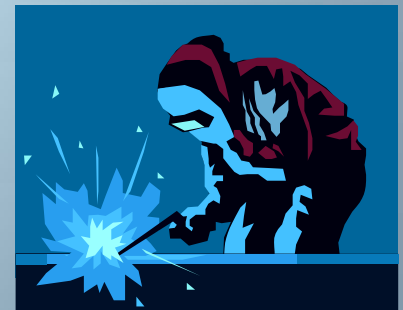
Safety Div.



Knowledge and experience elicitation



Maintenance Engineers



RUNNING OF FORAS

- ◎ 8007 flights were assessed between 2011/08/11 ~ 2011/10/25
- ◎ FORAS reports

Flight 001

○Crew :

Low risk value on fatigue, experience pairing, airport familiarization etc.

○A/C :

No MEL item.

○Sector :

Good visibility, precision APP & no terrain.

○ALRV: 2.77

FORAS Report

Flight Date: 2010	Flight No: BR	Sector:
Fleet: A330-200 All Passenger	A/C No: B16302	ETD: (GMT) ETA: (GMT)

ALRV : 2.77 (12.37%)

- Fleet Flight No & City Pair : 2.47

- Fleet Regional Average : 2.47

C0001-Crew Functionality : 3.51 (2.93) C0006-InterCrew Communication : 3.39 C0030-Multipilot Experience : 3.09 C0007-Crew Experience : 2.65 / 3.75 C0008-Airport Familiarity : 2.62 / 7.47 C0010-Flying Experience : 2.08 / 2.86 C0011-Aircraft Flying Experience : 1.00 / 1.00 C0003-Amount of Flying Experience : 1.00 / 1.00 C0002-PreEVA Experience : 9.00 / 7.00 C0024-PreEVA A/C Flying Experience : 10.00 / 10.00 C0031-Multipilot Stress : 3.97 C0012-Stress : 3.97 / 3.97 C0009-Overall Fatigue : 5.93 / 5.54 C0005-Transient Fatigue : 5.03 / 4.69 C0004-TF Work Amount : 1.00 / 1.00 C0014-TF Preflight Rest : 4.02 / 3.50 C0015-TF Inflight Rest : 10.00 / 10.00 C0016-TF Inflight Rest Availability : 10.00 C0017-Inflight Rest Quality : 8.24 / 8.24 C0018-Cumulative Fatigue : 5.66 / 5.74 C0019-CF Rest : 5.00 / 5.00 C0022-CF Work : 3.88 / 4.18 C0021-CF Work Preflying : 6.82 / 6.81 C0025-Prev7days Workload : 5.82 / 5.16 C0026-Prev7days Stress : 1.00 / 1.00 C0020-Prev30days Workload : 7.00 / 7.62 C0023-Prev30days Stress : 1.00 /	S0001-Sector Threat : 2.87 (2.53) S0002-Airport Issues : 3.10 S0004-ATC Functionality : 4.93 S0007-ATC & Crew Communication Quality : S0010-ATC & Crew Language Fluency : C0008-Airport Familiarity : 2.62 / 7.47 S0005-Airport Flying Complexity : 3.32 S0008-Airport Approach Complexity : 2.45 S0014-Flying Complexity of Approach : S0015-Approach Runway Complexity : S0009-Airport Environment Complexity : 1.27 S0018-Weather Issues : 1.22 S0020-Precipitation : 1.00 S0021-Wind or Turbulence S0022-Visual Conditions : 1.00 S0006-Airport Traffic Congestion Degree : 1.00 S0011-Airport Traffic Issues : 1.00 S0003-En-route Issues : 3.79 S0013-Flying Ride Concerns : 3.47 A0001-A/C Functionality : 1.00 (1.00)
---	--

Comments from FCD:

(1) "Terminal Variables" Which contribute to this high ALRV

(2) Action and Comments:

Prepared by: _____

FSD reviews:

* FORAS Approach & Landing Risk Value(ALRV) is a calculated risk assessment of the subject flight and will be used and reviewed by duty dispatcher and management as a risk evaluation and risk mitigation tool.

* The FORAS ALRV is from 1-10, lower value represent lower risk exposure.

ANALYSIS

Flight 002

●Crew :

Low risk value on crew pairing & experience, new airport to crew.

●A/C :

No MEL item.

●Sector :

Low visibility with VOR approach.

●ALRV: 3.02

FORAS Report

Flight Date: 2010	Flight No: BR	Sector:
Fleet: A330-200 All Passenger	A/C No: B16302	ETD: (GMT) ETA: (GMT)

ALRV : 3.02

- Fleet Flight No & City Pair : 2.47

- Fleet Regional Average : 2.47

<p>C0001-Crew Functionality : 3.62</p> <p>C0006-InterCrew Communication : 3.39</p> <p>C0030-Multipilot Experience : 4.06</p> <p>C0007-Crew Experience : 4.05 / 4.06</p> <p>C0008-Airport Familiarity : 10.00 / 10.00</p> <p>C0010-Flying Experience : 2.08 / 2.86</p> <p>C0011-Aircraft Flying Experience : 1.00 / 1.00</p> <p>C0003-Amount of Flying Experience : 1.00 / 1.00</p> <p>C0002-PreEVA Experience : 9.00 / 7.00</p> <p>C0024-PreEVA A/C Flying Experience : 10.00 / 10.00</p> <p>C0031-Multipilot Stress : 3.97</p> <p>C0012-Stress : 3.97 / 3.97</p> <p>C0009-Overall Fatigue : 5.93 / 5.54</p> <p>C0005-Transient Fatigue : 5.03 / 4.69</p> <p>C0004-TF Work Amount : 1.00 / 1.00</p> <p>C0014-TF Preflight Rest : 4.02 / 3.50</p> <p>C0015-TF Inflight Rest : 10.00 / 10.00</p> <p>C0016-TF Inflight Rest Availability : 10.00</p> <p>C0017-Inflight Rest Quality : 8.24 / 8.24</p> <p>C0018-Cumulative Fatigue : 5.66 / 5.74</p> <p>C0019-CF Rest : 5.00 / 5.00</p> <p>C0022-CF Work : 3.88 / 4.18</p> <p>C0021-CF Work Preflying : 6.82 / 6.81</p> <p>C0025-Prev7days Workload : 5.82 / 5.16</p> <p>C0026-Prev7days Stress : 1.00 / 1.00</p> <p>C0020-Prev30days Workload : 7.00 / 7.62</p> <p>C0023-Prev30days Stress : 1.00 /</p>	<p>S0001-Sector Threat : 3.60</p> <p>S0002-Airport Issues : 4.55</p> <p>S0004-ATC Functionality : 5.25</p> <p>S0007-ATC & Crew Communication Quality :</p> <p>S0010-ATC & Crew Language Fluency :</p> <p>C0008-Airport Familiarity : 10.00 / 10.00</p> <p>S0005-Airport Flying Complexity : 4.73</p> <p>S0008-Airport Approach Complexity : 4.02</p> <p>S0014-Flying Complexity of Approach :</p> <p>S0015-Approach Runway Complexity :</p> <p>S0009-Airport Environment Complexity : 5.88</p> <p>S0018-Weather Issues : 4.33</p> <p>S0020-Precipitation : 6.00</p> <p>S0021-Wind or Turbulence Warning :</p> <p>S0022-Visual Conditions : 4.28</p> <p>S0006-Airport Traffic Congestion Degree : 1.00</p> <p>S0011-Airport Traffic Issues : 1.00</p> <p>S0003-En-route Issues : 3.79</p> <p>S0013-Flying Ride Concerns : 3.47</p> <p>A0001-A/C Functionality : 1.00</p>
--	---

4.45

Comments from FCD:

(1) "Terminal Variables" Which contribute to this high ALRV

(2) Action and Comments:

Prepared by: _____

FSD reviews:

* FORAS Approach & Landing Risk Value(ALRV) is a calculated risk assessment of the subject flight and will be used and reviewed by duty dispatcher and management as a risk evaluation and risk mitigation tool.

* The FORAS ALRV is from 1-10, lower value represent lower risk exposure.

Flight 003

●Crew :

Medium risk value on fatigue and crew experience, etc.

●A/C :

One MEL item.

●Sector :

Low visibility with VOR approach and A/P surrounding with terrain.

●ALRV: 3.59

FORAS Report

Flight Date: 2010	Flight No: BR	Sector:
Fleet: A330-200 All Passenger	A/C No: B16302	ETD: (GMT) ETA: (GMT)

ALRV : 3.59

- Fleet Flight No & City Pair : 2.47
- Fleet Regional Average : 2.47

<p>C0001-Crew Functionality : 5.06 C0006-InterCrew Communication : 3.39 C0030-Multipilot Experience : 4.06 C0007-Crew Experience : 4.05 / 4.06 C0008-Airport Familiarity : 10.00 / 10.00 C0010-Flying Experience : 2.08 / 2.86 C0011-Aircraft Flying Experience : 1.00 / 1.00 C0003-Amount of Flying Experience : 1.00 / 1.00 C0002-PreEVA Experience : 9.00 / 7.00 C0024-PreEVA A/C Flying Experience : 10.00 / 10.00 C0031-Multipilot Stress : 6.97 C0012-Stress : 6.90 / 7.07 C0009-Overall Fatigue : 6.04 / 5.72 C0005-Transient Fatigue : 5.03 / 4.69 C0004-TF Work Amount : 1.00 / 1.00 C0014-TF Preflight Rest : 4.02 / 3.50 C0015-TF Inflight Rest : 10.00 / 10.00 C0016-TF Inflight Rest Availability : 10.00 C0017-Inflight Rest Quality : 8.24 / 8.24 C0018-Cumulative Fatigue : 7.95 / 8.06 C0019-CF Rest : 9.27 / 9.27 C0022-CF Work : 6.17 / 6.48 C0021-CF Work Preflying : 6.82 / 6.81 C0025-Prev7days Workload : 5.82 / 5.21 C0026-Prev7days Stress : 1.55 / 1.55 C0020-Prev30days Workload : 7.03 / 7.69 C0023-Prev30days Stress : 2.03 /</p>	<p>S0001-Sector Threat : 3.60 S0002-Airport Issues : 4.55 S0004-ATC Functionality : 5.25 S0007-ATC & Crew Communication Quality : S0010-ATC & Crew Language Fluency : C0008-Airport Familiarity : 10.00 / 10.00 S0005-Airport Flying Complexity : 4.73 S0008-Airport Approach Complexity : 4.02 S0014-Flying Complexity of Approach : S0015-Approach Runway Complexity : S0009-Airport Environment Complexity : 5.88 S0018-Weather Issues : 4.33 S0020-Precipitation : 6.00 S0021-Wind or Turbulence Warning : S0022-Visual Conditions : 4.28 S0006-Airport Traffic Congestion Degree : 1.00 S0011-Airport Traffic Issues : 1.00 S0003-En-route Issues : 3.79 S0013-Flying Ride Concerns : 3.47 A0001-A/C Functionality : 1.00</p>
---	---

4.83

Comments from FCD:

(1) "Terminal Variables" Which contribute to this high ALRV
(2) Action and Comments:

Prepared by: _____

FSD reviews:

FORAS Report

Flight Date: 2010 Flight No: BR Sector:
Fleet: A330-200 All Passenger A/C No: B16302 ETD: (GMT) ETA: (GMT)

ALRV : 2.77 (12.37%)

- Fleet Flight No & City Pair : 2.47
- Fleet Regional Average : 2.47

<p>C0001-Crew Functionality : 3.51 (2.93) C0006-InterCrew Communication : 3.39 C0030-Multiplier Experience : 3.09 C0007-Crew Experience : 2.65 / 3.75 C0008-Airport Familiarity : 2.62 / 7.47 C0010-Flying Experience : 2.08 / 2.86 C0011-Aircraft Flying Experience : 1.00 / 1.00 C0003-Amount of Flying Experience : 1.00 / 1.00 C0002-PreEVA Experience : 9.00 / 7.00 C0024-PreEVA A/C Flying Experience : 10.00 / 10.00 C0031-Multiplier Stress : 3.97 C0012-Stress : 3.97 / 3.97 C0009-Overall Fatigue : 5.93 / 5.54 C0005-Transient Fatigue : 5.03 / 4.69 C0004-TF Work Amount : 1.00 / 1.00 C0014-TF Preflight Rest : 4.02 / 3.50 C0015-TF Inflight Rest : 10.00 / 10.00 C0016-TF Inflight Rest Availability : 10.00 C0017-Inflight Rest Quality : 8.24 / 8.24 C0018-Cumulative Fatigue : 5.66 / 5.74 C0019-CF Rest : 5.00 / 5.00 C0022-CF Work : 3.88 / 4.18 C0021-CF Work Preflying : 6.82 / 6.81 C0025-Prev7days Workload : 5.82 / 5.16 C0026-Prev7days Stress : 1.00 / 1.00 C0020-Prev30days Workload : 7.00 / 7.62 C0023-Prev30days Stress : 1.00 /</p>	<p>S0001-Sector Threat : 2.87 (2.53) S0002-Airport Issues : 3.10 S0004-ATC Functionality : 4.93 S0007-ATC & Crew Communication Quality : S0010-ATC & Crew Language Fluency : C0008-Airport Familiarity : 2.62 / 7.47 S0005-Airport Flying Complexity : 3.32 S0008-Airport Approach Complexity : 2.45 S0014-Flying Complexity of Approach : S0015-Approach Runway Complexity : S0009-Airport Environment Complexity : 1.27 S0018-Weather Issues : 1.22 S0020-Precipitation : 1.00 S0021-Wind or Turbulence Warning : 5.92 S0022-Visual Conditions : 1.00 S0006-Airport Traffic Congestion Degree : 1.00 S0011-Airport Traffic Issues : 1.00 S0003-En-route Issues : 3.79 S0013-Flying Ride Concerns : 3.47</p>
--	---

A0001-A/C Functionality : 1.00 (1.00)

Comments from FCD:

(1) "Terminal Variables" Which contribute to this high ALRV

(2) Action and Comments:

Prepared by: _____

FSD reviews:

FORAS Report

Flight Date: 2010 Flight No: BR Sector:
Fleet: A330-200 All Passenger A/C No: B16302 ETD: (GMT) ETA: (GMT)

ALRV : 3.59

- Fleet Flight No & City Pair : 2.47
- Fleet Regional Average : 2.47

<p>C0001-Crew Functionality : 5.06 C0006-InterCrew Communication : 3.39 C0030-Multiplier Experience : 4.06 C0007-Crew Experience : 4.05 / 4.06 C0008-Airport Familiarity : 10.00 / 10.00 C0010-Flying Experience : 2.08 / 2.86 C0011-Aircraft Flying Experience : 1.00 / 1.00 C0003-Amount of Flying Experience : 1.00 / 1.00 C0002-PreEVA Experience : 9.00 / 7.00 C0024-PreEVA A/C Flying Experience : 10.00 / 10.00 C0031-Multiplier Stress : 6.97 C0012-Stress : 6.90 / 7.07 C0009-Overall Fatigue : 6.04 / 5.72 C0005-Transient Fatigue : 5.03 / 4.69 C0004-TF Work Amount : 1.00 / 1.00 C0014-TF Preflight Rest : 4.02 / 3.50 C0015-TF Inflight Rest : 10.00 / 10.00 C0016-TF Inflight Rest Availability : 10.00 C0017-Inflight Rest Quality : 8.24 / 8.24 C0018-Cumulative Fatigue : 7.95 / 8.06 C0019-CF Rest : 9.27 / 9.27 C0022-CF Work : 6.17 / 6.48 C0021-CF Work Preflying : 6.82 / 6.81 C0025-Prev7days Workload : 5.82 / 5.21 C0026-Prev7days Stress : 1.55 / 1.55 C0020-Prev30days Workload : 7.03 / 7.69 C0023-Prev30days Stress : 2.03 /</p>	<p>S0001-Sector Threat : 3.60 S0002-Airport Issues : 4.55 S0004-ATC Functionality : 5.25 S0007-ATC & Crew Communication Quality : S0010-ATC & Crew Language Fluency : C0008-Airport Familiarity : 10.00 / 10.00 S0005-Airport Flying Complexity : 4.73 S0008-Airport Approach Complexity : 4.02 S0014-Flying Complexity of Approach : S0015-Approach Runway Complexity : S0009-Airport Environment Complexity : 5.88 S0018-Weather Issues : 4.33 S0020-Precipitation : 6.00 S0021-Wind or Turbulence Warning : S0022-Visual Conditions : 4.28 S0006-Airport Traffic Congestion Degree : 1.00 S0011-Airport Traffic Issues : 1.00 S0003-En-route Issues : 3.79 S0013-Flying Ride Concerns : 3.47</p>
---	--

A0001-A/C Functionality : 1.00

Comments from FCD:

(1) "Terminal Variables" Which contribute to this high ALRV

(2) Action and Comments:

Prepared by: _____

FSD reviews:

* FORAS Approach & Landing Risk Value(ALRV) is a calculated risk assessment of the subject flight and will be used and reviewed by duty dispatcher and management as a risk evaluation and risk mitigation tool.

* The FORAS ALRV is from 1-10, lower value represent lower risk exposure.

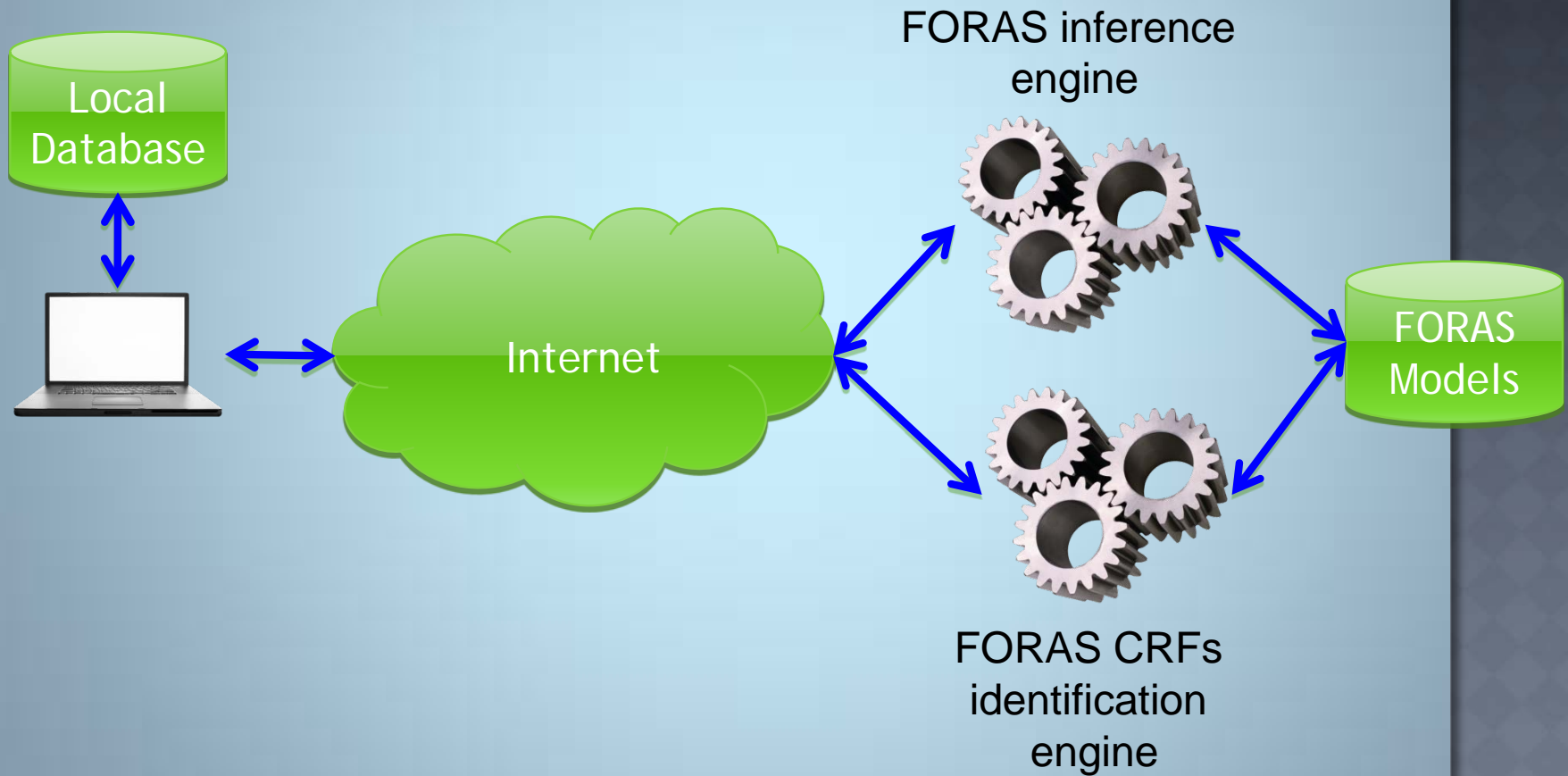
RESULTS

- ◎ Approach and Landing Risk Model
 - 53 base variables (risk factors), 39 rule sets (each rule set contains 4~27 rules)
- ◎ Departure Risk Model
 - 39 base variables, 30 rule sets
- ◎ A FORAS computer system that enables users to easily build any risk assessment model
- ◎ Real-time flight risk assessment report and online analysis

ONGOING DEVELOPMENT

- ◉ Analytic approaches for model validation
- ◉ Systematic approaches for group decision making process
- ◉ FORAS in a cloud computing architecture

CLOUD COMPUTING ARCHITECTURE IN DEVELOPING



THANK YOU!