

FORAS - A Predictive Tool for SMS

安全管理系統風險預測工具 - 飛航作業風險評估系統

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Safety Goal

- A predictive, proactive & reactive risk management approach to prevent the accident and human error from happening.



Safety Risk Management

- The core elements of Safety Management System are hazard identification & risk management.
- Adoption of best practice.

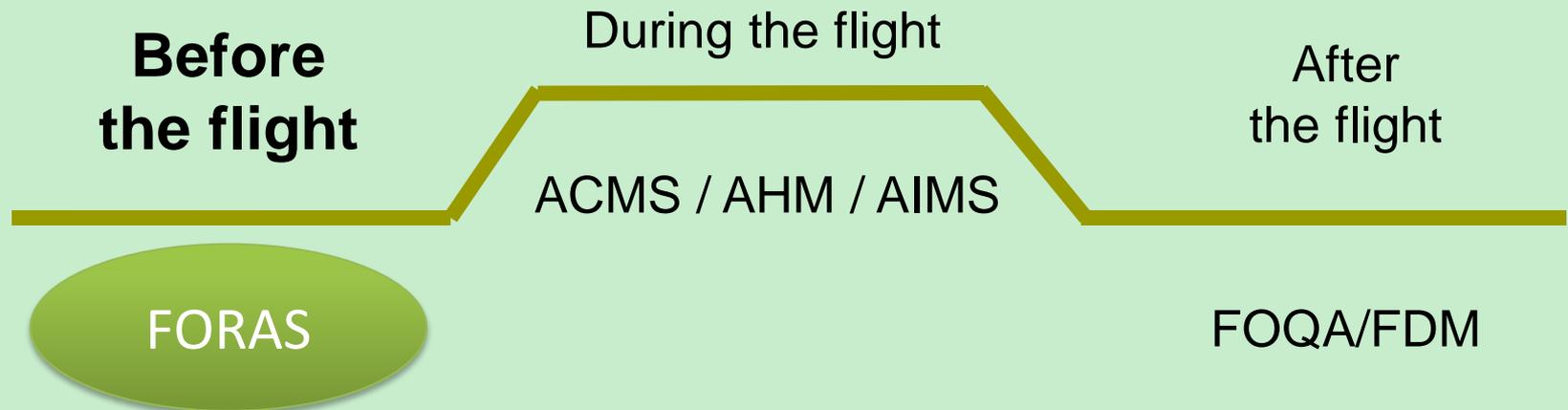


Flight Operation Risk

- ❑ Newly check out Captain and F/O flying together
 - ❑ Non precision approach or ILS out of service
 - ❑ Strong cross wind
 - ❑ Low visibility with rain or snow
 - ❑ Thrust Reverser INOP
 - ❑ RWY is not grooved
 - ❑ The complexity of approach procedure & runway configuration
 - ❑ Operating crew never operating into this airport before
 - ❑ Fatigued crew with MRT
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What is FORAS?

- FORAS is a methodology which serves as a tool on hazard identification and risk management in flight operation in order to achieve a *proactive and predictive* approach of Safety Management System.



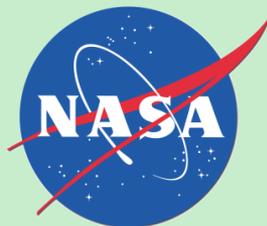
FORAS: Flight Operations Risk Assessment System

- ❑ To retrieve the data from crew, weather (TAF), NOTAM and MEL which related to departure and landing into the risk model for calculating the risk values(DRV/ALRV) on respective flight.
- ❑ It is a decision and support tool to measure and reduce risk exposure, not a GO or NO GO tool.



1. Project Background

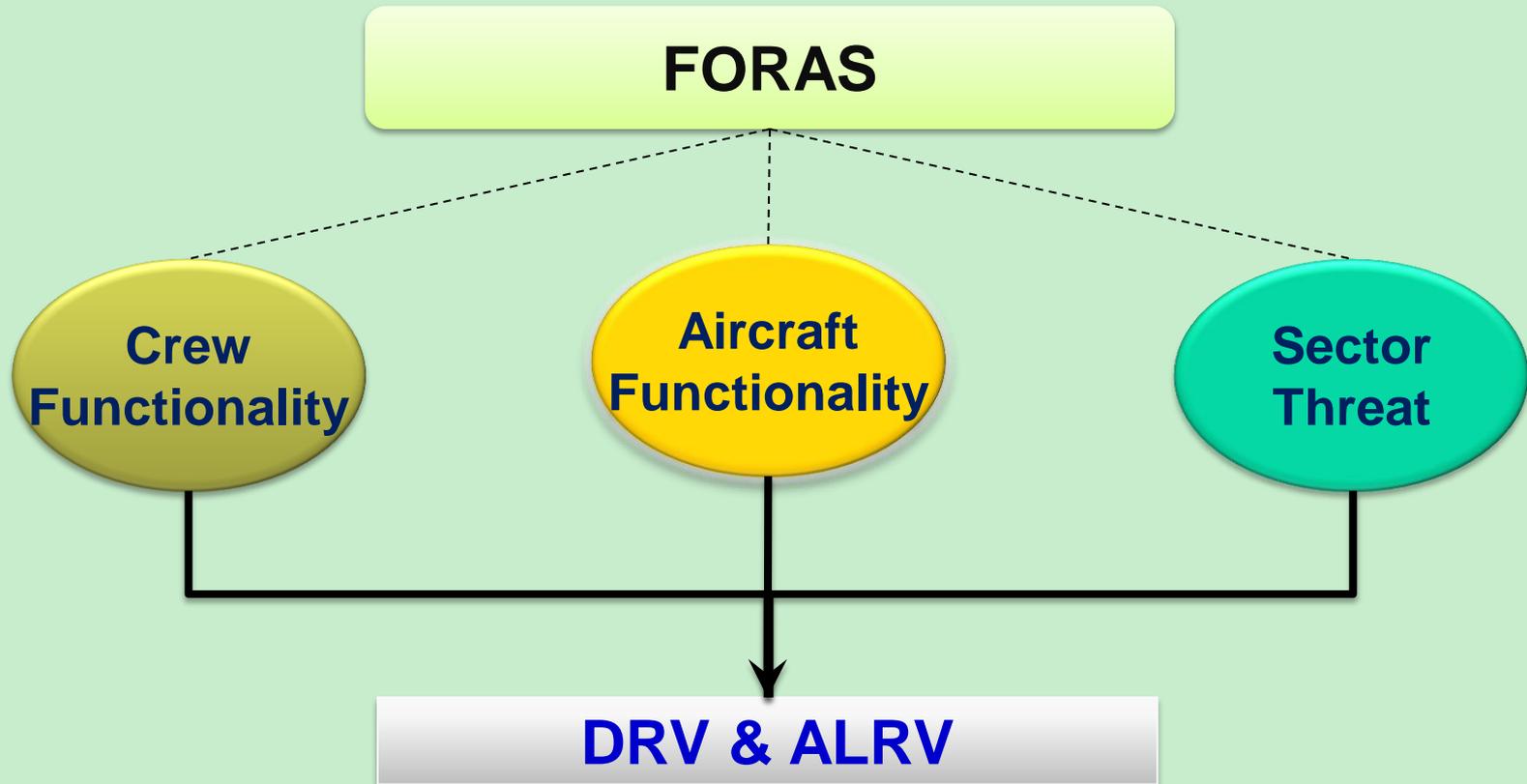
- ❑ Initiated by the ICARUS Committee of the Flight Safety Foundation in the middle 1990s, and was sponsored principally by the NASA Aviation Safety Program.
- ❑ The prototype of FORAS model was developed by Dr. Michael Hadjimichael, Naval Research Laboratory (NRL).
- ❑ EVA was cooperated with Dr. Michael Hadjimichael in 2004 to develop the FORAS which tailored to EVA's operations until 2008.
- ❑ A further development is being performed continuously between EVA and Tamkang University in Taiwan, since July, 2009.



Thinking about...

- **What** is average risk for sector TPE-LAX during 2015?
- **Why** has risk increased in the second half of 2015?
- **How** will risk assessment change...
 - when crew rest policies are altered?
 - when equipment is changed?
 - after a crew substitution in that flight?

2. System Architecture

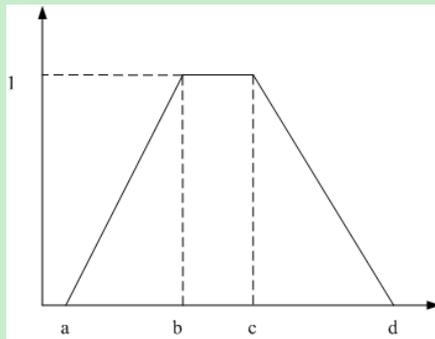


DRV : Departure Risk Value

ALRV : Approach & Landing Risk Value

3. FORAS Technology

- Assessment performed using a fuzzy set-based mathematical model which synthesizes inputs.
 - Membership Functions
 - Multi-Layer FIS (Rule Tables)
 - Defuzzification



$$\Pi(x) = \frac{1}{1 + \left(\frac{x-a}{b}\right)^2}$$



4. System Operations

- The system will generate two qualified risk values of DRV and ALRV automatically 2.5 HRs before the departure of respective flight.
- The classification of risk exposure

Green : 1 ~ <3

Yellow : 3 ~ <5



Red : 5 ~ 10

- When a yellow or red flight is triggered, an C.P.I. (Critical Parameter Index) will be generated and provided to crew for risk assessment.

- ❑ Crew could access the FORAS output via iPad on a Wi-Fi environment as part of their pre-flight preparations.
- ❑ The system also will calculate the ALRV 45 minutes before the arrival of respective flight for a comparison and trend analysis.

FORAS Flight Operations Risk Assessment System

FLIGHT STATUS INTERRUPT REPORT

Fleet Type: Regional Dep. Time(TPE): 2016/01/01 ~ 2016/01/01 Flight Number:

Normal Warning Alert Data Incomplete Above Avg. Interrupted Process

DEP	ARR	Dep. Time(TPE)	Flt No.	DEP A/P	ARR A/P	Fleet	A/C No.	Region	DRV	ALRV	Arr. T
2016/01/01	2016/01/01	23:40	BR61	TPE	EKK	A330	B16307	SEA	1.000	1.000 \ 1.000	2016/01/01
2016/01/01	2016/01/01	21:50	BR827	TPE	HKG	A321	B16220	CHN	1.000	1.000 \ 1.000	2016/01/01
2016/01/01	2016/01/01	21:45	BR810	HKG	TPE	A321	B16212	TWN	1.000	1.000 \ 1.000	2016/01/01
2016/01/01	2016/01/01	21:10	BR179	KIX	TPE	A321	B16216	TWN	1.000	1.000 \ 1.000	2016/01/01
2016/01/01	2016/01/01	21:05	BR761	TNA	TPE	A321	B16222	TWN	2.391	1.333 \ 1.333	2016/01/01
2016/01/01	2016/01/01	20:55	BR858	HKG	TPE	A330	B16308	TWN	1.000	1.000 \ 1.000	2016/01/01
2016/01/01	2016/01/01	20:30	BR261	TPE	MNL	A321	B16219	SEA	1.000	1.000 \ 3.000	2016/01/01
2016/01/01	2016/01/01	20:25	BR150	TPE	ICN	A330	B16335	JAK	1.000	1.000 \ 1.000	2016/01/01
2016/01/01	2016/01/01	20:20	BR806	MFM	TPE	A321	B16210	TWN	1.000	1.000 \ 1.000	2016/01/01
2016/01/01	2016/01/01	20:20	B7125	NGK	TPE	A321	B16221	TWN	1.000	1.000 \ 1.000	2016/01/01
2016/01/01	2016/01/01	20:05	BR705	PVG	KHH	A321	B16213	TWN	1.000	1.000 \ 1.000	2016/01/01
2016/01/01	2016/01/01	19:50	BR771	SHA	TSA	A330	B16331	TWN	1.127	1.127 \ 1.127	2016/01/01
2016/01/01	2016/01/01	19:50	BR171	ICN	KHH	A321	B16211	TWN	1.000	1.000 \ 1.000	2016/01/01
2016/01/01	2016/01/01	19:40	BR836	MFM	KHH	A321	B16205	TWN	1.333	1.333 \ 1.333	2016/01/01
2016/01/01	2016/01/01	19:40	BR195	NRT	TPE	A321	B16206	TWN	1.000	1.000 \ 1.000	2016/01/01



ARRIVAL ✕

Crew	Recommended Action(s)
<ul style="list-style-type: none"> CAP - 115 116 張 張 CHANG 	<ul style="list-style-type: none"> High X-wind may encountered, please check crew's X-wind limitation.
<ul style="list-style-type: none"> CAP - B7 113 113 張 張 LU 	<ul style="list-style-type: none"> High X-wind may encountered, please check crew's X-wind limitation.
<ul style="list-style-type: none"> FO - D3 118 118 張 張 LAI 	<ul style="list-style-type: none"> Crew is new to the type of A/C. High X-wind may encountered, please check crew's X-wind limitation.

PERSONAL
GROUP

Case Study

Crew Functionality:

- Low type hours(CM1 & CM2):
TC08_C → 300 hrs.
TC08 → 500 hrs.
- First time to SFO in the last 12 months
(CM1 & CM2):
TC07_C, TC07, TC05_C, TC05.

Sector Threat:

Non precision approach: ILS out of service.

Aircraft Functionality:

No MEL item

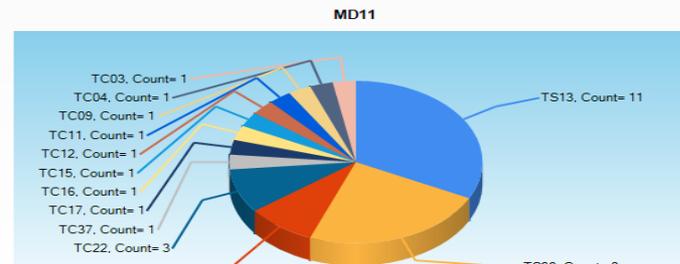
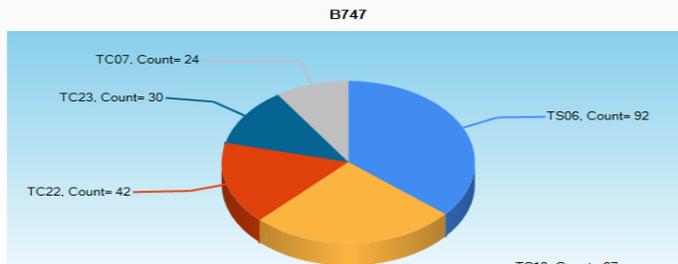
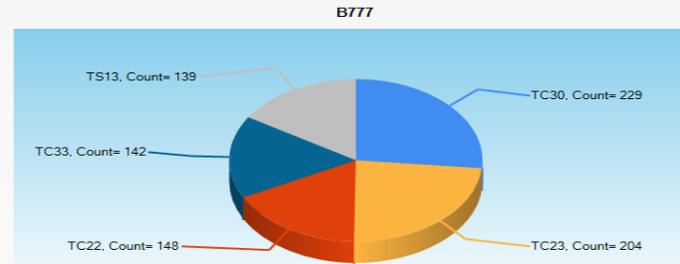
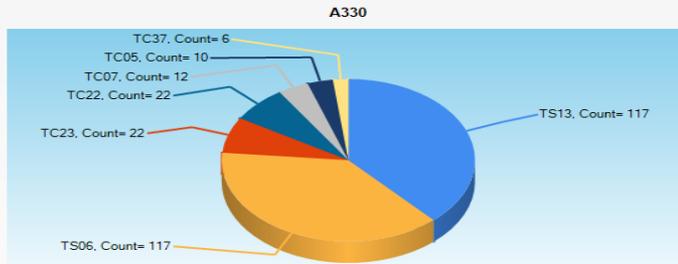


DRV: 1

ALRV: 4.13

Statistic Analysis

--- Wide Body CPI Analysis ---
TOP 5



A330 RANK_NO	A330 CPI_COUNT	A330 CPI_NODE_NAME_REVISIED	B747 RANK_NO	B747 CPI_COUNT	B747 CPI_NODE_NAME_REVISIED	B777 RANK_NO	B777 CPI_COUNT	B777 CPI_NODE_NAME_REVISIED	MD11 RANK_NO	MD11 CPI_COUNT	MD11 CPI_NODE_NAME_REVISIED
	117	TS13		92	TS06		229	TC30		11	TS13
	117	TS06		67	TS13		204	TC23		8	TS06
	22	TC23		42	TC22		148	TC22		3	TC23
	22	TC22		30	TC23		142	TC33		3	TC22
	12	TC07		24	TC07		139	TS13		1	TC37
	10	TC05								1	TC17
	6	TC37								1	TC16
										1	TC15
										1	TC12
										1	TC11
										1	TC09
										1	TC04
										1	TC03

5. Future Challenges

- Online Analytical Processing (OLAP)
- Big Data Application
- Real Time Monitoring

- Thank You -

