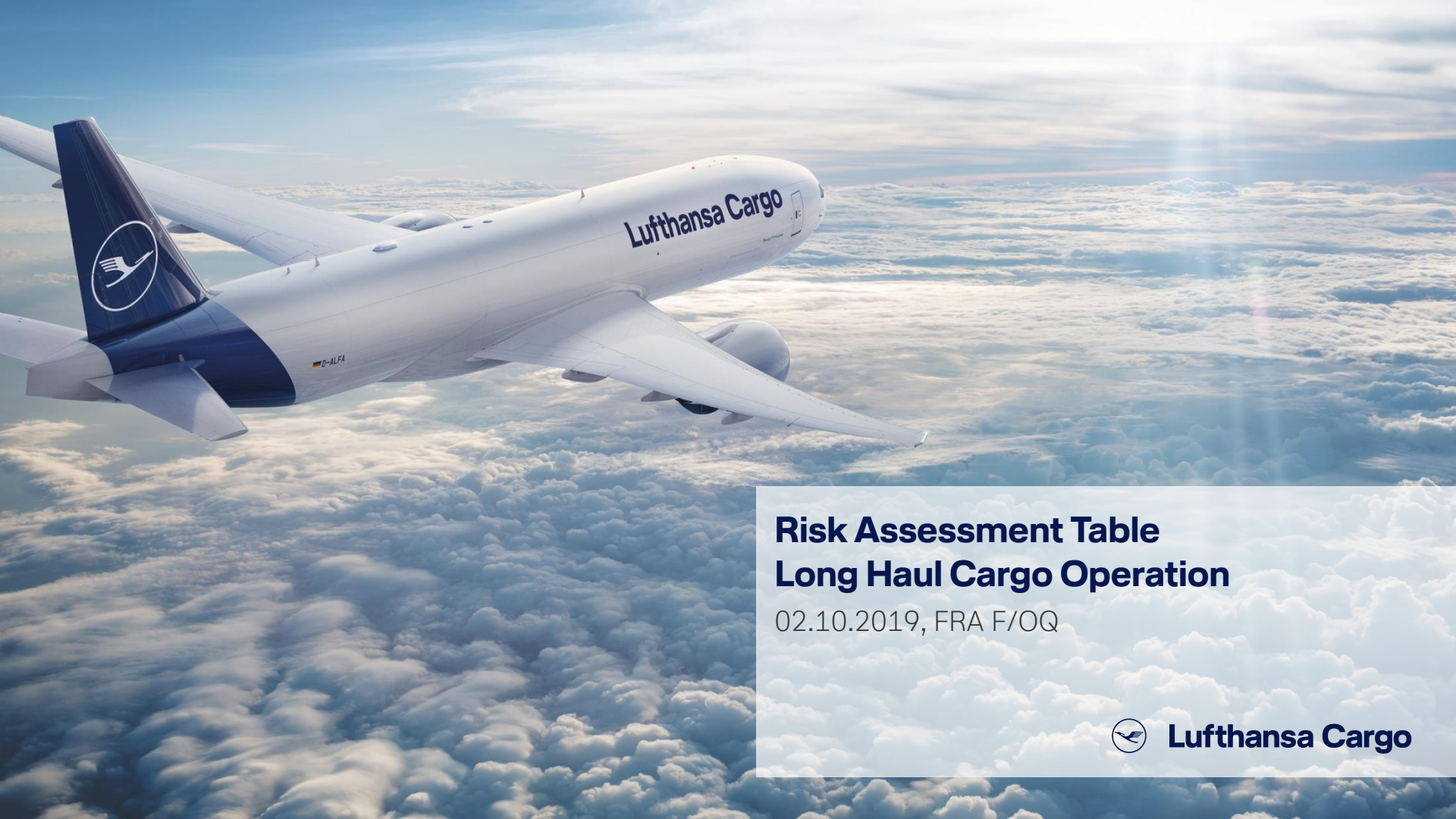

Risk Assessment Table
Long Haul Cargo Operation

02.10.2019, FRA F/OQ

Lufthansa Cargo

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Who am I?

...some personal facts...

- Moritz “Mo” Senkspiel, 38 years old, married, 2 boys, “home near Cologne, Germany”

- First Officer since 2005 – Germanwings A320family
- With Lufthansa Cargo since 2009
  - FO/SFO (PICR) MD11F (until 2013)
  - SFO (PICR) B777F

- Since May 2018 working at Lufthansa Cargo`s Flight Safety Department
  - Supervising the FRMS
  - Advisor to FRM Manager
- Since January 2019 – Chairman of Lufthansa Group FRM Team

Lufthansa Cargo – Overview Ops

...some company facts...challenges for FRM

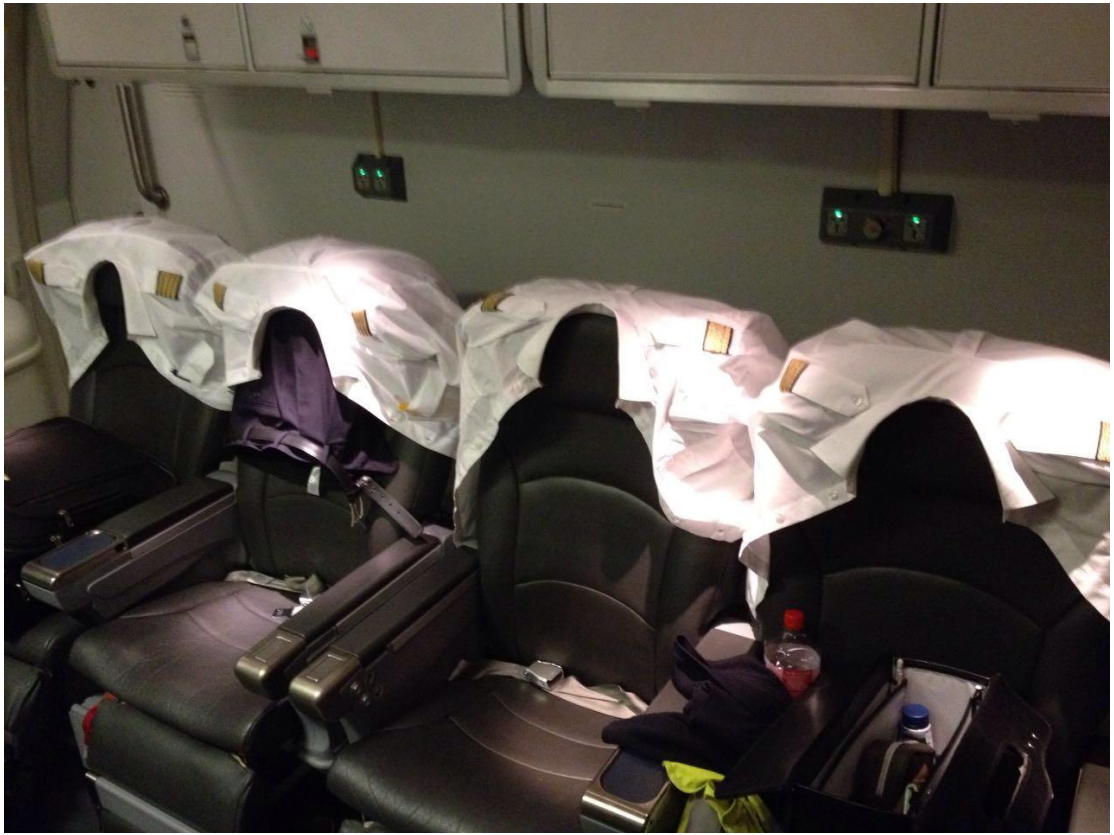
- Fleet:
  - 9 MD11F
  - 7 B777F

- Operation with FDT from **03:45h – 16:30h**
  - Crews from **2CM – 4CM**
- Operation with **two different crew rest compartments**
  - EASA Class 1 – B777F
  - EASA Class 2 – MD11F

- Mostly old IT-Systems **without** the possibility of directly implementing a “life” bio-mathematical model.

2 Leg-Enlargement

...what are we facing...



2 Leg-Enlargement

...what are we facing...

- After negotiations of different collective agreements in 2017, Lufthansa Cargo was allowed to fly so called “2 Leg-Enlargement” operation under the umbrella of FRM.
  - 3 CM – **FDT up to 16:00h** (one leg minimum 8h block time) – with **FSAG unanimity > 16:00h**
  - 4 CM – **FDT up to 17:30h**
  - Max. 2 legs
- At the beginning **no** operational experience – **gaining** more and more since then...
- Very few scientific studies on this specific operation.
- **Different combination of leg length** – especially with 4 CM
  - Short followed by long or vice versa
  - Two medium length

- **New approach of risk assessment required.**

Risk Assessment Table

...a “historic view”...

- The Risk Assessment Table was **originally developed** by Kristjof Tritschler in 2015.

- “Designed” for a low cost short haul ops it had to be **modified for long haul cargo operation**. New fatigue factors and acclimatization (“body time”) had to be added – e.g.:
  - *Less then two consecutive nights to recover preceding sleep depth*
  - *Flight into daylight and daylight longer present than at acclimatized time zone*

- **Latest scientific results** from “EASA Study” – Effectiveness of Flight Time Limitation – Final Report where added.

Risk Assessment Table

...bottom line – filet fatigue...

- The puzzle of fatigue containing of

SLEEP DEBT (x 1,25)	e.g. Previous night sleep reduced >4h (night: 22:00-08:00 BT)
WAKEFULLNESS (x1,0)	e.g. Time since awake >6h prior C/I
CIRCADIAN FACTORS (x 0,75)	e.g. FDP starting between 02:00 – 04:59 BT
WORKLOAD (x 0,5)	e.g. 2 consecutive flights/sectors – “Two-leg Enlargement Flights”

- Reasons/areas of fatigue differently weighted

Risk Assessment Table

...how to proceed...

- Getting the puzzle into numeric data – keeping it digitally simple
  - 1 = fatigue factor present
  - 0 = fatigue factor not present

- Summing up the numbers

- Asking the question if fatigue factors can be mitigated
  - 1 = fatigue factor still present
  - 0 = fatigue factor in mitigated

- Summing up the numbers

Risk Assessment Table

...the full table...

Lufthansa Cargo (augmented)

	Fatigue Factor:	Present/Suspected:	Mitigated:	Comments:	Scientific Source:
Sleep debt	Previous night sleep reduced ≤ 4h (night: 22-08 BT)**	0	0		3.,4.,15.,16.
	Previous night sleep reduced > 4h (night: 22-08 BT)**	0	0		3.,4.,15.,16.
	Reduced night sleep > 4h before previous night ***	0	0		3.,4.,6.
	Previous "night duty"** (day sleep only)**	0	0		14.
	Less than two consecutive nights to recover preceeding sleep depth	0	0	Only applicable when preceeding duty within rotation exists.	5.,9.
	Sum of fatigue factors x1,25:	0	0		
Wakefulness	Time since awake > 2h prior C/I *	0	0		8.,15.
	Time since awake > 6h prior C/I *	0	0		8.,15.
	Time on task > 10h (FDT)****	0	0		1.,2.,7.,17.,18.,19.
	Time on task > 12h < 14h (FDT)****	0	0	No time on task > 14h recommended.	1.,2.,7.,17.,18.,19.
	Sum of fatigue factors x1,0:	0	0		
Circadian Factors	Circadian disruption > 4h (TZD)	0	0	At time of C/I.	20.
	Flight into daylight and daylight longer present then at acclamitized time zone	0	0	If this is the case, use -1 as entry.	11.,12.,13.
	Flight into darkeness and darkness longer present then at acclamitized time zone	0	0		27.
	FDP starting between 02:00 - 04:59 BT	0	0		10.
	FDP ending between 02:00 - 05:59 BT and starting at 01:59 BT or earlier	0	0		10.
	FDP ending at 06:00 BT or later and starting at 01:59 BT or earlier	0	0		10.
	Sum of fatigue factors x0,75:	0	0		
Workload	2 consecituve flight/sectors - "Two-leg Enlargement Flights"	0	0		a.
	Known hassles (airport / ATC) and / or LCAG "hot spots" (incidents in database)	0	0		21.,22.,23.,24.,25.
	Training Flights	0	0		26.
	Sum of fatigue factors x0,5:	0	0		
	Sum of fatigue factors - weigthed:	0	0		

Assessment of fatigue factors:	BT= "body" time (acclimitisation 1,5h/day westwards, 1,0h/day eastwards)
0-3 relevant factors: accept	* Crew members's responsibility
4-6 relevant factors: check	** Depending on preceding duty
7-9 relevant factors: mitigate	*** The night before, 2 consecutive nights are relevant
> 10 relevant factors: not acceptable	**** FDT - in flight rest (min. rest time =2:30h in order to guarantee one full sleep cycle of 90min)

Note: Factors are weighted according to their importance! Sleep debt (x1,25), wakefulness (x1,0), circadian factors (x0,75) and workload (x0,5).

- Don`t try to read it – handout will be available as download ☺
- Two versions
  - Augmented
  - Non- augemented
- **BEHIND EVERY FATIGUE FACTOR THERE IS A SCIENTIFIC SOURCE.**

Risk Assessment Table

...how to proceed...Fatigue Acceptability...

- Taking the sum and putting it into risk categories

Relevant factors	Acceptability
0-3	Accept
4-6	Check
7-9	Mitigate
>9	Not Acceptable

e.g. Check for possible mitigation

e.g. Find and apply possible mitigation

- **DO THIS FOR BOTH "NUMBER SUMS" – FATIGUE FACTORS BEFORE AND AFTER MITIGATION**

Risk Assessment Table

...how to proceed...Risk Assessment...

- Taking the relevant factors into a risk assessment matrix

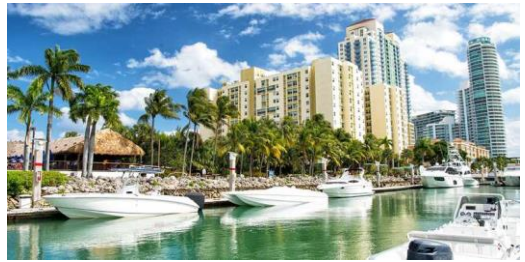
Relevant factors	Scheduled once per rotation	Scheduled twice per rotation	Scheduled three times per rotation
0-3	low	low	low
4-6	moderate	moderate	high
7-9	high	high	very high
>9	high	very high	very high

Examples

...2 Leg Enlargement Flights with different departure times...

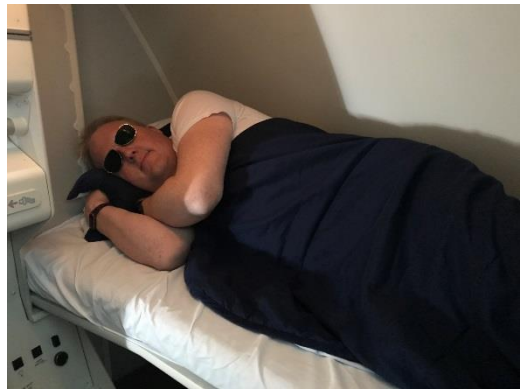
e.g. FRA – MIA – ATL
STD: 11:55 UTC

e.g. FRA – MIA – ATL
STD: 15:40 UTC



- FDT = 16:15h
- Operation with “heavy enlarged” crew – 2 CPT / 2 (S)FO.

?



Examples

...STD 11:55...

		Present/Suspected:	Mitigated:
Wakefullness	Time since awake > 2h prior C/I *	1	1
	Time since awake > 6h prior C/I *	0	0
	Time on task > 10h (FDT)****	1	1
	Time on task > 12h < 14h (FDT)****	1	1
Workload	2 consecituve flight/sectors - "Two-leg Enlargement Flights"	1	1
	Known hassles (airport / ATC) and / or LCAG "hot spots" (incidents in database)	0	0
	Training Flights	1	0

Examples

...STD 11:55...

		Present/Suspected:	Mitigated:
Circadian Factors	Circadian disruption > 4h (TZD)	0	0
	Flight into daylight and daylight longer present then at acclamitized time zone	-1	-1
	Flight into darkeness and darkness longer present then at acclamitized time zone	0	0
	FDP starting between 02:00 - 04:59 BT	0	0
	FDP ending between 02:00 - 05:59 BT and starting at 01:59 BT or earlier	0	0
	FDP ending at 06:00 BT or later and starting at 01:59 BT or earlier	1	1

Examples

...STD 11:55...

	Present/Suspected:	Mitigated:
Sum of fatigue factors - weigthed:	5	4,5

Relevant factors	Acceptability
0-3	Accept
4-6	Check
7-9	Mitigate
>9	Not Acceptable

Examples

...STD 15:40...

		Present/Suspected:	Mitigated:
Wakefullness	Time since awake > 2h prior C/I *	1	1
	Time since awake > 6h prior C/I *	1	0
	Time on task > 10h (FDT)****	1	1
	Time on task > 12h < 14h (FDT)****	0	0
Workload	2 consecituve flight/sectors - "Two-leg Enlargement Flights"	1	1
	Known hassles (airport / ATC) and / or LCAG "hot spots" (incidents in database)	0	0
	Training Flights	1	0

Examples

...STD 15:40...

		Present/Suspected:	Mitigated:
Circadian Factors	Circadian disruption > 4h (TZD)	0	0
	Flight into daylight and daylight longer present then at acclamitized time zone	-1	-1
	Flight into darkeness and darkness longer present then at acclamitized time zone	0	0
	FDP starting between 02:00 - 04:59 BT	0	0
	FDP ending between 02:00 - 05:59 BT and starting at 01:59 BT or earlier	0	0
	FDP ending at 06:00 BT or later and starting at 01:59 BT or earlier	1	1

Examples

...STD 15:40...

	Present/Suspected:	Mitigated:
Sum of fatigue factors - weigthed:	4	2,5

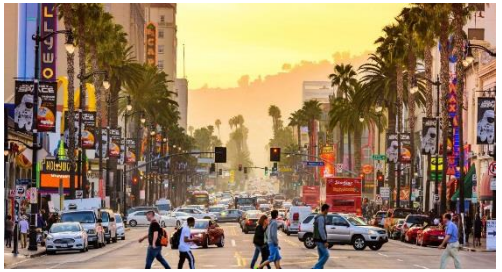
Relevant factors	Acceptability
0-3	Accept
4-6	Check
7-9	Mitigate
>9	Not Acceptable

Examples

...Enlargement Flights with different crew rotations...

e.g. LAX - FRA

STD: 00:30 UTC



- Operation with enlarged crew – 1 CPT / 1 SFO / 1 FO
- Crew rotations are different for CPT/FO and SFO – rendezvous at LAX

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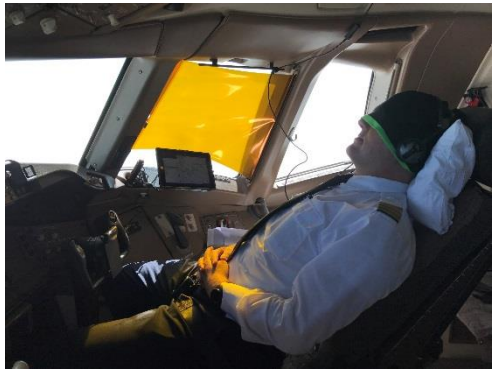


Examples

...CPT / FO...

		Present/Suspected:	Mitigated:
Wakefullness	Time since awake > 2h prior C/I *	1	1
	Time since awake > 6h prior C/I *	1	0
	Time on task > 10h (FDT)****	0	0
	Time on task > 12h < 14h (FDT)****	0	0
Sum of fatigue factors x1,0:		**2**	**1**
Circadian Factors	Circadian disruption > 4h (TZD)	1	1
	Flight into daylight and daylight longer present then at acclamitized time zone	0	0
	Flight into darkeness and darkness longer present then at acclamitized time zone	1	1
	FDP starting between 02:00 - 04:59 BT	0	0
	FDP ending between 02:00 - 05:59 BT and starting at 01:59 BT or earlier	0	0
	FDP ending at 06:00 BT or later and starting at 01:59 BT or earlier	1	1
Sum of fatigue factors x0,75:		**2,25**	**2,25**

Examples

...CPT / FO...

- Give recommendations to crew member (e.g.):
  - **Advice crew on importance of daylight exposure**
  - **Recommend nap before duty**

	Present/Suspected:	Mitigated:
Sum of fatigue factors - weigthed:	4,75	3,25

Examples

...SFO...

		Present/Suspected:	Mitigated:
Sleep debt	Previous night sleep reduced ≤ 4h (night: 22-08 BT)**	1	0
	Previous night sleep reduced > 4h (night: 22-08 BT)**	1	0
	Reduced night sleep > 4h before previous night ***	1	1
	Previous "night duty"** (day sleep only)**	1	0
	Less than two consecutive nights to recover preceeding sleep depth	1	1

Sum of fatigue factors - weigthed:	11	5,75

Examples

...SFO...

- We`re facing „rendezvoused“ crew @ LAX with different levels of fatigue.
- First there is a need for identifying mitigation measures for the SFO (e.g.):
  - **Change DH flight and possibly reduce minimum rest or extend rest to provide better sleep opportunities.**
- Second there is the need to evaluate the risk considering the complete crew:

ASSESSMENT TABLE HELPS TO FURTHER SUPPORT RISK EVALUATION AND PROVIDES A METHODOLOGY WHICH IS REPRODUCABLE.

Restrictions

...theory and practice...

- Table is **“tailored to cargo ops”** – needs to be modified for every operation.
- Table is **“Version 1.0”** and needs to **“mature”** with operational experience and further scientific results.
- Fatigue Risk Acceptability needs to be **“proven” during applicability of the table** and further operational experience (e.g. threshold for further risk assessment).

FRM Approach

...you know what it means...

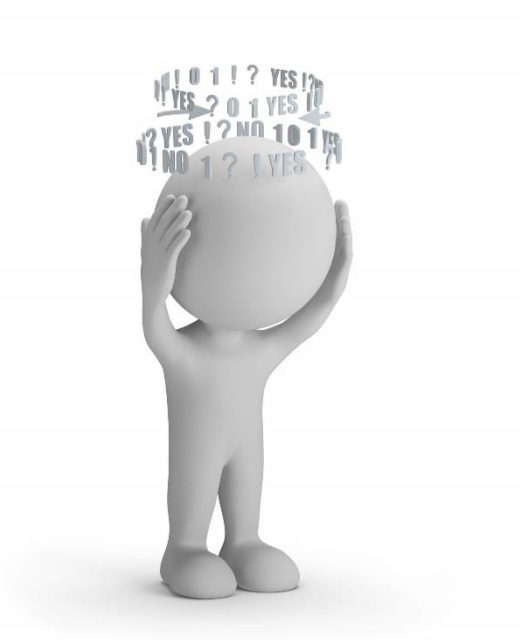
- Table is **PIECE OF RISK ASSESSMENT** – and part of multi-layered approach.
- Table is **PART OF ROOT CAUSE ANAYLYSIS**.

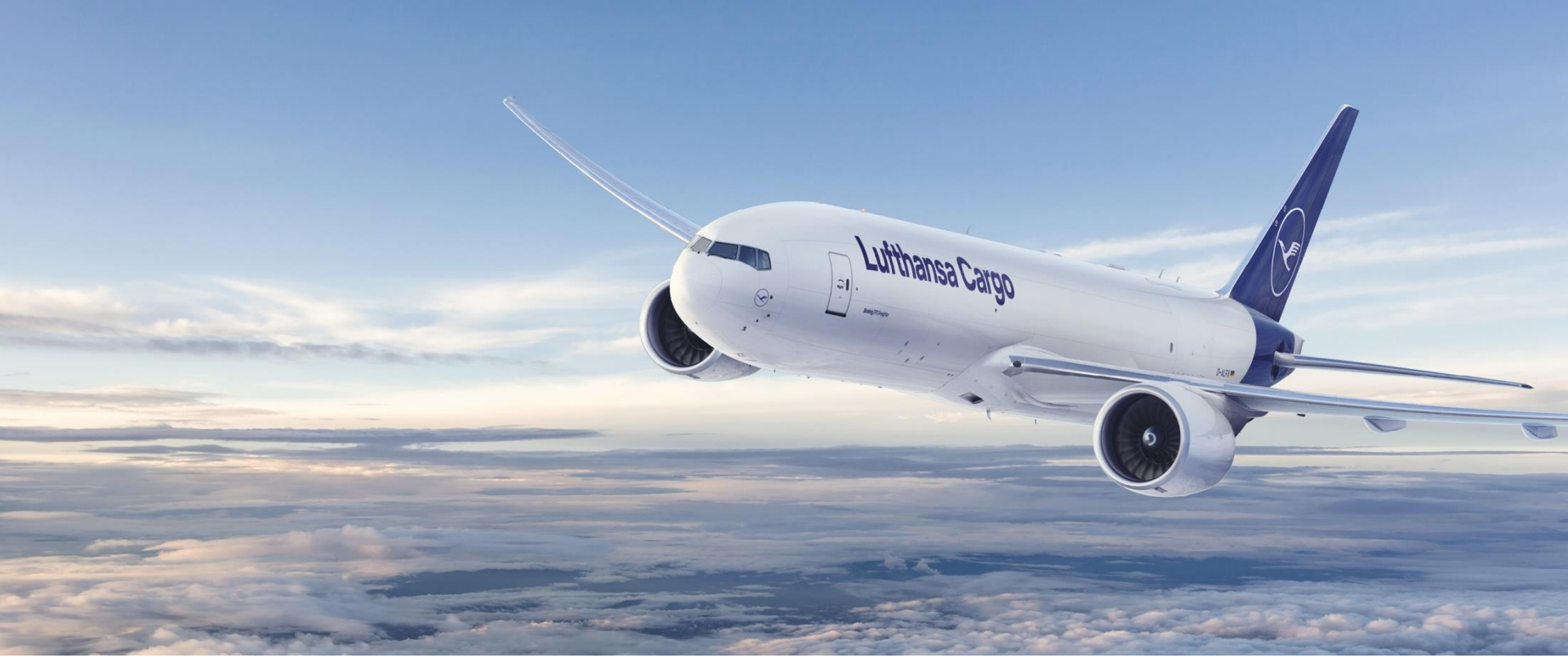
- **EXPERT ASSESSMENT** is indispensable.
  - “We know our ops” – “You know your ops”.
  - “We know where it hurts” – “You know where it hurts”.

- BUT:
  - Table provides **METHODOLOGY** in mitigation and gives **REPRODUCABLE RESULTS**.
  - Table gives **FACTS** and not **OPINIONS**.

Questions

...are there any...





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