FLIGHT DATA MONITORING
Energy Management Study
SMS Department

GOL – Largest low-cost airline in LatAm

- Standardized fleet of 120 Boeing 737-700 and 800 NG aircraft
- 64 destinations of which 11 international, in the South America and Caribbean
- 39 million passengers transported per year
- Leading position at Brazil's main airports with high on-time performance
- 860 flights per day
- +15,000 employees
- Extensive cargo operations serving more than 3,100 cities in Brazil and 15 abroad

Comprehensive Global Network

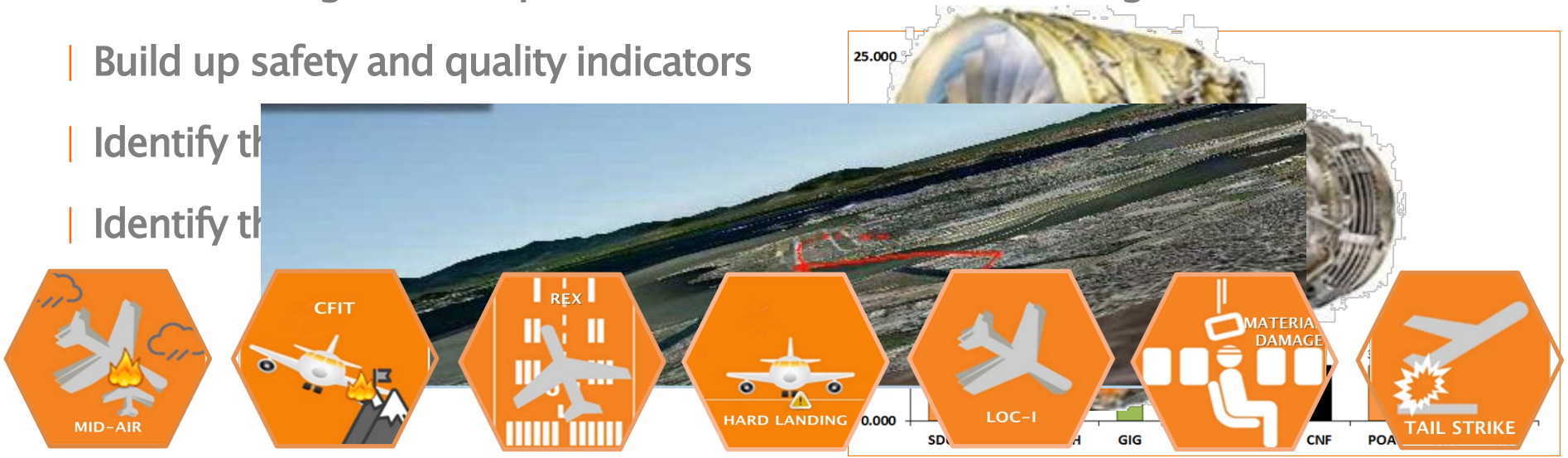
- DELTA — serving ~319 destinations in over 58 countries
- AIR FRANCE KLM — serving ~316 destinations in over 115 countries

AIR CANADA, ETIHAD, TAP, KOREAN AIR, Copa Airlines, QATAR, DELTA, Aerolineas Argentinas, Alitalia, AIR FRANCE KLM, AEROMEXICO

Data analysis

FDM Possibilities

- FDM can monitor many parameters of the aircrafts
- It allows the global comprehension of all moments of a flight
- Build up safety and quality indicators
- Identify th
- Identify th



Energy Management study: reasons

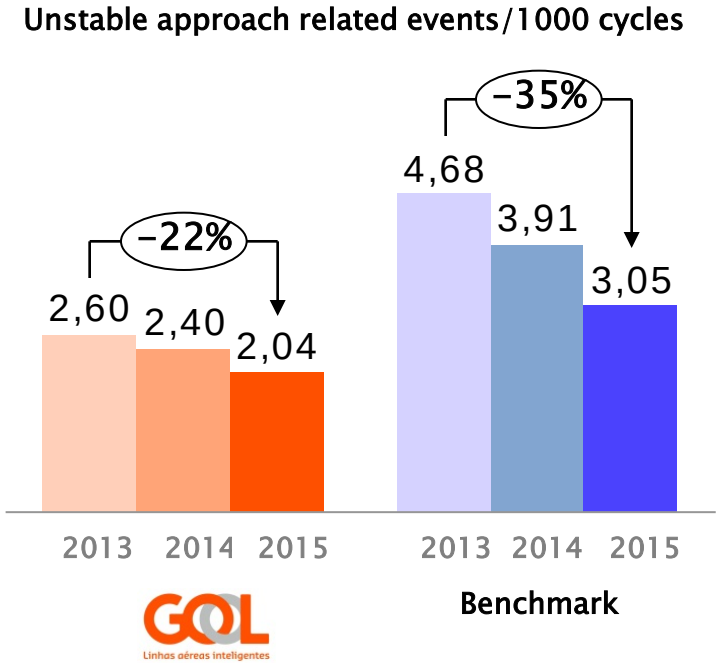
FDX Outcome

Analyzing the benchmarking with IATA of 2014 we realized that GOL's main issue was High Speed on Approaches…

… however, every FDM program is mute and deaf.

Source of Information

- We analyzed the outcome of:
  - Statistics
  - Events algorithm review
  - Pilots interview
  - Industry Benchmark
  - Flight emulations



FDX Outcome

- FDM events adjusted accordingly to severity
- ATC
  - The outcome of LOSA pointed that the ATC has a direct influence on a flight approach
  - Received ASR confirms that information
- Pilots techniques
  - Pilots have difficulties to recognize that the flight will be unstabilized at 1000ft.
  - Incorrect use of aircraft deceleration tools

LOSA

AQD

FDM

FDX

Data findings

Stabilized Approach

- Reduces workload
- Improves situational awareness
- Increases Safety
- Saves money

Unstable Approach

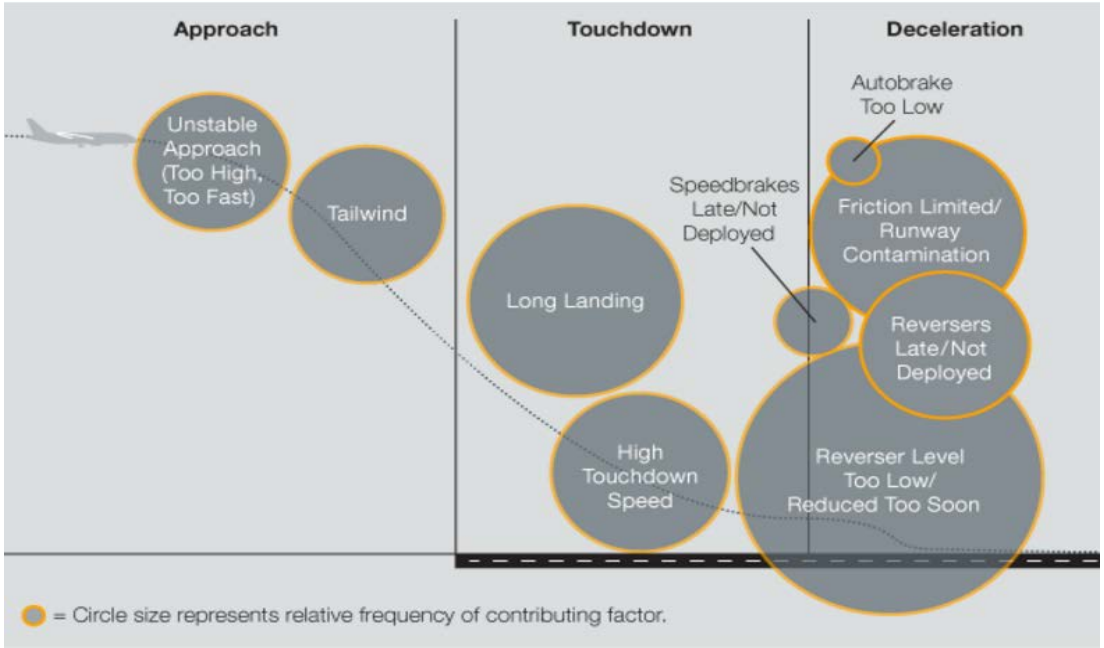
- Most are a result of bad energy management
- Most pilots proceed to landing
- ATC interference is a common percursor
- SAFETY WINDOW Pilot's don't recognize it until 1,000 feet

The idea came up...

…develop a method to help the pilots determine the point at which an unstable approach may become irreversibly.

Runway Overruns Precursors

In order to avoid a bigger problem it was important to work on the first problem pointed by Boeing



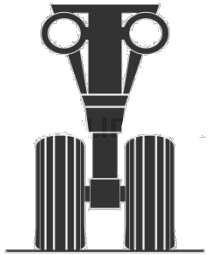
Reducing Runway Landing Overruns – Boeing

Academic Partnerships

Embry-Riddle Aeronautical University

- Most traditional aviation university in the world
- The cooperation aims to achieve a scientific confirmation of our findings
- ERAU will also develop a CBT based on our data
- This CBT could be shared with other airlines

Rules of thumb for energy dissipation

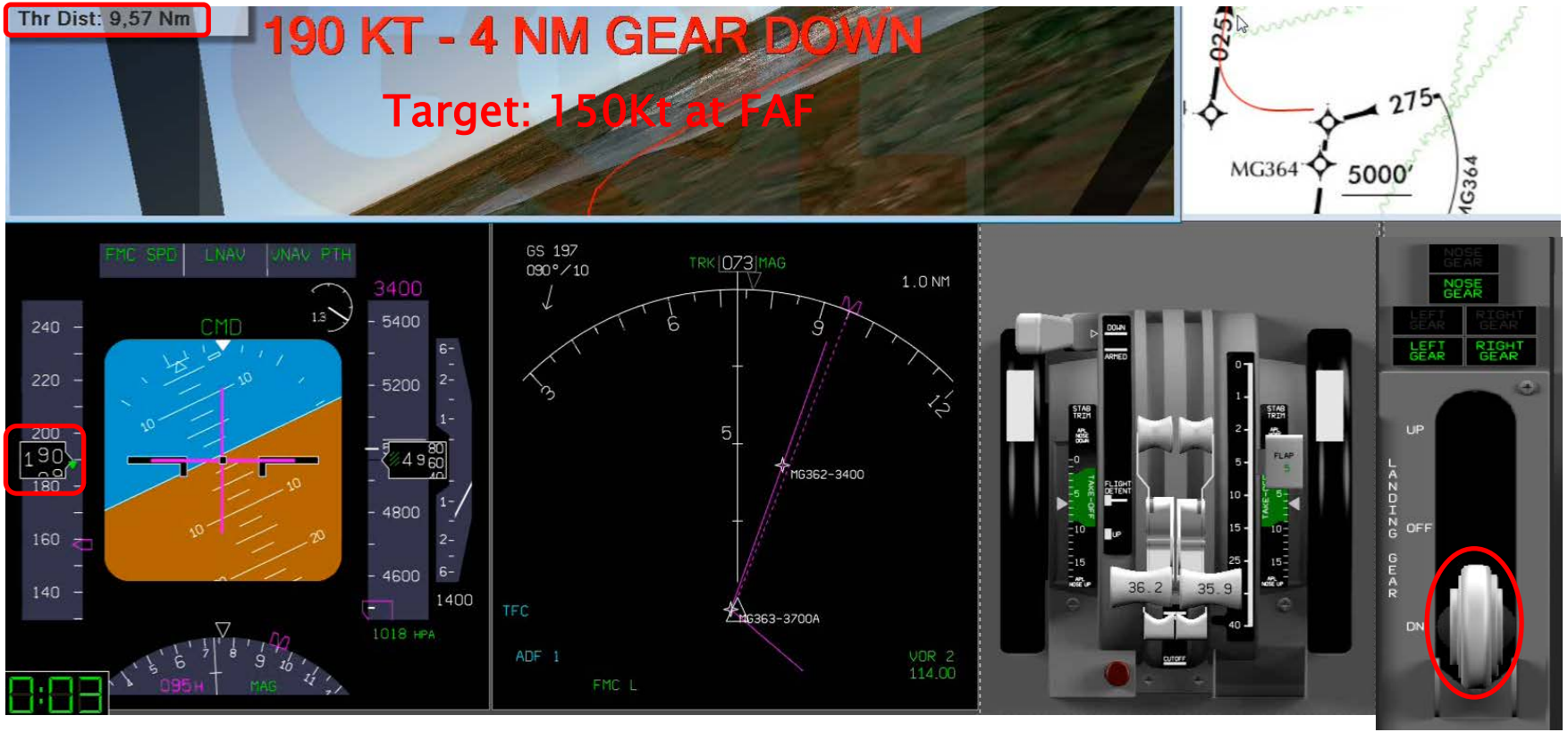


LANDING GEAR

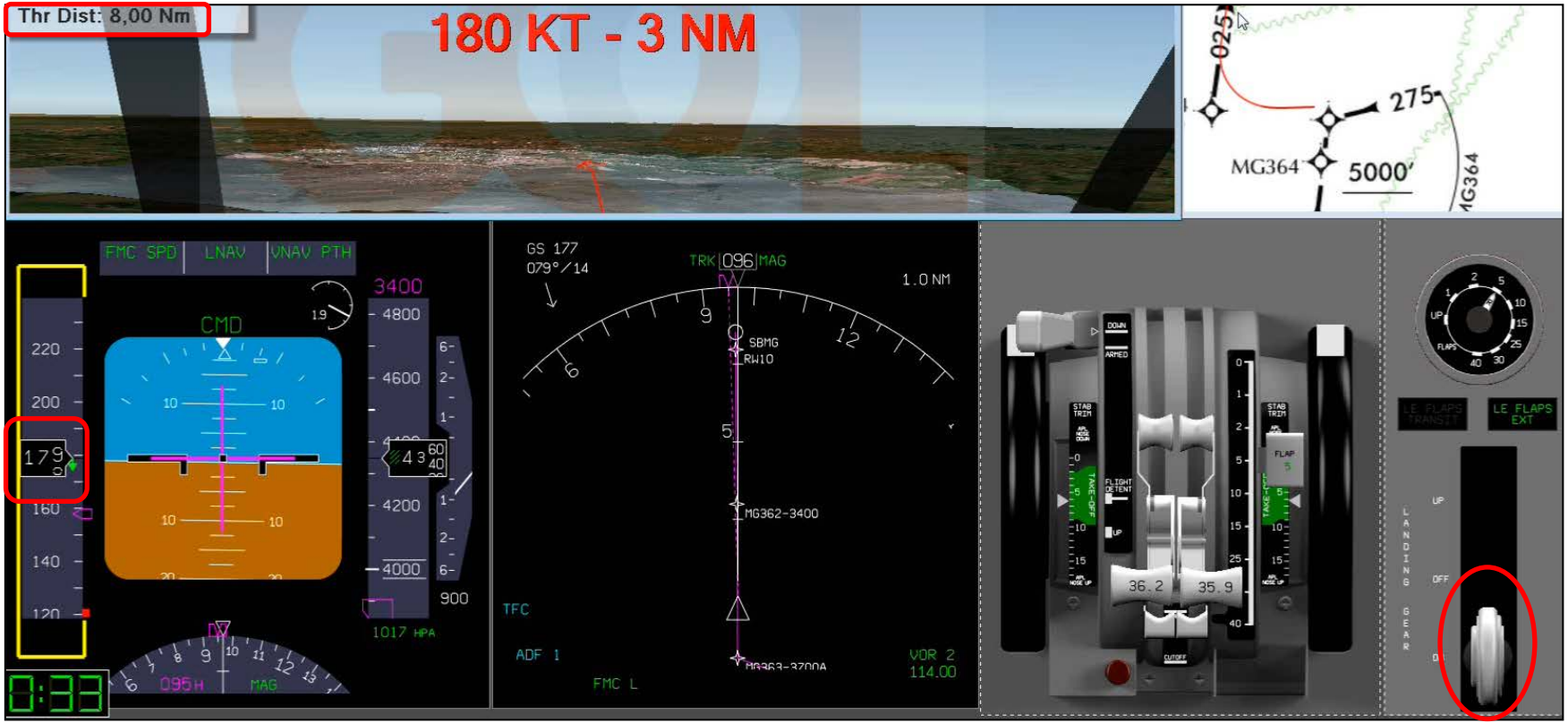
Most effective aid to decelerate the aircraft

- Identify the best moment to extend the gear is key for the success of the approach
- On a flight path of 3° typical aircraft decelerates 10kt/nm with gear down
- For each dot above the ideal flight path, gear extension should be anticipated in 1nm
- For every 20Kt of tailwind, 1nm should be added

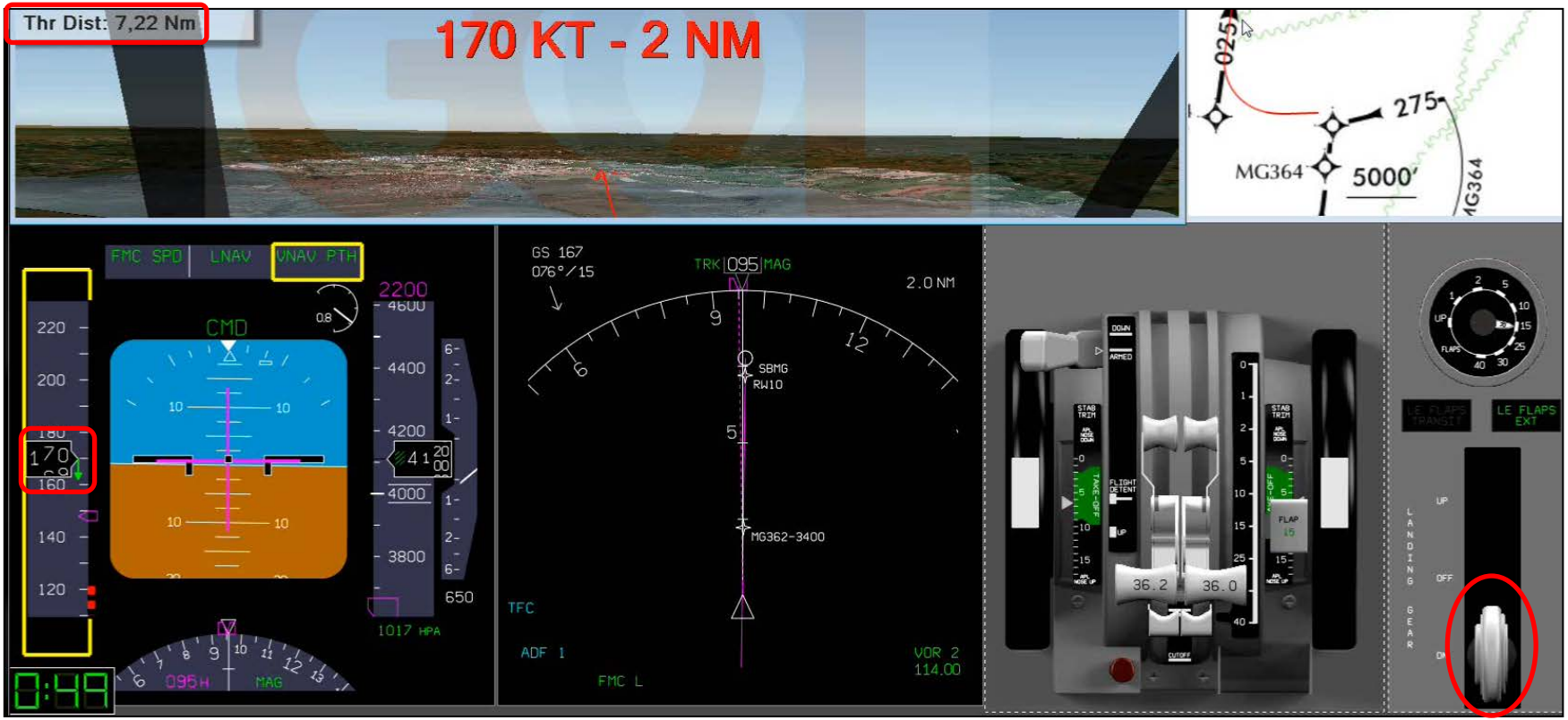
How we did it?


Thr Dist: 9,57 Nm
190 KT - 4 NM GEAR DOWN
Target: 150Kt at FAF
025
275
MG364
5000'
1G364
FMC SPD
LNAV
VNAV PTH
CMD
3400
240
220
200
190
180
160
140
5400
5200
4800
4600
1400
1018 HPA
095H
MAG
GS 197
090°/10
TRK 073 MAG
1.0 NM
MG362-3400
MG363-3700A
TFC
ADF 1
VOR 2
114.00
FMC L
DOWN
ARMED
STAB TRIM
FLIGHT DETENT
UP
FLAP
TAKE-OFF
36.2
35.9
CUTOFF
NOSE GEAR
LEFT GEAR
RIGHT GEAR
UP
LANDING GEAR
OFF
DN

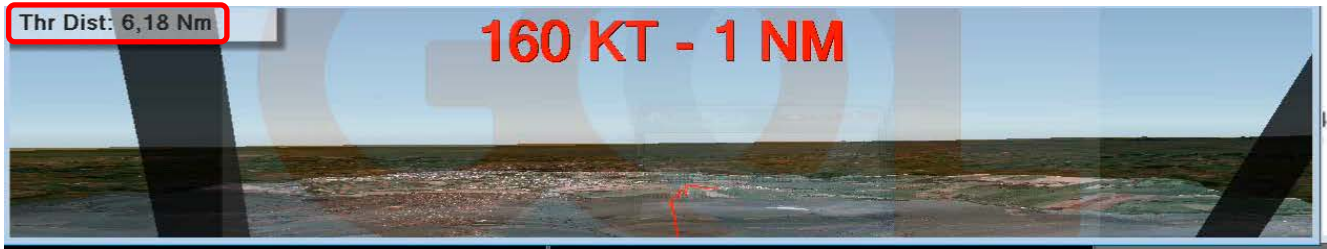
How we did it?

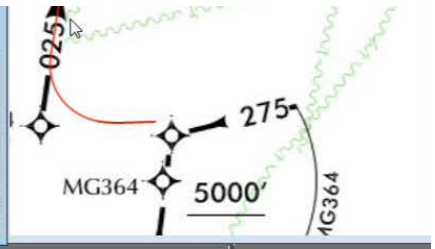

Thr Dist: 8,00 Nm
180 KT - 3 NM
025
275
MG364
5000'
1G364
FMC SPD
LNAV
VNAV PTH
CMD
3400
4800
4600
4200
4000
900
1017 HPA
220
200
179
160
140
120
GS 177
079°/14
TRK 096 MAG
1.0 NM
SBMG
RW10
MG362-3400
TFC
ADF 1
FMC L
VOR 2
114.00
36.2
35.9
LE FLAPS TRANSIT
LE FLAPS EXT
LANDING GEAR
UP
OFF

How we did it?

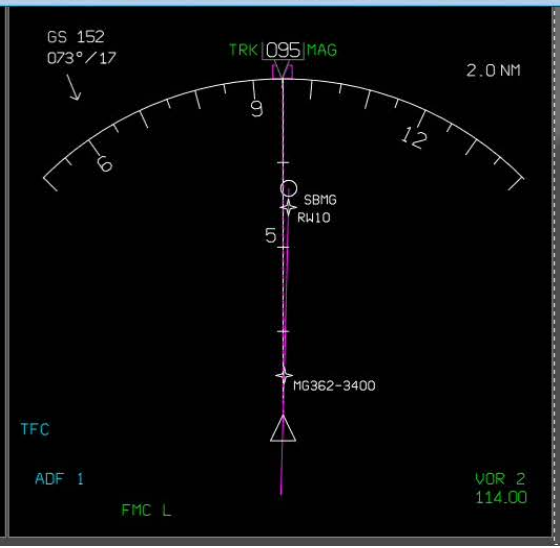

Thr Dist: 7,22 Nm
170 KT - 2 NM
025
275
MG364
5000'
1G364
FMC SPD
LNAV
VNAV PTH
CMD
2200
4400
4200
4000
3800
650
1017 HPA
0:49
GS 167
076°/15
TRK 095 MAG
2.0 NM
SBMG
RW10
MG362-3400
TFC
ADF 1
FMC L
VOR 2
114.00
36.2
36.0
LE FLAPS TRANSIT
LE FLAPS EXT
LANDING GEAR

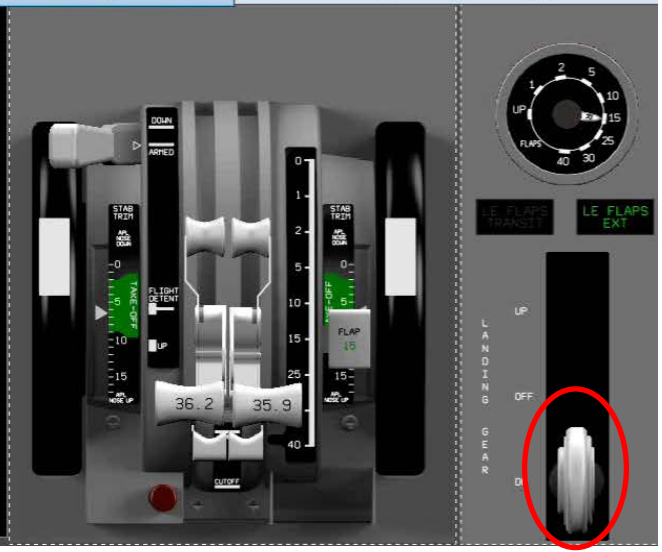
How we did it?


Thr Dist: 6,18 Nm
160 KT - 1 NM

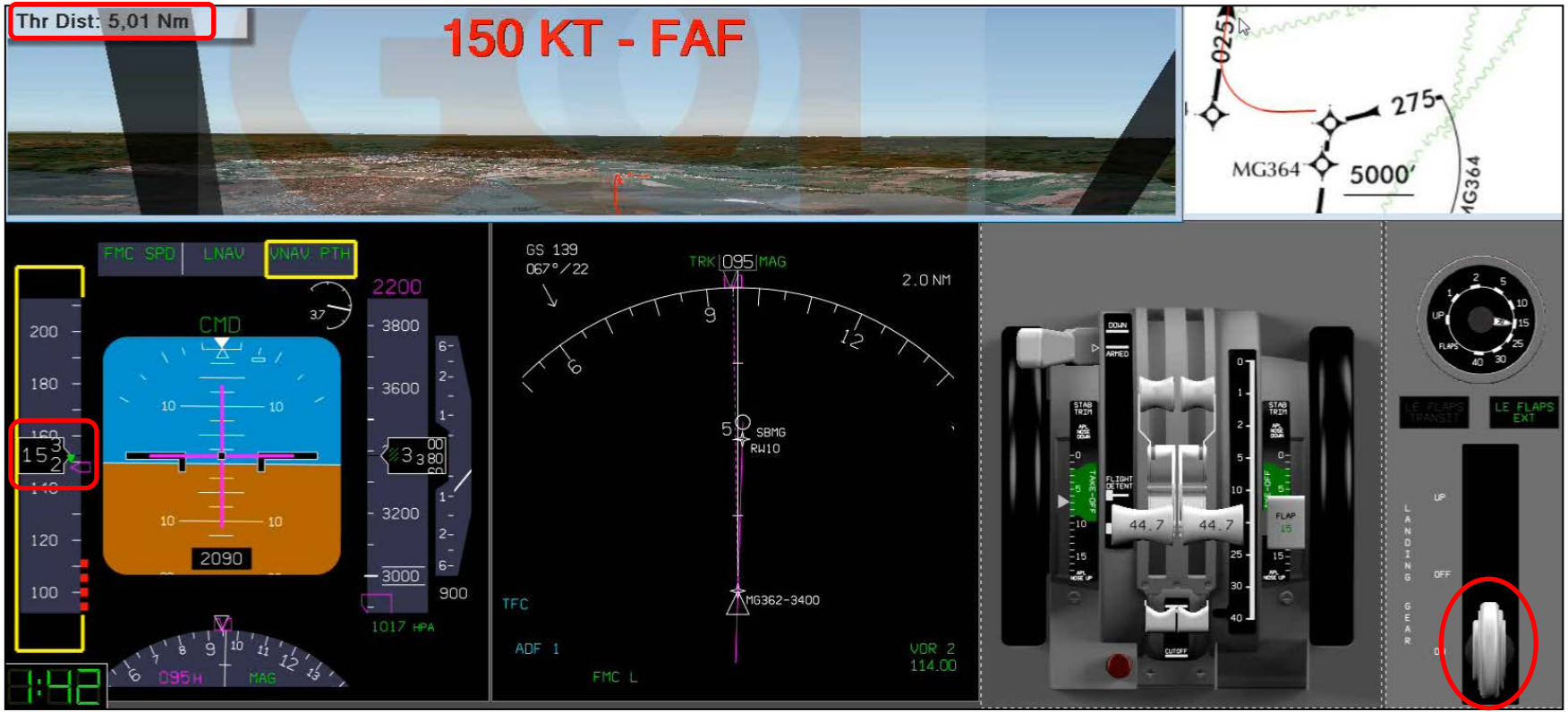

025
275
MG364
5000'
MG364


FMC SPD
LNAV
VNAV PTH
CMD
200
180
159
140
120
100
2200
4200
4000
3800
3600
3400
950
1017 HPA
095H
MAG


GS 152
073°/17
TRK 095 MAG
2.0 NM
SBMG
RW10
MG362-3400
TFC
ADF 1
FMC L
VOR 2
114.00

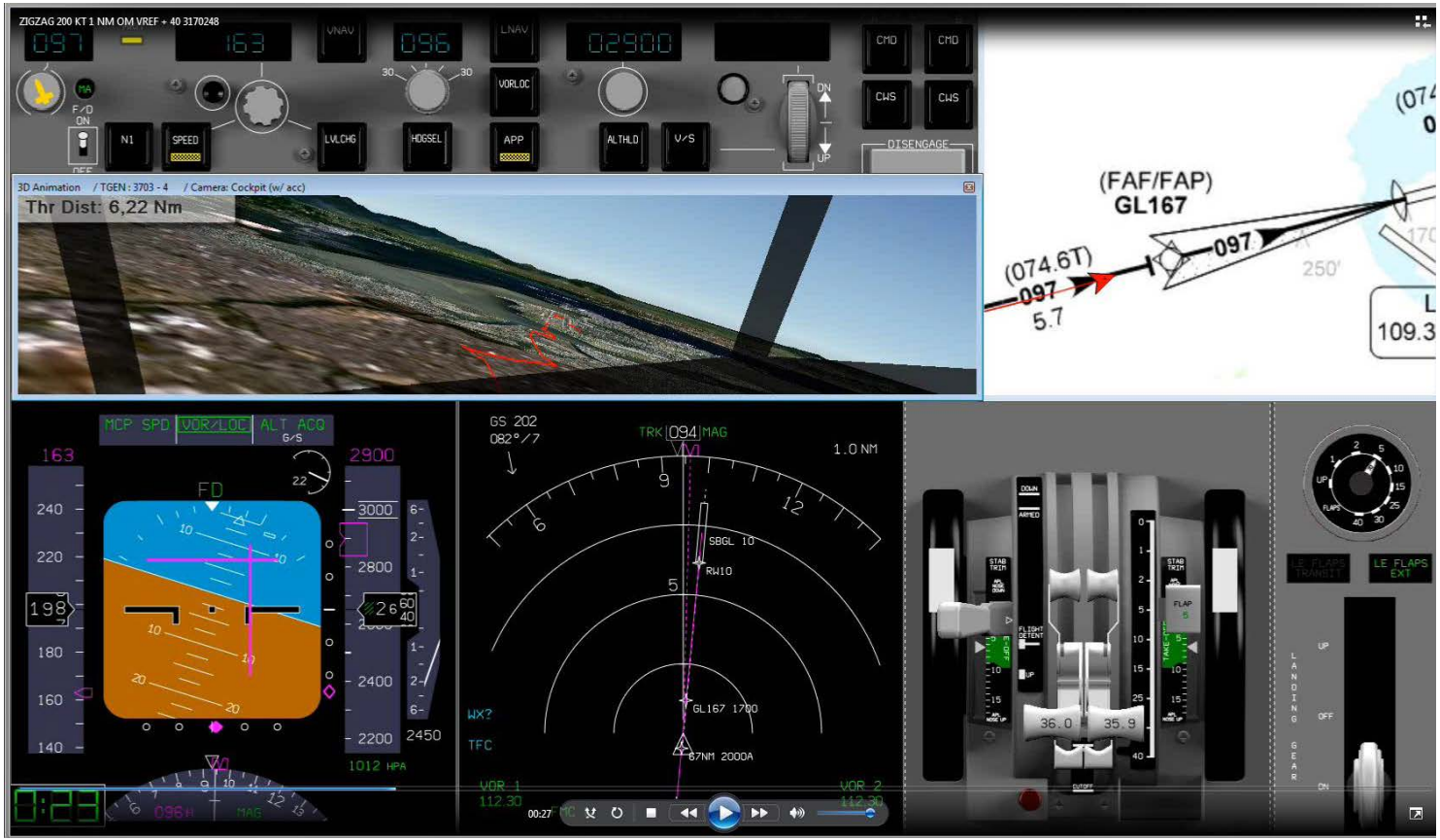

36.2
35.9
LE FLAPS EXT
UP
OFF
LANDING GEAR

How we did it?


Thr Dist: 5,01 Nm
150 KT - FAF
025
275
MG364
5000'
1G364
FMC SPD
LNAV
VNAV PTH
CMD
2200
2090
1017 HPA
GS 139
067°/22
TRK 095 MAG
2.0 NM
SBMG
RW10
MG362-3400
TFC
ADF 1
FMC L
VOR 2
114.00
LE FLAPS TRANSIT
LE FLAPS EXT
LANDING GEAR

Energy Management
Exemple 1

Flight Emulation – Energy Dissipation



Flight Emulation – Energy Dissipation

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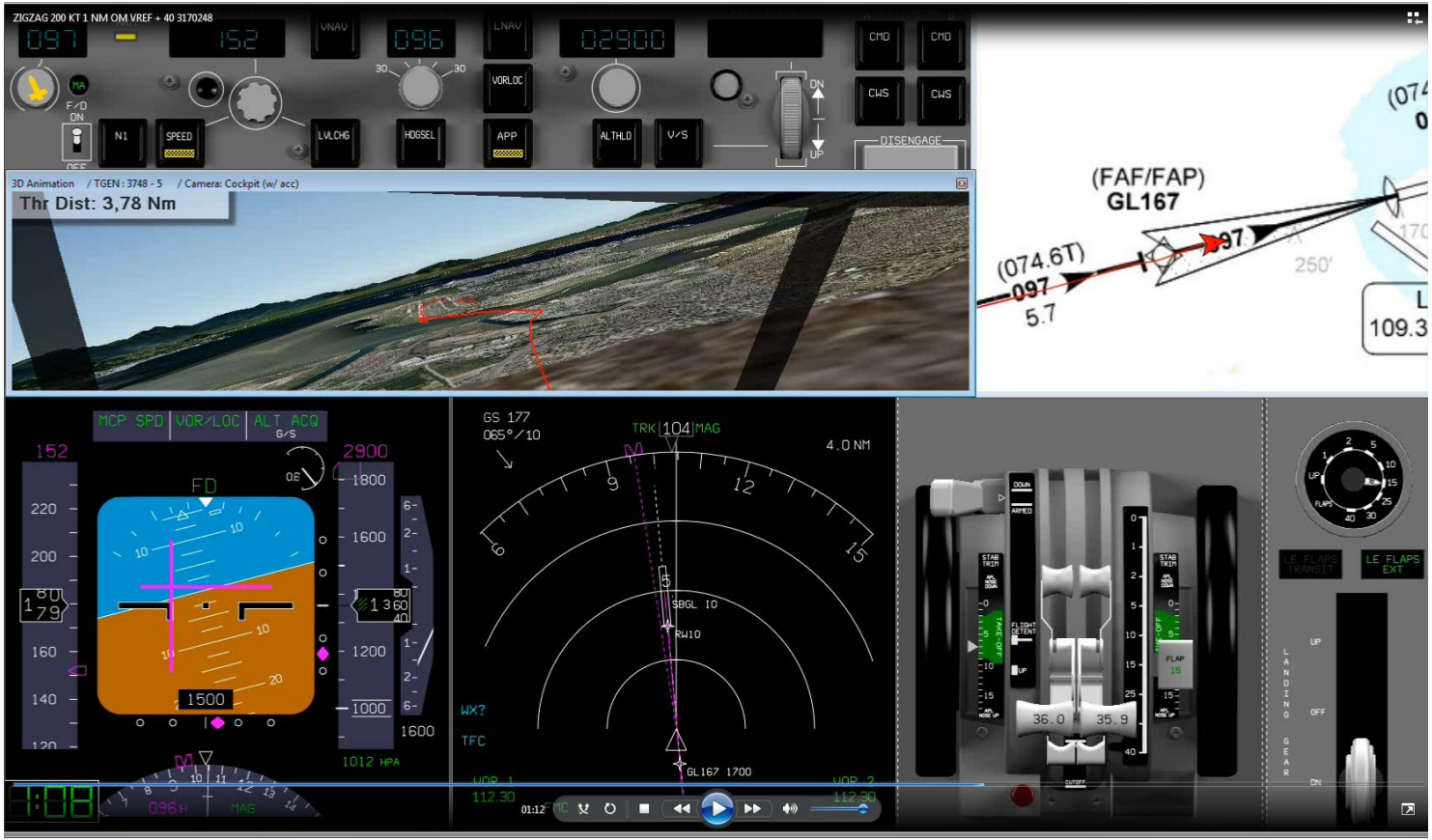
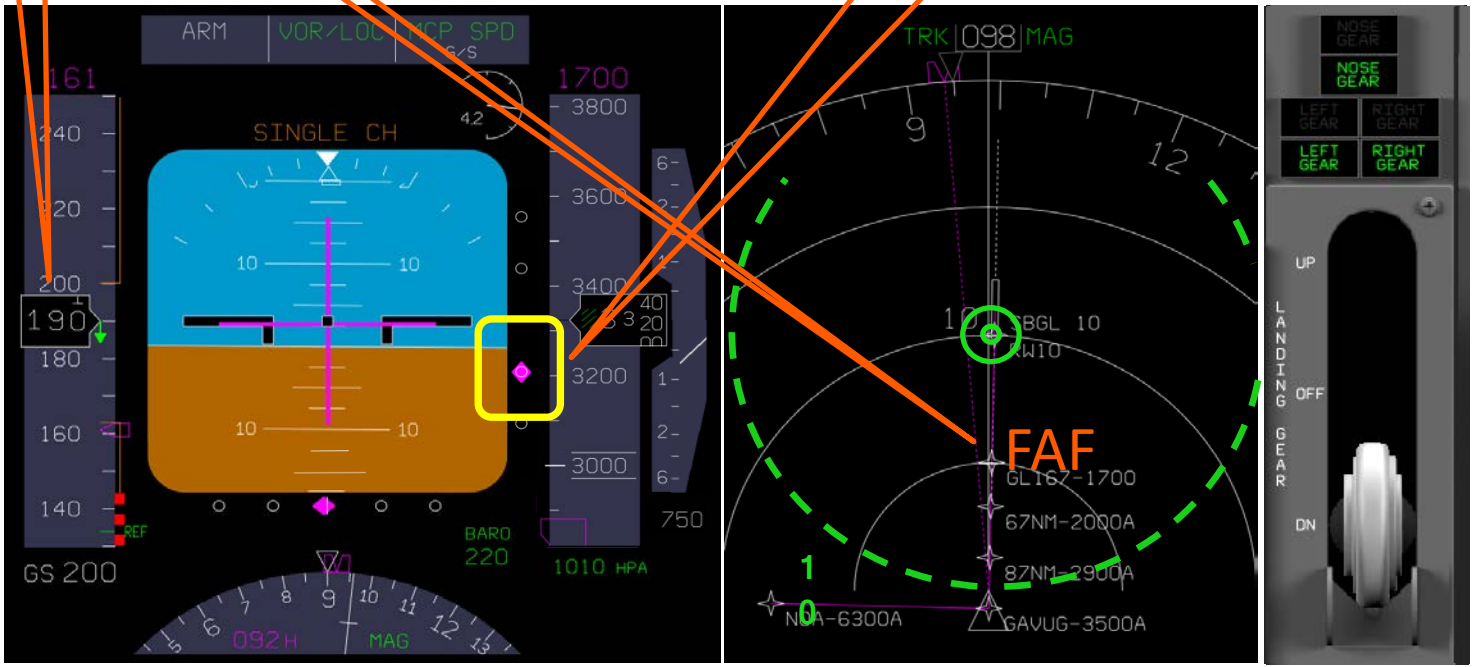


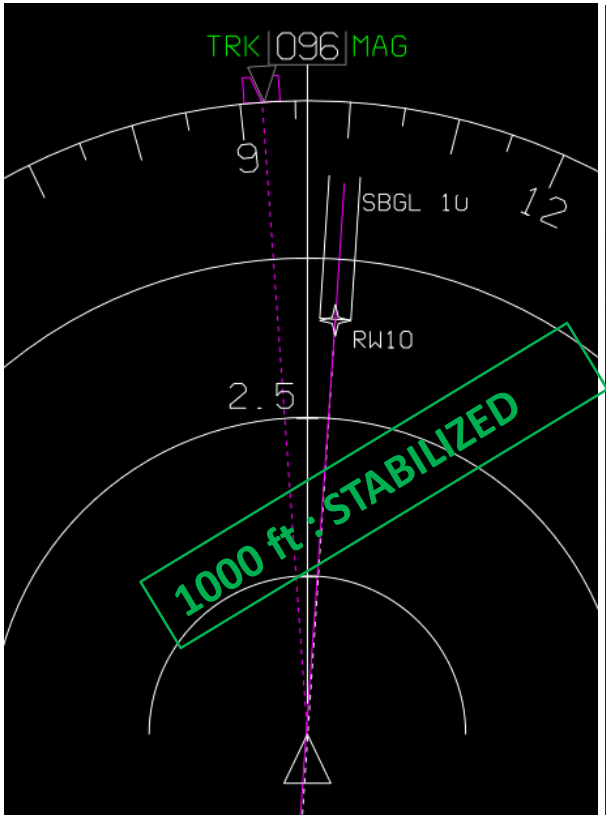
Energy Management
Exemple 2

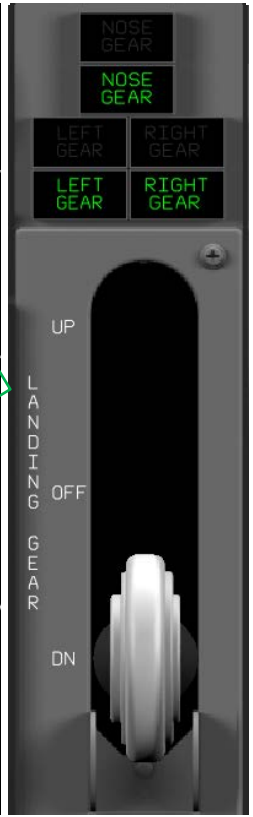
Flight Emulation – Above Glide Path

190 − 150 = 40 kt ➡ 4 + 1 Dot = 1 = 5 nm



Flight Emulation – Above Glide Path





Energy Management
Exemple 3

Flight Emulation – High Tailwind

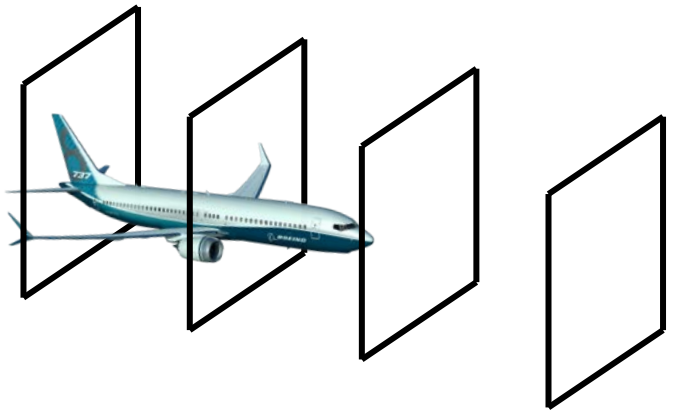
Flight Emulation – High Tailwind

Lessons learned

Keep in mind

- Apply the three rules for energy management:
  - Speed
  - Glide
  - Wind

- If you're still not stabilized… **GO AROUND!**



Cost avoidance

Cost avoidance

STABILIZED APPROACHES

saves money to the company

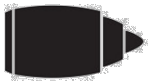
Direct costs:

Fuel
(go arounds reduction)

Up to
USD 400,000
per year

Brakes

Reverse



Tyres

Cost avoidance

STABILIZED APPROACHES

saves money to the company

Indirect costs:

Disruptions
(delays, cancellations)

Loss of image

Accident

Lessons learned

Lessons learned

- Flight patterns must be accomplished
- Efficient energy management starts before top of descent
- Identify the best moment to extend the gear is essential for the success of the any approach
- There are different sources of information that you must look for
- Share and exchange information with other operators
- Comprehend the cultural facts of your company is absolutely important
- Every safety rule must be accomplished
- Don’t hesitate to look for a good partner
- Remember that you are preserving lives and saving money!

Thank you!

Segurança Baixo custo Time de Águias Inteligência Servir