EWADE 2013

A Case Study in Aeronautical Engineering Education

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EWADE, September 17th, 2013,
Linköping

http://ewade2013.AircraftDesign.org
http://dx.doi.org/10.5281/zenodo.546420

Summary

- Introduction
- Case study on engineering education
- A case study in aeronautical
- Results
- Conclusions

Introduction

Singular characteristics on teaching-learning process of Aeronautics:

- Initial motivation

- The childhood desire can be a potential

- Great pedagogical opportunity to awaken the ***reminiscent knowledge*** that is on natural curiosity of people.

Introduction

- Example of this approach can be seen in many aeronautical schools where professors motivate students in activities that develop ***curiosity and creativity***:

Airplane Building Competition

Tests of Experimental Aircrafts

Introduction

In this context of pedagogical innovation and aeronautical culture:

"A case study was applied on aircraft design classes at university of São Paulo"

Education in engineering

Top Engineering Schools

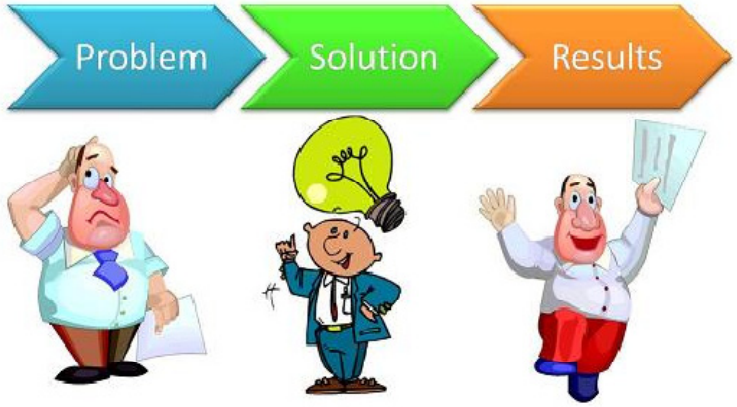
Strong academic background *in science to solve complex problems.*

Is it enough

Engineering enviroment

Wide engineering problem scenario requires ***understanding and attitude*** *to deal with different engineering situations.*

Case study on engineering education



Case Study fits well with this proposal !!!

"Engineering case study as an account of an engineering activity, event, or problem containing some of the background and complexities usually encountered by an engineer" **Anwar & Ford (2001)**

"Engineering case presents a scenario that practicing engineers are likely to encounter in the workplaces" **Anwar & Ford (2001)**

Case study possibilities

Anwar (2001) & ***Masseto (2003)*** suggested many possibilities of case study and we can apply in aeronautical environment:

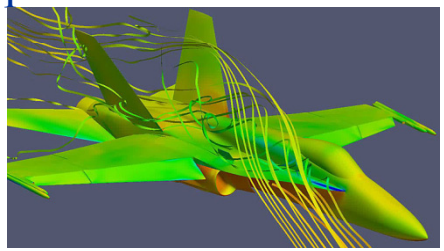
- ***Involve in real or simulated situation*** *in your profession area identifying and recognizing problems to figure out solutions.*

- ***Make diagnostic analyzes*** *for situation considering the* ***variables involved*** *exercising and making judgments.*

Case study possibilities

- Understanding and recognizing ***assumptions and inferences***, as opposed to concrete facts.

- Find out necessary information, ***understanding and interpreting data***, to solve problem-situation.



- Thinking ***analytically and critically***.

Case study in aeronautical engineering education

- Case study of aerodynamic design for two of the most classics aircraft in the world, ***Douglas DC-9*** and ***Boeing 737***

VS

*"**Embryonic mark of commercial aviation** and compete in the aeronautical market based on **similar engineering requirements** with different philosophies"*

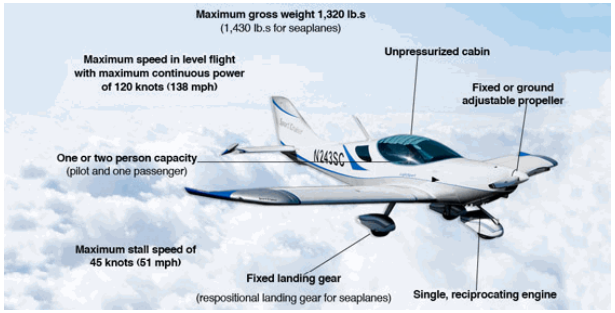
Case study in aeronautical engineering education

- The case study conducts engineering students to experiment discussions about issues related to ***historical facts, aerodynamics concepts, requirements, design philosophy, technologic and development***.

- The discussions for case study are based on scientific articles: ***"aerodynamic design philosophy of the Boeing 737"*** and ***"Aerodynamic Design Features of the Douglas DC-9"***

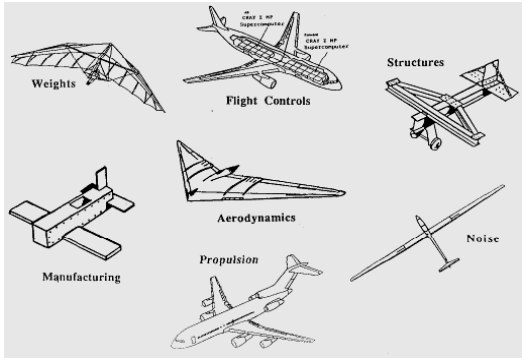
Education goals

- ***Requirements*** and their importance on design



- **Design philosophy** and airplane configuration choice

- ***Multidisciplinary*** view on design



Case study strutucure

2 Discussion groups : Douglas DC-9 and Boeing 737.

Aeronautical industry team and a Leader

Previous reading : Paper and Requirements

Discussions about educational goals

Cross-Dynamic

Requirements and their importance on design – "Perceptions"

Design requirements are well-defined

Boeing 707, 727 and 737

Aerodynamicists work hardly to achieve them

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(t/c)

Boeing 737

New step on comercial aviation

Short range and runway

Focus on Low speed design (B737)

- ***Less wing swept***
- ***Thicker profile***
- ***Complex High-lift devices***

Requirements and their importance on design – "Perceptions"

Douglas DC-9 → ***Short range and runway***

Differences : DC-8 vs DC-9 → ***Derived from DC-8 with regional requirements***

Critical design conditions → ***DC8: cruise DC9: Second segment climb***

Design philosophy and airplane configuration choice – "Perceptions"

One configuration is chosen, and some inherent engineering problems will take place, so aerodynamicists need to solve !!!!!!

- Both groups discussed about differences between ***T-tail and conventional*** configuration

- There are a mandatory criteria to chose a specific configuration

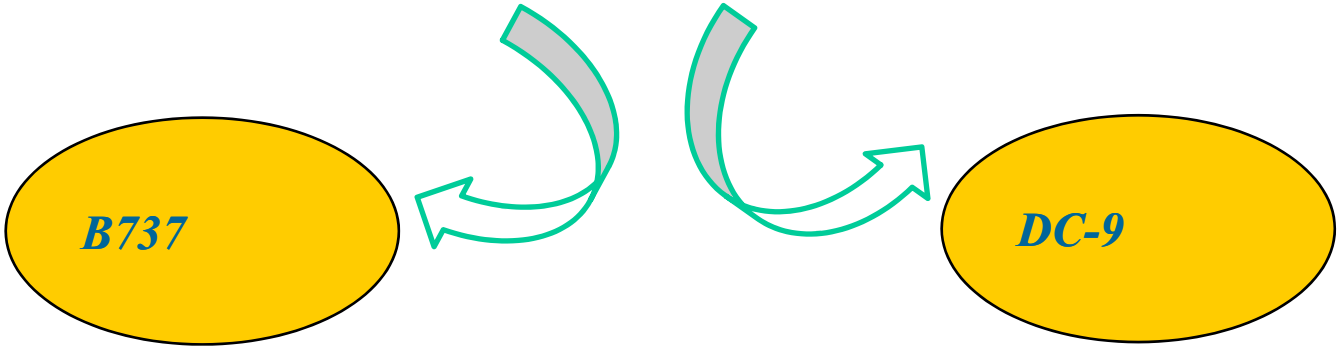
- They discussed particularly about ***"deep stall"*** phenomenon

- The nacelle configuration under-wing on B737 (problems in high speed !!!)
  Solution: Wind tunnel and CFD investigation

- T-tail configuration DC-9 (deep stall problem !!!!)
  Solution: Vortilon and greater horizontal came from exhausted analysis of wing wake and its influence on horizontal tail effectiveness.

Multidisciplinary view on design – "Perceptions"

Usually is hard, in aircraft design, to satisfy disciplines such as aerodynamics, aeroelasticity, performance, structure and weight at same time.



Outboard Aileron

B737 → *Entire flight regime*

Thicker profile
Less swept

B707,B727 → *Low speed regime*

Thinner profile
more swept

Deep stall

Deep stall → *Vortilon*

Vortilon → *Increase in drag and weight*

Increase in drag and weight → *Wing tip extension*

Cross-Dynamic – "Perceptions"

- Requirement of ***short range and runways***
- Boeing 737 and Douglas DC-9 have ***similar requirements***.
- ***Similar aerodynamic solutions*** to satisfy requirements
  (thicker profile, less swept wing, sophisticated high-lift devices)
- Distinct design philosophy (***different airplane configuration***) for similar requirements.
- There are ***characteristic problems*** for each specific configuration.

Conclusions

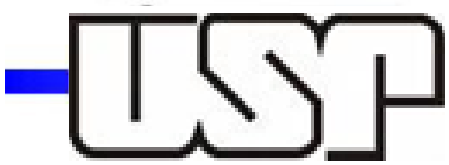
- The case study ***motivated strongly the engineering students***, since this activity established a relationship between theory and practice. (this is a problem in engineering education !!!! ☹)

- The education goals were achieved (***requirements, design philosophy and multidisciplinary view***)

- Teaching-learning process of Aeronautics is a ***great pedagogical opportunity***

- There are ***many possibilities*** applying case study in aeronautical education

- Case Study fits well with ***wide engineering problem scenario*** training students to deal with different engineering situations.



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Thank you for Coming !!!!