THE EVOLUTION OF JET AIRLINERS OBSERVED THROUGH THE RANGE EQUATION

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Which is the value of design education when only very few graduates will actually participate in the design of a new product; not to say in a new aircraft?

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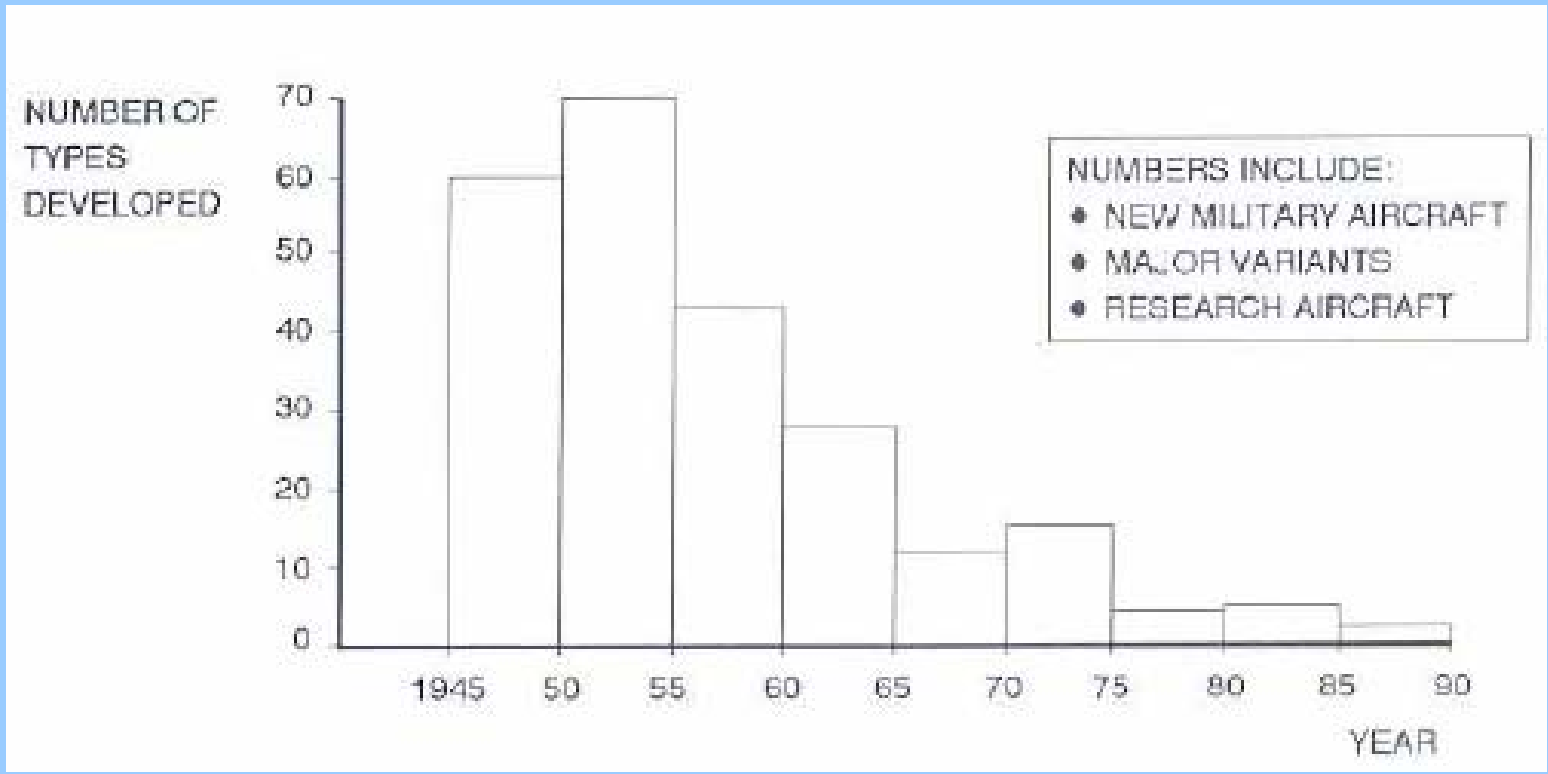
EVOLUTION OF MILITARY AIRCRAFT DESIGNED IN UK



However, the design process is central to the engineering profession. It is the engineering methods and the capability of design that binds all engineering disciplines together and defines the engineer.

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AIRPLANE DESIGN COURSE BACKGROUND

- Counterbalancing 15 years of oppositely-oriented education
- Ordinary lectures not enough to foster design skills
- Design exercises and design projects boost creativity
- Importance of economic factors in real life design

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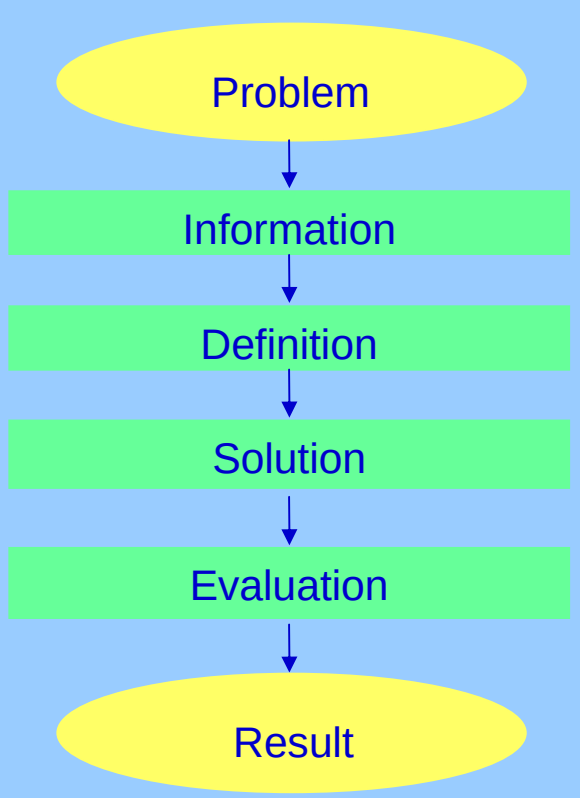
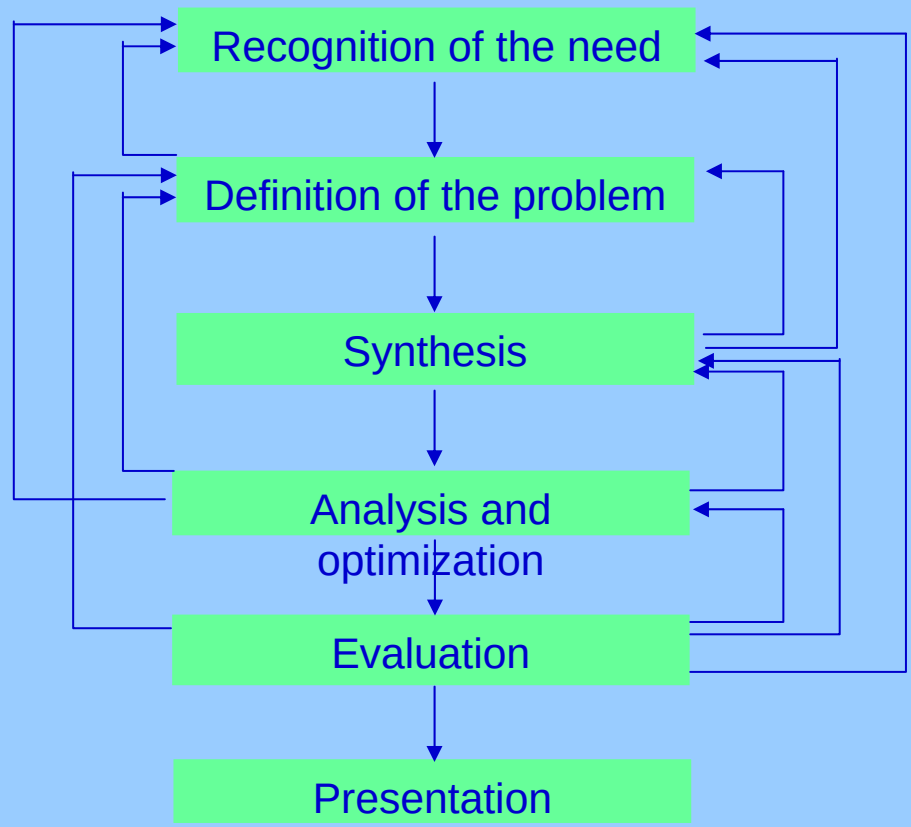
COMMON PROBLEM SOLVING AND DESIGN PROCESS





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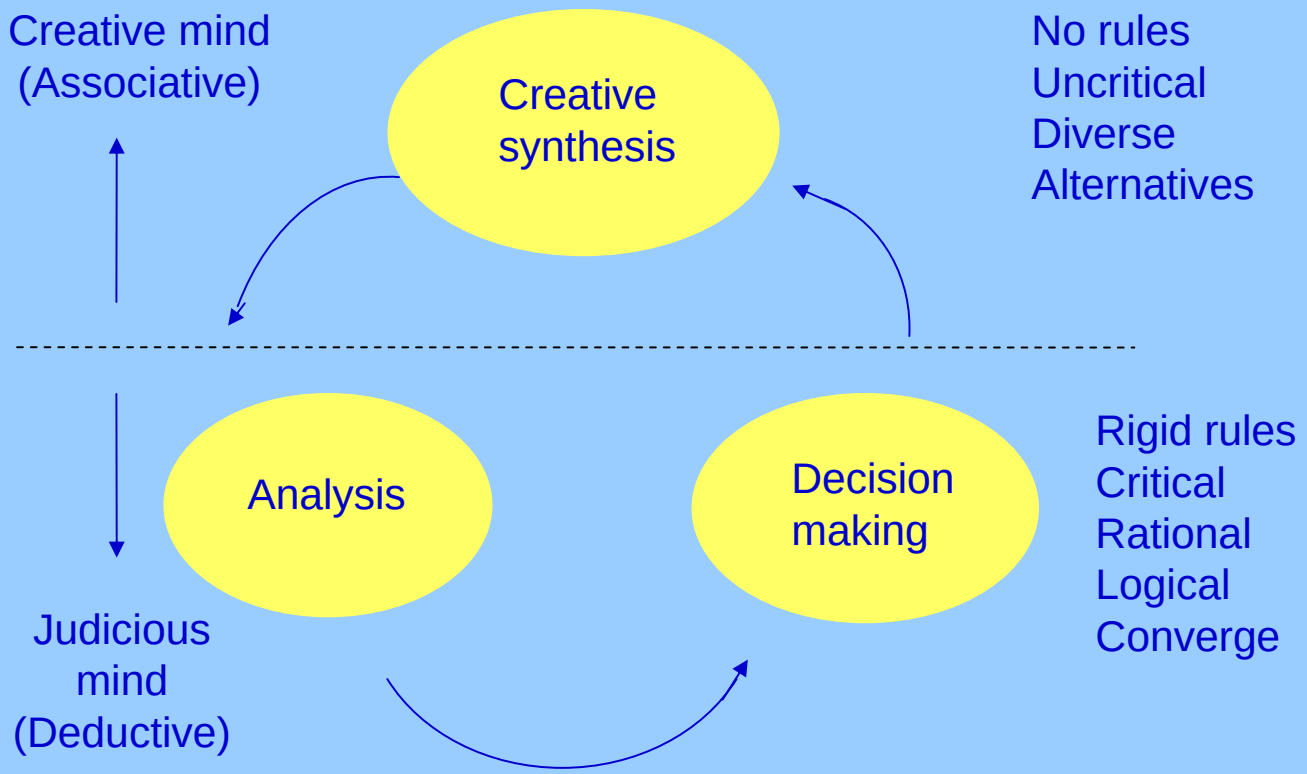
INTELLECTUAL CAPABILITIES IN THE ENGINEERING DESIGN PROCESS



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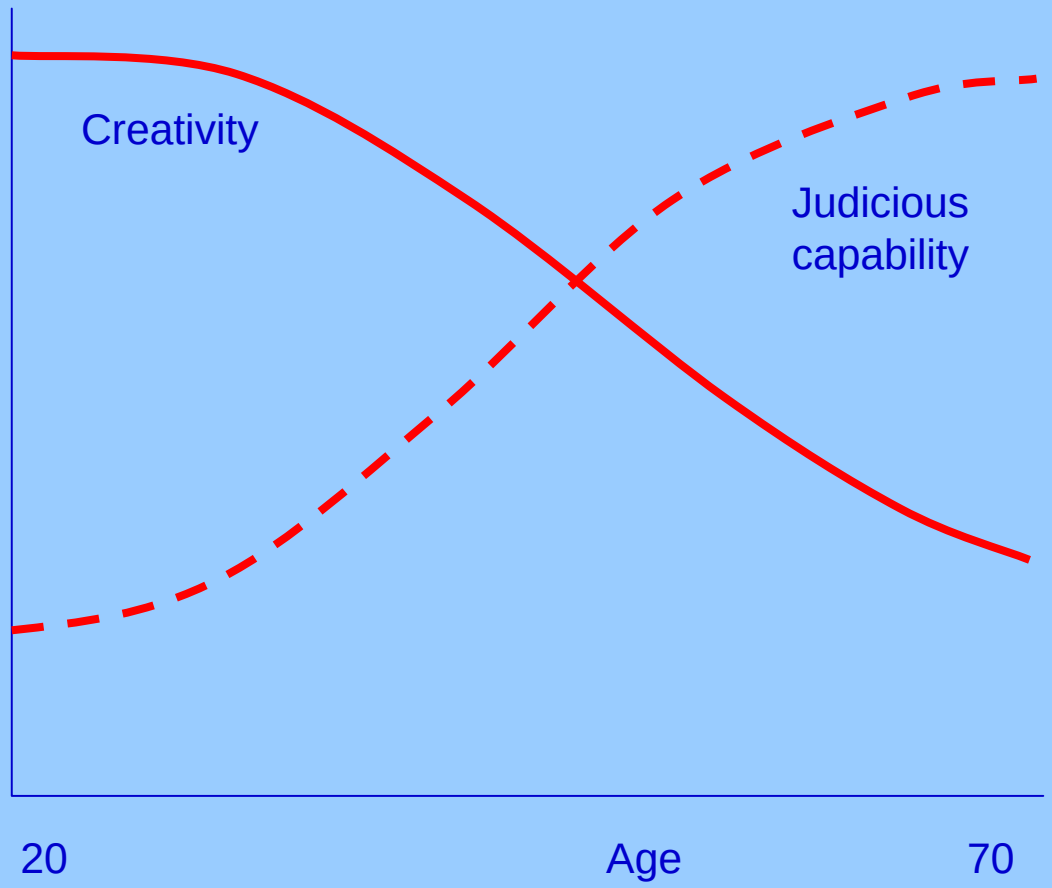
EVOLUTION OF INTELLECTUAL CAPACITIES



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ENGINEERING DESIGN KNOWLEDGE

- Design concepts
- Criteria and specifications
- Theoretical tools
- Quantitative data
- Practical considerations
- Design instrumentalities

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KNOWLEDGE-GENERATING ACTIVITIES

- Transfer from science
- Invention
- Theoretical engineering research
- Experimental engineering research
- Design practice
- Production
- Every-day operation

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INTERACTION BETWEEN KNOWLEDGE CATEGORIES AND GENERATION OF KNOWLEDGE

Categories / Activities	DC	CS	TT	QD	PC	DI
Transfer from science			⊗	⊗		
Invention	⊗					
Theoretical eng, research	⊗	⊗	⊗	⊗		⊗
Experimental eng, research	⊗	⊗	⊗	⊗		⊗
Design practice		⊗			⊗	⊗
Production				⊗	⊗	⊗
Daily operation	⊗	⊗	⊗	⊗	⊗	⊗

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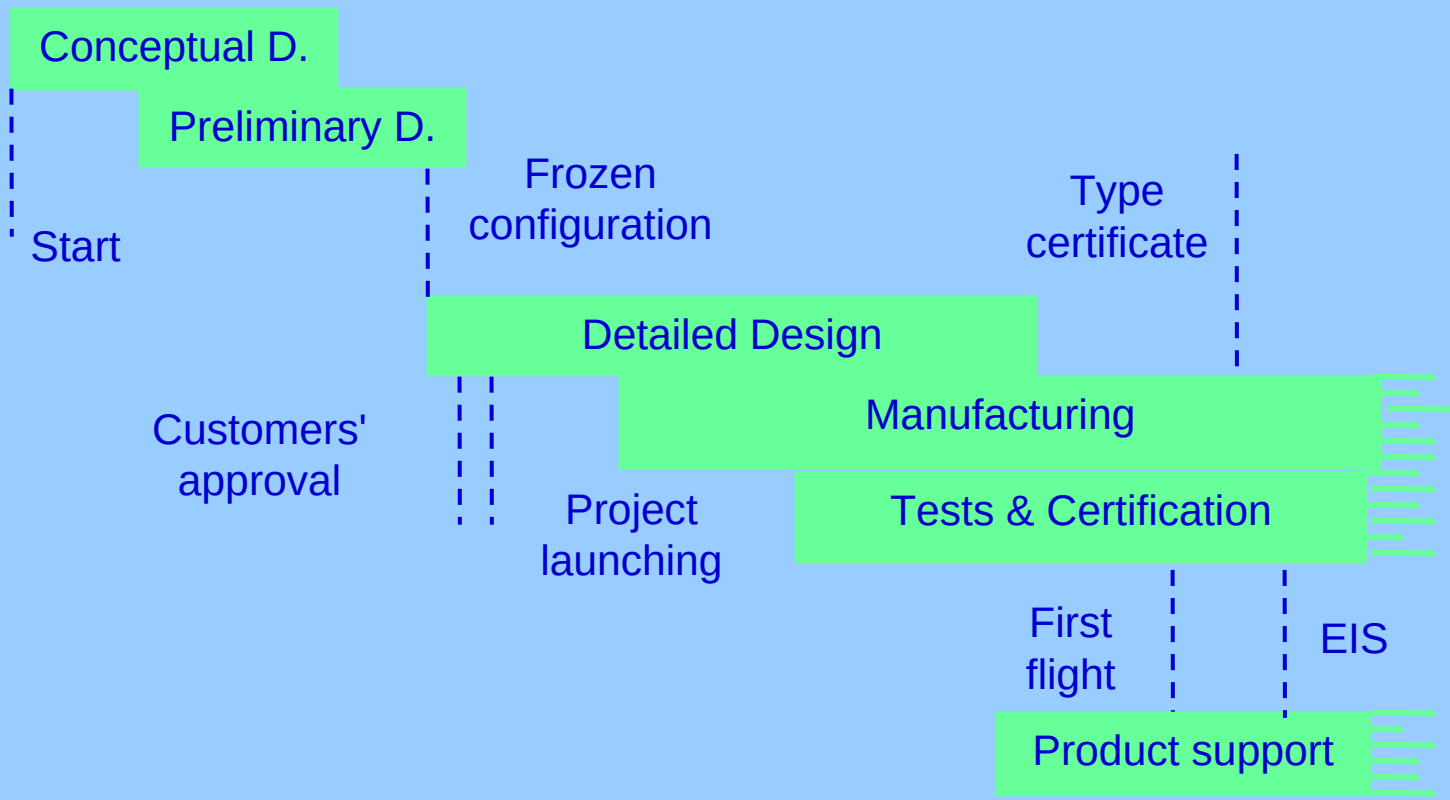
PHASES AND MAIN EVENTS OF AN AIRPLANE PROJECT



PHASES OF THE DESIGN PROCESS

Conceptual design

Outlining and assessment of alternative concepts fulfilling all/most specifications and requirements

Preliminary design

Optimisation of a few concepts and selection of the definitive configuration

Detail design

Extensive and complete definition of the chosen configuration

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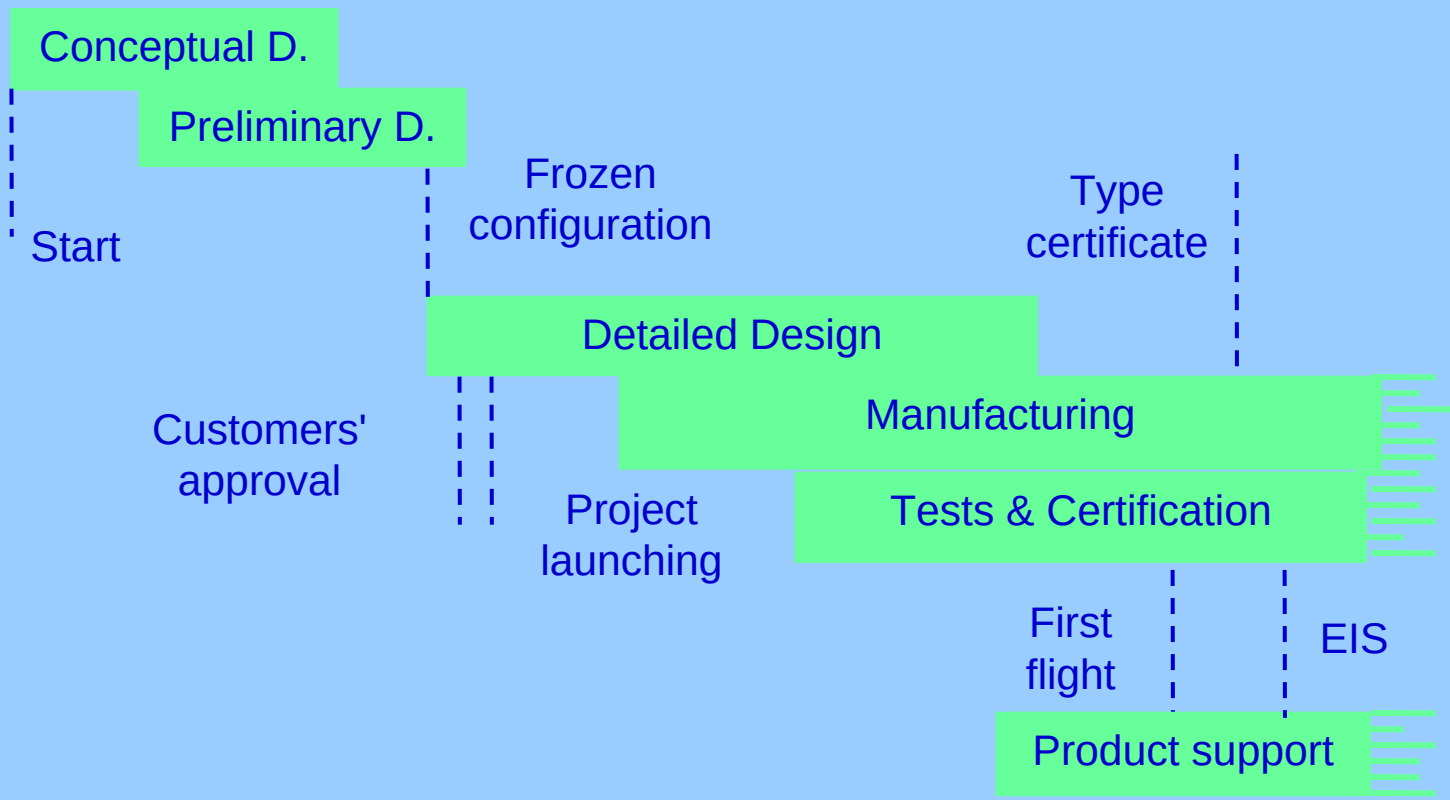
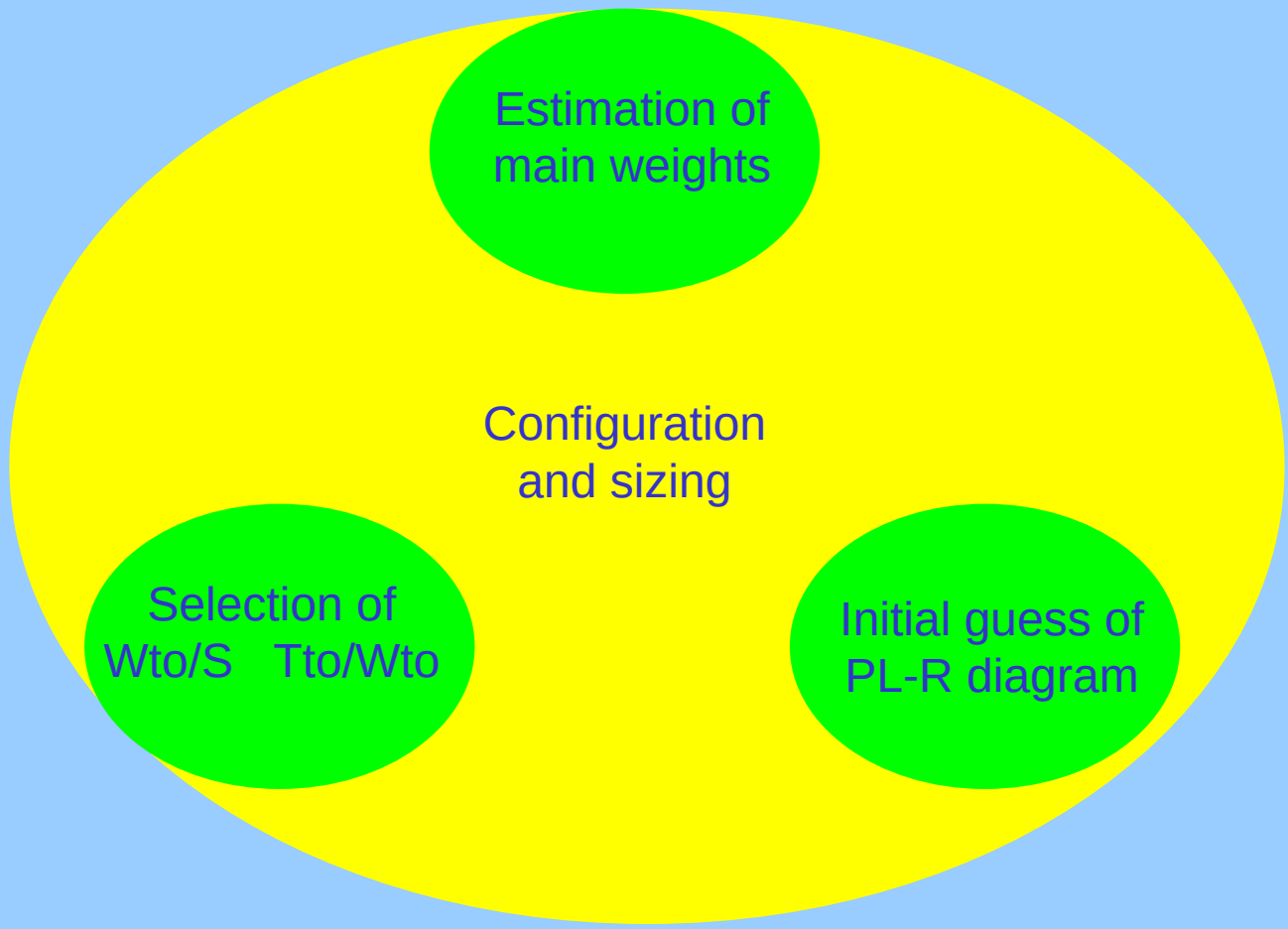
PHASES AND MAIN EVENTS OF AN AIRPLANE PROJECT



CONCEPTUAL AIRPLANE DESIGN



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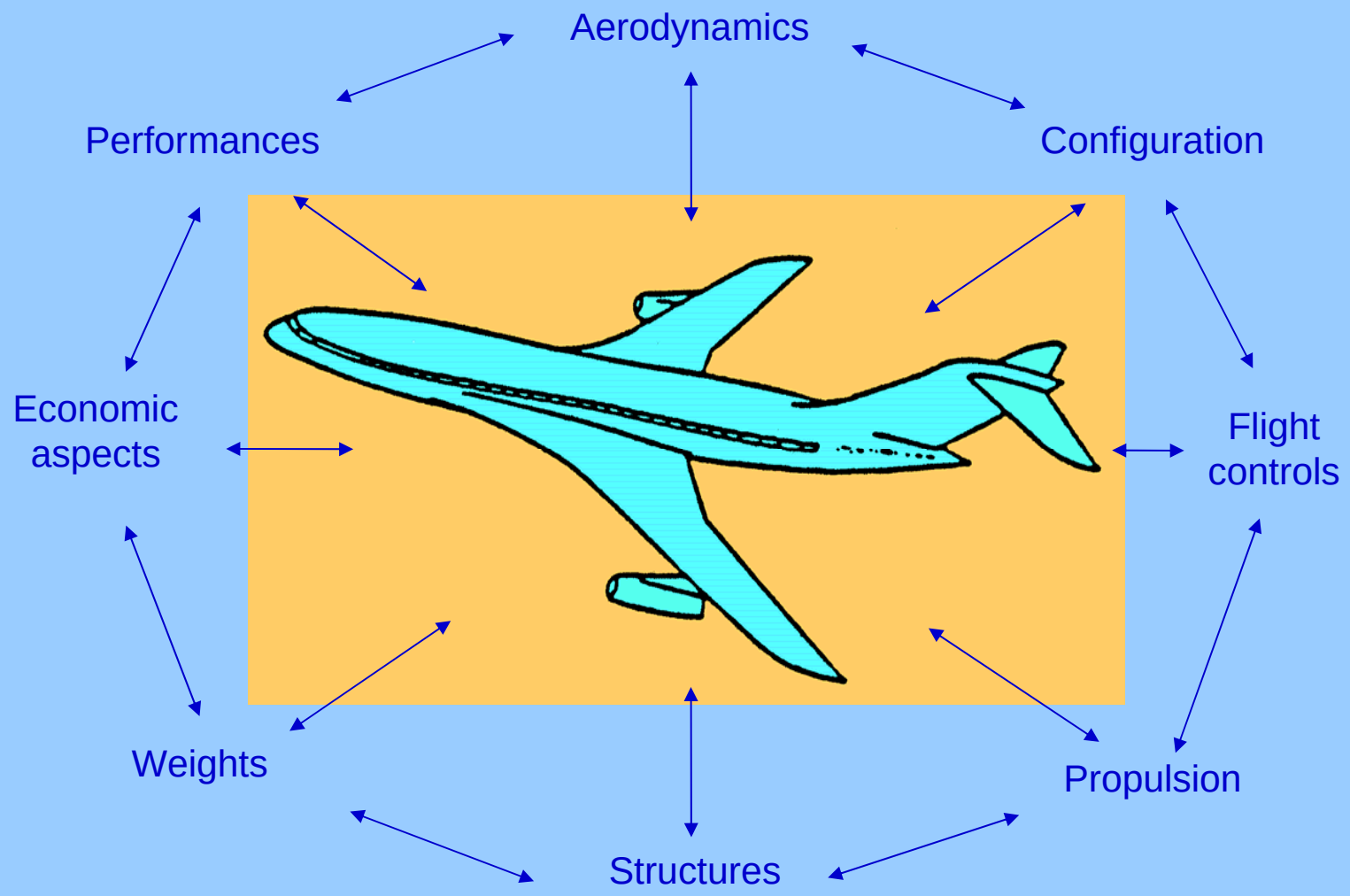
MULTIDISCIPLINARY APPROACH OF AIRPLANE DESIGN



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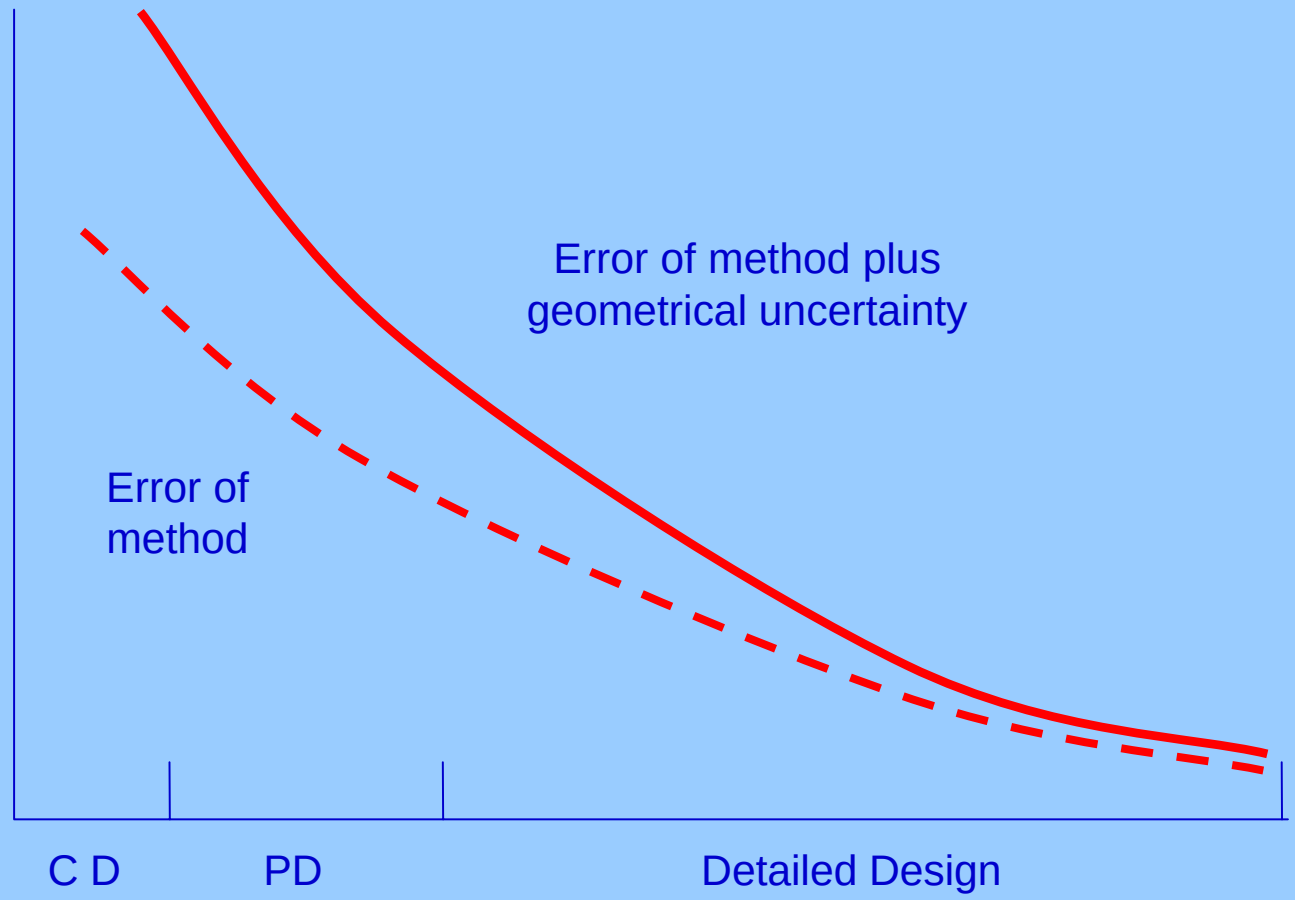
EVOLUTION OF ERRORS AND PREDICTION CAPABILITY



SIMPLE MATHEMATICAL MODEL

$$MTOW=OEW+PL+TF+RF$$

$$R = K \ln \frac{W_i}{W_f}$$

$$K = \frac{V}{c_j} \frac{L}{D}$$

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$$W_i = MTOW\ (1-\varepsilon)$$

$$W_f = (OEW+PL+RF)\ (1+\delta)$$

$$RF = \alpha\ (OEW+PL+RF)$$

$$R = K \ln \frac{(1-\beta)\, MTOW}{OEW + PL}$$

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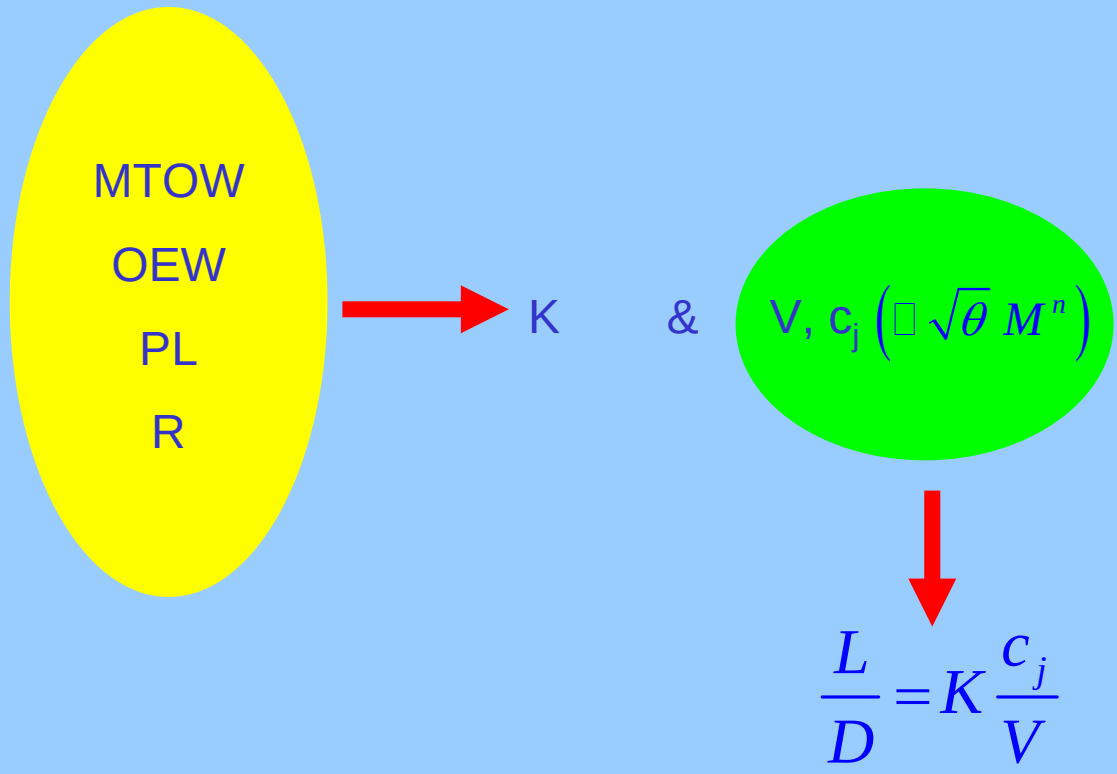

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Narrow bodies: B757-200, A320-200, B737-400, B737-800

Wide bodies: B747-200, L1011-100, DC-10-40, A300-600
B767-200ER, A310-300, B747-400, MD-11, A340-200
A330-300, B777-200, A380-800

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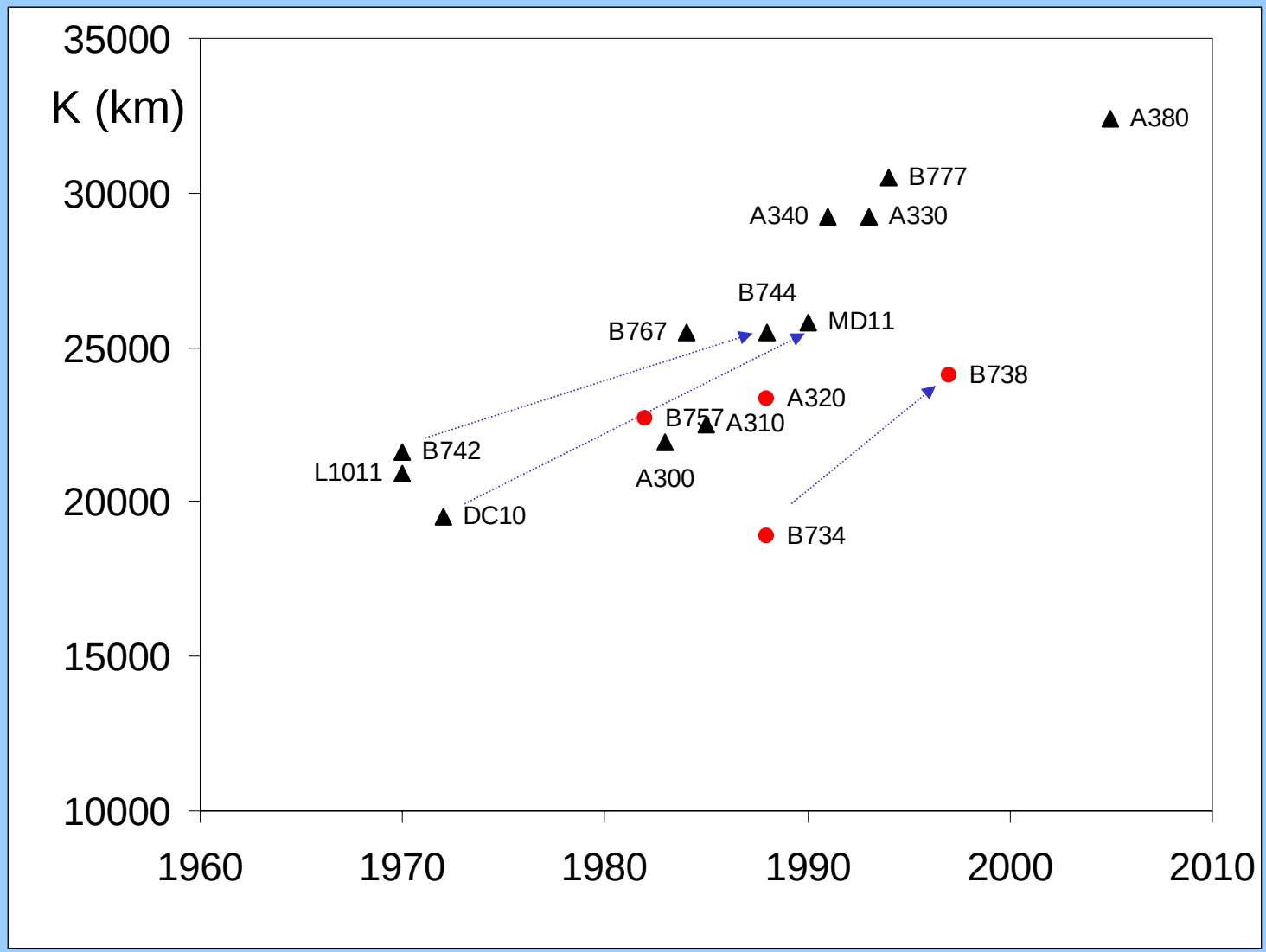

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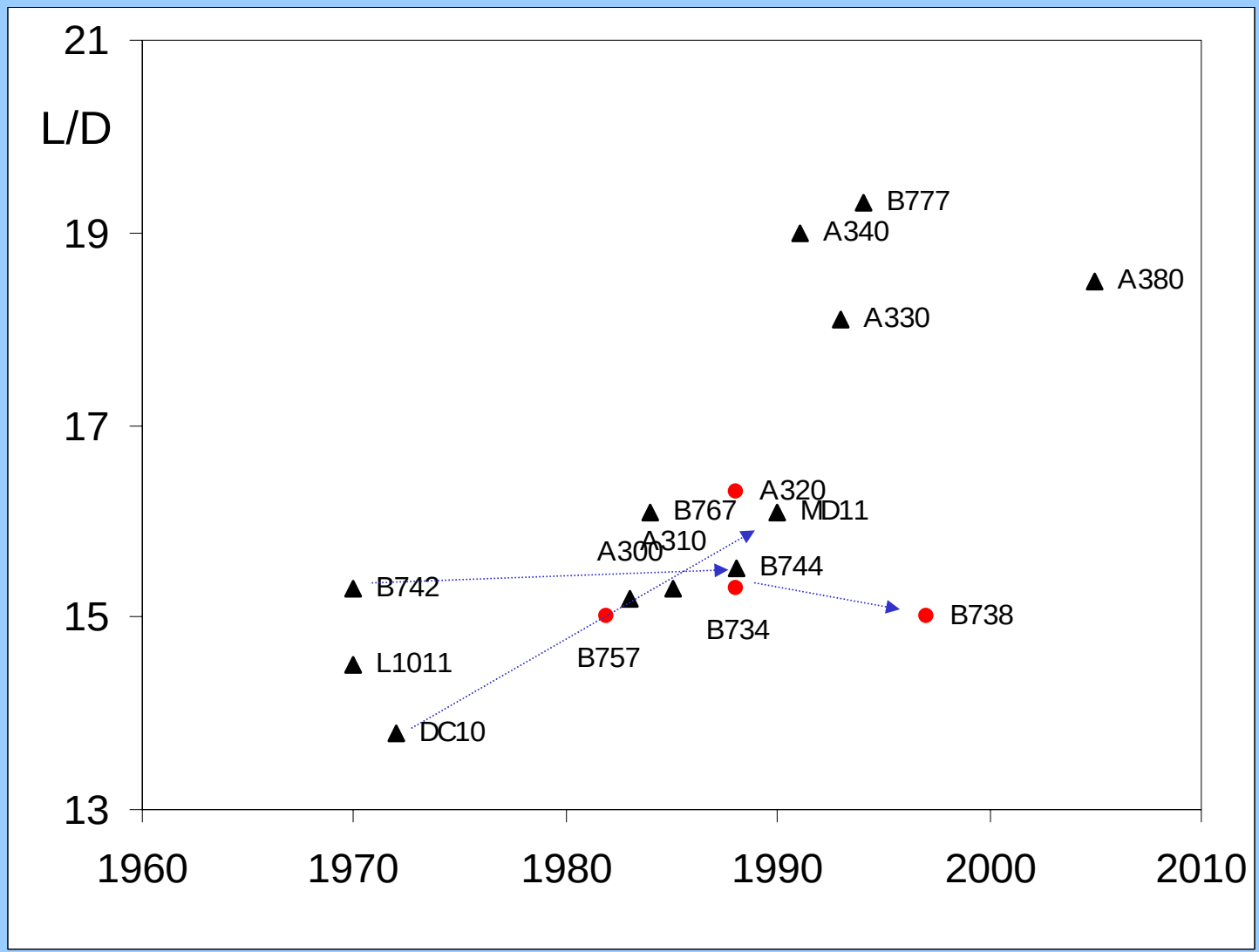

FINAL CONSIDERATIONS

- $\Rightarrow$ Simple methods are useful, powerful and pedagogic
- $\Rightarrow$ Contradictory demand of design courses
- $\Rightarrow$ Difficulties of teaching aircraft design
- $\Rightarrow$ Crisis in industry for economic and geopolitical changes
- $\Rightarrow$ Crisis in academia (Bolonia process, budget …)
- $\Rightarrow$ New job markets for aeronautical engineers
- $\Rightarrow$ Boost co-operation inside academia and with industry

Anyway, AD a key matter for engineering education