Aircraft Development: Problems & Failures
A Design Issue?

AIRTEC 2014
Frankfurt, 27-29 October

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Project problems & failures, the designers main responsibility?
Survey: An approach from history and from experience

Responsibilities for project problems & failures:

• The **designers** to be blamed?
• The **marketing**?
• „The **management**“?
• Unforeseeable: industrial/design challenges?
• Changes in market, technologies, tools?
• Politics? (industrial, national/international)
Developments ended after initial success

- **Airships**: long-range air transportation during 15 years, „Hindenburg“ as catalyst:
  - Basic operational-technical problems.
  - Superceded by technical capabilities of fixed wing a/c
- **Transatlantic flying boats**: transformation of sea-traffic to air:
  - Superceded by technique of land-based planes
  - Less suitable in operations, limited „footprint“ (T/O & landing sites), no revival (Do)
- **Concorde / Supersonic Transport**:  
  - Technical/operational success
  - Excessive operational cost, limited market (transatlantic), environment

Developments not in phase with market / too specific application
UK Developments, after great successes (WWII)

- **Airliners 1950-1965:** Trident, VC-10, BAC-111
  - Targeted for singular local airlines, ignoring world market
  - Fractioned industry structures, limited & dispersed capabilities
- **Total program failures:**
  - TSR 2 & Nimrod AEW
  - Cost, time, organisation, design/technical
- **Co-operation programs (Tornado, EF):**
  - Program successes, but too complex management and coordination structures
- Small market, fragmented industry, cost, design requirements
- Co-operative design programs: beyond the limits now
- Design responsibility in one hand, Airbus’ tremendous success!
- Future European „military air“? One single*, merged company!

(*instead of five..)
Development Today: Learning from the Past?

• **Airbus A400M**
  - Existing knowledge and capability ignored (Antonov 70)
  - Re-installed European capability (airframe, engine...)
  - Cost-increase by +50%, delay +60%

• **F-35 Lightning II**
  - 3 variants of basic design (failed already with the F-111)
  - Cost-increase by +100%, delay +80% (today…)

• Unrealistic program start: knowledge & capability
• Too many (exotic) requirements in one single program
• Too big to fail: survived with political and economic power
Vertical Integration, The Dangers

- System design & integration downloaded to component level / smaller units
- Prime contractor design & production experience & control under threat
- Span between programmes, loss of specialists

Measure (among others):
Maintaining know-how by engaging highly experienced specialists beyond retirement (Experience of ALR in conceptual design and operations analysis)
Design, Engineering & Management Capability
(US Data 2000)

typical staff career today: working on 1 program only
New Design Processes & Engineering Tools

Automated design tool

Mechanical Turk or Automaton
Chess Player, 1770
(Vienna, Maria-Theresia)

Yes, but…
will not replace experience, top experts and generalists
Concluding Aspects

- Understanding requirements is fundamental (designer and customer)
- Quality of concept design, early investment is essential
- Past experience must be fully integrated, knowledge transfer tools? Integrate retired/experienced staff
- New design/development/management tools: to enhance design process, not to replace long-term experience
- Tools often developed for existing/past programs. The new?
- Co-operative programs beyond the limits, restore leadership & authority, similar to the past chief designers (not same role)

Designers not to be blamed, **program set-up is fundamental**!

(initial aspects, more detailed analysis planned)
Appendix: The Technology Issue (mainly military)

- Demonstrated, too early application, enabling technologies not mature
  - VTOL Germany (VJ-101, VAK 191) engines and system technology, Requirements disappeared
  - Ultrafan-propulsion technology

- Re-invented because forgotten:
  - Weapons- and payload bay: European technology development despite early experience (transonic Buccaneer, V-bombers etc.)
  - Laminar Flow: no knowledge transfer, IPR issues

- Application in products:
  - Mismatch between marketing – management – engineering

- Fragmented European military landscape
  - Efforts from 5 aircraft-, 3 system- 2 engine-companies, parallel & wasted
  - Almost no European projects: ETAP (European Technology Acquisition Programme);
    EDA (European Defence Agency), under-funded! Constant IPR problems