Aircraft Development: Problems & Failures
A Design Issue ?

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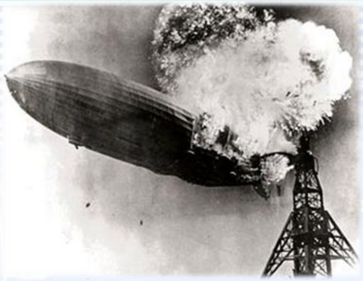
Project problems & failures, the designers main responsibility?





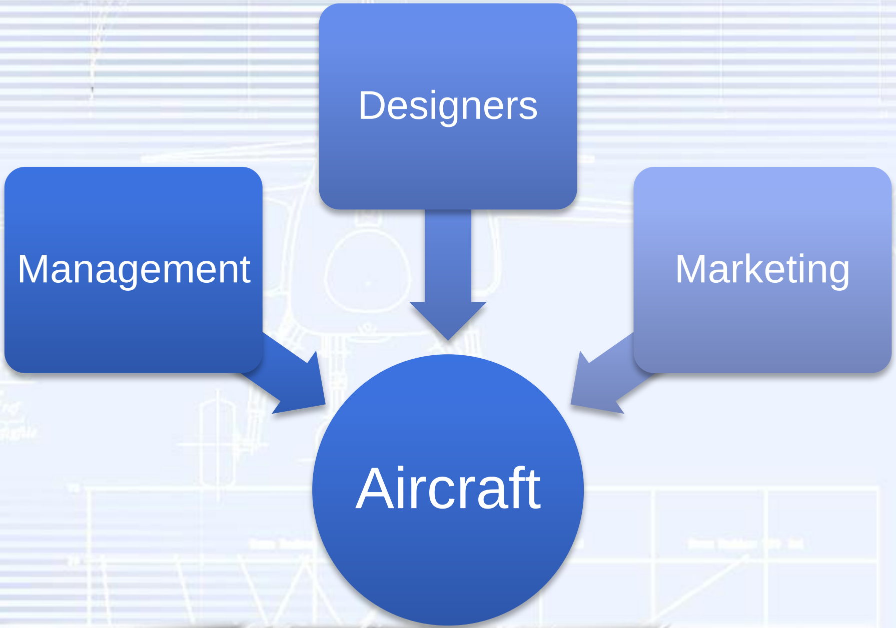





Survey: An approach from history and from experience

Reponsibilities for project problems & failures:

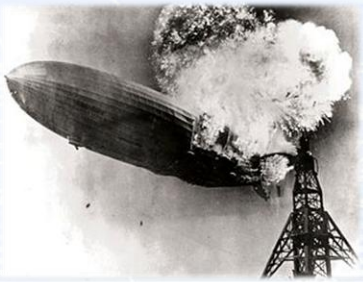
- The **designers** to be blamed?
- The **marketing**?
- „The **management“**?
- Unforseeable: industrial/design challenges?
- Changes in market, technologies, tools?
- Politics? (industrial, national/international)



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  - Superceded by technical capabilities of fixed wing a/c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  - Superceded by technique of land-based planes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%

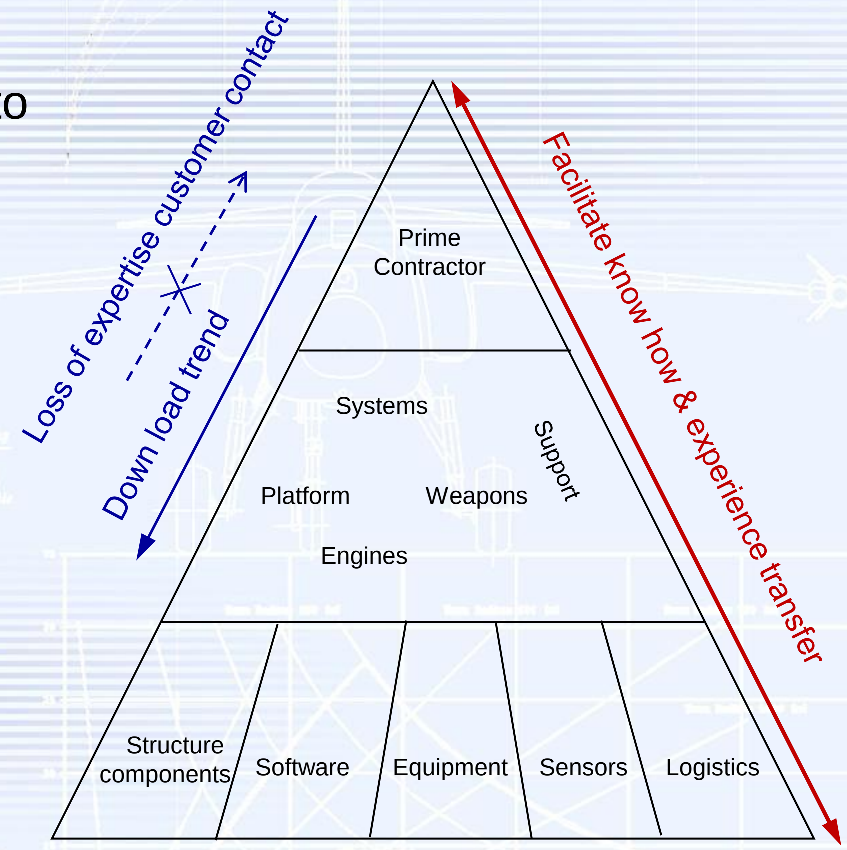
- **F-35 Lightning II**
  - 3 variants of basic design (failed already with the F-111)
  - Cost-increase by +100%, delay +80% (today…)

- 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

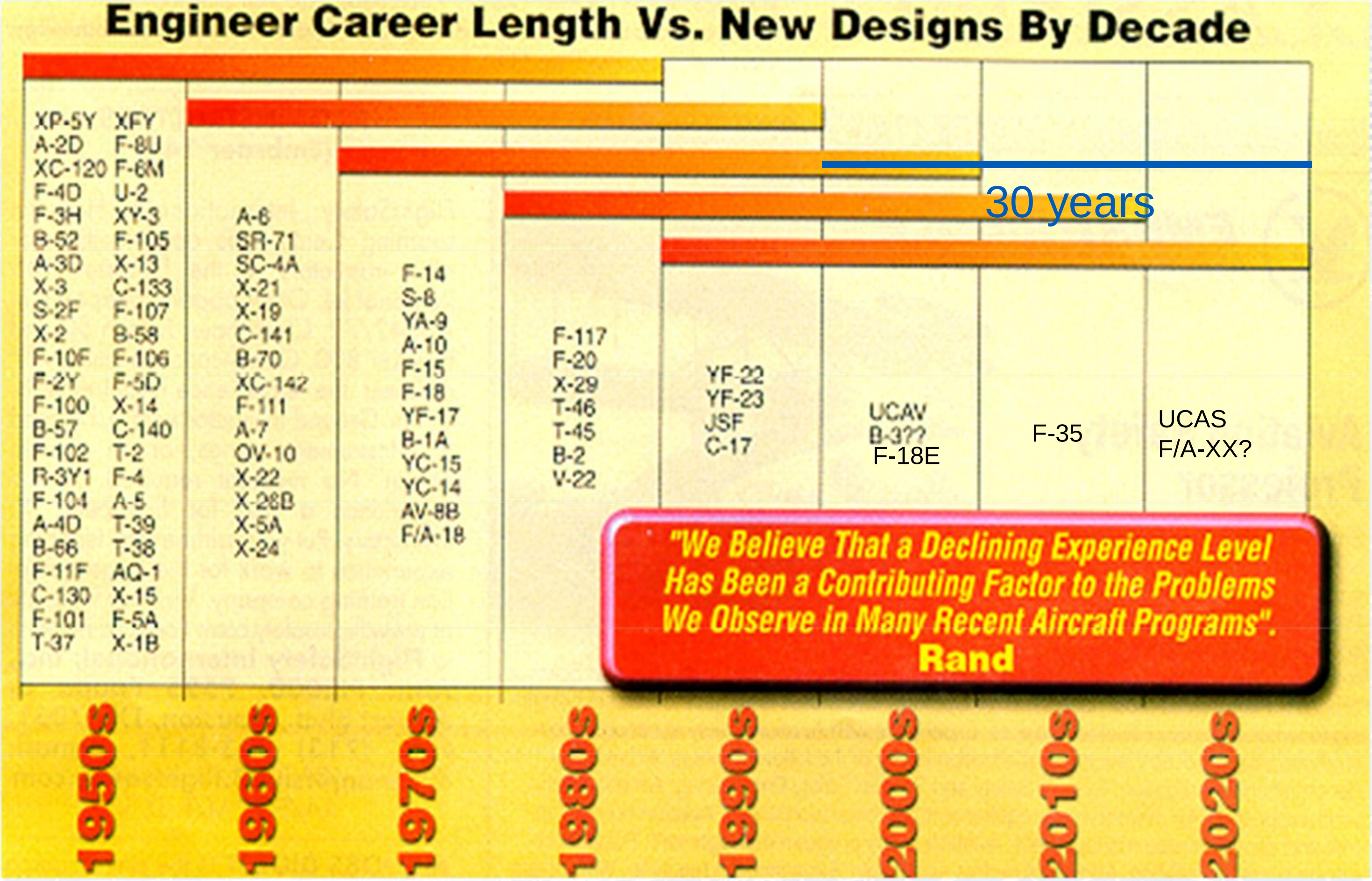
- System design & integration downloaded to component level / smaller units
- Prime contractor design & production experience & control under threat
- Span between programmes, loss of specialists

Measure (among others):
Maintaining know-how by engaging highly experienced specialists beyond retirement (Experience of ALR in conceptual design and operations analysis)



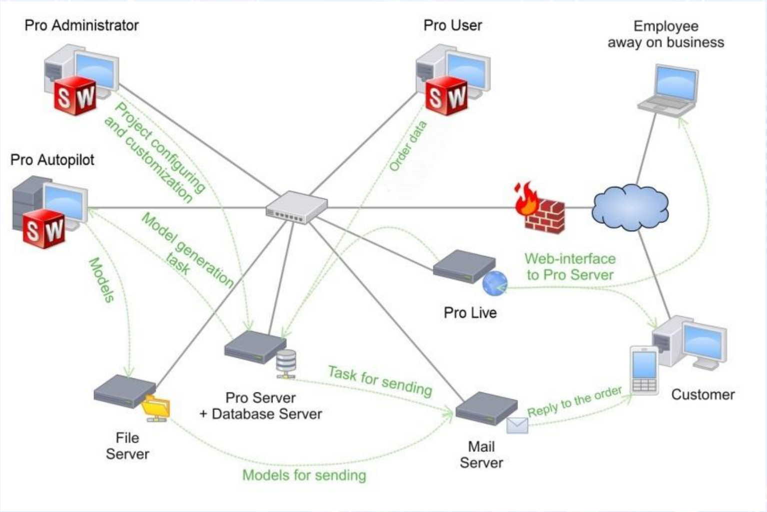
Design, Engineering & Management Capability

(US Data 2000)



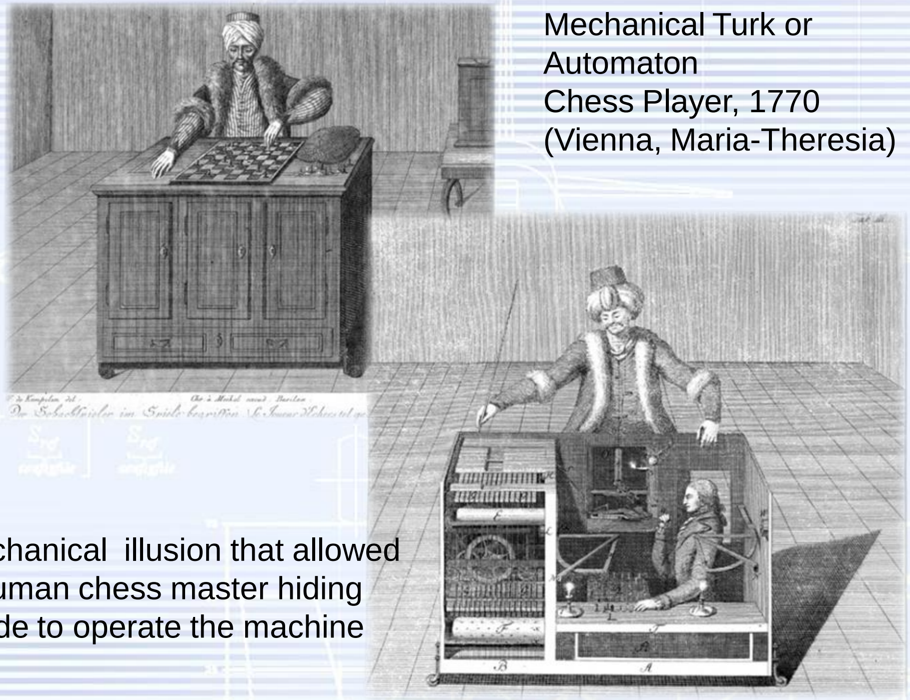
typical staff career today: working on 1 program only

New Design Processes & Engineering Tools



Automated design tool

(Credit to Pavel Zhuravlev, Moscow)



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

Mechanical illusion that allowed a human chess master hiding inside to operate the machine

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
  - Laminar Flow Technology (1980ies, 1990ies, 2000+)
  - 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 Acquísition Programme); EDA (European Defence Agency) , under-funded! Constant IPR problems