COST HOUSE

ECONOMIC PERFORMANCE

Implementing Design to Cost in early phases

Presentation

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Agenda

Benchmark des coûts DSI

Introduction

Breakdown of complete costs

Identification of main cost drivers

Value analysis

Cost/value optimization

Outcome

Introduction

Context and objectives

- Commercial satellite market faces unprecedented challenges
    - When replacing existing satellites, much higher performance to cost designs are expected.
    - Technical and environmental constraints in space remain the same …

    … yet competitors with alternate technologies (low orbit, land solutions), modify market expectations (prices and services)

- Eventually the financial paradigm is shifting with the need to find balance between
    - long operational lifetimes
    - shortening window of service and price visibility.

- This is when Design to Cost can provide new perspectives and opportunities

Breakdown of complete costs

Insight

- Before rushing into cost optimization, cost must be clearly defined and understood.

- Numbers, however, can be tricky and it takes some time and effort to properly define the perimeter
    - non recurring / recurring
    - design, assembly and testing
    - ground segment, launch
    - …

- In the present case, we had to cross analyze data
    - from previous programs
    - scarce information provided by suppliers,

- … only to find out that there were major discrepancies.

Breakdown of complete costs

The difficulty of estimating costs in a secretive environment

- Different estimates were used to extrapolate cost structure of a Telco satellite program
- Price history over past programs are used to estimate cost structure of complete program
  - Discussions with partners allowed us to extrapolate “cost+” (cost+margin) structure of spacecraft
  - Internal estimate of prices for major components of payload and antennas was used to bring some perspective
  - With the following results :

			Extrapolation from partners	Price history	Part cost estimates
Spacecraft		parts	100	115	40
Launch services					
Insurances					

- Differences show need for better understanding of actual costs.
  - Confronting suppliers and internal experts allowed us to make some assumptions on major cost drivers for engineering hours (project costs, studies, development) as well as major sub-systems (assembly, components), insurance and launch.

- This analysis, complemented with parametric analysis of previous satellites’ prices and sub-systems, showed that satellites have a high fixed* cost level (50-60%).

** Independent of payload design and performance*

Identification of main cost drivers for sub-assemblies

Parametric models at Airbus – Eric Van Landuyt

- In order to facilitate and secure cost estimates, parametric models can be used.

- At the Costing department of Airbus Defense and Space, we have developed since 2019 a methodology to create parametric cost models
  - based on a limited amount of reference projects/reference items (i.e. 20 past projects from the last 15 years)
  - and with an accuracy of +/-20% (or better, depending on the number and diversity of references).

- Cost models allow to predict cost or development efforts for new satellites, by domain :
  - mechanical/structure,
  - thermal,
  - propulsion,
  - antenna,
  - …

Identification of main cost drivers for sub-assemblies

Parametric models at Airbus – Process

- Method used can be described in 10 steps :

    1. Brainstorm with experts and/or well experienced people about probable major cost-drivers

        important : rank (i.e. from 1 to 5) all cost-drivers (from a pure “Engineering-judgment”)

    2. Create a cost-database with at least 20 reference projects/reference items

        Make sure scope/perimeter is consistent across sample

    3. Create a scale (i.e. from 0 to 5) for all qualitative cost-drivers (i.e. heritage, complexity, performances)

    4. Characterize each reference-project or item across all brainstormed probable major cost drivers

Cost + performance database

Identification of main cost drivers for sub-assemblies

Parametric models at Airbus – Process

5. Use Valoptia.CER to create/propose formulas containing the most important ("à priori") major-cost-drivers

   Target formulas with decent correlation to the reference-values (i.e. $R^2>0.85$)

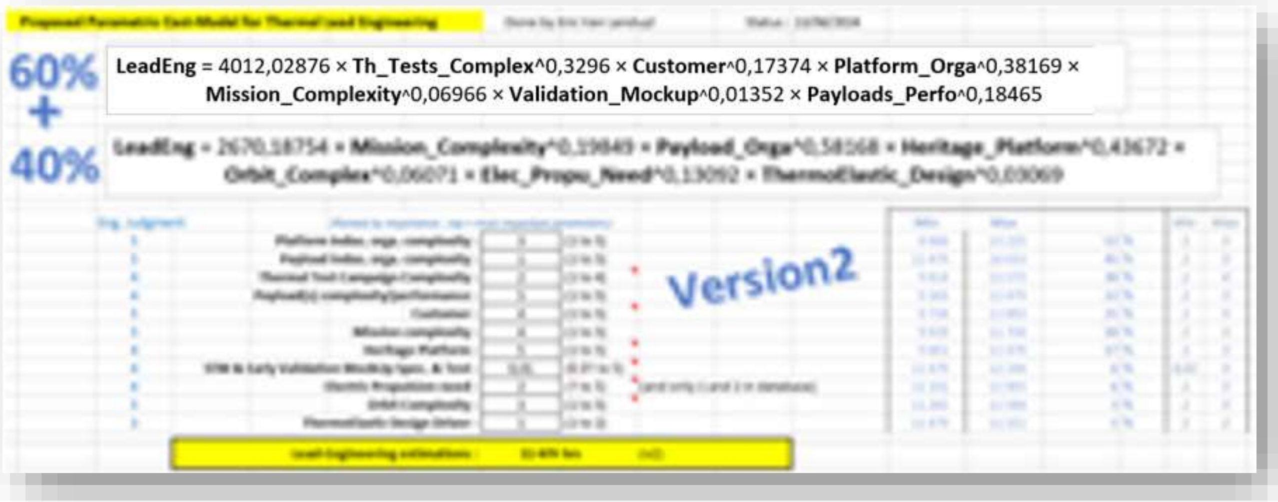
6. If necessary, create several formulas that will be added together

   weigh each formula, also based on "Engineering-judgment"

7. Let experts/specialists use (play with) cost-model as much as they can and collect feedback

   i.e. some cost-drivers that seem too important or too weak ; assessing the relevance of the formulas is key for improvements !

8. Enhance the cost-model (content of the formulas) based on feedback



Cost Estimating Relationship (extract)

VALOPTIA cer

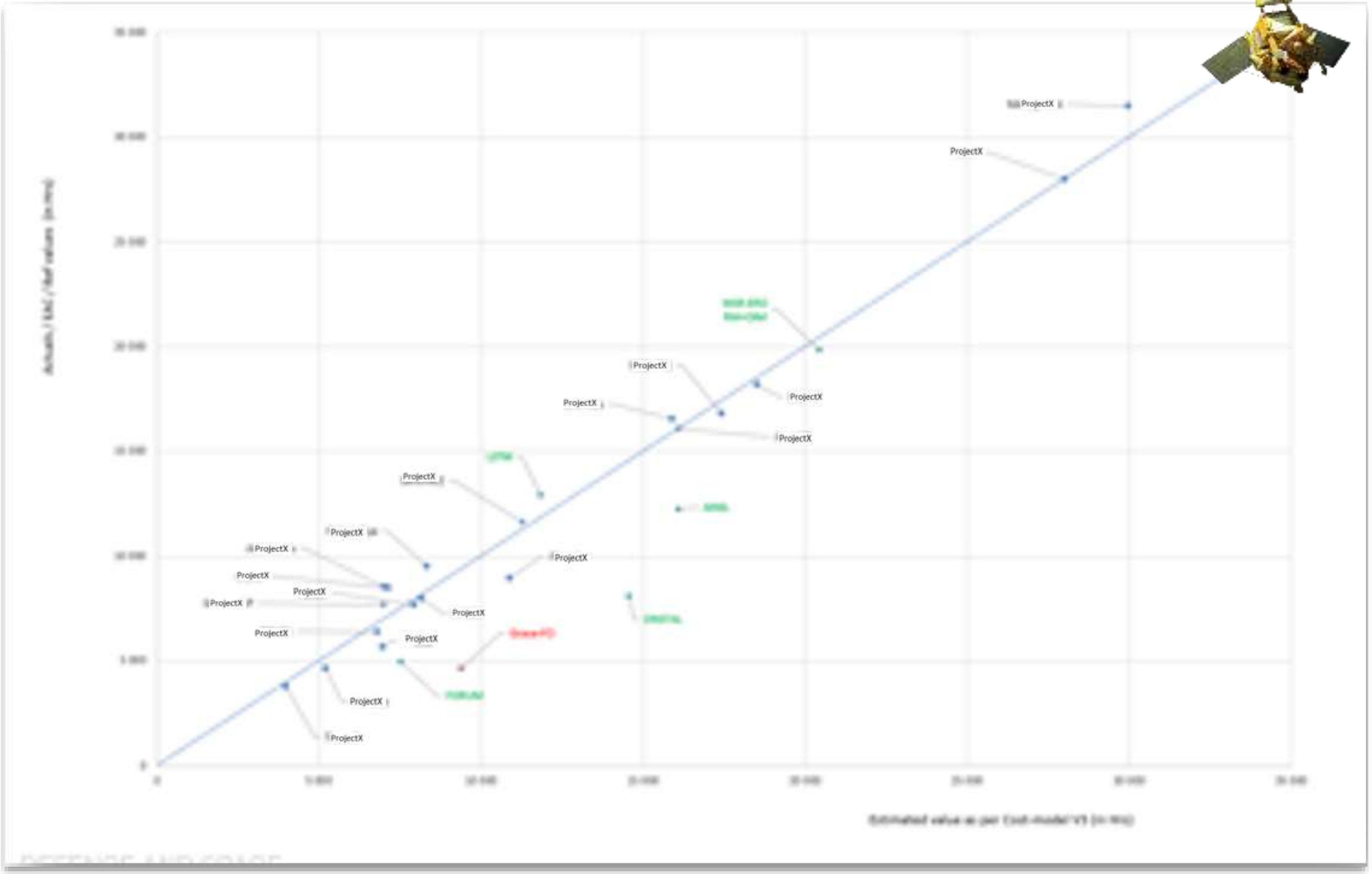
Identification of main cost drivers for sub-assemblies

Parametric models at Airbus – Process

9. Create a graph showing the gaps between the estimates and the reference-projects/reference-items

   Use scatter plots in order to see the cost range, for which the cost-model shall have the best accuracy

10. Once a year, try to increase the number of references in the database and re-iterate



Scatter plot Estimate vs Actual

(reference points in black, new projects in green)

Value analysis

Focusing on client need

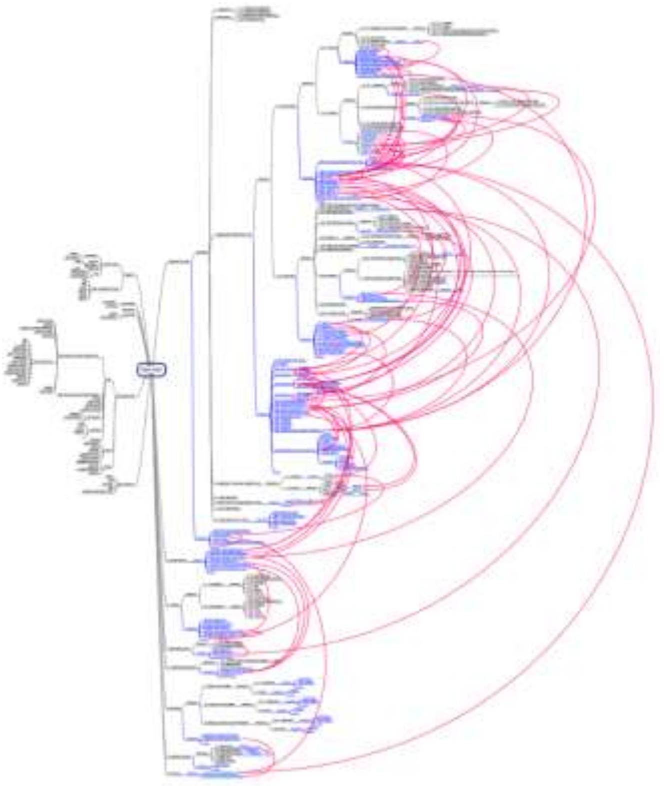
- Understanding business model associated to operating the satellite allows to define appropriate performance criteria for customer (instead of engineering).

➡ **sell bandwidth over a defined area,** not satellites with channels and amplifiers.

- Analysis of performance and size dependencies between sub-systems is too complex to grasp and optimize entirely.

➡ focus on prevailing dependences between highest cost sub systems, identify areas with cost relevant trade-offs, eg **antenna, power, structure**.

- Key performance criteria for profitability:
  - Payload capacity and flexibility => Amount of revenues.
  - Payload performance and coverage => Commercial differentiator
  - Duration of procurement, launch services and transfer orbit (time to orbit delivery + possible ground commissioning) =>Time To Market, i.e. timing when revenues set-in.
  - Lifetime as per propellant reserve, component lifetime and redundancies => Duration of revenues.
  - Complexity, and customization instead of standardization => Cost and duration



Cost/value optimization

Cooperation with industrial partners

- The main industrial partners had to be embarked in order to identify and estimate potential cost savings.
  - This proved to be a challenging endeavor

- Open cooperation is based on trust and mutual interest. This needs to be secured through MoU or contract covering various aspects
  - Project scope, cost reference and target, schedule
  - Intellectual property (patent registration, rights and royalties, right of use)
  - Economics (how investments and savings are shared)
  - Commitment for future business (nb of satellites, € amount, timeline, competition rules)
  - Understanding that a credible offer is needed with a clear schedule and real cost effectiveness

- Cost optimizations are possible and require various major changes:
  - Cost per sold capacity vs cost of available capacity => smaller platform
  - Cultural change to move from product/system testing to process control
  - Improvement of “interaction” with partners’ design and manufacturing processes
  - Model cost vs performance and flexibility
  - Build to print approach

Conclusion

Insight

- In an industry where most players consider cost as a necessary secret, implementing a design to cost approach does not come easy.

- Yet, taking little steps on all its key concepts allowed the team to
  - gain cost awareness,
  - challenge current design and decision making processes
  - identify areas with promising trade-offs, eg
    - design for more variable cost of platform and launch
    - paradigm shift in redundancy management
    - optimization of design and engineering time (soft and hard) between recurring and non-recurring
  - pave the way for future programs

Cost House

10 M€
Turnover

350
Clients

44
FTE's

4
Locations worldwide

COST HOUSE

Consulting, Benchmark and Training

- Cost engineering
- Improvement project
- Economic simulation
- Benchmark

Solutions logicielles

VALOPTIA

- Total cost calculation
- Cost estimating relationships
- Time tracking
- Cost estimation from a CAD drawing