

BEYOND CERs AND DATABASES:

LESSONS LEARNED FROM A UNIVERSITY-INDUSTRY EDUCATIONAL INITIATIVE

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The space cost engineering paradox

Cost is often the main criterion to receive green light for programme implementation

THE
PARADOX

Yet, cost engineering remains a niche discipline, still (partly) decoupled from the mission definition flow

Why the paradox persists

- Academy and industry also tend to separate cost from the other engineering disciplines, leading to a cultural, functional and operational gap
- Limited cost engineering awareness among stakeholders involved in the mission definition, including technical disciplines, systems engineering, PA, procurement, PM, BD & sales, PCCO

The opportunity

- Treat cost as an engineering budget and a common design language to strengthen feasibility, transparency and ownership of cost estimations
- Integrate cost into the engineering logic from the definition of the first mission concept
- Build cost awareness across all functional units (industry, institutional, and academic level)

The capability gap

The main constraint is not methodological alone

01 Limited university visibility

Standard aerospace engineering programmes rarely cover cost engineering, so graduates often enter industry with limited awareness of the discipline

02 Informal entry into the field

Most people begin in another technical role and first encounter cost through a proposal, an early-phase study or an unexpected project need

03 Unstructured training

Junior engineers learn primarily on the job, so their development depends on the methods, data and expertise available within their organisations, which seldom provide structured cost engineering training

Result Capability development depends heavily on the specific organisation, while access to the field remains partly a matter of circumstance

Risks

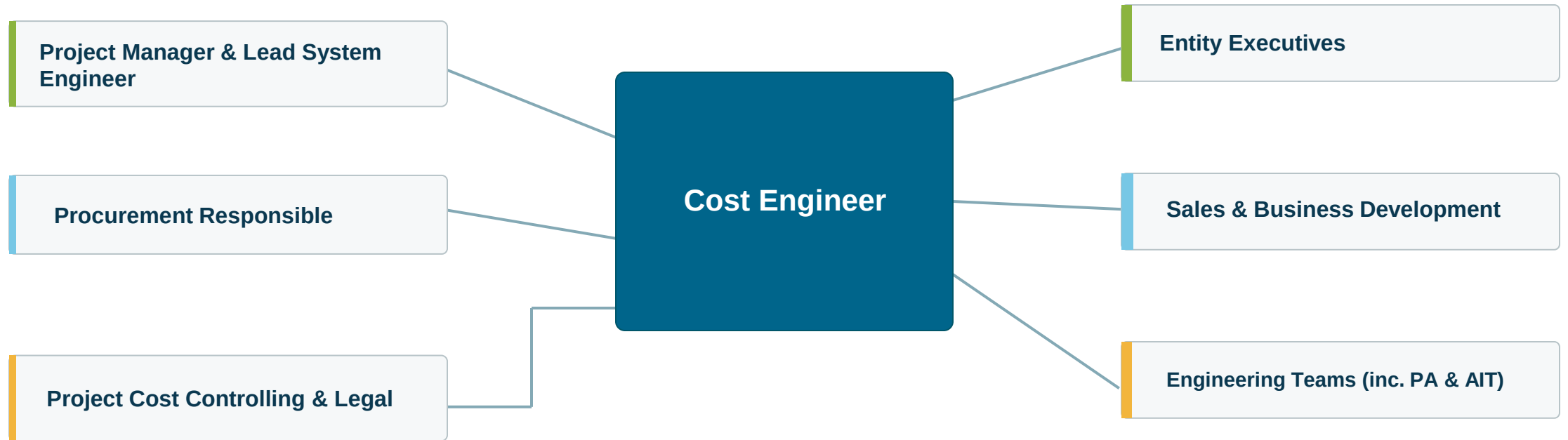
- Increase cost pressure on space programmes
- Retirement of experienced specialists
- Discontinuity of knowledge
- Reduced recruitment pool
- Inconsistent practices across organisations
- Limited visibility among future engineers

Opportunity

More structured and qualitative education / training pathway can broaden access, preserve knowledge and strengthen the profession

The cost engineer as an integrator

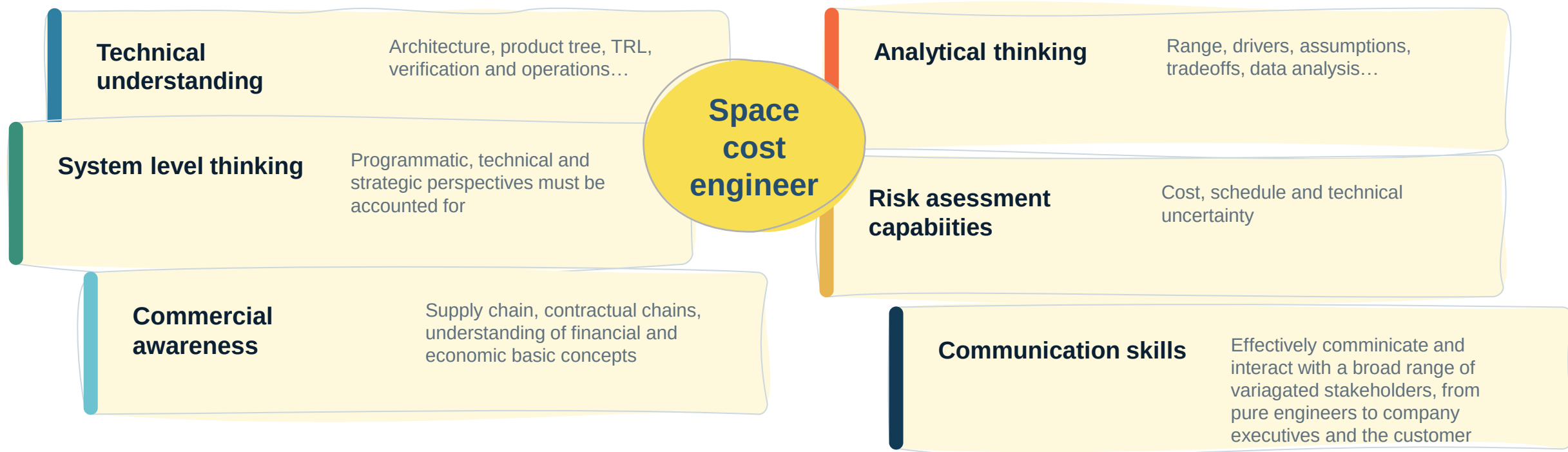
Translating technical and programme decisions into a common language



The same connecting role applies throughout the value chain



The space cost engineer profile require a combination of skills and capabilities



The University of Bremen experience

- **As part of the Space Engineering MSc System Engineering course of the Bremen University**
- **DLR and OHB jointly gave lectures on cost engineering**

Audience

Approximately 30 MSc Space engineering students

Format

A 90-minute foundations session followed by a 60-minute decision-oriented session

Pedagogy

Short theory blocks followed by a role-based Phase 0 mission design game under a fixed cost cap

Purpose: Theoretical foundation plus first practical experience to build practical judgement

What University lectures can bring

Confidentiality heavily determined what could be shared in the lectures

What can be shared 'freely'	What can shared with 'care'	What cannot be shared
<ul style="list-style-type: none">● Generic principles and process● Common terminology● Method selection and risk assessment● Design to cost and design to value	<ul style="list-style-type: none">● Sanitised use cases● Lessons learned without sensitive values	<ul style="list-style-type: none">● Proprietary databases● Internal CERs, models and tools● Supplier quotations and RFIs● Programme governance and commercial assumptions

Common principles, terminology and a general awareness can be built at university without interfering with property data

THEORETICAL LECTURE

1

Section 1: Basics of Cost Estimation for Space Projects

- Why cost engineering matters?
- What is different in space?
- Engineering approaches and impacts on costs
- Essential terminology
- Systems and cost engineering synergy
- Cost dimensions

2

Section 2: Cost Estimation Methodologies

- Cost Estimation Methodologies: Analogy
- Cost Estimation Methodologies: Parametric
- Cost Estimation Methodologies: Bottom-up
- Cost Estimation Methodologies: Overview
- Cost Estimation Methodologies: Tools

3

Section 3: Cost Estimation Preparation

- Preparing a cost estimate...
- Cost Breakdown Structure (CBS)
- Cost Breakdown: Mission Lifecycle costs
- Data normalization: Why cannot I compare historical project costs directly?
- Cost risk analysis
- Refining a cost estimate: from first unit to multiple unit costs
- ESA projects

4

Section 4: Engineering Approaches to Cost

- Design to Cost
- Design to Value

PRACTICAL EXERCISE

SCENARIO

Phase 0 optical Earth-observation mission. Students assumed engineering roles and developed a concept under a fixed cost cap

LEARNING MECHANISM

A role-based mission exercise to make cost part of the system decisions

OBSERVED OUTCOME

Students recognised cost engineering as a systems discipline and better understood the interfaces between the cost engineer, technical specialists and management

The class became a Phase 0 mission team

Cost estimation and D2V first practical experience

MISSION CONCEPT

Propose an optical EO satellite that maximizes mission value within 160 cost tokens

Launch 2032 SSO

Cost cap: 160 token

Role	Task
Mission scientist	Maximize scientific return
Systems engineer	Meet all technical requirements
Cost engineer	Maximize value while staying in the cost cap
Project manager	Balance budget, risk and value
PA engineer	Ensure mission reliability

Teams selected payload, resolution, lifetime, RAMS, propulsion and verification options

Observations made from the practical exercise

- All teams **remained within the cost cap**, yet developed different and valid mission concepts (at this stage)
- The **different outcomes** showed how technical and programmatic assumptions influence cost and mission design
- The role-based exercise made trade-offs and **competing priorities more tangible**.
- Students **recognised cost engineering** as a systems **discipline closely connected to the technical domains**.
- The **exercise clarified the interfaces between the cost engineer, technical specialists and management**.
- **Cross-disciplinary consequences remained difficult to anticipate for the students**, such as combining lower-TRL equipment with a lighter model philosophy.
- At this early phase, **cost compliance alone did not determine a single preferred concept**.

Lessons learned

WHAT WORKED

1

Sustained student engagement

Students asked questions throughout the theoretical session and responded positively to the practical cost engineering exercise

2

A stronger systems perspective

The practical exercise helped students recognise cost engineering as a systems discipline closely connected to technical decisions

3

Credibility through complementary experience

The combination of DLR and OHB System perspectives grounded the content in real cases and professional practice

WHAT SHOULD BE IMPROVED IN NEXT ITERATIONS

Cross-disciplinary effects

Students did not always anticipate how choices such as lower-TRL equipment and a lighter model philosophy could affect cost and programme risk

Limited time for the practical exercise

Two lectures totalling 2.5 hours provide valuable initial exposure, but cannot offer a comprehensive view while also accommodating a practical exercise

Cost engineering capability requires a structured development pathway

01

UNIVERSITY EDUCATION

Create awareness and a shared language

Introductory teaching on principles, methods and the role of cost in system decisions

Suggestion: integrate a 10–20h cost engineering module into the space engineering MSc programmes

02

ORGANISATIONAL DEVELOPMENT

Build capability

Structured internal training and mentoring

Suggestion: available at major EU space organisations

03

INDEPENDENT EXPERIENCE

Develop autonomous cost engineers

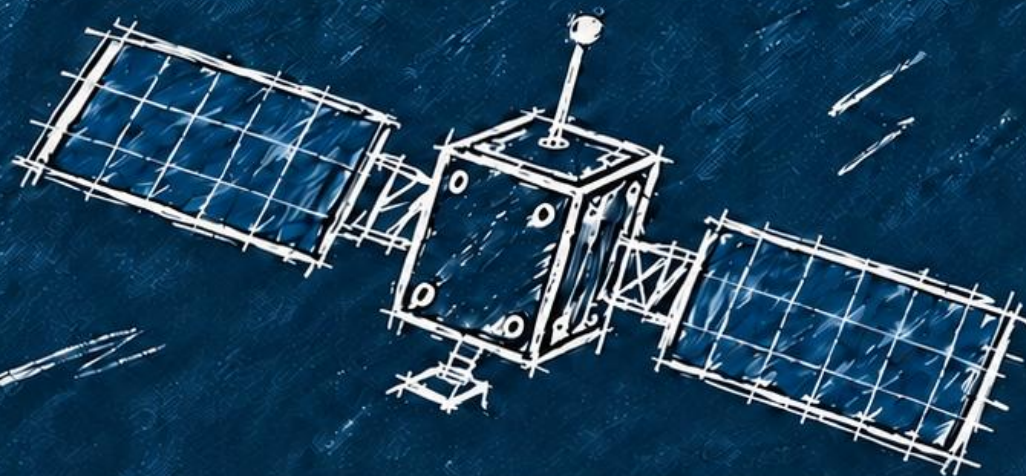
Professionals who can produce estimates, challenge assumptions and advise projects independently

Suggestion: maintain expert working groups at European level

Cost engineering should not be discovered by chance. It should be developed as a recognised space engineering discipline

We welcome your perspectives: how can academia, agencies and industry build this pathway together?

How much will the mission cost?



Mass: TBD

Requirements:
evolving

Schedule:
not fixed yet

TRL: maybe 5

Launch: soon



**THANK YOU
VERY MUCH!**

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