DOLPHIN Mission Design: A Feasibility Study

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Abstract & Background: DOLPHIN will study interstellar dust to answer key questions in ***planetary science and astrophysics***. It has an estimated launch date in 2031 (or 2047) during the solar cycle minimum. This project is done in collaboration with ETH Zurich. The goal is to analyse if the mission Cost at Completion (CaC) can be brought under 175 M€ according to ESA F-Class constraints.

Can we launch this interplanetary mission within 175 M€?

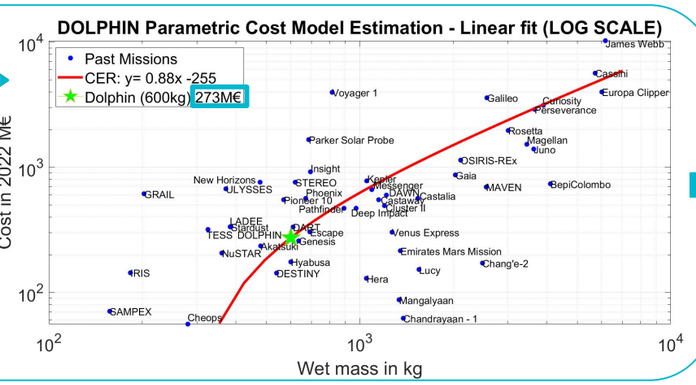
Initial Cost Estimations

1. **Our parametric cost model** →

Data collection: CaC and wet masses data from 50 interplanetary missions
Tool: MATLAB curve-fitting algorithms, linear fit

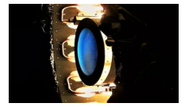
2. **Small Spacecraft Cost Model (SSCM)** CaC: 214 M€

Input initial mass breakdown:
Based on statistical averages of previous missions' mass budgets

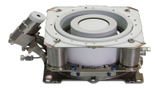


Subsystem Design Through Trade Offs & Cost Engineering

Propulsion System Design:
A comparative study was done on TruePlanning to find which thruster will lead to *a lower cost per kg* while meeting the requirements.



Thruster Next-C



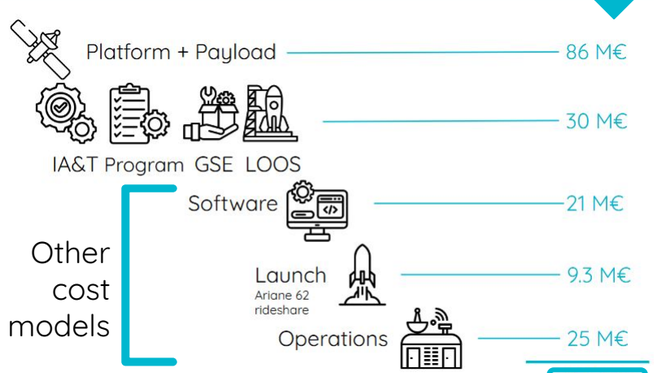
Thruster PPS1350

kg +17% € -57%

Cost Budget Refinement

Mass budget refinement:
Through components selection: dry mass reduced from 503 kg to 397 kg (with margins) (21% reduction) → input to SSCM

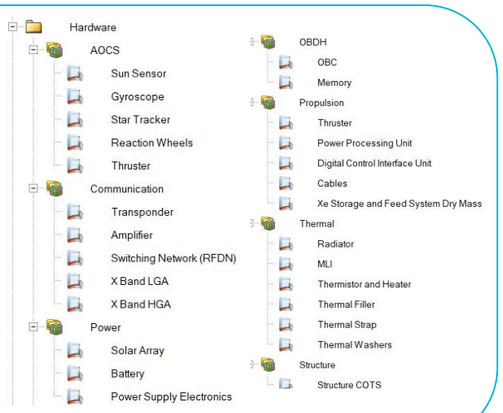
All space mission cost elements included in the CaC estimation



TruePlanning Initial Model

TruePlanning® by PRICE® Systems

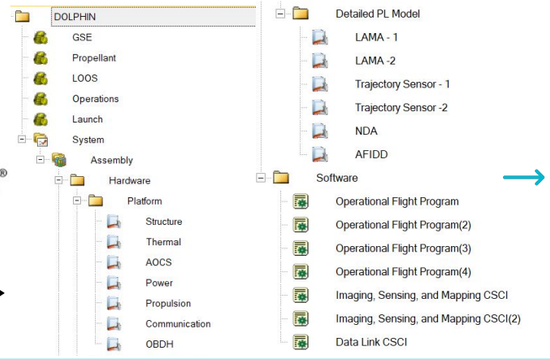
Initial model with the PBS in TP does not include the assembly cost of all the subsystems made of COTS.

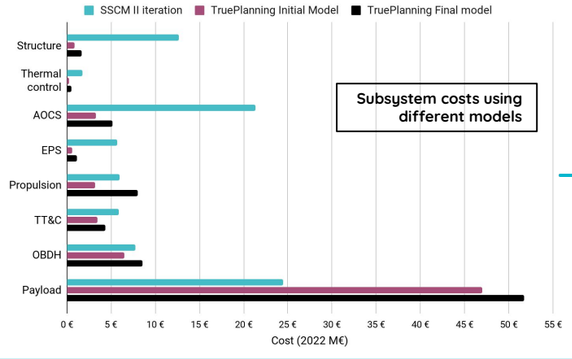


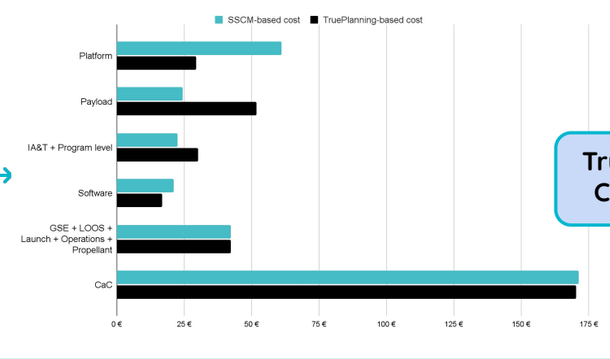
TruePlanning Analysis

TruePlanning® by PRICE® Systems

TruePlanning Final Model →



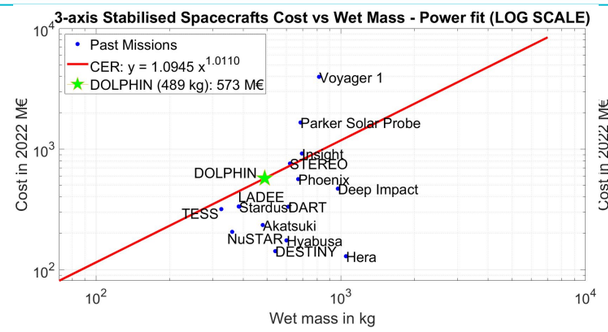


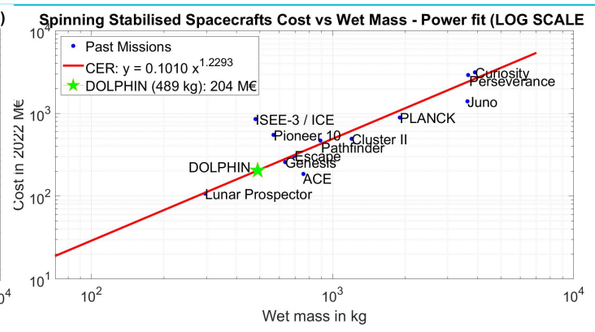


TruePlanning CaC 170 M€

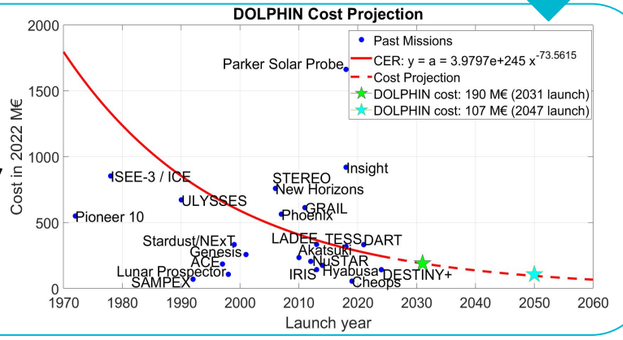
Cost Reduction Ideas

1. AOCS stabilization
3 axis → spinning
64% cost reduction





2. Launch date
2031 → 2047
44% cost reduction



Conclusion: DOLPHIN fulfils the ESA F-Class cost constraints and can be launched within 175 M€!