



Mission Analysis

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Introduction – What is Mission Analysis ?

”Mission analysis is a structured method of ensuring that the mission success criteria's are clear and well understood.”

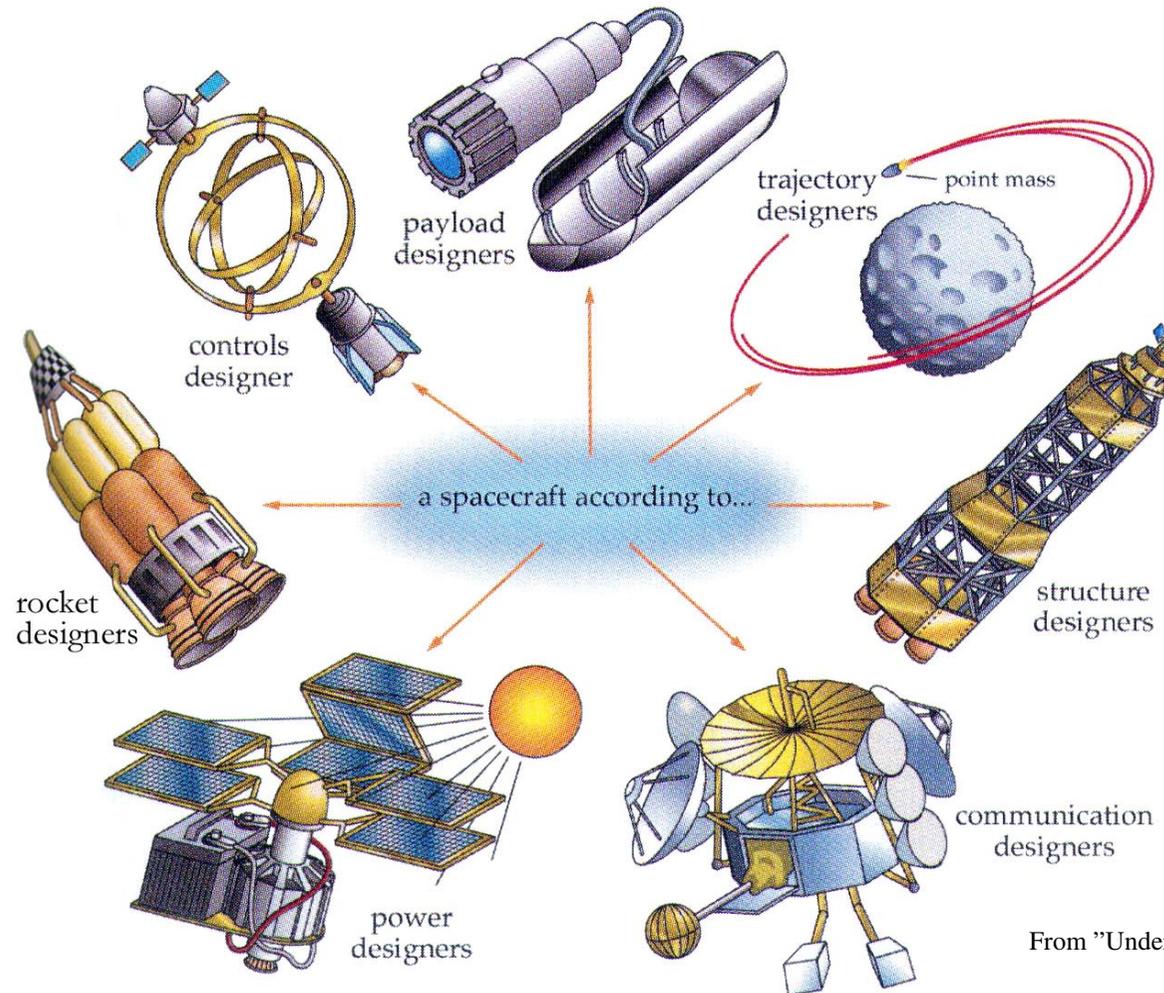
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”Mission analysis ensures, that the mission fulfils the overall success criteria's and at the same time stays within the project boundary conditions technical, political and financial.”

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”Mission analysis define the on-board subsystems configuration and basic subsystem requirements.”

Introduction – where would we be without Mission Analysis



From "Understanding Space" by Jerry Jon Sellers



Example 1 - Building a Backyard Deck

- 1. I need a nice deck or patio to put the BBQ and a place to relax in the sun**

I really have to resist the urge to drive to the hardware store to buy a load of lumber and start filling the garden with sawdust. I say to myself..... Think first then act.

- 2. I carefully define what I really need before I drive down to the hardware store.**

- How much money do I have**
- How big do I want it to be. How big does my wife want it to be**
- What colour should it be**
- What kind of materials and tools to I need**
- How long time do I have to built it.**
- Can I buy it off-the-shelf**
- What is the cost**

- 3. If the cost is too high ???? Can I do it in time for the garden party next week ???**

- 4. My wife comes a couple of days later and says I also want a nice hot tub – right there.....Hmm..**

- 5. Again I have to go back and see if I can accommodate a tub within the constraints.....if you respect your wife's wish that is !**

- 6. When I am reasonably certain I buy what I need and start building the Deck**



Initial Considerations – Mission Requirements and Constraints

During the **FIRST** steps of the Space systems engineering process we define mission requirements and constraints. This involves

Define Mission Statement Incl.

- State the mission objective – why we do the mission
- Identify mission users – who will benefit from or use the information produced by the mission
- Create the operations concept – how will all the mission elements fit together
- Identify mission constraints (Cost, schedule and performance)



Initial Considerations – System Requirements

During the **SECOND** step of the space systems engineering process we derive the system requirements

- Review the constraints on mission architecture (Launch vehicle, orbit, operations, lifetime etc.)
- Identify and characterize the mission subject – (eg. "what" will the spacecraft instrument complex (payload) do ?)
- Derive payload requirements
- Derive orbital requirements
- Determine basic spacecraft size and mass (envelope)
- Identify potential launch vehicles
- Derive operations network requirements (Groundstations).



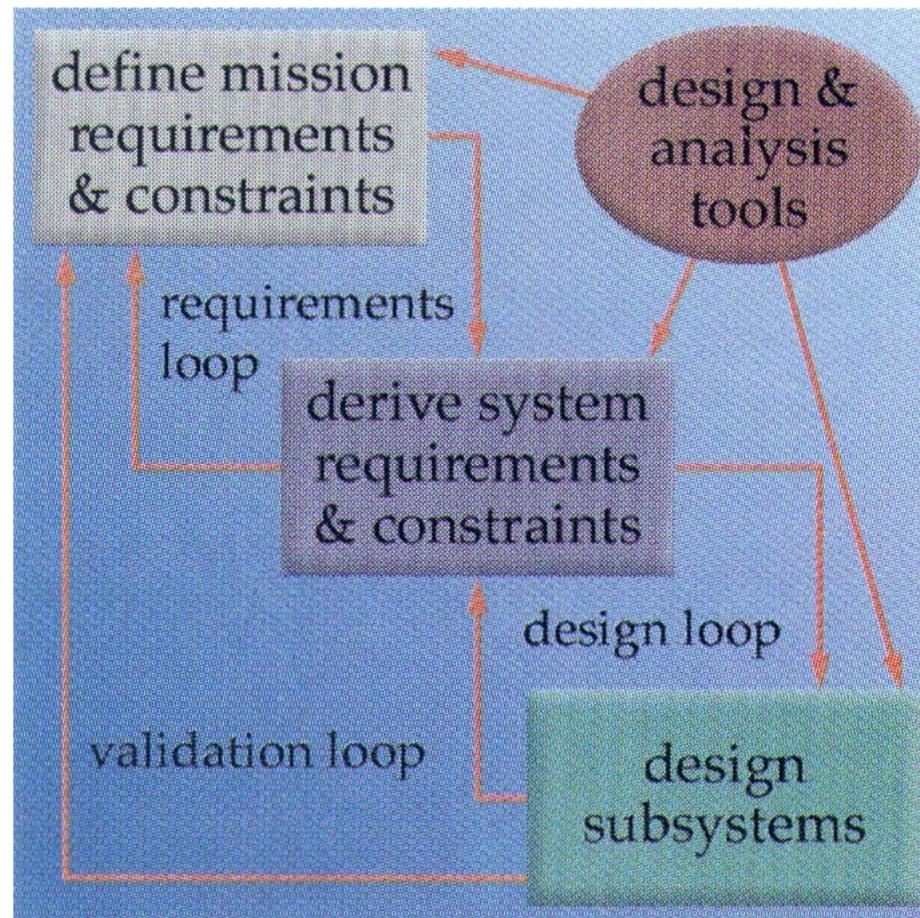
Initial Considerations - Subsystem definition

During the **THIRD** step of the space systems engineering process we start defining the subsystems, and after a few iterations of the requirements etc, the design can begin.

1. Define ACS concepts (based on pointing, positioning and stability requirements)
2. Define redundancy concepts.
3. Define onboard subsystems (EPS, COM, CDH, Payload computer, On board SW, ACS etc.
4. Perform data flow analysis
5. Determine ground coverage and communications concept link budget
6. Determine needed power and power output analysis
7. Define thermal requirements and perform initial analysis
8. Determine structural requirements and perform initial analysis
9. Analyse radiation environment
- 10. RE-ITERATE ALL**



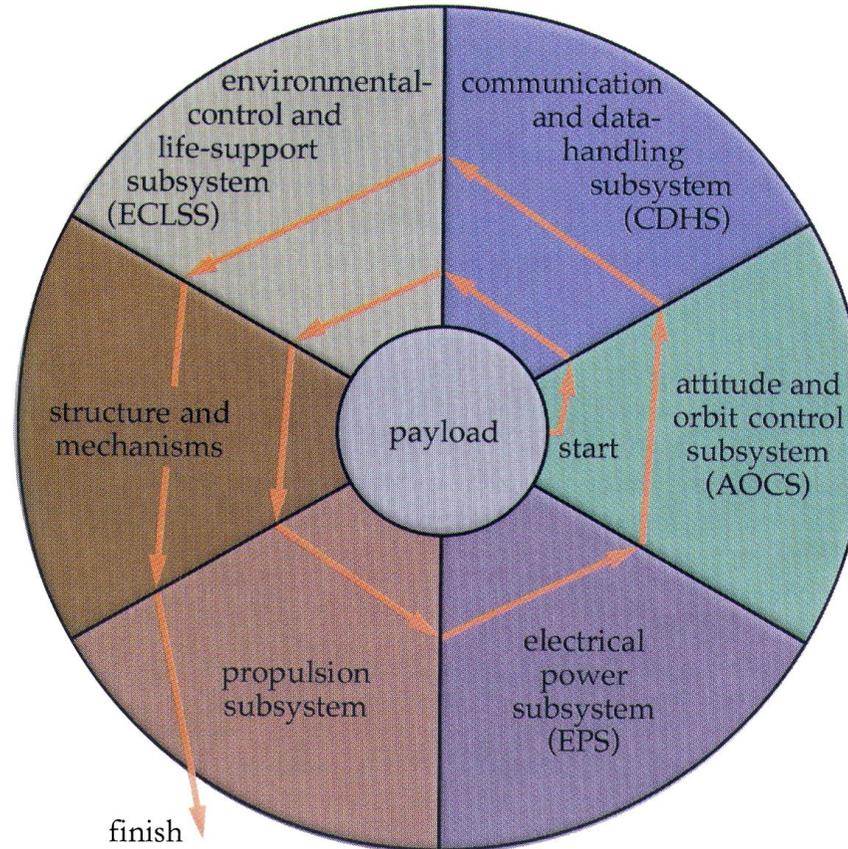
Mission Analysis – Flow



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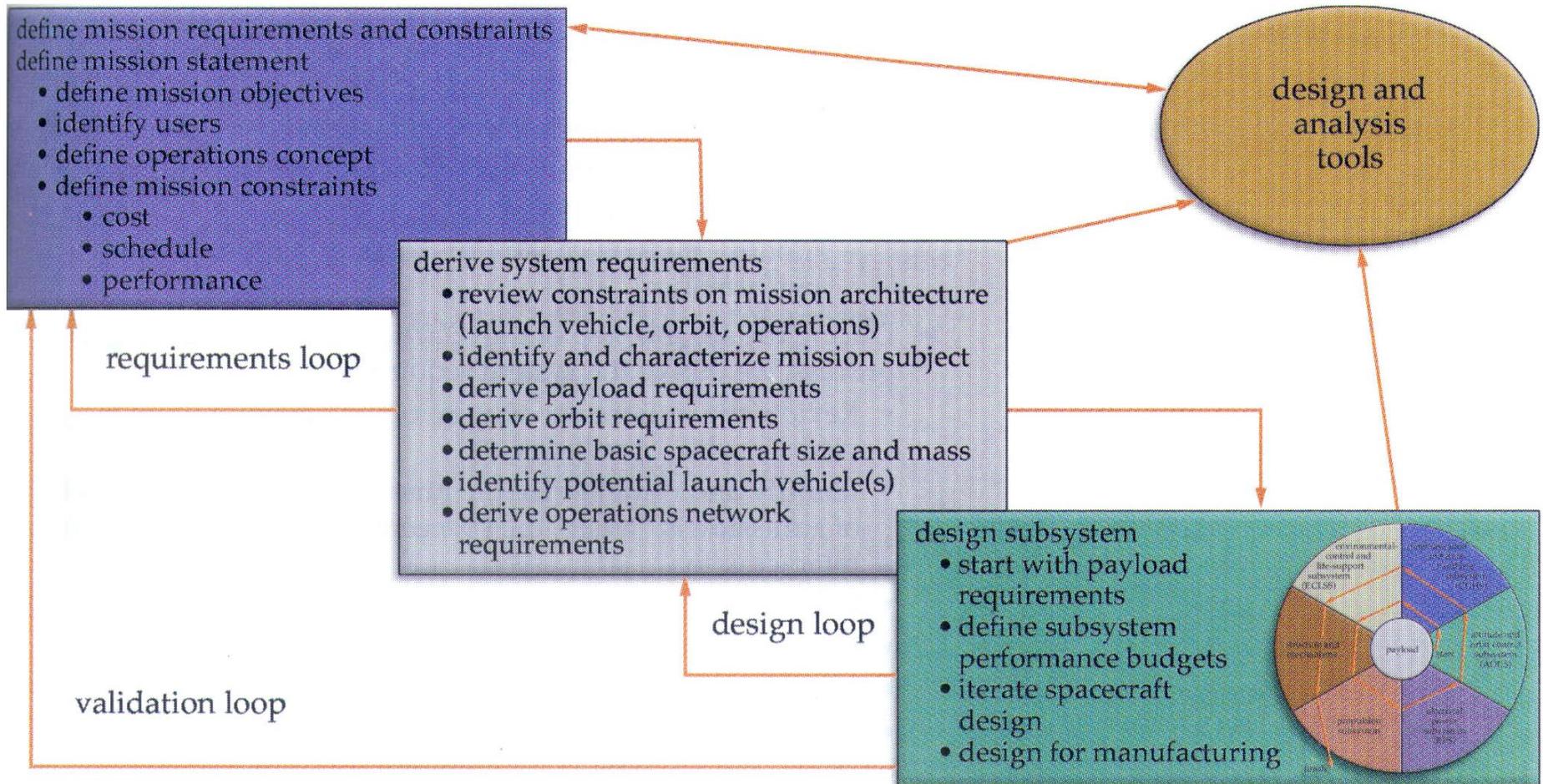
Mission Analysis - Iterations



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Mission Analysis - Details



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Design and Analysis Tools

Design and analysis tools include computerbased and other techniques to calculate subsystem specifications and simulate trade-offs. Examples include:

- Spreadsheet (eg mass calculations, power output, link budget)
- Mathcad, Matlab, IDL for simulation of eg. ACS algorithms, power output and link budgets
- CAD Designtools etc for mechanical design. Eg Autocad, Mechanical desktop etc.
- Structural & Thermal design tools (Ansys, Ideas, NASTRAN, ESA-RAD/ESA-TAN)
- STK "Satellite Tool Kit" for orbit analysis, ground tracks, pointing, visualisation, power output, link budgets operation implications
- Orbit analysis Nova for windows (WWW.NLSA.COM), realtrack
- Radiation environment analysis ([www.spennis.oma.be/spennis.](http://www.spennis.oma.be/spennis))

Just remember "garbage in ...means garbage out"always have a sound understanding of the input and of the results.



Basic Rule 1 - Keep It Simple & Stupid (KISS)

KISS



Basic Rule 2 – Keep track of interfaces

Keep track of interfaces



Basic Rule 3 – Have fun

HAVE FUN