Fourth Barcelona TechnoWeek
Course on Nanosatellites
Institute of Cosmos Sciences, Barcelona, 17-21 June 2019

Project Management

María Balaguer Jiménez

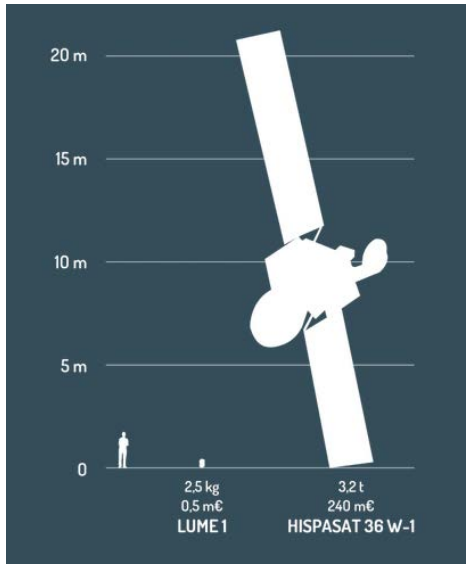
Instituto de Astrofísica de Andalucía (IAA-CSIC)

What is Project Management ?

- Coordination of resources to achieve a goal within a restricted time.
- It plays a sig … all aspects of the projec … rs, financial managemen…
- Importance …
- Not the sam … pplicable to all the projects

Nanosatellites main features (I)

- Complete stand-alone systems including platform, payload, ground segment & operations
- Low level of complexity (relative to other ESA space projects)



Satellite types according to mass:

- Large satellites: More than 1,000 kg
- Medium-sized satellites: 500-1,000 kg
- Small satellites:
  - Minisatellite: 100-500 kg
  - Microsatellite: 10-100 kg
  - Nanosatellite: 1-10 kg
  - Picosatellite: Less than 1 kg

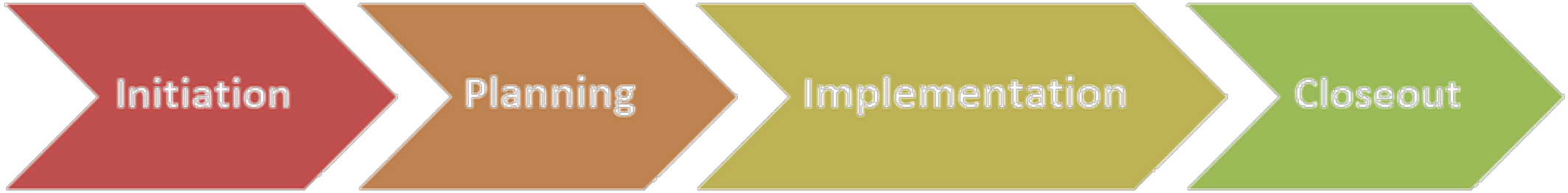
Nanosatellites main features (II)

- Low cost and short schedule
  - A nanosatellite can be built and placed in orbit for 500000 euros.
  - The cost of a conventional satellite can be as high as 500 million euros.
  - Between 5 and 15 years for average-sized or large satellites
  - Less than 2 years for flight readiness for nanosatellites
- Short operational lifetime
  - (typically <1 year in low altitude LEO)

Nanosatellites main features (III)

- Acceptance of single point failures
- Limited redundancy
- Limited fault tolerance
- Extensive use of commercial off-the-shelf elements
- Simple project organization
- Traditional project management procedures as European Cooperation on Space Standardization (ECSS) can be too over-specified

Project Management Processes



Preparation

- Requirements
- Statement of work
- Authorization to proceed

Plan project

- PM plan
- WBS
- Schedule
- Budget
- Roles
- Risk
- Quality

Monitoring and controlling

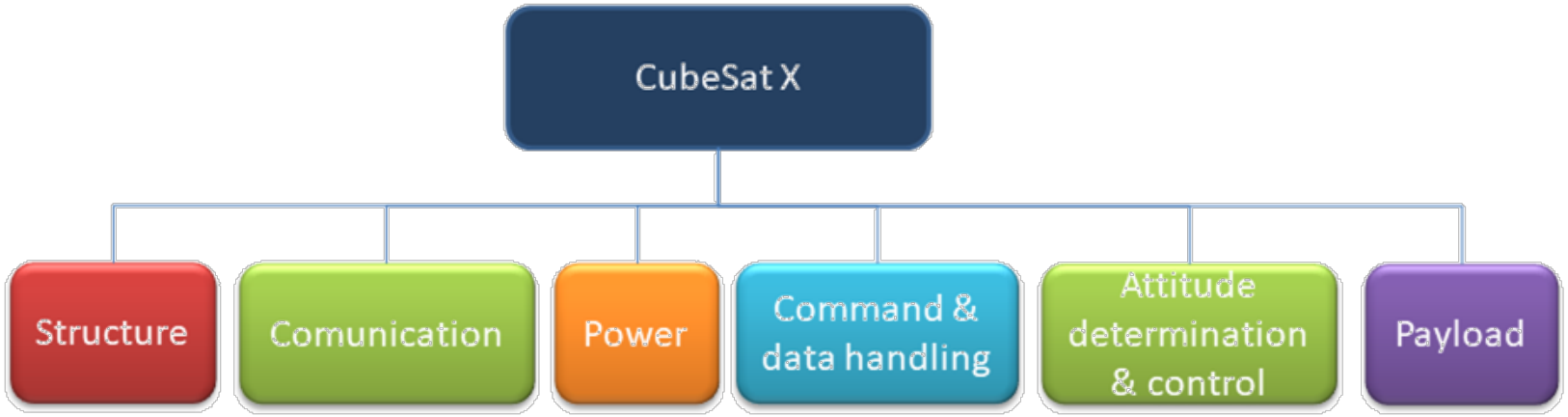
End of project

- Finish product
- Finish documentation
- Close-out
- Lessons learned

Project breakdown structures

- They break the project down into manageable elements
- Advantages:
  - Common understandings by identifying items, associated tasks, and responsibilities
  - Identification of interfaces
  - Management of configuration and recording of changes
  - Enhancement of the effective project management

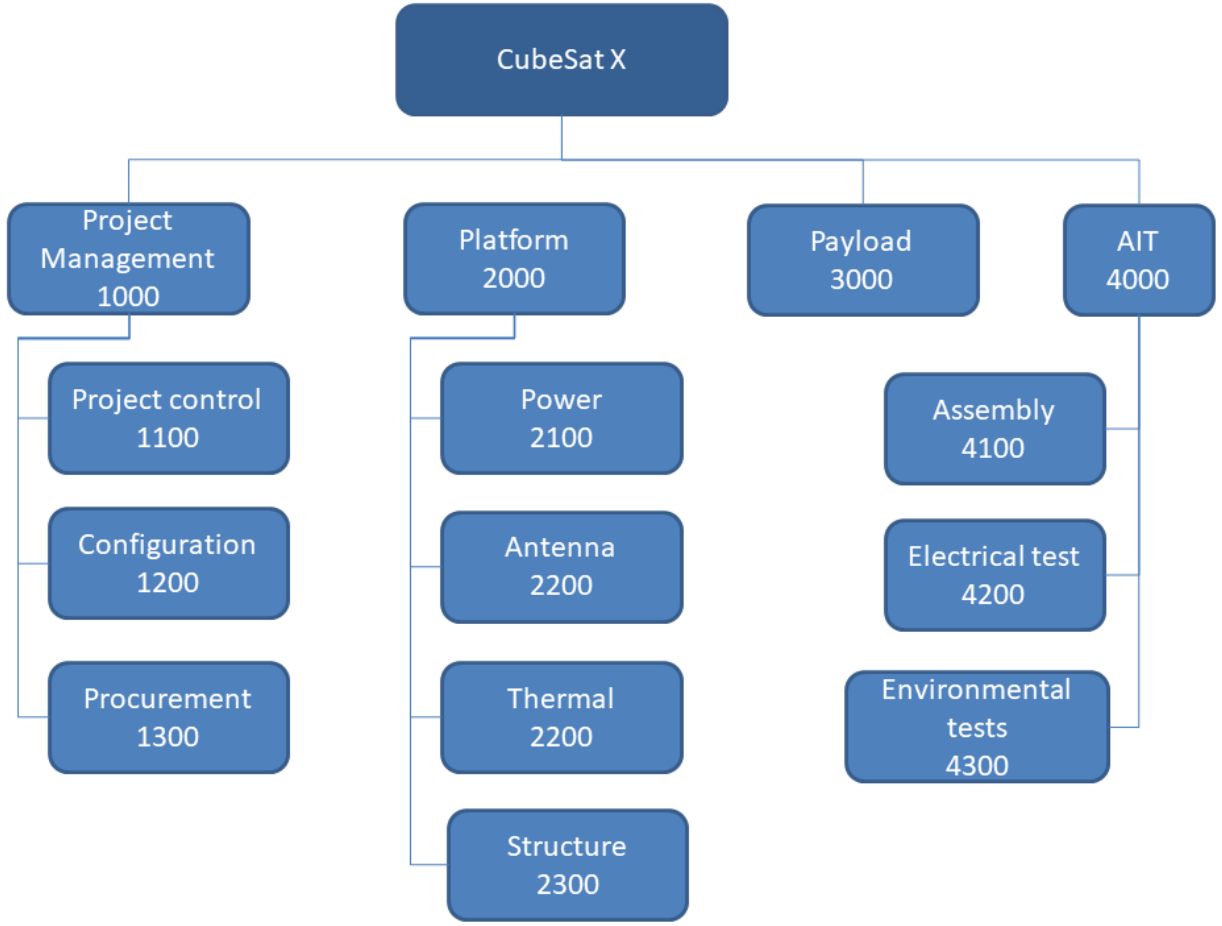
Product Tree (PT)



- The product tree represents the hardware and software components
- Product trees can be two separated hardware and software tree
- Each component listed in those trees shall be uniquely identified with an identification number (CI)

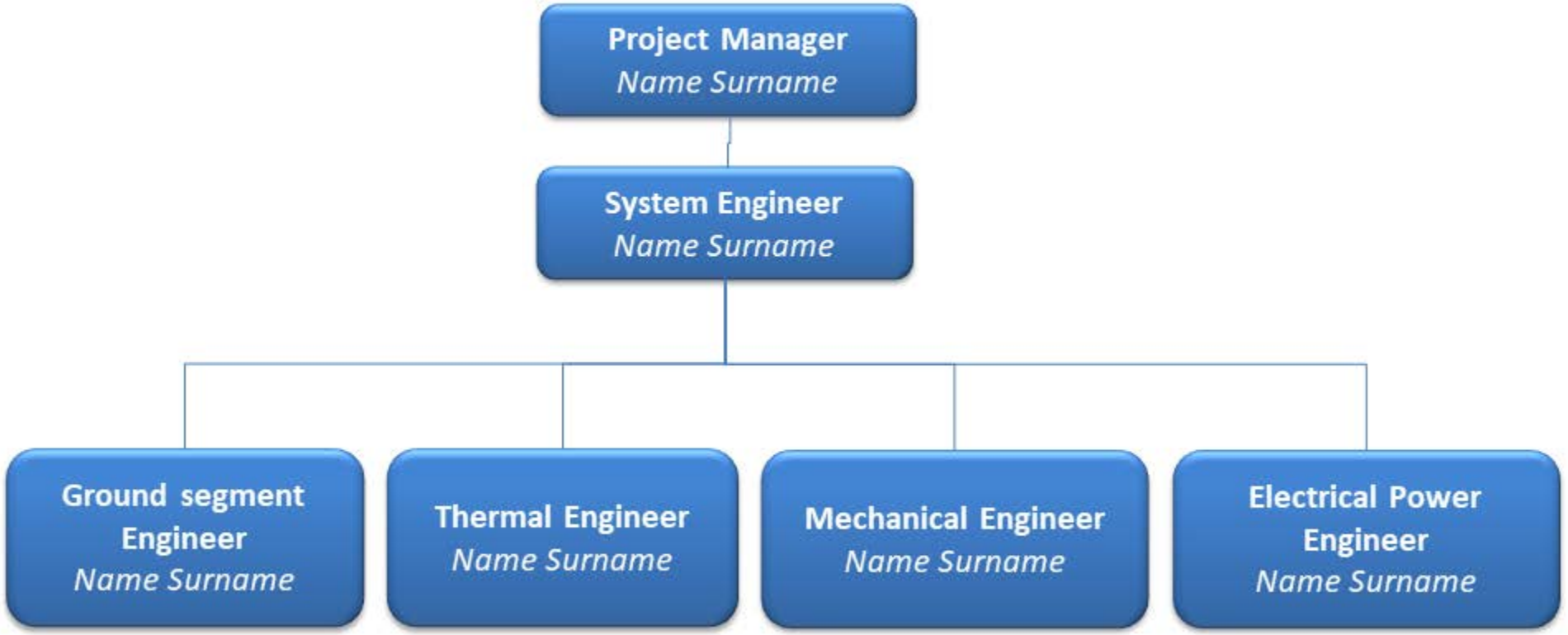
Work Breakdown Structure (WBS)

- Summary of work packages:
  - Descriptions specific works
  - Human ressources
  - Time durations
- Important to derive:
  - The schedule management
  - Documentation management



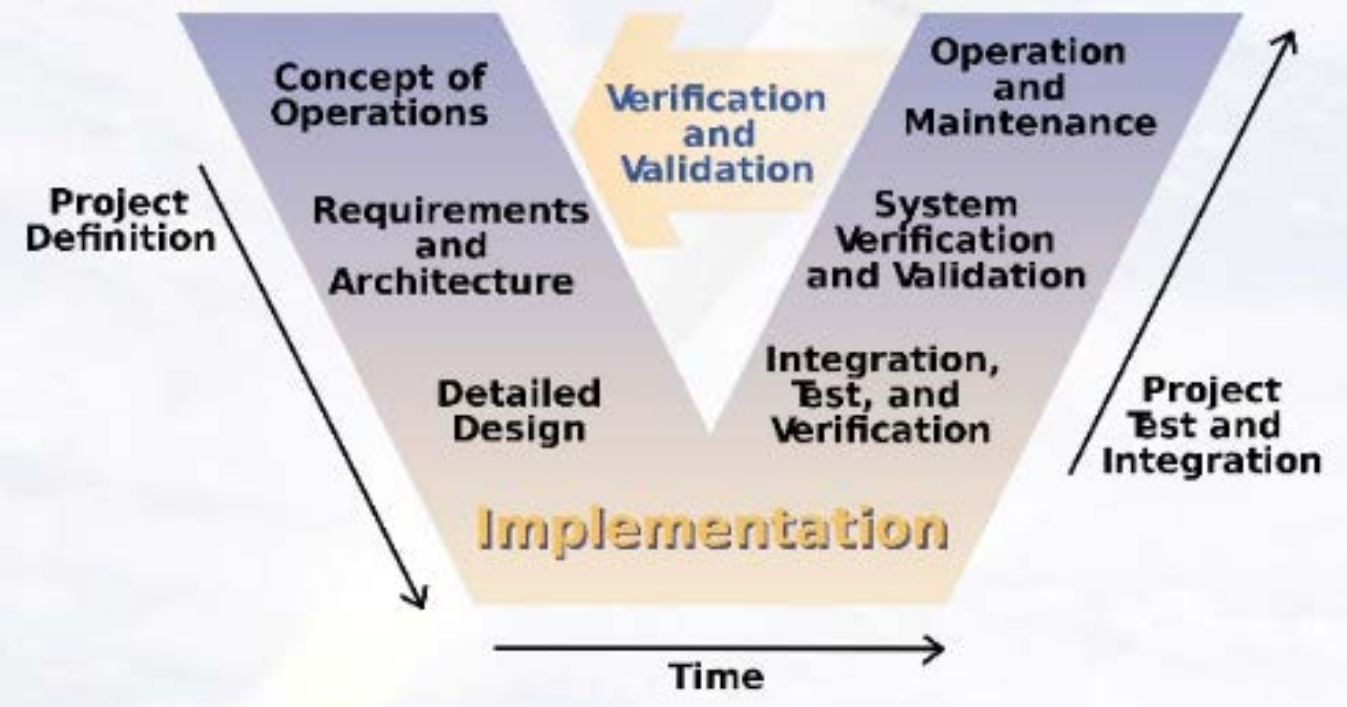
Organization Breakdown Structure (OBS)

- C
  re
- Ir
  jc
- T
  sl
  re



Project life cycle, phases & reviews

Typical space project life cycle



Project life cycle, phases & reviews

Planning

Clear phases defined and strict phase review at the end of each phase and acceptance

- Phase 0 - Mission analysis/needs identification
- Phase A - Feasibility
- Phase B - Preliminary Definition
- Phase C - Detailed Definition
- Phase D - Qualification and Production
- Phase E - Operations/Utilization
- Phase F - Disposal

Project life cycle, phases & reviews

Phase 0	Phase A	Phase B	Phase C	Phase D	Phase E	Phase F
Feasibility study	Conceptual design	Preliminary design	Critical design	Assembly&Integration	Testing&Shipping	Commissioning

Hardware & Software models

- The model philosophy will depend on the project complexity and development time
- Two models approach is usually followed

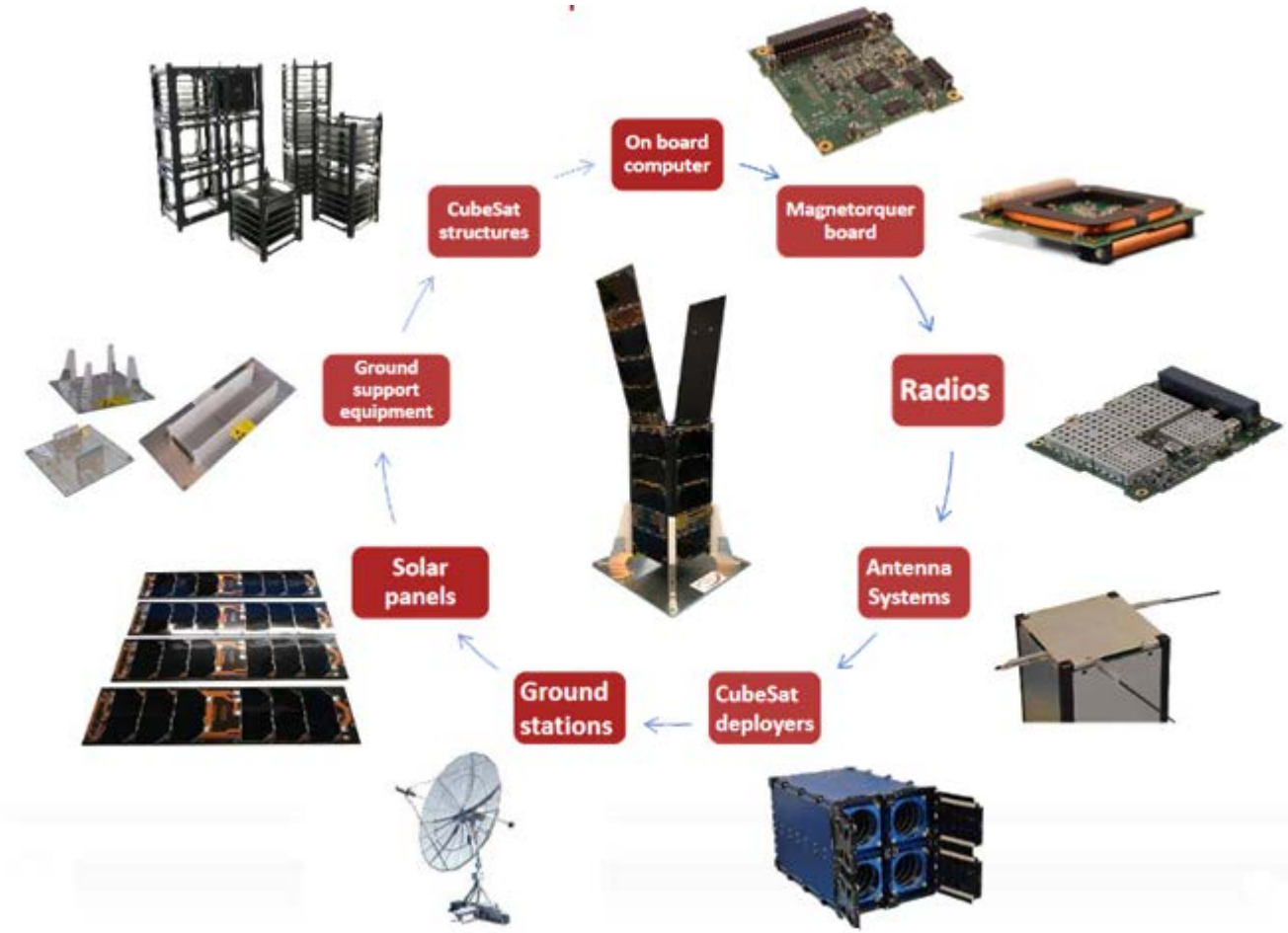
  - **Engineering model**:
    - » Functional test and staff training
  - **Proto-flight model**
    - » Acceptance testing and system qualification
    - » Components for two models could be the same to simplify qualification and acceptance procedures

Schedule

- The schedule should contain
  - Project phases and milestones
  - Activities duration, start and finish dates
  - Critical path activities
- Directly derived from hardware development: flexible and agile
- It can be quite troublesome because of uncertainties:
  - Personnel resources
  - Finalcial resources and testing opportunities
  - The launch date to be fixed at a late phase of the project

Budget plan (I)

- Perform a cost estimation in the early phases of the project
- Continuos tracking of the costs during the project lifecycle
- Some of the components are COTS, easy to find costs information



Budget plan (II)

- In case of students-driven projects, the influence from personnel cost to the project total cost is much less.
- In this sense, the project cost could be reduced to: hardware development and tests campaings
- Margin for unexpected events

Risks Management

- A risk is an uncertain event or condition that, if it occurs, has a negative effect on the project‘s objectives
- Identify and analize the risks to determine the impact (on schedule, cost, quality) and the likelihood
- Define mitigation plan for the identified risks

Risks Management. Some examples

Planning

Risk	Impact	Mitigation plan
Most student have little or no practical exprience	Quality problems Delays in schedule	To define a training plan systematically
The period a student is engaged in the project can be shorter that the entire project lifecyle	Delays in schedule	Tasks handovers
Most students have multi-activities like thesis or classes	Delays in schedule	Taks distribution
Risk of failures due to low-cost, fast-delivery programs	Quality problems, delays in schedule	Define a proper qualification process

Risks Reduction

- Keep the design as simple as possible
- Learn from the failures in order not to repeat them again
  - Understand the source of the problem and the meaning of the failure
- Avoid designing to the limit. Include margins
- Be conservative
- Use familiar components
  - Whenever possible choose components that have flown before

Documentation & data management

Planning

- Document templates
- Document coding system to be stablished, normally based on WBS
- Document code Example:

PRO-WP-DT-XXX Issue Y, Revision Z

PRO → Project Identifier

WP → Workpackage code

DT → Document Type: report (RP), procedure (PR)

XXX → consecutive number

Documentation & data management

Planning

- It is important to define a cycle for documents approval
  - Documents drafts
  - Who needs to review which documents
  - When a document is officially released. Approval proccess
- Implement digital signature for the released documents
- Documentation databases
- SW code repositories

End Item Data Packages (EIDP)

Planning

- For every stablished review or flight hardware delivery an EIDP will be defined
- It contains a set of documents with specific documentation
- Flight EIDP
  - Material list
  - Dimensional verification
  - Tests procedures and reports, photos
  - Mass properties report (CoG, MoI)

Configuration management

Planning

- Configuration items definition based on breakdown structure
- The content of a CI is described in the standarized documentation (TN, RP…)
- Baselines defined at important project milestones (CDR, EM, FM)
- Track changes in the stablished baselines
  - IFs, requirements….
- Unambiguous configuration control of the hardware and documentation

Project controlling: communication & reporting

Implementation

- Make sure information is correctly distributed
- Communication with the team
  - Use different communication strategies (mail, meetings, teleconferences)
  - Face-to-face meetings whenever possible, frequent teleconferences
- Meeting and teleconferences
  - Send the agenda beforehand and notes afterwards
- Have clear schedules, milestones and deadlines
- Make sure everyone feels part of the team

Project controlling

- Monitor everything that has been planned
  - Schedule
  - Budget
  - Risks
  - Procurement
  - Documentation control
- Tasks management
  - Identify action items, follow-up, implementation and closure

Project controlling: changes

- Identify changes and parts affected by the change
- Decide what to do: implement or “use as is”
- Implement changes: updated documentation
- Hint: keep record of almost everything you do
  - Reports
  - Photos are really usefull

Project closeout

- Acceptance review → End Item Data Package
- Shipping
- Operations
- Lesson Learned
- Celebrate