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Student
Ballooning
Course

Project Management, Lifecycle and Documentation

Project Management Unit #1

What is a project?

- A project is a complex, non-routine, one-time effort limited by time, budget, resources, and performance specification designed to meet specific needs.
  - Examples include construction of a chemistry department building, holding a teacher development workshop, creating a new French dining experience
- Projects generally have a particular set of characteristics in common
  - A clearly stated objective
  - A specific life span with beginning and end
  - Multiple departments or people working together
  - Usually something that has never been done before
  - Must be done within specific time, cost and performance requirements

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Why manage a project?

- Accomplish objectives of project within constraints
- Balancing trade-offs between time, cost and performance
  - These three constraints can be mutually exclusive
  - An effective balance is necessary for project success
- Anticipating, identifying and handling the unexpected
  - Unexpected events will happen throughout a project (Murphy's Law)
  - Risk planning is an essential component to project management
- Taking into account unique project features
  - As project complexity increases coordination and risk also increase
  - New technology development is usually associated with increased risk and complexity

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Project Team Structure

- Dedicated project team structure
  - Create independent team composed of specialists to focus exclusively on project
- Project team management structure
  - Maximum cohesion and focus provides fast response
  - Resistance to “outsiders” and constrained staff expertise
  - Appropriate for complex or organizations with many projects
- You should establish a “Team Contract” to define your organization and interaction as a team

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Stages of Team Development

- **Forming:** Get acquainted stage when ground rules, roles and interpersonal relations are established
- **Storming:** Conflict stage when group control, decision making, group & project constraints are contested
- **Norming:** Stage when close relationships develop and the group demonstrates cohesiveness
- **Performing:** Established expectations of how to work together and the group begins channeling energy into achieving project goals
- **Adjourning:** Attention is focused on completing the project and could include conflicting emotions

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Building a Project Team

- Early on establish ground rules such as the following
  - How will the project be planned?
  - What will be the specific roles and responsibilities?
  - How will progress be assessed and tracked?
  - How will project changes be documented and instituted?
  - How, when and where will meetings be scheduled and run?
- Conduct project meetings that are regular, crisp, have a focused agenda and are time constrained
- Establish a team identify and create a shared vision
- Facilitate group decisions by identifying underlying problems, generating alternate solutions, fostering a consensus and following-up on solution implementation
- Accepting, managing and encouraging functional conflict

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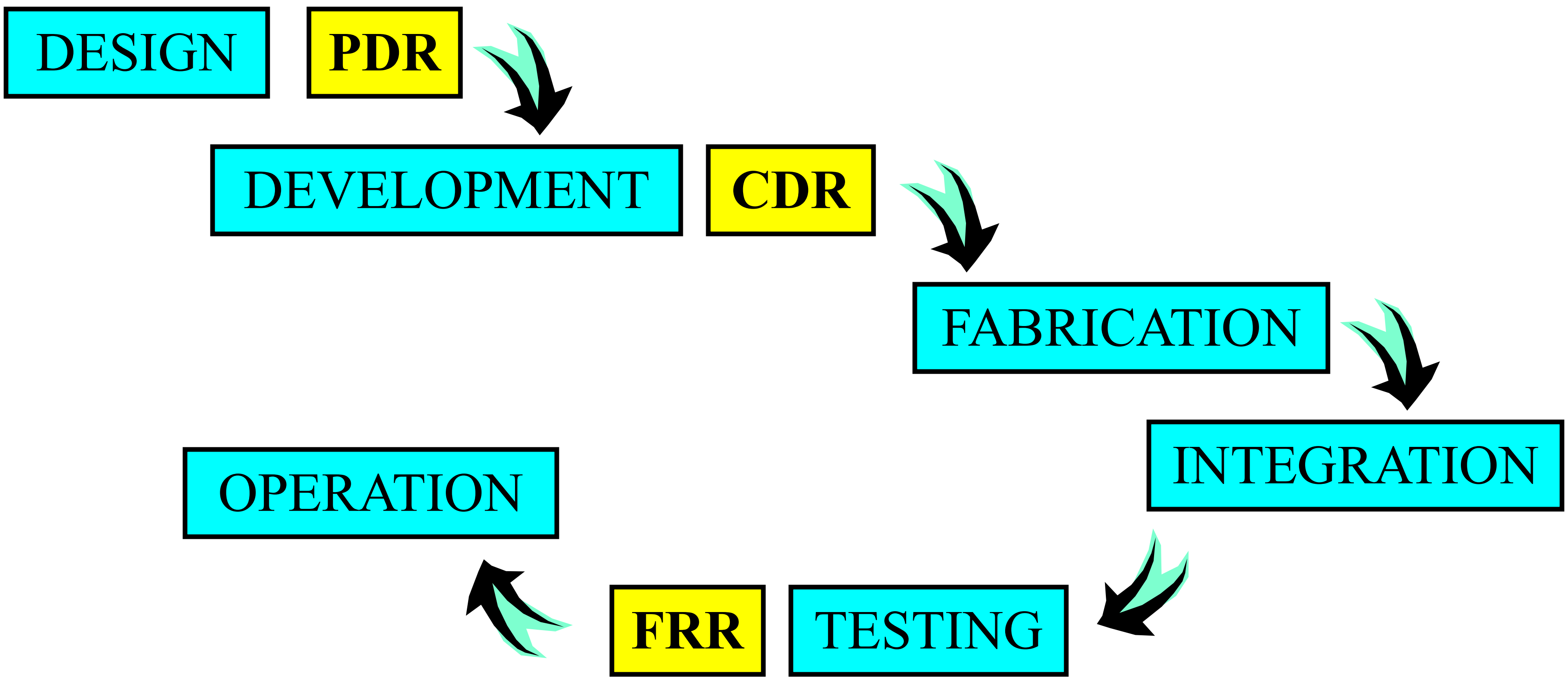
Project Team Pitfalls

- Project teams and managers need to be aware of various pitfalls that can lead to poor decisions.
- A team can become convinced that its decisions are infallible.
- Fail to examine alternate solutions and problems that might arise from the current plan.
- Stereotype outsiders negatively so that external concerns, issues or solutions remain unconsidered.
- Opposition by a member to a particular direction or solution might be repressed by the team.

The Project Phases

- All projects complete roughly the same phases from inception to completion



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The Design Phase

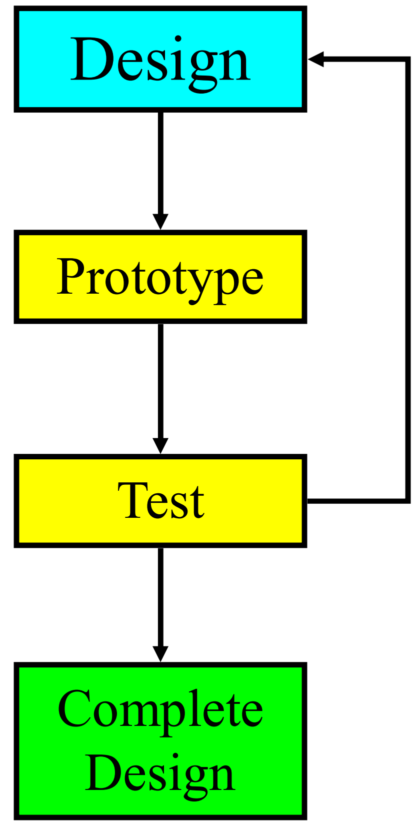
"Paper" study of all issues to establish major concepts and plans

- Little to no hardware testing or prototyping
- Define science goals and objectives
- System level design (subject of a later lecture)
  - System requirements derived from goals and objectives
  - Identify major subsystems and interfaces
- Concept hardware and software design
  - Derived from system requirements and constraints
  - Identify parts, costs & availability
- Establish tasks, schedule, resource needs and plans for remaining phases of life-cycle
- Develop preliminary risk assessment & management plan
- Phase terminates with Preliminary Design Review (PDR)

The Development Phase - 1

Detailed in-depth study when all design components are finalized

- Test concepts by prototyping
  - Not building flight hardware
  - Used to gain information necessary to refine or finalize a design
  - Applies to structure, electronics, sensors and software
- Finalize hardware & software design
  - Complete system design
  - Define interfaces and develop appropriate Interface Control Documents (ICD)
  - Complete detailed design



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The Development Phase - 2

- Purchase long lead items (identified at PDR)
- Finalize plans for pre-flight phases
  - Fabrication, integration, calibration and testing
  - Tasks, schedule, procedures, resource needs, costs
- Update risk assessment & management plan
  - Preliminary plan should already be in use for tracking and mitigating risks during development
- Develop preliminary mission operations & data analysis plan
- Phase terminates with Critical Design Review (CDR)

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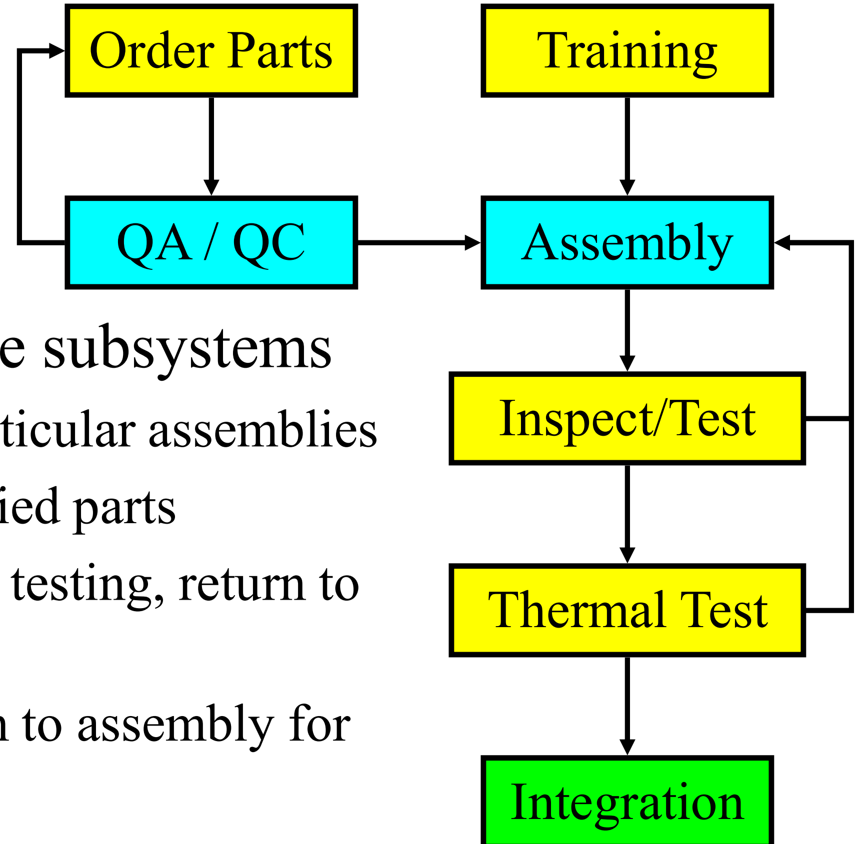
The Fabrication Phase

Implement construction of flight components

- Parts procurement
  - Test that parts satisfy flight requirements before assembly
- Assemble hardware & software subsystems
  - Training may be required for particular assemblies
  - Fabricate component with qualified parts
  - If part fails initial inspection and testing, return to assembly for rework / fixing
  - If part fails thermal testing return to assembly for rework / fixing
- Once complete move to integration



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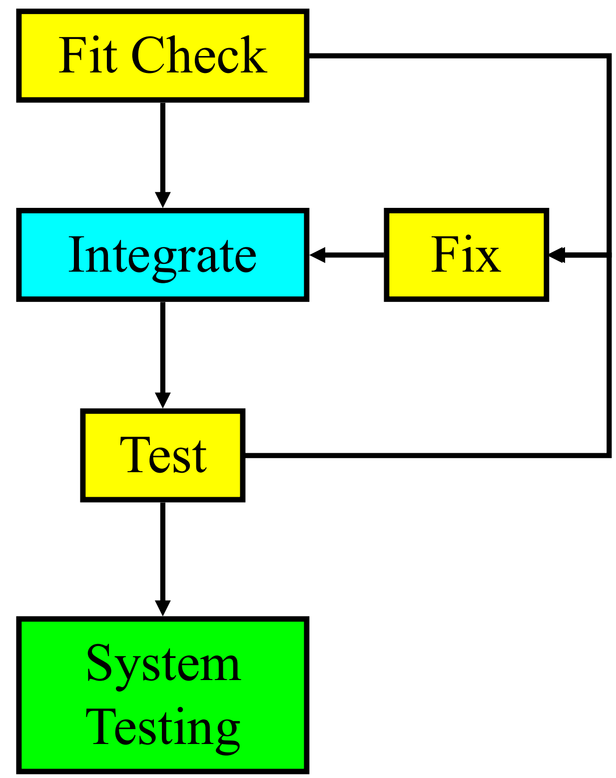
The Integration Phase

Subassemblies are put together to make the final package

- Make sure all parts fit together, if not then rework
- Make sure power system is delivering proper voltage and current
- Connect electronics and sensors
- Install software and run
- Fix issues before proceeding to system testing



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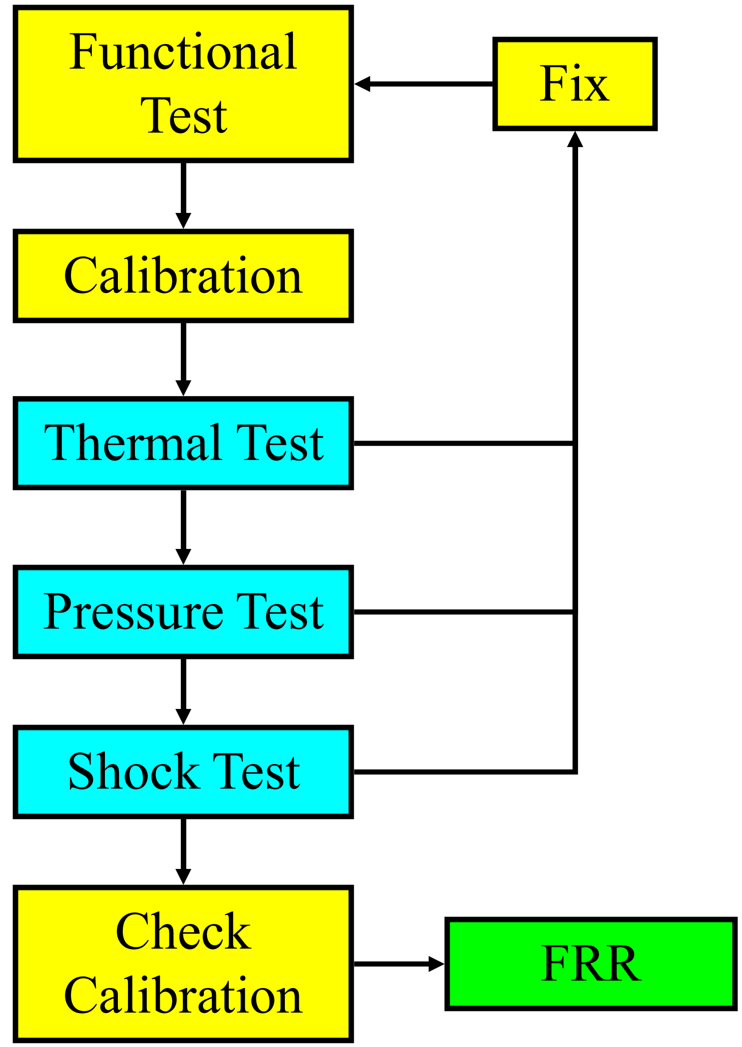
The System Testing Phase

Payload flight certification

- Integrated payload must first be fully functional
- Calibration values are determined
  - Sensors, ADC gain, timing
- Payload must function correctly during thermal, pressure & shock testing
  - If not, fix and begin again
  - If OK, then validate calibrations
- Test and test data must be documented
- Proceed to Flight Readiness Review



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Mission Operations & Data Analysis (MO&DA)

Operate payload during flight & obtain science results

- Mission Operations plan includes the following
  - Sequence of operations to prepare payload for vehicle integration
  - Sequence of operations to prepare payload for launch
  - Flight profile requirements
  - Operations, commanding, contingencies during flight
  - Recovery handling and operations
- Data Analysis plan describes what happens to the flight data
  - Flight data handling, processing and analysis sequence
  - Specify data required from vehicle

The need for communication

- Communication and documentation is key for a successful project
  - "If it is not written down, it did not happen!" *(ancient wise saying)*
  - "If you wrote it down, you agreed to do it!" *(not as ancient wise saying)*
- Communication assures coordination of effort across stakeholders
  - Agreement on how to proceed
  - Tracking of progress
  - Assure functioning interface between units
- Written documentation provides the "glue" that stabilizes components and unifies the project
  - Helps assure "end-to-end" thinking
  - Show agreement on roles, tasks, schedule
  - Provides proof of performance
- Reports & presentations set precedent for acknowledgement of effort and / or discoveries

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The Project Reviews

- There are at least three major reviews during a project
  - Preliminary Design, Critical Design, Flight Readiness
  - Also including a Pre-PDR and Pre-CDR to divide the reviews into more manageable sections
- These reviews provide a check on project progress for all stakeholders
- PDR, CDR and FRR are major project milestones
  - Pre-PDR by end-January
  - PDR by mid-February
  - Pre-CDR by first part of March
  - CDR by mid- to late- March
  - FRR document by May & defense prior to launch
  - Imposed duration on schedule is a risk to be managed
- The team must prepare written documents and oral presentations for each review
- Each review has a somewhat different objective and emphasis

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Preliminary Design Review (PDR)

- The primary objective for the PDR is to review results from your design phase
- At the end of the PDR you should have been able to show that you have "thought the problem through"
- There will be two parts for the PDR
- The Pre-PDR will focus on your mission goal, science background, objectives and requirements.
  - Expect to do a Pre-PDR presentation
- During the PDR you will build on the Pre-PDR
  - Resolve issues identified in the Pre-PDR
  - Add system design, concept instrument hardware & software design, risk analysis.
  - There will be a PDR presentation AND document

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PDR Topics

- The PDR should focus on the following topics:
  - Goals and objectives 🡐 **Pre-PDR**
  - Science background and requirements 🡐 **Pre-PDR**
  - Preliminary System design
  - Concept hardware & software design
  - Tasks, schedule, resource needs, long-lead items 🡐 **Pre-PDR**
  - Preliminary risk assessment & management plan
- Use document template to guide your PDR write-up
  - Similar document for CDR and FRR
- PDR presentation should be about 30 minutes
  - 20 minutes of PowerPoint presentation
  - 10 minutes of questions from the review panel
  - Cover content of PDR document

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Critical Design Review (CDR)

- The primary objective of the CDR is to review the results from your development phase
- Determines whether you are ready to begin building your payload
- There will be two parts for the CDR
- The Pre-CDR will focus on your PDR issues, prototype results, "proven" design, final system and interfaces.
  - Expect to do a Pre-CDR presentation
- During the CDR you will build on the Pre-CDR
  - Resolve issues identified in the Pre-CDR
  - There will be a CDR presentation AND document

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CDR Topics

- CDR should follow the same format as the PDR
  - Modify document template for CDR
  - Same oral presentation format
- CDR should emphasize the following topics:
  - Resolving issues identified during the PDR ← **Pre-CDR**
  - Prototyping results and "proven" designs ← **Pre-CDR**
  - Completed system design and defined interfaces ← **Pre-CDR**
  - Finalize tasks, schedule, procedures and costs
  - Updated risk assessment & management plan
  - Preliminary MO & DA plan

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Flight Readiness Review (FRR)

- Determine that all issues from CDR have been resolved
- Document Experiment Readiness
  - As-built configuration
  - Environmental testing results
  - Calibrations performed
- Provide quantitative evidence that the payload:
  - Meets requirements
  - Is safe
  - Will perform properly
- Determine any impact on other payloads or the vehicle
- Describe procedures for checkout, integration with the vehicle and mission operations
- Identify outstanding issues that must be addressed prior to flight

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FRR Topics

- FRR document follows same format at CDR
  - Documentation of as-built configuration
  - Prove that payload is safe, will perform properly and satisfies flight constraints
  - Written FRR document sent to LA ACES Project two weeks before flight
- Oral FRR presentation during the launch trip

- The FRR will determine whether you are allowed to attach your payload to the flight vehicle!

Post-Flight Science Report

- During the launch trip you will be required to present a report on your preliminary science results
  - PowerPoint presentation including science background, brief description of instrument, calibrations, analyzed data, science results and error analysis
- You will have a full day following the flight to analyze your data and prepare your report
- You will be provided with a time to altitude converter program for your flight
- Recommend the following prior to the launch trip
  - Have your presentation done except for the science results
  - Have your calibrations complete and ready to apply
  - Have your ground data handling and analysis software complete, tested and ready to go

LSU 2020 Report Schedule

- **Pre-PDR**
  - Presentation — January 28, 2020
- **PDR**
  - Presentation — February 11, 2020
  - Document Due — February 14, 2020
- **Pre-CDR**
  - Presentation — March 12, 2020
- **CDR**
  - Presentation — March 19, 2020
  - Document due — March 31, 2020
- **System Testing**
  - Thermal / Vacuum Test — April 17, 2020
- **FRR**
  - Document due — April 28, 2020

All presentations start at 18:00 and all documents are due by 22:00 central time.

LaACES 2020 Flight Schedule

• Travel to NASA CSBF	May 17, 2020
• FRR Presentation	May 18, 2020
• Launch, Flight Ops	May 19, 2020
• Data Analysis	May 20, 2020
• Science Presentation	May 21, 2020
• Contingency Day	May 22, 2020